A Human-Centered Design Approach to Legal Analytics

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We used a human-centered design approach to provide users with access to information about the workings of the U.S. federal legal system. Presently, most of the records associated with the federal judiciary are provided through a difficult-to-use interface that prevents users from readily exploring systematic patterns about the court's activities. In order to build a human-centered platform that makes it possible for any person to ask questions and get answers about the mechanics of federal court, we conducted interviews, observations, and surveys to uncover the needs of our users. We found that users had challenges due to limited analytical skills and domain knowledge. We present the resulting design, which provides an intuitive interface for searching for court dockets as well as an analytical component for discovering answers to more advanced litigation questions.

CCS Concepts: • **Human-centered computing** → **Human computer interaction (HCI)**.

Additional Key Words and Phrases: human-centered design, prototype, surveys, interviews, law

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1 INTRODUCTION

The United States court system is the primary mechanism through which U.S. laws are formally adjudicated. Understanding how fairly, efficiently, and effectively the litigation system operates is critical to maintaining public trust [5, 8], which is one of the reasons why detailed records of all federal litigation are maintained by the courts. There is longstanding recognition of the scholarly potential contained within these records and the need to adopt methods from other social sciences to mine that potential [29]. Despite this, legal research has not benefited from the methodological advances in big data and analytics as much as in other fields [7, 10, 17, 21, 28].

This slow progress in conducting systematic analyses is not due to an actual lack of data volume. The U.S. federal court system has three main levels: district courts, circuit courts, and the Supreme Court. In 2018 alone, the 94 district courts, 13 circuit courts, and one Supreme Court composing the federal district court system handled approximately 275,000 federal civil cases and 80,000 criminal actions [38]. In fact, the complete federal litigation dockets are already maintained on a system operated by the Federal Judiciary, known as the Public Access to Court Electronic Records (PACER), that is available online to the public.

However, while most court records are technically accessible via PACER, there are significant costs [30] and it has a non-intuitive user interface with differing standards for recording court information across courts [24]. Despite the recognized need to conduct large-scale systematic analyses across multiple legal subject areas, few legal scholars

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have the technical ability to extract and manipulate the necessary content. Instead, anyone using PACER is largely constrained to using it in the primary way its designers had in mind: crafting specific queries to identify a single case.

While other tools exist which aim to address this issue and provide an improved user interface, such as Westlaw, LexisNexis, Bloomberg, and Lex Machina, they are still limited due to their cost as well as targeting a more narrow user base, lawyers. By identifying the needs of our users, which consists primarily of legal scholars and journalists, we were able to develop an easy-to-use, web-based interface that goes beyond what others have done to offer an approach to searching and analyzing court dockets.

This research proposes a legal analytics platform based on a human-centered design approach that focuses on legal scholars, journalists, and even the public accessing information in court records. Our approach eliminates the requisite technical skills that constrain the potential pool of users and researchers to only those with specific computational and statistical expertise. In this way the details of the federal judiciary and insights can be available and understandable to everyone.

2 RELATED WORK

In order to design a system that efficiently searches and answers questions on federal court records, we wanted to understand the target users and their needs to ensure the usability of the system. Therefore, we incorporated human-centered design strategies.

Researchers have shifted their focus from the technology itself to the users of a system [27]. The International Organization for Standardization (ISO) has defined human-centered design, or user-centered design, as "an approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques" [19].

Human-centered design has expanded to applications in numerous areas, such as health [15], education [9], business modeling [3], and journalism [1]. Studies using this method have included feedback from users, designers, and even community leaders [18]. In the book Change by Design, Tim Brown from the firm IDEO describes how design methods can be expanded to numerous areas such as the organizations themselves, hospitals, and universities [6].

Few studies focus on using human-centered design in the legal realm to make legal applications usable for users, such as legal scholars, journalists, and the public. Jackson [20] proposes that law schools teach human-centered design in addition to technology courses. This initiative is already happening in some universities [13]. Hagan [11] mentions that design thinking is particularly suitable for legal practitioners due to the potential to better solve problems, manage information, and provide more positive experiences overall for both lawyers and clients. Hagan [14] used human-centered design research to focus on the needs of users, rather than lawyers, when redesigning California county courts' in-person and online Self Help Centers. Hagan [12] found that users want legal help sites to have clarity, open access, authority, comprehensiveness, modern design, and conversation. Quintanilla [34] proposes a human-centered civil justice design to discover how people respond to features of the civil justice system.

