Forking the Docuverse: A Digital Document System Developed For Mapping and Accessing the Interconnective Structure of Documents Through Interaction

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This weblog is the documentation of a research project conducted in the context of the Media Technology MSc program at Leiden University. Each entry functions as a snapshot of the process. Visit the Github repository to access the commit history,

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Abstract

Documents can be seen as containers of content items (representing ideas, beliefs, facts, and so on). By creating different types of connections among content items, an interconnective structure can be formed. This research project explores new approaches to representational concepts for mapping and accessing the interconnective structure of documents to enable new ways of traversing documents through interaction. These concepts have been derived through examining prominent document systems considered influential in the evolution of information technologies. The method is based on an iterative process of content creation, concept design, and creating interactive prototypes of a digital document system.

Based on the conception of documents as modular, the resulting prototype comprises three bidirectional link types developed for mapping connections according to type: taglink, seqlink, and transclusion. The prototype uses sample content developed throughout the process, serving as an example of how these three link types can be applied to realize the interconnective structure of documents.

Two view modes have been developed to engage with the complexity of information, enabling zooming in and out to gain different perspectives on documents at different levels of detail. And tags can be attached to links and documents, enabling a grouping mechanism and the capability to filter to view a subset of the document collection based on any taxonomy.

Entry 01 Project Outline

This is the first of a series of weblog entries that function as snapshots of the research process. This entry introduces the topic of research, the research plan, and the scope of the project.

1. Title
2. Question
3. Hypothesis
4. Method
5. Documentation
6. Evaluation

1. Title

~~Tinkering with Document Structures: A Digital Construct~~

~~A Construct for Tinkering With Digital Documents~~

~~Re-conceiving Document Representation and Interaction~~

~~Forking the Docuverse: Mapping and Accessing Multiple Structures~~

~~Modular Docuverse: Taking New Approaches to Representational and Interactive Concepts for Mapping and Accessing the Interconnective Structure of Documents~~

~~Forking the Docuverse: A Digital Document System Developed by Taking New Approaches to Representational Concepts For Mapping and Accessing the Interconnective Structure of Documents Through Interaction~~

Forking the Docuverse: A Digital Document System Developed For Mapping and Accessing the Interconnective Structure of Documents Through Interaction

2. Question

~~What may result from undermining the biases and conventions inherited from paper documents when creating a construct for digital documents based on accommodating interconnection?~~

~~In creating a docuverse, what may result from reworking (and taking new approaches to represent and interacting with) concepts derived from prominent examples of systems that accommodate interconnection?~~

~~What may result from reworking (and taking new approaches to representing and interacting with) concepts for mapping and accessing multiple structures of documents to create a digital construct?~~

~~Can new approaches be taken to representational and interactive concepts for mapping and accessing the interconnective structure of documents, and what are the consequences?~~

What new approaches can be taken to representational concepts for mapping and accessing the interconnective structure of documents to enable new ways of traversing documents through interaction, and what are the consequences?

3. Hypothesis

Documents can be seen as containers of content items (representing ideas, theories, facts, beliefs, and so on). By creating different types of connections among content items, an interconnective structure can be formed. Types of connections can be implicit or explicit and external or internal. It is contended that the way concepts and conventions derived from paper documents have been transferred to the digital realm constrains the potential for mapping and accessing that interconnective structure.

The properties of a medium yield particular capacities and constraints to what (and how a) modality is transmitted. Bound by the material properties of paper, conventions developed for mapping interconnective structures in the ages of manuscript and print entailed embedding information in the form of concepts such as footnotes (explicit internal connections) and citations (explicit external connections). The convention of embedding (the type of) information (that is considered additional to the type that is considered the main sequence) has been transferred from paper documents to digital documents, inheriting its biases and constraints. For example, the graphical implementation of footnotes suggests a hierarchical relationship between the content item to which the footnote is attached and the content item in the footnote. Further, the convention for how footnotes are applied dictates that it is not possible to map multiple connections to the same content item.

A system for digital documents — having different properties than paper documents — can be created without those constraints and have the capacity for realizing the interconnective structure of documents. Mapping the interconnective structure of documents will ultimately result in complex layers of information. A digital document system can offer ways to (re)arrange, (un)group, and show/hide documents and links through interaction, beyond what is possible with paper documents.

4. Method

The method is based on an iterative process of content creation, concept design, and creating interactive prototypes of a digital document system.

Step 1: Content Creation

The first step involves creating content on the topic of interconnection and related terms and concepts, which will serve as sample content in the final prototype. Those terms and concepts will be derived by examining prominent document systems considered influential in the evolution of information technologies. The purpose is to gather insight into which features of those systems can be utilized for step 2.

Step 2: Concept Design

This is the blueprint step. It entails working out and creating sketches of the concepts comprised by the digital document system.

Step 3: Interactive Prototypes

This step involves creating interactive prototypes of the current state of the concept design and the content created as sample content. The purpose is to determine what aspects work as intended and which need refining.

Questions include how to design interactions for switching view modes or how different categories of information are visually distinguished. For example, if footnotes are abandoned, then what concept will

allow mapping the type of content that is conventionally inserted as footnotes?

The interactive prototypes created in this step are expected to inform modifications to the design. As each informs the other, steps 2-3 are iterated until it is surmised that enough has been gathered for step 4.

Step 4: Implementation

This step involves completing the content and the design by making improvements based on what has been gathered in the previous steps. Within the bounds of feasibility, the final prototype will allow people to access the interconnective structure of documents by switching view modes (to gain different perspectives) and traversing documents containing the sample content.

5. Documentation

For each iteration of steps 2-3, the resulting interactive prototypes are published in this weblog. Each entry contains the current state of the content created and the design of the digital document system (i.e., the interactive prototypes described in step 3). Reflections will be written at different stages of the process, serving to inform modifications for improvement. Consultations with supervisors will occur between each entry. The final prototype will be developed in prototyping software and published online.

The next entry elaborates on the terms used in this entry.

Entry 02 Background: Terms

This entry elaborates on the terms used in the previous entry.

1. What is the *docuverse*?
2. What is meant by *paper document*?
3. What are those *concepts* and *conventions* and the inherited *biases* and *constraints* derived from paper documents?
4. Why use the phrase *digital realm*?
5. What is meant by *digital document*?
6. What are the distinct properties of digital documents and paper documents?
7. What does it mean to *map* and *access* the interconnective structure of documents?
8. What is *the interconnective structure of documents*?

1. What is the *docuverse*?

The docuverse — as in *universe of documents* — is a term coined by Ted Nelson that describes a universal library system on networked computers. As Nelson writes in *Literary Machines*:

> All of storage near and far must therefore become a united whole— what is now called a "distributed database." [...] The documents and their links unite into what is essentially a swirling complex of equi-accessible unity, a single great universal text and data grid, or, as we call it, the docuverse (Nelson 1987).

In other words, the docuverse is a construct in which documents reside, understood as a metadocument with all the information about the (changes made to the) content, links, and metadata of all documents.

Nelson's vision of the docuverse, Xanadu, is examined in the next entry.

2. What is meant by *paper document*?

A paper document primarily contains the modality text, and the medium[1] used for its transmission is paper, meaning it encompasses the manuscript and print traditions.

3. What are those *conventions* and *concepts* and the inherited *biases* and *constraints* derived from paper documents?

Conventions particular to paper documents are derived from what Adriaan van der Weel (2012) calls the *Order of the Book* — presentation and structure of text based on the form of books and defined by the format of manuscript and print. Engaging with paper documents thus requires familiarity with concepts such as a table of contents, chapters, running head, page numbers, citations, reference lists, appendices, and how they are used as parts of a system. Beyond those pertaining specifically to the paper page are concepts derived from the environments in which people engage with paper documents. Examples are the *clipboard*, *paper bin*, *folders*, *files*, *desktop* and activities such as *cutting*, *pasting*, *highlighting* and *paging* — transferred to the digital realm as metaphorical concepts. These are some of the conventions and concepts derived from paper documents.

Inherited biases and constraints can be seen in the conception of digital documents as *files* organized into nested *folders*. How the *file system* (a paper document management system) has been transferred into the digital realm is grounded in the assumption that all files are independent objects that fit neatly into a hierarchical structure. Even if a file conceptually belongs to multiple categories, it can only exist in one. If it is insisted upon that a file belongs to more than one category, then just as with a paper file, that digital file must be *copied* to the *clipboard* and *pasted* into another folder, and we now have two separate *copies*.[2]

Concepts and conventions derived from paper documents have been transferred to the *digital realm*, inheriting the biases and constraints. It begins at the computer operating system level but permeates the digital realm.

4. Why use the phrase *digital realm*?

Realm in *digital realm* is used to emphasize that it is a constructed space. The *digital realm* is a space in which any conceivable construct can exist, made up of any sets of concepts that take any conceivable shape and behave and interact in any conceivable way. If, for example, the file system is not convenient for organizing documents, then such a system can and should be re-conceived.

5. What is meant by *digital document*?

Documents that pertain to the digital realm. A digital document primarily contains the modality text, and the medium used for its transmission is digital computers.

6. What are the distinct properties of digital documents and paper documents?

Whereas a paper document primarily contains text and images and other graphic elements, a digital document can also contain video, sound, and other interactive elements. Operating under the premise (substantiated below) that the medium used for the transmission of text yields particular constraints and capacities, two distinct properties are relevant to the juxtaposition of paper documents and digital documents:

1. Text on the paper page is inscribed and static; text in the digital realm is encoded and dynamic (Weel 2012).
2. With text on the paper page, actions are direct; with text in the digital realm, actions are interactive.

1. Text on the paper page is inscribed and static; text in the digital realm is encoded and dynamic.

With text on the paper page, language takes a static material form. From a historical perspective, the materialization of language significantly impacted human cognition. In *The Mind on Paper: Reading, Consciousness and Rationality*, developmental psychologist David Olson (2017) gives an analysis incorporating a historical account of the relationship between literacy and forms of thought. By his account, engaging and working with paper documents engendered critical thinking and systematic knowledge (Olson 2017). Similar claims are made by Eric Havelock (1976), who in *Origins of Western Literacy* establishes an integral relationship between the technology of writing and rational and analytic thought. And on the study of reading and its impact on cognition, as Neil Postman (1986) points out, it has been concluded by most scholars "that the sequential, propositional character of the written word fosters what Walter Ong calls the 'analytic management of knowledge.'"

That is not to suggest that analytic thought and rationality were not possible prior to written language, but to engage with text is "to follow a line of thought, which requires considerable powers of classifying, inference-making and reasoning" and requires mapping ideas, comparing assertions, "connect[ing] one generalization to another" (Postman 1986). For example, from research within the learning sciences, Roy Pea (1985) discusses the form of arguments, contrasting oral and written language, and its impact on logical analysis. With text on the paper page, human memory capacities were extended, allowing an argument to be stored and directly available to the reader/writer to evaluate the relationship between its parts for consistency and locate potential contradictions. With the advent of print technology, in particular, there was a greater capacity for "precision in the transmission of detail," leading to a "much greater exactness in the representation of knowledge [...] through the use of such typically typographic aids as tables and different typefaces, font sizes, and white space as a means of ordering information" (Weel 2012).

> Uniformity, predictability, consistency, and standardization were prerequisites for analytical and scientific thinking. (Weel 2012)

These effects on human cognition are related to the staticity of (and what it entails to engage with) text on the paper page.[3] In contrast to text on the paper page, digital text is marked by dynamicity and modifiability. At a basic level, digital text is encoded as a bit pattern (e.g., 1010111) representing a character unit (e.g., W). As Stéfan Sinclair and Geoffrey Rockwell (2016) suggest, these properties imply the potential for rearrangement and restructuring (i.e., move these bits here to there, extract only those bits, rearrange them according to this, then that, and put those here). At yet another level, digital text is encoded through a markup language. Encoding text involves "marking up" the structure, the visual presentation, and the metadata—all of which can be utilized to modify (the form, content, and meaning of) texts. For example, a content item that is a title in one document can be transformed into a list item in the same or another document (e.g., an expandable table of contents). Importantly, modification of digital text by modifying the code that transcribes it can be done without repercussions to source content. That is, rearranging parts,

transforming between formats, extracting and sorting text segments, and annotating or performing analyses on those extracted text segments involves operations that can be performed without repercussions to the source content. With paper documents, such actions are enacted directly upon the material.

2. With text on the paper page, actions are direct; with text in the digital realm, actions are interactive.

Any action is direct when engaging with text on the paper page. Actions such as writing, underlining, erasing, cutting out, pasting in, folding, stacking, sorting, and resorting, are in a direct relationship between the action, the operations involved in that action, and the perception of that action. In the digital realm, a command — a keystroke, a tap on a touchscreen, a verbal utterance — can equate near-infinite set of (opaque) operations. For example, selecting a particular interactive element through a mouse click can result in an instantaneous rearrangement and transformation of the shape of documents, which can be reversed by selecting another interactive element. Given these distinctive properties, text in the digital realm invites modification of its parts in ways that are infeasible with text on the paper page. This project aims to explore the potential of these properties.

7. What does it mean to *map* and *access* the interconnective structure of documents?

To map is the activity of establishing connections by creating links or attaching metadata to documents. Mapping connections can be done by the reader and writer of a document. *To access* is used to encompass *retrieving*, *bringing into view*, *filtering*, *arranging*, and *traversing* documents based on those connections in a visually coherent way.

8. What is *the interconnective structure of documents*?

The concept of interconnection is elaborated on in the next entry.

Entry 03 Background: Documents and Interconnection

The first section of this entry introduces the concept of interconnection, the various terms used to express the idea of interconnection across fields, and the underlying philosophical position.

The second section examines prominent document systems comprising concepts for mapping the interconnective structure of documents. Those concepts are juxtaposed to how they have been implemented in commonly known systems, such as how hypertext is implemented on the web. The biases and conventions inherited from paper documents are also discussed, including the (dis)advantages of transferring these (or how these have been transferred) to the digital realm.

The aim is to gather insight into which features of the systems can be utilized, which is discussed in the third section. The motivation behind this approach resonates with what Mary Hopper stated in her introduction to the 1998 symposium *Hypertext in Historical Context: Vannevar Bush and Ted Nelson Revisited*:

> Consider that there may be vast potentials in electronic media that we still haven't implemented, and we may be in danger of missing some of the greatest potential in electronic media because we mistake some situational limitations in technical development or project management for impossibility. This is the grounds upon which I suggest that the past is of more than just historical interest. The past, and the pioneers who shaped the past, may hold many suggestions as to paths it might be valuable to explore in the future and advice on the most productive ways to go down those paths. (Hopper 1998)

1. Documents and Interconnection
2. Examination of Prominent Document Systems
   - The Encyclopédie by Denis Diderot (1713 - 1784) and Jean d'Alembert (1717 - 1783)
   - The work of Paul Otlet (1868 - 1944)
   - The original hypertext project Xanadu by Ted Nelson (1937)
3. Insights

1. Documents and Interconnection

The concept of interconnection here denotes the various connections among documents' content items[4]. As Ted Nelson (1987) explains, connections can be internal or external to a document, stated implicitly or explicitly. For example, phrases such as "in the example given below" or "as defined previously" establish **implicit internal connections**. **Explicit internal connections** are content items that, by convention, take the form of a footnote — the content of which can be a commentary on an idea, clarification of a term, parenthetical information, and suchlike. **Explicit external connections** are inclusions of one document segment into another (what Nelson (1980) coined transclusions) or some other direct connection by way of reference (paraphrased content with a citation, for example). Interconnection thus implies multiple potential structures other than the content-item-by-content-item sequence in a document (or, in conventional terms, the paragraph-by-paragraph sequence).

Other terms express similar notions about the various connections between documents. As Borgman (2015) writes, "[t]he body of relationships among documents is sometimes known as '*hypertextuality*.'" *Hypertext* is commonly associated with how it has been implemented on the web, understood in general terms as "a computer construct of links and data corresponding to files or parts of files that can be displayed in windows of various dimensions (Vandendorpe 2009)." Another term, used particularly within semiotics and literary theory, is *intertextuality* which describes abstract connections "as in the influence of one text on the meaning of another" (Borgman 2015). One such connection can be how one text is derived from a preceding text, as with Ulysses by James Joyce, which is a transformation of Odyssey by Homer (Vandendorpe 2009). In the definition of an *intertext* as it was first proposed, there is an emphasis on the perception of the reader, namely that the connections between one text and one that preceded or followed it results from the activity of reading (Vanderndorpe 2009). Ted Nelson (2015) calls it *intertwingularity* which "expresses a philosophical position about cross-connection," namely that "all subjects and issues are intertwined and intermingled."

Hypertextuality, *intertextuality*, and *intertwingularity* coincide but not completely. These terms are similar yet different lenses (used within particular fields) to express the idea that

> documents do not stand alone, even if they look like independent objects. Rather, they are deeply connected to many other objects. (Borgman 2015)

Interconnection is a general term chosen and used to encompass these various connections between documents that ultimately result in complex layers of information. These connections can be established through reading and writing but also computational methods, such as applying natural language

processing techniques for classifying text and keyword extraction. In the next section, prominent analog and digital document systems.

2. Examination of Prominent Document Systems

In what follows, three document systems are examined to gather insight into which features can be utilized to create an interactive prototype of a digital document system for mapping and accessing the interconnective structure of documents.

1. The Encyclopédie by Denis Diderot (1713-84) and Jean d'Alembert (1717-83)
2. The work of Paul Otlet (1868-1944)
3. The original hypertext project Xanadu by Ted Nelson (1937)

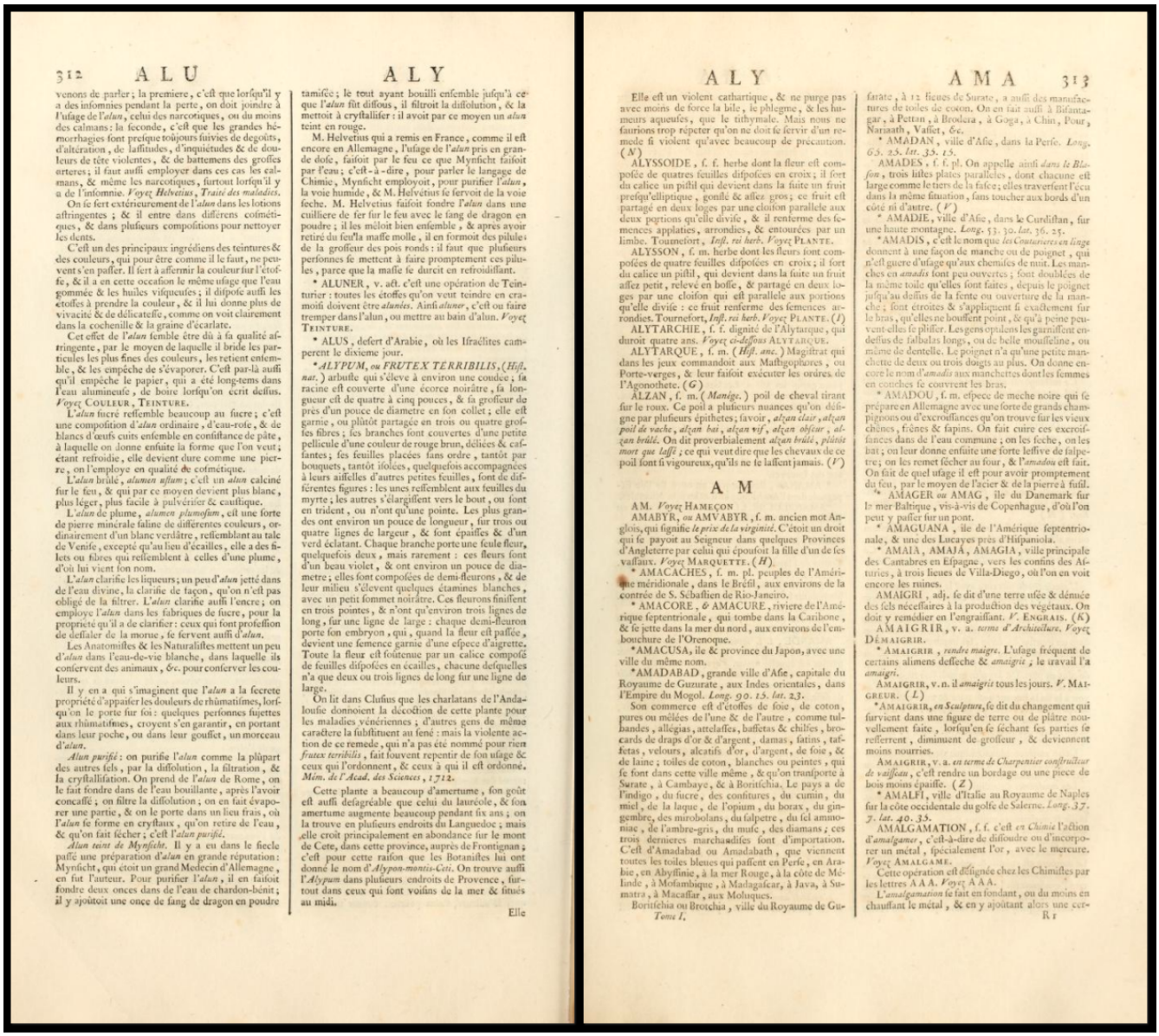
All three are considered influential in the evolution of information technologies. The encyclopedia by Diderot and d'Alembert is exemplary of the eighteenth century; the work of Otlet is exemplary of the nineteenth century; and Xanadu by Nelson of the twentieth century. All are grounded in particular notions about the structure of ideas and how knowledge evolves, reflected particularly in the conceptualization of documents as modular — made up of parts connected to other parts through some link mechanism.

1 The Encyclopédie by Denis Diderot (1713-84) and Jean d'Alembert (1717-83)

Various information technologies for mapping the interconnective structure, allowing access through (non-)hierarchical renditions of contents, were produced in the eighteenth century, ranging from atlases, encyclopedias, dictionaries, and suchlike.

Published between 1751 and 1772, the encyclopedia by Diderot and d'Alembert was, as Rosenberg (2015) argues, an innovative system for its time, utilizing textual and diagrammatic ways of mapping multiple structures.

In its entirety, their encyclopedia is a system of *intraconnections* — which is to say, a closed system of internal connections — "comprising 28 volumes, 72,000 articles by over 2,000 writers, and more than 3,000 plates" (Rosenberg 2015). Though the design incorporates concepts for representing external connections, their encyclopedia was conceived and meant to be used as an independent system. A significant feature is the multiple renditions of the contents, offering multiple entry points to the articles. One structure is the alphabetical structure, embedded as running heads throughout the volumes (seen in the image below), allowing access to content by keyword.



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venons de parler ; la premiere, c'eſt que lorſqu'il y a des inſomnies pendant la perte, on doit joindre à l'uſage de l'*alun*, celui des narcotiques, ou du moins des calmans : la ſeconde, c'eſt que les grandes hémorrhagies ſont preſque toûjours ſuivies de degoûts, d'altération, de laſſitudes, d'inquiétudes & de douleurs de tête violentes, & de battemens des groſſes arteres ; il faut auſſi employer dans ces cas les calmans, & même les narcotiques, ſurtout lorſqu'il y a de l'inſomnie. *Voyez Helvetius, Traité des maladies.*

On ſe ſert extérieurement de l'*alun* dans les lotions aſtringentes ; & il entre dans différens cofmétiques, & dans pluſieurs compoſitions pour nettoyer les dents.

C'eſt un des principaux ingrédiens des teintures & des couleurs, qui pour être comme il le faut, ne peuvent s'en paſſer. Il ſert à affermir la couleur ſur l'étoffe, & il a en cette occaſion le même uſage que l'eau gommée & les huiles viſqueuſes ; il diſpoſe auſſi les étoffes à prendre la couleur, & il lui donne plus de vivacité & de délicateſſe, comme on voit clairement dans la cochenille & la graine d'écarlate.

Cet effet de l'*alun* ſemble être dû à ſa qualité aſtringente, par le moyen de laquelle il bride les particules les plus fines des couleurs, les retient enſemble, & les empêche de s'évaporer. C'eſt par-là auſſi qu'il empêche le papier, qui a été long-tems dans l'eau alumineuſe, de boire lorſqu'on écrit deſſus. *Voyez* COULEUR, TEINTURE.

L'*alun* ſucré reſſemble beaucoup au ſucre ; c'eſt une compoſition d'*alun* ordinaire, d'eau-roſe, & de blancs d'œufs cuits enſemble en conſiſtance de pâte, à laquelle on donne enſuite la forme que l'on veut ; étant refroidie, elle devient dure comme une pierre, on l'employe en qualité de cofmétique.

L'*alun* brûlé, *alumen uſtum* ; c'eſt un *alun* calciné ſur le feu, & qui par ce moyen devient plus blanc, plus léger, plus facile à pulvériſer & cauſtique.

L'*alun* de plume, *alumen plumoſum*, eſt une ſorte de pierre minérale ſaline de différentes couleurs, ordinairement d'un blanc verdâtre, reſſemblant au talc de Veniſe, excepté qu'au lieu d'écailles, elle a des filets ou fibres qui reſſemblent à celles d'une plume, d'où lui vient ſon nom.

L'*alun* clarifie les liqueurs ; un peu d'*alun* jetté dans de l'eau divine, la clarifie de façon, qu'on n'eſt pas obligé de la filtrer. L'*alun* clarifie auſſi l'encre ; on employe l'*alun* dans les fabriques de ſucre, pour la propriété qu'il a de clarifier : ceux qui font profeſſion de deſſaler de la morue, ſe ſervent auſſi d'*alun*.

Les Anatomiſtes & les Naturaliſtes mettent un peu d'*alun* dans l'eau-de-vie blanche, dans laquelle ils conſervent des animaux, *&c.* pour conſerver les couleurs.

Il y en a qui s'imaginent que l'*alun* a la ſecrete propriété d'appaiſer les douleurs de rhûmatiſmes, lorſqu'on le porte ſur ſoi : quelques perſonnes ſujettes aux rhûmatiſmes, croyent s'en garantir, en portant dans leur poche, ou dans leur gouſſet, un morceau d'*alun*.

Alun purifié : on purifie l'*alun* comme la plûpart des autres ſels, par la diſſolution, la filtration, & la cryſtallifation. On prend de l'*alun* de Rome, on le fait fondre dans de l'eau bouillante, après l'avoir conſaſſé ; on filtre la diſſolution ; on en fait évaporer une partie, & on le porte dans un lieu frais, où l'*alun* ſe forme en cryſtaux, qu'on retire de l'eau, & qu'on fait ſécher ; c'eſt l'*alun purifié*.

Alun teint de Mynſicht. Il y a eu dans le ſiecle paſſé une préparation d'*alun* en grande réputation : Mynſicht, qui étoit un grand Medecin d'Allemagne, en fut l'auteur. Pour purifier l'*alun*, il en faiſoit fondre deux onces dans de l'eau de chardon-bénit ; il y ajoûtoit une once de ſang de dragon en poudre tamiſée ; le tout ayant bouilli enſemble juſqu'à ce que l'*alun* fût diſſous, il filtroit la diſſolution, & la mettoit à cryſtalliſer : il avoit par ce moyen un *alun* teint en rouge.

M. Helvetius qui a remis en France, comme il eſt encore en Allemagne, l'uſage de l'*alun* pris en grande doſe, faiſoit par le feu ce que Mynſicht faiſoit par l'eau ; c'eſt-à-dire, pour parler le langage de Chimie, Mynſicht employoit, pour purifier l'*alun*, la voie humide, & M. Helvétius ſe ſervoit de la voie ſeche. M. Helvetius faiſoit fondre l'*alun* dans une cuilliere de fer ſur le feu avec le ſang de dragon en poudre ; il les mêloit bien enſemble, & après avoir retiré du feu la maſſe molle, il en formoit des pilules de la groſſeur des pois ronds : il faut que pluſieurs perſonnes ſe mettent à faire promptement ces pilules, parce que la maſſe ſe durcit en refroidiſſant.

* ALUNER, v. act. c'eſt une opération de Teinturier : toutes les étoffes qu'on veut teindre en cramoiſi doivent être *alunées*. Ainſi *aluner*, c'eſt ou faire tremper dans l'alun, ou mettre au bain d'alun. *Voyez* TEINTURE.

* ALUS, deſert d'Arabie, où les Iſraélites camperent le dixieme jour.

* *ALYPUM, ou FRUTEX TERRIBILIS, (Hiſt. nat.)* arbuſte qui s'éleve à environ une coudée ; ſa racine eſt couverte d'une écorce noirâtre, ſa longueur eſt de quatre à cinq pouces, & ſa groſſeur du près d'un pouce de diametre en ſon collet ; elle eſt garnie, ou plûtôt partagée en trois ou quatre groſſes fibres ; ſes branches ſont couvertes d'une petite pellicule d'une couleur de rouge brun, déliées & caſſantes ; ſes feuilles placées ſans ordre, tantôt par bouquets, tantôt iſolées, quelquefois accompagnées à leurs aiſſelles d'autres petites feuilles, ſont de différentes figures : les unes reſſemblent aux feuilles du myrte ; les autres s'élargiſſent vers le bout, ou ſont en trident, ou n'ont qu'une pointe. Les plus grandes ont environ un pouce de longueur, ſur trois ou quatre lignes de largeur, & ſont épaiſſes & d'un verd éclatant. Chaque branche porte une ſeule fleur, quelquefois deux, mais rarement : ces fleurs ſont d'un beau violet, & ont environ un pouce de diametre ; elles ſont compoſées de demi-fleurons, & de leur milieu s'élevent quelques étamines blanches, avec un petit ſommet noirâtre. Ces fleurons finiſſent en trois pointes, & n'ont qu'environ trois lignes de long, ſur une ligne de large : chaque demi-fleuron porte ſon embryon, qui, quand la fleur eſt paſſée, devient une ſemence garnie d'une eſpece d'aigrette. Toute la fleur eſt ſoûtenue par un calice compoſé de feuilles diſpoſées en écailles, chacune deſquelles n'a que deux ou trois lignes de long ſur une ligne de large.

On lit dans Cluſius que les charlatans de l'Andalouſie donnoient la décoction de cette plante pour les maladies vénériennes ; d'autres gens de même caractere la ſubſtituent au ſené : mais la violente action de ce remede, qui n'a pas été nommé pour rien *frutex terribilis*, fait ſouvent repentir de ſon uſage & ceux qui l'ordonnent, & ceux à qui il eſt ordonné. *Mém. de l'Acad. des Sciences, 1712.*

Cette plante a beaucoup d'amertume, ſon goût eſt auſſi deſagréable que celui du laureole, & ſon amertume augmente beaucoup pendant ſix ans ; on la trouve en pluſieurs endroits du Languedoc ; mais elle croît principalement en abondance ſur le mont de Cete, dans cette province, auprès de Frontignan ; c'eſt pour cette raiſon que les Botaniſtes lui ont donné le nom d'*Alypon-montis-Cati*. On trouve auſſi l'*Alypum* dans pluſieurs endroits de Provence, ſurtout dans ceux qui ſont voiſins de la mer & ſitués au midi.

Elle

ALY AMA 313

Elle eſt un violent cathartique, & ne purge pas avec moins de force la bile, le phlegme, & les humeurs aqueuſes, que le tithymale. Mais nous ne faurions trop répeter qu'on ne doit ſe ſervir d'un remede ſi violent qu'avec beaucoup de précaution. (*N*)

ALYSSOIDE, ſ. f. herbe dont la fleur eſt compoſée de quatres feuilles diſpoſées en croix ; il ſort du calice un piſtil qui devient dans la ſuite un fruit preſqu'elliptique, gonflé & aſſez gros ; ce fruit eſt partagé en deux loges par une cloiſon parallele aux deux portions qu'elle diviſe, & il renferme des ſemences applaties, arrondies, & entourées par un limbe. Tournefort, *Inſt. rei herb. Voyez* PLANTE.

ALYSSON, ſ. m. herbe dont les fleurs ſont compoſées de quatre feuilles diſpoſées en croix ; il ſort du calice un piſtil, qui devient dans la ſuite un fruit aſſez petit, relevé en boſſe, & partagé en deux loges par une cloiſon qui eſt parallele aux portions qu'elle diviſe : ce fruit renferme des ſemences arrondies. Tournefort, *Inſt. rei herb. Voyez* PLANTE. (*I*)

ALYTARCHIE, ſ. f. dignité de l'Alytarque, qui duroit quatre ans. *Voyez ci-deſſous* ALYTARQUE.

ALYTARQUE, ſ. m. (*Hiſt. anc.*) Magiſtrat qui dans les jeux commandoit aux Maſtigophores, ou Porte-verges, & leur faiſoit exécuter les ordres de l'Agonothete. (*G*)

ALZAN, ſ. m. (*Manige.*) poil de cheval tirant ſur le roux. Ce poil a pluſieurs nuances qu'on déſigne par pluſieurs épithetes ; ſavoir, *alzan clair, alzan poil de vache, alzan bai, alzan vif, alzan obſcur, alzan brûlé*. On dit proverbialement *alzan brûlé, pliûtôt mort que laſſé* ; ce qui veut dire que les chevaux de ce poil ſont ſi vigoureux, qu'ils ne le laſſent jamais. (*V*)

A M

AM. *Voyez* HAMEÇON

AMABYR, *ou* AMVABYR, ſ. m. ancien mot Anglois, qui ſignifie *le prix de la virginité*. C'étoit un droit qui ſe payoit au Seigneur dans quelques Provinces d'Angleterre par celui qui épouſoit la fille d'un de ſes vaſſaux. *Voyez* MARQUETTE. (*H*).

* AMACACHES, ſ. m. pl. peuples de l'Amérique méridionale, dans le Bréſil, aux environs de la contrée de S. Sebaſtien de Rio-Janeiro.

* AMACORE, *&* AMACURE, riviere de l'Amérique ſeptentrionale, qui tombe dans la Caribone, & ſe jette dans la mer du nord, aux environs de l'embouchure de l'Orenoque.

*AMACUSA, île & province du Japon, avec une ville du même nom.

*AMADABAD, grande ville d'Aſie, capitale du Royaume de Guzurate, aux Indes orientales, dans l'Empire du Mogol. *Long. 90. 15. lat. 23.*

Son commerce eſt d'étoffes de ſoie, de coton, pures ou mêlées de l'une & de l'autre, comme tulbandes, allégias, atteſſaſſes, baſſetas & chilſes, brocards de draps d'or & d'argent, damas, ſatins, taffetas, velours, alcatifs d'or, d'argent, de ſoie, & de laine ; toiles de coton, blanches ou peintes, qui ſe font dans cette ville même, & qu'on tranſporte à Surate, à Cambaye, & à Boritſchia. Le pays a de l'indigo, du ſucre, des confitures, du cumin, du miel, de la laque, de l'opium, du borax, du gingembre, des mirobolans, du ſalpetre, du ſel ammoniac, de l'ambre-gris, du muſc, des diamans ; ces trois dernieres marchandiſes ſont d'importation. C'eſt d'Amadabad ou Amadabath, que viennent toutes les toiles bleues qui paſſent en Perſe, en Arabie, en Abyſſinie, à la mer Rouge, à la côte de Mélinde, à Moſambique, à Madagaſcar, à Java, à Sumatra, à Macaſſar, aux Moluques.

Boritſchia, ville du Royaume de Gu-

ſarate, à 12 lieues de Surate, a auſſi des manufactures de toiles de coton. On en fait auſſi à Bifantagar, à Petton, à Brodera, à Goga, à Chin, Pour, Nariaath, Vaſſet, *&c.*

* AMADAN, ville d'Aſie, dans la Perſe. *Long. 63. 25. lat. 33. 15.*

AMADES, ſ. f. pl. On appelle ainſi *dans le Blaſon*, trois lilles plates paralleles, dont chacune eſt large comme le tiers de la faſce ; elles traverſent l'écu dans la même ſituation, ſans toucher aux bords d'un côté ni d'autre. (*V*)

* AMADIE, ville d'Aſie, dans le Curdiſtan, ſur une haute montagne. *Long. 53. 30. lat. 36. 25.*

*AMADIS, c'eſt le nom que *les Couturieres en linge* donnent à une façon de manche ou de poignet, qui n'eſt guere d'uſage qu'aux chemiſes de nuit. Les manches en *amadis* ſont peu ouvertes ; ſont doublées de la même toile qu'elles ſont faites, depuis le poignet juſqu'au deſſus de la fente ou ouverture de la manche ; ſont étroites & s'appliquent ſi exactement ſur le bras, qu'elles ne bouffent point, & qu'à peine peuvent elles ſe pliſſer. Les gens opulens les garniſſent endeſſus de falbalas longs, ou de belle mouſſeline, ou même de dentelle. Le poignet n'a qu'une petite manchette de deux ou trois doigts au plus. On donne encore le nom d'*amadis* aux manchettes dont les femmes en couches ſe couvrent les bras.

* AMADOU, ſ. m. eſpece de meche noire qui ſe prépare en Allemagne avec une ſorte de grands champignons ou d'excroiſſances qu'on trouve ſur les vieux chênes, frênes & ſapins. On fait cuire ces excroiſſances dans de l'eau commune ; on les ſeche, on les bat ; on leur donne enſuite une ſorte leſſive de ſalpetre ; on les remet ſécher au four, & l'*amadou* eſt fait. On ſait de quel uſage il eſt pour avoir promptement du feu, par le moyen de l'acier & de la pierre à fuſil.

* AMAGER *ou* AMAG, île du Danemark ſur la mer Baltique, vis-à-vis de Copenhague, d'où l'on peut y paſſer ſur un pont.

* AMAGUANA, île de l'Amérique ſeptentrionale, & une des Lucayes près d'Hiſpaniola.

* AMAIA, AMAJA, AMAGIA, ville principale des Cantabres en Eſpagne, vers les confins des Aſturies, à trois lieues de Villa-Diego, où l'on en voit encore les ruines.

AMAIGRI, adj. ſe dit d'une terre uſée & dénuée des ſels néceſſaires à la production des végétaux. On doit y remédier en l'engraiſſant. *V.* ENGRAIS. (*K*)

AMAIGRIR, v. a. *terme d'Architecture. Voyez* DÉMAIGRIR.

* AMAIGRIR, *rendre maigre.* L'uſage fréquent de certains alimens deſſeche & *amaigrit*, le travail l'a *amaigri*.

AMAIGRIR, v. n. il *amaigrit* tous les jours. *V.* MAIGREUR. (*L*)

*AMAIGRIR, *en Sculpture*, ſe dit du changement qui ſurvient dans une figure de terre ou de plâtre nouvellement faite, lorſqu'en ſe ſéchant ſes parties ſe reſſerrent, diminuent de groſſeur, & deviennent moins nourries.

AMAIGRIR, v. a. *en terme de Charpentier conſtructeur de vaiſſeau*, c'eſt rendre un bordage ou une piece de bois moins épaiſſe. (*Z*)

* AMALFI, ville d'Italie au Royaume de Naples ſur la côte occidentale du golfe de Salerne. *Long. 37. 7. lat. 40. 35.*

AMALGAMATION, ſ. f. c'eſt *en Chimie* l'action d'*amalgamer*, c'eſt-à-dire de diſſoudre ou d'incorporer un métal, ſpécialement l'or, avec le mercure. *Voyez* AMALGAME.

Cette opération eſt déſignée chez les Chimiſtes par les lettres AAA. *Voyez* AAA.

L'*amalgamation* ſe fait en fondant, ou du moins en chauffant le métal, & en y ajoûtant alors une cer-

Image source: [Internet Archive]

Other structures are the various diagrams, offering different renditions of the contents, such as the tree diagram from the first volume seen in the image below, functioning as a visual index.

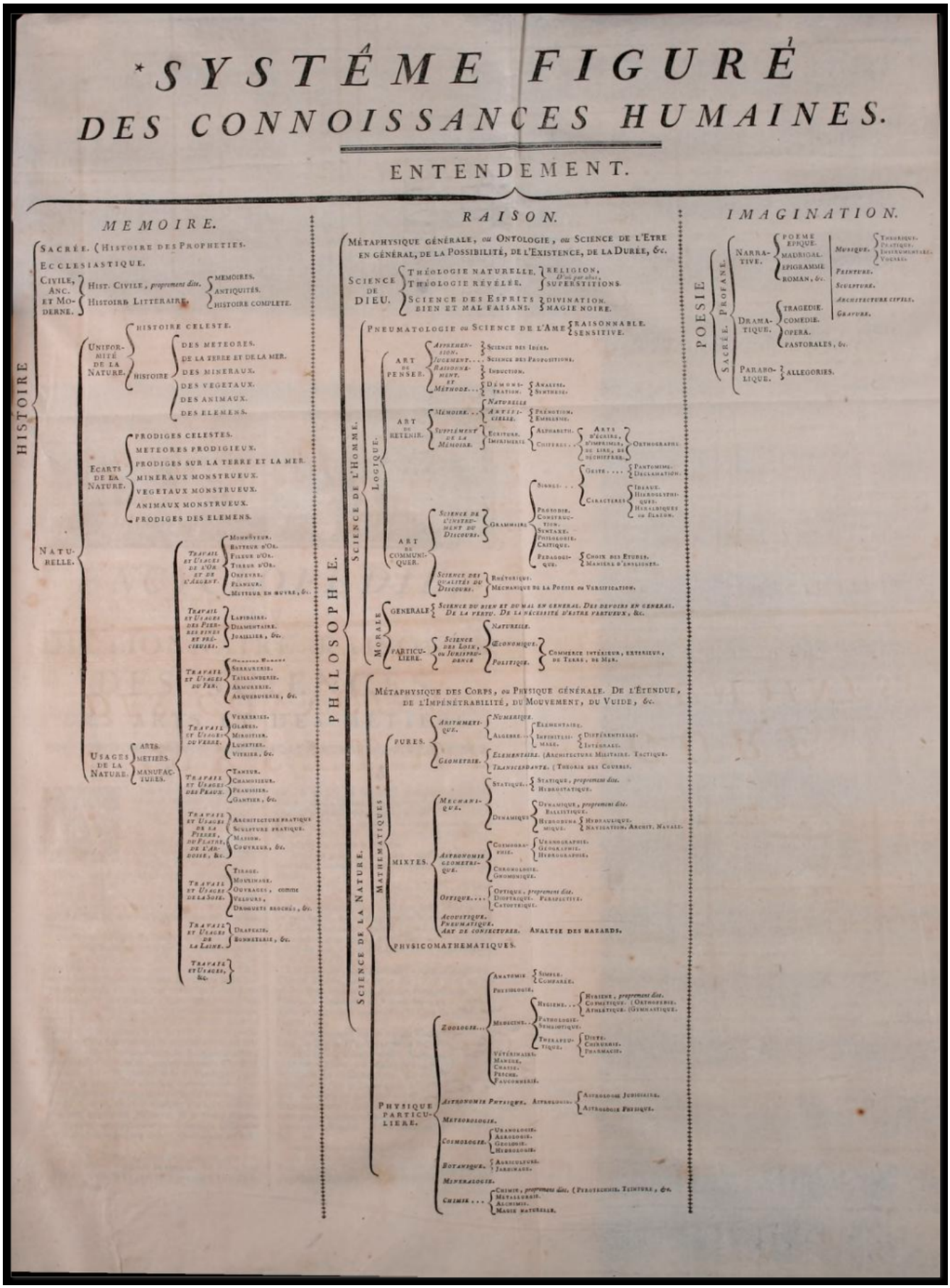


Image source: Internet Archive

These textual and diagrammatic ways of mapping structures are hierarchical, as was the convention at the time. However, as Rosenberg explains:

> Older encyclopedias were generally organized hierarchically and by subject. Theirs was designed to be navigated by keyword, to allow readers to enter and exit at any useful point. Additionally, their encyclopedia was hypertexted. Articles were linked in a web through a system of renvois or cross-references. The Encyclopédie also offered a hierarchical subject map, echoing the structure of older works, but, in the work of Diderot and d'Alembert, the tree of knowledge was presented as only one of several heuristics. (Rosenberg 2015)

The other structure — the implementation of cross-references — is a system of internal connections linking articles together. Within this system, there are two types of internal connections. The first type of connection is recommendations for further reading on related subjects and topics, linking together, as Diderot put it, "...Dialectics to Metaphysics; Metaphysics to Theology; Theology to Jurisprudence; Jurisprudence to History; History to Geography and Chronology [...]" (Curran 2019) and so on. The second type of connection "put contradictory articles into dialogue," for example, the article *Freedom of Thought* is linked to Diderot's article *Intolerance* (of the Christian Church), inviting the "reader to cultivate a critical viewpoint" (Curran 2019). As the computer-generated diagram (seen in the image below) further elucidates, implicit in the system of internal connections is an underlying network structure.

Diagram by Olsen and Blanchard (Image source: Rosenberg (2015))

Additionally, the diagram elucidates that conceiving knowledge as fundamentally hierarchical is not "paradigmatic of Enlightenment epistemology," nor is it intrinsic to print (Rosenberg 2015). Rather, all subjects are interconnected, and as Rosenberg argues, though the

> network diagram would not have been familiar to the generation of the Encyclopedists, the concepts behind it were. They too were thinking about intellectual phenomena in terms of underlying structures

> and aggregate relationships. (Rosenberg 2015)

2 The work of Paul Otlet (1868-1944)

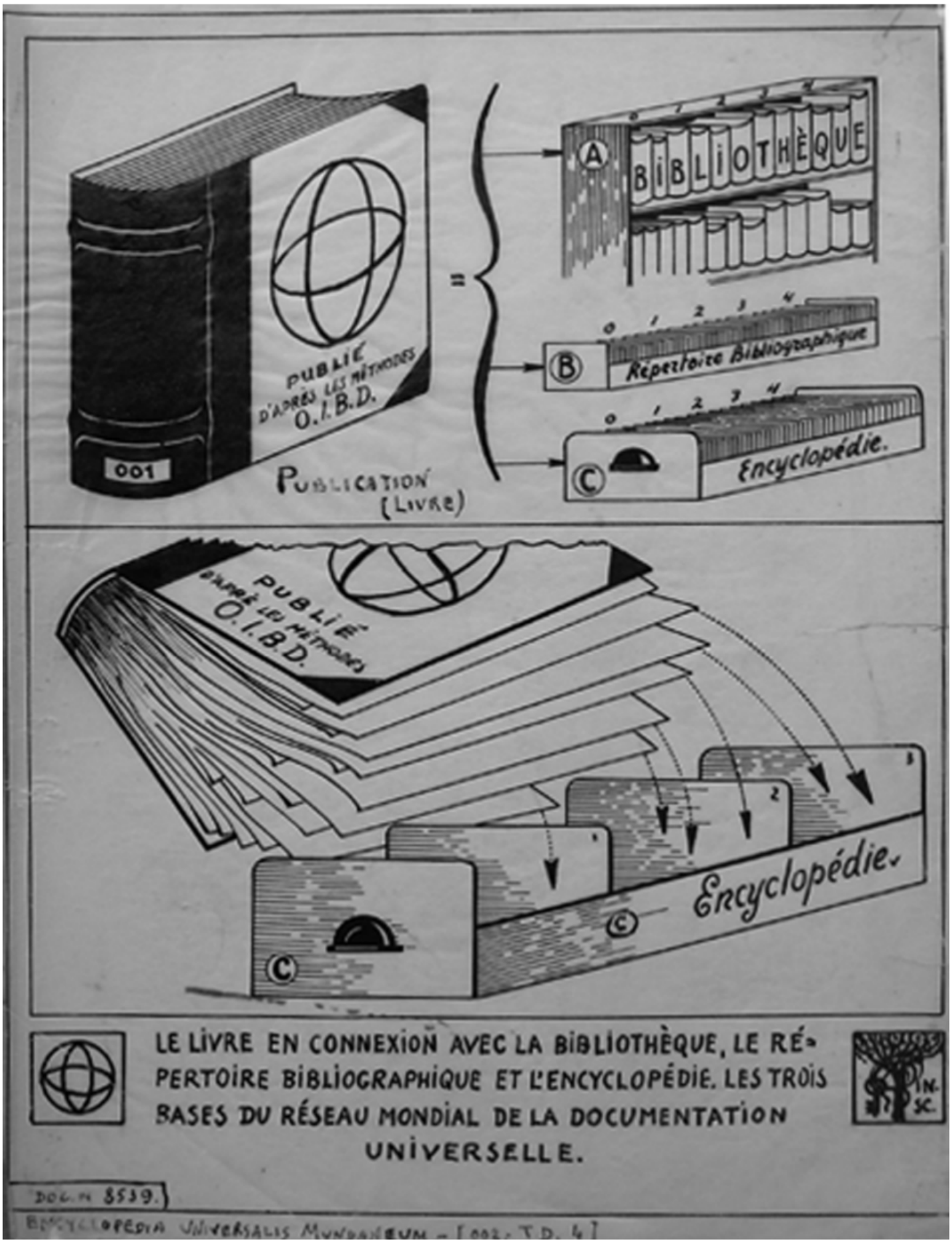
The work of Paul Otlet — regarded as a pioneer of the field once called documentation that branched into what is now called information science (Le Deuff and Perret 2019) — developed new approaches to organizing and accessing information by devising models[5] and establishing theoretical principles of information. Otlet also explored how information organization might be in the future (once media other than the book would take precedence) in the form of metaphorical illustrations of a global network of documents (Heuvel and Rayward 2011).

Similar to the Encyclopédie — a project that is seen as in response to the eighteenth-century information overload (Rosenberg 2015) — Otlet's work was in response to the nineteenth-century problem of "the enormous growth in the number of publications, specialist congresses, and international exhibitions" (Manfroid 2013). The problem that Otlet analyzed and explored solutions to was "how most effectively to create, maintain, and change institutional arrangements for collecting, storing, preserving, organizing, retrieving, and disseminating all of the recorded information that is — or will be — needed within society" (Rayward 1994). With that complex problem at hand, Otlet envisioned new approaches to storing, organizing, and disseminating information.

Otlet conceptualized documents as modular — made up of parts connected to other parts. An appropriate system, according to Otlet, must therefore allow and facilitate establishing links between these *parts* (i.e., content items). In designing such a system, Otlet explored the re-conceptualization of the Book as a global system of documents. As told by Heuvel and Rayward:

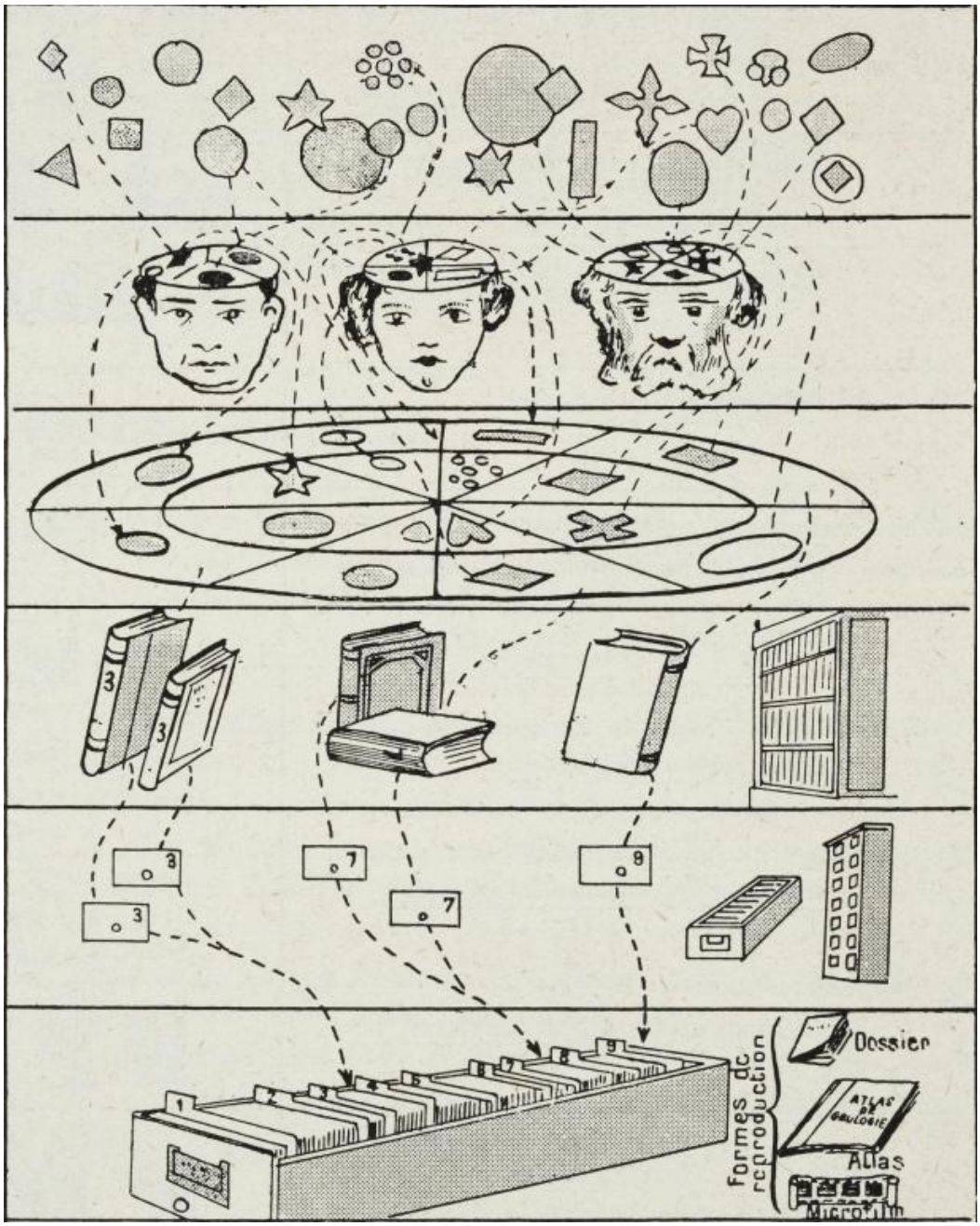
> In a 1911 lecture on the future of the book and of bibliography, Otlet came back to the idea he had first expressed in 1892 and in subsequent publications: 'The arbitrary division into lines and pages of the book in its present format, does not at all correspond all with the presentation of ideas' (p. 291). He envisioned the emergence of a future format of the book in which 'each intellectual element, in corresponding to a physical element, will create a structure such that any combination of ideas, notions, and facts will be possible.' He suggested that this process can operate in so mechanical a fashion that in the future, the book will truly become a machine to think with (Otlet in Heuvel and Rayward (2011))

As the illustrations below suggest, for Otlet, the development of such a system entails *ripping* content items (representing ideas, notions, facts) from books and collecting each on separate paper cards.



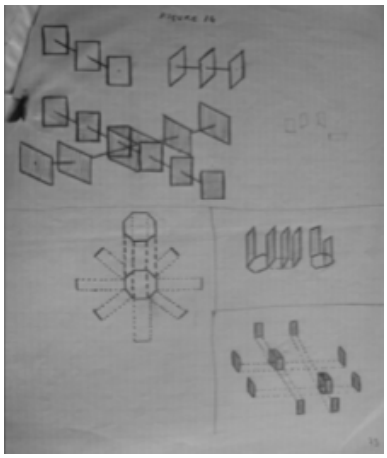
Global Network of Universal Documentation (Image source: Heuvel and Rayward (2011))

The illustration below expresses a similar notion about how knowledge evolves.



Title and Source

Otlet conceived knowledge as a process of decomposition and recomposition (analysis and synthesis). A document system must facilitate this continuous process by accommodating expansive growth and extensive reuse. One of his explorations includes a paper card-based system (seen in the image below) in which multiple links can be established to and from a card.

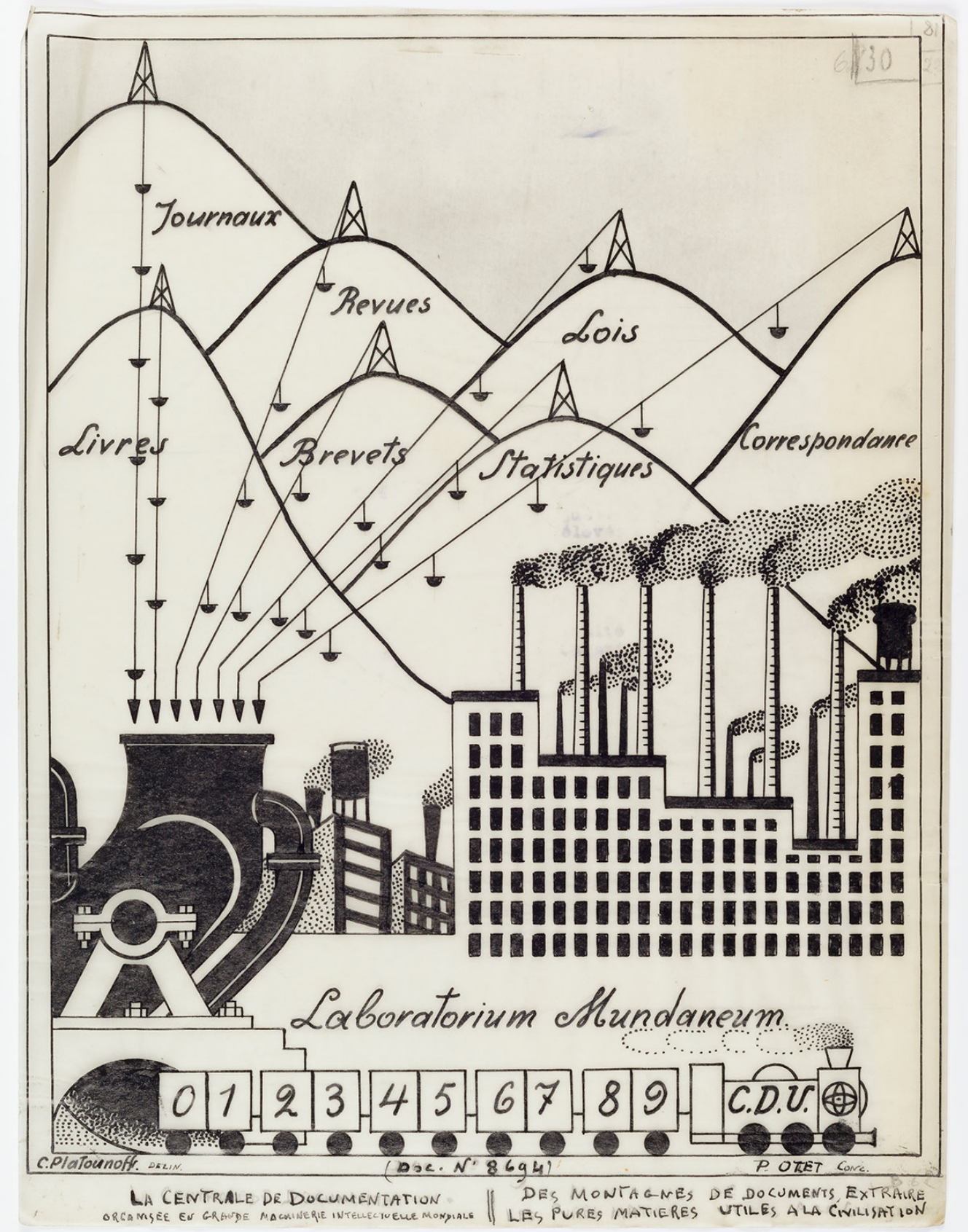


Multidimensional card system (Image source: Heuvel and Rayward (2011))

Connections between content items could be established through links and metadata. As Otlet writes:

> To increase the number of sides, one might well abandon the rectangular form of the card and adopt a polygonal form, an octagon for example. For sorting and systematically selecting the ideas that have been classified hierarchically, the cards are suspended from their centre. The Book as a structure of cards thus takes a quasi-circular form and can rotate. [I]ts structure [...] constitutes a Book [...] that has abandoned the traditional form of linear text arranged according to a unique plan. It has been transformed in some way into a body with several dimensions, as many dimensions as headings such that different searches using the same graphic elements on the cards are possible. (Otlet in Heuvel and Rayward (2011))

As Heuvel and Rayward (2011) point out, the material manifestation of such a paper card system is "impractical for many reasons." However, what Otlet describes is an open system in which many (types of) connections to and from the same content item (card) can be established through a link mechanism, forming an interconnective structure of documents. Beyond these experiments with paper cards, Otlet envisioned new visual representations of knowledge as a process of decomposition and recomposition. For example, as seen in the image below, "Otlet uses the architectural metaphor of the factory to visualize this process" (Heuvel 2017).



