Semantics-Based Legal Citation Network

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ABSTRACT

We describe and discuss the use of semantics-based citation networks in a new legal research tool. Such networks are generated based on citation relations between cases found in legal corpora as well as legal issues being discussed with these citations. Unlike traditional tools, the System allows legal professionals to efficiently study legal issues without having to go through whole cases or tedious manual citation search. This shift of focus from cases to individual issues within cases would greatly reduce time required for attorneys and legal scholars who have specific research problems in mind.

The Systems User Interface (UI) allows users to easily navigate in the citation networks and study how citations are interrelated and how legal issues have evolved in the past. Various forms of natural language processing (NLP) technologies are used in building the metadata behind the prototype. Formal evaluation confirmed the Systems capability of accurately identifying citations relevant to given legal issues.

General Terms

Algorithms, Design, Languages, Legal Aspects

Keywords

Citation Network, Semantics, Legal Research, Visualization.

1. BACKGROUND AND MOTIVATION

The U.S. and some other countries follow the common law system, where laws developed over centuries and were derived from judicial opinions. The legal systems are largely based on the doctrines implicit in court decisions, customs, and usages, rather than on codified written rules. Common laws rely heavily on the concept of precedence - on how the courts have interpreted the law in individual cases (hence, the term *case law*). This reliance on precedence by the legal system makes it critical for legal practitioners to study case citations - how issues related to his or her current case were discussed and ruled in previous cases.

When an attorney starts researching with a legal problem in mind, he goes through a repetitive mental process of forward and backward searching in the imaginary space of legal issues embodied mainly by previous cases. Sutton [18] discussed this kind of mental model, by way of which the attorney's cognitive map of a legal doctrine in question is built. During this research, the attorney, "armed with one or more seed cases", "engages in what observers call 'gathering citations' [17], 'chaining' [6], or what Bates [3] calls 'footnote chasing' and 'citation searching"' [18]. Figure 1 (from Sutton, [18]) illustrates part of this process as a general attorney behavior model. In the center of the figure is the seed or root case of interest. The arrows represent the direction of the searcher's chaining; the passage of time is represented by the position of each case, i.e. from left to right. From the Known Seed Case 15 (in the center), the attorney first finds Case 18 and Case 19 through shepardizing (a term that means finding cases that cited a given case in the legal corpus). He then finds Cases 11 and 12 by Internal Tracking, which involves reading the document and searching for more citations. Here the search is bidirectional: forward chaining to find cases that cited the current case, and backward chaining to find cases that the current case cited to. The whole process is recursive; at each step the researcher finds one or more cases. Each of these new cases is then used to trace and find more cases in the same manner. Marx [12] called this mental process "exhaustive shepardizing", and noted that, since cases are cited for numerous legal propositions, many of which may not be relevant to the current problem, this mental process is really a "selective process".

There are tools and services that aim to assist attorneys in this kind of research. Citator services (e.g. LexisNexis's Shepard's[1], and WestLaw's KeyCite[2]) allow the user to see the whole list of citations that directly reference to a given case. The legal information retrieval (IR) and artificial intelligence (AI) fields have also been offering help [2]. Search-based tools can identify cases that are conceptually close to what the user needs by searching with key words the user enters, or by matching important terms between two cases. AI-based techniques, such as machine learning, are also used for relevant prior case retrieval [1]. All these help the researchers tremendously in each of the steps described above. More recently, use of legal taxonomy, ontology, or

[1] http://law.lexisnexis.com/shepards
[2] http://west.thomson.com/keycite

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semantic networks has been introduced to the legal IR field. ([2], [4], [7], [10], [15], [20], [21])

However, to do a decent job, the attorney, at each step of his research, has to sift through many case documents before he could move to the next search stage. This exhaustive and selective search process required for this line of work is still very timeconsuming.

In the following Sections, we describe Semantics-Based Legal Citation Network Viewer, a new research tool for legal professionals. The Network Viewer can create a semantics-based citation network with a focus on one single legal issue. The visualization-based user interface (UI) lets the user easily navigate in the network forwards and backwards to see how the issue was discussed in different cases, how the citations are inter-related, which ones are more popular than others, and how the legal issue has evolved over the years. We believe the system design of the Network Viewer fits the attorney's mental process model described previously.