Non-lawyers report twice as many usability difficulties than lawyers when completing information retrieval tasks on legal databases [26]. In order to make contracts readable to non-lawyers, studies have found that including visualizations of text-based contracts improved participants' answering speed and accuracy [31–33]. Hornbæk and Frøkjær [16] found that users prefer being provided with an overview of a document in addition to the details.

While court records are generally accessible for a fee via PACER, it has a non-intuitive user interface and the data is often unusable in practice [2, 24]. Research has shown that people benefit from systems that automatically present data visually [23, 39]. Our work focuses on federal litigation data and creating an easy-to-use search interface with dynamic

visualizations to better help users understand and answer questions they may not have been able to answer before without data analytical skills.

3 GENERATING USER NEEDS

In order to learn more about how legal scholars and journalists typically find answers to questions regarding court records, we first conducted user interviews (both in person and over the phone) and surveys. In-person interviews generally included observations first on how users used their current system for their legal research.

We conducted 28 sets of interviews on a total of 38 people (25 male and 13 female). Sixteen sets were in-person, with three interviews containing three people, two containing two, and the remaining 11 being individual interviews. Twelve sets of interviews were over the phone with two interviews having two people on the call and the remaining ten phone interviews being individual interviews. For the interviews, we chose institutions that would represent a variety of legal interests and functions. The specific organizations and individuals were a non-random convenience sample that either responded to a direct e-mail solicitation or contacted us because of publicity on social media. In-person interviews were approximately an hour and phone interviews 30 minutes, as in-person interviews generally contained observations as well. Those interviewed included faculty in law, sociology, and economics; lawyers; reporters; a journalism student; and directors of civil and criminal justice centers and commercial legal companies.

In order to reach a larger pool of participants, we sent surveys to our legal contacts and networks. We advertised the survey by emailing our networks as well as posting it on social media. See Supplementary Material for the full survey. Fifty one respondents completed the survey with 37 respondents providing occupational information. Of those respondents, 62% reported being academics with 17% of academics from law schools (Figure 1). The category labeled Communication/Marketing also included a marketing communication program housed in the School of Journalism. Examples areas of legal expertise of our respondents included intellectual property law, immigration, race and ethnicity, criminal procedure, and health. One academic in Chemical and Biological Engineering specialized in renewable energy.

3.1 Interview/Observation Results

During our phone and in-person interviews, we asked participants questions relating to the types of resources they currently used, what would be beneficial for them, and the types of research questions they would like to ask. During in-person interviews, we also conducted observations where we asked participants to show us the current tools they use for their research.

Participants generally accessed and analyzed legal data through advanced Google searches, PACER, Westlaw, Caselaw Access Project, and Bloomberg Law. One participant reported using Python or STATA for analysis and another participant had a custom-developed application that was created for her own research purposes. Participants reported wanting to answer advanced questions currently beyond their capabilities, such as searching by outcome on a specific issue and finding out information such as Plaintiffs argue X issue in Y motion and it is successful Z% of the time. A small portion of users with sufficient skills were doing additional ad hoc analysis work to pick up from where the tool left off and mentioned benefitting from a cleaned dataset. One participant mentioned not trusting others to do the data manipulations for them and wanting to do it themselves.

We also noticed how tied participants were to search features that looked like what they were accustomed to. One participant, for example, said he would only use a system that was similar to what he knew in terms of advanced searching. However, these users still wanted to be able to do more and ask additional questions that currently were not possible. One user mentioned wanting to be able to search in different ways based on topics, answers, and opinions.