Laboratorium Mundaneum (*Image source:* Wikimedia Commons)

Though the material constraints of paper-based technologies inhibited Otlet (e.g., books, paper cards, shelves, cabinets, and desks), he envisioned new ways of organizing and accessing information beyond what Adriaan van der Weel (2012) calls the *order of the book*.[6]

3 The original hypertext project Xanadu by Ted Nelson (1937)

Nelson is most known for inventing the *back button*, and developing concepts such as *hypertext*, *virtuality*, and the *docuverse*. Hypertext is likely the most known but is merely one of the many concepts Nelson has spent decades developing within a larger project called Xanadu. Though Xanadu has never been fully implemented, the many prototypes and writings throughout the decades since the 1960s have had a profound impact on the evolution of hypertext.[7]

Xanadu is a hypertext system, a docuverse, technically a piece of software that, since its conception, has been designed to run on a global network of computers in which every document is to reside (Ridi 2018). Much akin to the work of Otlet, Xanadu is based on particular notions about how knowledge evolves and the structure of ideas. As Nelson writes:

> The physical universe is not all that decays. So do abstraction and categories. Human ideas, science, scholarship, and language constantly collapsing and unfolding. Any field, and the corpus of all fields, is a bundle of relationships subject to all kinds of twists, inversions, involutions, and rearrangements. (Nelson 1965)

According to Nelson, too, it is this continuous process that a system must be designed to accommodate by having the capacity for new categorization systems and any arrangements of old and new content. Further, on the structure of thoughts and ideas, Nelson writes:

> [A]s you consider a thing, your thoughts crisscross it constantly, reviewing first one connection, then another. Each new idea is compared with many parts of the whole picture, or with some mental visualization of the whole picture itself. (Nelson 1987)

In line with the notion that the structure of ideas is nonsequential, in his book Literary Machines (first published in 1980), Nelson defines *hypertext* as "nonsequential writing—text that branches and allows choices to the reader" (Nelson 1987). Whereas writing and structuring sequential text entails choosing "one expository sequence from among the possible myriad," writing nonsequential text entails deciding on the "interconnective structure" — "where to put things in the searchable maze" (Nelson 1987). It is based on these definitions and notions about how ideas and knowledge evolve that Nelson envisioned Xanadu.

Xanadu has gone through many revisions and different prototype implementations over six decades, but the core concepts have remained fundamentally the same. In what follows, those concepts are examined with reflections on some of the implementations and juxtaposed to how those concepts are implemented on the web.

Integrated History Management

Xanadu is a system that stores (and makes accessible) every change made to documents, integrated in such a way that former states can be retrieved and reworked (Nelson 1987). As seen in the image below, people can choose whether those changes are local/private or online/public.

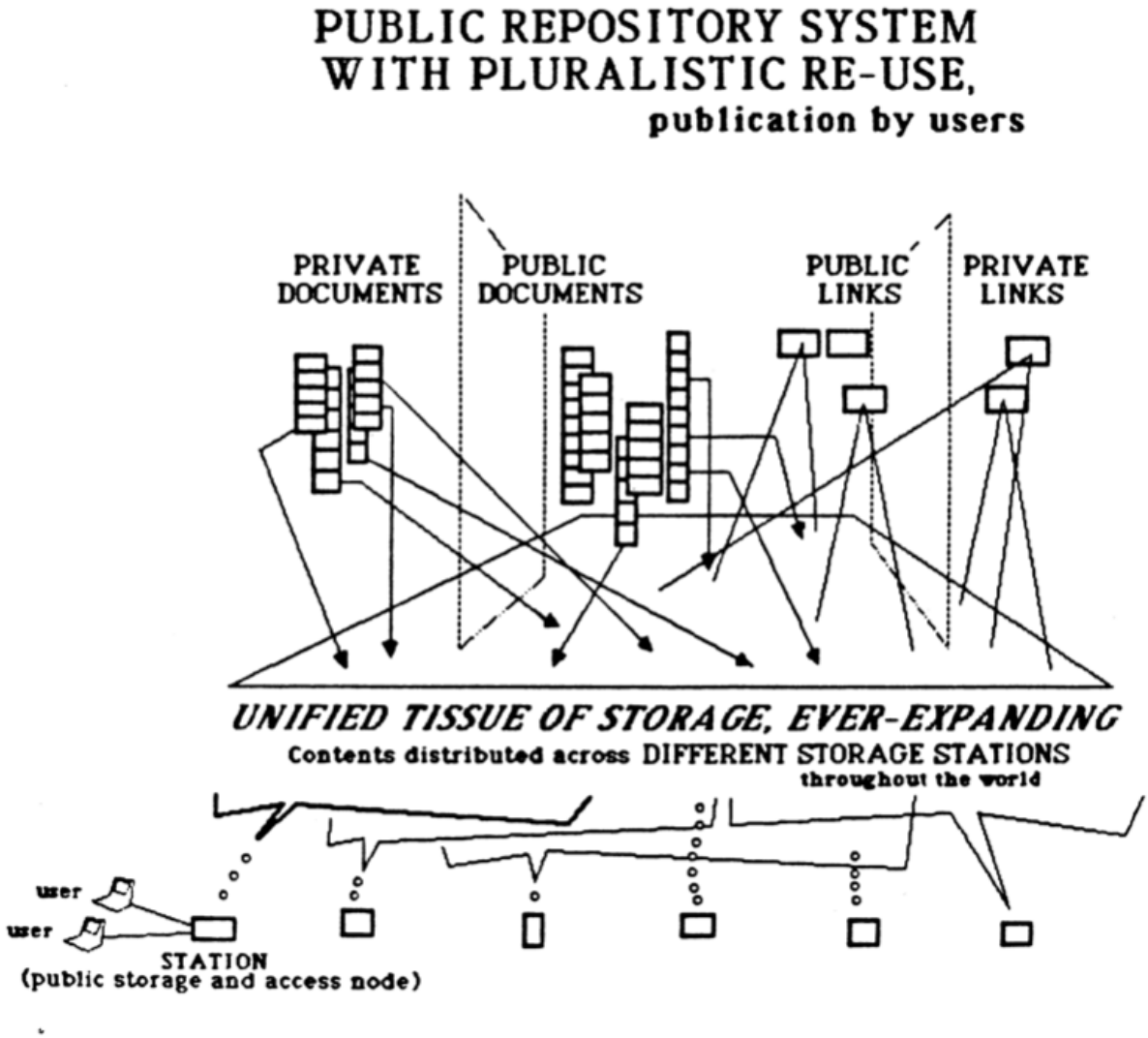


Image source: Nelson (1987)

Once a document is online/public, any changes made (e.g., if the writer revises the content, or readers reuse parts of a document or create links to/from a document) are stored; effectively, the history of every document is accessible to anyone. This would be the same if the web were built with an integrated history management system such as Git, not as an optional tool but as a core feature.

Bidirectional Visual Links

The multidimensional structure of Xanadu is designed for two main types of connections between documents, expressed by the two link types *content links* and *transclusions*. All links are implemented as bidirectional visual links. Content links are the arbitrary connections people (writers and readers) create as they engage with text, and *transclusions* are reused content items. By convention, transclusions are what are known as excerpts and typographically distinguished as block quotes or inline quotes, and the link between the *copied* and the *pasted* is usually embedded as a citation. However, as Nelson writes:

> Transclusion is what quotation, copying and cross-referencing merely attempt: they are ways that people have had to *imitate* transclusion, which is the true abstract relationship that paper cannot show. (Nelson 1999)

Content items are not duplicated; rather, *transcluded* — included in a document with a visual link to the original document. Since all links are bidirectional, every outward and inward-pointing link is accessible,

which means the original document also points to documents that reuse parts of its contents. Transclusions offer a way to retrieve "the origins and context of quotations, excerpts and anthologized materials, and content transiting between versions" (Nelson 1999).

On a technical level, links are not embedded but implemented as an overlay, much akin to "a cache, or an alias on the desktop" (Nelson 1999), enabling multiple overlapping links to the same (part of a) document. Additionally, because all changes are stored, even if the original document undergoes changes, it is always possible to view the content item in its original context at the time it was transcluded.

In contrast, links on the web are embedded (in HTML) and only point outward. When a website is cited as a source in a text, it usually indicates the date the website was accessed. However, if the contents of the website have been deleted or changed since then, there is no way of accessing previous versions. Additionally, on the web, it is only possible to establish links at the document level (or *page* level)[8] whereas, in Xanadu, link endpoints are at the level of the content item. As for how this would look and work, Nelson envisioned Xanadu as a system in which documents are viewed side-by-side with visual links, expressed by two concepts: *parallel documents* and *transpointing windows* (Nelson 1999).

Side-By-Side Documents With Visual Links

Parallel documents, according to Nelson:

> are everywhere, but are not generally acknowledged. There are relatively few explicitly parallel documents (like Tom Stoppard's play "Rosencrantz and Guildenstern Are Dead", which is explicitly parallel to "Hamlet" -- showing events that occur offstage in "Hamlet" and vice versa). But implicitly parallel documents are everywhere -- the parallelism of commentaries, the parallelism of long and short versions of reports, the parallelism of translations, the parallelism of holy books. (Nelson 1998)

Thus documents should be viewed side-by-side with *transpointing windows* to:

> support analysis and detailed understanding -- by parallel commentary, precise annotation and the explication of contents; by the facilitation of pinpoint controversy. These are needed not just in scholarship, but legislation, diplomacy, and anywhere that interrelated documents need to be seen[…for] detailed explication, commentary or disagreement[, and for] comparing successive versions of a document. (Nelson 1999)

A prototype from 2003, in which the links are solid lines pointing to and from content items within windows, is seen in the image below.[10]

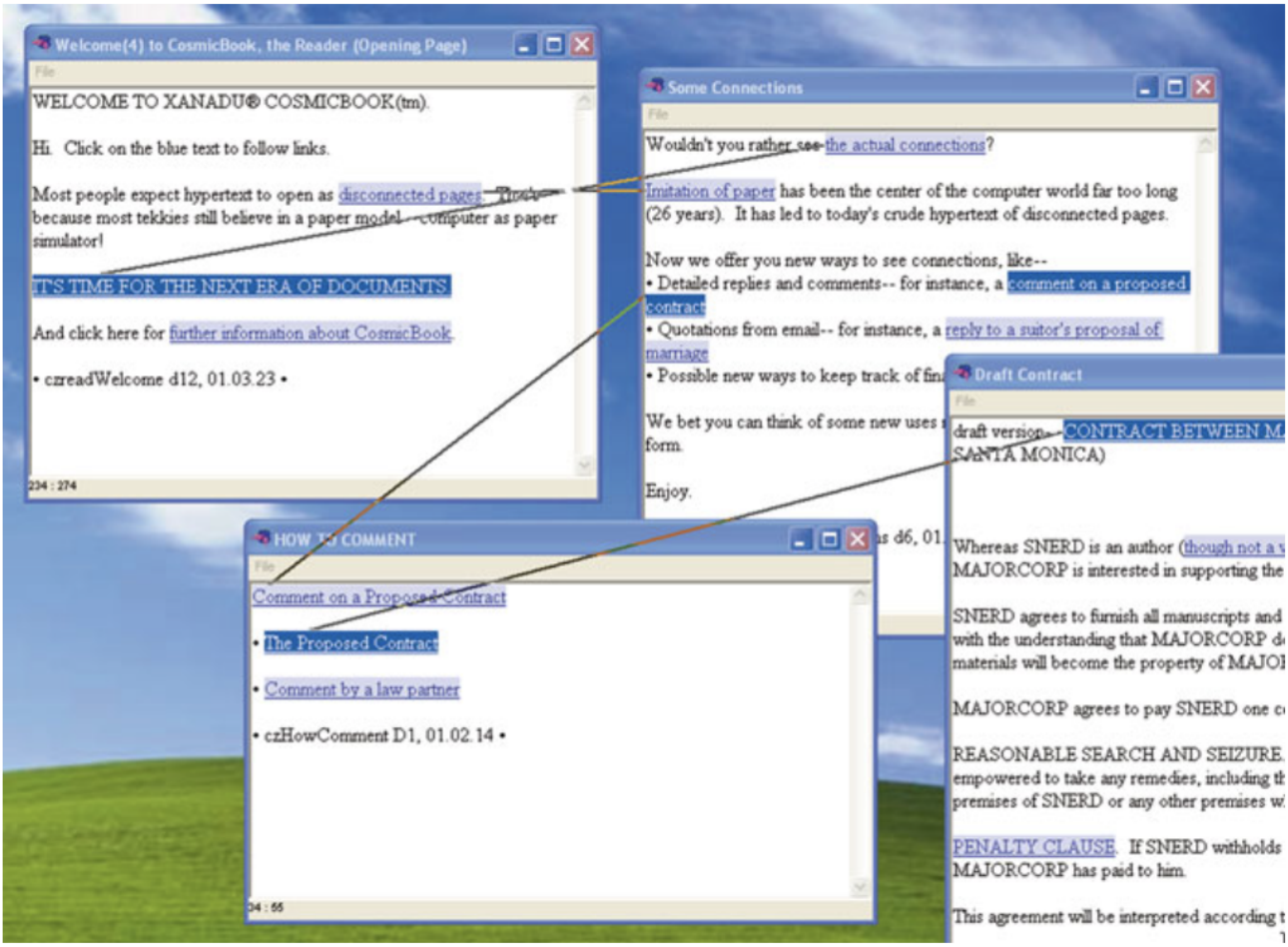
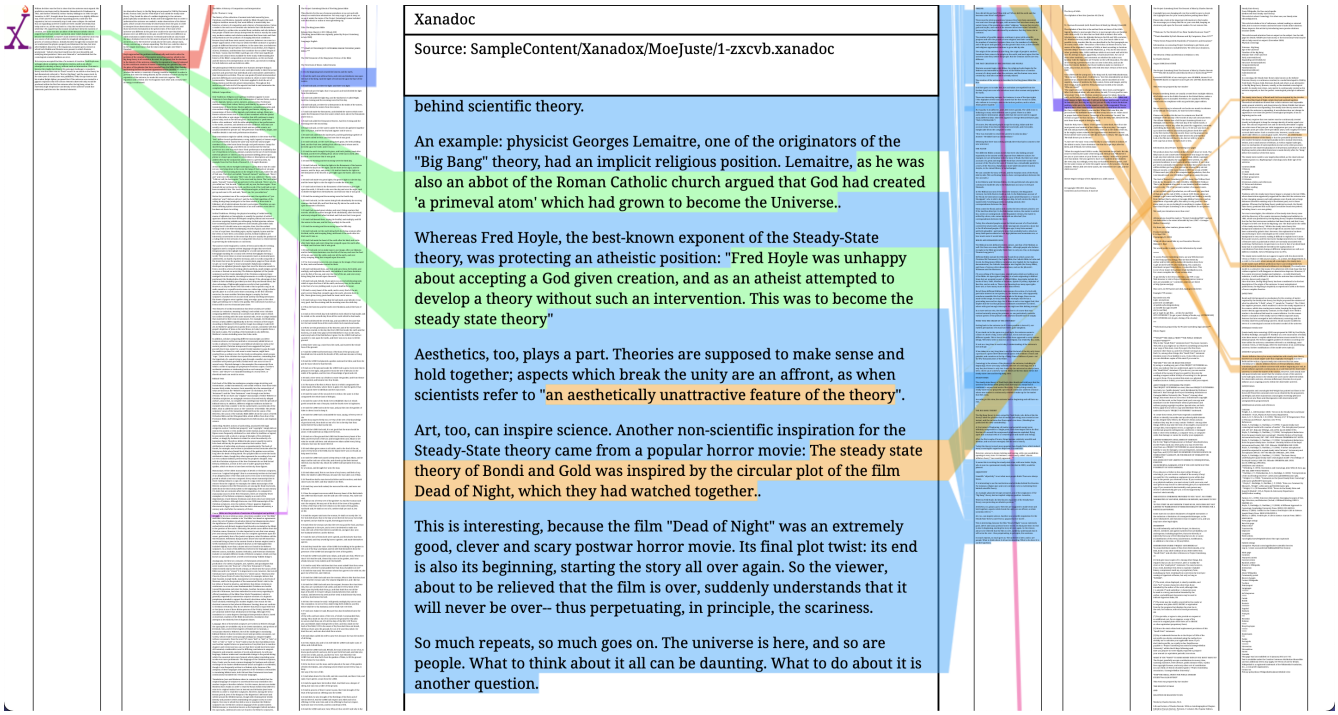


Fig. 17.11 CosmicBook, programmed by Ian Heath

Image source: Nelson (2015)

In another prototype, the links are applied not as solid lines but as color-coded highlights. Additionally, the main document is in the middle, and the linked documents are on the left and right sides with a smaller font size.



Screenshot of Xanadoc (try the interactive demo here)

In the latest Xanadu prototype, which is in 3D,[11] the linked documents appear on the sides when moving through the contents, or as Nelson puts it: "all objects sworfing (swooping and/or morphing) together" (Nelson 2016).

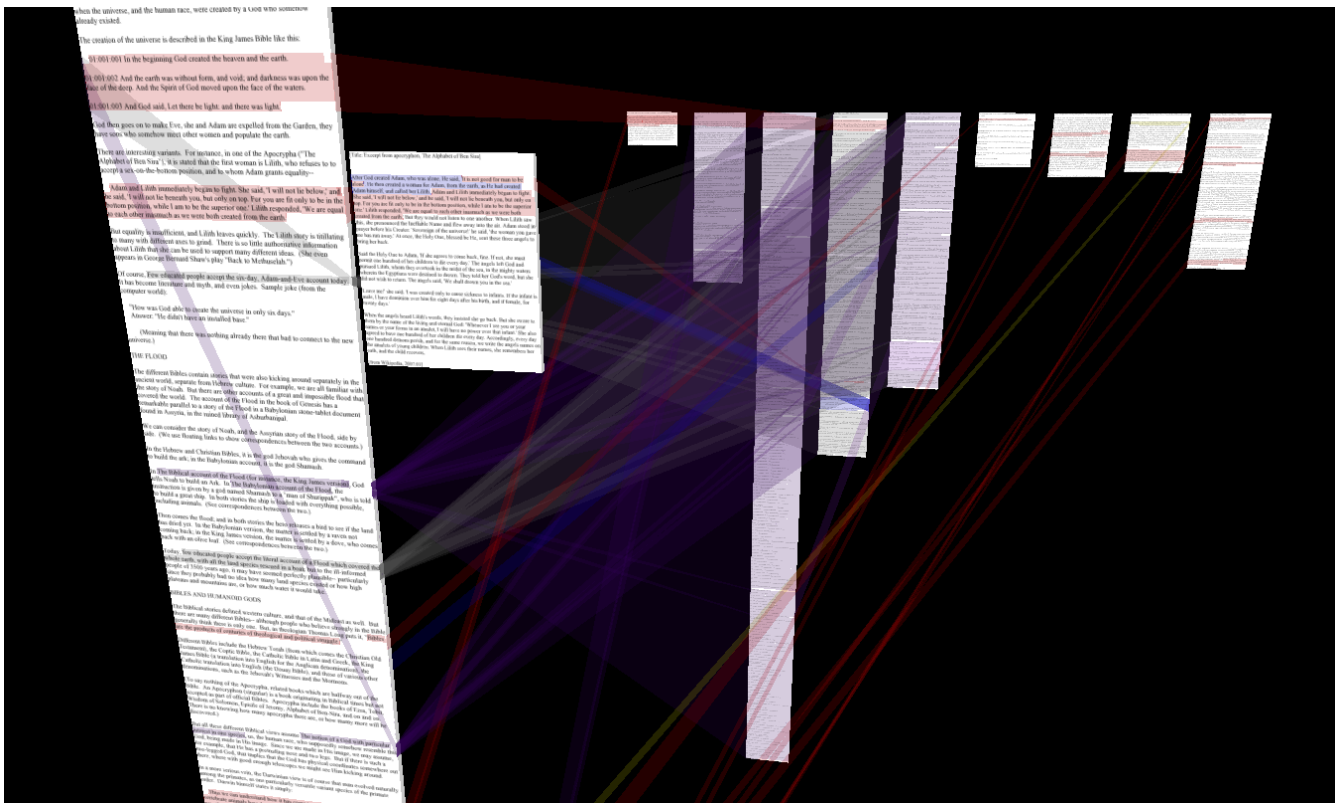


Image source: Nelson (2016)

A demonstration of *sworfing* is given by Nelson in the video below.[12]

Go to video

These implementations elucidate that creating multiple overlapping *transclusions* and *content links* results in complex (visual) information. Whereas Otlet's experiments with paper cards are impractical in terms of implementation because of material constraints, the problem of mapping the interconnective structure in the digital realm has to do with how to visualize and interact with the resulting complex information. This has been a central concern for decades, as Conklin (1987) suggested in his analysis of hypertext systems in the 1980s. Referring to the image below, titled *Tangled web of links*, he writes:

> This experimental implementation of a global map in the intermedia system shows the difficulty of providing users with spatial cues once a linked corpus contains more than a few dozen documents. This global map only represents about one tenth of the documents in a corpus[.] Conklin (1987)

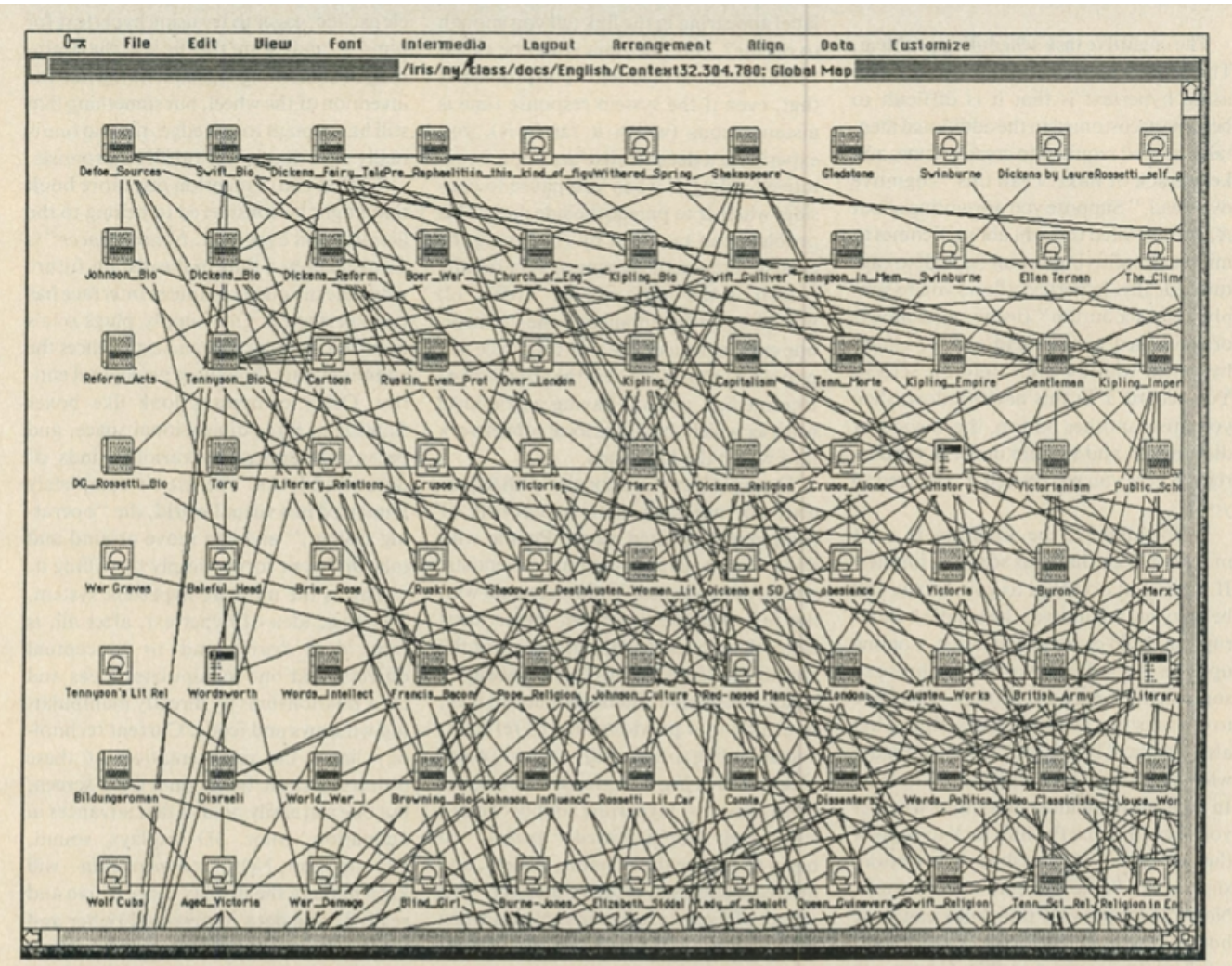


Figure 11. Tangled web of links. This experimental implementation of a global map in the Intermedia system shows the difficulty of providing users with spatial cues once a linked corpus contains more than a few dozen documents. This global map only represents about one tenth of the documents in a corpus designed for a survey of English literature course.

Image source: Conklin (1987)

Nelson refers to it as the *framing problem*, to which he notes that "filtering links is a key aspect of front-end design [which] is a separate study in itself" (Nelson 1987).[13]

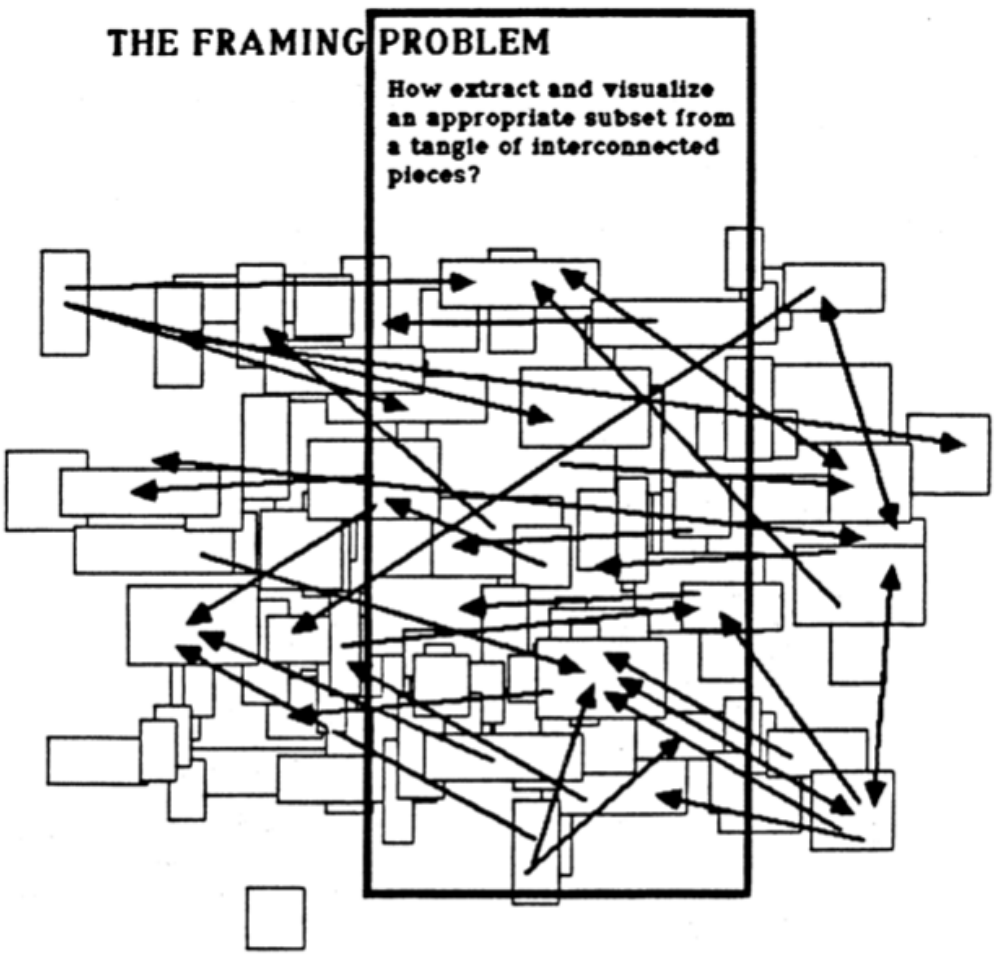


Image source: Nelson (1987)

3. Insights

Distilled from these examples, an interactive prototype of a digital document system (henceforth Nexae) will be developed based on the following conditions:

1. Documents are modular.
2. There must be multiple renditions.
3. Links are to be developed by distinguishing them according to types of connections.

1. Documents are modular.

The structure of ideas is multi-sequential, and knowledge is not fundamentally hierarchical. Knowledge is a process of decomposition and recomposition (analysis and synthesis). To realize the interconnective structure of documents and to facilitate the continuous process of decomposition and recomposition, Nexae will be developed based on the conception that documents are modular. Modularity implies the possibility for:

- a link to point to an entire document or a particular content item within a document,
- a content item existing in multiple documents,
- overlapping links, and
- the possibility for documents to be organized according to (and belong to) multiple categories.

2. There must be multiple renditions.

Significant to the design of the Encyclopédie is that there are multiple entry points through textual and visual renditions of its contents, which can be implemented as different view modes in the digital document system. The computer-generated diagram, elucidating the underlying network structure of connections within the Encyclopédie, is deemed particularly useful for gaining an infographic-like overview of the number of connections between documents belonging to different categories.

There must be multiple renditions to convey different information about the interconnective structure, whether that be different representations of documents or arrangements, both hierarchical and non-hierarchical. Each view mode will be developed to offer different perspectives on documents at different levels of detail (e.g., view mode A at the document collection level, view mode B at the level of document selection, and view mode C at the level of content items).

3. Links are to be developed by distinguishing them according to types of connections.

Xanadu is a system with two link types: transclusions and content links. These two link types are based on distinguishing between arbitrary conceptual connections and those created when content is reused in another document. Importantly, unlike the convention of inserting reused content between quotation marks, transclusion also encompasses connections between content transiting different versions. For example, two drafts will have shared content items, and these are also transclusions. Transclusions enable content to be inserted from one document into another, keeping track and providing direct access to its original context, which relies on bidirectional links. The development of links will be based on distinguishing transclusions and non-transclusions. Adopting the concept of transcluding content means abandoning the concept of *copying* and *pasting*. Additionally, distinguishing links will involve exploring the visual form of links, how to indicate the link direction, and how to provide direct access to linked documents through interaction, whether by viewing documents side-by-side or some other means.

The next entry involves the concept design of the digital document system.

Entry 04 Concept Design: View Modes

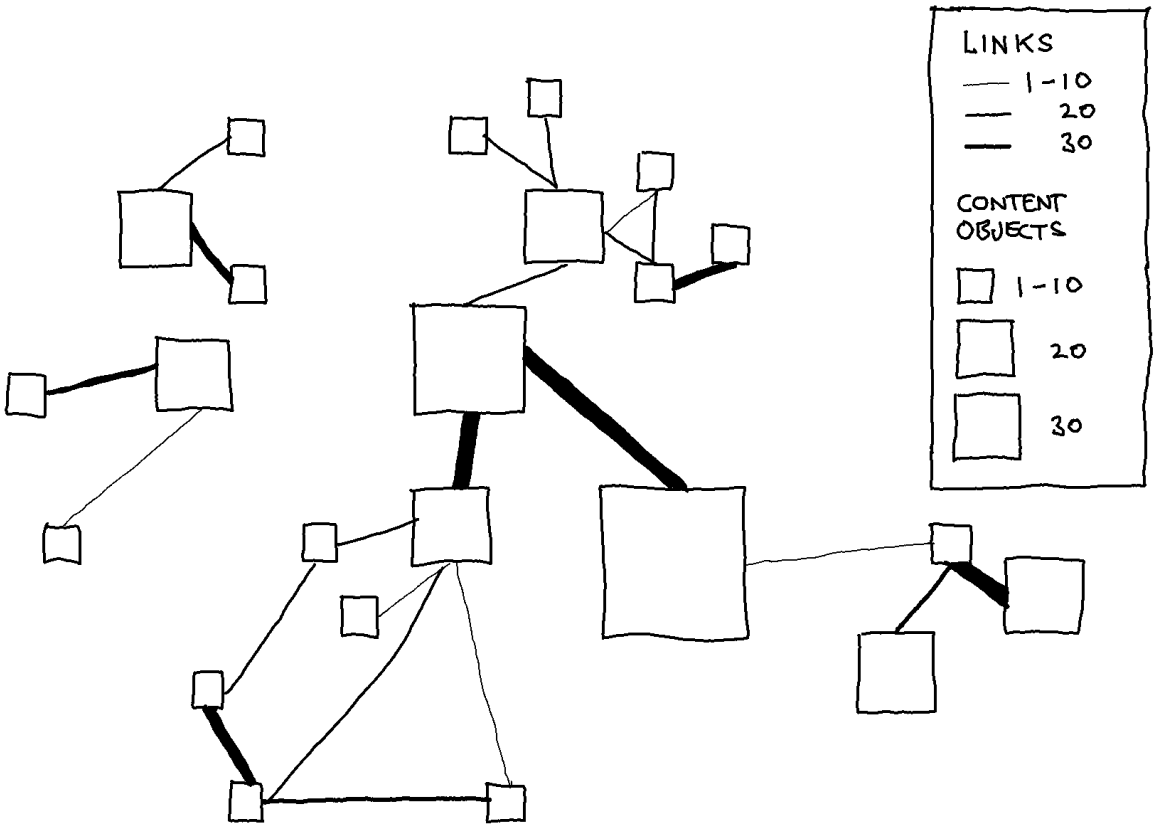
View modes are different levels of perspective on documents. In addition, each view mode differs in how documents and links are represented.

1. **Inventory View**
   - At the level of the document collection.
   - Documents are represented as nodes, connections as links in a two-dimensional diagram.
   - Shows the number of connections between documents.
2. **Stack View**
   - At the level of a selection of the document collection.
   - Documents are represented as layers, connections as links in a three-dimensional stack.
   - Shows selection of connections (link type subcategories).
3. **Merge View**
   - At the level of content items.
   - A document is represented as a single frame (full screen).

- Shows connections side-by-side or top-to-bottom.

1. Inventory View

In this view mode, the entire inventory is visible and represented as a diagram in which a **node** denotes a document and a **link** denotes connections of various types (specified below).



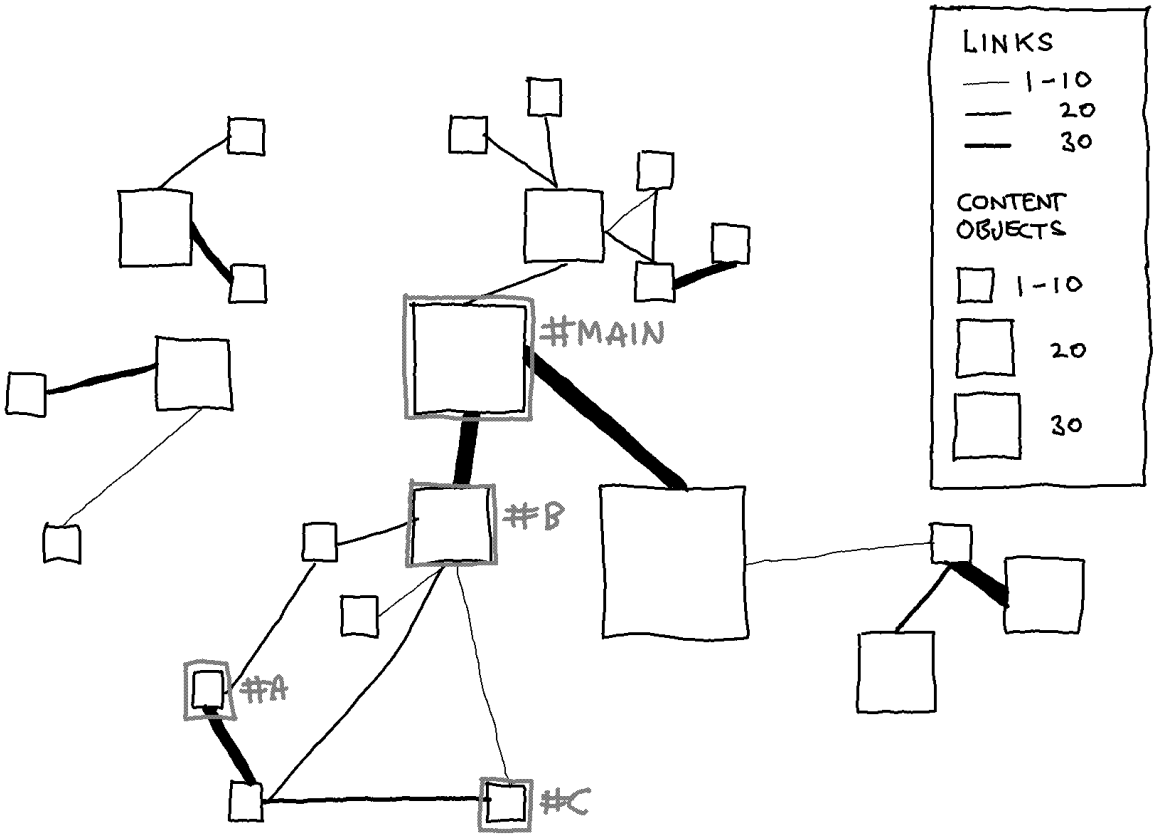
Node

The node's size reflects the number of content items it contains (i.e., the size of the document).

✱ This will allow for a quick visual distinction of documents that contain parenthetical information (1-2 content items) from documents that contain body text (50+ content items).

Link

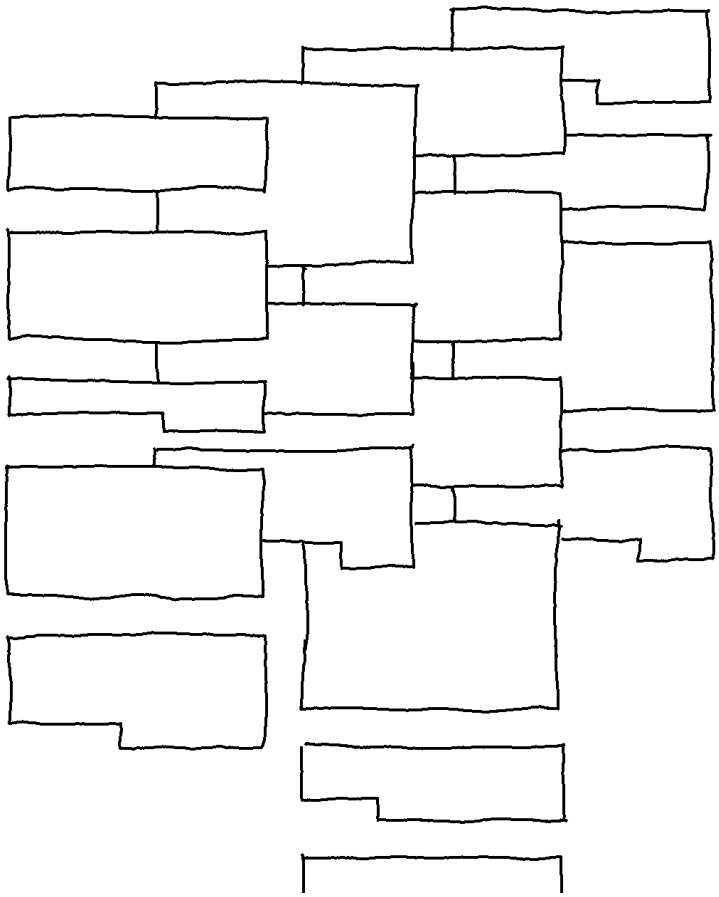
The thickness of a link reflects the number of links between documents.



In Inventory View, it is possible to select nodes to create a stack for entering Stack View, as seen in the image above.

2. Stack View

A **stack** comprises a set of documents represented as **layers** that contain **content items**.



Stack

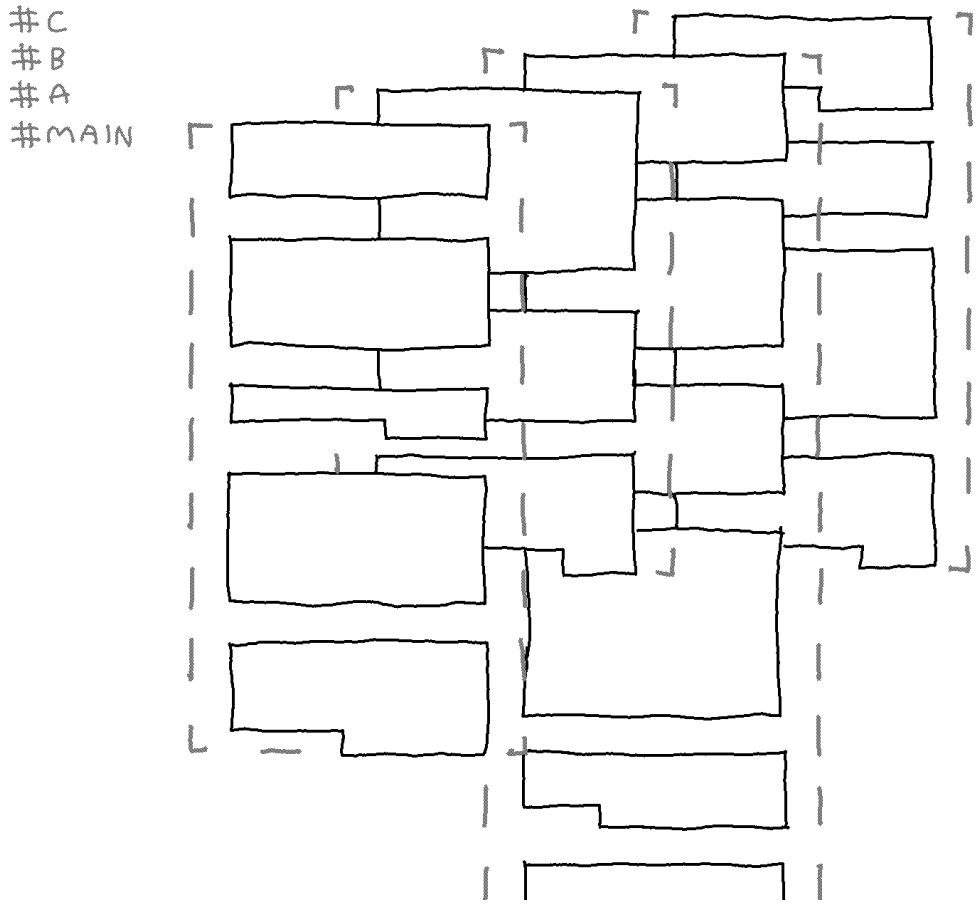
A stack can be thought of as a workspace. The inventory in its entirety may contain complex layers of information, so creating stacks is a convenient method for engaging with complexity by selecting those to view in more detail.

Layer

A document is represented as a layer, which instead of having a single title, has a tag. In the image below, there are four layers: `#MAIN,` `#A,` `#B,` and `#C.`

Content Item

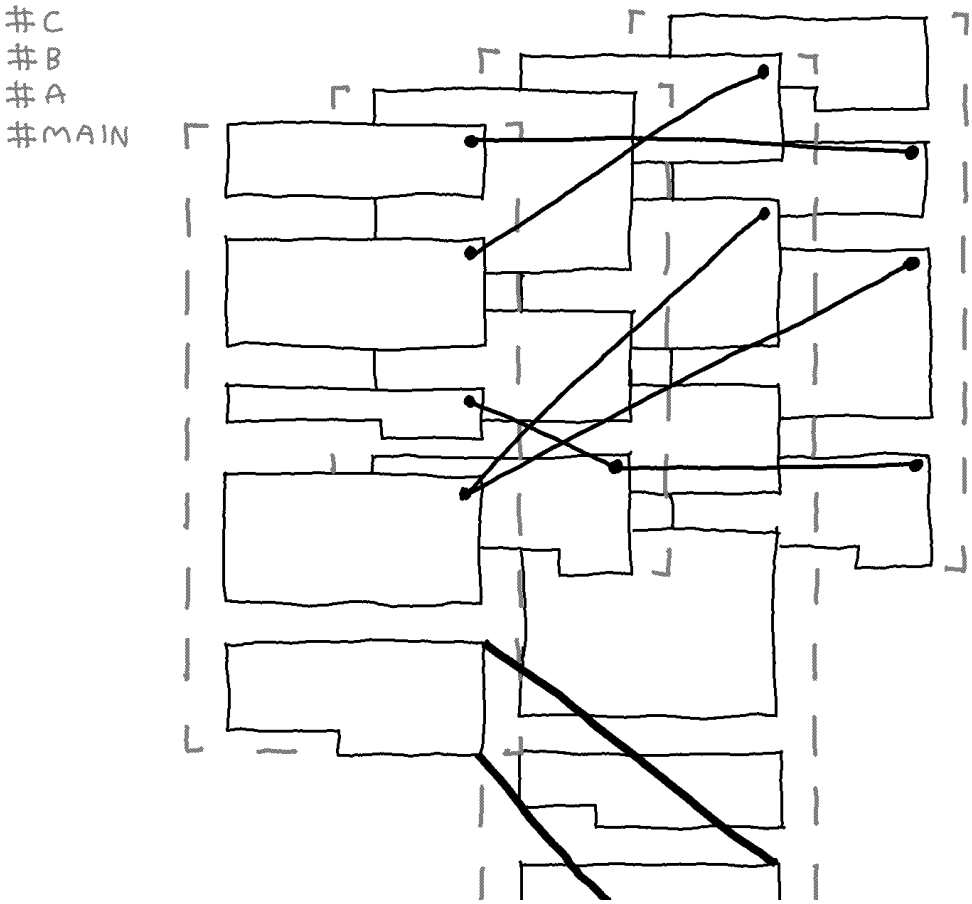
Content items are the parts that make up a text. A content item can have any number of tags, placing it in multiple layers.



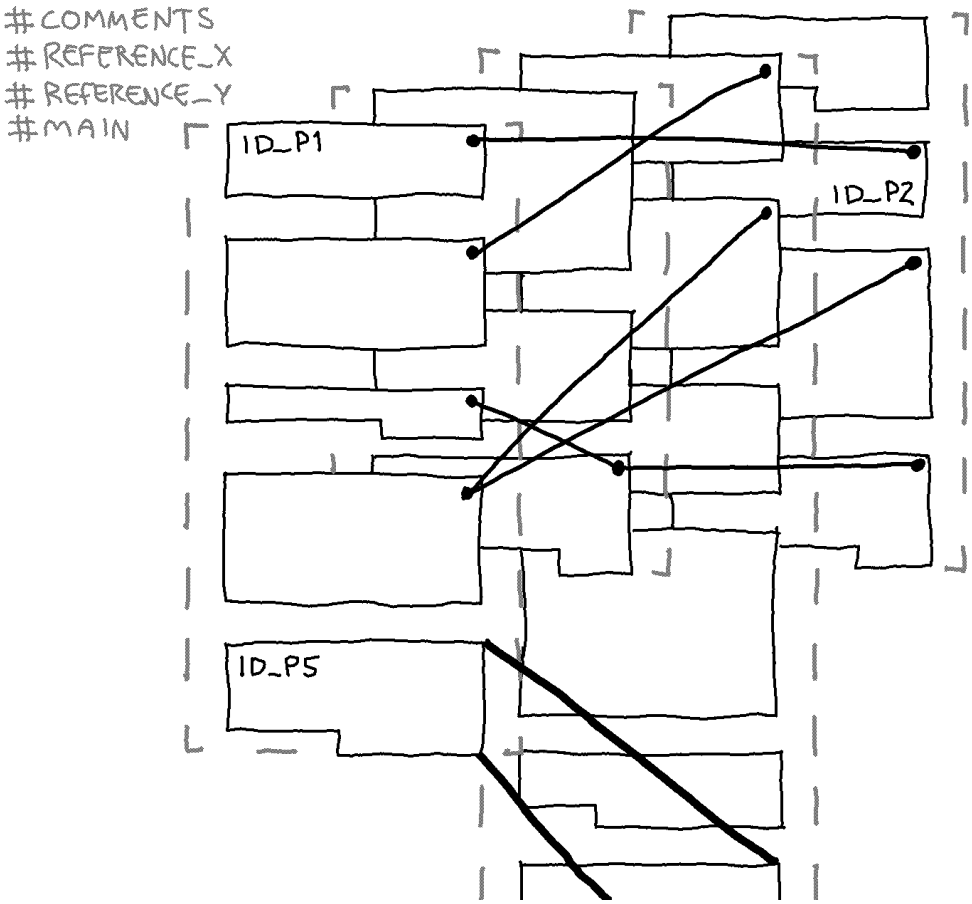
Link Types

In the image below, there are several links between the layers. As defined in the previous entry, there are two main types of connections: those that are transclusions (reused content items; inclusions of (a part of) a document into another document) and those that are not transclusions (arbitrary conceptual connections). In the image below, these two types are visually distinguished by dot-line-dot links and side-surface links.

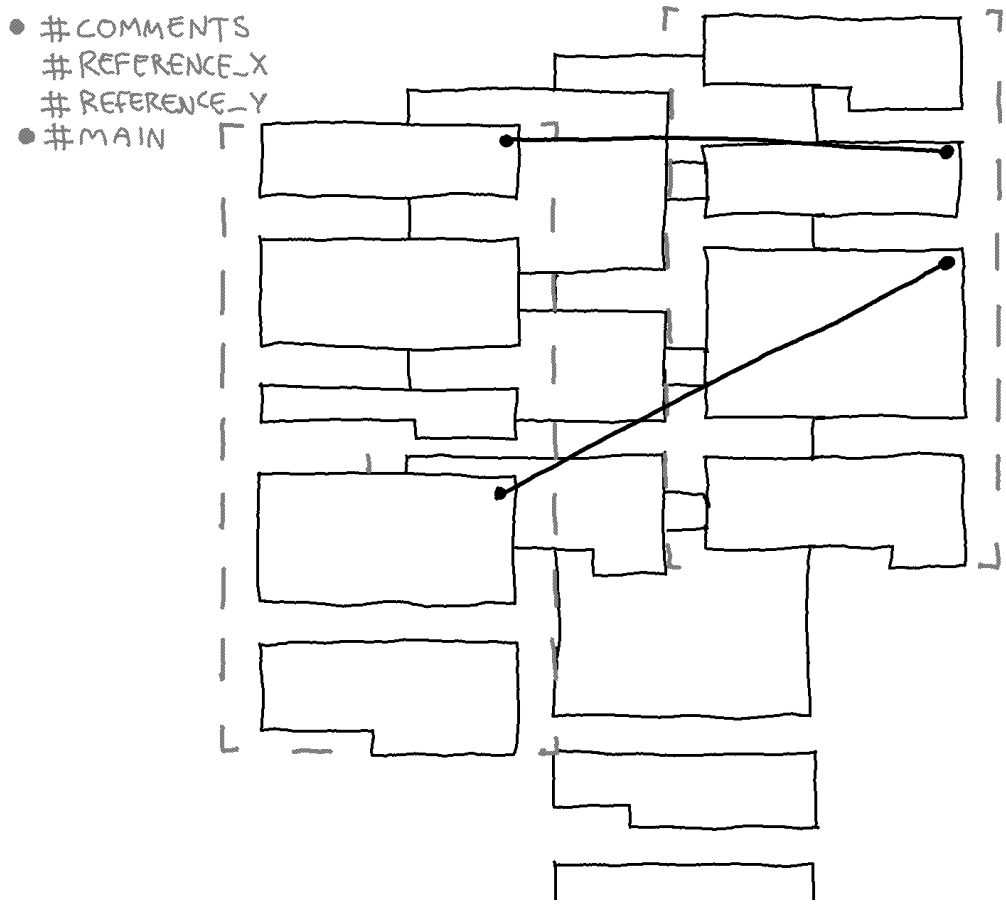
✱ These two link types must be visually distinguished, but the visual form is subject to change.

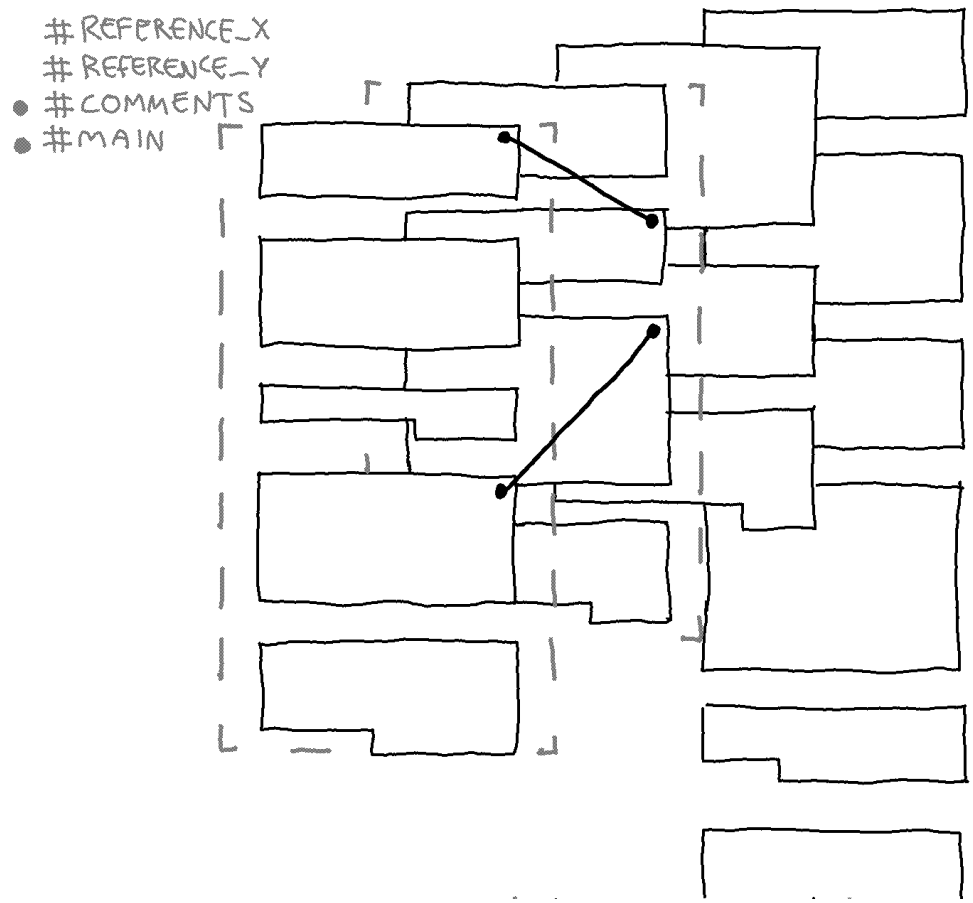


The links that are not transclusions can be categorized according to any taxonomy, hence the appropriation of the common usage of a hashtag as a metadata tag. For example, in the image below, if content item `ID_P2` is a comment on content item `ID_P1`, then the layer could be tagged `#COMMENTS.` If the other two layers are different references, these layers could be tagged `#REFERENCE_X` and `#REFERENCE_Y.`



It is also possible to show links only between a selection of layers in the stack. Upon selection, the stack is rearranged. The layers `#MAIN` and `#COMMENTS` are selected in the two images below, showing the links between them, followed by stack rearrangement.

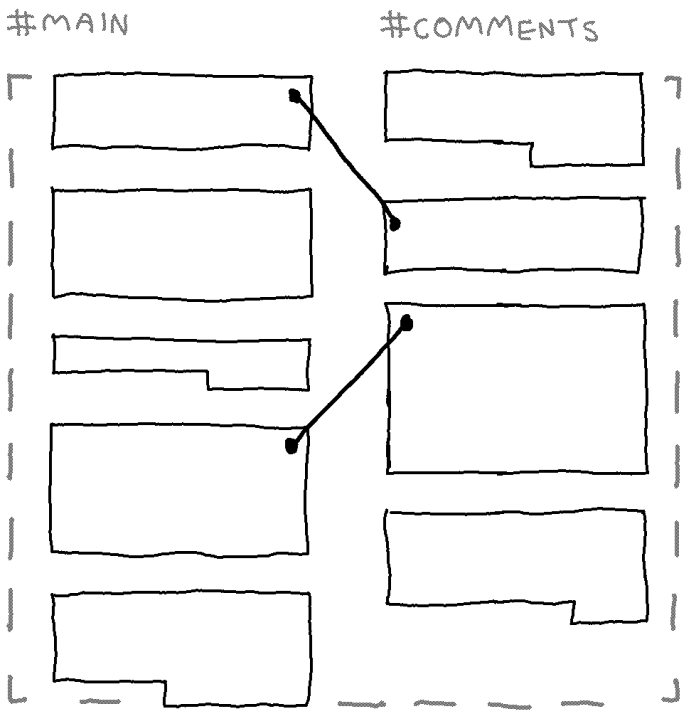

#COMMENTS
#REFERENCE_X
#REFERENCE_Y
#MAIN


#REFERENCE_X
#REFERENCE_Y
#COMMENTS
#MAIN

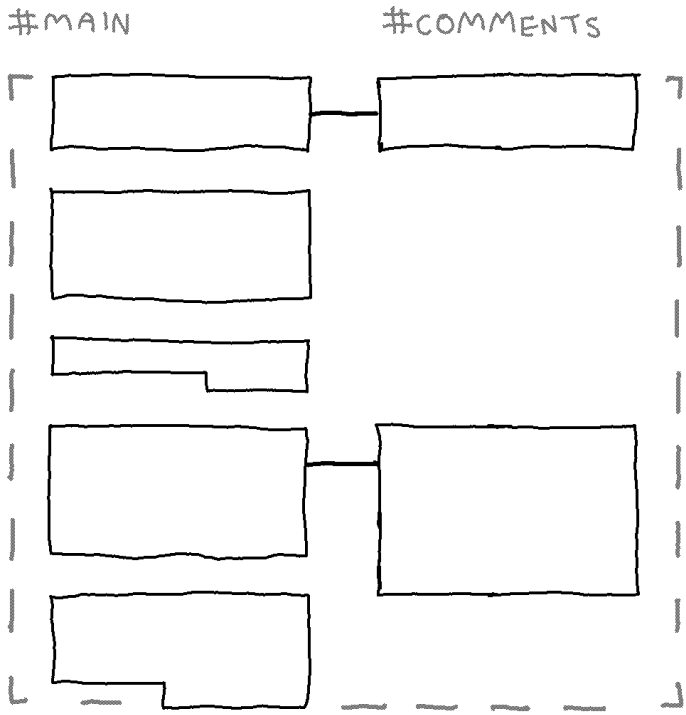
While in Stack View, all or a selection of layers can be merged. The arrangement of the stack will determine how the layers are merged.

3. Merge View

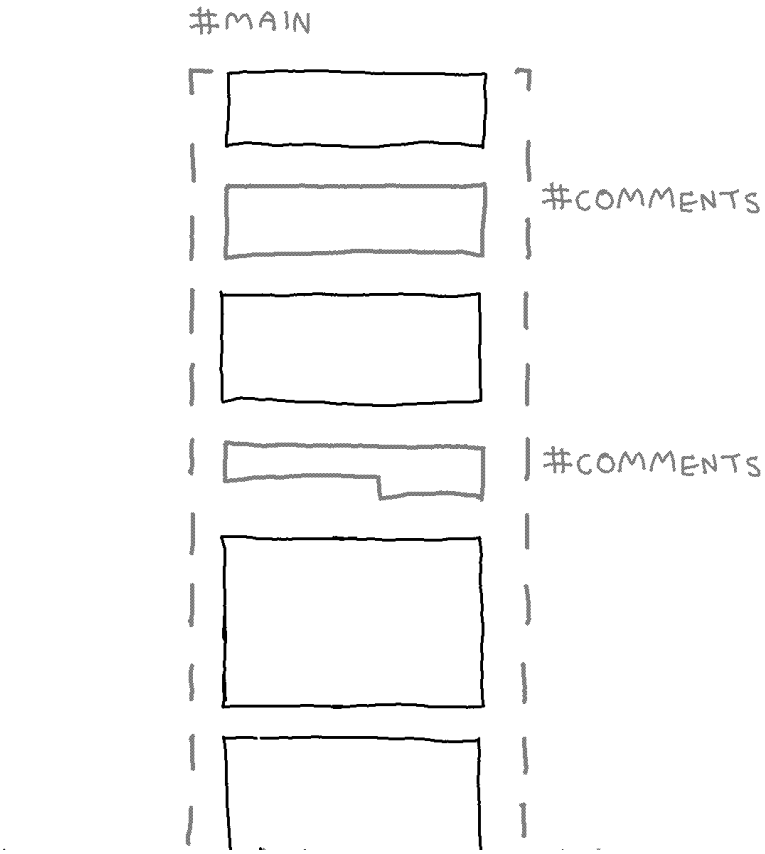
`#MAIN` and `#COMMENTS` are merged side by side in the image below.



Only the linked content items (between `#MAIN` and `#COMMENTS`) are shown side by side in the image below.



The image below shows the option for merging the content items sequentially. If another layer were included, the order would depend on the arrangement of layers in Stack View.



The next entry reflects on the design presented in this entry.

Entry 05 Reflection: View Modes

This entry reflects on (and discusses points for improving) the design presented in the previous entry.

To Engage With Complexity

The purpose of Stack View is to enable the (re)arrangement of a selection of documents in a particular order for entering Merge View. Creating *stacks* is supposed to be a convenient method for engaging with complexity by selecting which to view in more detail. Shifting from a 2D to a 3D perspective may obfuscate and not serve that purpose well.[14]

In abandoning Stack View, proceeding first requires defining the basic concepts more clearly. Questions are:

- What constitutes a document?
- How are links attached?
- What link types?