2. SEMANTICS-BASED CITATION NETWORK

Researchers and scientists have noticed the intricate network relations existing among entities in society, be it relation between human beings, geographic locations, events, organizations, or publications of various forms. Historically, for example, bibliometric methods have been used to trace relationships amongst academic journal citations. Citation analysis, which involves examining an item's referring documents, is used in searching for materials and analyzing their merit. Citation indices allow users to search forward in time from a known article to more recent publications which cite the known item. [11] The search-engine giant, Google, uses PageRank to re-order its search results. PageRank "makes use of the link structure of the Web to calculate a quality ranking for each web page." [5]. Here not only is direct linking crucial, but also "indirect" links, as the mechanism prioritizes links based on how many other popular sites link to them. More recently, researchers have been interested in the nature of "social networks". Kleinberg [9] pointed out that, while researches had focused on the most clearly visible on the Web - the Hyperlinks connecting documents, the Web has always contained a second network, less explicit but equally important; and this is the "social network" on the users. The emergence of social networking systems and rich social media, as well as the availability of largescale e-mail and instant messaging datasets, etc. has highlighted the crucial role played by on-line social networks.

In a recent paper, Nie [13] points out that "Traditional web linkbased ranking schemes use a single score to measure a page's authority without concern of the community from which that authority is derived." In other words, this type of ranking is insensitive to contexts, or semantics, of the links. Nie proposed a "Topic PageRank Model", where "topic distribution" is incorporated into regular PageRank scores so that ranking of the links is influenced by contexts as well as numbers of links.

Here we see that networking, as a general phenomenon, has become one of the focal points of research in the field of information science. In this Section, we discuss the idea of legal concept networking embodied by complex organization of citation relations.

2.1 Legal Citation Network

When a case document is written, the author often cites previous cases in support of his own arguments; these cases, in turn, have cited other cases for the same purpose. Over time, these citingcited relations between cases form a network. The citation relations in the network are complicated, but they are non-arbitrary as "citational links exist because at some point in time a judge and a lawyer decided that a logical connection existed between certain cases" [12]. It follows that knowledge embedded in citation network can be a valuable source for attorneys and legal scholars. Legal professionals and computer scientists have been interested in this phenomenon. Smith, for example, after a thorough study of the American case citations, concluded that the law system "suggests a high degree of intellectual coherence", and that "studying the legal network can shed light on how the legal system evolves and many other questions" [16]. BankXX, a System proposed by Rissland et al. [14] to support legal argumentation, uses citation links between cases in their knowledge base. Hooge et al. [7] described the LLT Program, which creates "Legal Logic Tree" for a given case based on citation relations between cases.

2.2 Multi-Dimensionality of Legal Citations

Legal citations are semantically multi-dimensional. This is because a case can cite several cases each supporting a different proposition; and, likewise, a case can be cited by other cases for different reasons. Two citations pointing to the same case may not necessarily be semantically related because they may each be based on a different legal issue. The following example shows this multi-dimensionality in one California cases, *People v. Green* (1980). The case was cited by hundreds of other cases; and the legal issues that these citations are for can be grouped into over ten different categories. Here are some of the more popular legal issues the case was cited for:

<a>When the sufficiency of the evidence is challenged on appeal, the court must review the whole record in the light most favorable to the judgment to determine whether it contains substantial evidence – i.e., evidence that is credible and of solid value – from which a rational trier of fact could have found the defendant guilty beyond a reasonable doubt.

<b>... the initial question to be decided in all cases in which a defendant complains of prosecutorial misconduct for the first time on appeal is whether a timely objection and admonition would have cured the harm.

<c>... when the prosecution presents its case to the jury on alternate theories, some of which are legally correct and others legally incorrect, and the reviewing court cannot determine from the record on which theory the ensuing general verdict of guilt rested, the conviction cannot stand. The rule has been applied in various contexts.

<d>... since the enactment of section 352 the Ford requirement - - i.e., that on a motion invoking this ground the record must affirmatively show that the trial judge did in fact weigh prejudice against probative value – has been reiterated both by the courts ('People v. Holt' [disapproved on a different ground in 'Evans v. Superior Court') and by the writers (e.g., Jefferson, op. cit. supra, 22.1, pp. 289-290).