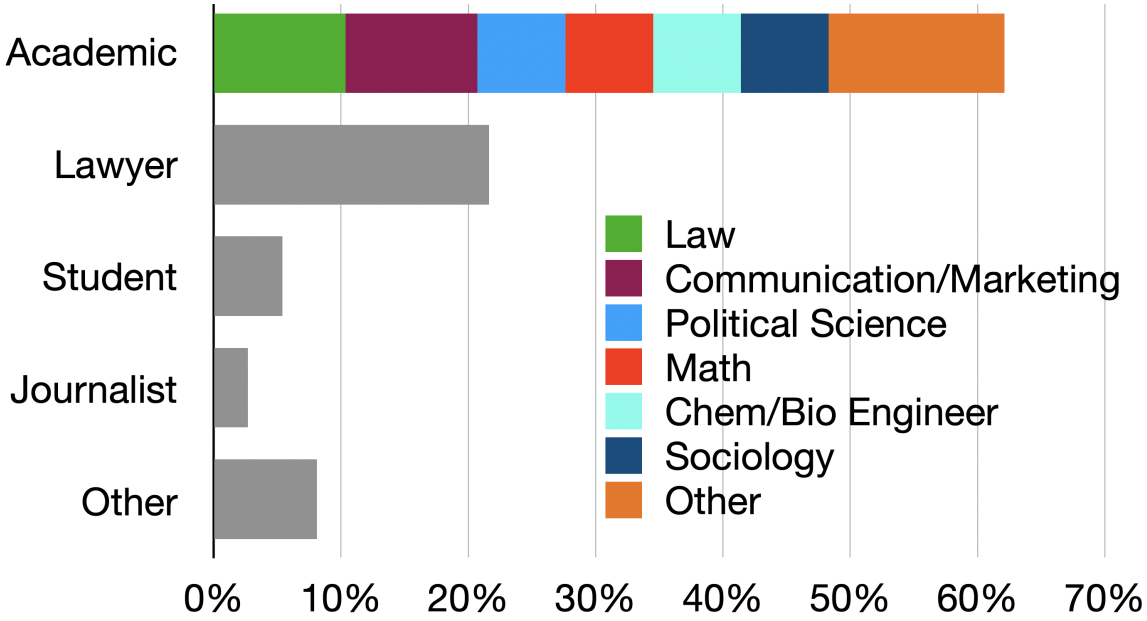


Fig. 1. Breakdown of Survey Participants by Profession

Others mentioned wanting visualizations of the data. The common theme that emerged from the interviews was that users felt they were limited by the tools they were currently using and wanted to ask questions of the data that they currently could not answer.

3.2 Survey Results

The goals of the survey were to determine user skills (both technical and legal) and questions users would like to answer but are unable to. When discussing who would generally be using our system and what their technical and legal skills were, we initially had a matrix with two components, technical and legal knowledge (Figure 2a). However, we realized that the legal knowledge of a law professor who does social-science research is quite different from the legal knowledge of a litigator who is in court most days. Both have expert knowledge, but the researcher has knowledge looking from the outside of the legal system in, while the attorney has inside knowledge. Similarly, we recognized that our user base varied in terms of comfort with common search tools, which is a separate dimension from comfort with statistics and data analysis. Therefore, we realized that we were interested in measuring four types of user skills (Figure 2b).

Hence our survey had four main questions, and choices to these questions ranged from not familiar/comfortable, generally familiar/comfortable, advanced, and expert. We analyzed the data of our four main questions on users' data skills and legal knowledge (Figure 3), and found that 53% of the respondents were only comfortable with general keyword searching, which we denote as Generally Familiar, with 37% conducting advanced searches (Advanced), and only 10% had advanced coding skills to search for and construct complex queries (Expert). Similarly, 51% of respondents were comfortable reading graphs (Generally Familiar), 30% were able to use statistical tools (Advanced), and only 12% were able to build programs to extract information from data (Expert). Note that 8% of the respondents reported not being comfortable with data analysis (Not Familiar).