These questions are explored in the next entry.

Entry 06 Concept Design: Link Types

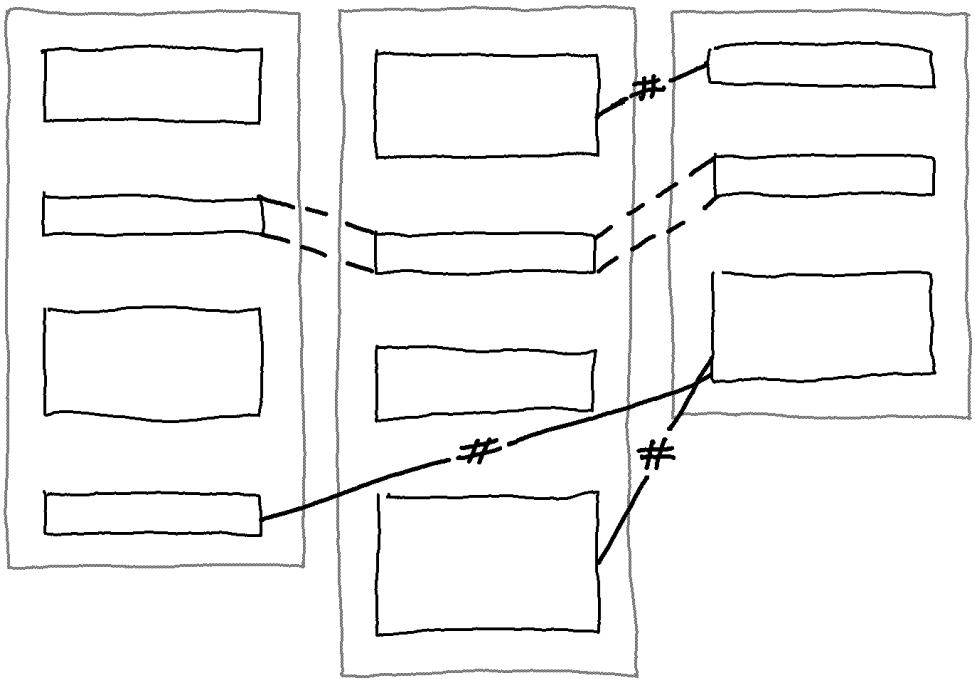
Questions are:

- What constitutes a document?
- How are links attached?
- What link types?

Documents, Content Items, and Link Types

A document is a container of (one or many) content items to which links can be attached (on the content item or document level). Two main link types can be established between content items: transclusions and non-transclusions — now called *taglinks*.

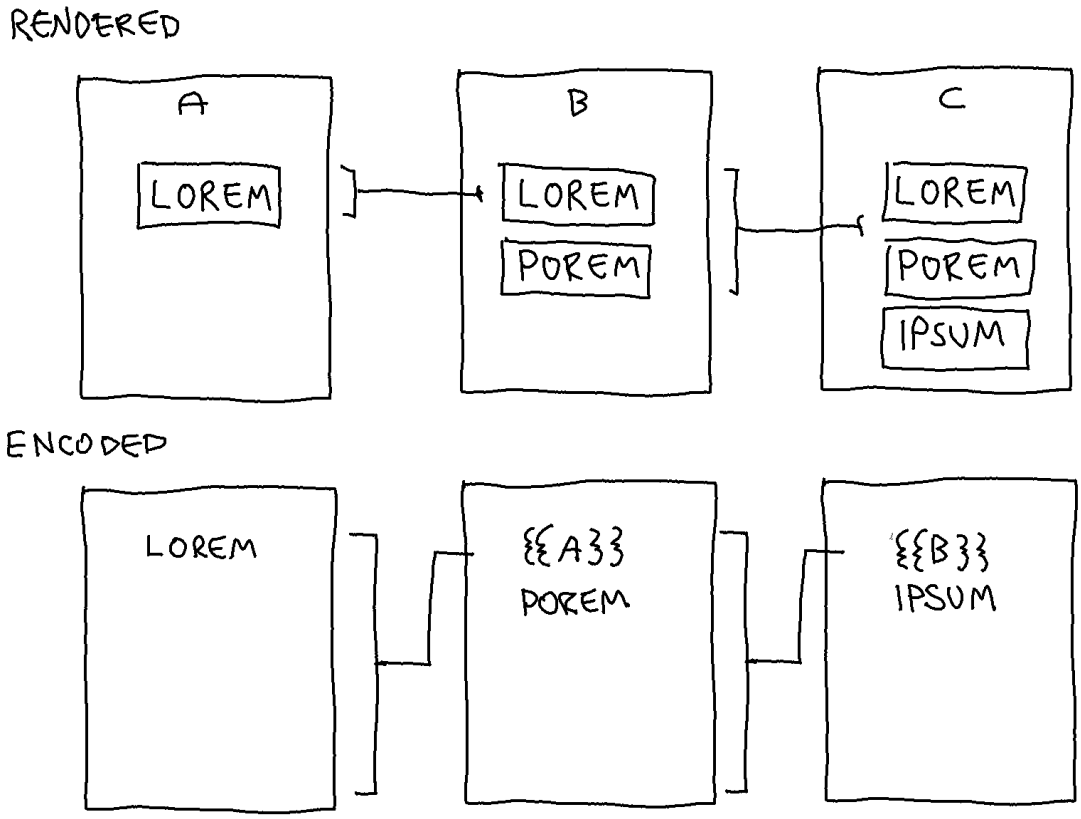
1. Transclusion ----
2. Taglink –#–



1. Transclusion ----

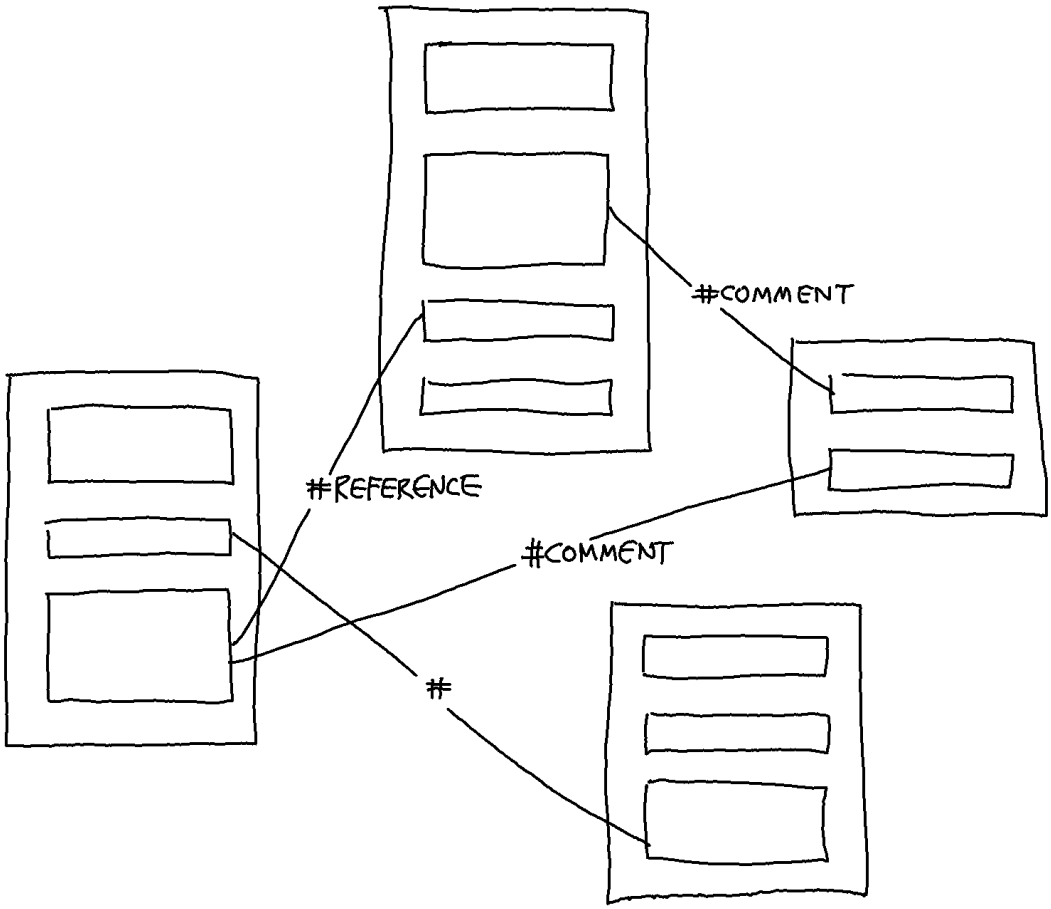
Transclusion is the inclusion of (a part of) a document into another document.[15] When a content item is reused in another document, a visual (transclusion-type) link is automatically created, offering a way to retrieve "the origins and context of quotations, excerpts and anthologized materials, and content transiting between versions" (Nelson 1999).

The image below shows the concept of transclusion on a technical level.



2. Taglink –#–

A taglink is any arbitrary conceptual connection created between (a part of) documents and can include a descriptive label (#Label) or remain empty (#). Utilizing the common usage of hashtags,[16] taglinks enable the organization of links based on any taxonomy. Examples of taglinks are given below.



The link types and the view modes developed so far are explored in a prototype in the next entry.

Entry 07 Prototype: How to Switch View Modes (Round 1)

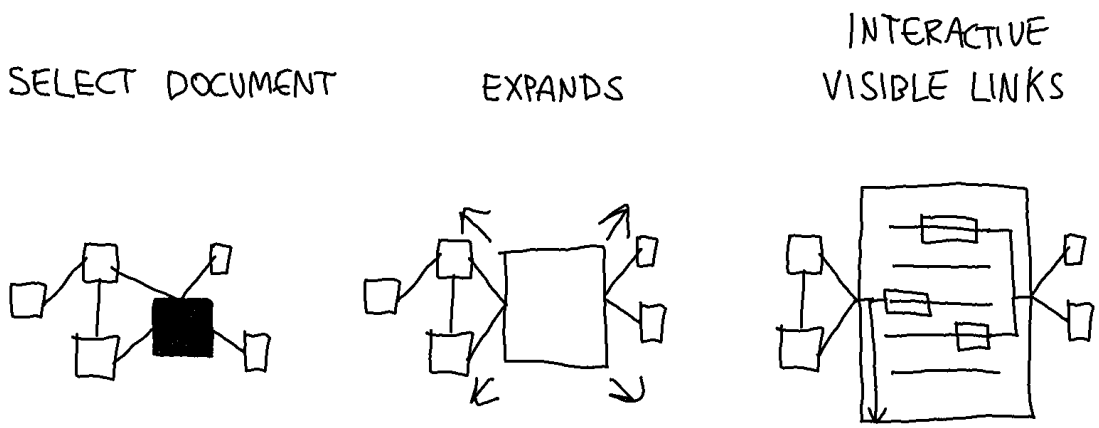
Alterations and additions:

- Stack View is abandoned due to being visually incoherent and overwhelming.
- All view modes are now 2D.
- Labels can be attached to links (called *taglinks*)

While in Inventory View, selecting a node opens a document. Selecting another node will close the already-open document and open the other. There are two versions of how this might look and work.[17]

From Inventory View to Lateral Mode

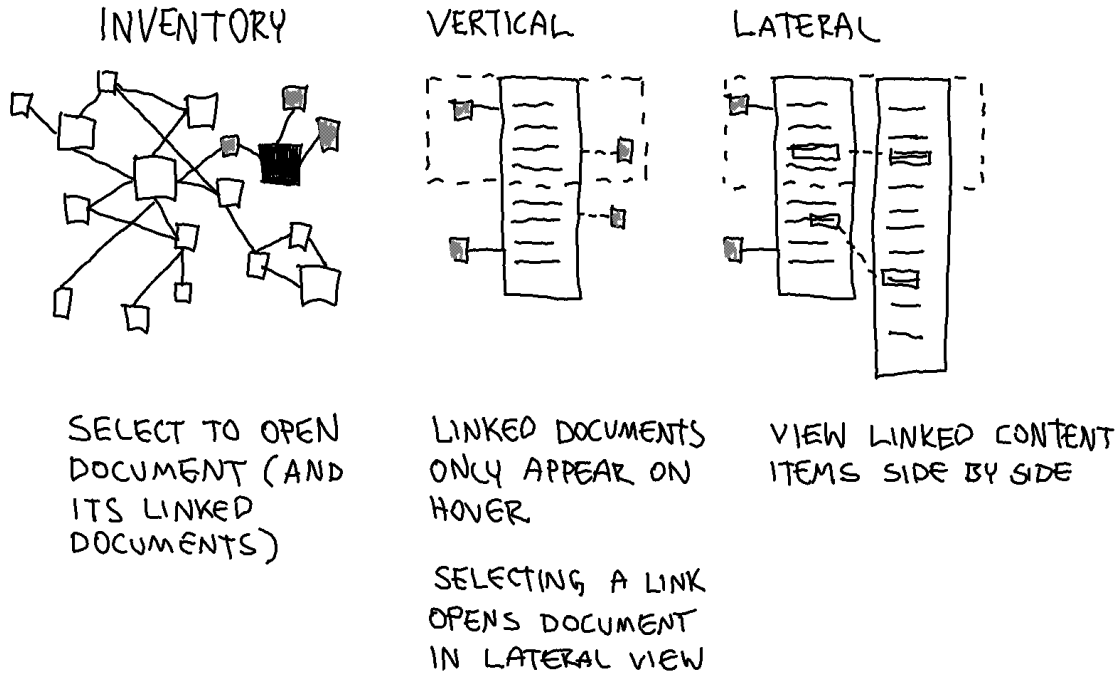
Version 1



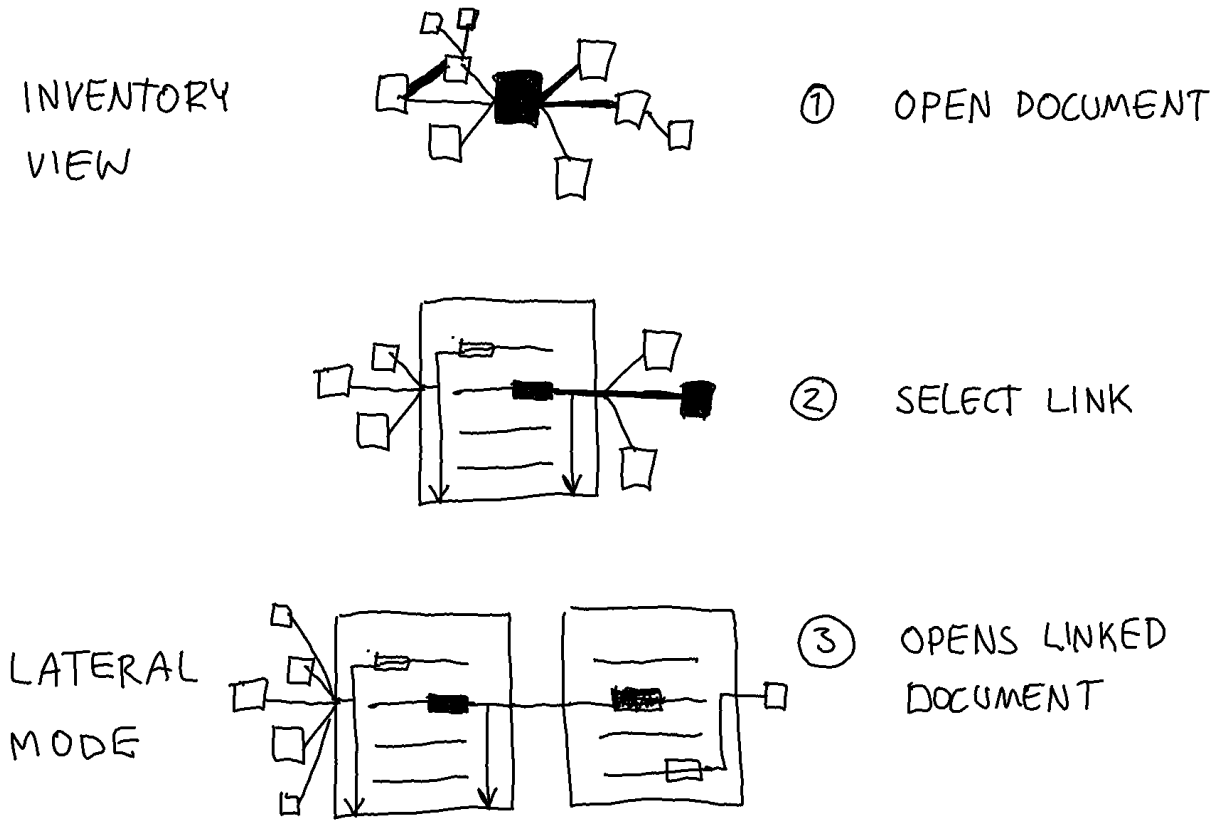
In the image above, the linked documents are always visible and join in the middle of the open document.

Version 2

The image below shows an alternate version in which the linked documents are only visible when hovering on a link in the open document (called Vertical View).

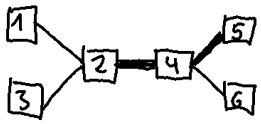


In both versions, if a link is selected within an open document, the corresponding document is opened, and the linked content items align (in Lateral Mode).

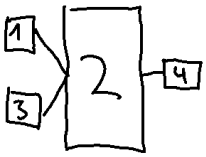


Open/Close Mechanism

While in Lateral Mode, if another link within one of the two open documents is selected, the other document closes, and the corresponding document opens. This open/close mechanism allows traveling by links while retaining one document as the main document. The main document is always the document from which a link is selected. In the image below, the open/close mechanism is shown.



open 2

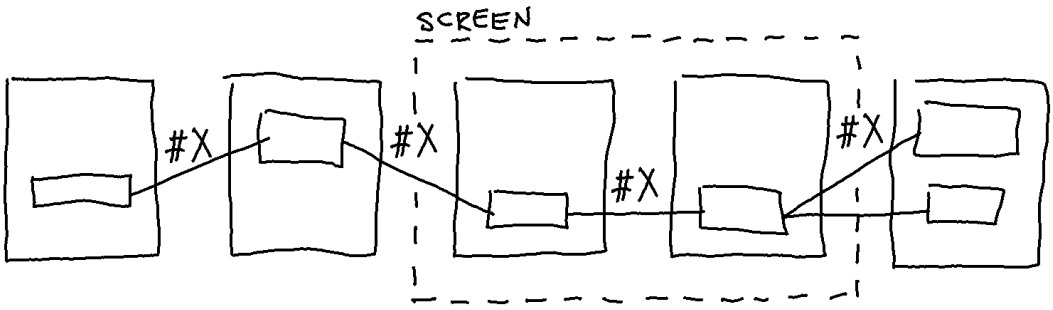


open links from 2 to 4

open links from 4 to 5

Only the first-level linked nodes of an open document are visible in Lateral Mode. As indicated in the last step in the image above, closing a document will hide its linked nodes unless linked to one of the open documents.

Lateral Mode (as in the lateral reading strategy) enables checking the original context of a transcluded content item through deliberate action. Using taglinks makes it possible to filter which link types should be shown/hidden. This means traveling by a link path is possible according to a selected tag (e.g., #comment, #elaboration, #definition).



Demo Video

In version 1, the neighboring documents are always shown, whereas in version 2, hovering on a link shows documents as nodes on the side.

Version 1

Go to video

Version 2

Go to video

Reflection

In version 2, hovering on a link to show (documents represented as) nodes in Vertical Mode is not particularly useful since the size is only informative when seen in relation to other nodes.

In the next entry, the representation of linked documents is explored further.

Discarded Attempts

Opening a Document in Inventory View

In the video below, the links are visualized as vertical lines on each side of the document. The thickness of the lines corresponds with the number of linked content items. One of the drawbacks is that too much information is visualized simultaneously.

Go to video

The video below demonstrates a slow transition from Inventory View to Vertical Mode. The question here is, what is the best way to animate a link within an open document to a closed document? In this example, hovering on a link extends the line to the content item within the open document, and the closed document (node) scales up. A drawback is that the scaling effect does not immediately capture attention.

Go to video

Attempts at Visualizing Opening a Document in Vertical Mode

Once in Vertical Mode, the selected link opens the corresponding document. The question is how the linked content objects should interact. In this example, upon opening a document by selecting a link, the linked content objects align, and the links fade out. The alignment of the content items may suffice.

Go to video

Entry 08 Prototype: How to Switch View Modes (Round 2)

Alterations and additions:

- The possibility for filtering taglinks and documents for opening documents is added.
- The representation of linked documents in versions 1 and 2 demonstrated in the previous entry are discarded.
    - Linked documents are no longer represented as nodes in Vertical and Lateral Mode, but rather as icons, of which there are two versions: preview icon and expand icon.
- Transition animations are divided into steps to indicate that the links in Inventory View split into individual links in Lateral Mode.

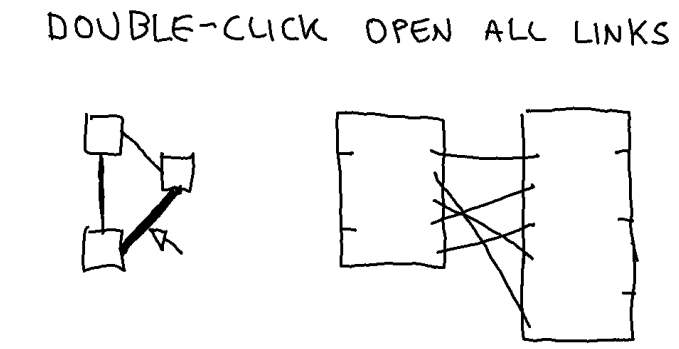
Ways of Opening Documents

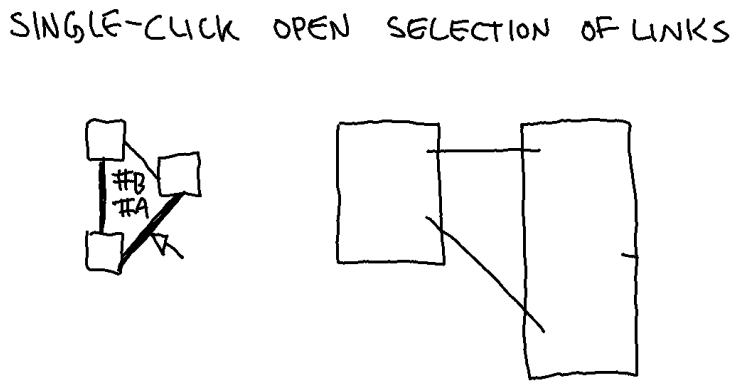
Inventory View functions as an infographic-like overview of all the documents by conveying information about the size and number of links. From this overview perspective, people should somehow be able to select one or more documents to view in more detail, essentially entering a subset of the docuverse. To that end, a filtering technique is explored. It is possible to filter documents based on their metadata and taglinks based on their labels. In addition, besides selecting a node in Inventory View to open documents, it is also possible to select links to open documents and enter Lateral View.

Selecting Links to Enter Lateral View

As seen in the previous entry, selecting a node in Inventory View opens a single document. It is also possible to open two documents by selecting the links between them. There are two ways of opening documents by selecting links:

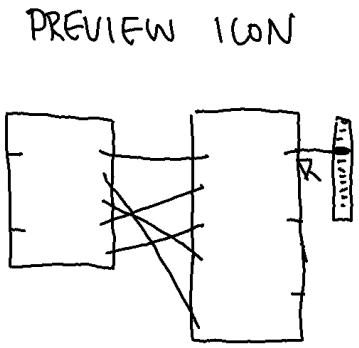
1. **Double-click** on links between two nodes opens the two linked documents, and all links are visible between documents.
2. **Single-click** on links between two nodes reveals a menu of the taglinks. Selecting a taglink will open the two linked documents, and only the selected taglinks are visible.

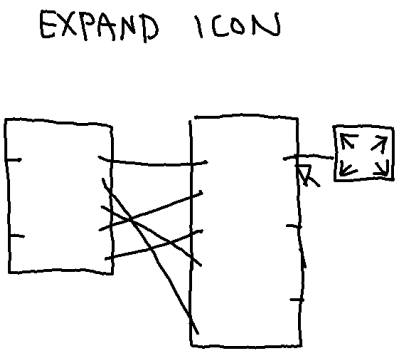




Icons for Representing Linked Documents in Lateral Mode

Hovering on a link in an open document reveals the linked document. There are two versions of how to represent a linked document: an expand icon and a preview icon.





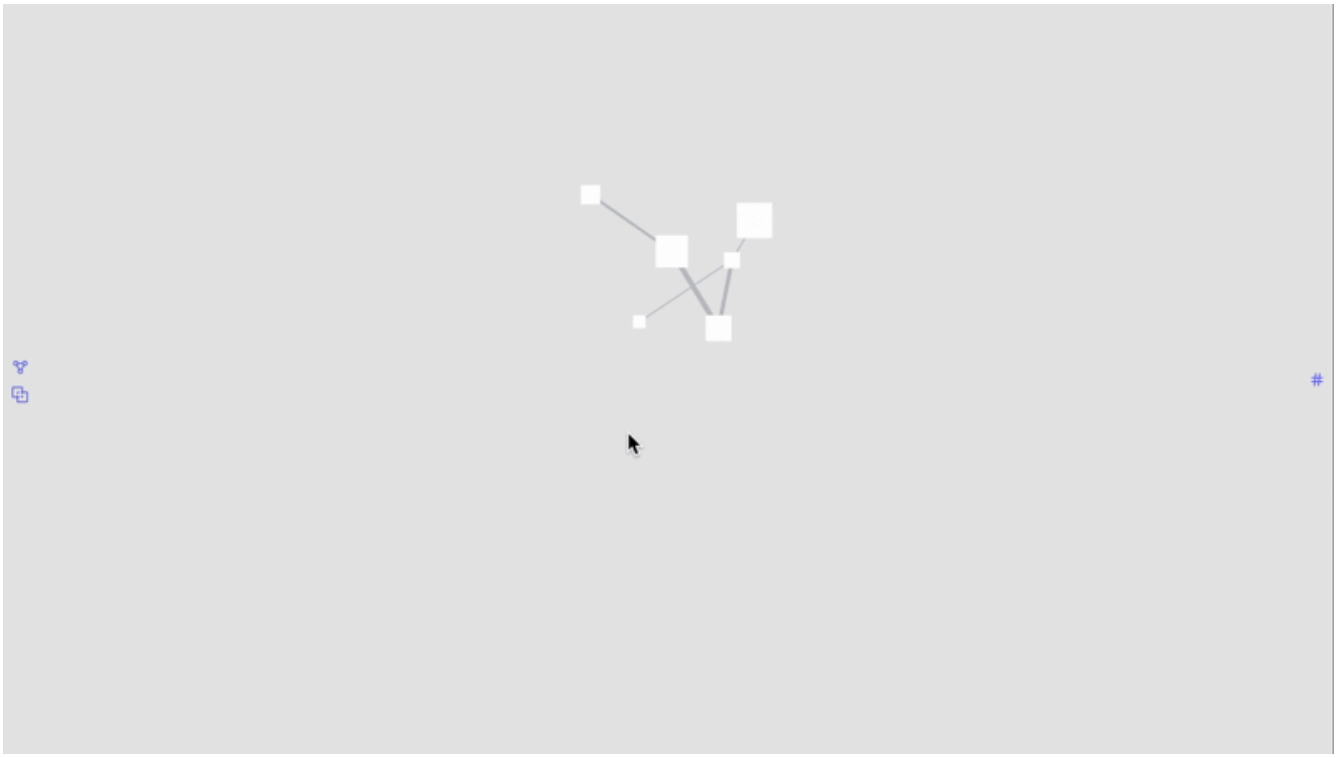
Demo Video

The video below shows how to filter links by selecting #Labels and selecting links to open documents.

Go to video

Filtering from side menu

Go to video



Filtering by selecting taglink

The next entry reflects on the representation of linked documents in Lateral View.

Entry 09 Reflection: How to Represent Linked Documents

Ted Nelson envisioned the docuverse implemented with bidirectional visual links that have been explored in many models and prototypes:

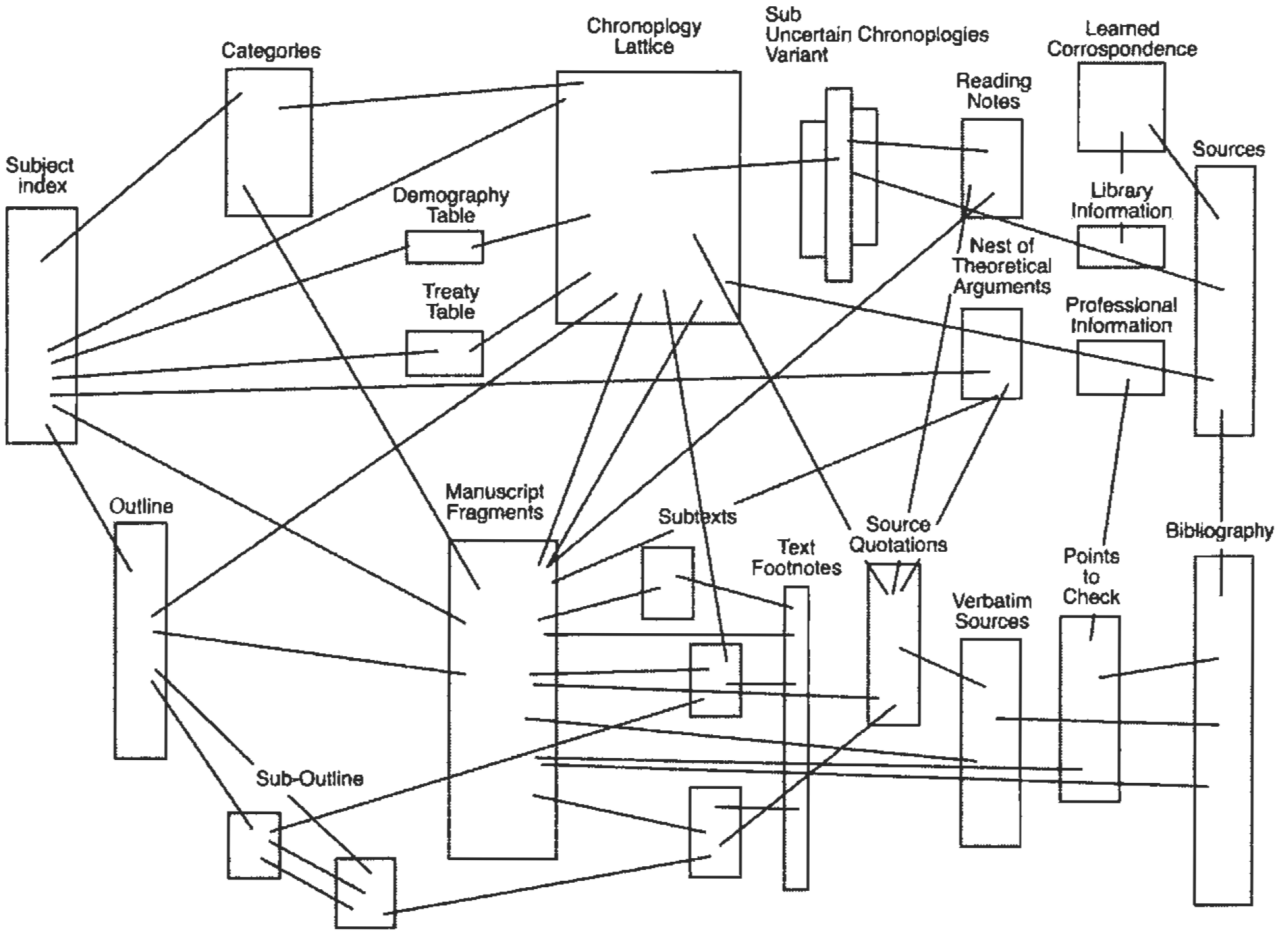


Figure 11.4. ELF's capacity for total filing: hypothetical use by historian. (A thin line indicates the presence of links; a heavy line indicates that some linked entries are identical.)

Image source: Nelson (1965)

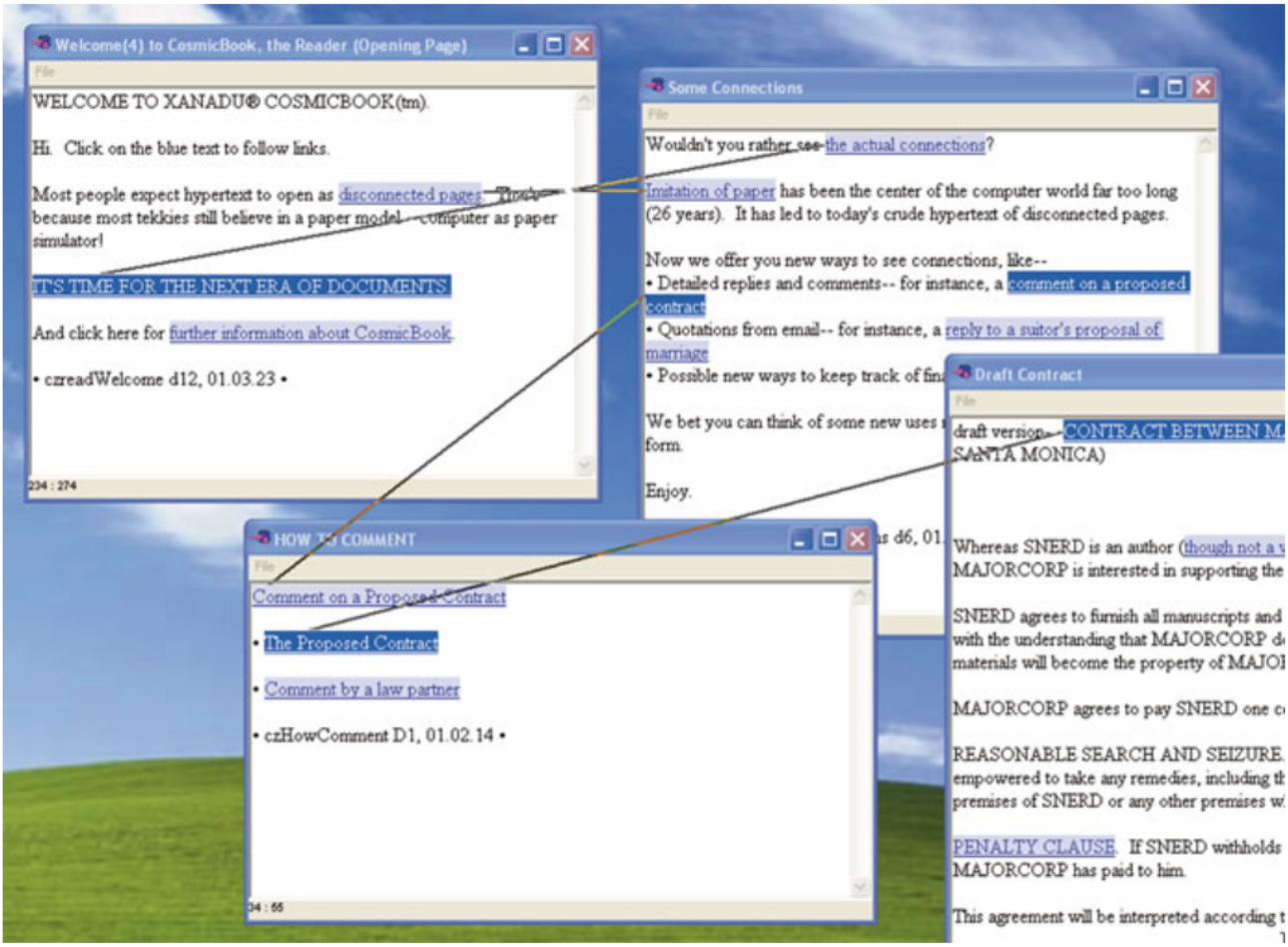


Fig. 17.11 CosmicBook, programmed by Ian Heath

Image source: Nelson (2015)

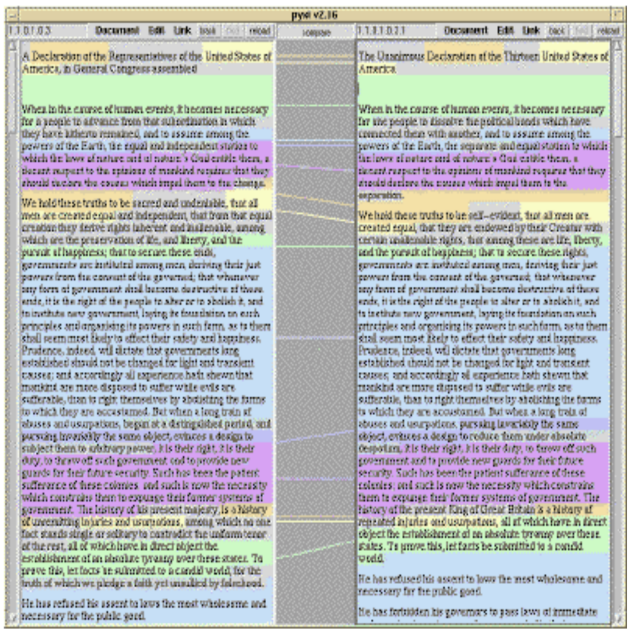
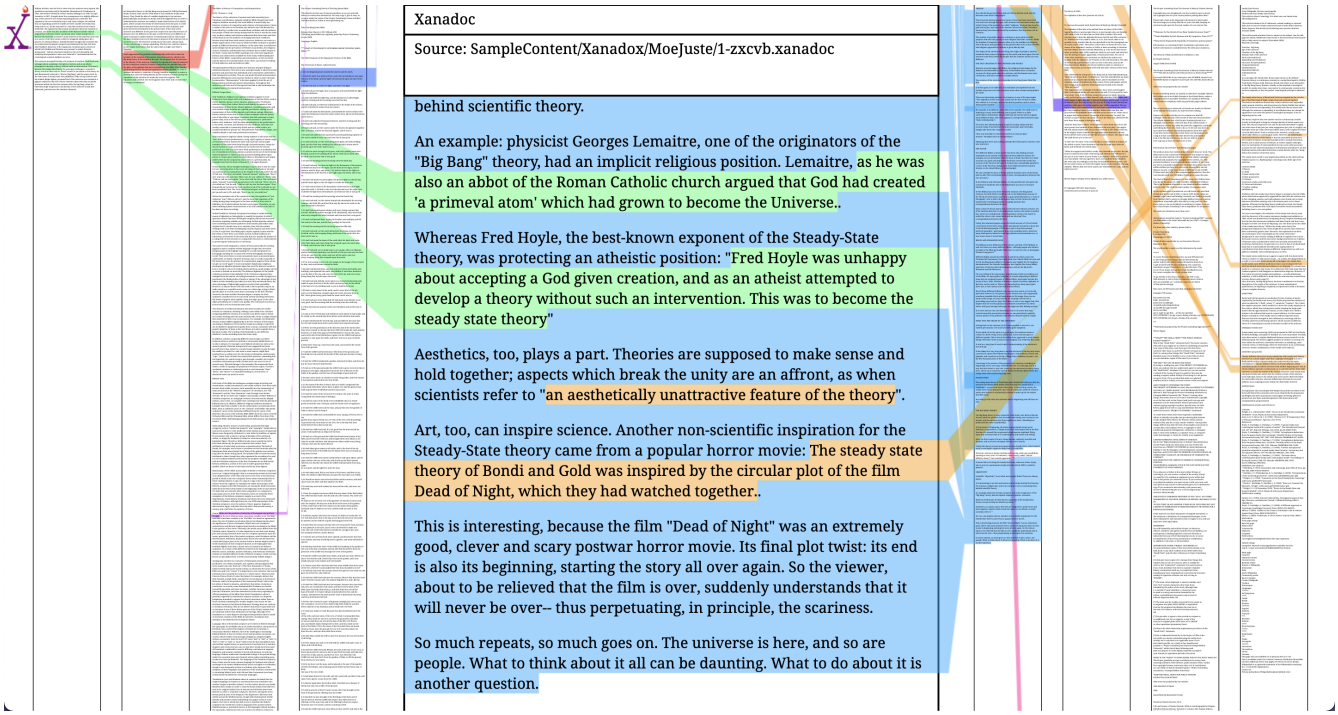


Figure 5. Screen shot of transpointing windows by Ka-Ping Yee, showing his PYXI viewer served from Udanax Green server (xu88 model). Only transclusions happen to be shown, though PYXI also handles content links.

Image source: Nelson (1999)



Screenshot of Xanadoc (try the interactive demo here)

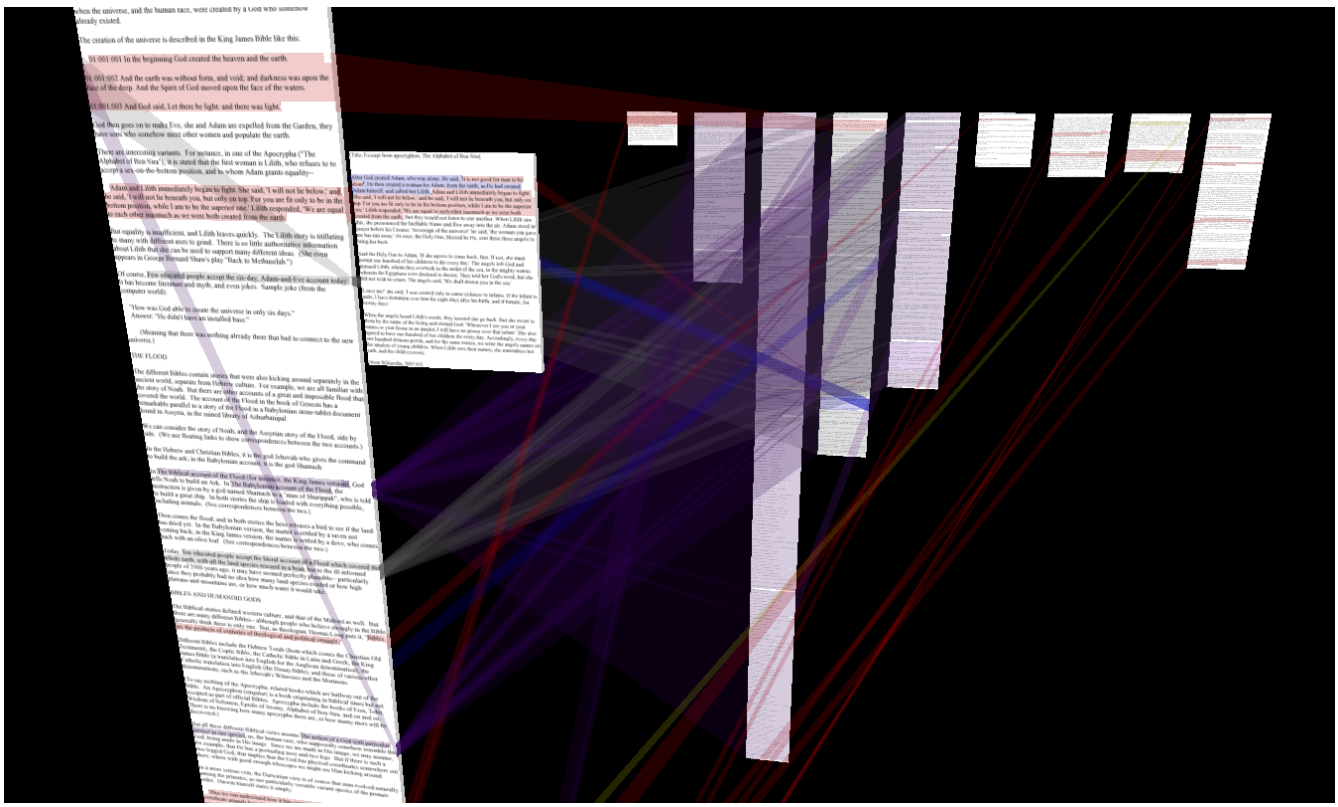
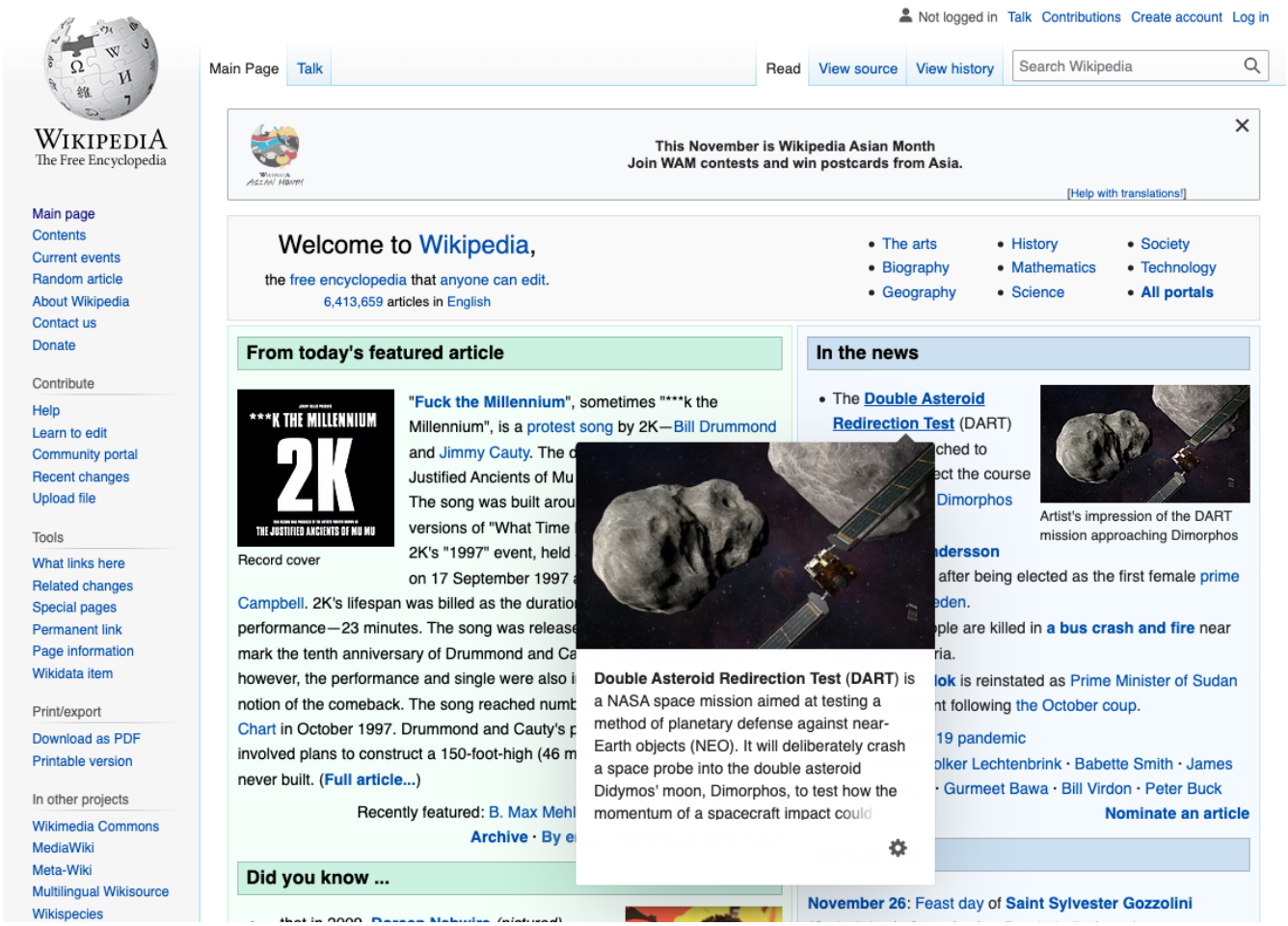


Image source: Nelson (2016)

As discussed in entry 03, working with documents side-by-side and visual links is beneficial. One of the benefits is that content included in one document from another (i.e., transclusion) is directly and visually available for cross-examination. Direct access to the original context enables the ability to assess whether the meaning conveyed in the original document has been misconstrued in other documents. On the Web,

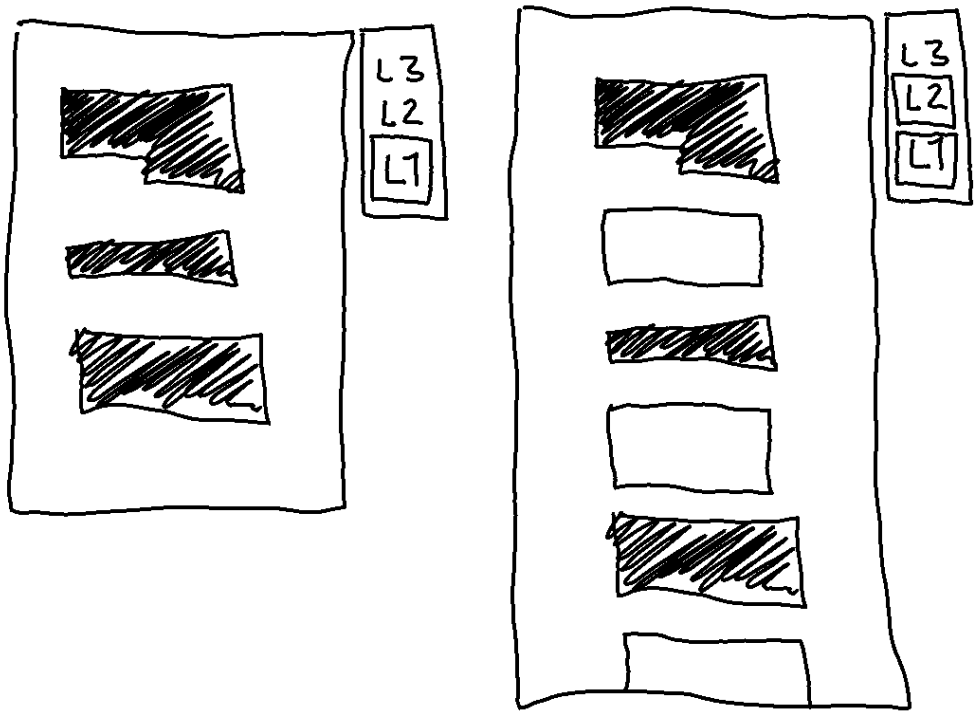
links are one-directional, and the linked documents (if at all) take the form of previews (of the *web page*, not a particular content item)[8-1] as the cursor hovers on a hyperlink.



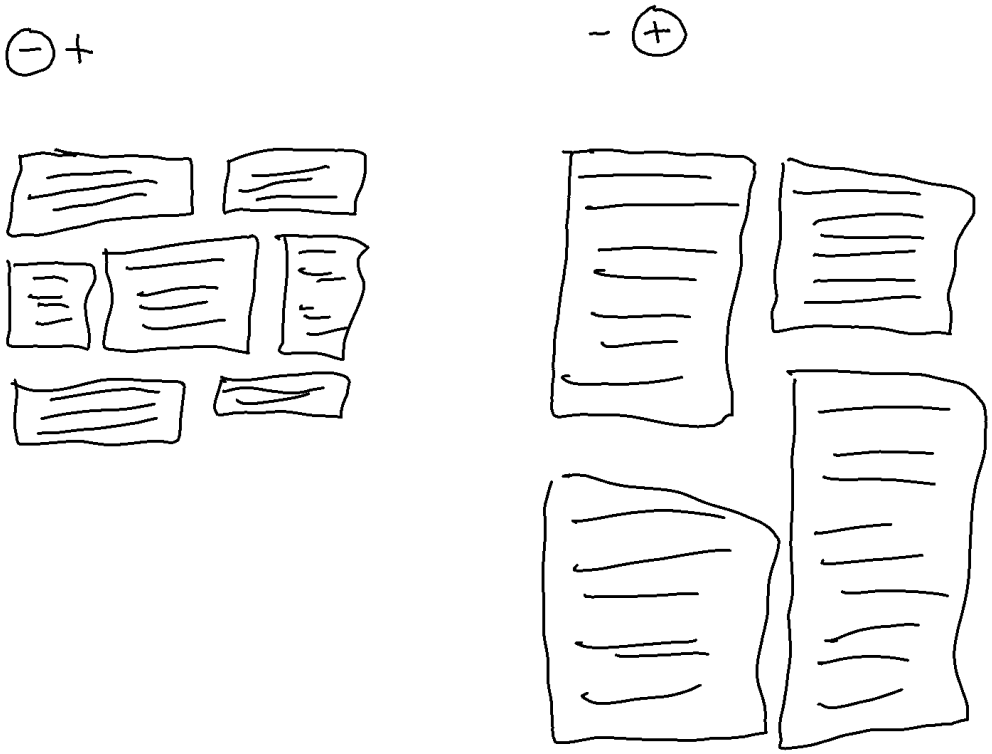
Screenshot of Wikipedia

As has been explored in the interactive prototypes, some issues come with visual links between documents, mainly due to the complexity of information as various links crisscross each other. Several ideas for engaging with that complexity have been explored, some of which have been implemented as prototypes:

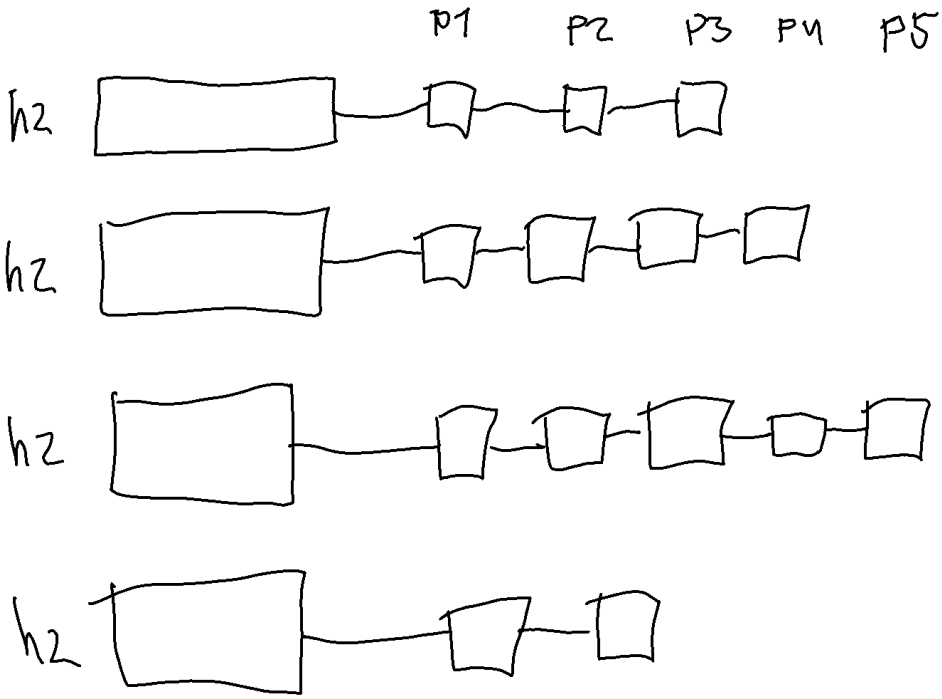
Layers



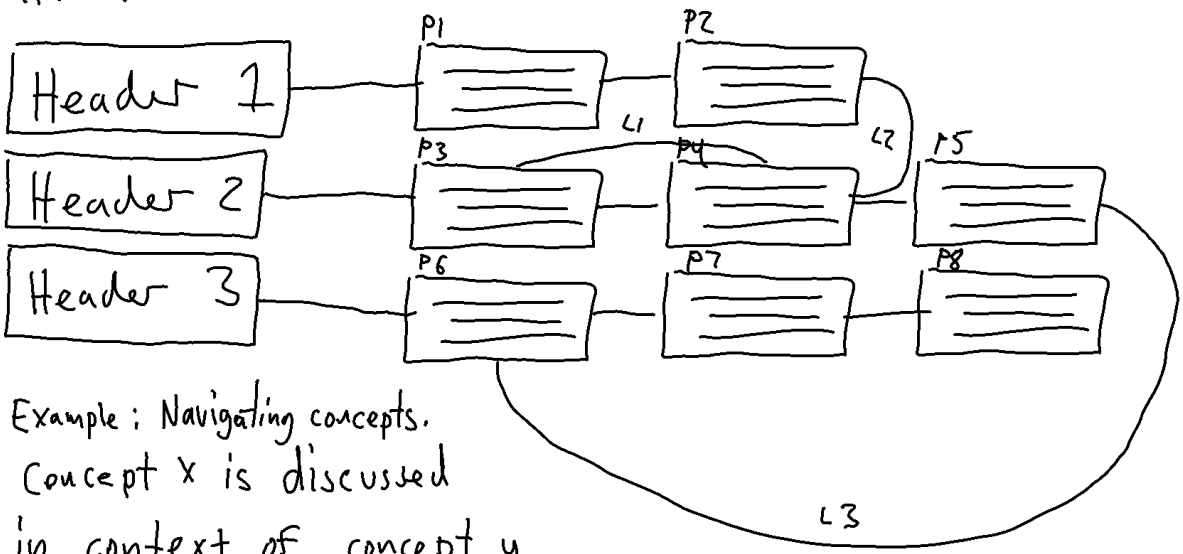
Expandable grids



Modular hierarchical blocks linked non-hierarchically



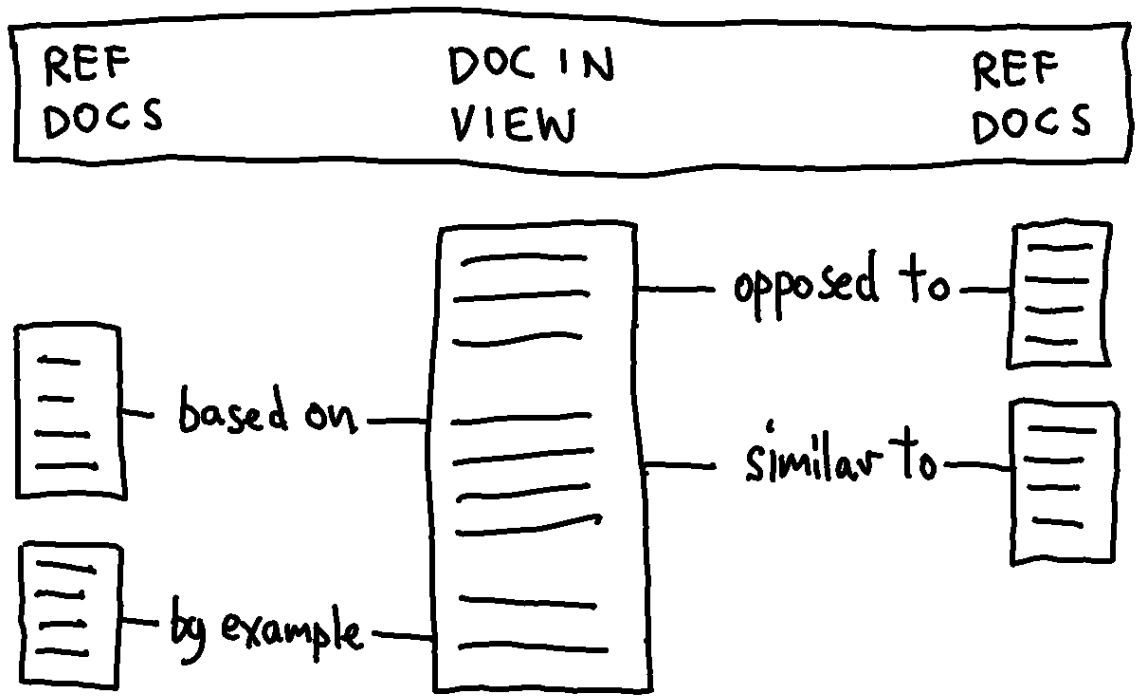
Hierarchical and non-hierarchical view



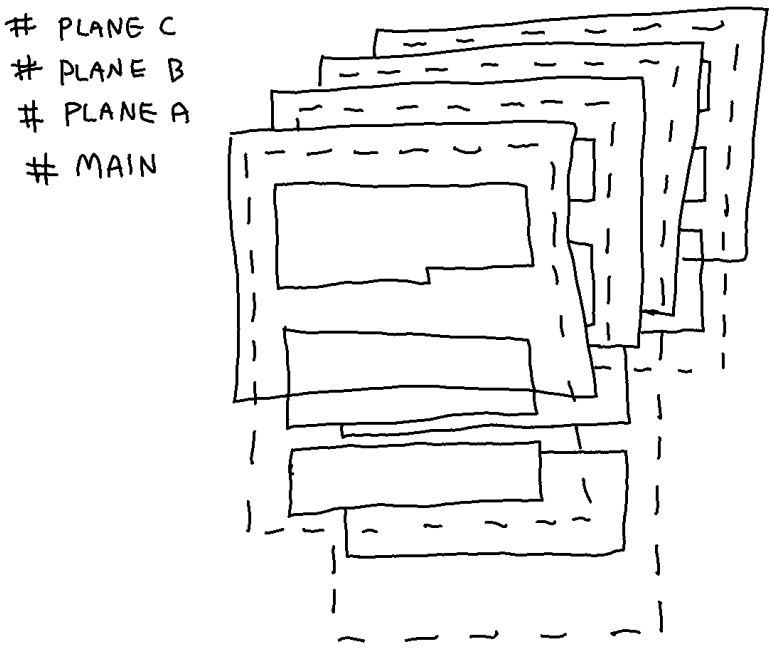
Example: Navigating concepts.
Concept x is discussed in context of concept y in p6 + p5, which forms cluster 1, connected by line 3.