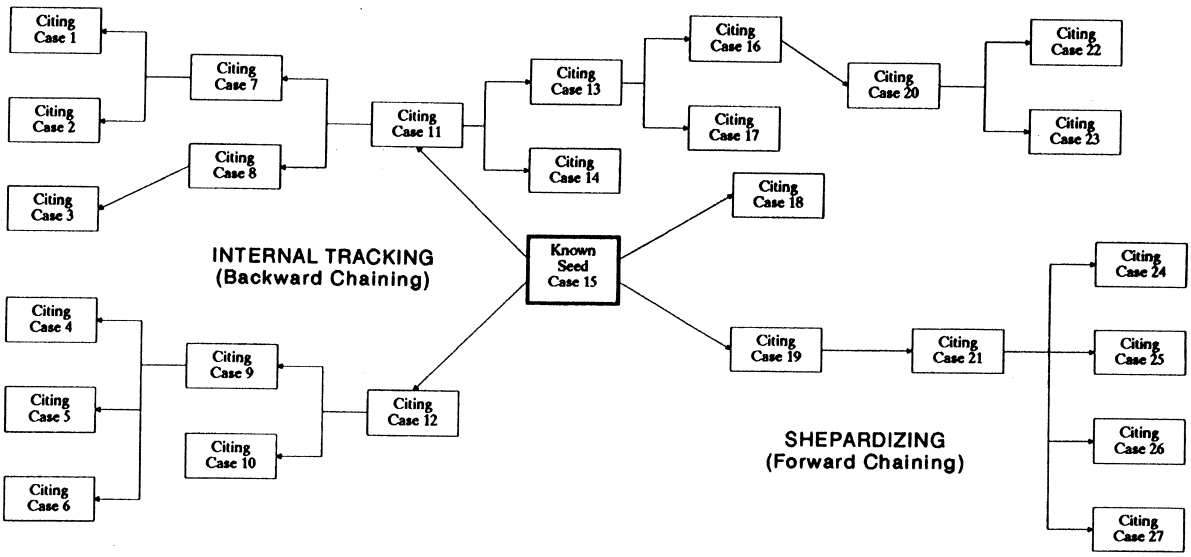

Figure 1: Citation Tracking (from Sutton, 1994

<e>The jury's discretion to impose the death penalty was strictly limited to those cases of first degree murder presenting one or more of several enumerated special circumstances; in all other cases the murder, no matter how willful, deliberate and premeditated, was a noncapital offense. The permissible circumstances were defined in elaborate detail (former 190.2); in summary, they included (1) murder for hire, (2) murder by means of explosives, (3) murder of a police officer or a witness, (4) murder by torture, (5) murder by a person previously or concurrently convicted of another murder, and (6) murder during the commission or attempted commission of five specified felonies, to wit, robbery, kidnaping, forcible rape, lewd act upon a child, or burglary.

<f>. . . the act of force or intimidation by which the taking is accomplished in robbery must be motivated by the intent to steal in order to satisfy the requirement of section 20: if the larcenous purpose does not arise until after the force has been used against the victim, there is no "joint operation of act and intent" necessary to constitute robbery.

This case was cited by another CA case, *People v. Fabert*, in 1982:

"Defendant argues that since the instructions failed to explain that a defendant's wrongful intent was required and that the wrongful intent and act must concur in the sense that the act must be motivated by the intent (Pen. Code, 20; People v. Green (1980) 27 Cal. 3d 1), the court erred in refusing to give CALJIC Nos. 3.31 (concurrence of act and specific intent) and 3.31.5 (concurrence of act and mental state), as requested."

From language around the cite, it is clear that the author was referring to discussion of "*wrongful intent*" in the *Green* case (Issue <f>listed above). In the same year (1982), another CA case, *People v. Haskett*, also cited *People v. Green*:

"Defense counsel made no objection to them at trial, however, and can complain for the first time on appeal only if timely objection and admonition could not have obviated the prejudicial effects of the remarks. (People v. Green, supra, 27 Cal.3d 1, 27.)"

Reading of language around the cite shows that the author, even though citing the same case, was targeting on a different legal issue, *"objection and admonition"* (Issue <b>listed above).

Here we see that two citations, while both pointing to the same case, may not be semantically close. This semantic multidimensionality of citations poses a problem to legal researchers who want to focus on individual legal issues because they have to read all cases retrieved by way of citations to select ones that are on issues of their own interest.

2.3 Semantics-Based Citation Network

The semantic multi-dimensionality of citations has also made the use of legal citation network impractical because a general network traversing function would retrieve indiscriminately huge number of cases and soon fill the network space, making the viewing and reading impossible.