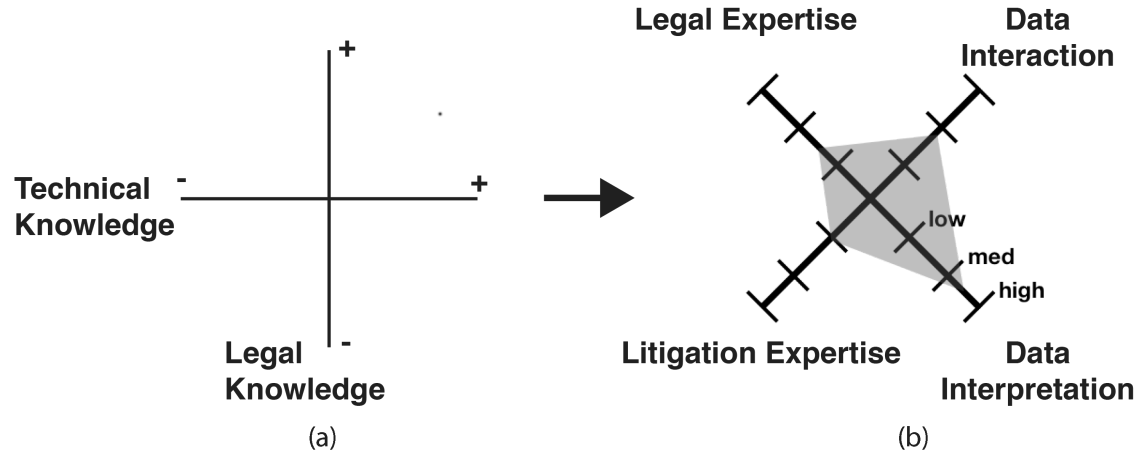


Fig. 2. Skills Matrices (a) Initial Skills Matrix (b) Revised matrix showing an example of a user measured across four dimensions.

In terms of their legal knowledge, 10% were not familiar with the justice system (Not Familiar) while 41% were generally familiar with how the U.S. justice system works (Generally Familiar). The remaining 22% (Advanced) and 27% (Expert) had legal expertise in one or more areas respectively. With regard to their litigation expertise, 8% were not familiar with litigation (Not Familiar), 63% of the respondents had a general understanding of civil and/or criminal procedures (Generally Familiar), 20% studied litigation (Advanced) , and 10% were litigators (Expert).

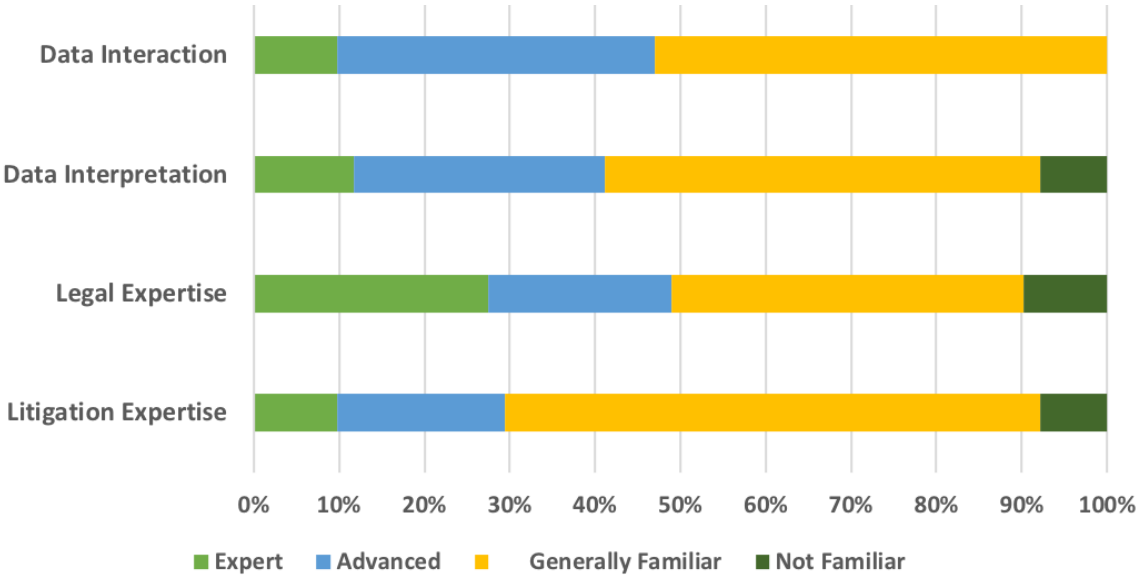


Fig. 3. Participants' self-ranked levels of data and legal expertise

Based on users' responses to these four questions, we asked follow-up questions to discover more about their experiences, such as the legal, analytical, and visualization tools they currently used. In order to determine what research questions users would like to answer, we also wanted to find out answers to:

a What are users currently trying to answer?
b What obstacles do they encounter?
c What questions would they like to explore but are unable to?