Navigating concepts by restructuring content objects.

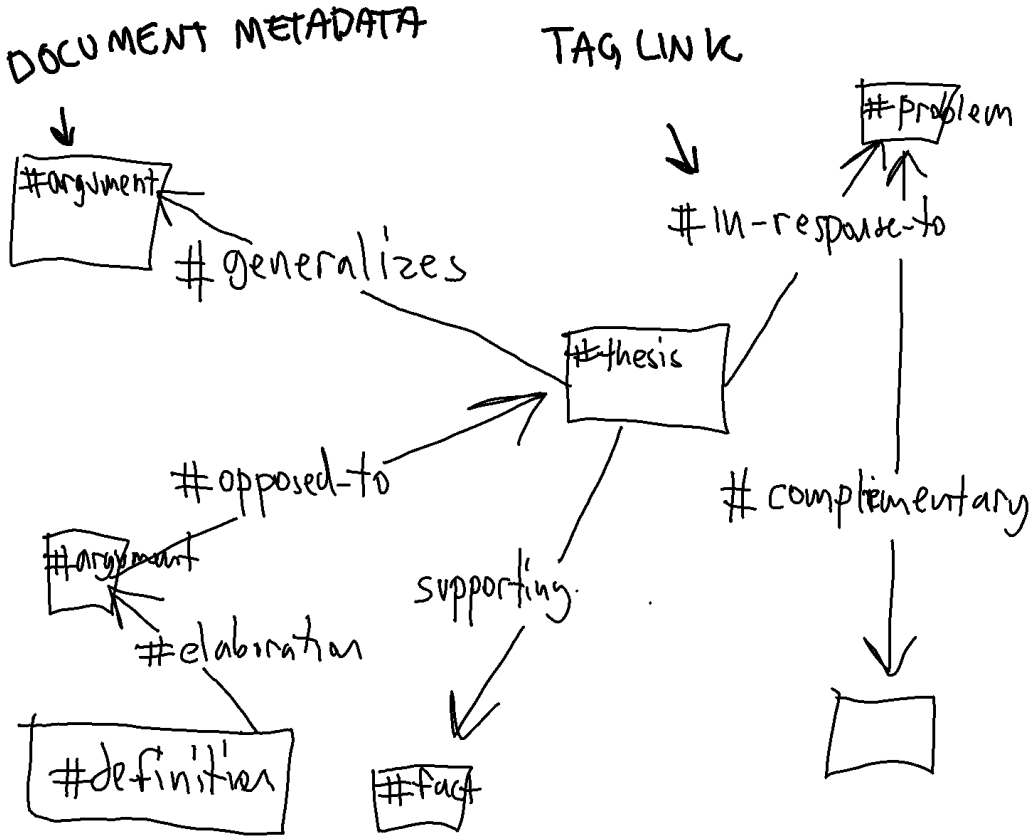
Layout inspired by concept maps



Sets of sequential content items (re)arranged in a stack



Applying tags to links and documents



In the previous entry, the possibility to apply #Labels to taglinks (and document metadata) in order to filter information was introduced, which is deemed useful, particularly in Inventory View. However, in Lateral Mode, the crisscrossing visual links between documents is potentially distracting and does not make interacting with the connections manageable. In the previous entry, the proposed solution took the form of preview icons that are only visible on deliberate action (i.e., as the cursor hovers a link). However, that proposal results in the same problem as with links on the Web: the link endpoint is not seen, and viewing a linked document means leaving the currently open document. A new representation of linked documents (in Lateral Mode) is explored in the next entry.

Entry 10 Prototype: Linked Documents Represented As Aliases

Alterations and additions:

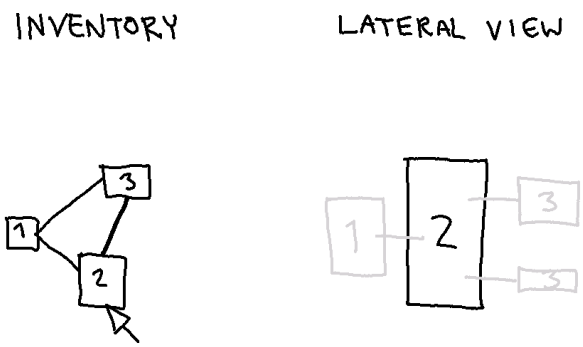
- Lateral Mode renamed Lateral View
- Redesign of Lateral View
  - The preview icons (seen in entry 08) are now aliases positioned on the sides of the open document.
  - Only one document can be open, positioned in the middle.

In this entry, one document is the main document, and its linked documents are represented as aliases.

Opening Documents

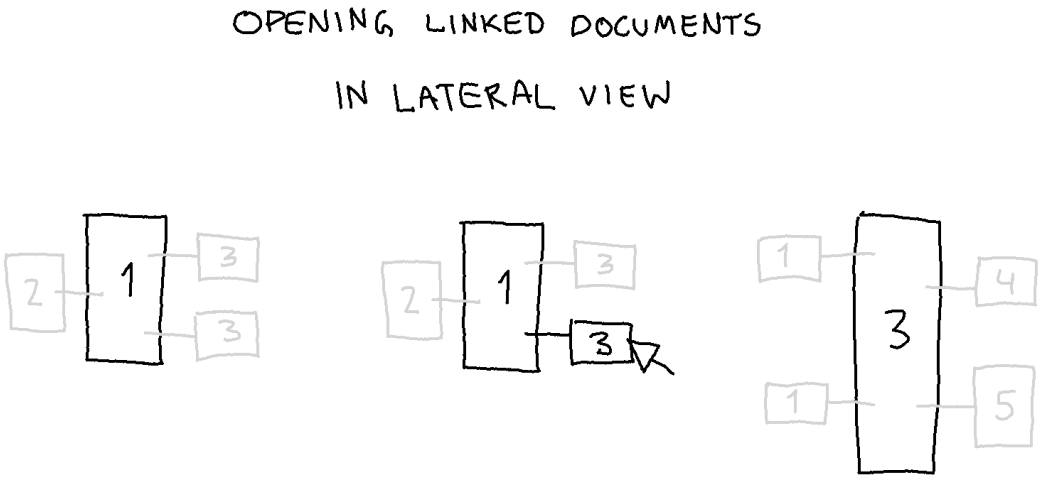
Inventory View

The image below shows how to open a document in Inventory View to enter Lateral View.



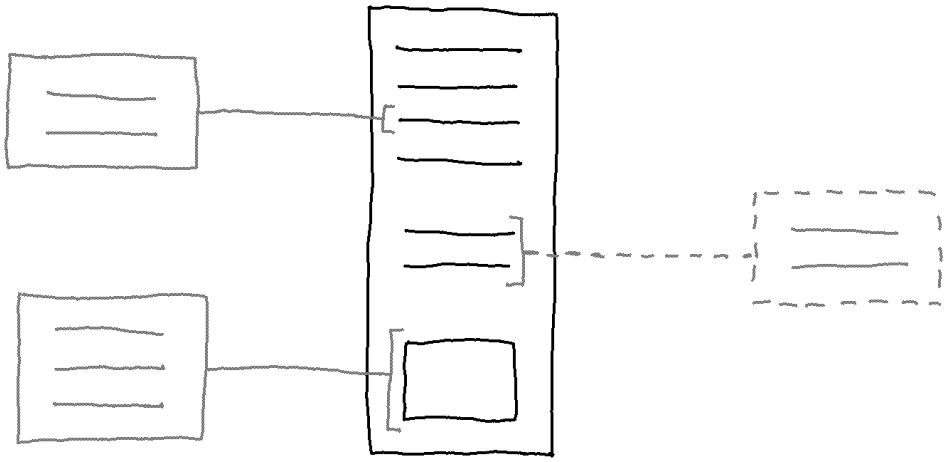
Lateral View

While in Lateral View, it is possible to open the linked documents. Note that each linked content item can be of the same document, in which case there are multiple aliases of the same document (in the example below, document 1).

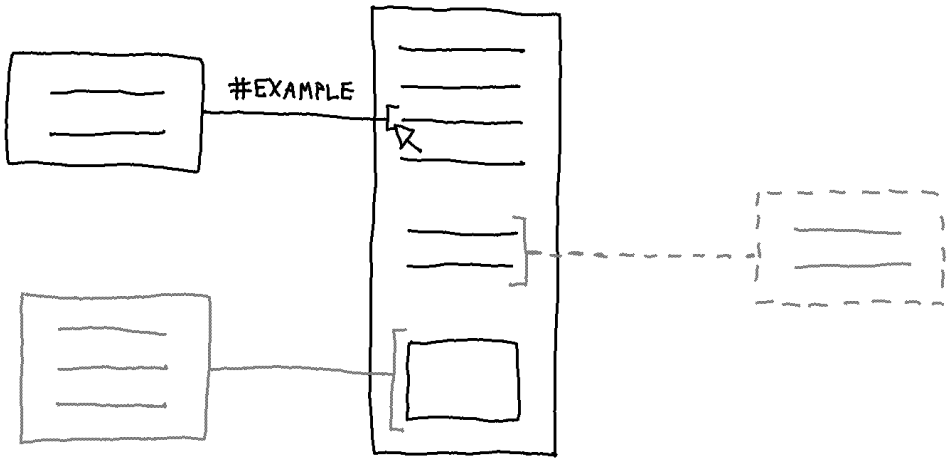


Aliases

The aliases show the particular linked content item (i.e., inactive) on the side of the open document. In the example below, there are two taglinks and one transclusion.



Upon hovering on a link, the alias comes into view (i.e., active) together with the #Label of the taglink.



Interactive Prototype

The interactive prototypes below explore how to indicate active and inactive states and how to animate multiple aliases of the same document.

Active/Inactive Aliases

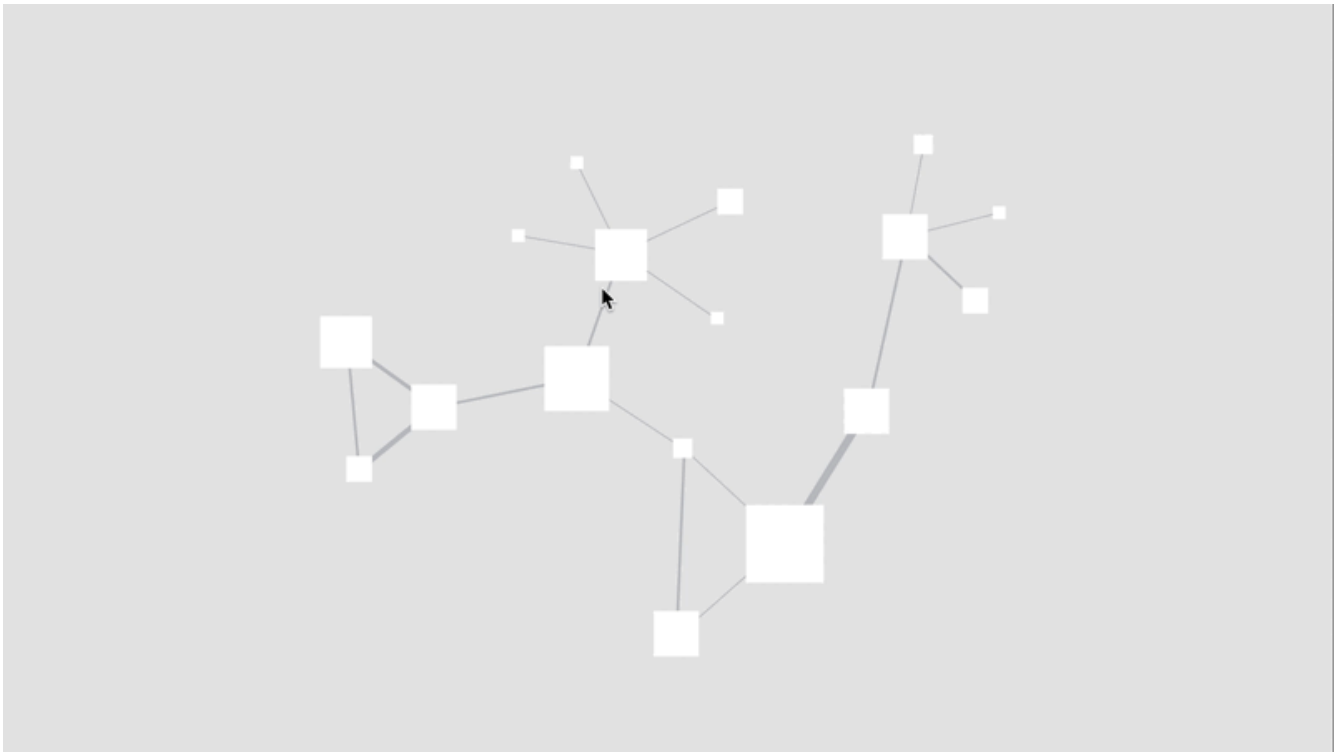
Two versions of aliases are shown below.

Color Code Version

Go to video

Opacity Version

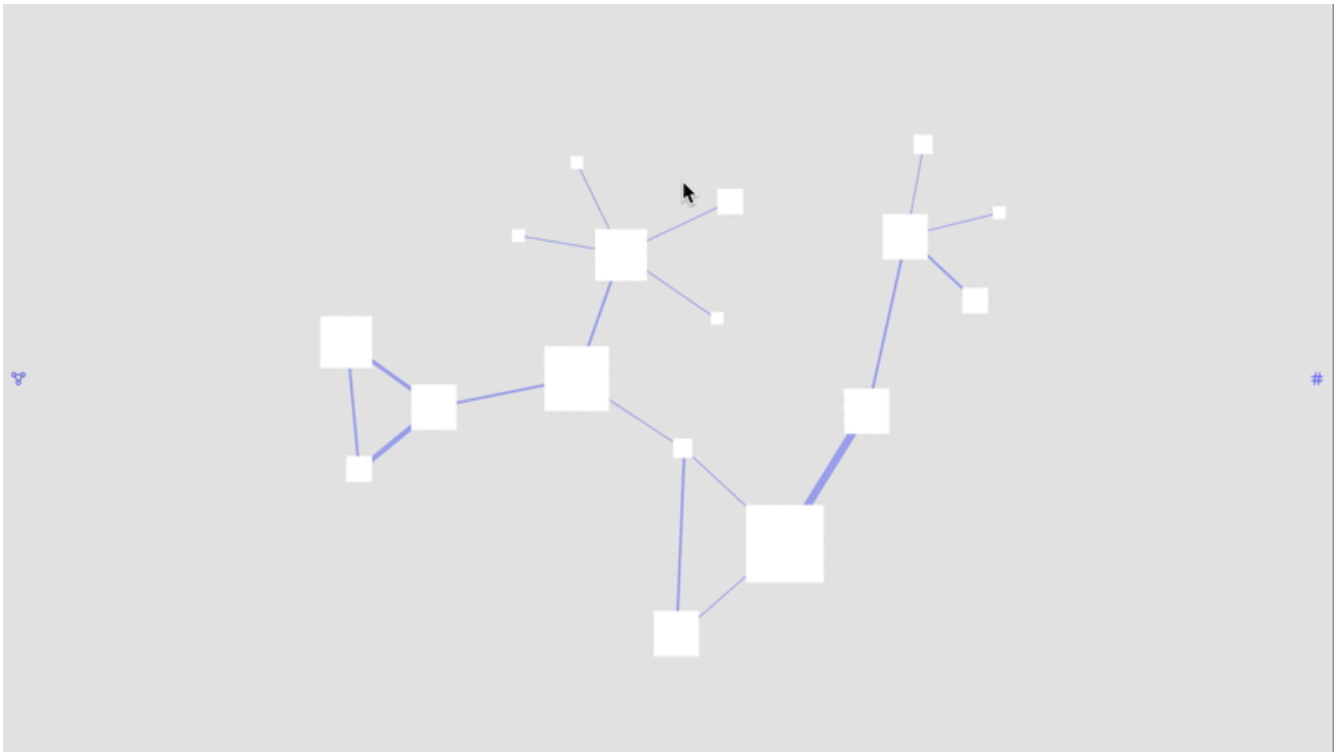
Go to video



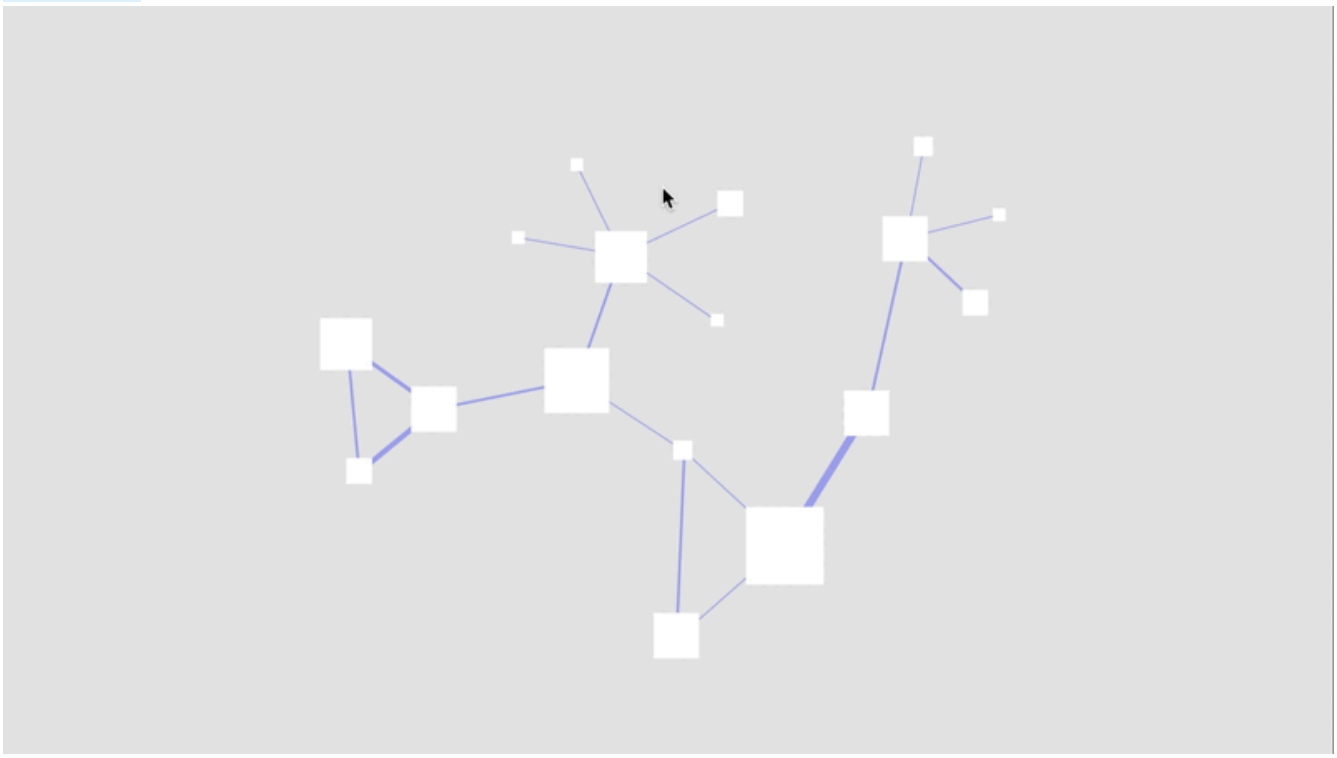
Animating Multiple Aliases of the Same Document

If the open document has several links to the same document, then that document has multiple aliases. In the first image below, multiple aliases appear before a document is open, and in the second image, aliases appear after the middle document is open.

Go to video



Go to video



In the next entry the view modes (and the visual form of the links) are further developed.

Entry 11 Prototype: Link Types and Link Endpoints (Round 3)

In this entry, the view modes are renamed and redesigned.

- Lateral View is renamed Zoomed-In View
- Inventory View is renamed Zoomed-Out View

The main challenges in redesigning Zoomed-In View involve color coding and how cursor events change the display states of different categories of information. Those different categories of information are:

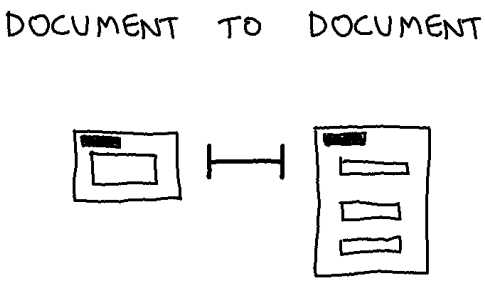
1. Link endpoints: whether a link points to an entire document or a content item within a document.
2. Link direction.
3. Link type; whether it is a transclusion or taglink.
4. Taglink labels.

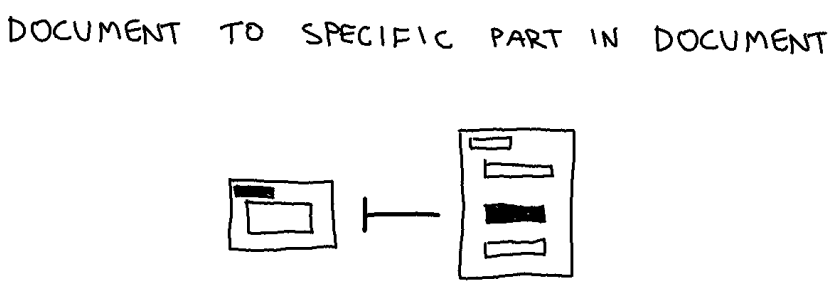
Questions are:

- How should these be visualized?
- When should they be shown or hidden?
- How should they animate between a shown and hidden state?

Link Endpoints

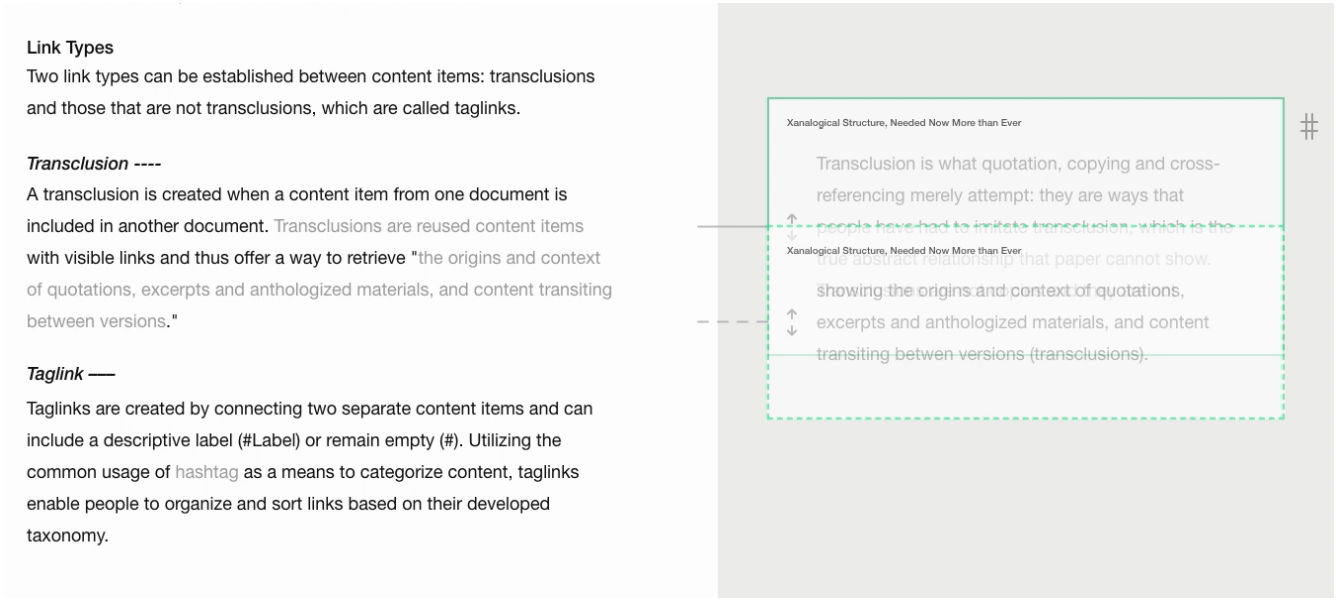
To distinguish between a link that points to an entire document or a content item within a document, the link's endpoint is either bracketed or pointed. Additionally, if a link points to a content item within a document, the linked content is emphasized, and if a link points to an entire document, its title is emphasized. These distinctions are demonstrated in the image below.

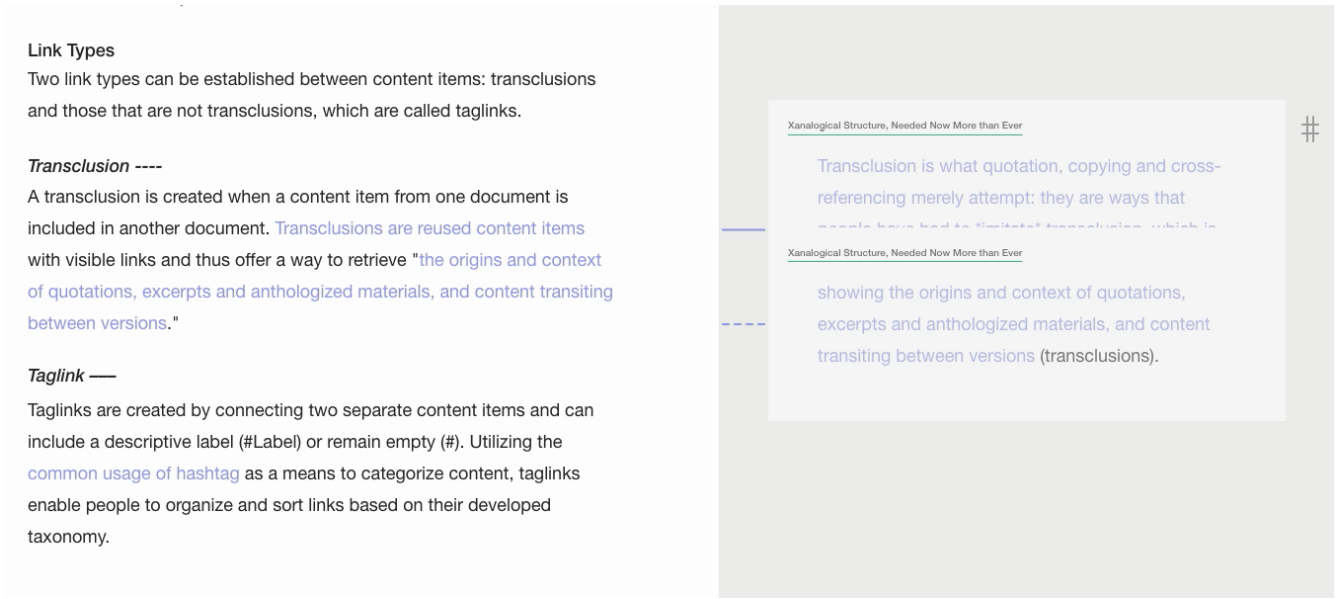




Link Types

In the two images below, the version with the colored border is compared to the version with the underlined title. In both cases, the dashed line indicates a transclusion type link, and the solid line indicates a taglink.

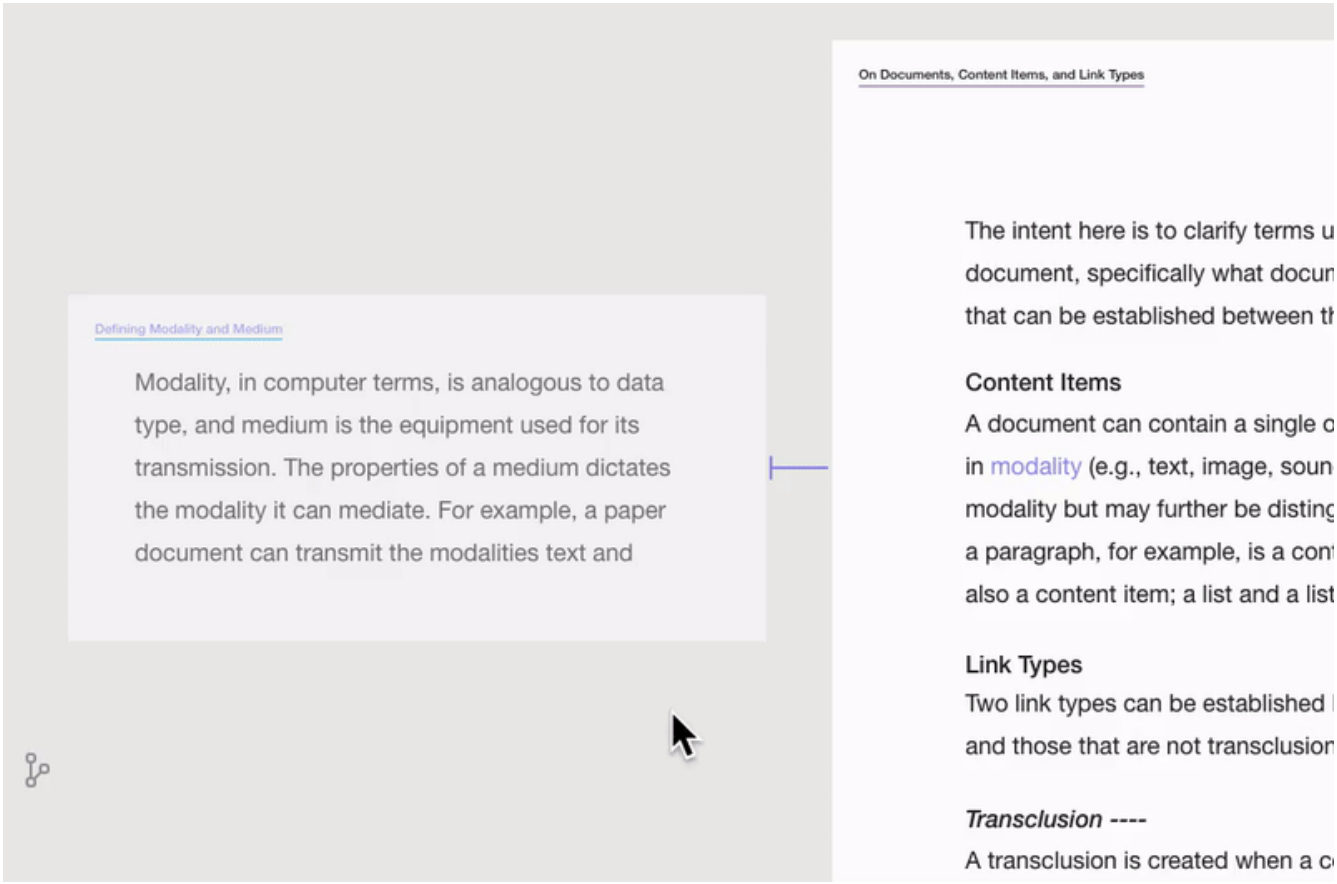




Position and Visualization of Taglink Labels

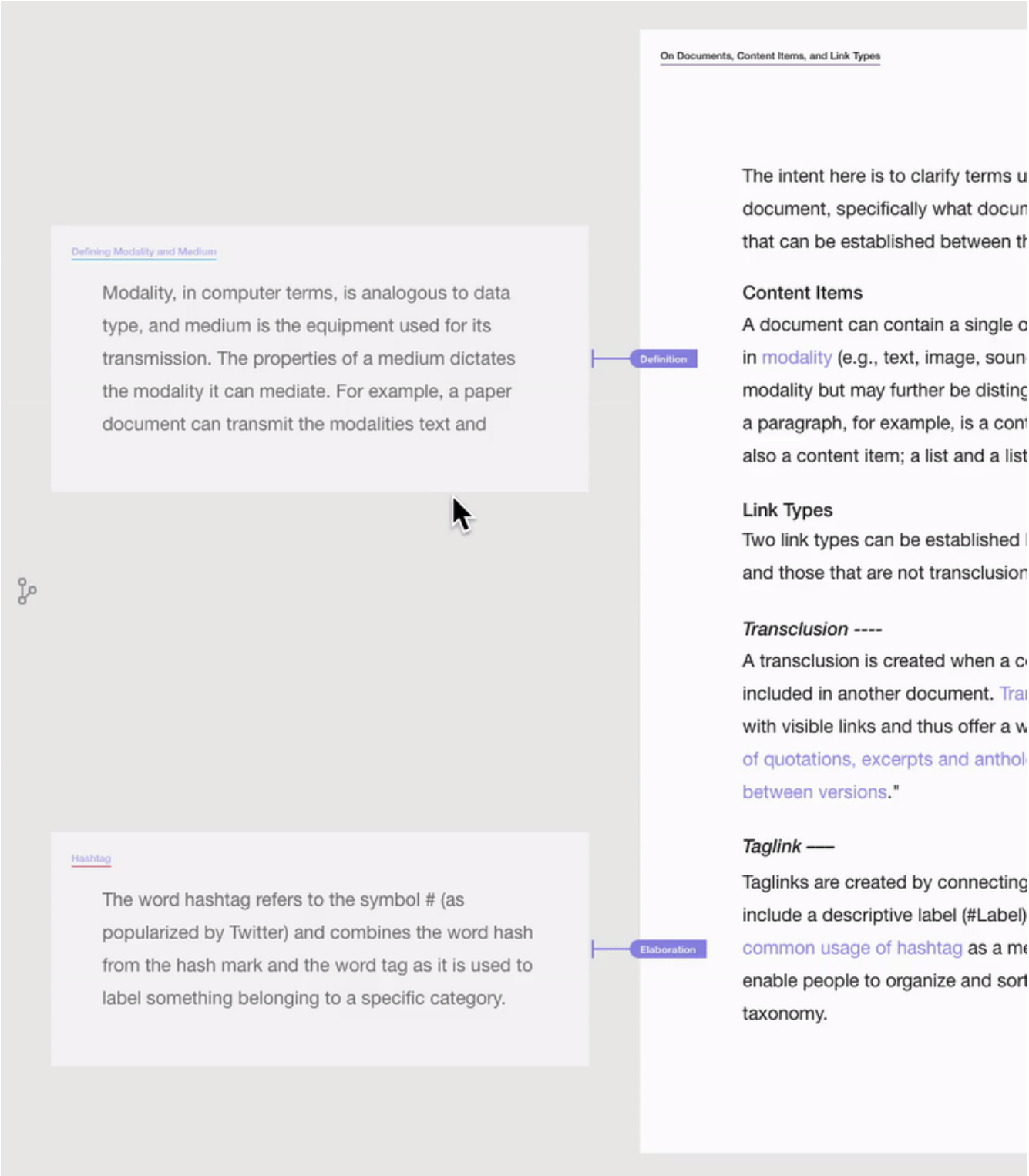
In the examples below, the taglink points from a particular content item in the open document (middle) to the entire side document. Specifically, the word *modality* is linked to the document titled *Defining Modality and Medium*. The direction of the taglink is visually indicated by the label *Definition*. The three images below show variations of the position of the label.

Go to video



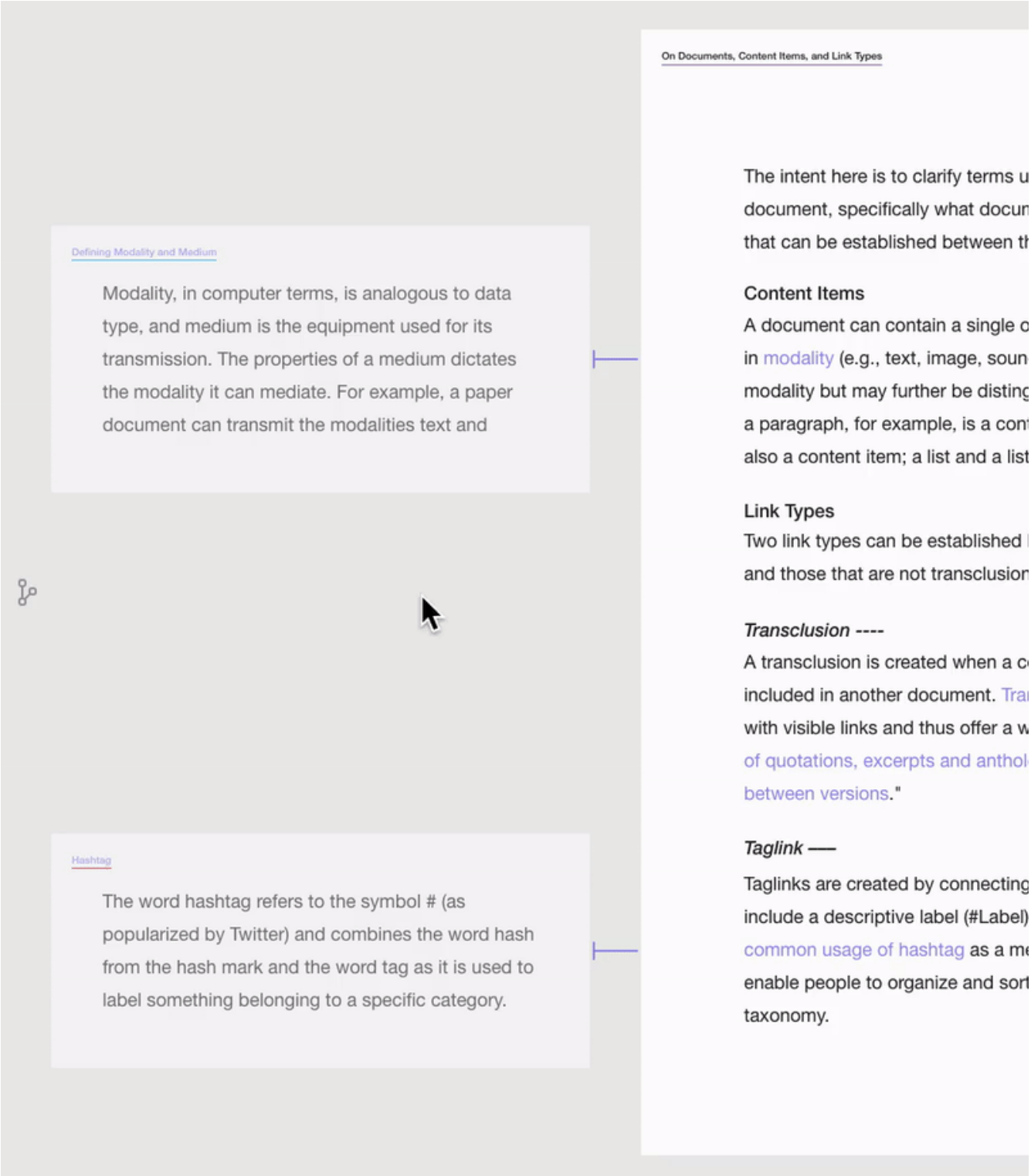
In the image above, **while not hovering** shows whether the link points to a particular content item within a document or the entire document. **While hovering** shows the label combined with the link direction.

Go to video



In the image above, all information categories are shown **while not hovering**. Only the display state of the *expand* icon is toggled on the two different cursor events.

Go to video



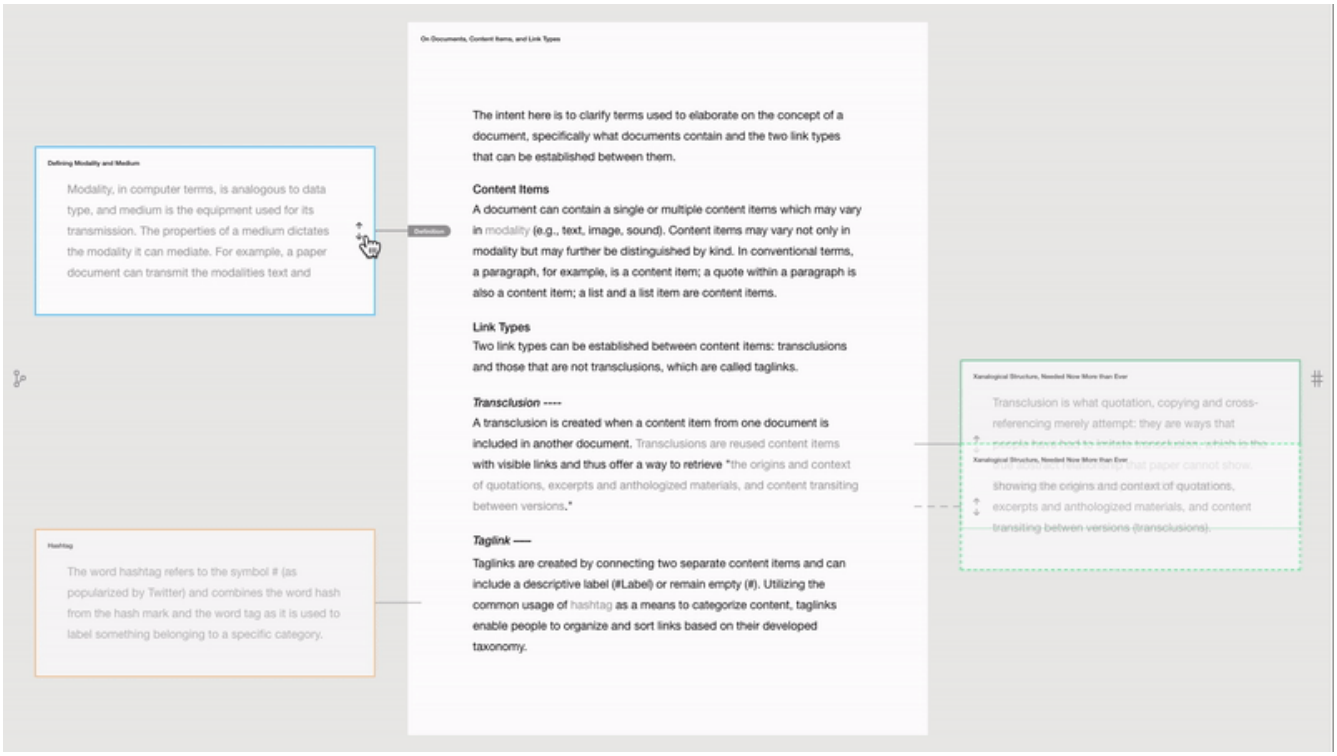
In the image above, **while not hovering** shows whether the link points to a particular content item within a document or the entire document, and **while hovering** hides the previous information and shows the label combined with the link direction.

In the next entry, the design of Zoomed-In View is explored further.

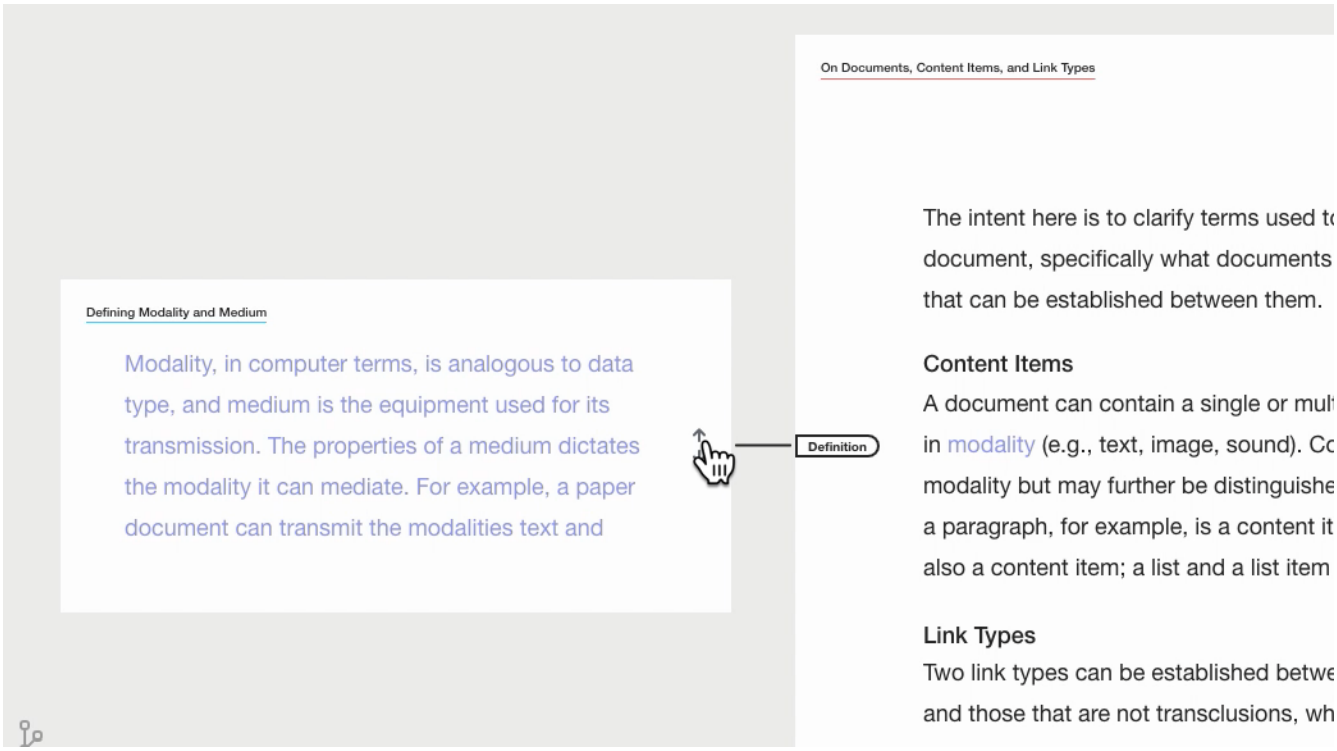
Discarded Attempts

As seen below, one of the problems with the color border is the awkward transition animation effects.

Go to video



Other variations of the color-coding system are seen in the following images.

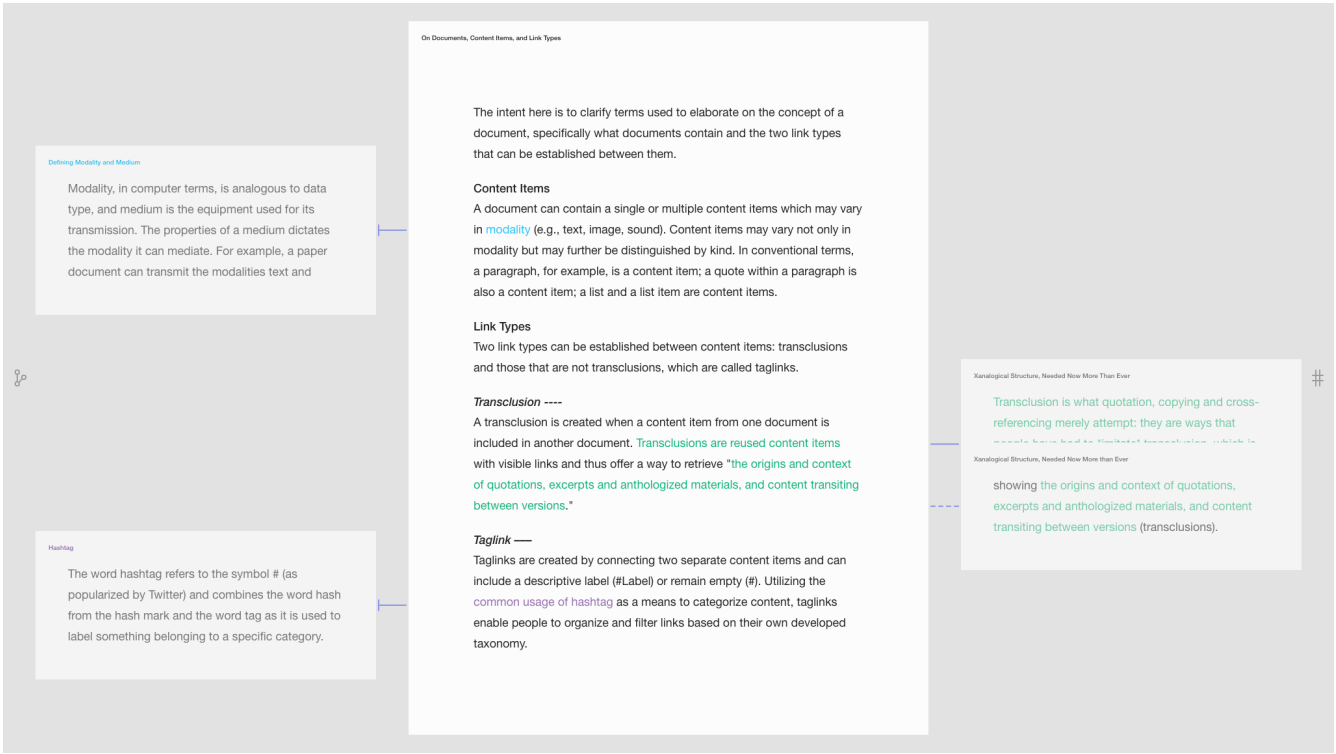


Entry 12 Prototype: Multiple Aliases of the Same Document (Round 4)

In designing Zoomed-In View, one of the challenges is indicating that there are multiple aliases of the same document. Below are variations of applying a color code.

Verison 1

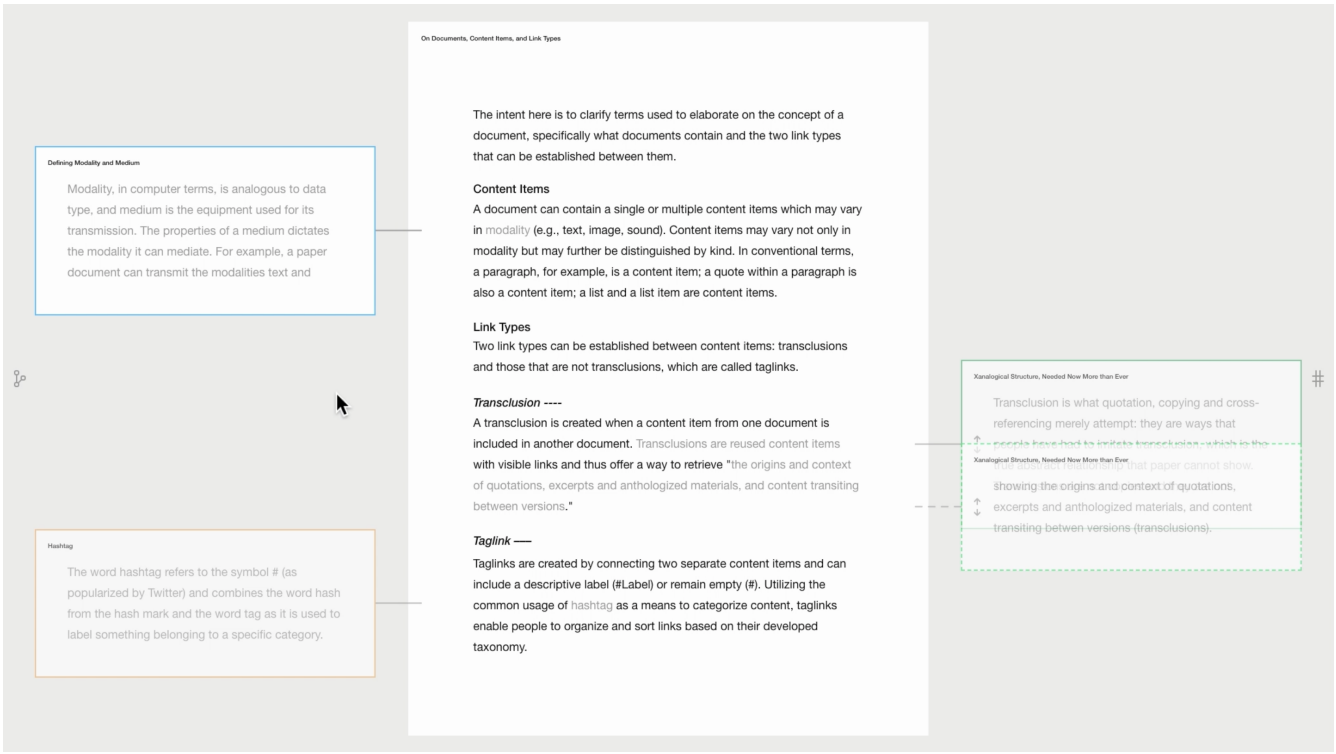
In version 1, linked content items share the same color.



In the top-left corner in the image above, the blue color-coding and shape of the link indicate that the word "modality" in the middle document is linked to the entire side document. In the bottom-right of the image, the green color coding and shape of the link indicate that only parts of each document are linked.[18]

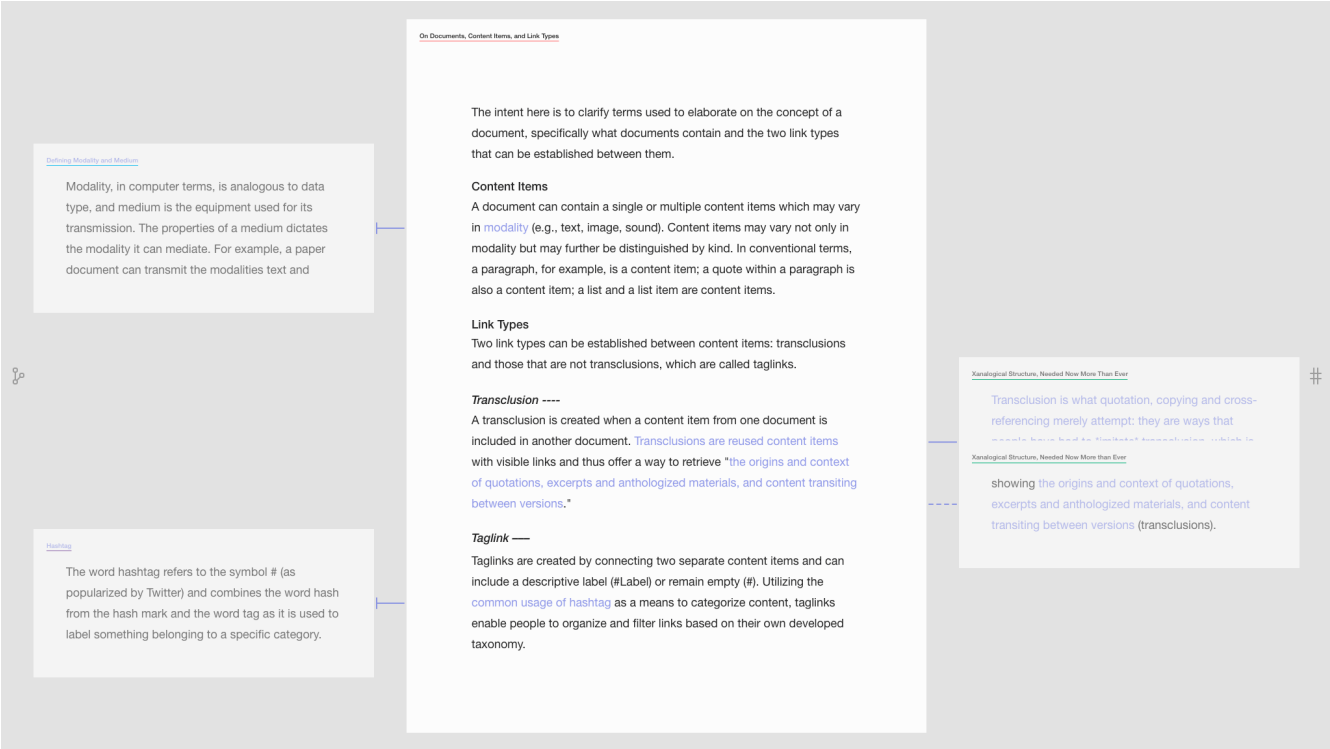
Verison 2

A color-coded border around the side previews is applied in version 2, as seen in the image below. All linked content is gray, including the links.



Verison 3

A more subtle approach is taken in version 3, having underlined titles. Additionally, all linked content items are purple, while navigation icons remain gray, indicating two distinct categories of information.



Interactive Prototype

Go to interactive prototype

The next entry reflects on the potential of the link types developed so far.

Entry 13 Reflection: Multisequential Structures

Both the reader and writer of a document can map structures.[19] Attaching links or metadata to documents to establish connections between them results in multisequential structures, or "interconnective structure[s]" (Nelson 1987). There may be an intended content-item-by-content-item sequence, in conventional terms, paragraph-by-paragraph, list-item-by-list-item, and so on. Several other structures also exist and can be (and usually are) mapped.

For example, in conventional terms, the order of a set of chapters and subchapters is the sequential order intended by the writer.

One chapter may be the last in one sequence (of chapters) and the second in (and adapted for) another sequence (of chapters). In this case — conceptualized as a chapter — it is the same set of points with some differences existing in two places (i.e., sequences). These two versions are inherently connected. Further, within that sequential order, there can be reused content items from other sources or other categories of information that point to internal or external content items (conventionally embedded and visually distinguished from the main text). Mapping those various connections results in an interconnective structure, offering multiple sequences of documents and content items.

> It should be noted, furthermore, that while a novel on paper is far from being automatically linear, a hypertext is not necessarily nonlinear. The pages or segments may be rigorously sequential, forcing the reader to read them in a fixed order, one even more fixed than that of the pages of a book, because it is always possible to open a book to any page one wishes while a hypertext can be programmed to totally control the reader's path. This said, hypertext by nature lends itself ideally to a variety of reading paths and to multisequential navigation. (Vandendorpe 2009)

The digital document system should allow arranging not only content items but also documents in sequential order, with the possibility of showing and hiding sequences. To that end, a third link type called *seqlinks* will be developed.[20]

The next entry further explores traversing documents in Zoomed-Out View and Zoomed-In View.

Entry 14 Prototype: How to Switch View Modes (Round 4)

Alterations and additions:

- Metadata of documents accessible through the ellipsis icon.
- Title underline is chosen over border color.

This entry is a continuation of entry 11, showcasing an interactive prototype allowing traversing documents in Zoomed-Out View and Zoomed-In View.

Interactive Prototype

Go to interactive prototype

Reflection

- The title underline is deemed too subtle to indicate multiple aliases of the same document.
  - Color-coded borders might be better suited.[21]
  - The color-coded borders should also appear upon hovering a document in Zoomed-Out View for coherency.

Improvements Due

- Apply color-coded borders.
- While in Zoomed-In View, create a frame showing an overview of the current location in Zoomed-Out View to facilitate orientation.
- Apply *seqlinks* at the top and bottom of open documents.
- Visually distinguish link direction.
- Improve visualization of link endpoints.

The next entry involves redesigning the visual distinction of links — the link type, direction, and endpoint.

Entry 15 Concept Design: Link Type, Direction, and Endpoint

Alterations and additions:

- Redesign of links to distinguish:
  - Link direction.
  - Link endpoint (by improving the design of the brackets).
- Added a legend (a list of the icons and symbols).
- Color coding:
  - Title underline is replaced by border color.

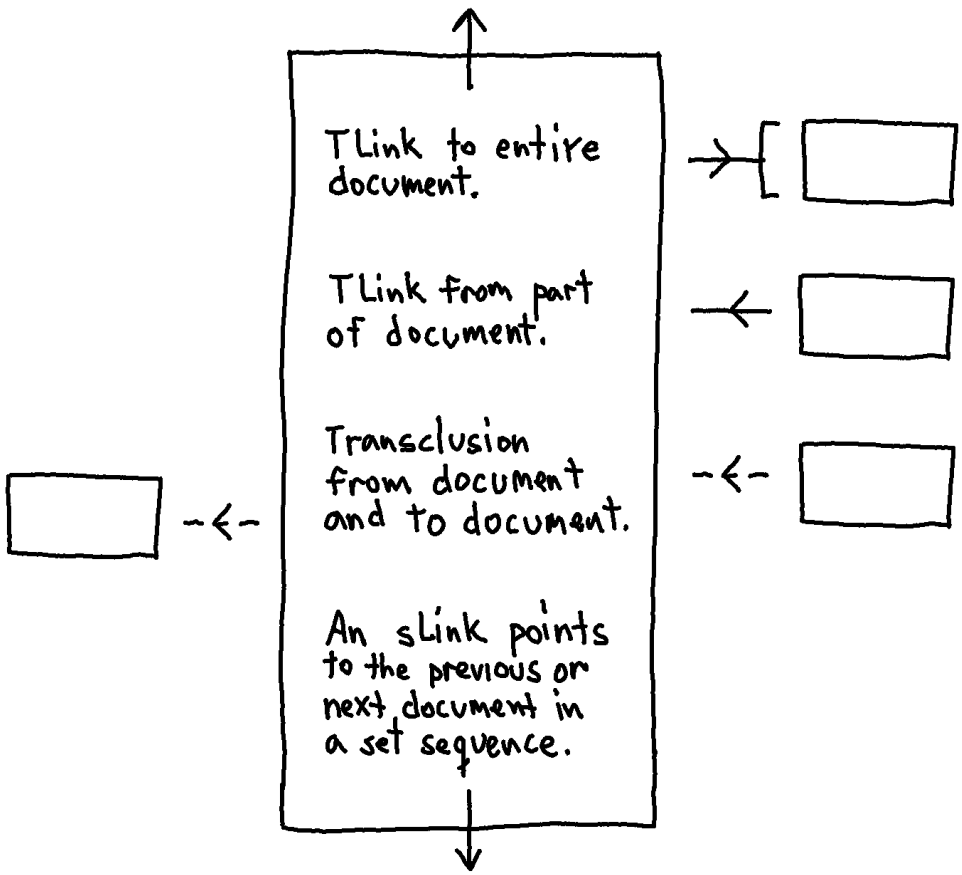
Visual Distinction of Links: Link Type, Link Direction, Link Endpoint

Link types: *Transclusion*, *seqlink*, and *taglink*.