To get the full benefits of legal citation network, we have to dissect the general, multi-dimensional network into sub-networks each focusing on one specific legal issue. This process is shown in Figure 2.

In the resulting semantics-based sub-networks, each node represents the discussion of one legal point within one case instead of the whole case. Nodes in one such network are all on the same legal issue, which are networked to show how they are interrelated by citations.

Figures 3-8 show such semantics-based networks generated on legal issues from the *People v. Green* case listed in the previous Section. In each of the networks, the Starting Issue from the *Green* case is marked with a circle. (Number of nodes is reduced by distances to the Starting Node for simplicity; for details, see later Sections.)

A network generated this way is homogenous in that all

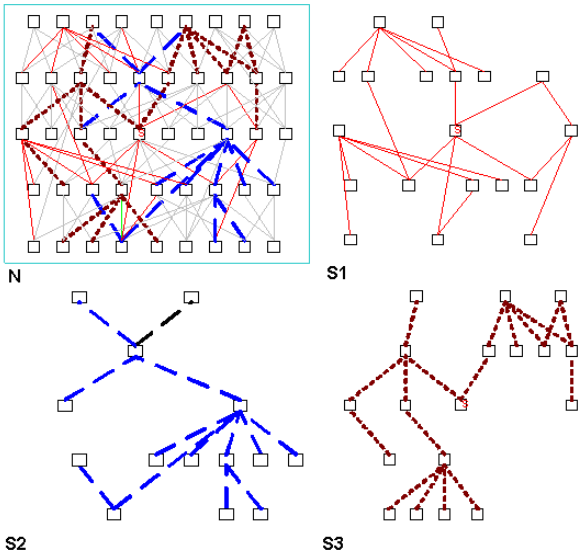

Figure 2: Network N is dissected into sub-networks, S1, S2, and S3, each focusing on one legal issue. Line patterns indicate different semantic dimensions.

the nodes in it are highly relevant to the same legal issue.

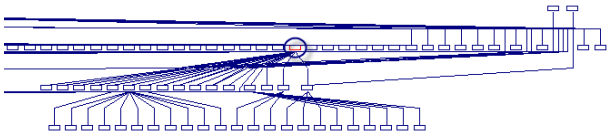

Figure 3: Partial network for Issue <a>

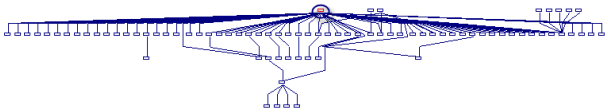

Figure 4: Network for Issue <b>

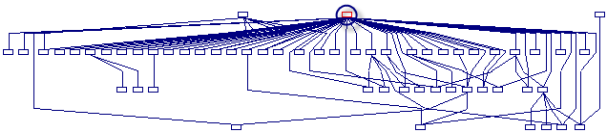

Figure 5: Network for Issue <c>

A simple study of the 6 example networks shows that, of the 1,076 unique cases included in the networks, 39 cases occur in 2 networks (i.e. each of them cites or is cited for 2 of the 6 legal issues), 1 case occurs in 3 networks, and 2 cases occur in 4 networks. The rest 1,034 cases each only occur in one network. This indicates that the networks are

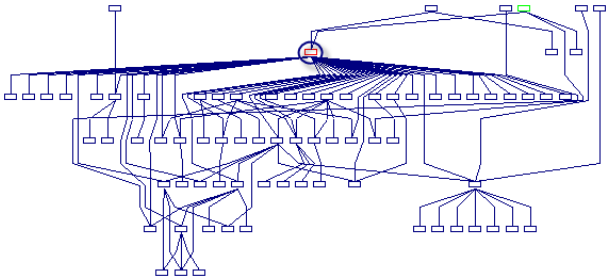

Figure 6: Network for Issue <d>

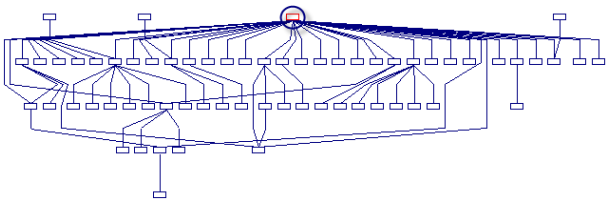

Figure 7: Network for Issue <e>

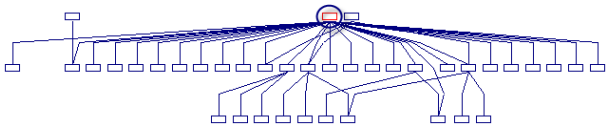

Figure 8: Network for Issue <f>

significantly distinctive one to the other in terms of their composition.