Some examples we found for what participants were currently asking with the data, included: "Can environment be linked to crime?"; "Who was judge? Who was refugee in asylum case (name and other PII)?"; "Is there a relationship between characteristics of sentencing and the reentry process, including monetary sanctions and probationary requirements?" Sample responses for what questions users would like to ask but are currently not able to include:

> "I would love to assess how predictive a person's criminal record/history, especially juvenile history, is of future gun offenses. I would also love to know whether sending someone to prison (for a gun offense) has both an individual and general deterrence effect."

> "I don't have specific questions, but as a journalist would love simple access to legal cases. I have tried (and been confused by) PACER; I cannot afford and don't have training in Lexis searches."

In terms of challenges they experienced, many shared that they had limitations regarding their lack of data skills, some examples include: "Unexpected data format while parsing data. Personal knowledge limitations." and "lack of skills." Many of the survey respondents reported seeking assistance when they could not do the analysis themselves.

We generated three types of personas for our users based on the survey results.

(1) Basic Searchers: The largest category of our users were generally familiar with the US justice system, had a general understanding of civil and/or criminal procedures, were comfortable with a basic keyword search using a search engine, and were comfortable reading a quantitative graph, table, or chart. As noted in Figure 3, 53% of the respondents were only comfortable with general keyword searching and 43% reported being both comfortable with basic keyword searching and reading graphs. We call these users 'Basic Searchers.' Figure 4a depicts a sample user who would fit in this persona.
(2) Legal Analysts: We also noticed 35% of respondents had legal expertise in one or more areas of law in addition to advanced searching skills and/or advanced data interpretation skills such that they could use statistical tools to build visualizations. We name these users 'Legal Analysts.' Some Legal Analysts had both statistical and advanced searching skills. A sample of a Legal Analyst is depicted in Figure 4b.
(3) Advanced Users: Nine respondents (18%) reported being advanced coders or using programming to extract data, but rarely both. We refer to them as 'Advanced Users.' Most of our advanced users had only a general understanding of the U.S. justice system, with only two out of nine respondents having advanced legal knowledge. See Figure 4c for an example of an Advanced User.

3.3 User Needs

Based on the user interviews, observations, and surveys, we created personas of our different types of users and uncovered four main user needs: Access to Raw and Clean Data; Better Searching Options; Clarity on Documents; and Answers to Research Questions.

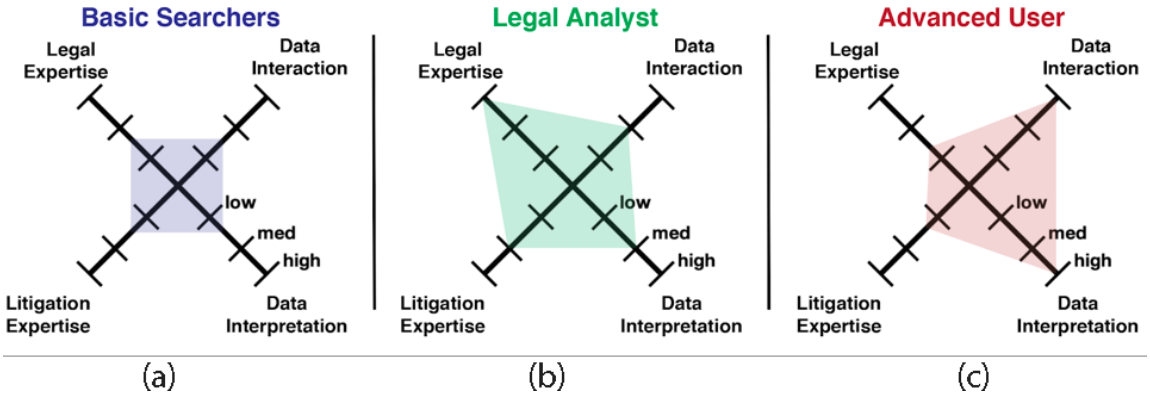


Fig. 4. User Personas (a) Example of a Basic Searcher (b) Example of a Legal Analyst (c) Example of an Advanced User

Access to Raw and Clean Data

While the majority of our users were not comfortable with code, some of our Advanced Users wanted to have access to the raw data to perform their own analysis. We noticed comments indicating this both in the interviews and survey results. A couple of participants mentioned not trusting analysis unless they did it themselves. Many, however, requested a system that would process and standardize the data in order to make it more consistently structured, for example, tracking cases across different courts.