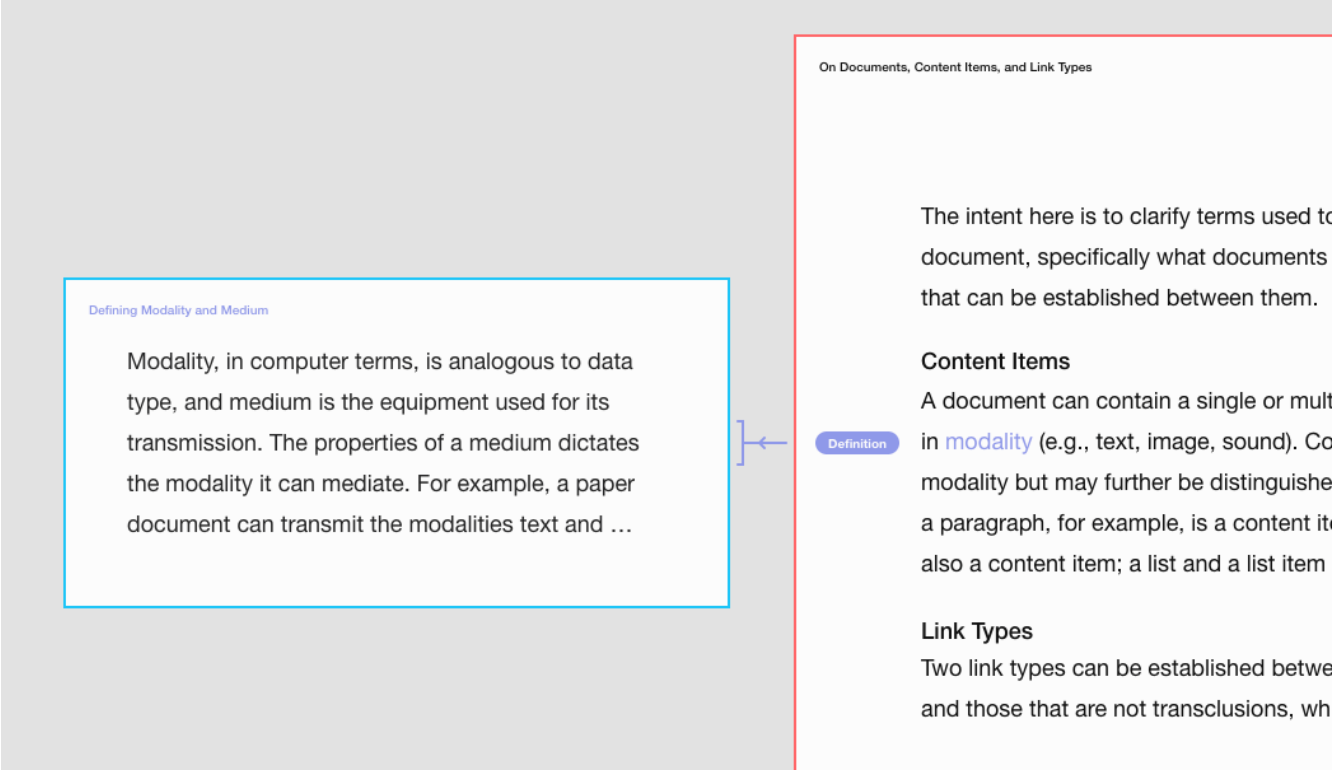
Link direction: To or from a document and another.

Link endpoints: Distinguishing between a link that points to an entire document and a link that points to a particular part of a document.

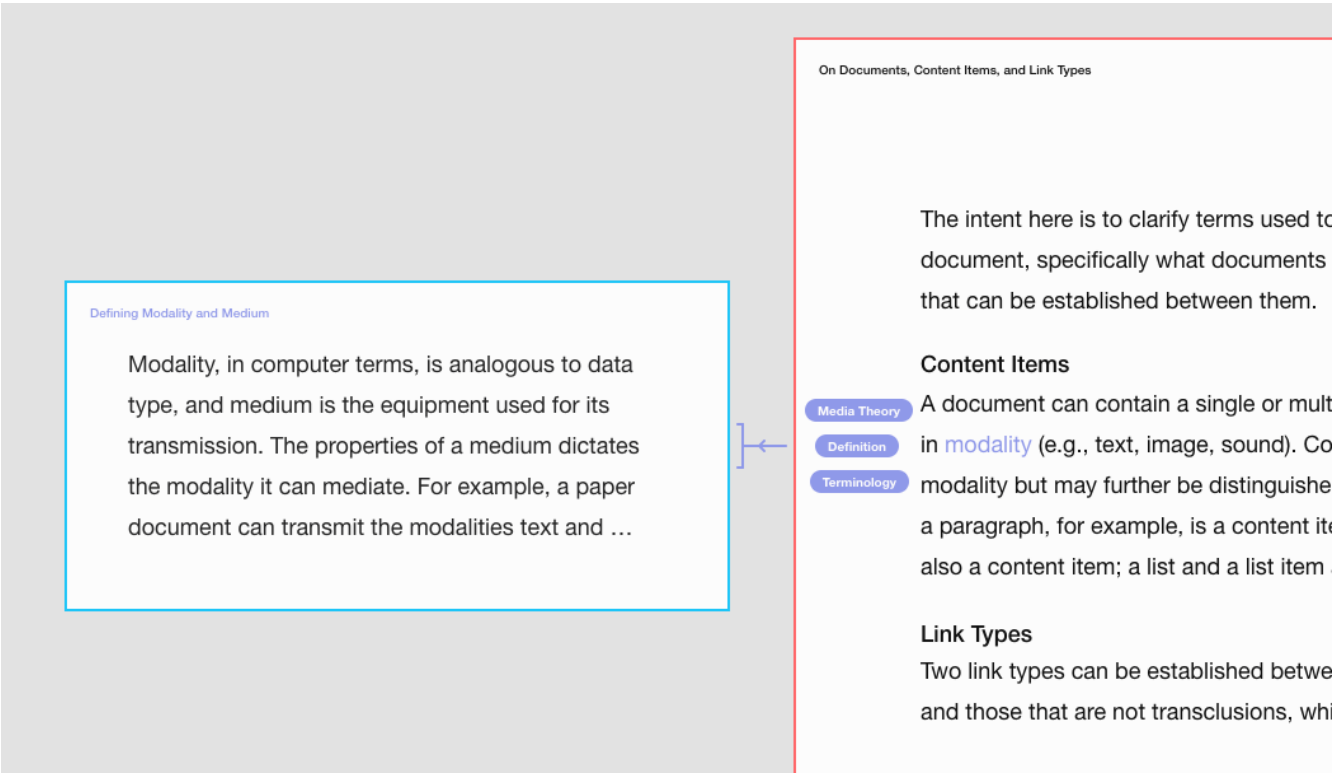
Examples of different link types, directions, and endpoints are seen in the image below.



Links are visualized as a single element separate from the label.



The image below shows what it would look like if multiple labels were attached to a taglink.



Improvements Due

- Color-coding needs improvement.
  - As noted in the previous entry, there are only so many distinct colors. A two-color system can be applied. One active color for the open document and an inactive color for the aliases.

The next entry explores the implementation of these alterations in the concept design.

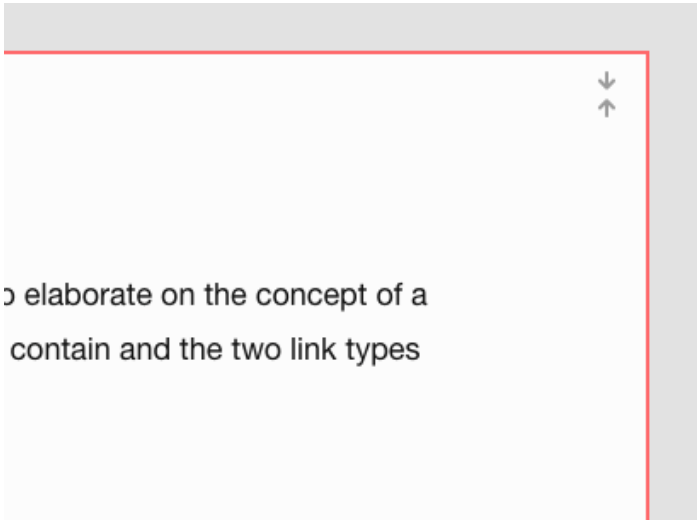
Entry 16 Prototype: How to Switch View Modes and Traverse Documents (Round 05)

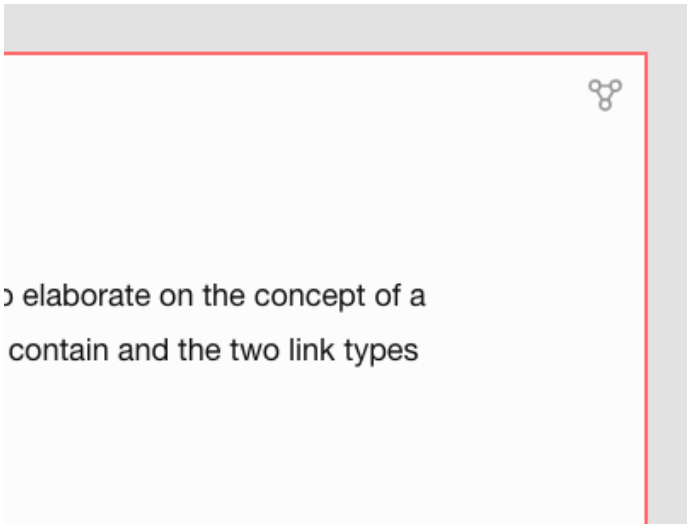
Alterations and additions:

- Added a location frame, showing Zoomed-Out View while in Zoomed-In View.
- Minimize icon is replaced by a node-link icon, triggering the movement from Zoomed-In View to Zoomed-Out View.
- Aliases no longer have expand icons but use brightness to indicate that it can be triggered to open the linked document.

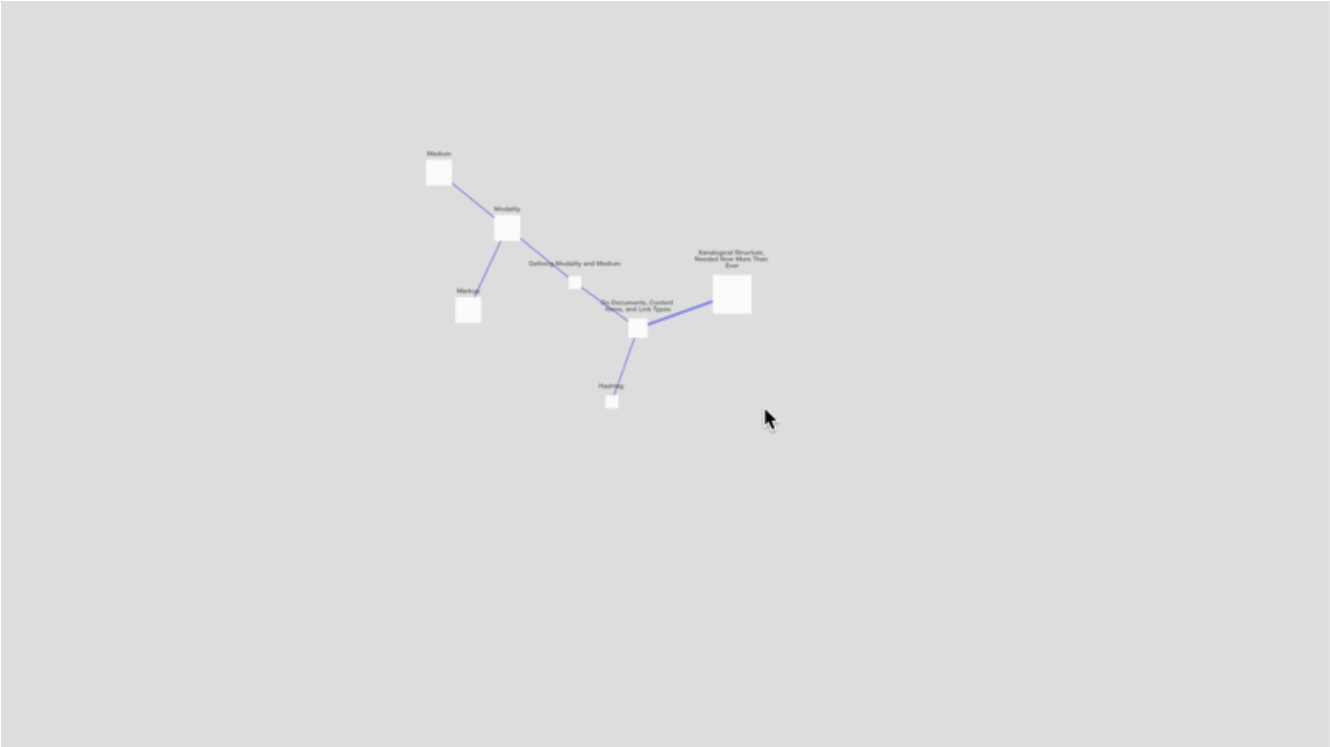
Switching View Modes

The expand icon is replaced with a node-link icon, which triggers the movement from Zoomed-In View to Zoomed-Out View.



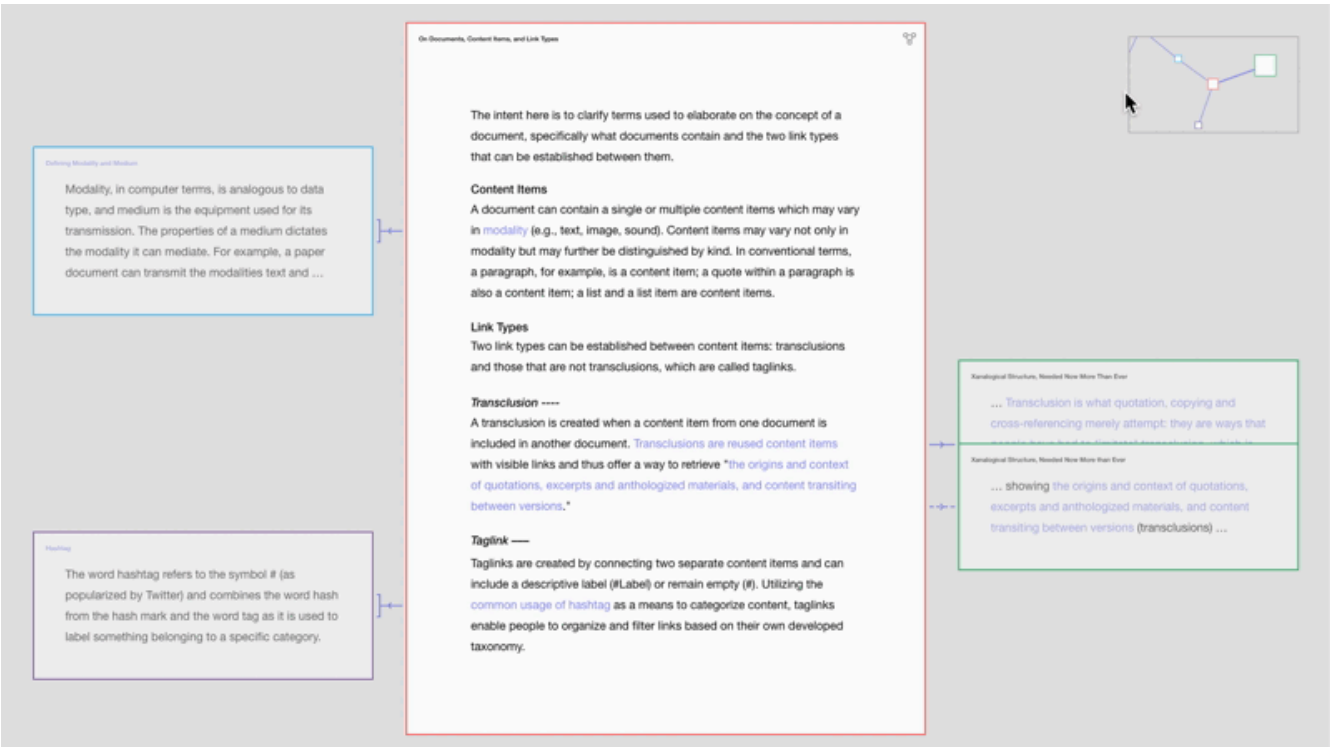


Go to video



Traversing Documents in Zoomed-In View Using the Location Frame

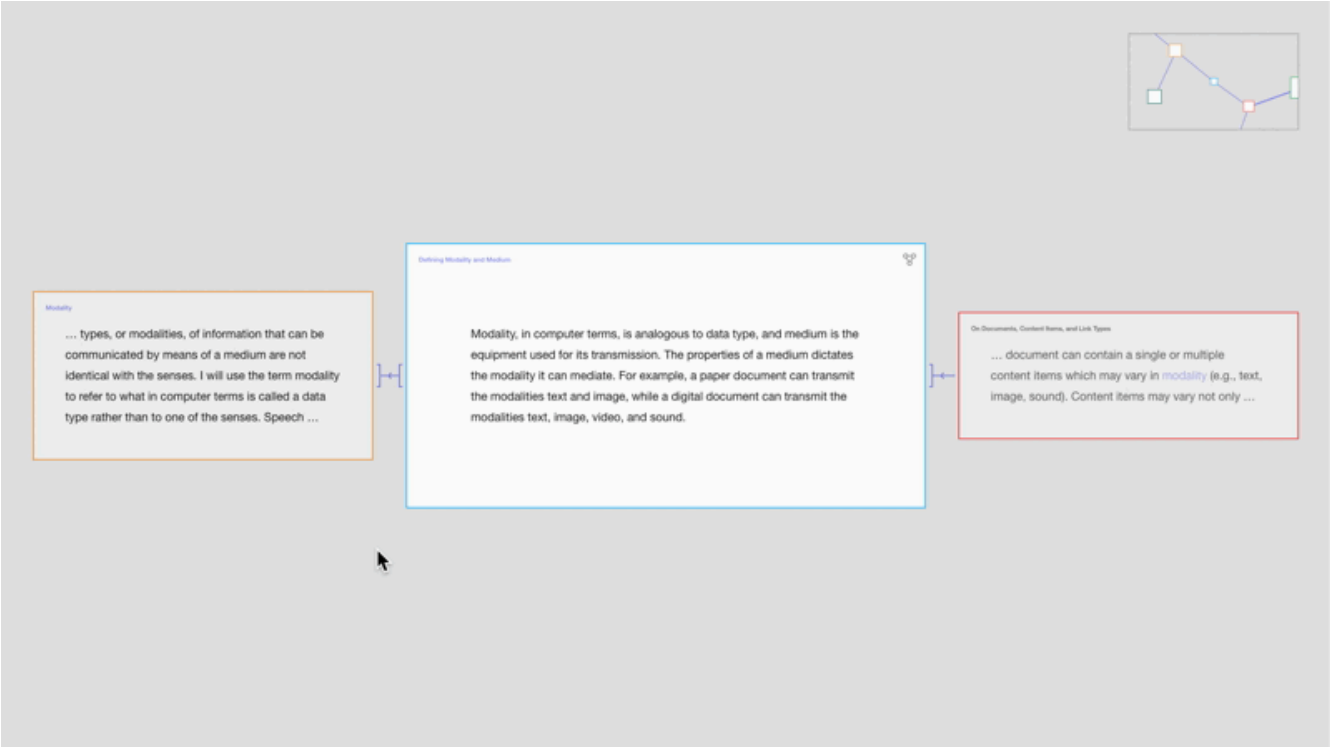
Go to video



Redesign of Aliases

The expand icons are removed, and now the brightness and change of cursor indicate that clicking an alias will open the linked document. The ellipsis indicates that the aliases only reveal part of the linked document.

Go to video



Interactive Prototype

Traverse documents in the interactive prototype below.

Go to interactive prototype

Improvements Due

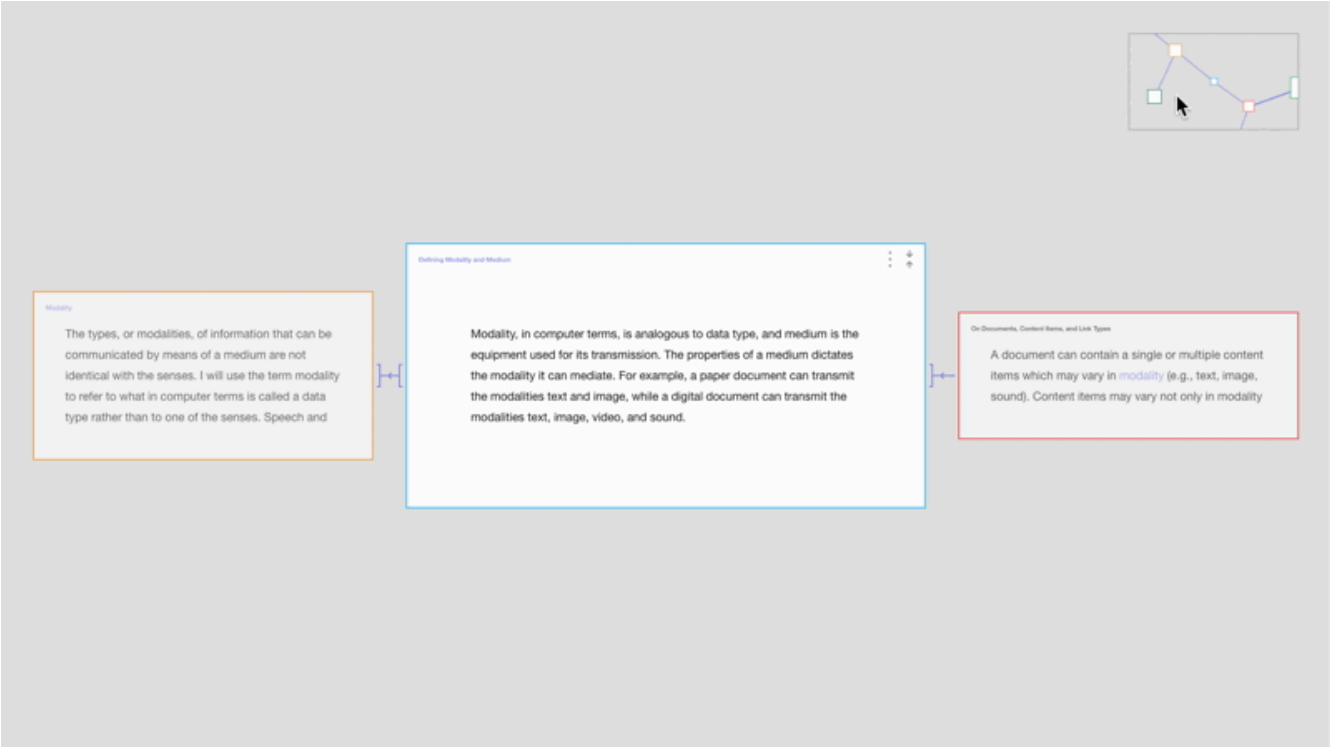
- In Zoomed-In View:
  - Hovering a preview should bring that preview to the front.
  - Hovering linked text (or preview) should result in active-color linked text.
  - Visualization of multiple links to/from the same content item.
- Filter menu

The next entry further explores the design of the view modes and links.

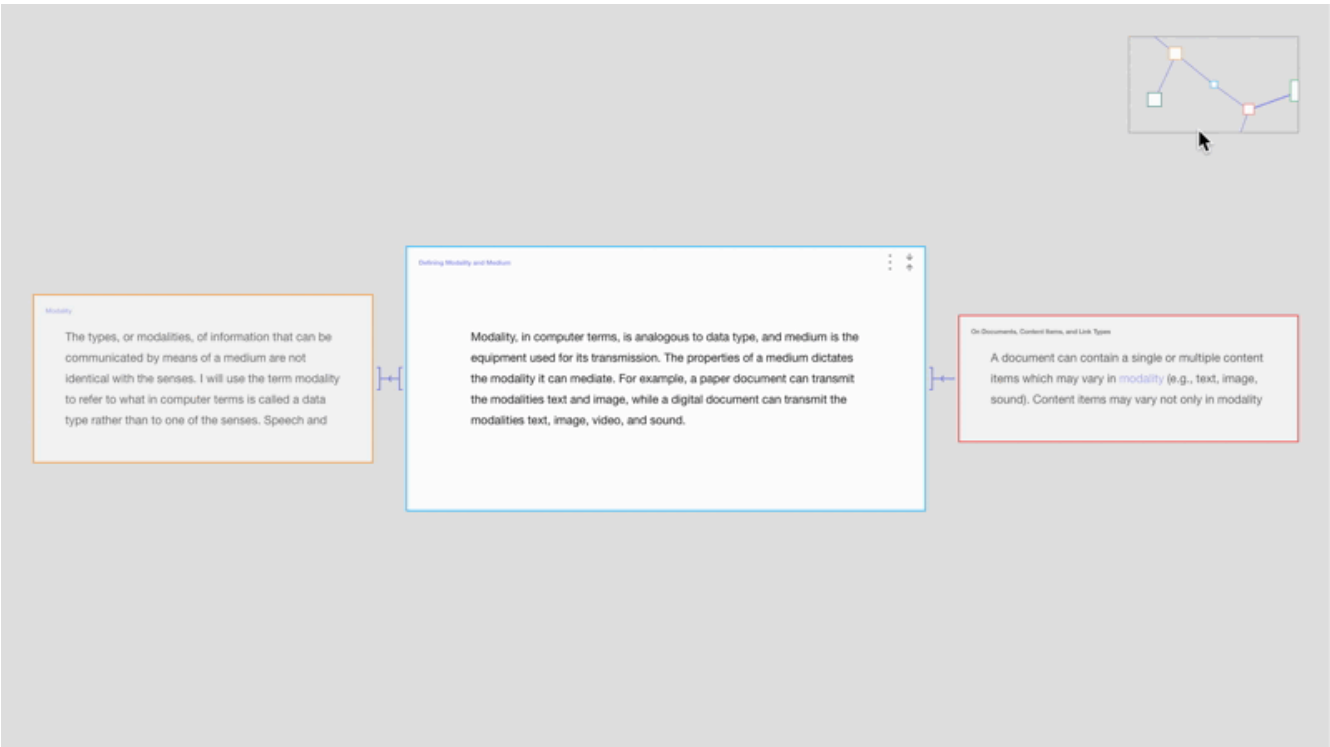
Discarded Attempts

Location Frame Transitions

Go to video



Go to video



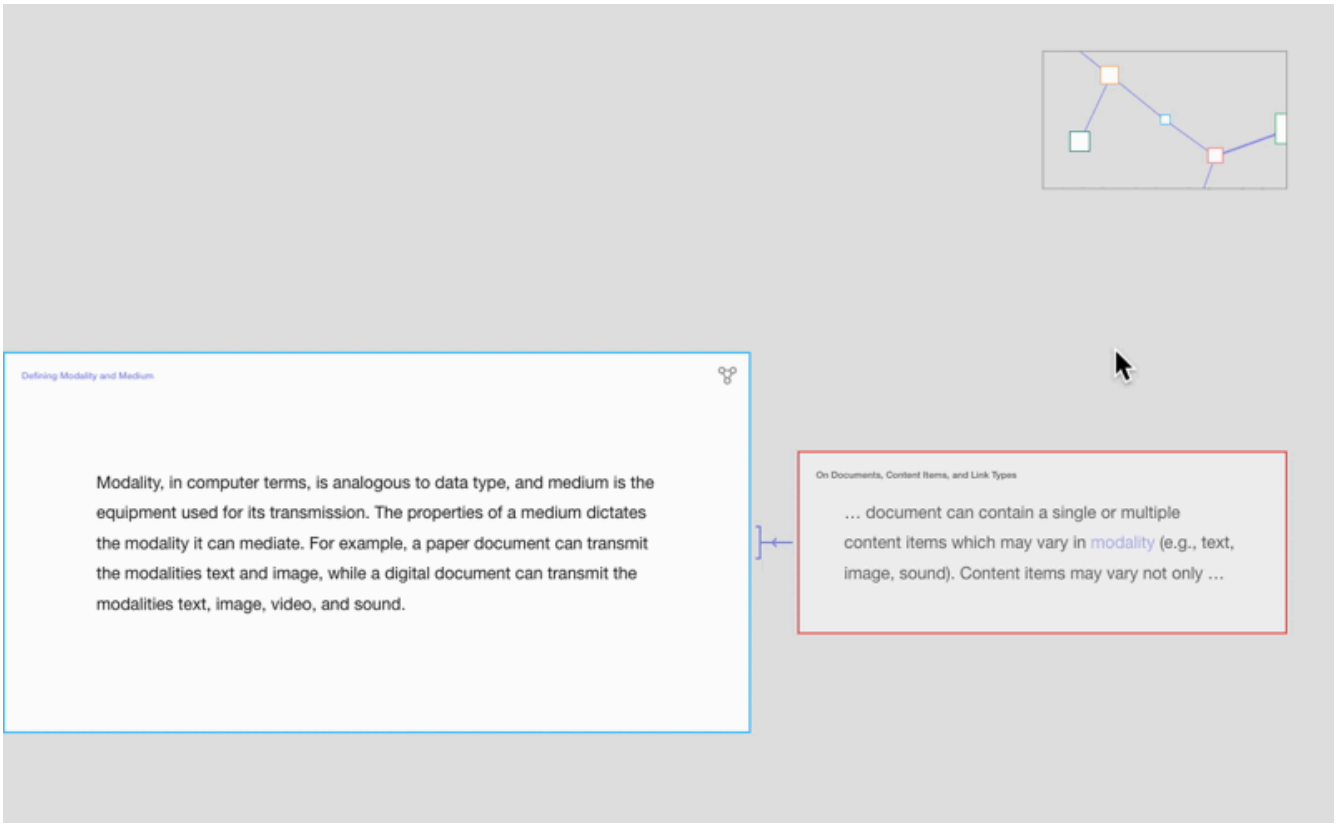
Entry 17 Prototype: View Modes and Links (Round 06)

In this entry, elements in the two view modes are redesigned.

Redesign of the Location Frame

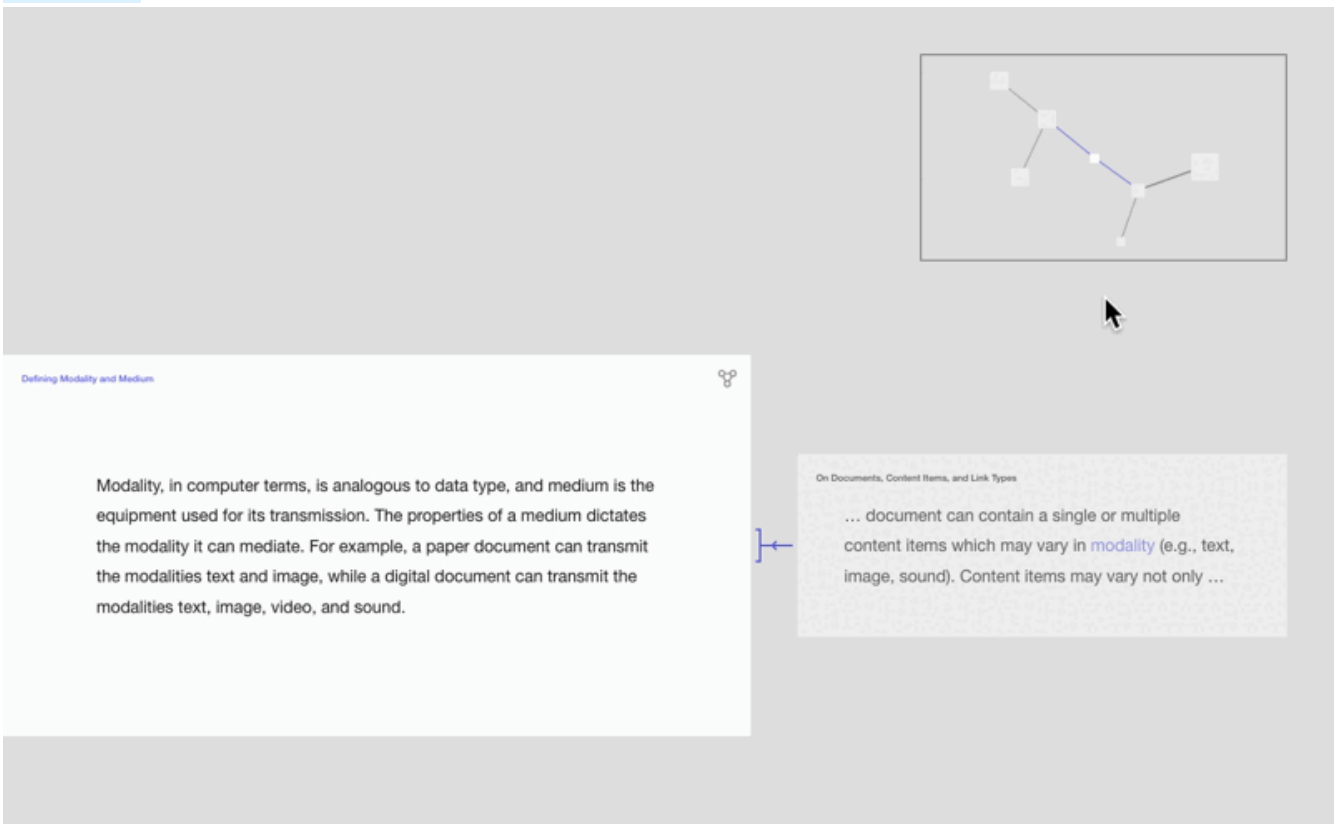
In the previous version of the location frame, traversing documents meant that movement was animated both in the main frame and the location frame.

Go to video

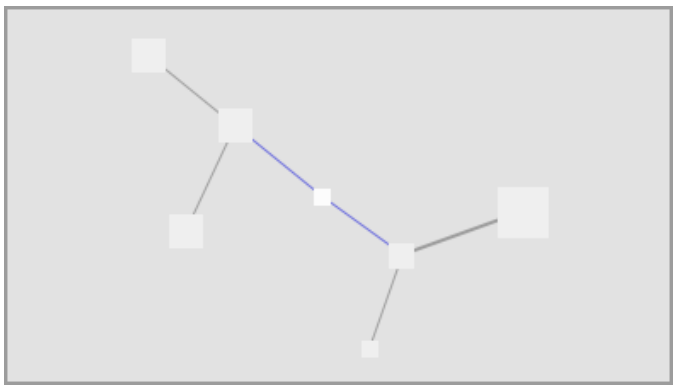


In the current version, all documents are shown in the location frame, and the movement is animated through a change in link color and node brightness.

Go to video



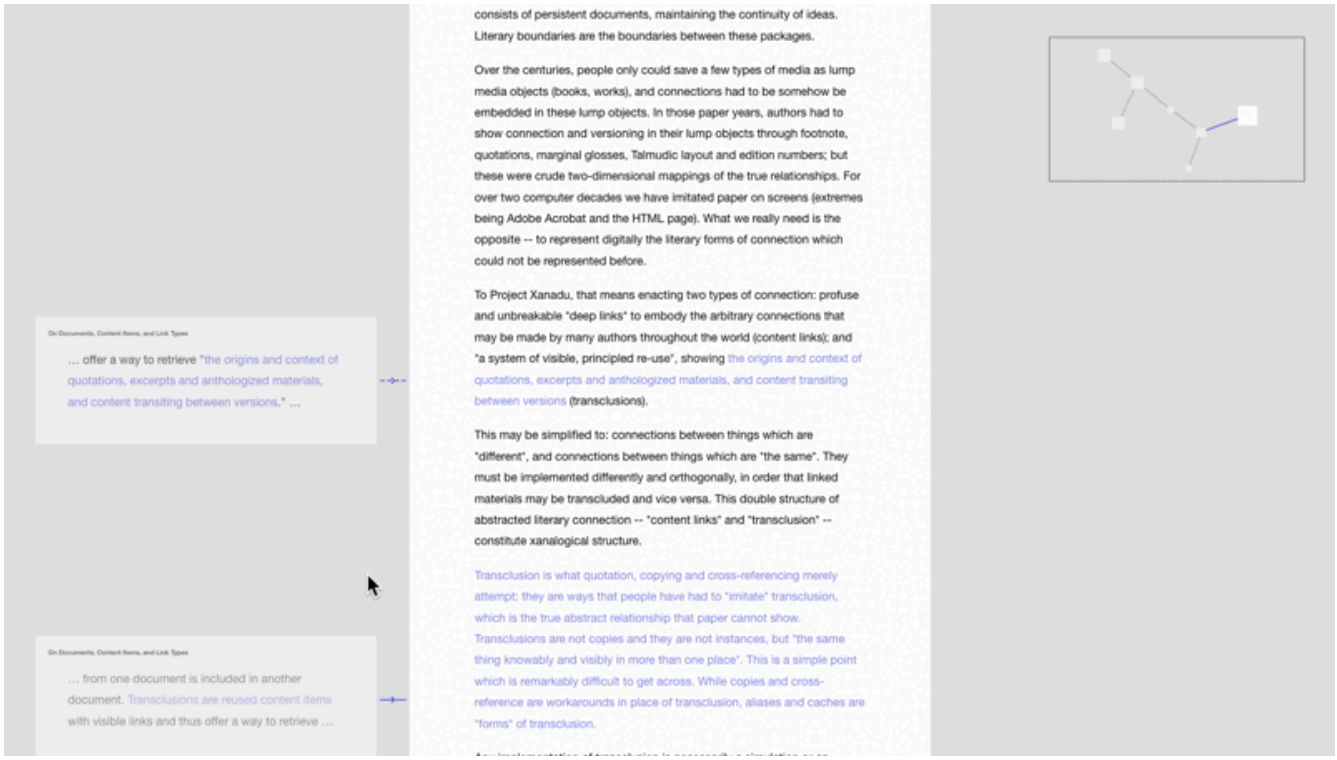
The brightest document is the one that is active (i.e., open), and the purple links indicate the inactive (linked documents).



Transition Animations: Spawning Alias Documents

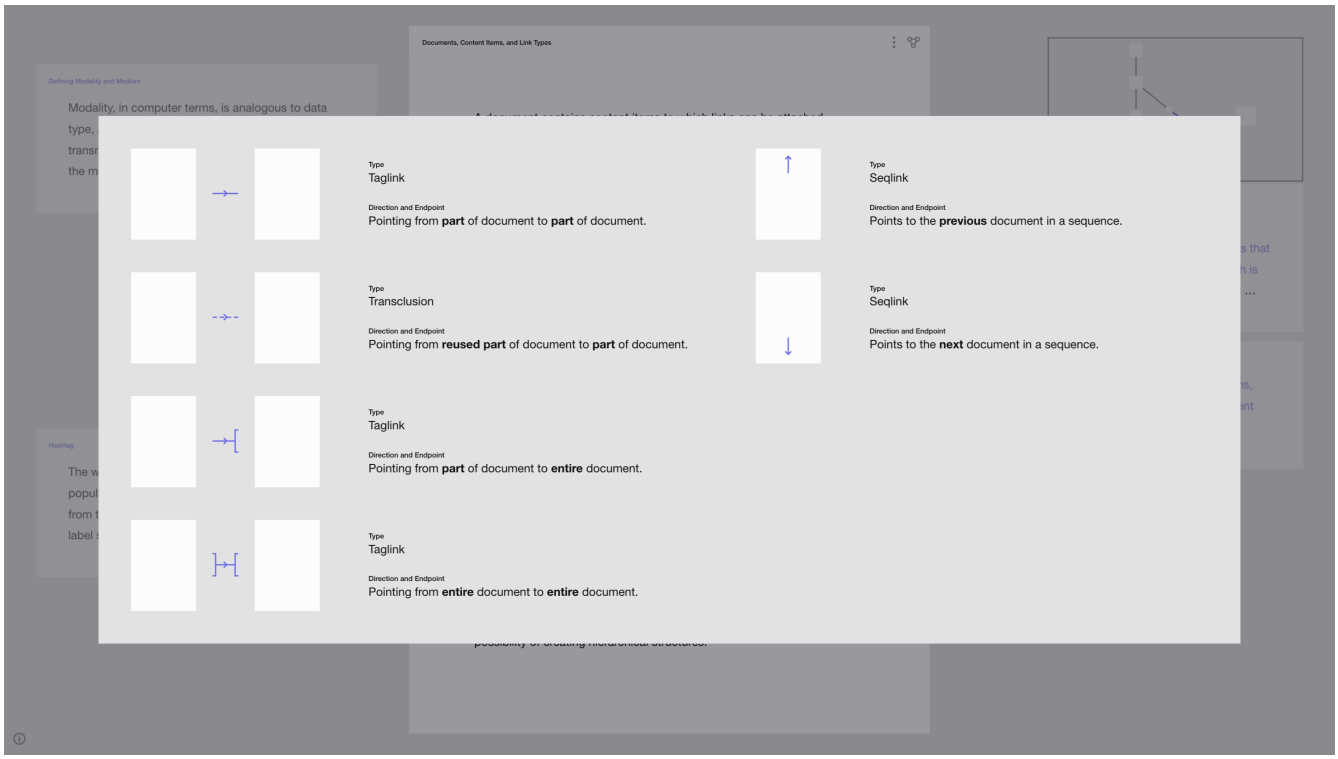
The animation of the links now split into separate links as multiple aliases spawn.

Go to video

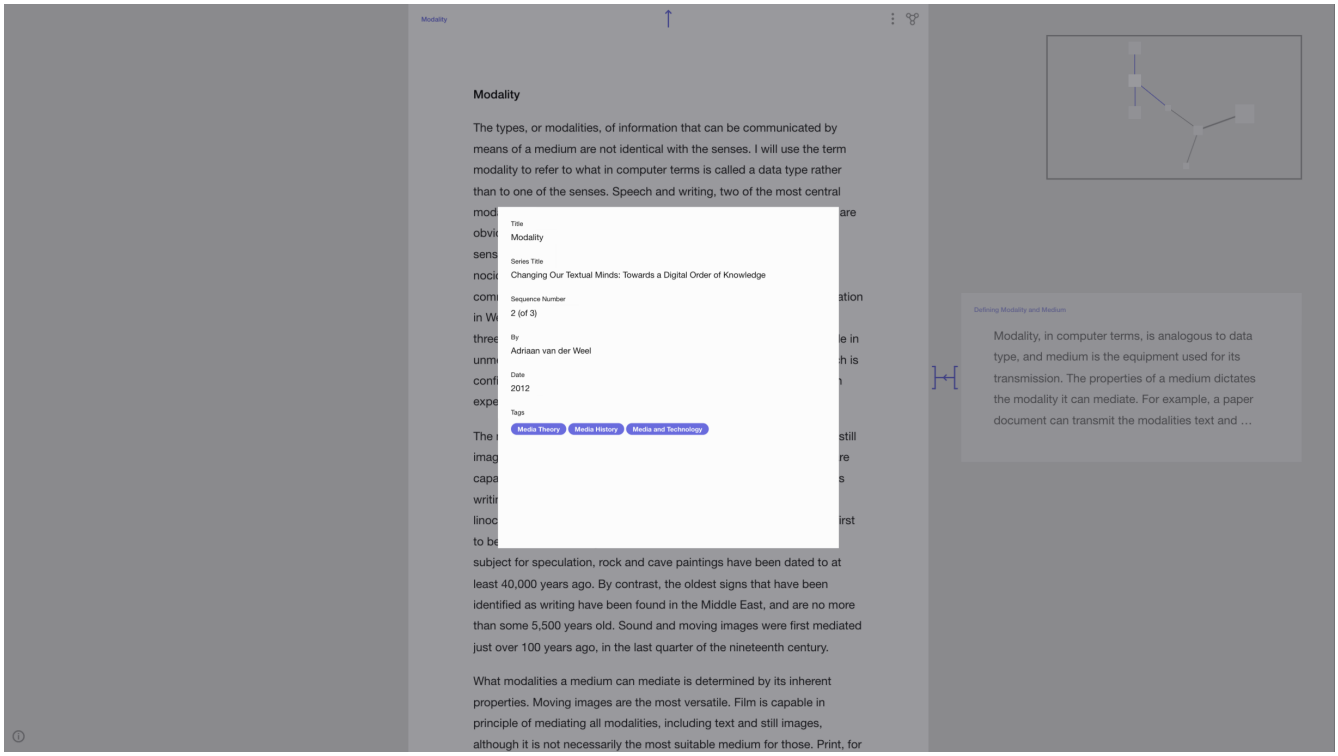


Addition of a Legend

The legend — accessible through the info icon in the bottom left corner — provides information about the various link types.



Addition of a Metadata Window



Interactive Prototype

[Go to interactive prototype]

The next entry explores the utilization of metadata to filter documents and links.

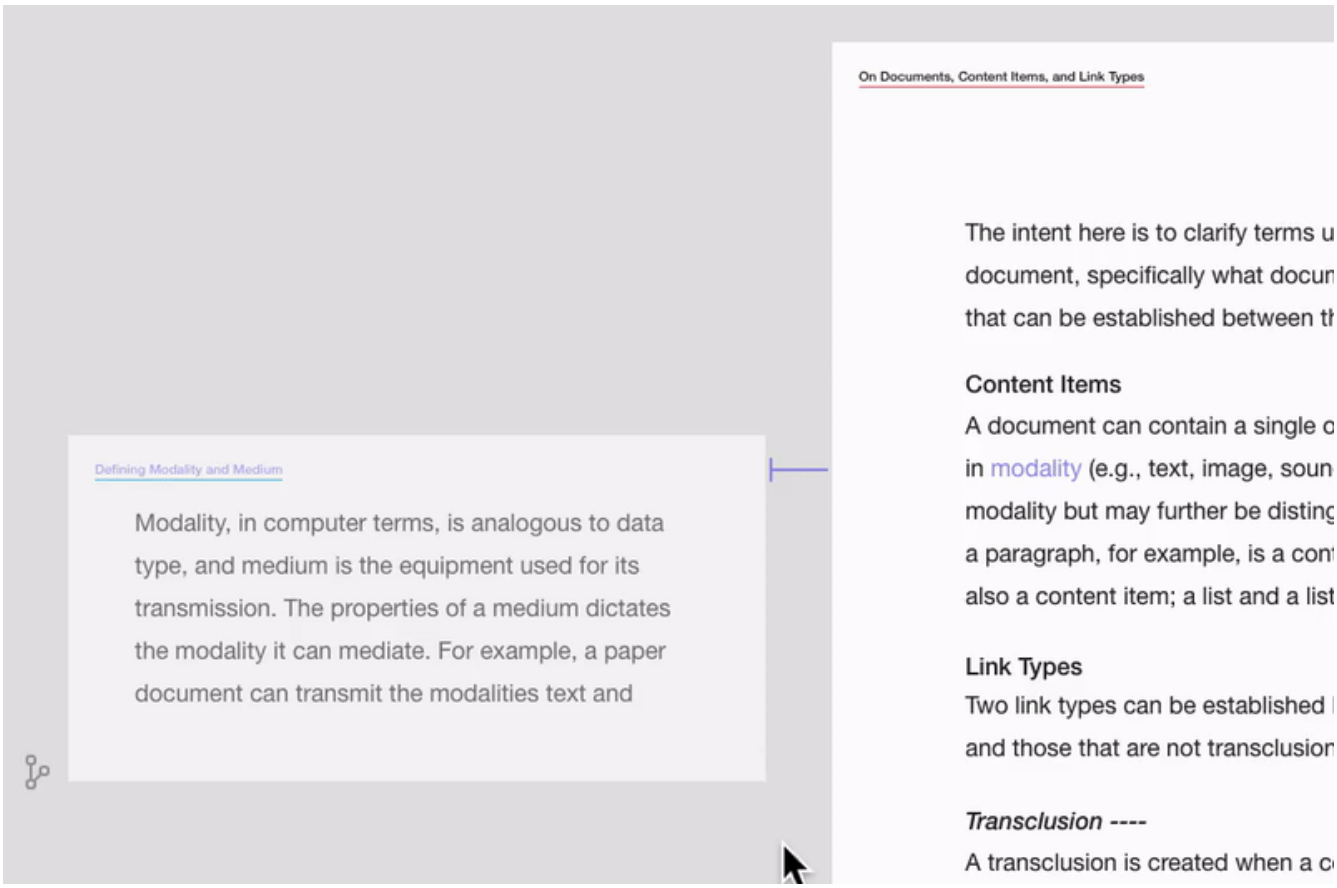
Discarded Attempts

Visual Distinction of Links

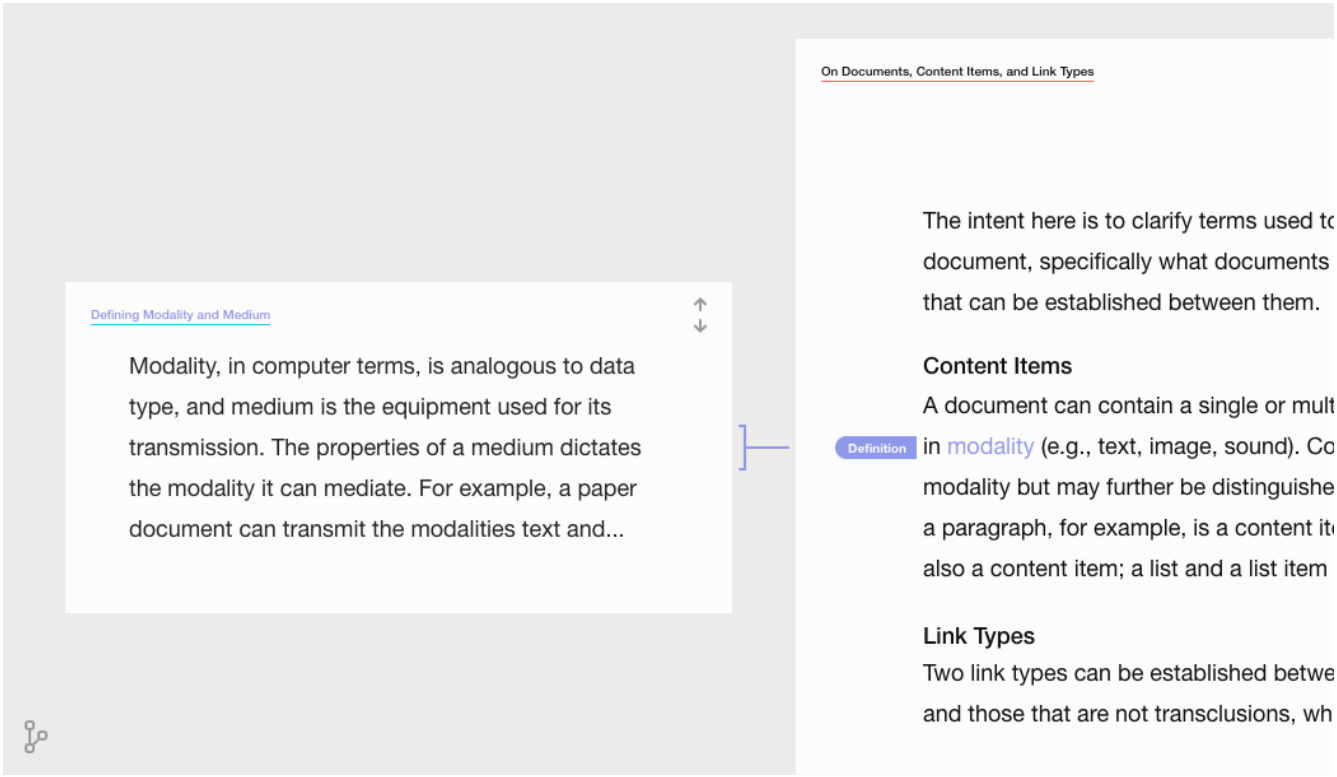
Position and Alignment

In the image below, in addition to the left-bracket link, the title, the link, the label, and the linked text are aligned to emphasize that it points from the entire document on the left to a particular part in the document on the right.

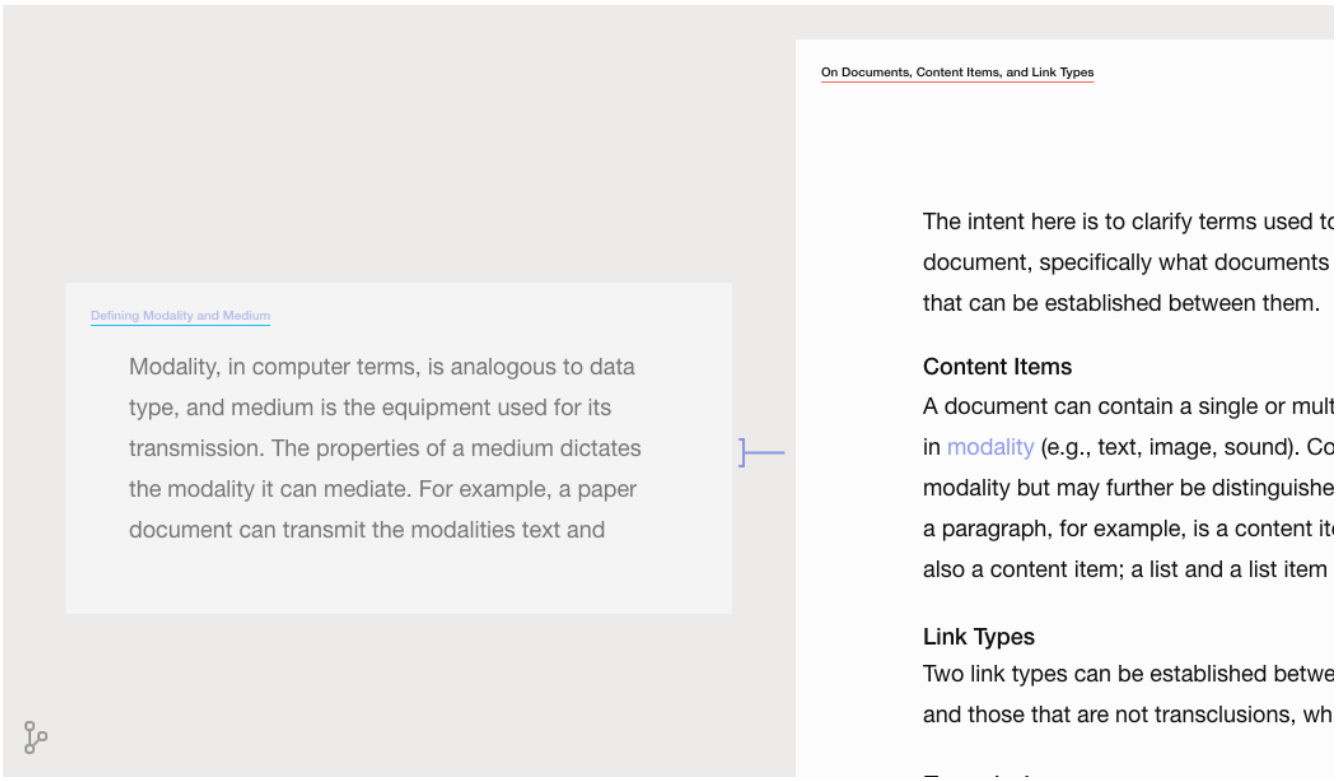
Go to video



In the image below, the label is placed close to the linked text within the open document.



Design of Brackets



Defining Modality and Medium

Modality, in computer terms, is analogous to data type, and medium is the equipment used for its transmission. The properties of a medium dictates the modality it can mediate. For example, a paper document can transmit the modalities text and

The intent here is to clarify terms used to
document, specifically what documents
that can be established between them.