This idea of semantics-based citation network is the basic design concept behind our System, the Legal Citation Network Viewer.

3. SYSTEM IMPLEMENTATION

In this Section, we describe the design of Semantics-Based Legal Citation Viewer, a visualization-based interactive legal research tool. A prototype of the System was built with California cases (prior to April 2004) as the experimental data source. We first discuss the major components of the System that facilitate semantics- driven network traversing. We then describe the prototypical UI of the Network Viewer.

3.1 Identifying Points of Interest

To distinguish citations based on legal issues, we use the concept of Reason for Citing (RFC) [8]. In a legal document, an RFC is the text area around a case citation, which suggests the reason for the citing. During data process, the System recognizes citations, e.g. "*People v. Green (1980) 27 Cal.3d 1*" The RFC technology then helps to correctly locate RFC text areas as well as their proper boundaries in the document. In the following paragraph, for example,

Finally, defendant maintains that the evidence was insufficient to support the jury's finding that the murder was committed with premeditation and deliberation. ***Although the case is close, we are mindful that "[the] test on appeal is whether substantial evidence supports the con-***

clusion of the trier of fact, not whether the evidence proves guilt beyond a reasonable doubt." *(People v. Arcega (1982) 32 Cal.3d 504, 518 [186 Cal. Rptr. 94, 651 P.2d 338].)* ***"Evidence, to be 'substantial' must be 'of ponderable legal significance . . . reasonable in nature, credible, and of solid value."'*** *(People v. Johnson (1980) 26 Cal.3d 557, 576 [162 Cal. Rptr. 431, 606 P.2d 738, 16 A.L.R.4th 1255].)* ***Moreover, in making this determination, we are required to "review the whole record in the light most favorable to the judgment to determine whether it contains substantial evidence . . . from which a rational trier of fact could have found the defendant guilty beyond a reasonable doubt."*** *(People v. Green (1980) 27 Cal.3d 1, 5 [164 Cal. Rptr. 1, 609 P.2d 468].),*

three RFSs are identified (underlined texts) that are associated with citations following each of them.

In our System, RFCs within each case are considered text of interest (TOI) as a base for linking legal issues. (The System also uses other text areas as TOIs; but RFCs are the most important for network traversing. For simplicity, we are not discussing those other text areas in this paper.)

3.2 Metadata Creation

To allow for network traversing, several metadata files were created.

Each case document in the corpus was first processed with all citations and TOIs extracted. The TOIs (RFCs and other text areas; see above) were then converted into vectors (through steps such as key term extraction, lexical normalization, weighing, etc.). In the metadata file, each citation is associated with the vector produced from the RFC around that citation.

Another data file contains citation pairing information, i.e. Case A cited Case B, where cases are represented by a fixed number of characters for quick access during run time.

The third data file contains semantic pairing between RFC in the citing case and TOI in the cited case. Generally speaking, when two cases are linked by citation, locating RFC in the citing case can be done deterministically (see last Section), but the text area in the cited case that the citation is for is usually implicit. The observation that serves as a basis behind our operation for this step is that, if a case was cited for a legal issue, there is usually a text area in the document that discusses this issue; and in most cases, this text area is around another citation (an RFC) referencing to yet another case. It is this kind of linking that makes it possible for our System to "relay" and "chain" semantically related citations together. In order to identify the TOI in the cited case that is related to the issue the current citation is for, we compared the TOIs (RFCs and other text areas, see above) in the cited case with the current RFC in the citing case. A simple vector comparison function was used to measure the similarity:

$$Sim(x,y) = \sum_{\substack{T \varepsilon X \\ T \varepsilon Y}} Wt(x,T) \times Wt(y,T),$$

where T is a term occurring in both vectors x and y, and Wt(x,T) and Wt(y,T) are weights of the term in the vectors. The relevant TOI in the cited case is defined as the one with the highest similarity to the citing RFC:

$$TOI \Rightarrow \max_{i=1}^{K}(Sim(V_i, SV)),$$

where K is the number of all TOIs in the cited case; V is the vector for one of them; SV is the vector of the starting RFC (in the citing case).

This relevant TOI is considered the reason the current case was cited for. And the citing RFC and this TOI were paired and written to an RFC pairing table (together with the similarity measure). In this table, citing and cited TOIs are semantically linked, which is used to support the network traversing.