Intuitive Search Interfaces

Many users, who were typically our Basic Searchers, mentioned wanting better searching options/filters to limit cases of interest. They wanted an easier-to-use user interface for searching. Some users mentioned wanting to have key cases appear, similar cases appear, and the ability to search by specific entities they were interested in such as a judge or location. In addition, they wanted to have graph visualization of this data.

Clarity on Documents

There were a number of users, particularly journalists and other Basic Searchers, who did not understand the documents/dockets and felt some type of summarization or reformatting/highlighting of the documents themselves would be helpful. In addition, some mentioned the possibility of having searching/tagging within the documents in order to find pertinent information such as complaints.

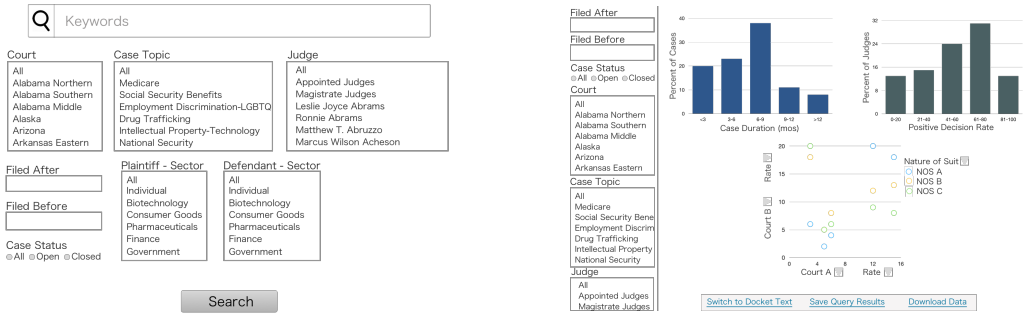
Answers to Research Questions

Many of our users, primarily Basic Searchers and Legal Analysts, mentioned that they would benefit from being able to answer more advanced research questions, such as correlations, and being provided with visualizations. Visualizations could make it easier for a non-technical person to obtain answers to questions they are unable to answer themselves.

4 PROTOTYPE DESIGN

Based on users' needs from surveys and interviews, we created rough mockups of a potential system (Figure 5). During the needfinding process, we found that users' primary goal was to get data and answer research questions after using a

search that looked familiar to what they were used to. Therefore, our initial mockups included a system that would take them from the search interface directly to visualizations of the data. We tested it on users at a large institutional civil justice center and technology law clinic.



(a) (b)

Fig. 5. User Personas (a) Example of a Basic Searcher (b) Example of a Legal Analyst (c) Example of an Advanced User

Based on their feedback of the prototype, we found that there were certain elements that users found difficult given their previous experience. Notably, moving from a search page directly to data visualizations confused them given their past experience with text-based search interfaces. Before moving on to making visualizations, they wanted to be able to see all of the cases and be able to scroll through results in order to understand what was in the data since they had not previously had this level of access. Users also made it clear they wanted the ability to track their search history in order to help them later recall how they arrived at certain search results. Below we summarize highlights from user testing on the prototypes. Our users:

- Wanted a feature to keep track of their search history.
- Wanted a short search summarization of their results.
- Wanted transparency regarding the order results appear and whether machine learning was used to analyze the data vs. tagged keywords.
- Wanted to see graphs fitting for their own research, not what was predetermined in the prototype.
- Wanted the keywords they searched on to be highlighted in the docket.
- Did not want a search feature that took them directly to visualization. They wanted a way to see the data returned first in order to verify the results.