Content Items

A document can contain a single or mult
in modality (e.g., text, image, sound). Co
modality but may further be distinguishe
a paragraph, for example, is a content it
also a content item; a list and a list item

Link Types

Two link types can be established betwe
and those that are not transclusions, wh

Close

On Documents, Content Items, and Link Types

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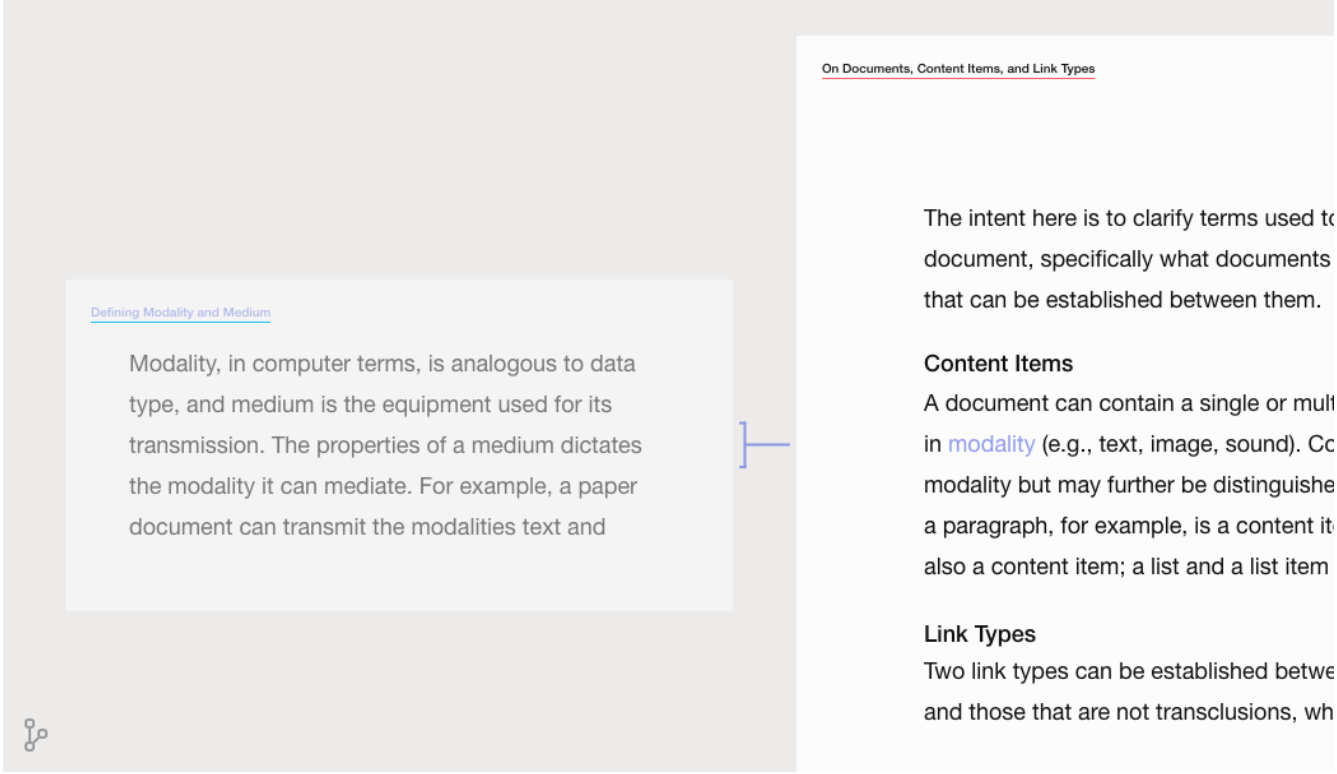
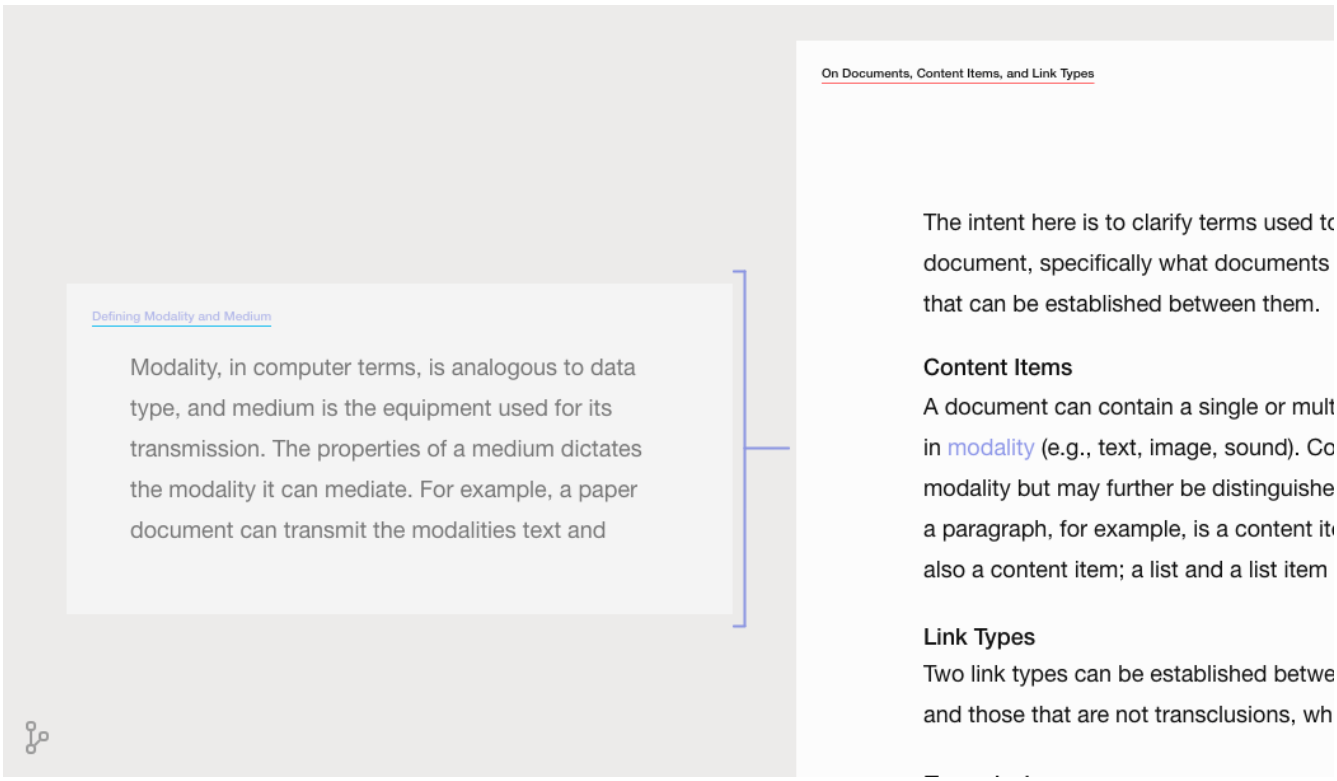
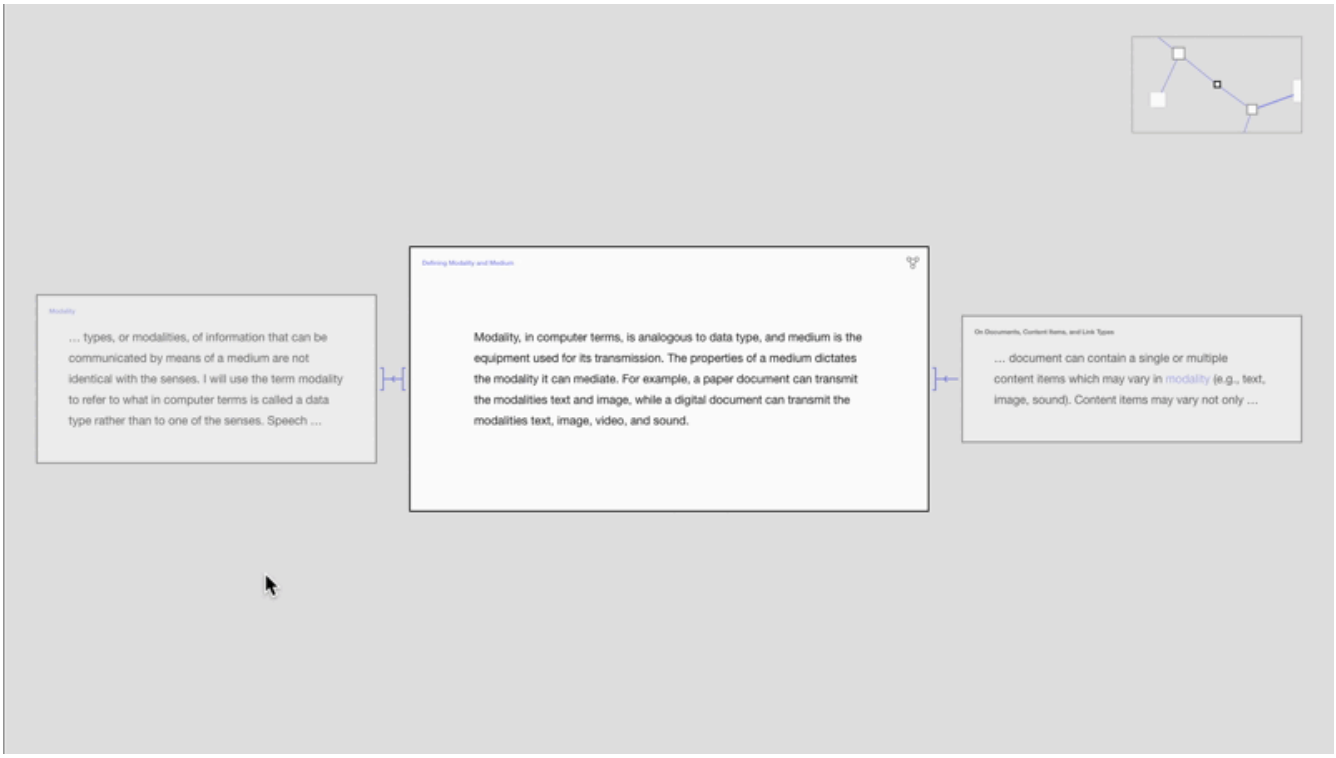




Indicating the Active Document and the Inactive (Linked) Documents

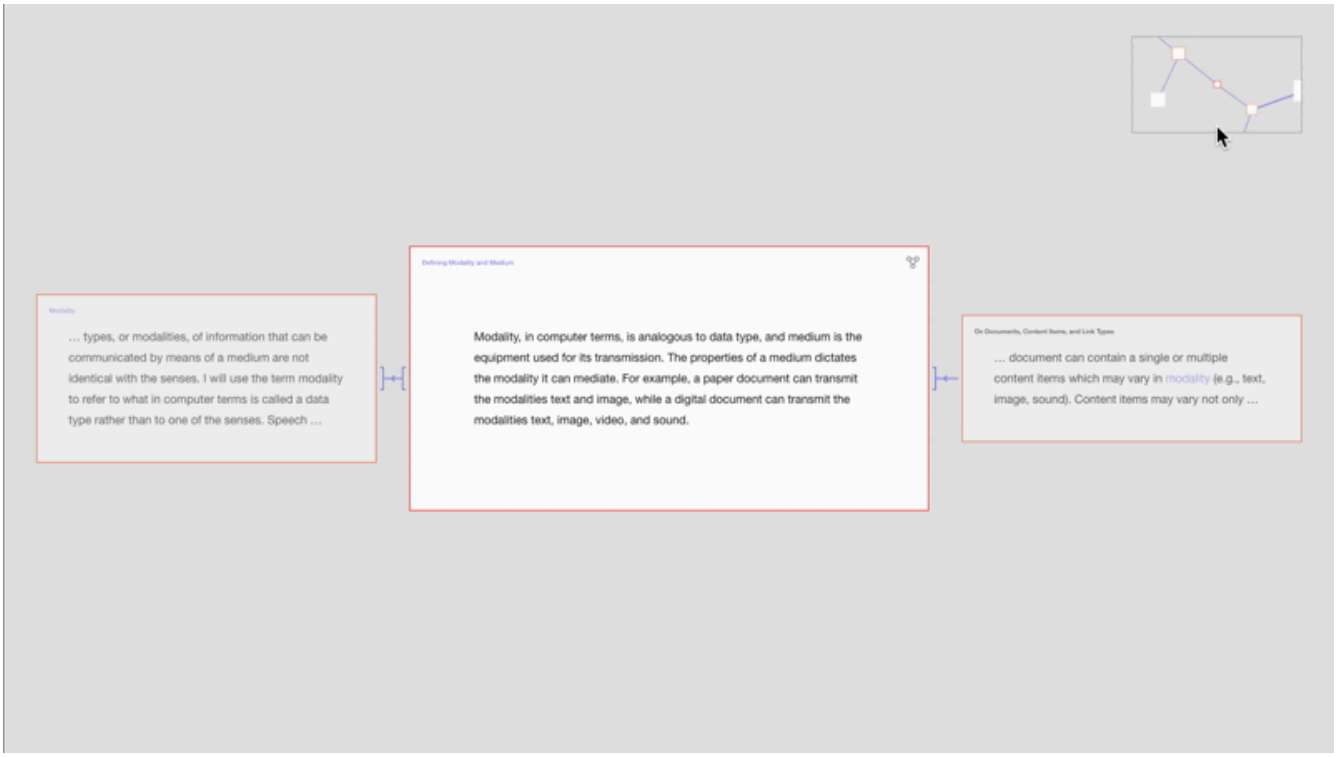
Go to video



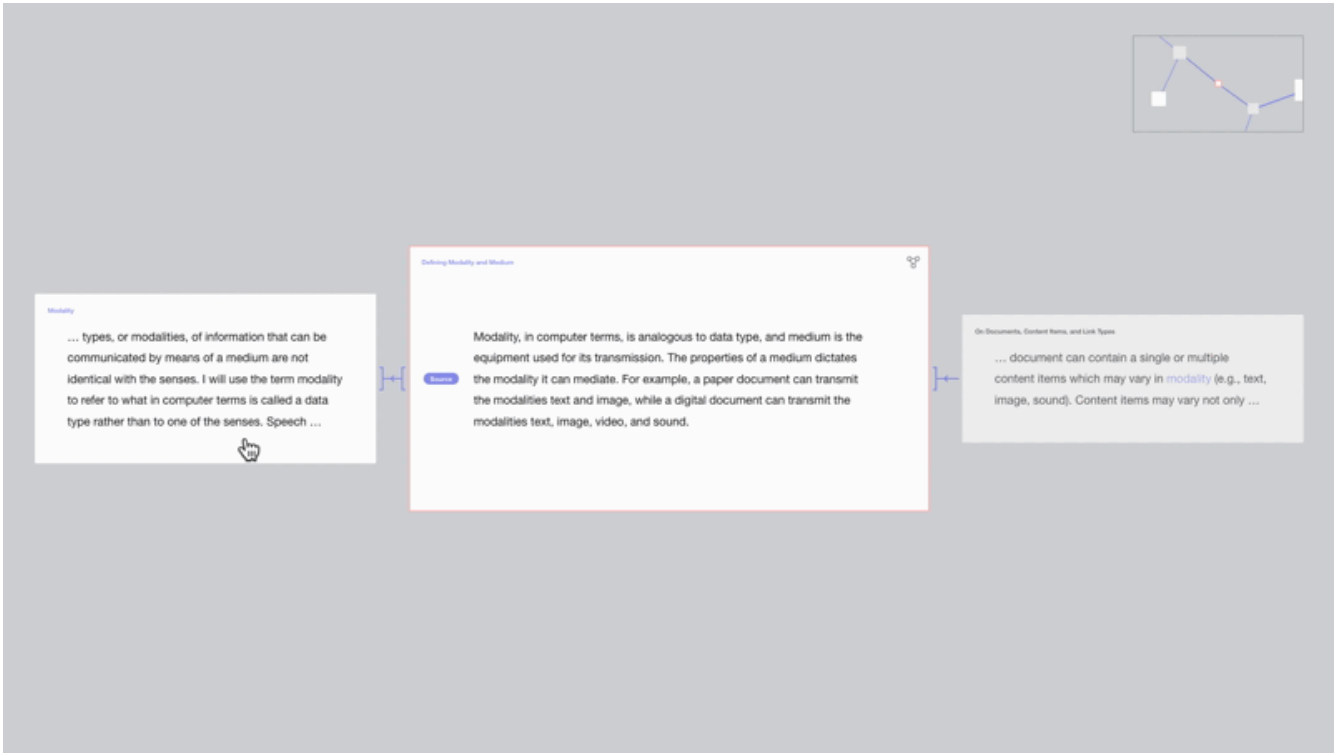
Go to video

Go to video

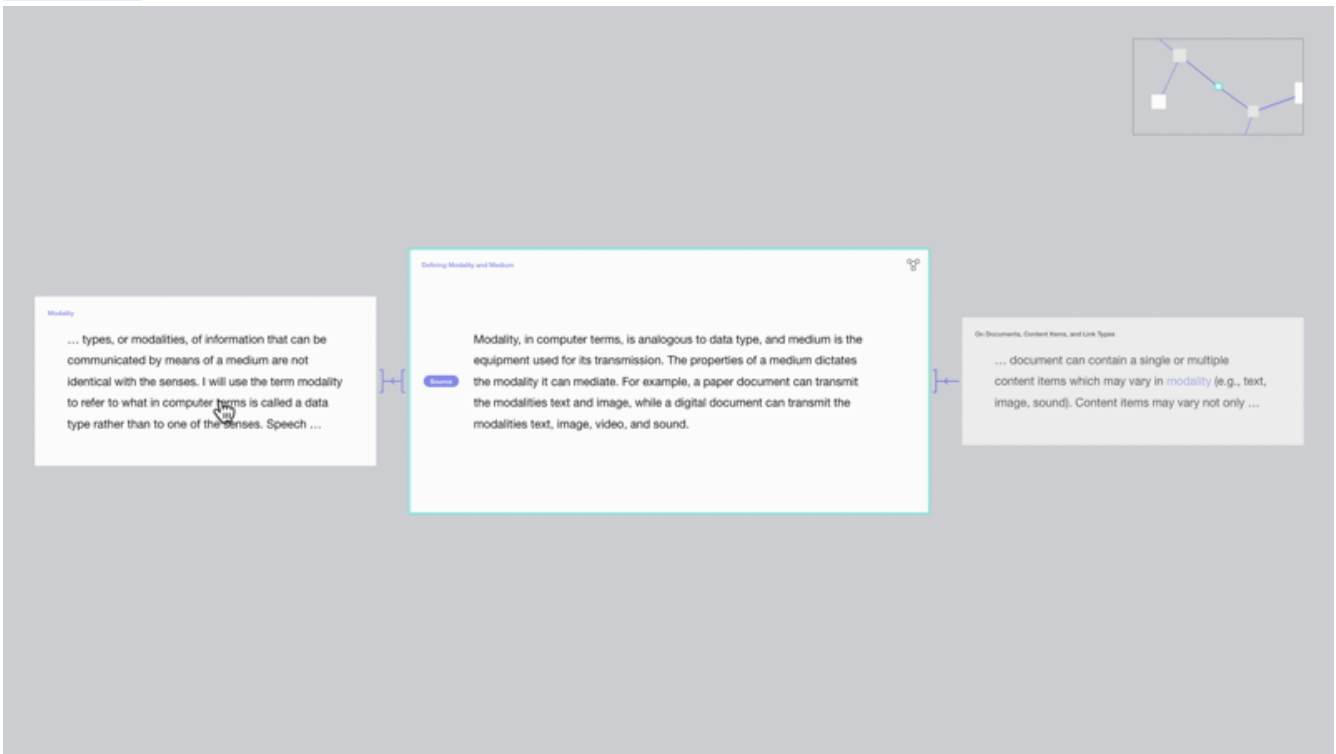
Go to video



Go to video



Go to video



Entry 18 Prototype: How to Filter Documents and Links (Round 07)

Additions and alterations:

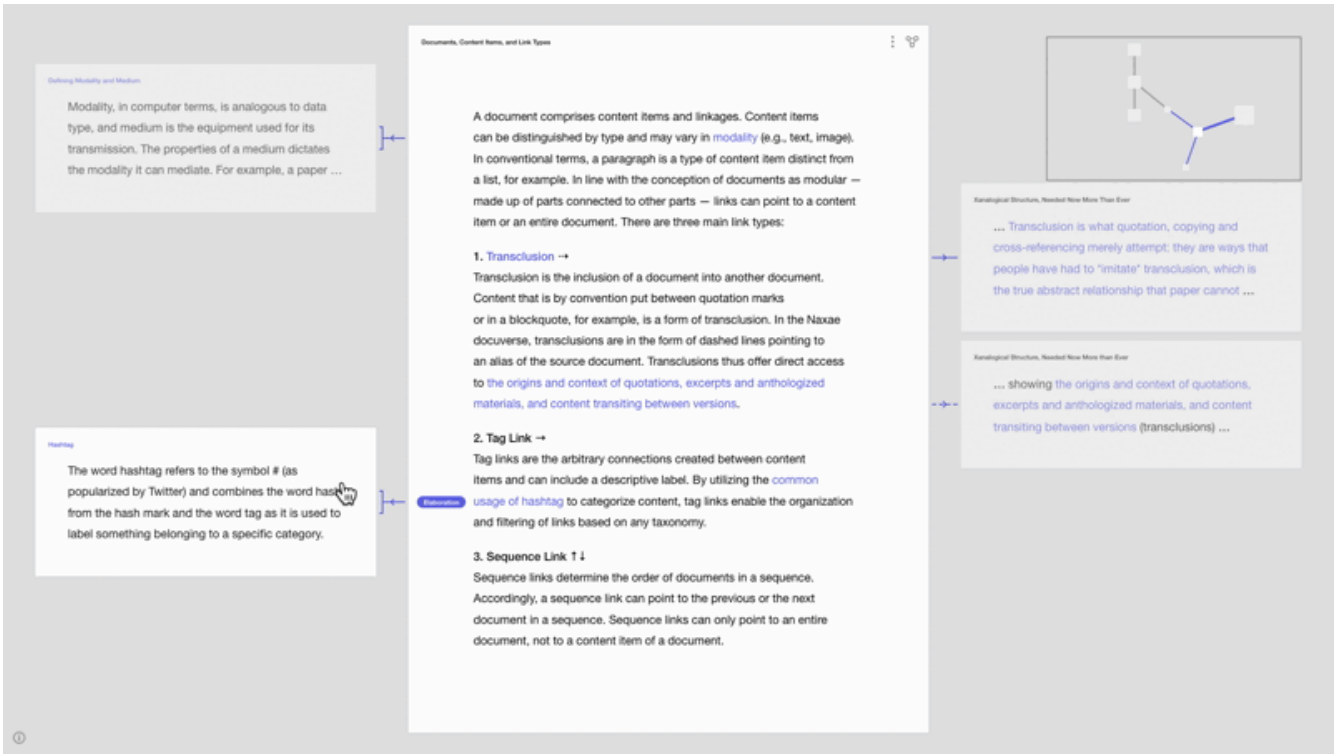
- Thicker lines in location frame.
- Updated content in documents.

- Addition of a filter menu.
- Redesign of metadata window.

Metadata Frame and Filter Menu

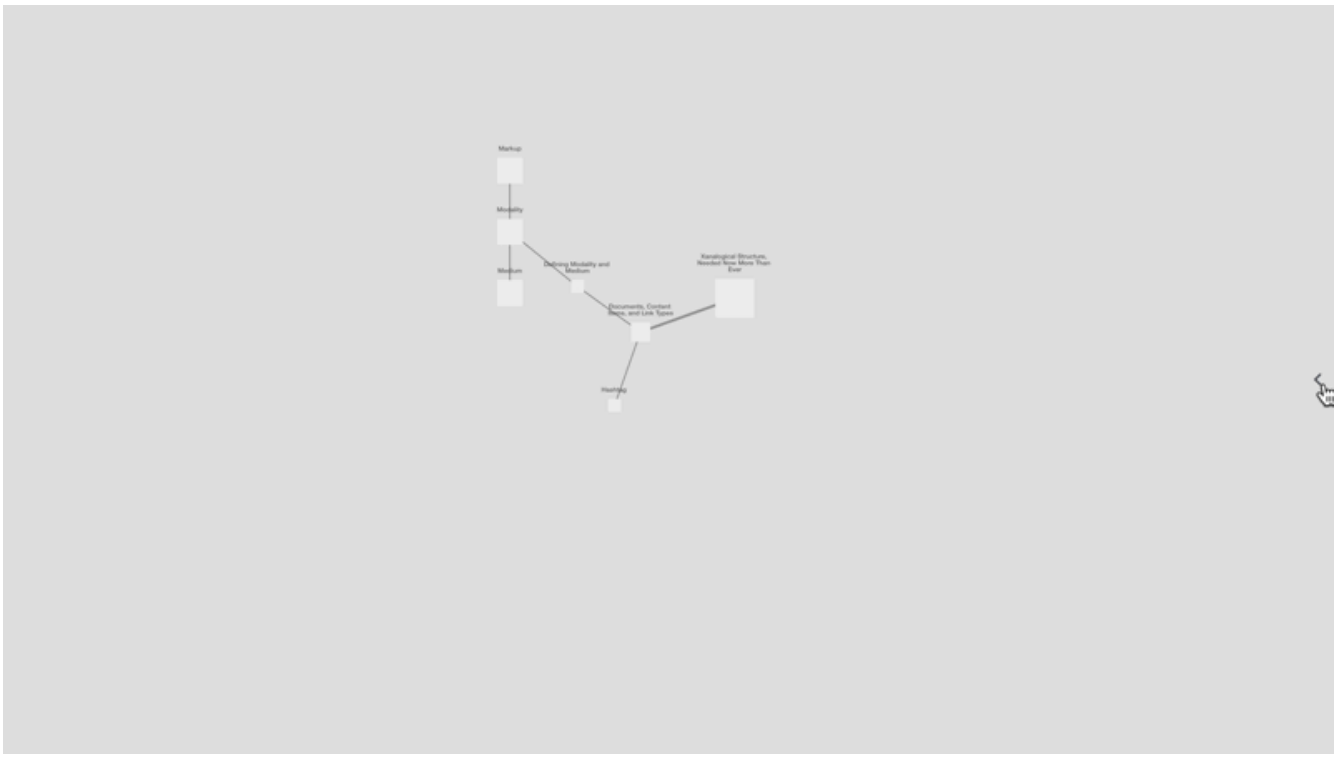
To facilitate the understanding that metadata is attached, not embedded, the metadata window is animated as a layer *on top of* the document.

Go to video



Document and link metadata can be utilized for filtering.

Go to video



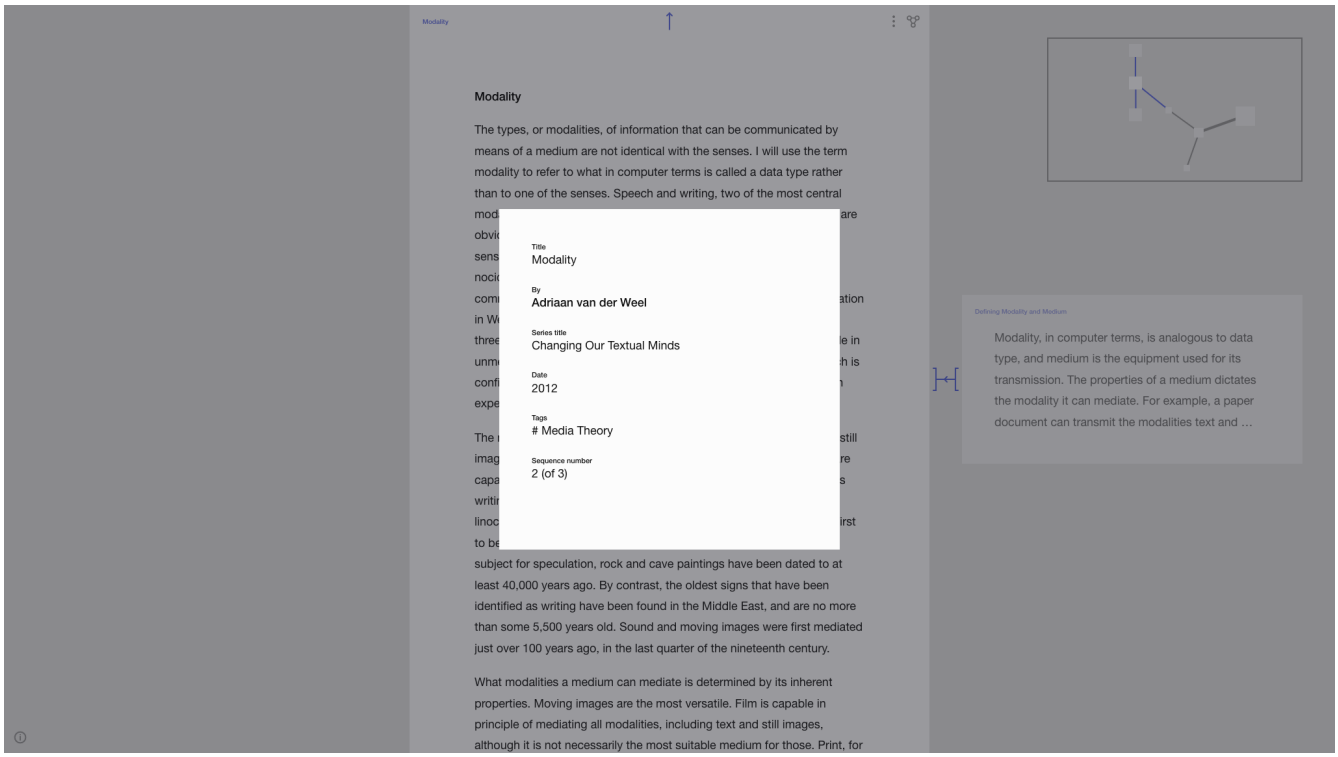
Interactive Prototype

Go to interactive prototype

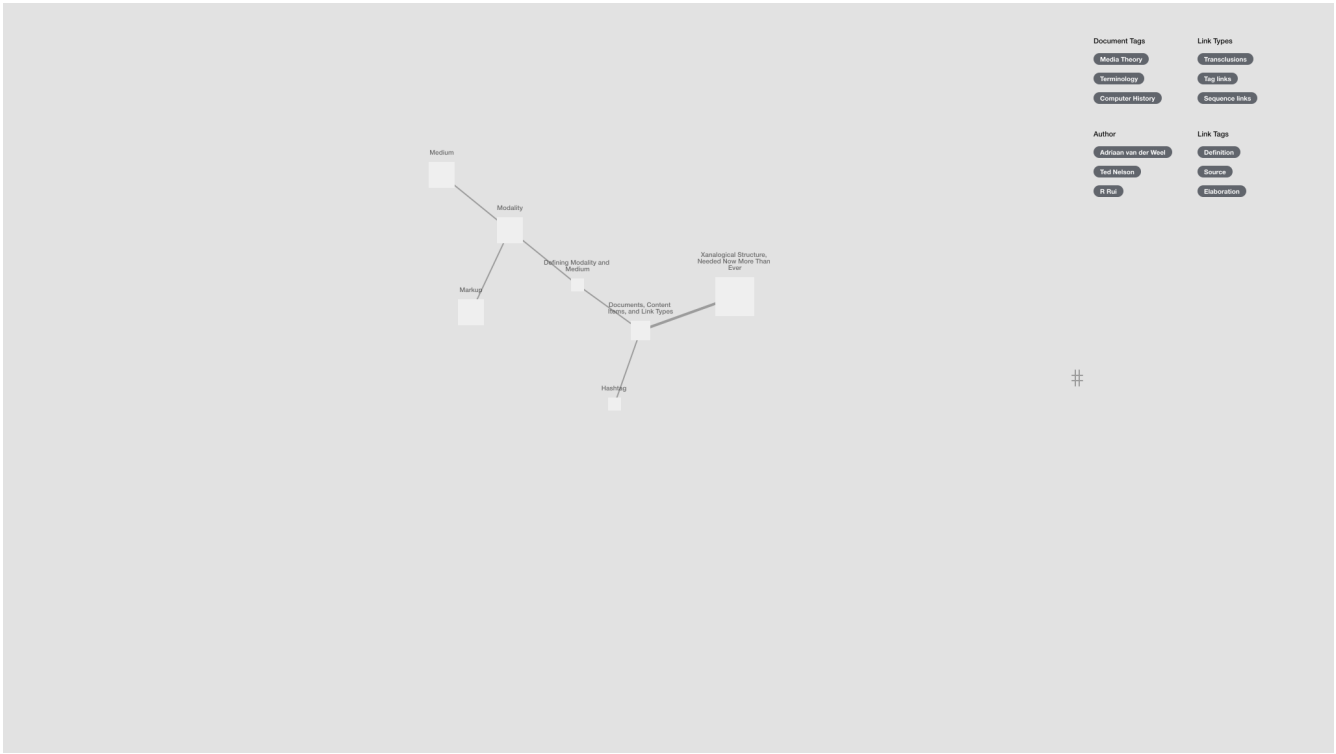
The next entry reflects on the process and result of this research project.

Discarded Attempts

Metadata Window

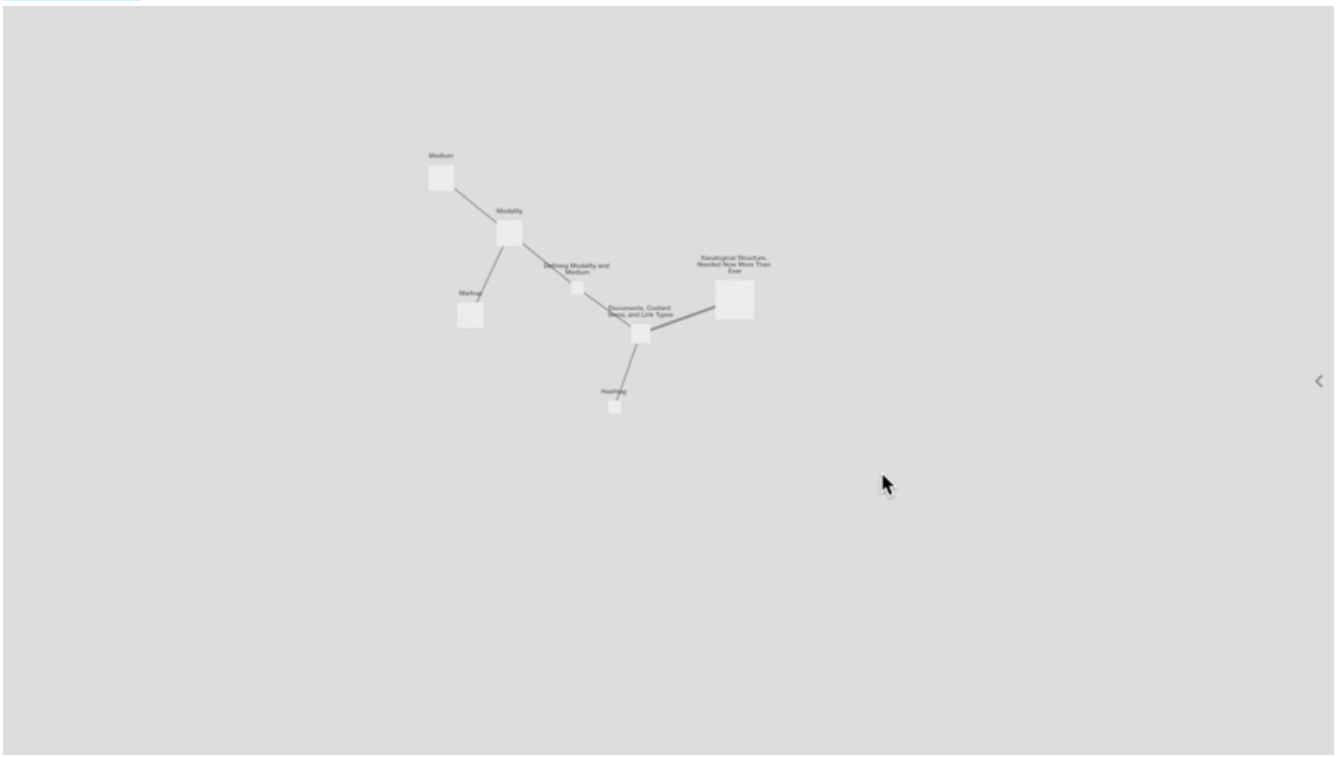


Filter Menu



Cursor

Go to video

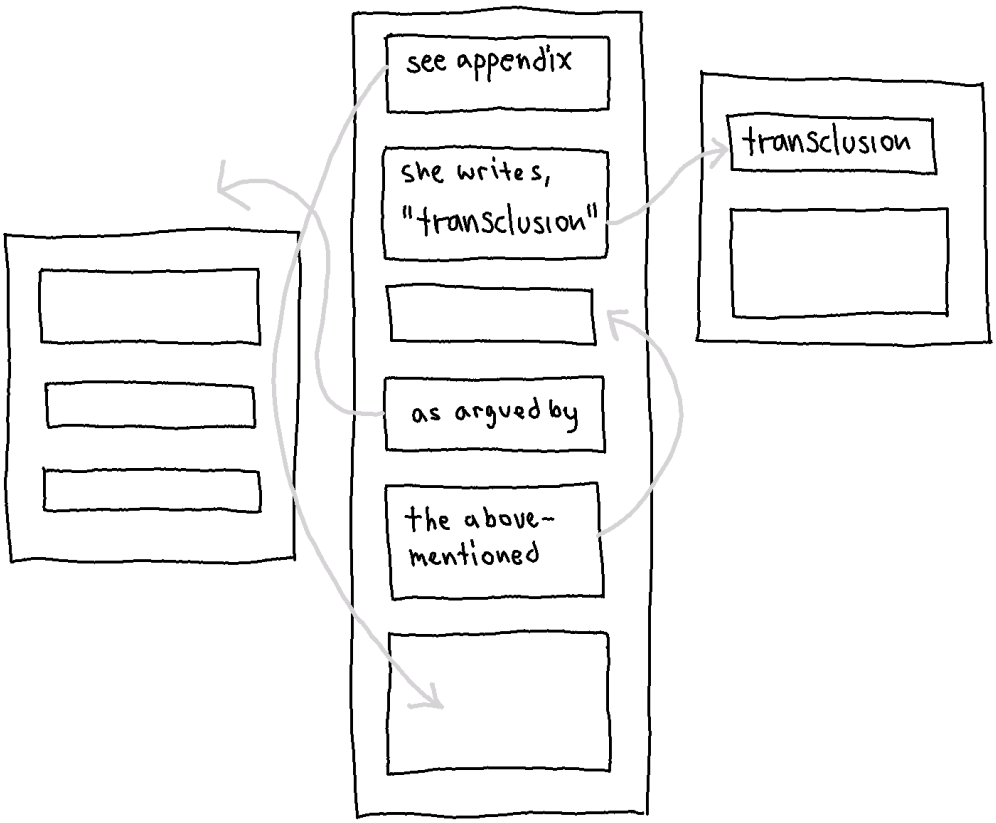


Entry 19 Reflection

The following summarizes and reflects on the process and result of this research project.

Summary of the Background

Documents are containers of content items (representing ideas, theories, facts, beliefs, and so on). By creating different types of connections among content items, an interconnective structure can be formed. Types of connections can be implicit or explicit and external or internal.



Model of different types of connections

Currently-available software does not offer ways for mapping the interconnective structure of documents, nor is it visualized. Instead, it remains an underlying structure. For example, computer documents are conceptualized as *files* inserted into *folders*, as if they are independent objects that fit neatly into a hierarchical structure. Even if a file conceptually belongs to multiple categories, it can only exist in one. If it is insisted that it belongs to more than one, then just as with a paper file, that digital file must be *copied* to the *clipboard* and *pasted* into another *folder*, and we now have *two separate copies*. Concepts and practices derived from paper documents have been transferred into the digital realm, inheriting the biases and material constraints. It begins at the computer operating system level but permeates the digital realm.

The problem is not that concepts derived from paper documents *have* been transferred to the digital realm, but *how* they have been transferred. This problem led to the research question: What new approaches can be taken to representational concepts for mapping and accessing the interconnective structure of documents to enable new ways of traversing documents through interaction, and what are the consequences?

The method is based on an iterative process of content creation, concept design, and creating interactive prototypes of a digital document system. An interactive prototype of a digital document system has been developed by taking new approaches to representational concepts for mapping and accessing the

interconnective structure of documents. The concepts have been derived through examining prominent document systems considered influential in the evolution of information technologies:

1. The Encyclopédie by Denis Diderot (1713-84) and Jean d'Alembert (1717-83)
2. The work of Paul Otlet (1868-1944)
3. The original hypertext project Xanadu by Ted Nelson (1937)

All three are grounded in particular notions about the structure of ideas and how knowledge evolves (discussed below). Distilled from these examples, Nexae was developed based on the following conditions:

1. Documents are modular.

The structure of ideas is multi-sequential, and knowledge is not fundamentally hierarchical. Subsequently, it was established that a digital document system must support mapping multiple structures, and hierarchy should not be the predominant structure into which content must fit. Knowledge is a process of decomposition and recomposition (analysis and synthesis). To realize the interconnective structure of documents and to facilitate that continuous process of decomposition and recomposition, Nexae was developed based on the conception that documents are modular.

2. There are multiple renditions of content.

Different view modes were developed to convey different information about the interconnective structure of documents, which, together with the capability to filter documents and links, offer multiple renditions of content.

3. Links are distinguished according to types of connections.

To facilitate the modularization of documents, links were conceptually and visually distinguished according to types of connections. Those links could be applied to realize the interconnective structure of documents, providing access through interaction.

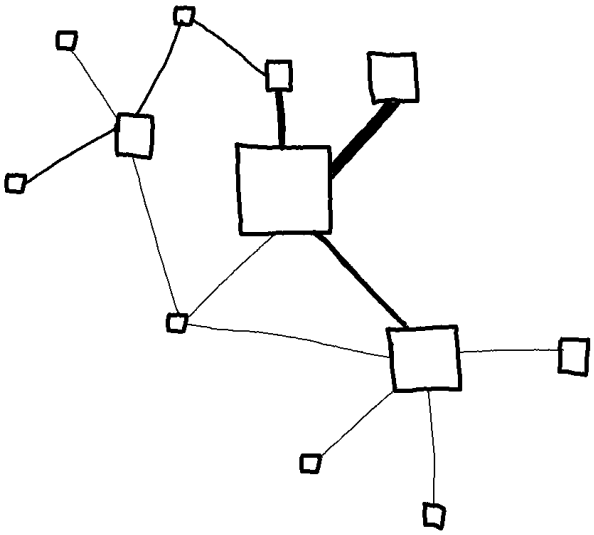
4. It is a closed system.

For the system to support the developed concepts and how they interact, Nexae is envisioned as a closed system (i.e., no external links).

Development of the Concepts and the Prototype

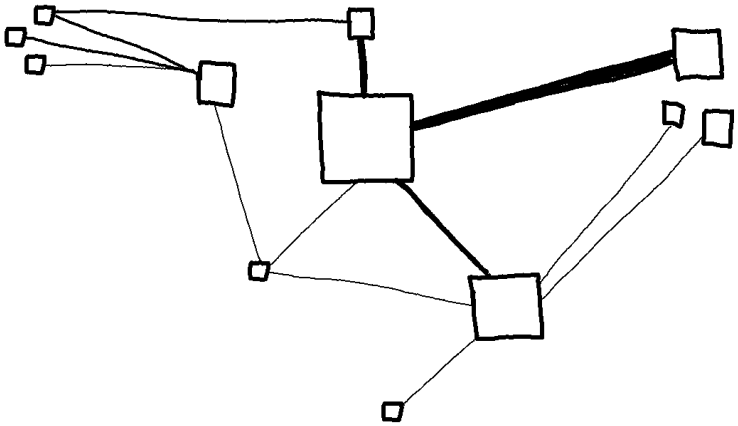
Multiple Renditions Implemented as Two View Modes

Two view modes were developed to convey different information about the interconnective structure of documents, enabling zooming in and out to gain different perspectives on (and representations of) documents at different levels of detail. Zoomed-Out View is at the document collection level, and the Zoomed-In View is at the document level.



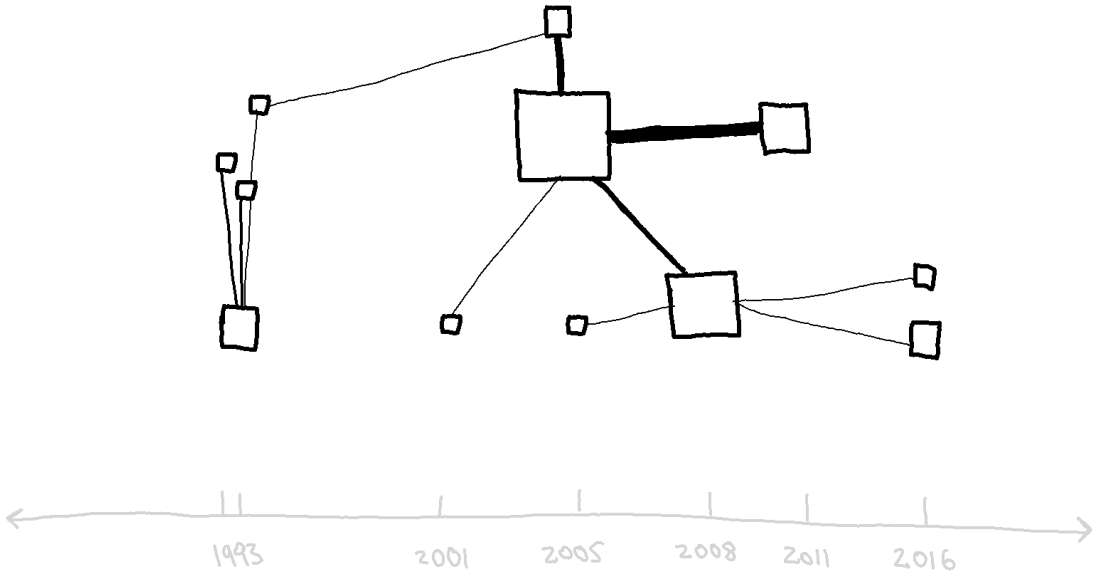
Model of Zoomed-Out View

Zoomed-Out View is a network diagram using a node-link model. All documents are viewed in relation to each other, conveying information about the size of each document (indicated by the node size) and the number of links (indicated by line thickness). Functioning as an infographic, it allows understanding a lot of information at a glance. The idea with this view mode is that it should be possible to configure the node-link structure based on document (and link) metadata. Documents could be grouped in clusters according to a shared subject, keywords, or writer name.



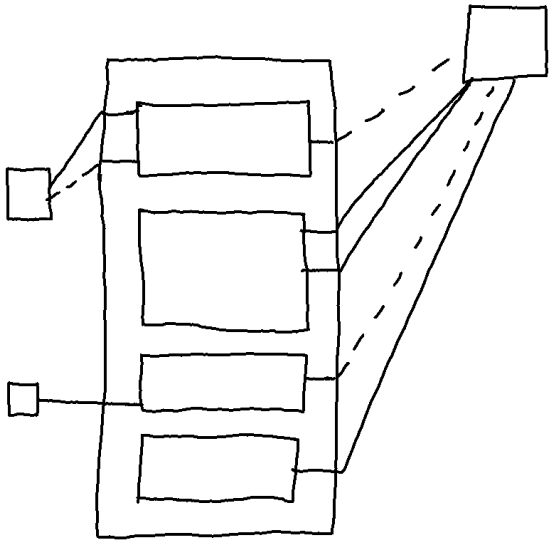
Model of Zoomed-Out View, cluster arrangement

Alternatively, the node-link structure could be arranged in the form of a timeline based on the date of creation or the date last modified.



*Model of Zoomed-Out View, timeline arrangement**

From Zoomed-Out View, a document could be selected to enter Zoomed-In View. In Zoomed-In View, the selected document is viewed in more detail, conveying information about the type of connections to/from that document.

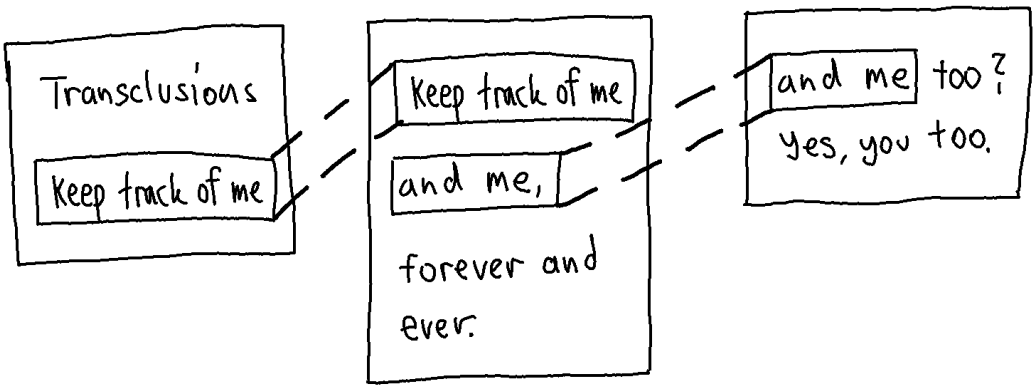


Model of Zoomed-In View

Two Link Types: Transclusions and Non-Transclusions

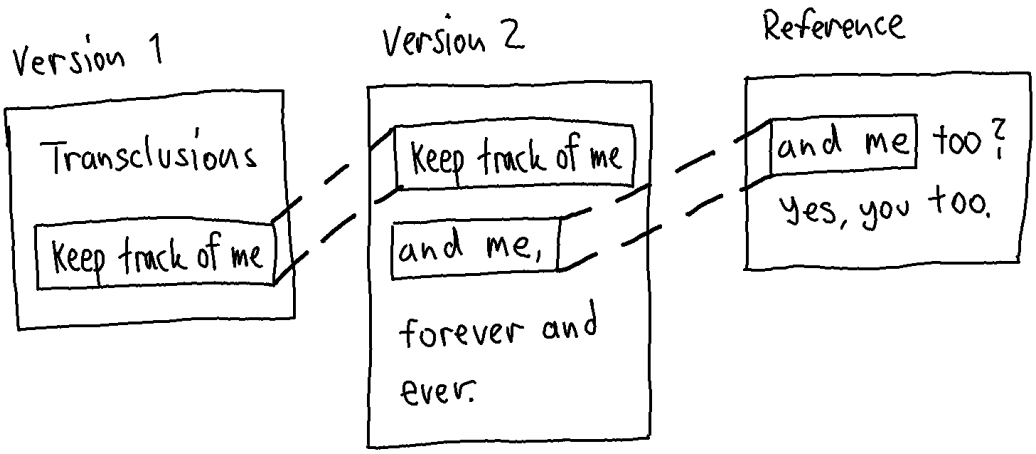
Two link types were first developed based on two distinct types of connections: reused content items across documents (transclusions) and arbitrary conceptual connections (non-transclusions).

Transclusion is the inclusion of (a part of) a document into another document. In Nexae, content is *transcluded* rather than *copied* and *pasted*. And unlike the copy/paste method, when content items are transcluded, an automatic link is generated, keeping track and providing direct access to its original context. In line with the conception of documents as modular, through transclusion, a content item can exist in multiple documents. Transclusions enable, for example, a content item to be the third list item in one document and the title of the fifth section in another document.

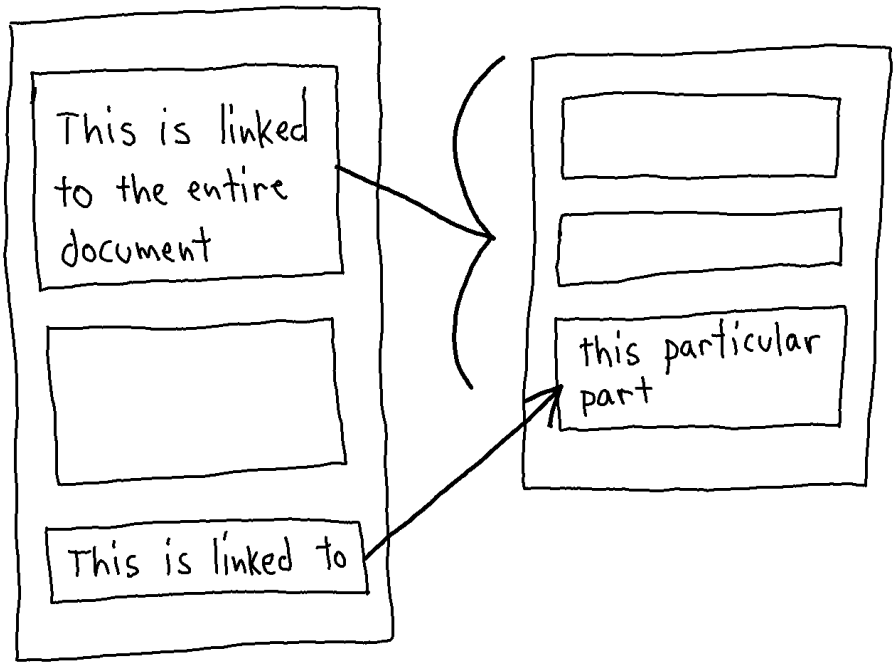


Model of transclusions, allowing content items to exist in multiple documents

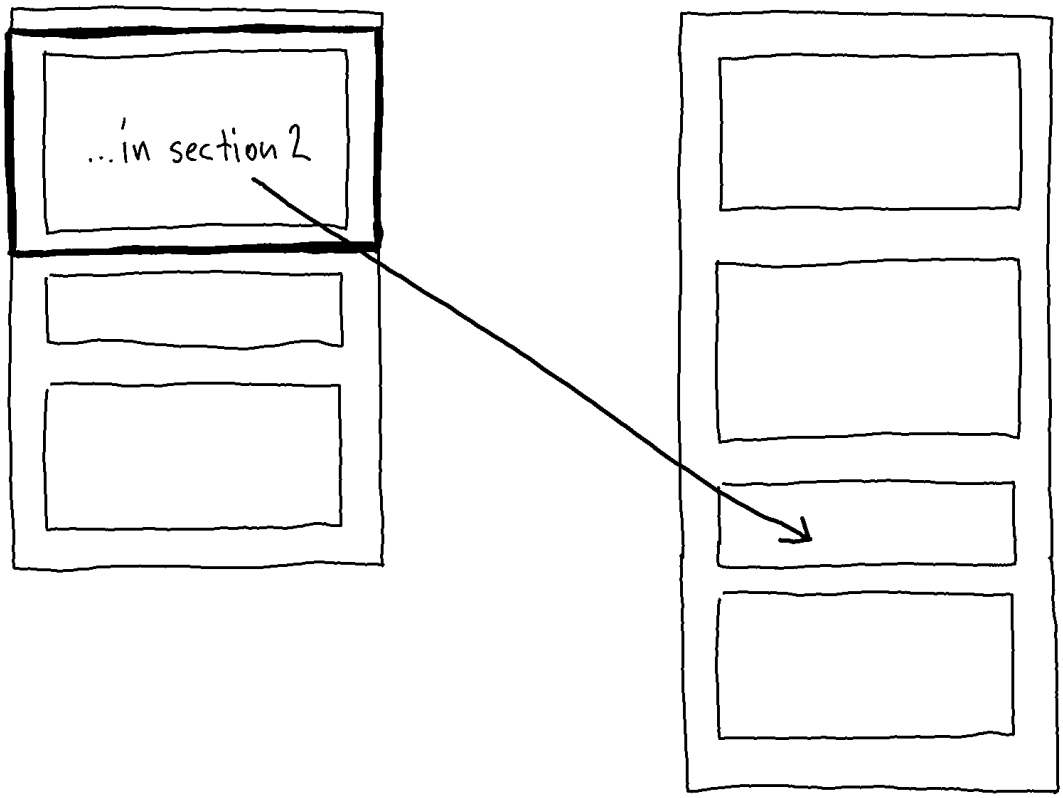
Different document versions will have shared content items, which are also transclusions. Content that is by convention inserted between quotation marks or in a block quote, for example, is a *form* of transclusion. Transclusions also include connections that exist between content transiting between different versions. The image below shows two different drafts and a document with reference material.



Both link types were developed with the capacity to point to an entire document or a particular part of a document.

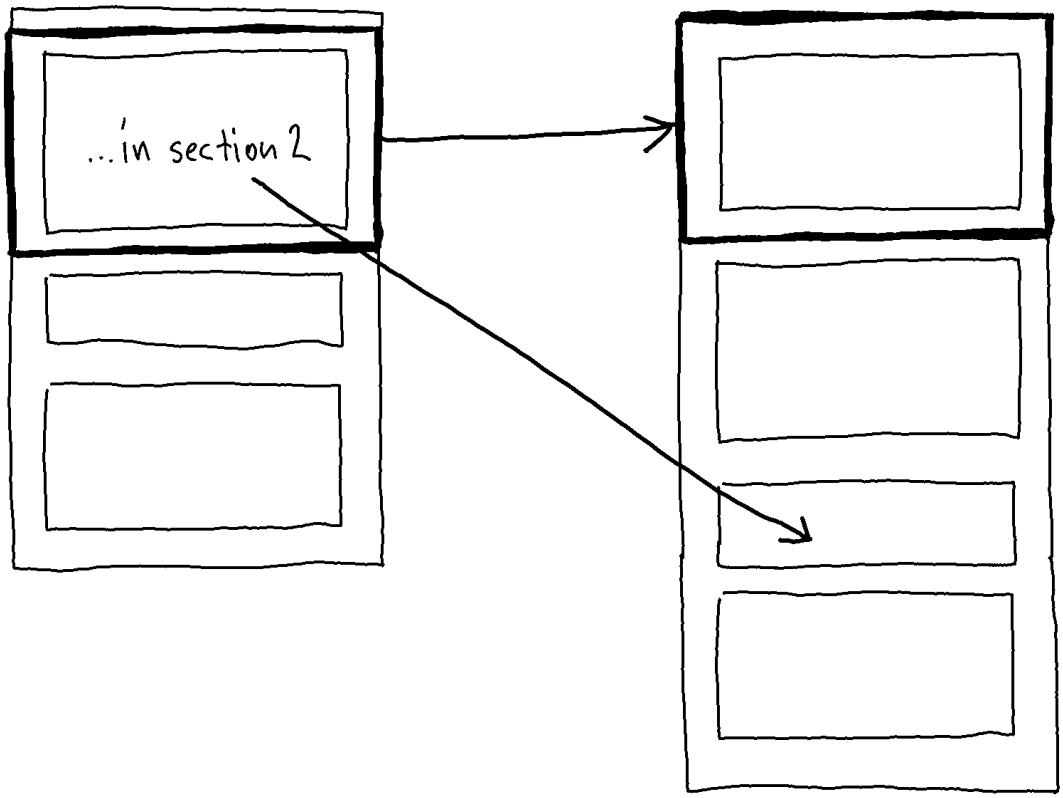


In contrast, on the web, it is only possible to create links at the document level (i.e., at the webpage level). Even if a sentence refers to a particular part, it is not possible to link directly to it.



Model of a sentence referring to a particular part of another webpage

Selecting a link, therefore, results in blindly landing on the top of a webpage.



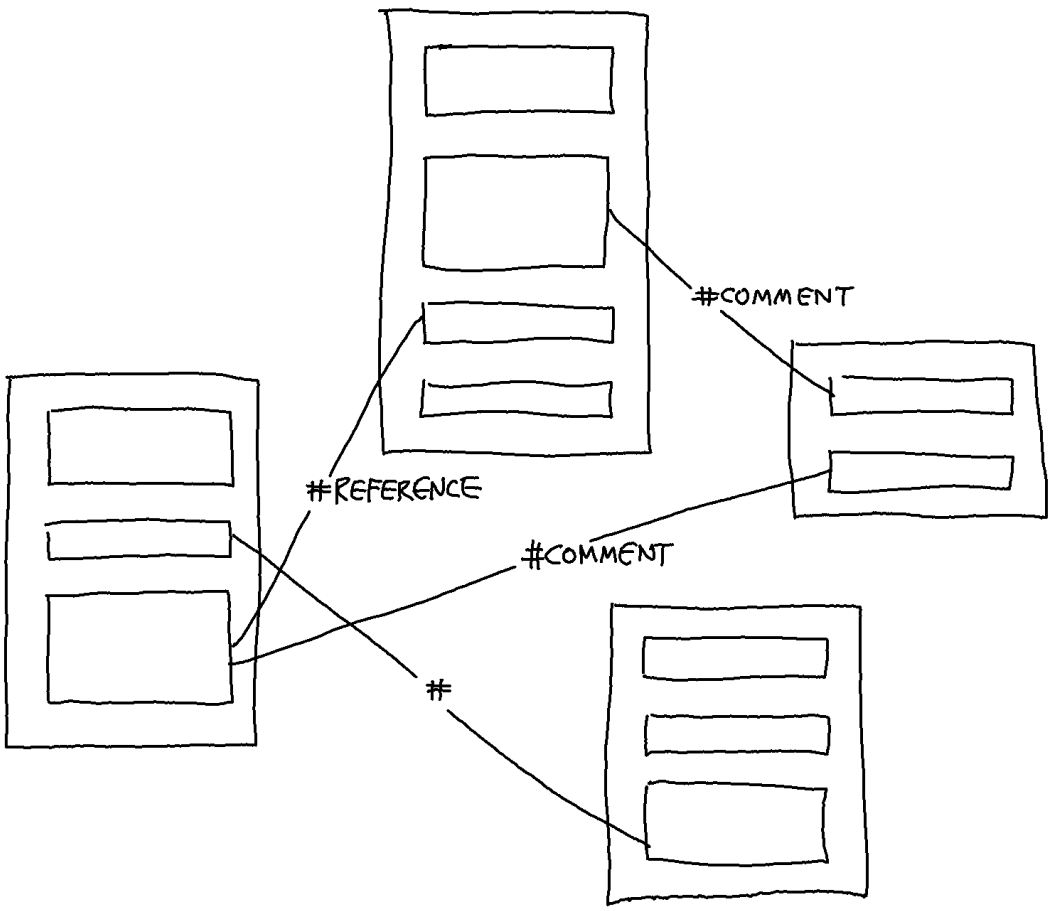
Model of selecting a link and landing on the top of another webpage

At this stage, the prototype had two link types.

Prototype with two link types: transclusions (dashed lines) and non-transclusions (solid lines)

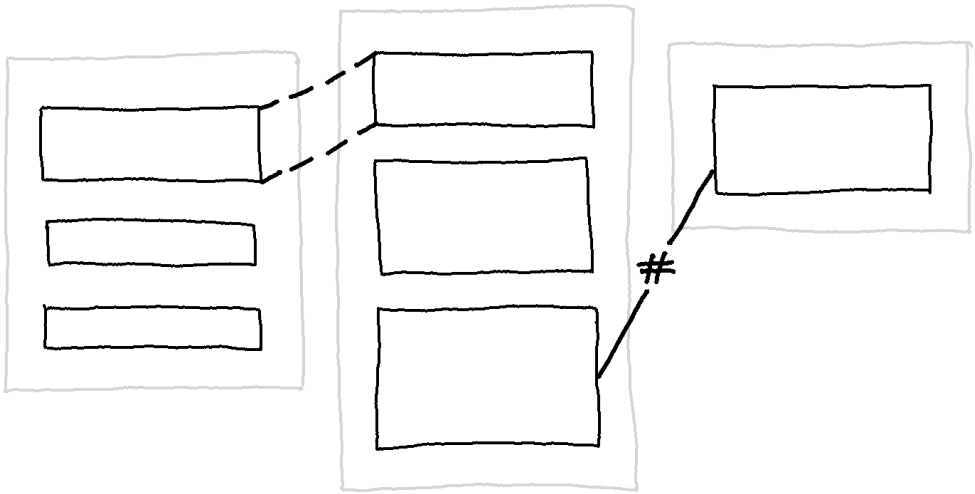
Alteration to Non-Transclusion Type Links

The type of connections that are not transclusions could be further subcategorized, for example, as a comment, reference, tangent, definition, a lateral line of thought, or an opposing view.



Model of subcategorized non-transclusions

Instead of developing link types for every potential type of connection that is not transclusion, one link type (called taglink) was developed to accommodate them all.



Model of two link types: transclusion and taglink

Utilizing the common usage of hashtags, taglinks offer a way to describe the connection by attaching a label, enabling a grouping mechanism and the capability to filter to view a subset of the document collection based on any taxonomy.