There are other supporting files, mainly, text files for displaying, and various hash files to facilitate quick access to data.

3.3 Semantics-Driven Network Traversing

The semantics-driven network traversing function is able to link citations related to the user-specified legal issue during a breadthfirst search in the network space.

During run time, the traversing function, starting from a given citation (with a specific TOI), searches the RFC pairing table (see above). It retrieves all citations referenced to by the current citation (backward chaining), as well as citations that cited the current case (forward chaining). Since TOIs in the pairing table are semantically linked, this step serves as a filter, blocking citations that are not relevant to the given issue. The retrieved citations are then used for further searches in the same manner. This recursive search operation goes on till exit conditions are met (e.g. N^{th} level/distance from the starting case, or the citation referencing to cases outside the jurisdiction). The retrieved citations are used to form a network. Since they are all semantically "chained" to the starting RFC, the network is semantically homogeneous. (In actual implementation, thresholds are used to keep the traversing close enough to the very beginning citation.)

3.4 User Interface

The current version of the System allows the user to launch the network function within a case document. When the user chooses a citation from the case and starts the Network Viewer, a network is generated with the RFC of the citation as the Starting Issue (see last Section). The relevant citations retrieved and the pairing information between them are sent to a Java program, which starts the user interface of the Viewer.

The prototypical UI of the Viewer has two windows, the Network Window on the left, and the Digest Window on the right (See figure 9).

The network is displayed in the UI's Network Window. In this Window, citations are represented by small boxes linked by lines indicating citing relations. When two boxes are linked, it is always the box in the lower position citing the one in the higher position. The user can move the cursor over boxes to see information of different citations (in pop-ups) as well as direct citing lines to and from the cases (highlighted with color). He can also click on a box to "focus" it. The TOI of a "focused" box is displayed in the Digest Window on the right. This allows the user to quickly browse and read how his Issue was discussed in different cases. He may also find some cases more interesting. For example, after viewing the network, the user finds the case,

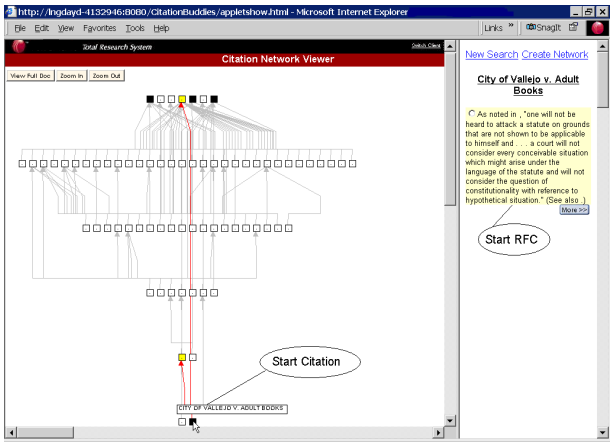

Figure 9:

"*In re Cregler*", interesting because it is the most popular one, and possibly, a landmark case. He clicks on the box to "focus" it. This brings the RFC of the new citation to the Digest Window (See figure 10).

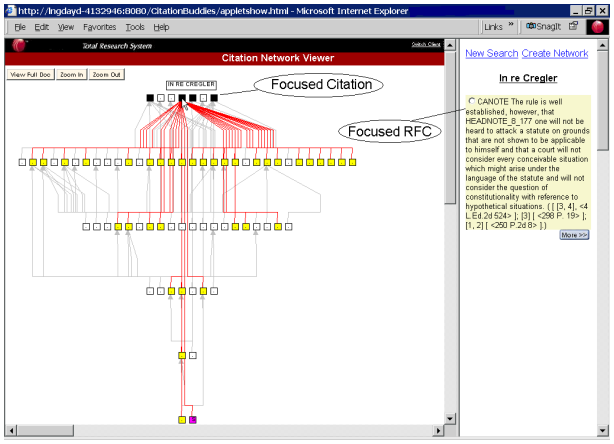

Figure 10:

The user can also expand the Digest Window and press the MORE button to start the digest function. This brings all important legal issues of the focused case to the Digest Window (a Digest View of the case). The user can easily browse this Digest by scrolling up and down the list. If he finds another issue relevant to his research problem, he can click on it, and press the "Create Network" button to "jump" to a different legal issue. (See figure 11)

The System will then start a network for this new citation and new issue (See figure 12).