There were also discussions regarding the purpose of the site and how lawyers and academics would use it differently. Whereas lawyers want to see outcomes, academics would want trends over time and more complex data analyses.

The user feedback from the prototype led us to the development of three main use cases for our system:

(1) Users who want only a way to search and find relevant case documents.
(2) Users who want more targeted analyses, such as with cases regarding a particular judge.
(3) Users who want more advanced analyses on the system, such as scrutinizing past trends.

5 USER INTERFACE

We followed the 'notebook' platform pioneered by Mathematica and popularized by the Jupyter notebook project [22, 35], where a notebook is composed of individual cells that can be written and run independently. Each notebook can store multiple searches, which can be accessed using a navigation sidebar. The interaction model we adopted will promote sharing and reproducibility. Figure 6 shows screenshots of our web-based interface.

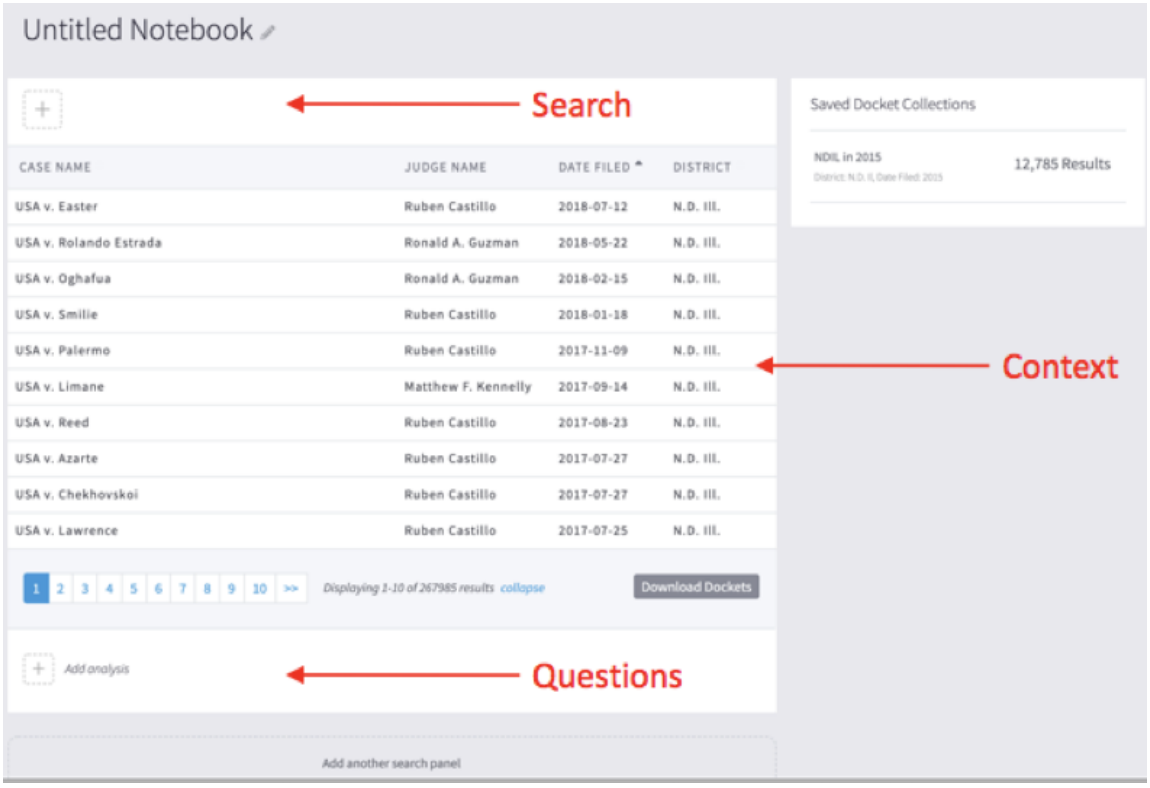


Fig. 6. Interface from the point of view of Context (the collection of cases in our focus), Search (the ability to filter this set by entities and free text), and Questions (the ability to ask questions about the context and elements within it)

In response to user input, we opted for a data-focused search model. Every new cell in a notebook starts by displaying the full set of records in the database as paginated results. This allows users to track the current composition of the database. A user can then add filters to narrow the displayed results (for example, "Court must be Northern District of Illinois"). After adding a filter, the search results are immediately updated, enabling the user to learn how the filter has restricted the data, and to determine whether the filter used produced the desired behavior.