Filtering Documents and Links

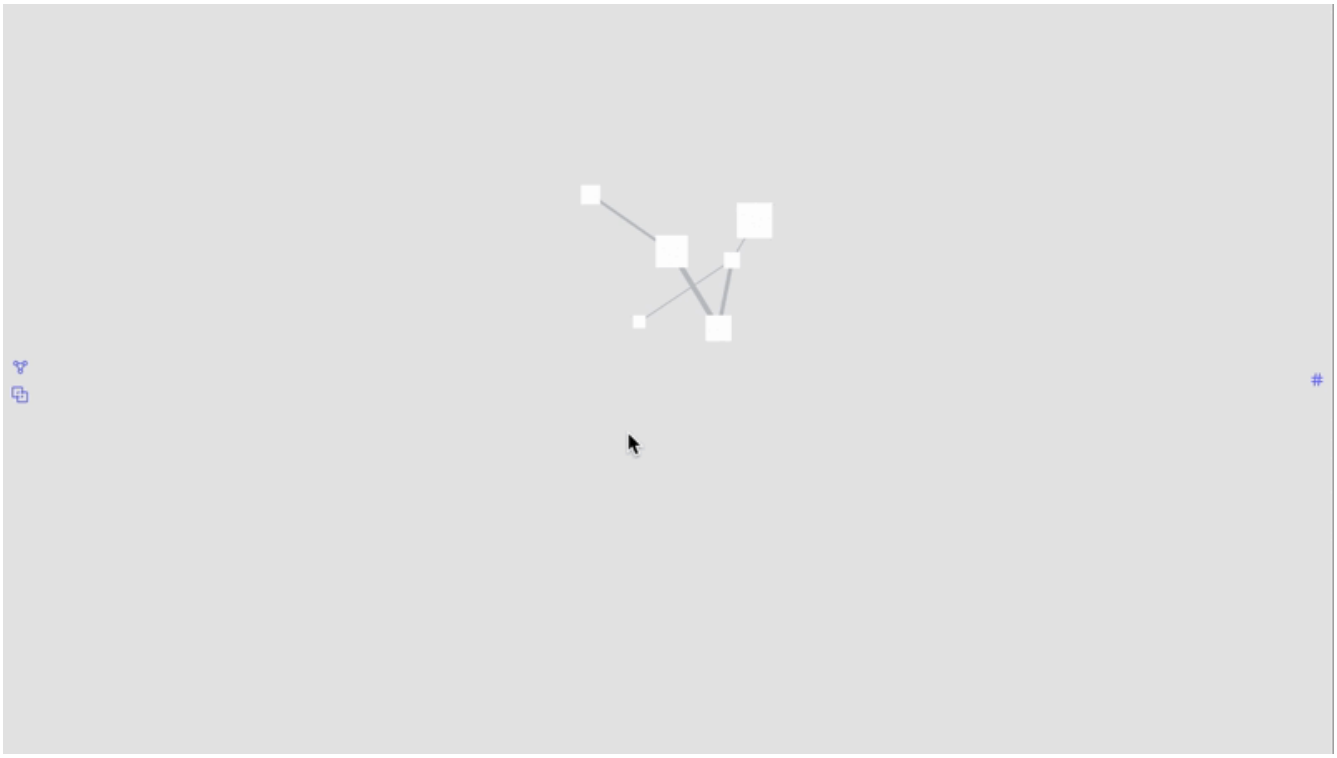
At this stage, links and documents could be filtered in a side menu (seen in the demo below).

Go to video

Filtering in a side menu

Filtering by right-clicking directly on the links and selecting a taglink label (seen in the demo below) was also possible.

Go to video

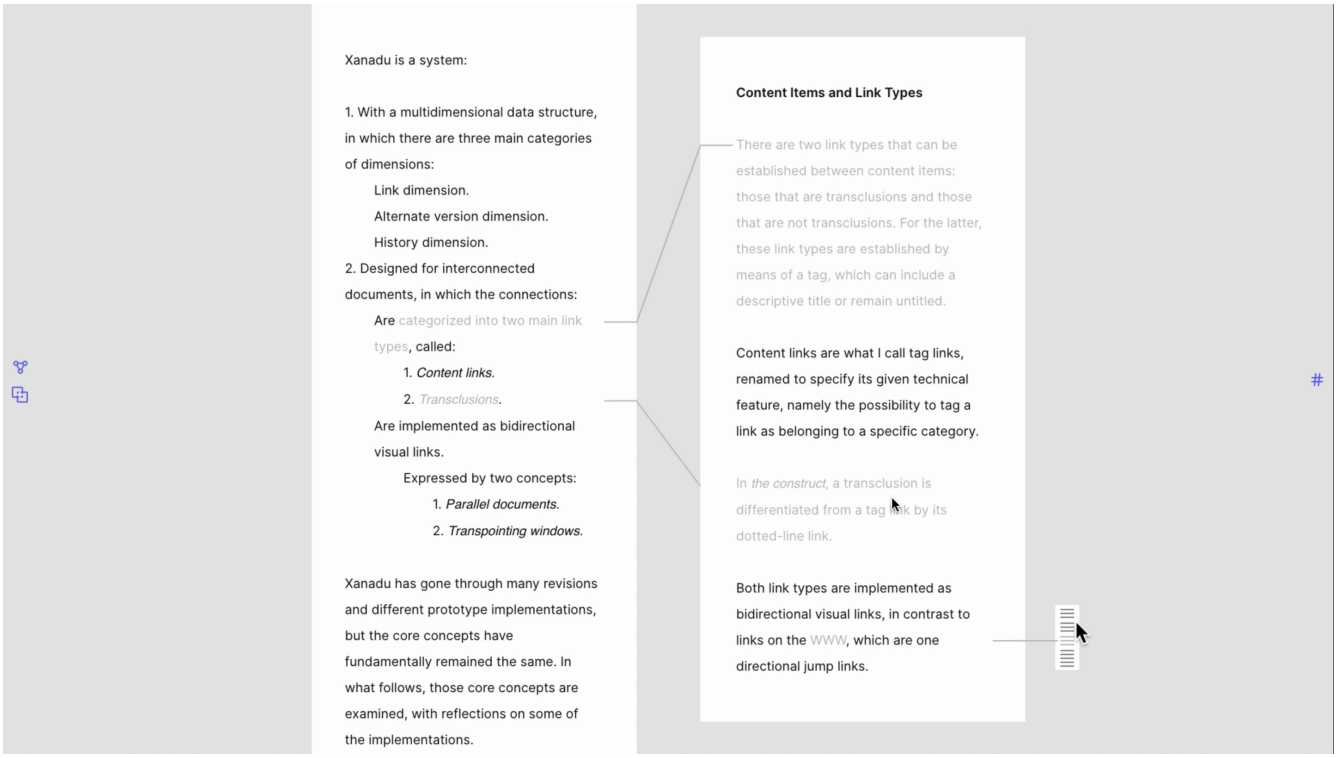


Filtering by selecting a taglink label

Representing Linked Documents as Aliases

At this stage, there are two main issues with the prototype. One issue was the visual incoherency of the crisscrossing lines, not offering much information about the connection for easy access. The other issue

had to do with how linked documents are represented as icons (seen in the image below), not providing a preview of the link endpoint.



Prototype showing linked document as a preview icon

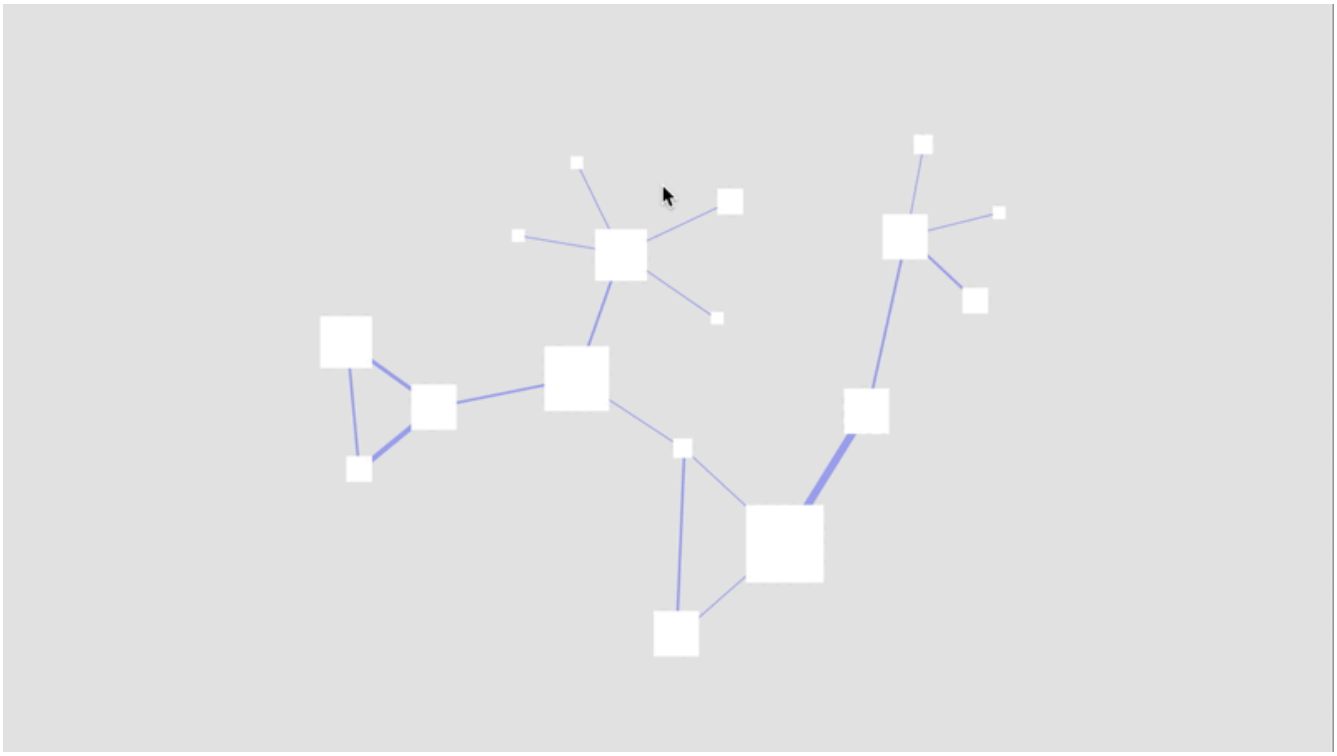
Another representation of linked documents was explored: visualizing linked documents as aliases.

Model of opening a document (2) with linked documents represented as aliases (1,3)

The image above shows single links between 1 and 3 and between 1 and 2. Between 2 and 3, there are two links. Selecting document 2 results in document 3 spawning into two aliases on the side of 2.

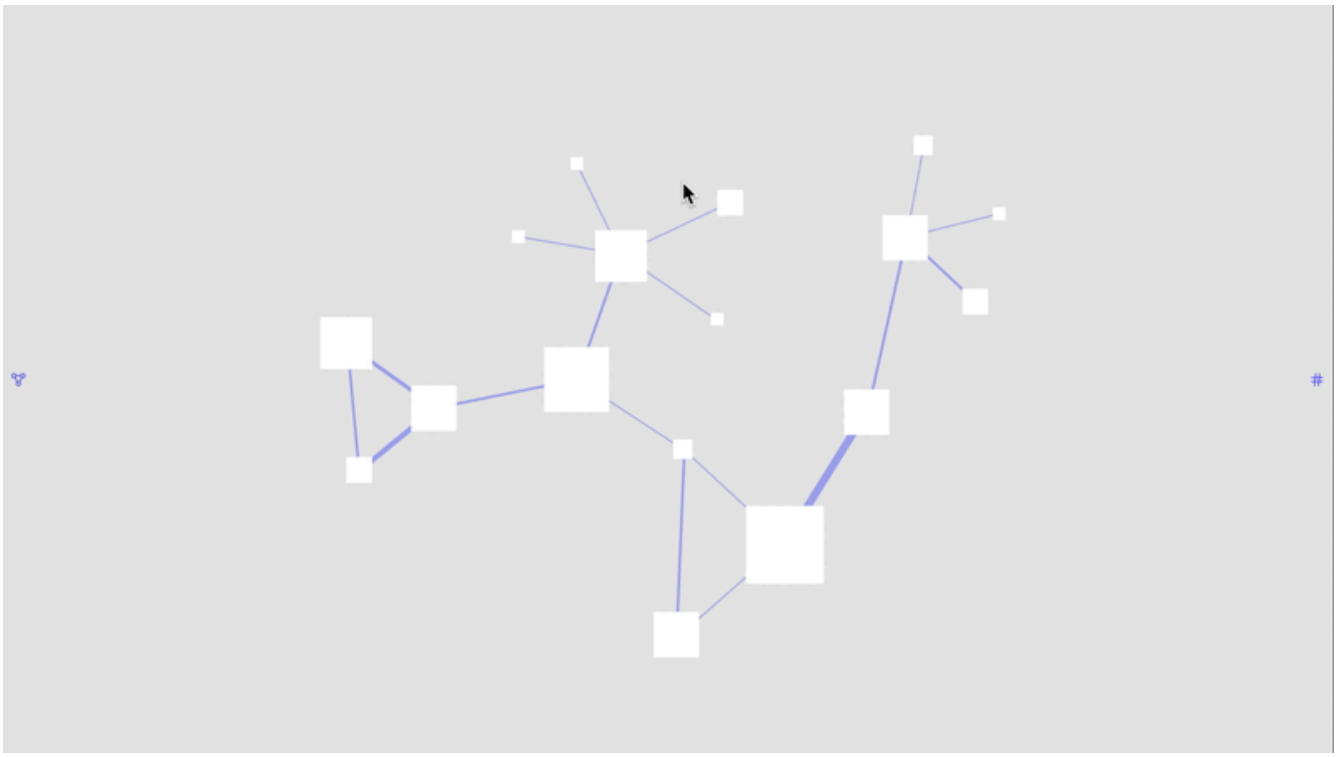
As seen in the two demos below, an animation showing a document splitting into two was implemented to indicate multiple aliases of the same document.

Go to video



Demo of opening a document with linked documents splitting into aliases (version 1)

Go to video



Demo of opening a document with linked documents splitting into aliases (version 2)

Discarding the crisscrossing lines, Zoomed-In View was redesigned based on the diagrammatic visual language of concept maps, such that the taglink label is shown when the cursor hovers a linked document (seen in the demo below).

Go to video

Zoomed-In View: Hovering linked documents shows the taglink label

Applying a Diagrammatic Visual Language to Convey the Link Direction and Link Endpoint

To convey further information about a connection, the link direction and endpoint were also applied through a diagrammatic visual language.

Link direction denotes whether:

1. a connection is established *to* a document, or
2. *from* a document.

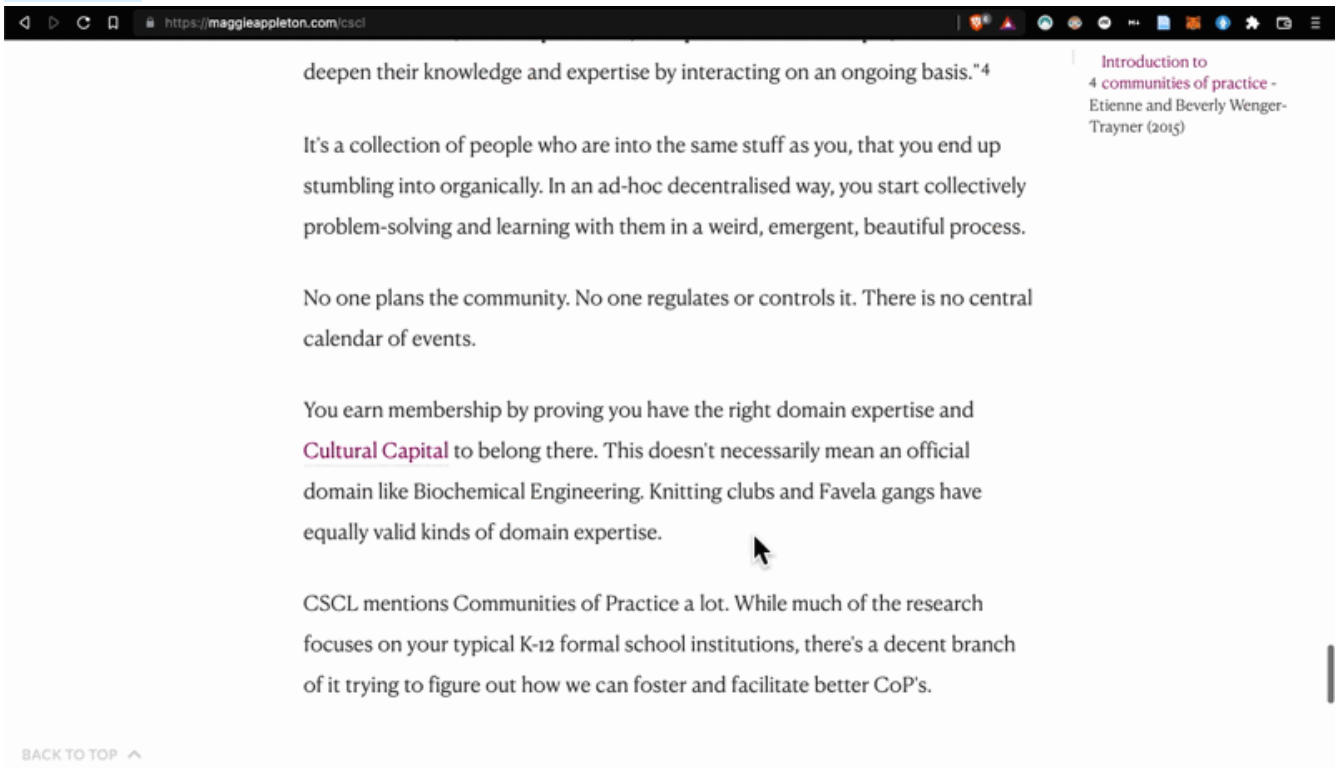
Link endpoints denotes whether there is a connection to:

1. an entire document or
2. a part of a document.

Most common on the web are one-directional links pointing *to* another (external) website or (internal) webpage. Since links do not indicate the destination, once it has been selected, the only way to retrieve the original webpage is to select the back button in the browser to navigate back.

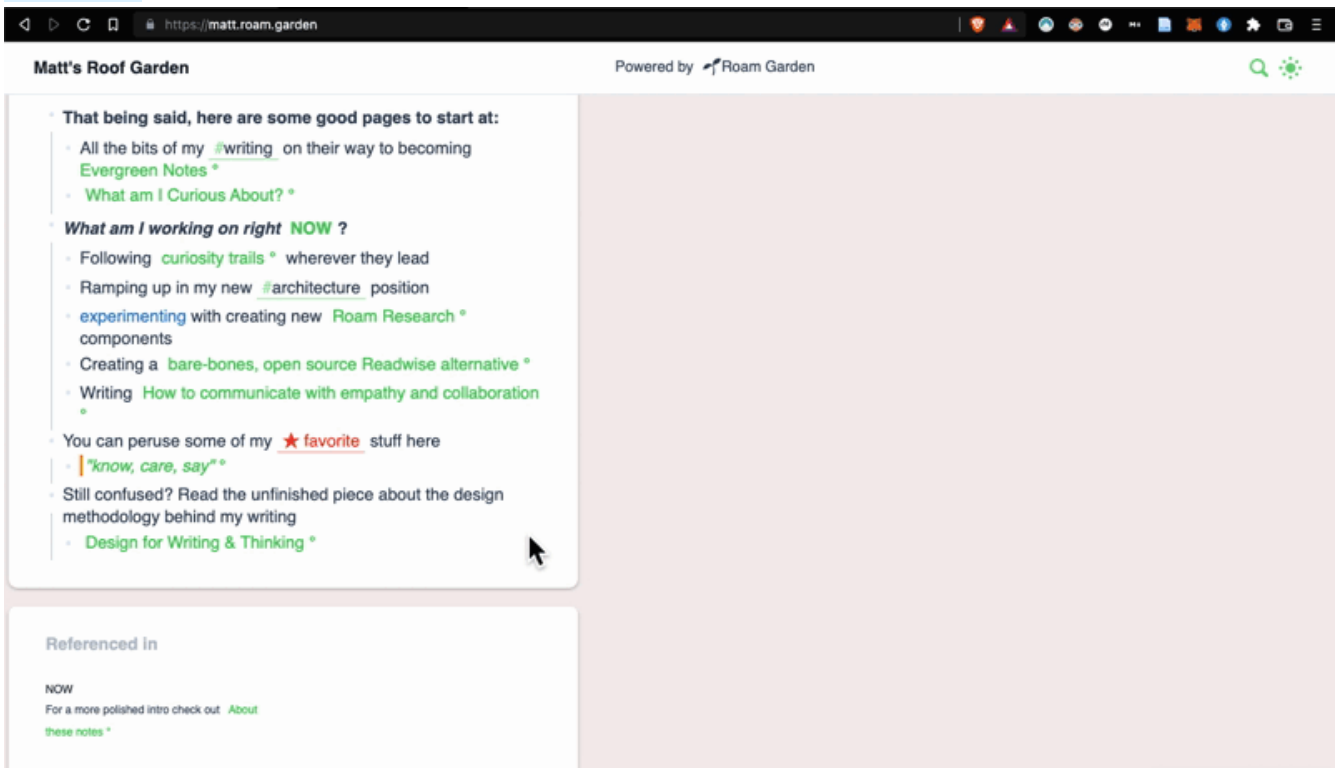
Less common are backlinks, often implemented in what is called digital gardens. *Backlinks* are links that point *from* another document. If *Document A* contains a link to *Document B*, then *Document B* contains a backlink to *Document A*. Roam Research is known for popularizing backlinks, and others like Notion have followed suit. Usually, backlinks are presented in a list and commonly at the bottom, as seen in the three following images.

Go to video



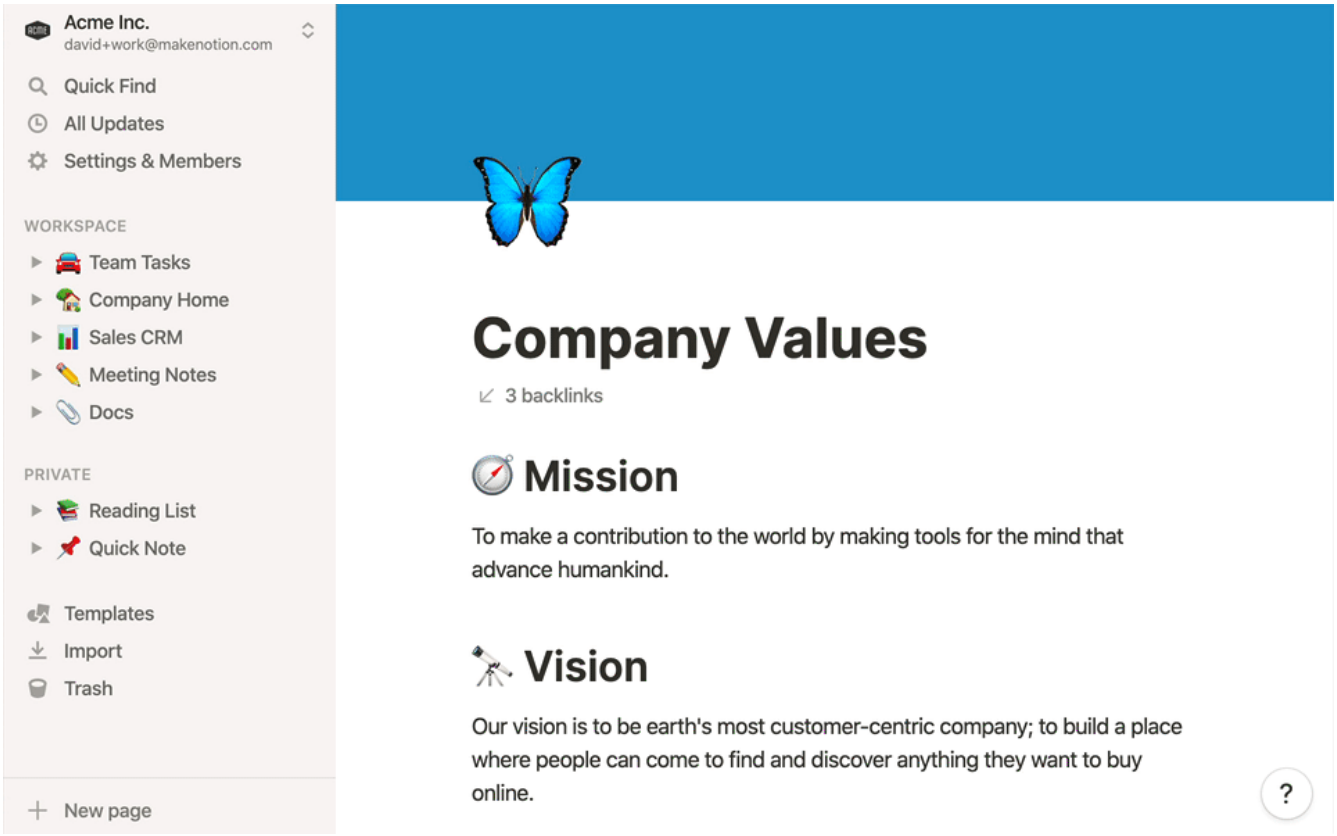
In the example above, selecting a backlink results in instantly *landing on a page*. In the example below, selecting backlinks results in the document opening on the side, enabling a comparison of the two linked documents without leaving the document.

Go to video



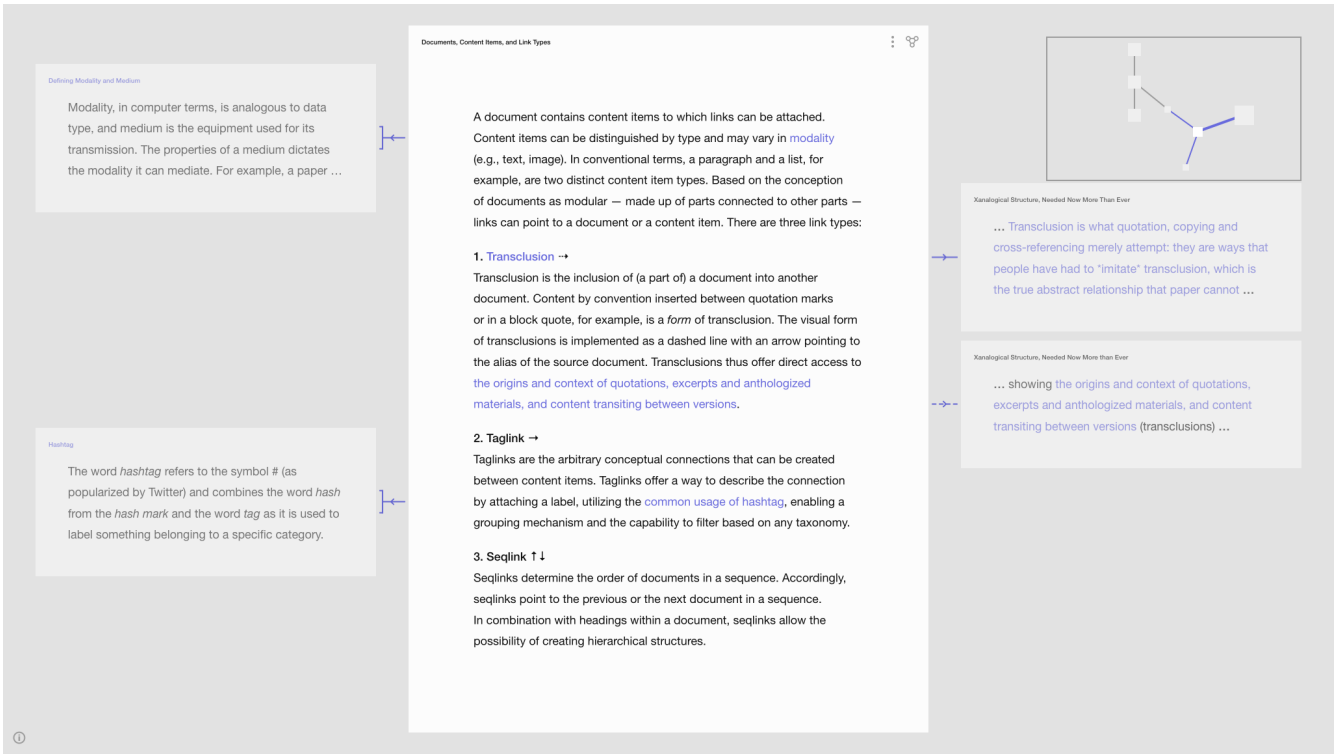
In Notion, backlinks are hidden in a list that only expands upon deliberate action. Additionally, the list is underneath the title, not at the bottom.

Go to video



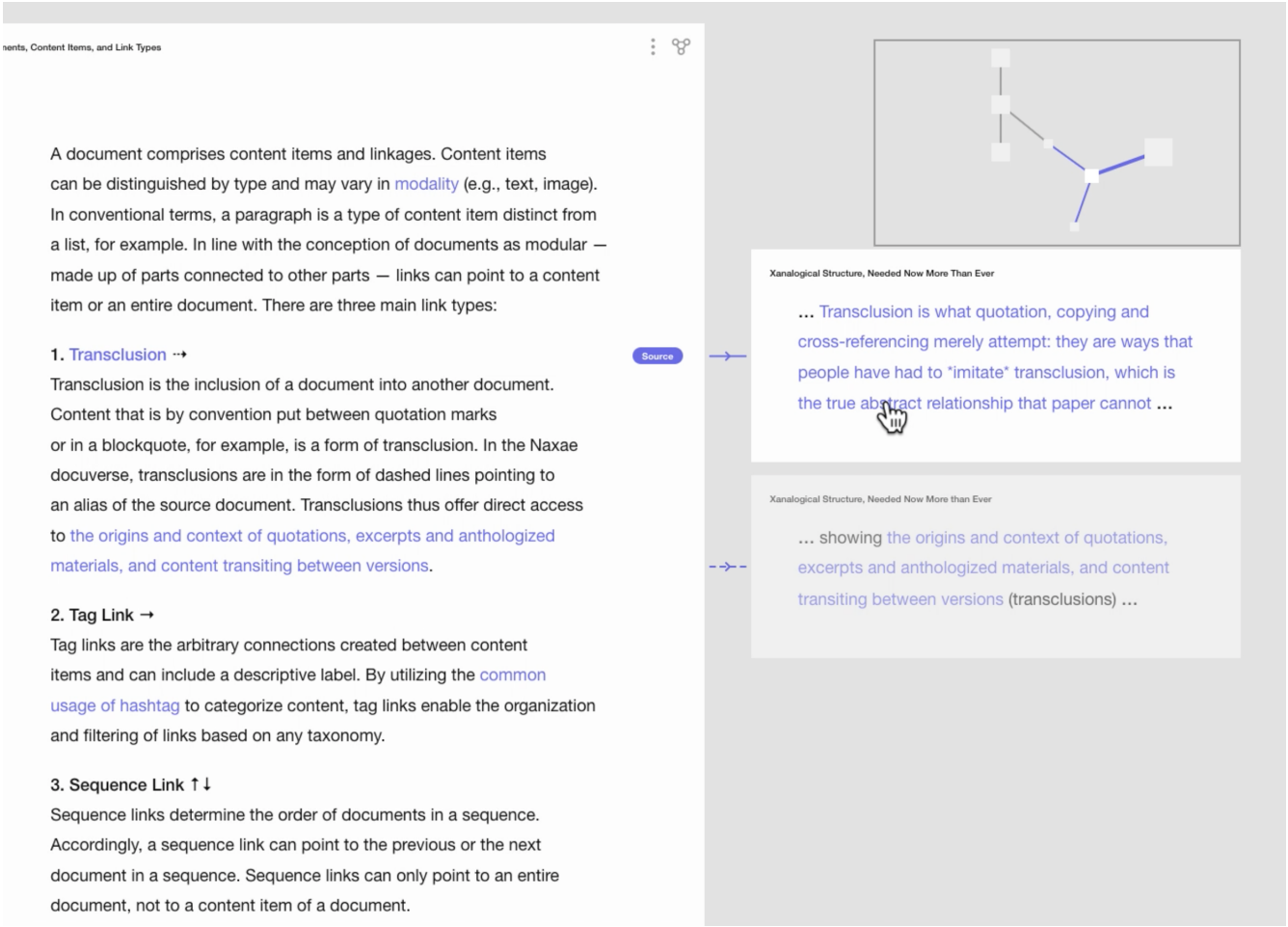
In all these examples, links pointing outward are inline hyperlinks. Links pointing inward are in a separate list, which means that the backlinks do not make available where exactly the document has been mentioned (the link endpoint) nor how many times.

In Nexae, outward and inward links are not separated; both are inline, with the arrow symbol indicating the link direction. Additionally, because links can be attached at the content item level, unlike backlinks, the endpoint of a link provides direct access to the particular part of a document.



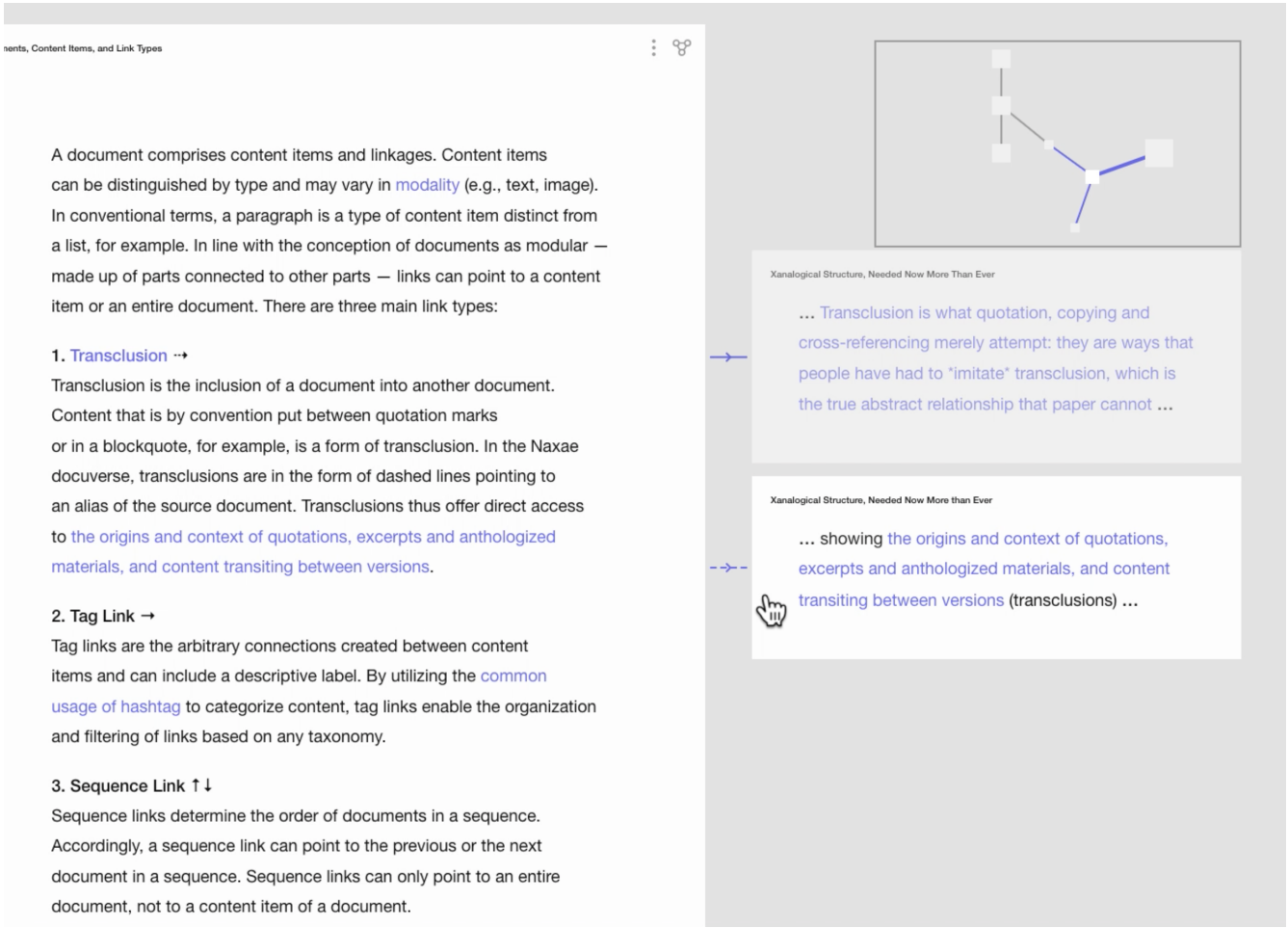
Zoomed-In View (with a location frame of Zoomed-Out View in the upper-right corner)

An arrow symbol indicates the link direction. A line with a bracket indicates that the link points to the entire document, and a line without a bracket indicates it points to a particular part, and that particular part is shown in the alias window. For example, in the image below, a taglink connects the term *transclusion* to a document in which it is defined, which is appropriately labeled *source*.



Example of a taglink in Nexae

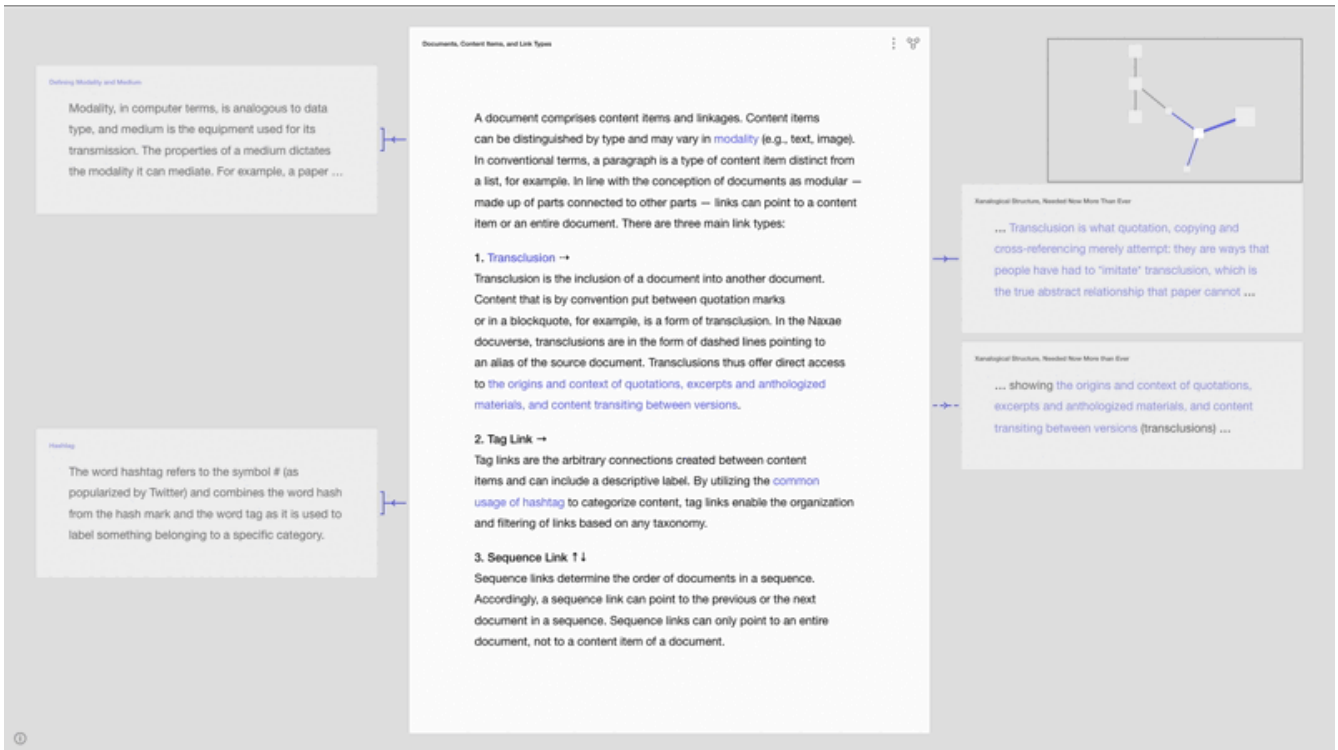
And in the image below is a transclusion type link showing the original context of the reused sentence fragment.



Example of transclusion in Nexae

Because all links are bidirectional, selecting an alias to access the original context means that it also links back (as seen in the demo below).

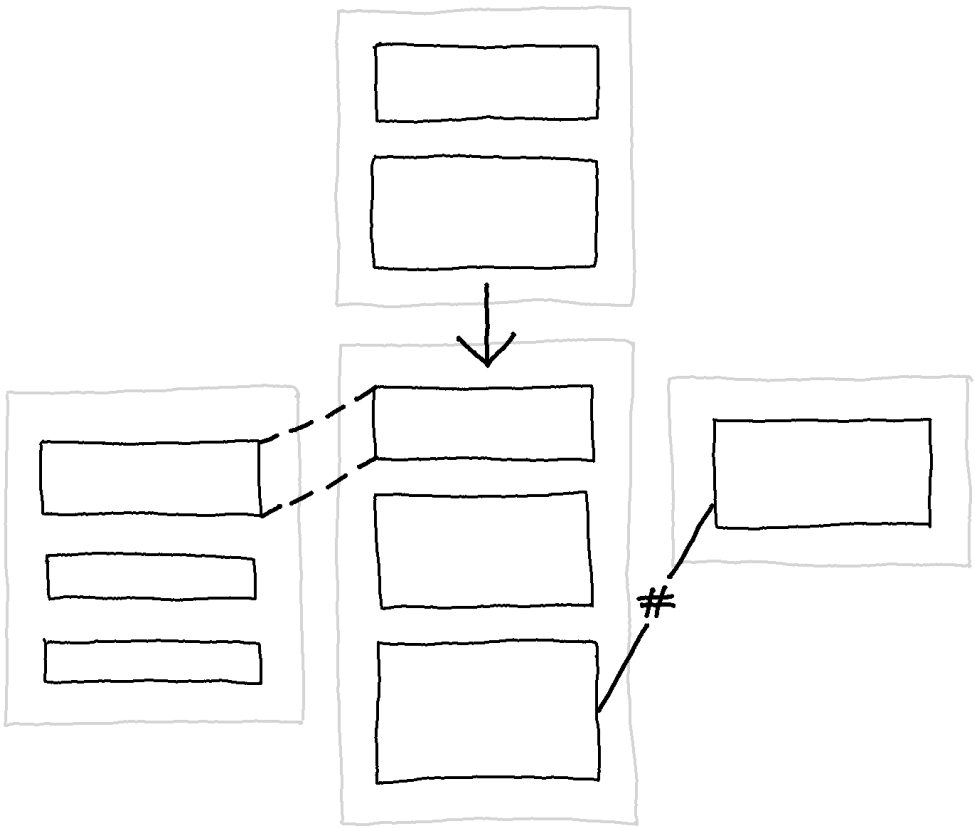
Go to video



Traversing by selecting a transclusion

A Third Link Type: Seqlink

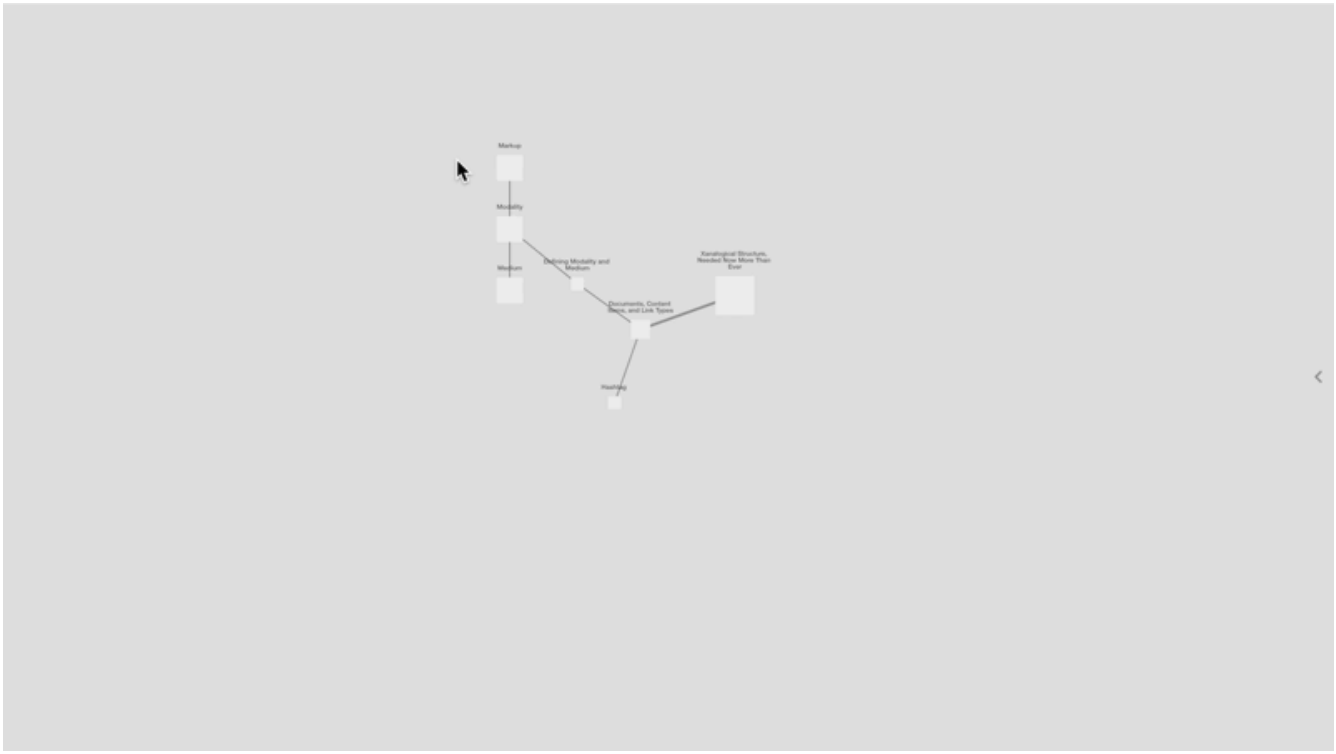
At this stage, sequences of content items within documents can be nested to create a hierarchical structure. However, the two link types (transclusion and taglink) do not offer a way to set a sequence at the document level. To that end, another link type was developed (seqlinks), enabling establishing the order of documents in a sequence.



Model of the three link types: transclusion, taglink, and seqlink

Determining the order of documents in a sequence, seqlinks accordingly point to the previous or the next document in a sequence. In combination with headings within a document, seqlinks allow the possibility of creating hierarchical structures. The sequential order of documents (and the possible hierarchical order of content items within a document) co-exists with the order offered by the other two link types. Seqlinks also enables the arrangement of the node-link structure (in Zoomed-Out View) to show the intended sequential order of documents (seen in the demo below).

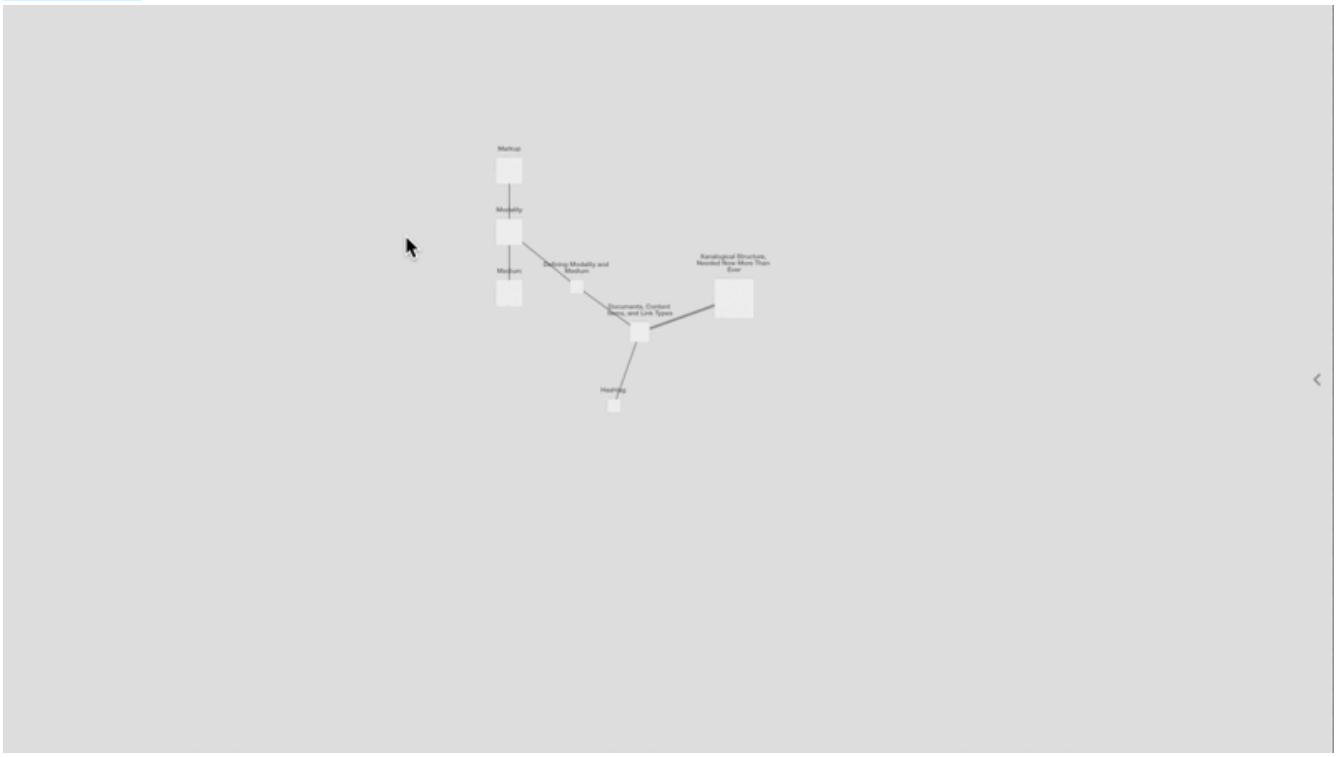
Go to video



Zoomed-Out View, node-link structure arranged according to seqlinks

While in Zoomed-In View, it is possible to traverse documents by selecting seqlinks, as seen in the demo below. The location frame (in the upper right corner) shows which document is currently open (including linked documents as active links) in that sequence.

Go to video



Traversing documents by selecting seqlinks

Current State of the Prototype

In the current state of the prototype, there are three link types and two view modes in which it is possible to filter documents and links.

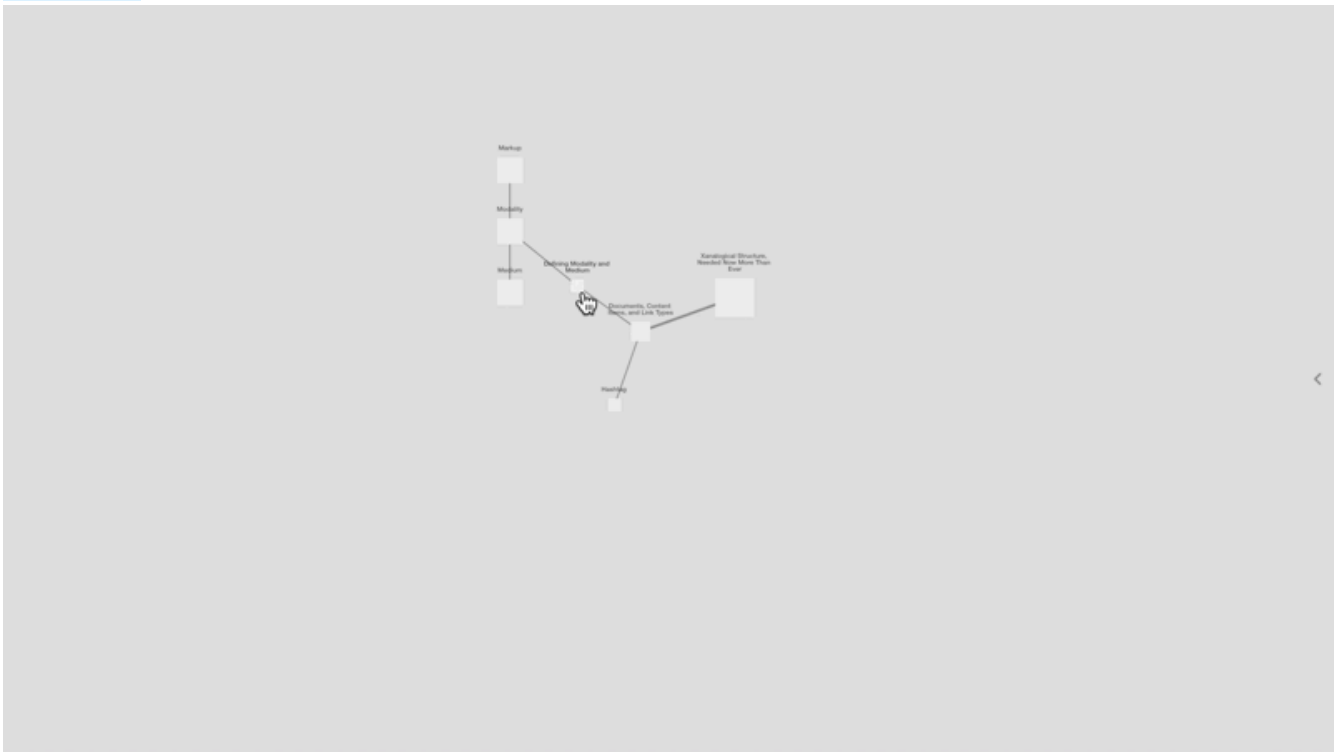
Three Link Types: Transclusions, Taglinks, and Seqlinks

All links are implemented through a diagrammatic visual language, specifically lines with arrow symbols to denote the direction, and taglinks and transclusions have alias windows showing the linked document. To convey further information about a connection, beyond the three link types, there are two link directions and two link endpoints, also conveyed through a diagrammatical visual language. The direction of a link is indicated by an arrow symbol. The link endpoints describe whether there is a connection to an entire document or a part of a document, providing direct access to that particular part. A bracketed line indicates that the link is attached to the entire document; an unbracketed line indicates that the link is attached to a particular content item within the document.

Switching View Modes

Switching view modes involves transition animations suggesting the movement of zooming in and out on documents. Switching from Zoomed-Out View to Zoomed-In View is done by opening a document, equivalent to zooming in on a document.

Go to video



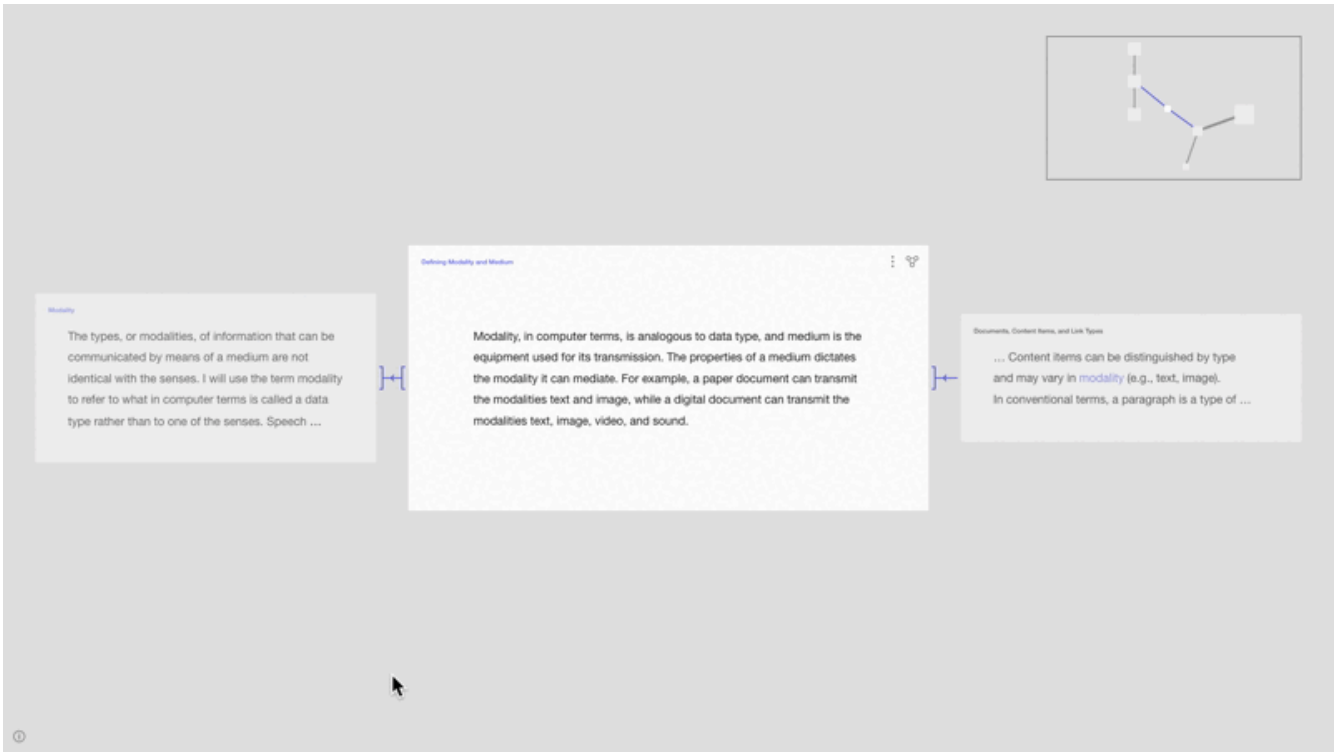
In Zoomed-In View, the selected document is viewed in more detail, conveying information about the type of connections to/from that document.

Traversing Documents

While in Zoomed-In View (i.e., having opened a document), opening a linked document by selecting one of its aliases also brings about a transition animation (seen in the demo below). Additionally, a location frame shows the open document as an active node seen through the perspective of Zoomed-Out View (in

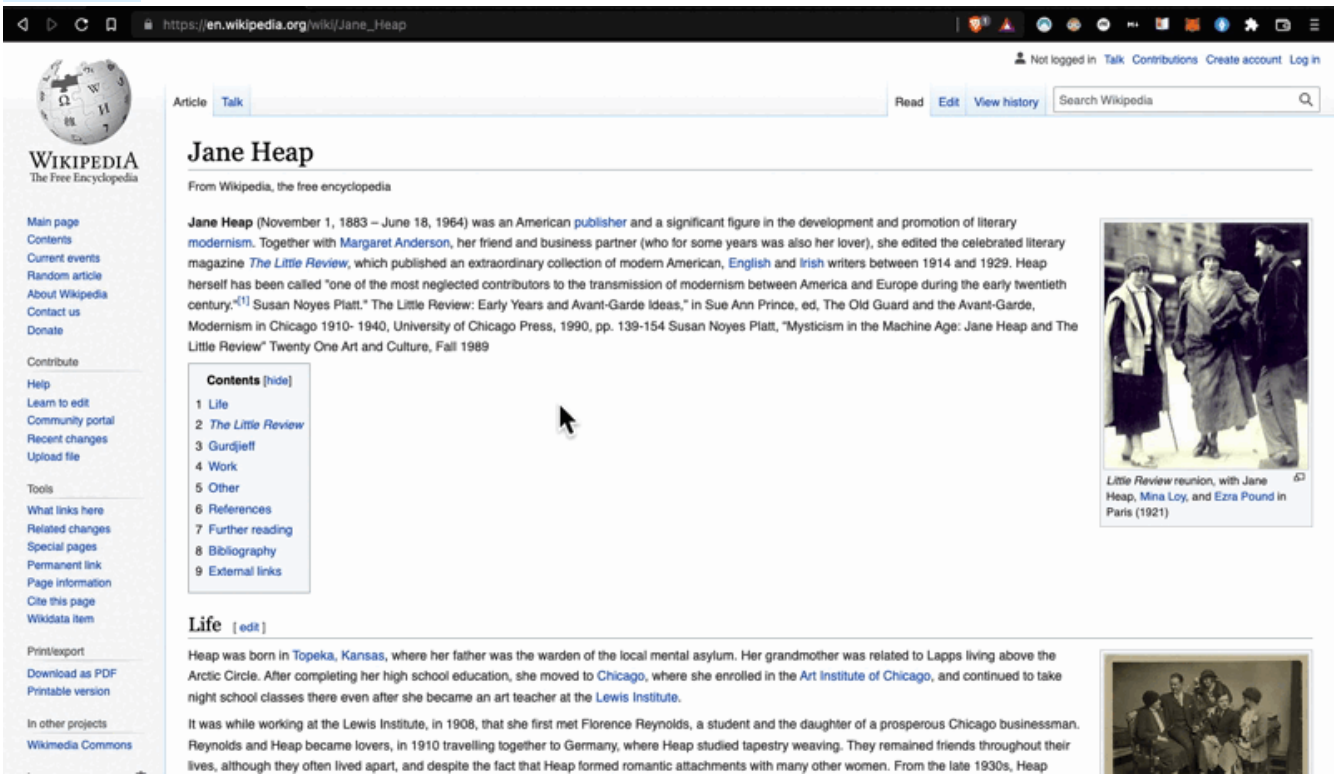
the upper-right corner). The location frame, originating with cartography, is implemented to support orientation.