Under this UI design, the user can easily navigate among citations and across different legal issues that are related to his research problem. At any time he can double-click a node to go to the full document of the case.

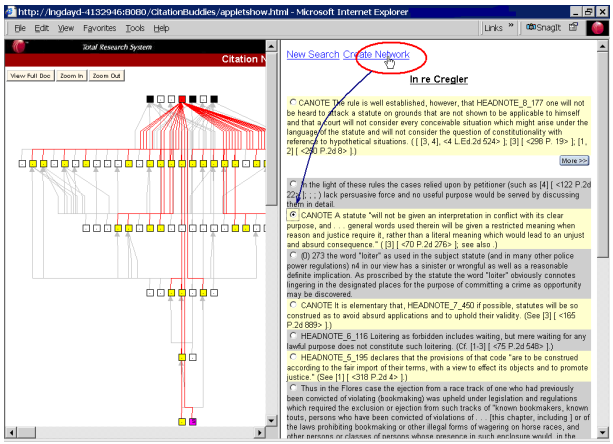

Figure 11:

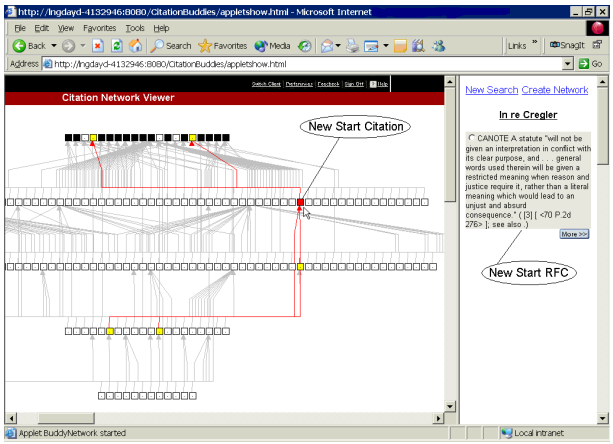

Figure 12:

4. SYSTEM CAPACITY & EVALUATION

4.1 User Benefits and Experience

- While traditional citation services focus only on citing relations, our System imposes semantics to these links. (The latest LexisNexis service, *Shepardize: Restrict By HeadNote*, also has the same feature.) This way, researchers can concentrate on legal issues that they are interested in.

- The System traversing is bi-directional and recursive. It goes both forward in time (finding cases citing to current case) and backward (for cased cited by current case); and "relaying" searching is automatic (e.g. finding cases that cited the citing cases to current case). Traditional citators, however, find only cases that cited the current case (uni-directional, one-level/non-recursive).

- Being data-driven, the System does not rely on and is not limited by existing classification systems.

- The "Digest View" (see 3.4) of the UI allows the user to quickly see important points of each case, and "jump"

to a different legal issue that might also be relevant to his own case.

- The caveat of the System is that, not being a search engine, the System requires the user to start the search from a given legal issues, not from a query or key words. Sometimes when a given issue is not popular in the corpus, the networking does not go very far. However, we found that issues of some importance all generate networks of reasonable size. We believe this could be an issue of customer expectations.

- The graphic display of networks by the System allows the user to easily see "hubs" or popular cases for a given legal issue. However, unlike Shepard's and KeyCite, which give information as to how each citation to the current case was treated (e.g. "overruled", "followed", etc.), the current version of our System does not indicate this kind of treatment information. Work is being done in this respect. (See 5).

4.2 Network Search

Our design enables the System to include into a network cases that discuss the same legal issue even if they are not in direct citation paths and the language used in discussion is not linguistically close.

Figure 13 shows an example of such situation. The network shown here is not an actual UI screen, but a print-out from a graphics tool based on a network generated by the System's traversing function. For purpose of presentation, some nodes and links were removed so that the graphics is easier to read. In this example, the traversing begins with the Start Case (*Tobe v. City of Santa Ana*). The Start Case cited case C-1 among other cases; C-1 was cited by C-2, which also cited C-3. And C-3 cited C-4. Here, from Start Case, the System successfully traced to C-4, which is remote from Start Case in the network space (i.e. not on its direct citing path). In terms of time, the two cases are sixty-four years apart. And even though the RFCs of the two cases are discussion of the same legal issue, they are not linguistically close, which can be seen from the text in the two RFCs:

Tobe v. City of Santa Ana (Start Case): *A facial challenge to the constitutional validity of a statute or ordinance considers only the text of the measure itself, not its application to the particular circumstances of an individual. "'To support a determination of facial unconstitutionality, voiding the statute as a whole,* petitioners cannot prevail by suggesting that in some future hypothetical situation constitutional problems may possibly arise *as to the particular application of the statute ... Rather, petitioners must demonstrate that the act's underlineprovisions inevitably pose a present total and fatal conflict with applicable constitutional prohibitions."'*

People v. Perry (C-4): *the courts will not give their consideration to questions as to the constitutionality of a statute unless such consideration is necessary to the determination of a real and vital controversy between the litigants in the particular case before it. It is incumbent upon a party to an action or proceeding who assails a law invoked in the course thereof to show that the provisions of the statute thus assailed are applicable to him and that he is injuriously affected thereby.* This kind of connection is not possible by using traditional search methods without large amount of manual work on the part of the researchers.

Table 1: System Evaluation

	Total	Good	Bad	Accuracy
Set 1	616	588	28	95.45%
Set 2	815	688	127	88.41%
Set 3	681	647	34	95.00%
Overall	**2112**	**1923**	**189**	**91.05%**

4.3 Evaluation

A formal evaluation was conducted to assess the quality of the networks generated by the System's function, i.e. how relevant the selected citation links are to the starting legal discussion. A total of twenty-seven randomly-selected topics (divided into three sets) were processed by the System's network function. The resulting RFCs were read by three attorneys, who marked the RFCs as Excellent, Good, Fair, or Poor based on their judgment as to how similar each RFC was to the starting topic. Later, Excellent and Good markings were combined into the Good category; and Fair and Poor markings were collapsed into the Bad category. These were then used for the evaluation. Markings agreed on by at least two of the three attorneys were used to calculate the accuracy for each set. We calculated the System's accuracy, which is the ratio of good RFCs to total RFCs. An overall accuracy reading of 91.05% was recorded for the System. The result is shown in Table 1.

5. CONCLUSION AND FUTURE WORK

We have presented the Semantics-Based Legal Citation Network Viewer as a research tool for legal professionals. The Network Viewer accurately traces a given legal issue in past and subsequent cases along citation links, and gives the user a visual image of how citations on the same legal issue are interrelated. The user is allowed to navigate in the network, studying how his issues have evolved in the past and visually identifying possible landmark cases. The Viewer's "Digest Window" lists important legal discussion areas in the case, and lets the user "jump" to different points of interest quickly. Unlike traditional legal research tools, the Legal Citation Network Viewer enables legal researchers to focus their study on issues rather than whole cases and, in this way, save time. We believe that the System fits the attorneys' working model described in Section 1 of this paper, and should help researchers and legal scholars greatly in their line of work.

As a next step, we are working to add symbols to each case in the network to indicate how the case citation is treated so that the user could decide on its value. We may also incorporate secondary sources into the networks, which would further assist the legal professionals in their research.

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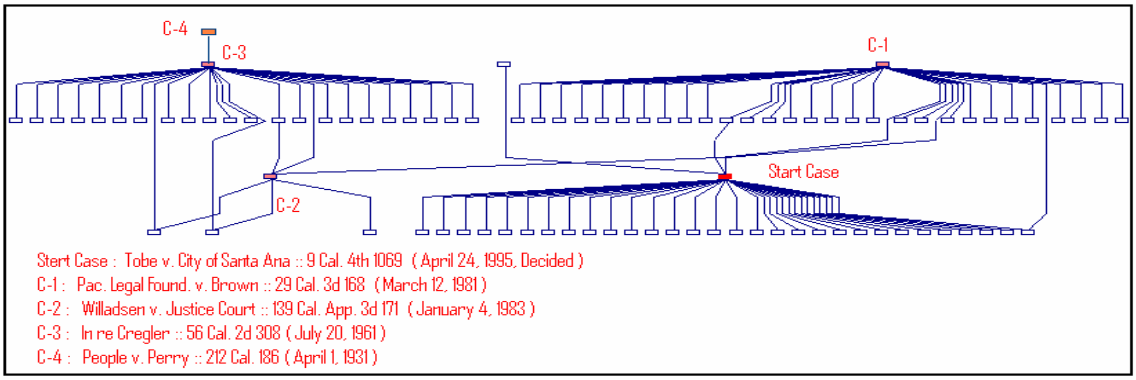

Figure 13: Network example

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