Go to video



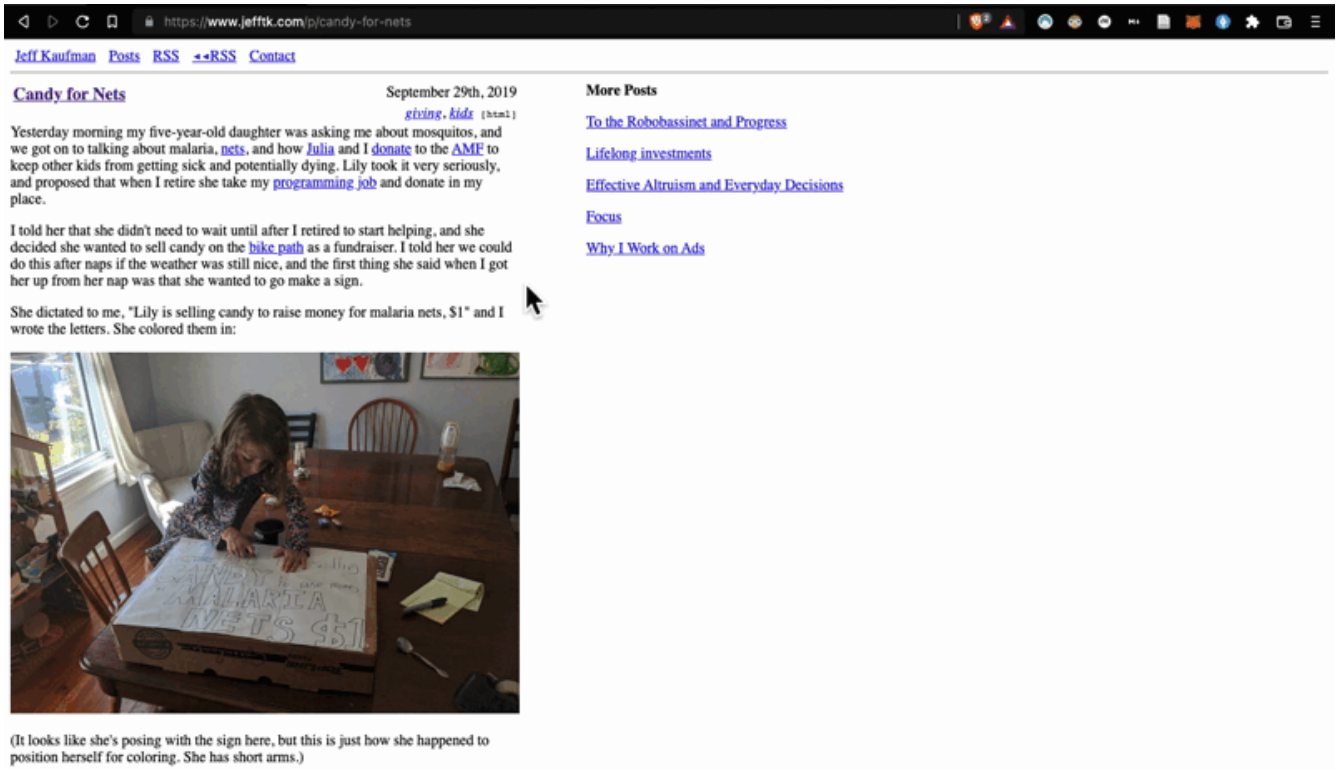
In contrast, opening webpages by selecting hyperlinks occurs instantly (i.e., *landing on a page* without a transition animation) and does not make the destination explicitly apparent. Some implementations on the web attempt to make the destination of links more apparent, such as the preview windows seen in Wikipedia (but only for internal links, i.e., other Wikipedia pages).

Go to video



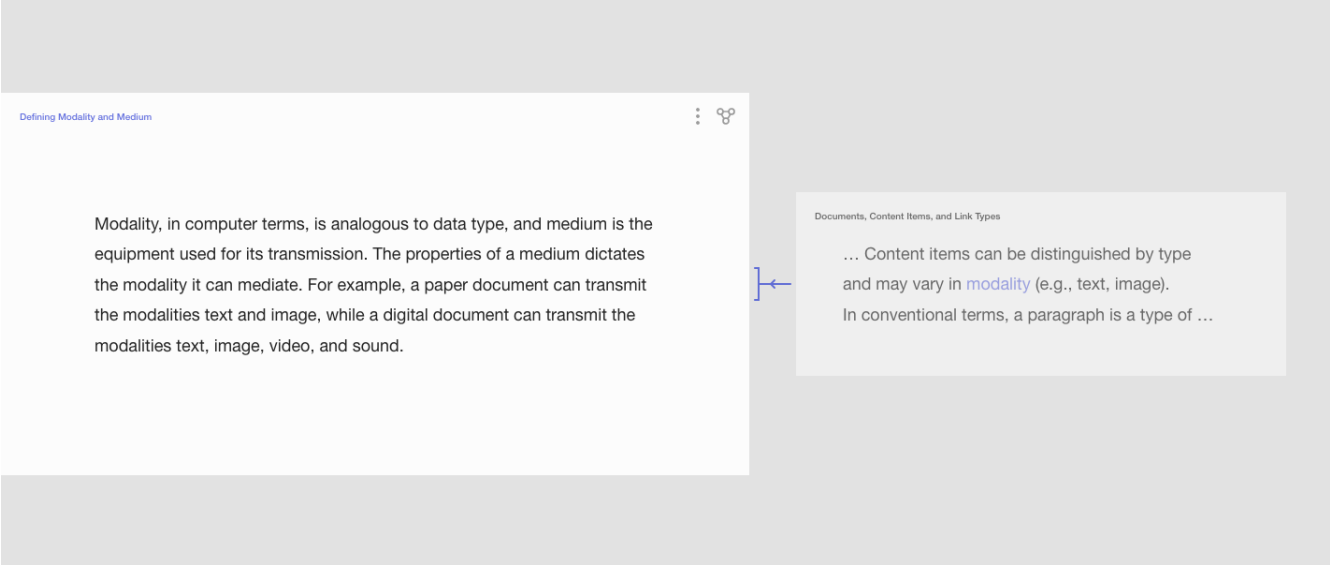
These windows support quick decision-making for opening a link based on whether it is relevant content. However, these preview windows pop up and overlap the content, demanding attention and requiring deliberate action to get a glimpse. To circumvent these issues, Jeff Kaufman implemented preview windows so that they appear in a side panel rather than on top of the content.

Go to video



In Nexae, linked documents are idle aliases that are always visible (unless hidden by filtering links and documents). Additionally, the preview windows in the examples above only show the top part of the linked webpage, not indicating whether the connection points to a particular part.

In Nexae, links can be attached on the document level but also at the content item level. Aliases can therefore bring into view the particular content item to/from which the open document is linked. The visual form of the link additionally aids in conveying whether the connection points to the entire document or a part of the document. As seen in the image below, a bracketed line indicates that it is attached to the entire document. An unbracketed line indicates that it is linked to a particular content item within the document (in which case, the linked content item is shown in purple).

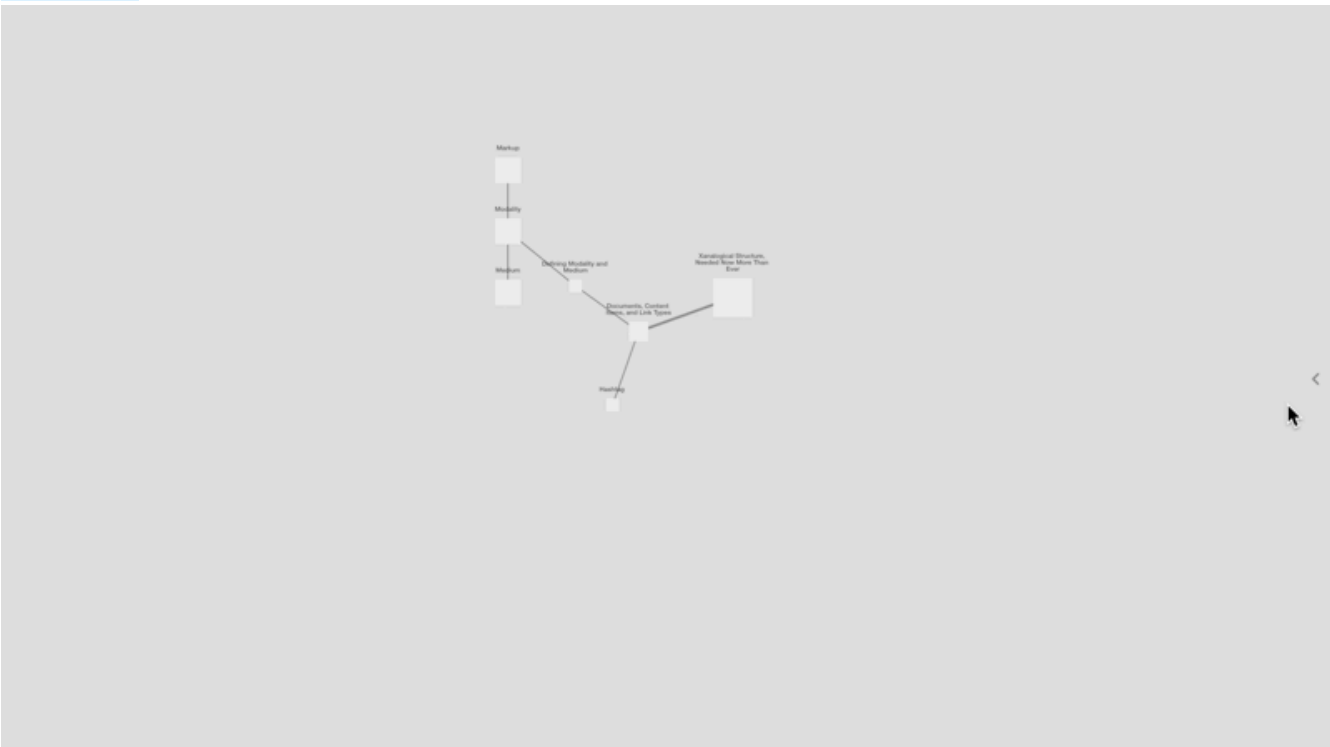


The means of visually distinguishing different categories of information is by convention done typographically. The main text has a large font size, and additional information, such as footnotes, has a small font size, implying a hierarchical relationship. In Nexae, information categories are assigned through the three link types, not a predefined hierarchical structure. So information that is by convention embedded as footnotes would be in separate documents to which metadata can be attached and a taglink label that describes the content and the connection(s). There is no implicit hierarchy, and through filtering, it is possible to view a subcategory of the additional information.

Filtering Documents and Links

Both documents and links can be filtered (based on metadata) so that only a subset of the document collection is shown.

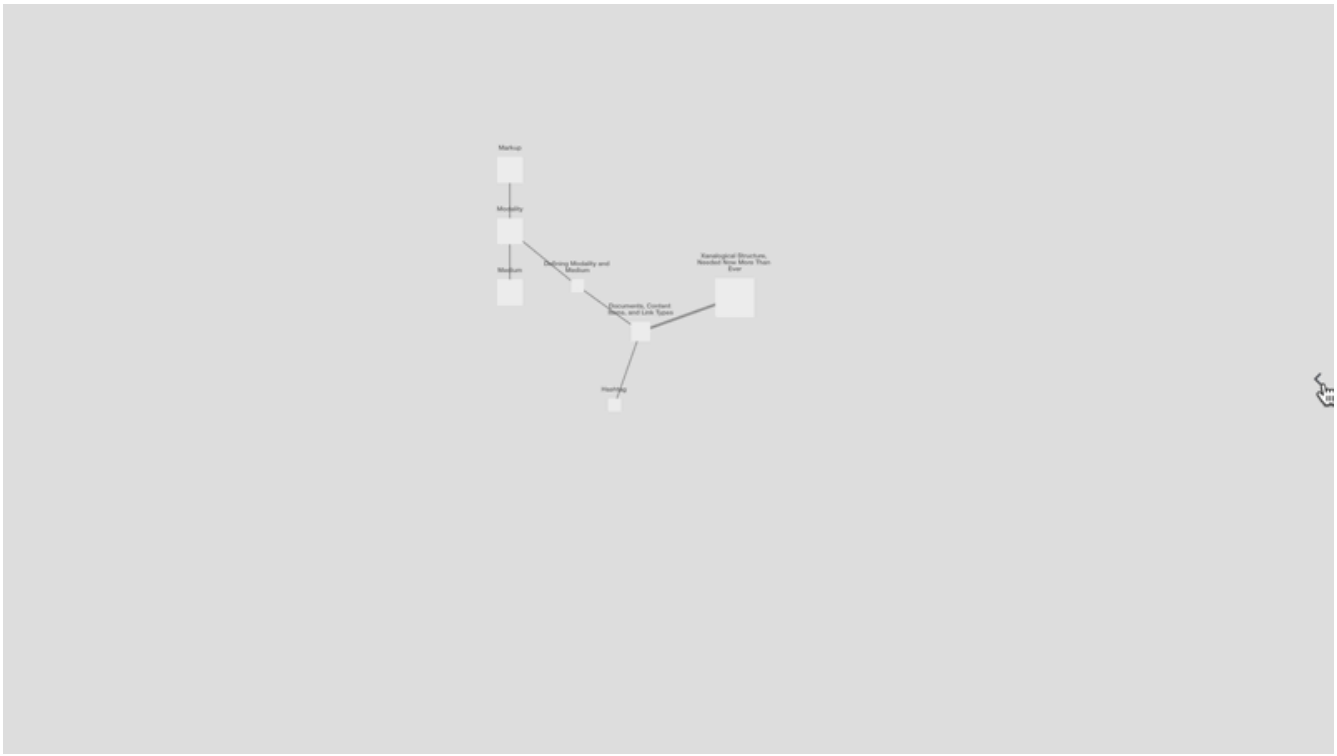
Go to video



Filtering by documents by author and links by taglink label

It may be useful, for example, to view only documents with the tag `#terminology` (seen in the demo below), or it may be useful to view only transclusions and taglinks labeled `#source`, which ultimately means looking only at connections to content items that are extracted or paraphrased or based on reference material.

Go to video



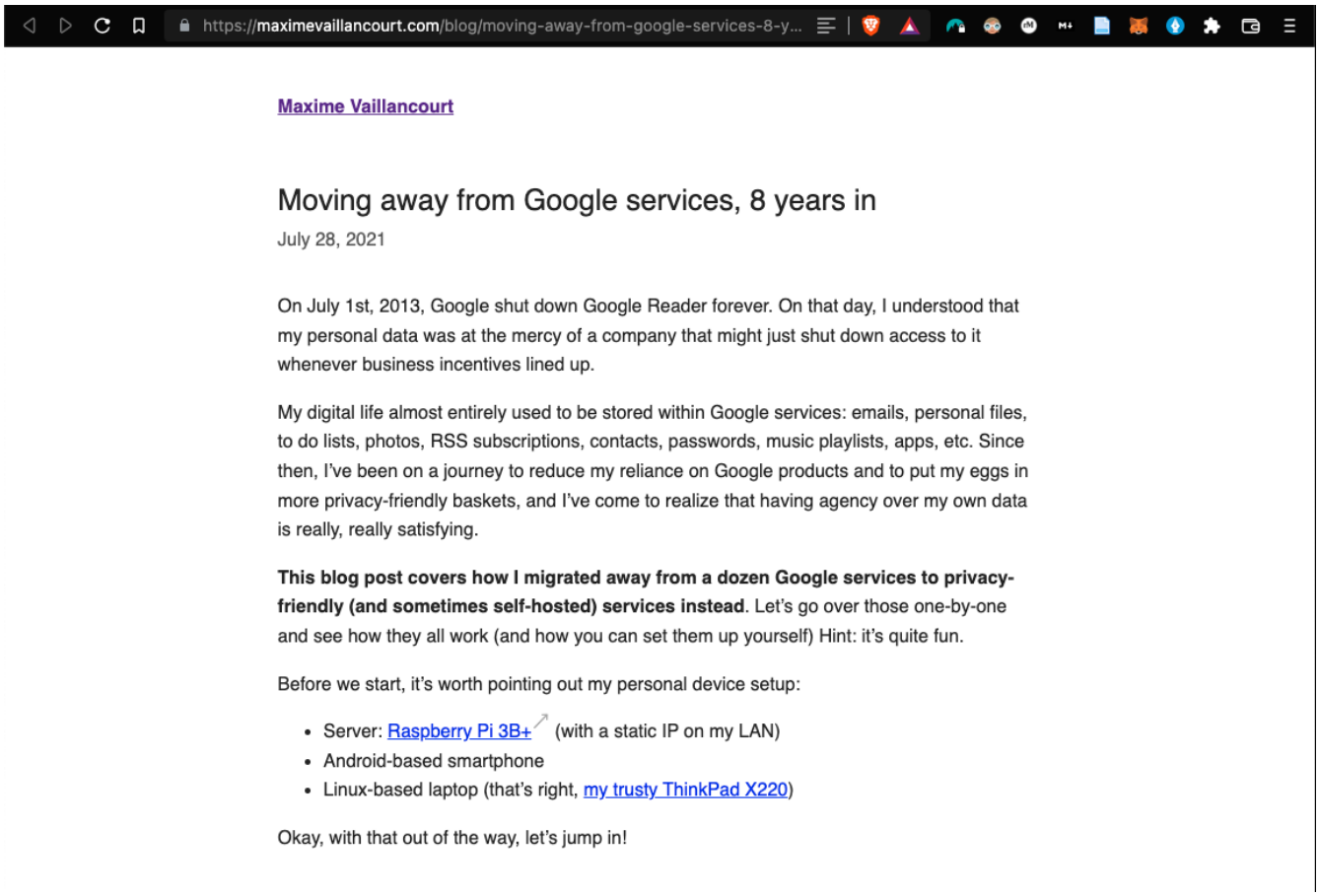
Filtering by documents by author and links by taglink label

System of Internal Links, No External Links

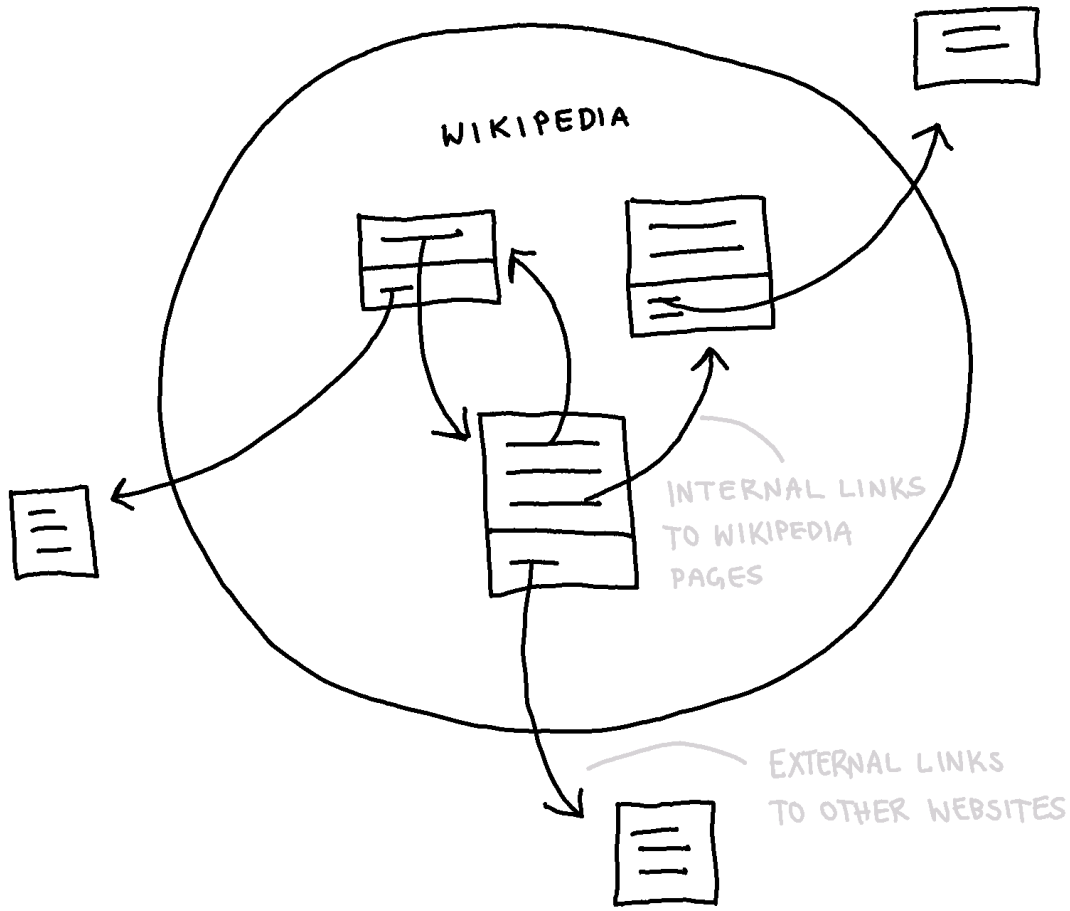
To support the developed concepts and how they interact, Nexae is envisioned as a closed system.

To compare, websites built with wiki structures, such as digital gardens and Wikipedia, are very similar to the encyclopedia by Diderot in that they are semi-closed systems, meaning there is an emphasis on internal links, although establishing external links is possible. In both examples, internal and external links are somehow visually distinguished. In the Wikipedia system, internal links (links to other Wikipedia pages) are implemented as hyperlinks in the main text or panels with other categories of information located on the side of the main text. External links, which can be connections by reference or arbitrary connections, are implemented as footnotes, and the links are located at the bottom of the webpage. Selecting an external link results in leaving Wikipedia, whether that be a link to download a PDF or opening another website in another browser tab.

Digital gardens also contain internal and external links, applied as inline links and commonly visually distinguished. External links are visually distinguished from internal links by the northeast arrow symbol, as seen in the image below.

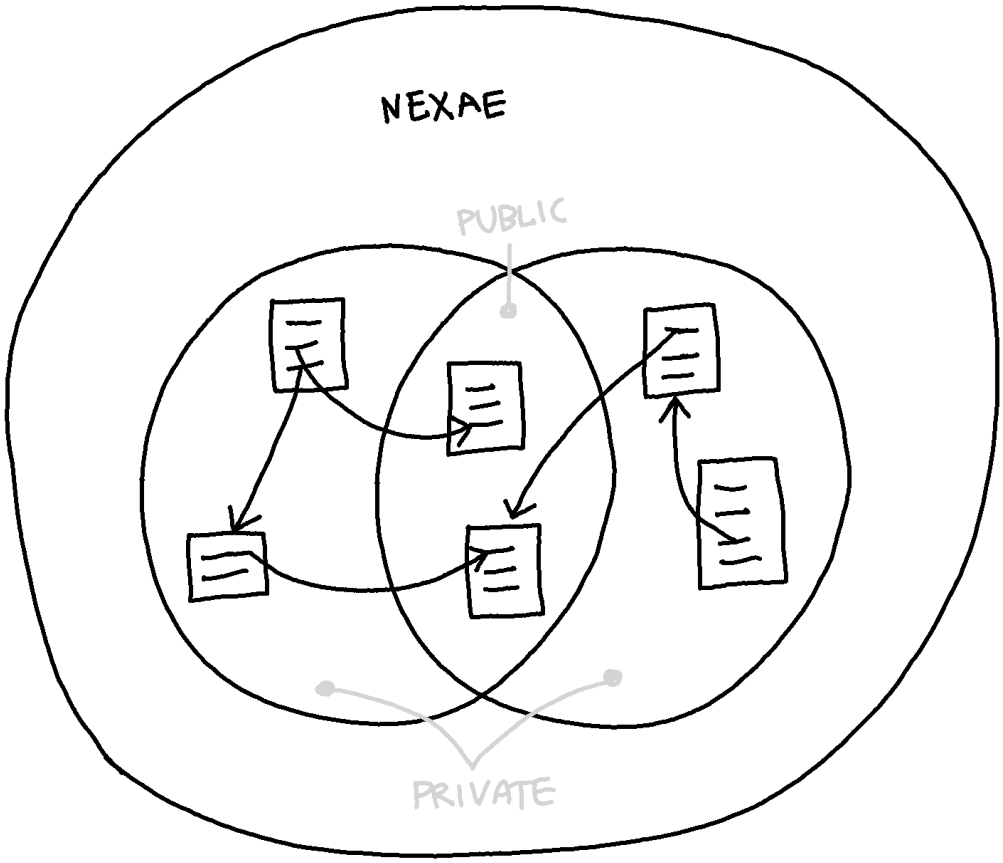


In sum, Wikipedia has two main link types (external and internal), distinguished through layout design.



Model of internal and external link mechanisms in Wikipedia

Nexae has been designed with no external links because, in order to have direct access to a linked document, it must exist in Nexae. Content is added rather than linked to external sources. The only distinction is between private documents (only accessible to the person who added them) and public (accessible to everyone or a selection of people in Nexae).



Model of internal links (that can be private or public) in Nexae

Further developments are proposed in the next entry.

Entry 20 Further Developments

The prototype uses sample content developed throughout the process, serving as an example of how the three link types (taglink, seqlink, and transclusion) can be applied to realize the interconnective structure of documents and how it can be accessed through interaction.

Each taglink has a descriptive label describing the connection between documents. It is possible to select a document in Zoomed-Out View to enter Zoomed-In View and select aliases to traverse linked documents. It is, however, not yet possible to edit or add documents and links. It is possible to filter documents and links in Zoomed-Out View, enabling people to view a subset of the document collection based on the sample metadata. The default arrangement of documents and links in Zoomed-Out View is set according to the seqlinks. However, many other arrangements based on the metadata and link types should be configurable.

There are many possibilities for further development of this research project. The proposed next steps involve determining the technical implementation of the prototype and:

1. Developing an edit mode with a time dimension.
2. Extending the filtering capabilities.

3. Extend the capacity for arranging documents and links to produce different renditions based on metadata.
4. Developing a feature for overlapping links.
5. Make the (UI) configuration modifiable.
6. Extending the features based on Nexae being a closed system.

1. An edit mode with a time dimension

The prototype allows only for accessing the pre-mapped structure of sample content, which means that the option to edit documents, links, or metadata is not yet possible.

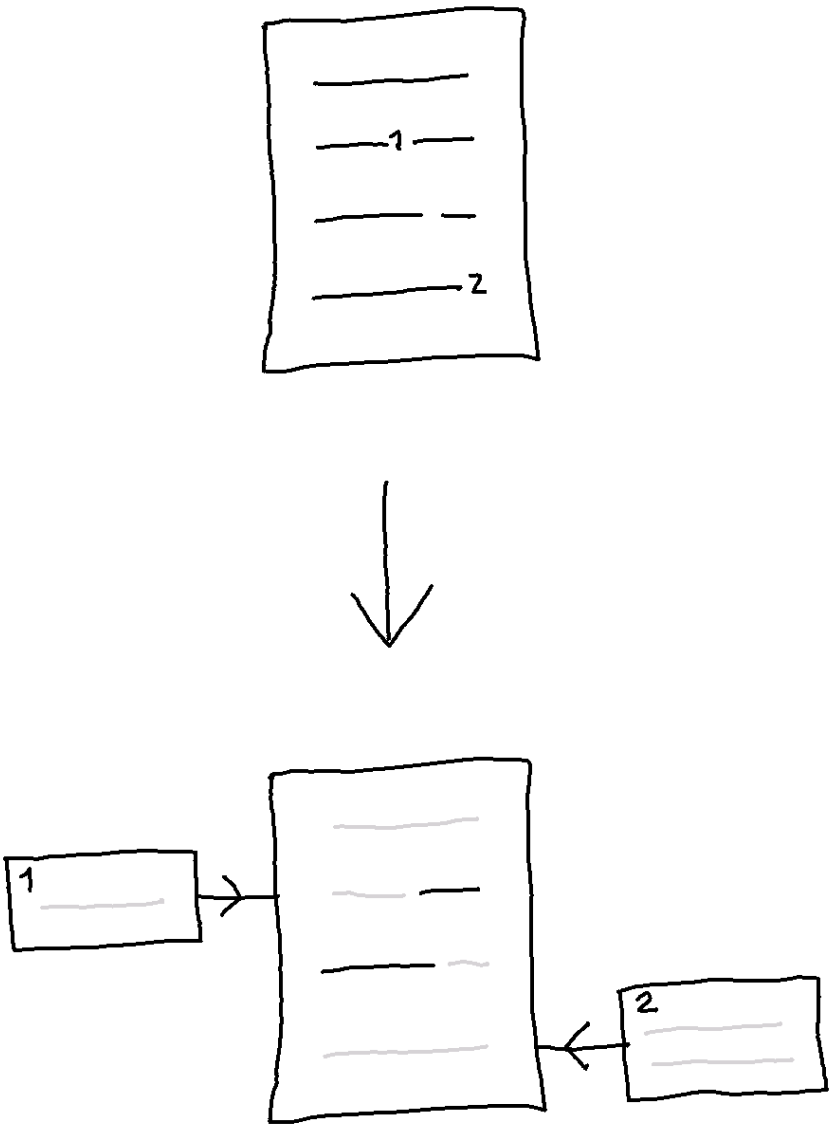
Questions that arise with developing an edit mode are:

- What happens when documents undergo changes?
- What happens when adding a document referencing other documents that have not been added to Nexae?
- What happens when adding documents containing concepts that have been abandoned, such as footnotes and citations?

A time dimension would need to be developed so that different states of documents are stored and can be accessed. A timestamp plugin could be implemented, with the possibility to give timestamps titles (i.e., name different versions.

It could involve a prompt asking for the referenced document to be added or a computer program that searches the web for the linked document and automatically adds (and transforms) it. If the documents are not found, then the question is, what would the visual implementation of a missing linked document look like and function?

Adding a document with footnotes could entail the content items (s) transforming into separate documents linked (with a taglink) to the added document.



Adding a document with footnotes to Nexae

Through NLP techniques, suggestions for labels of the taglinks and metadata to the document could be provided, which could be manually confirmed. Alternatively, the suggestions could be skipped, and the labels added manually.

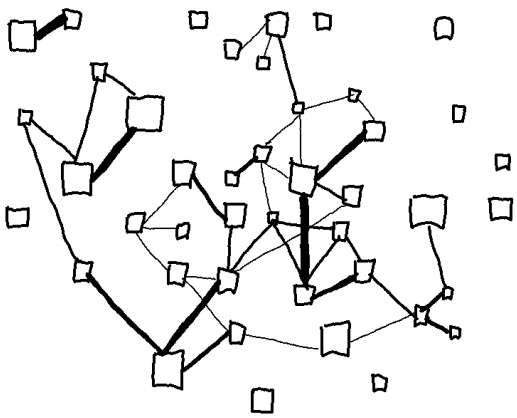
2. Extending the filtering capabilities

A key problem with mapping multiple structures is that it inevitably leads to complex overlapping information. Filtering documents and links (together with the two view modes) have been proposed as a way to engage with the complexity of information. At this stage, the prototype offers basic filtering — select a tag to view only that tag. This could be further explored by designing ways for organizing and selecting sets of tags according to presets. Presets would allow people to traverse the docuverse by viewing only a set of tags instead of (de)selecting each tag individually.

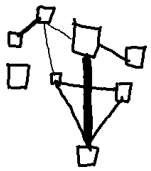
Seeing as multiple taxonomies would co-exist, another question is how people would be able to share the presets of their developed taxonomies.

3. Extending the capacity for arranging documents and links to produce different renditions based on metadata

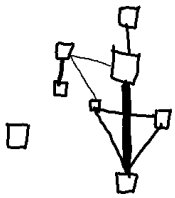
Beyond utilizing metadata for filtering, it could also be utilized for arranging documents in Zoomed-Out View to gain an infographic-like overview. For example, the image below could be a document collection seen in Zoomed-Out View.



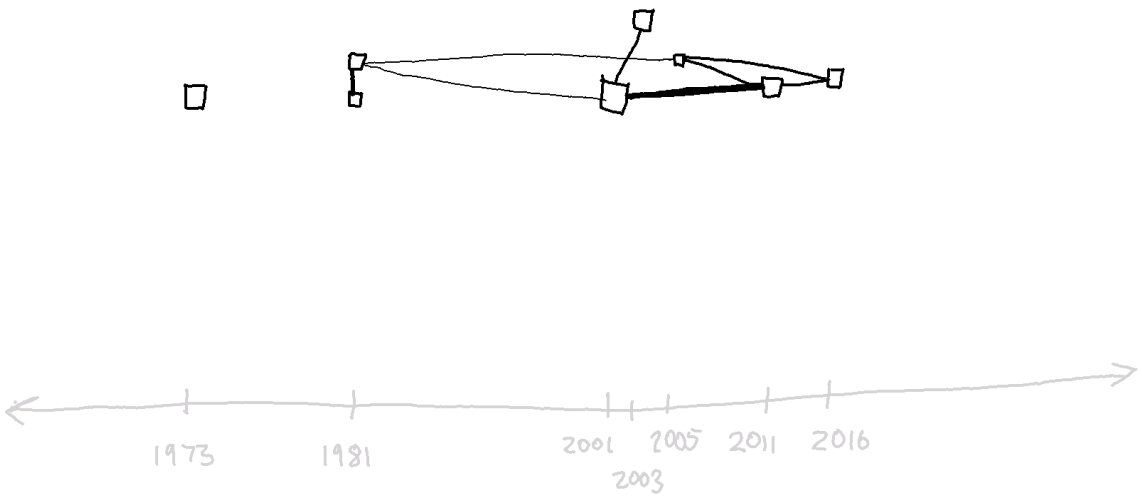
To investigate the concept of evolution, `#evolution` (or a preset named *Evolution* that contains a set of related tags) is selected in the menu, filtering the document collection so that only a subset is shown:



The possibility of arranging the documents according to the set sequences (determined by seqlinks) could be useful for the investigation.

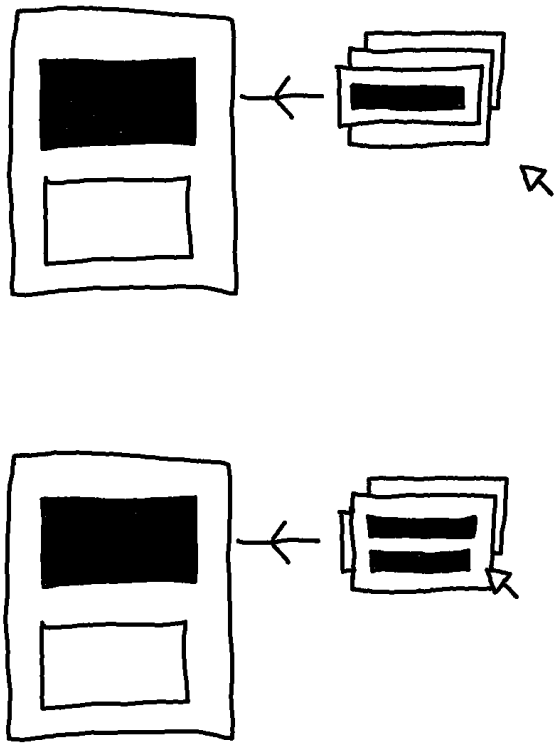


Alternatively, to investigate how the concept has evolved, it may be useful to arrange the documents and links according to the date of publication, rendered in a timeline view:



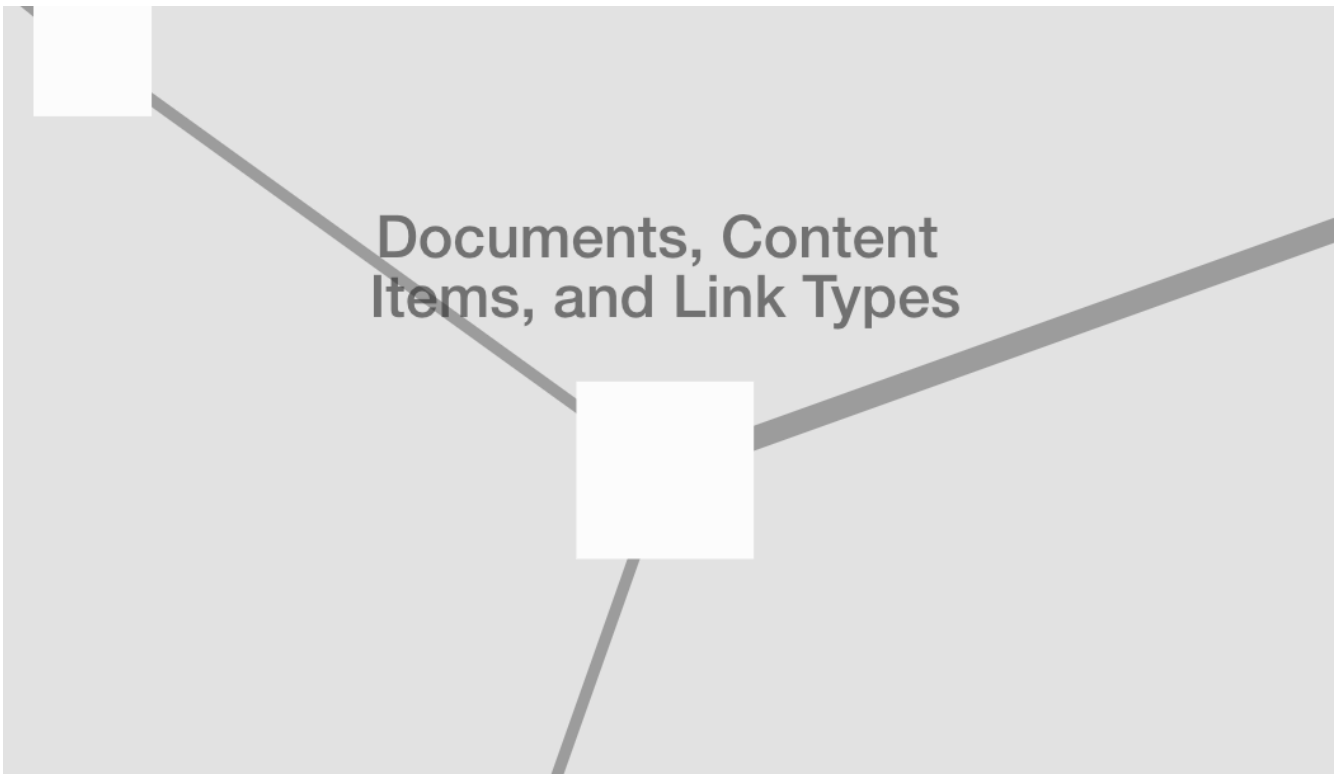
4. Developing a feature for overlapping links.

The idea is that instead of embedding links, they are attached. In this way, links are an overlay on top of the content. The implementation of overlapping links still needs to be explored. Below is a sketch of stacking multiple links to the same content item in the form of a deck. Upon hovering on an alias, it comes to the front, and it should be possible to rearrange the order.

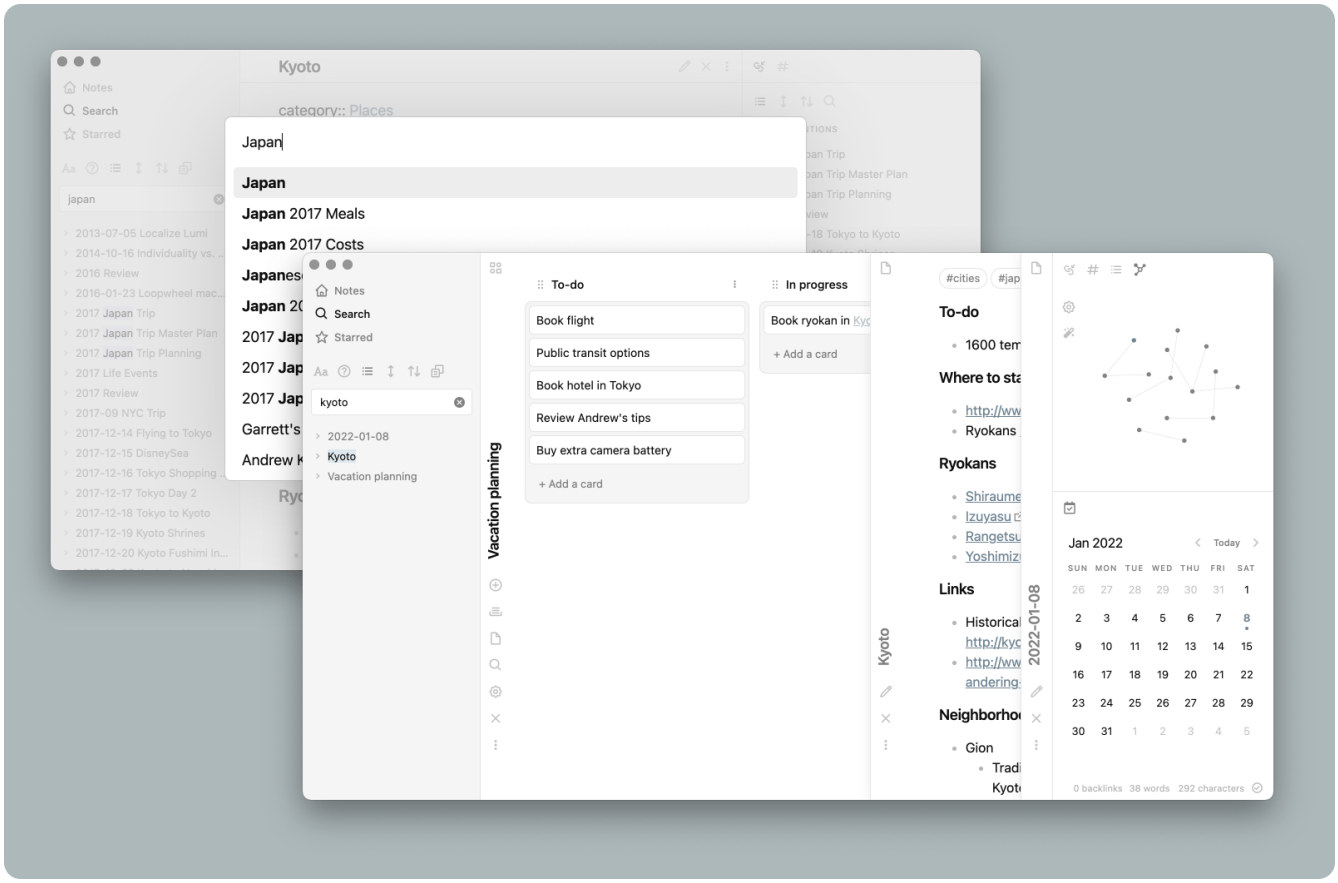


5. Make the (UI) configuration modifiable.

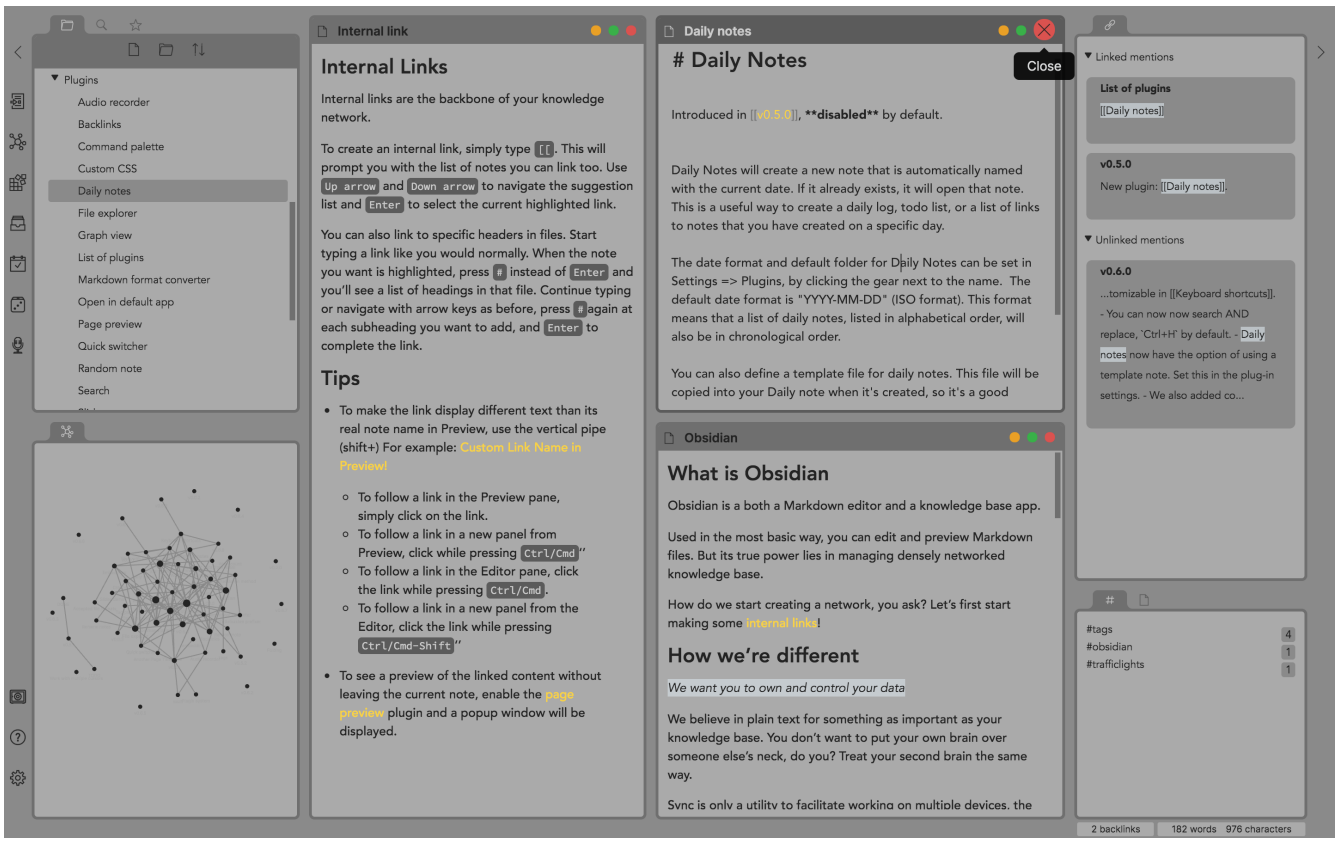
The default configuration of Zoomed-Out View shows the title of a document above each node. However, it should be configurable to show any metadata (e.g., year of creation, status, version number).



Like most plain text editors (e.g., Atom, Sublime Text 3) and Markdown editors (Obsidian, Typora), configuring the UI theme should also be possible. Obsidian, for example, can be configured to have documents stacked side by side as sliding panels:



Or as multiple windows in different sizes within the main window:



6. Extending the features based on Nexae being a closed system.

Making documents by another writer public

Content is added to Nexae rather than linked (externally). Based on the premise that there can be no copies, what happens if a document is made public that has already been added by someone else? If a document has already been added to Nexae, it must merge with the existing document (links and metadata).

Sharing and collaborating

Once a document is made public, it should be possible to configure the edit settings. For example, granting *full edit mode* would allow people to edit the contents and links. Granting *limited edit mode* would allow people to only create links to that document. In both cases, granting open access or access to a select number of people should be possible.

This research project is concluded in the next entry.

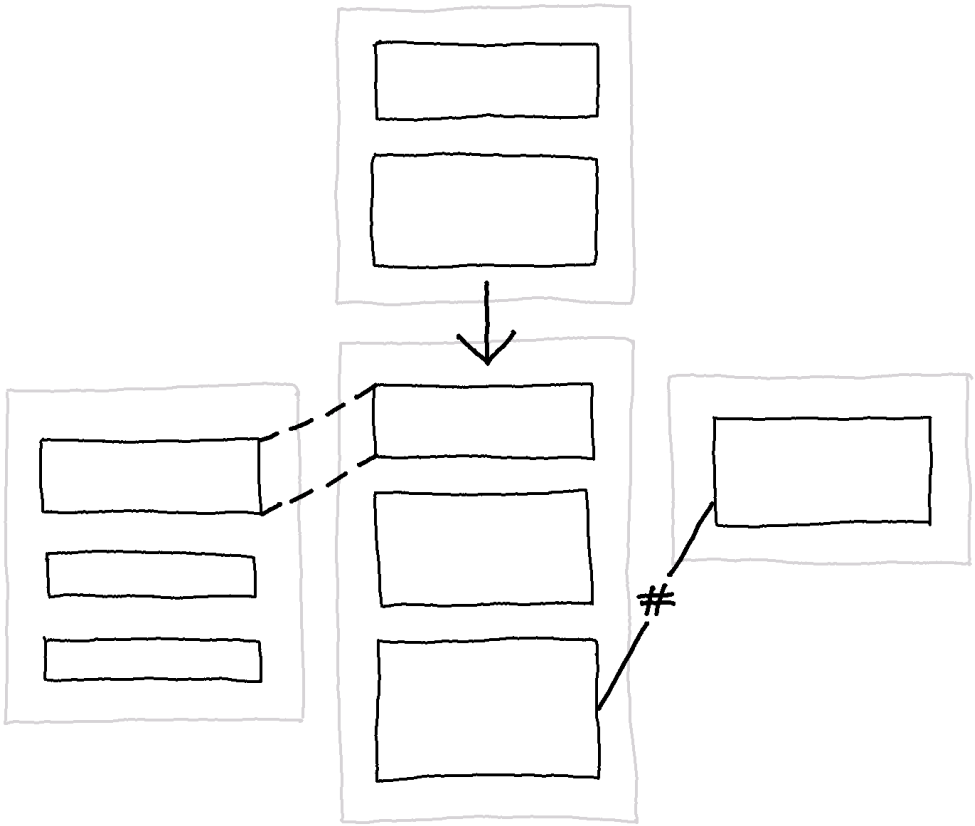
Entry 21 Conclusion

An interactive prototype of a digital document system has been developed by taking new approaches to representational concepts for mapping and accessing the interconnective structure of documents. The concepts have been derived through examining prominent document systems considered influential in the evolution of information technologies. The method is based on an iterative process of content creation, concept design, and creating interactive prototypes of a digital document system. Through examination, the prototype was created based on the following:

1. Documents are modular.
2. Links are distinguished according to types of connections.
3. There are multiple renditions of content.
4. It is a closed system of different types of internal connections.

Based on the conception of documents as modular, the resulting prototype comprises three link types developed for creating connections according to type:

- Transclusion ----
- Taglink –#–
- Seqlink ↓



All links are bidirectional. The link types, link direction, and link endpoints are visually distinguished and implemented through a diagrammatical visual language. Transclusions are the connections made when a content item in a document is included in another. The visual form of transclusions is implemented as a dashed line with an arrow pointing to (and can be accessed by selecting) the alias of the source document.

A transclusion-type link enables a content item to be inserted from one document into another, keeping track and providing direct access to its original context.

Taglinks were developed to accommodate all the other types of connections — the arbitrary conceptual connections created between content items. Borrowing from the diagrammatical visual language of concept maps, taglinks make it possible to attach labels to describe the connection between two documents. Utilizing the common usage of hashtags, taglinks enable the organization of links based on any taxonomy.

Importantly, taglinks replace linking mechanisms derived from paper documents that are used for mapping both implicit external connections (e.g., paraphrased content with citations) and explicit internal connections (e.g., footnotes).

Unlike footnotes, with taglinks, there is no implicit hierarchy; instead, multiple sequences are on the same level. Within a document are the vertical content-item-by-content-item sequence and the horizontal linked documents (represented as aliases) offering other sequences.

Seqlinks determine the order of documents in a sequence, which, together with headings within a document, allow the possibility of creating hierarchical structures. Implemented as lines with arrows

pointing to the previous or the next document in a sequence, which can be selected to traverse a document sequence. It is also possible to rearrange documents in Zoomed-Out View according to seqlinks. The sequential order of documents (and the possible hierarchical order of content items within a document) co-exists with the order offered by the other two link types.

The prototype uses sample content developed throughout the process, serving as an example of how these three link types can be applied to realize the interconnective structure of documents and how it can be accessed through interaction.

Two view modes have been developed to engage with the complexity of information, enabling zooming in and out to gain different perspectives on documents at different levels of detail.

Zoomed-Out View is at the document collection level, and the Zoomed-In View is at the document level.

Zoomed-Out View is a network diagram using a node-link model, in which all documents are viewed in relation to each other, conveying information about the size of each document (node size) and the number of links (line thickness). Functioning as an infographic, it allows understanding a lot of information at a glance. Zoomed-Out View needs to be further developed so that the node-link structure can be reconfigured based on metadata.

Zoomed-In View, the selected document is viewed in more detail, conveying information about the type of connections to/from that document by visually distinguishing the three link types, the link direction, and the link endpoint.

Switching view modes involves transition animations suggesting the movement of zooming in and out on documents. While in zoomed-in view, opening a linked document by selecting one of its aliases also brings about a transition animation, moving laterally. Additionally, a location frame shows the open document as an active node seen from the zoomed-out perspective, which supports orientation. Document metadata and taglinks enable a grouping mechanism and the capability to filter to view a subset of the document collection based on any taxonomy.

Currently in the proof of concept stage, the proposed next steps are to determine the technical implementation of the digital document system, develop features such as an edit mode, a time dimension, overlapping links, and extend the current filtering capabilities.

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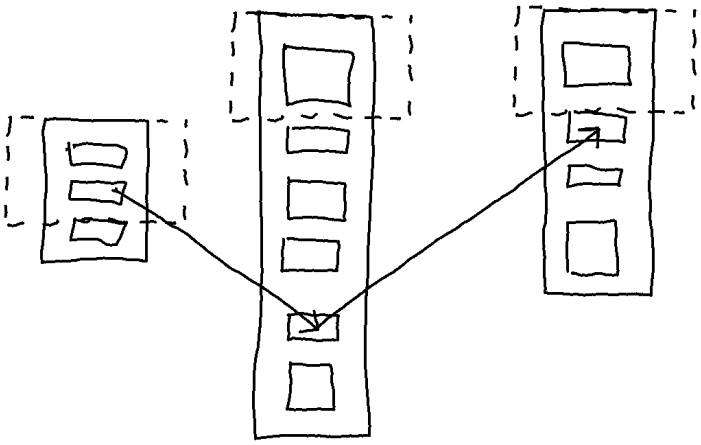
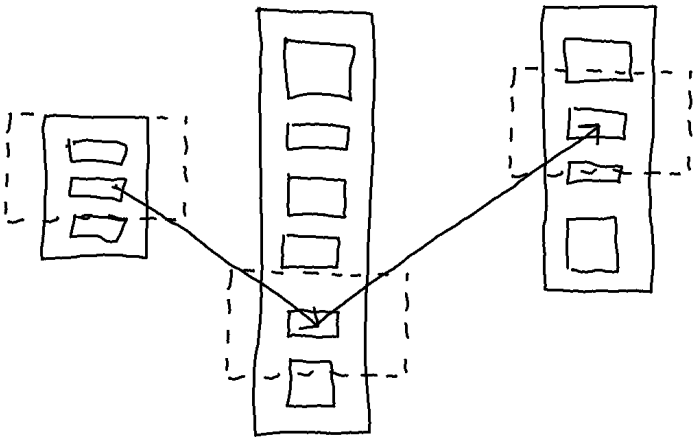
Endnotes

1. Modality, in computer terms, is analogous to data type, and medium is the equipment used for its transmission (Weel 2012). The properties of a medium dictate the modality it can mediate. For example, a paper document can transmit the modalities text and image, while a digital document can transmit the modalities text, image, video, and sound.↩
2. The Macintosh operating system System 6 introduced in 1988 offered a fixed seven-color label option enabling grouping mechanisms for sorting files and folders. This feature was not extended until 2013, when descriptive labels for tagging files were introduced on Mavericks. Software that extends the features of Finder — the graphical user interface shell employed on all Macintosh operating systems — includes ForkLift, TotalFinder, muCommander, and XtraFinder, to name a few. However, these are workarounds to the inflexibility of the file system grounded in constraining organization principles. They are pieces of software developed to fix the problems of another piece of software.↩
3. For these reasons, it should be clear that developing a digital document system does not involve abandoning all conventions, practices, and concepts derived from paper documents. Rather, the aim is to take new approaches to those concepts by considering the potential inherent to the digital realm.↩
4. Content items are what Steven DeRose (1990) calls "content objects," what Charles van den Heuvel and W. Boyd Rayward (2011) call "information chunks," and what Ridi (2018) calls "information units." In conventional terms, a paragraph, for example, is a content item; a quote within a paragraph is also a content item; a list and a list item are content items.↩
5. One example is Otlet's model, Functional Requirements for Bibliographic Records, in which entities are linked on multiple levels in the form of a network (Borgman 2015). With this model, Otlet proposed to restructure the library catalog databases based on the conceptual structure of information resources.↩
6. As stated in [Questions That Follow], the *order of the book* is the presentation and structure of text based on the form of books and defined by the format of manuscript and print.↩
7. As acknowledged by Tim Berners-Lee, Xanadu influenced the development of the web (Ridi 2018).↩
8. Traversing content on the Web by selecting hyperlinks commonly entails blindly *jumping* and landing at the top of the page:



An improvement would be landing at the particular linked part of a document:



↩↩

9. It is possible to use anchor links that point to a specific section of a webpage, but it relies on the creator applying an HTML id attribute to the section title (see Stack Overflow).↩
10. Note that the link direction is unclear, and the position and overlap of the windows are not convenient.↩
11. One problem with this 3D version is that there is no obvious way of navigating the space. For reading and editing a document, it could be useful to snap into a full-frame view of a particular part of a document.

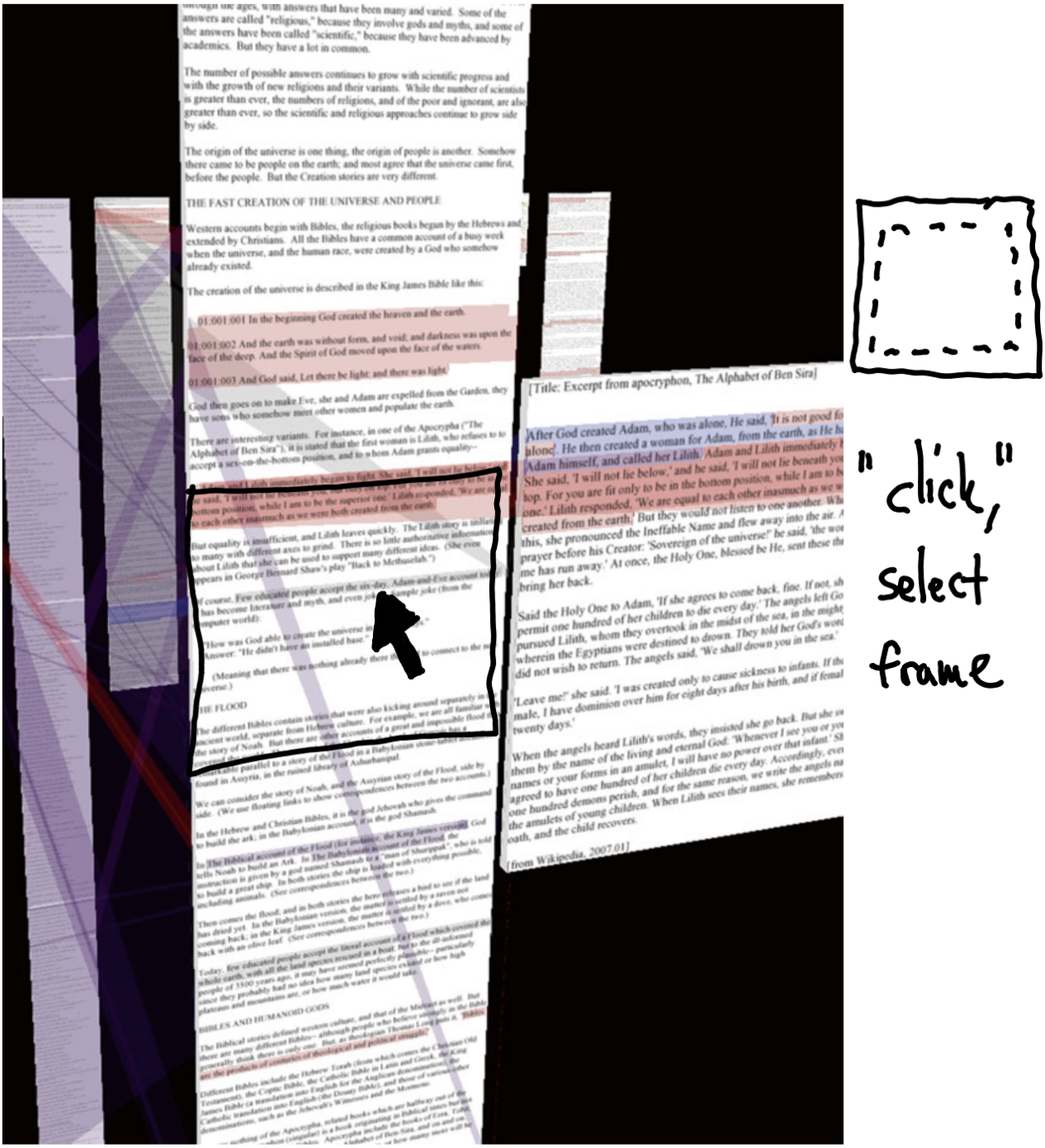


Fig. 17.10 Parallel connected pages in the XanaduSpace demo, implemented by Robert Adamson Smith, 2014

↩

12. The idea of viewing documents side-by-side is solid, but having documents fly in and out of view as you move through the document is not. There should be an interaction step in which the content is only opened through deliberate action.↩
13. a problem to which this research project aims to propose a solution.↩
14. A filtering technique might be a better solution, which requires a grouping mechanism (explored in entry 08. ↩
15. Content by convention inserted between quotation marks or in a block quote, for example, is a *form* of transclusion.↩
16. The word hashtag refers to the symbol # (as popularized by Twitter) and combines the word hash from the hash mark and the word tag as it is used to label something belonging to a specific category.↩
17. This is similar to when selecting a website URL from the bookmarks library in a browser results in replacing the currently open webpage. It is possible to open a new browser tab. However, the difference here is that the documents can be opened in the same window, and the connections are visual links.↩
18. Having multiple colors throughout the main document may become distracting.↩
19. As noted in entry 03, computational methods, such as applying natural language processing techniques for classifying text and keyword extraction, are not excluded.↩

20. *Seqlinks* are introduced in entry 15.↩
21. …though once there are more documents, there will be too many indistinguishable colors.↩