Figure 7 shows a context that can be searched with free text or through a focus on specific aspects of a case (judge, district, type of case). In this example, we are searching for all cases in which "Kennelly" was listed as a judge at some point during the case, generating a new context. When exploring the context, users also have the option to view the original case document since many users felt more comfortable with access to the original data.

Note that some functionality is still in the prototype phase. For example, the Download Dockets button on the bottom right and the saved docket search history on the right are currently placeholders and will be implemented in our next release in version 2. The download docket button will be for those who will want to download the data for their own use and the saved docket collections will allow users to save a context for future reference.

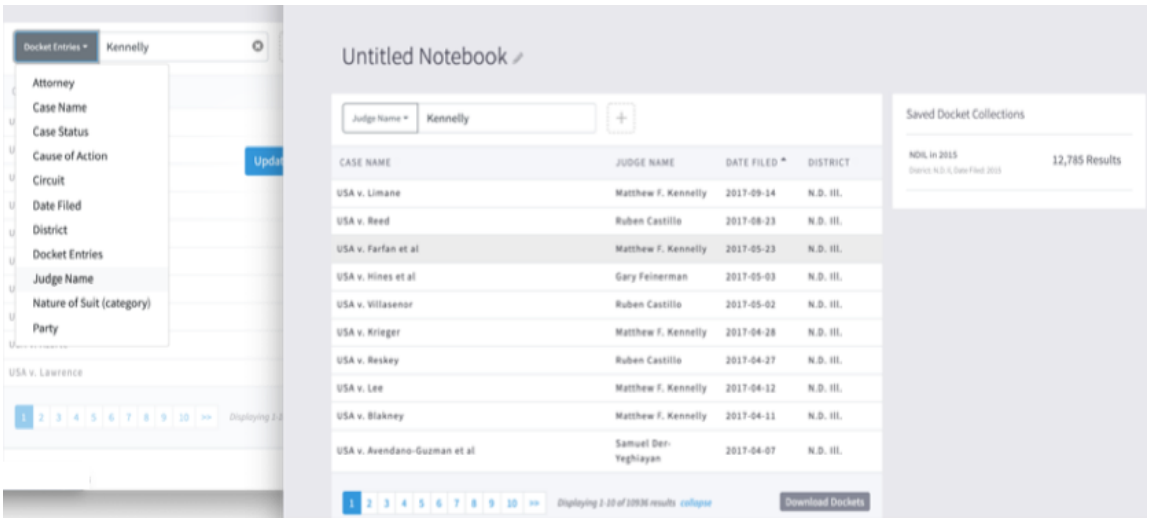


Fig. 7. Searching for a Judge

The final feature of our notebook cells interface is statistical analyses of the search results. This includes both basic and complex aggregations. Basic aggregations include questions such as "what is the average duration of a case" (Figure 8). This can be refined by searching within it, such as for the Northern District of Illinois as each notebook's search context is connected to the analyses of that cell. This multi-level functionality enables easy toggling between the search results and data visualization, enhancing data exploration.

Fig. 8. Asking questions

Complex aggregations can include asking questions such as how the number of habeas corpus cases per capita varies by jurisdiction. Users can also do time-series analyses of the search results such as graphing how the number of immigration cases changes over time for a given period. Through these functionalities, users can do legal analysis such as looking at the evolution of case duration over time by looking at how it changes year over year or whether there is a relationship between the number of cases given to judges and the number of years that judge has been on the bench (Figure 9).

Fig. 9. Asking questions (a) Trends over year (b) bar graph depicting average case duration based on judge tenure

6 DISCUSSION

We developed an interface using human-centered design principles which allows academics, journalists, or the public—including those without technical or data analytical skills—to be able to ask questions of federal court data and receive answers. We used a human-centered approach where we interviewed, observed, and surveyed users and found four main user needs: Access to Data, Intuitive Search Interfaces, Clarity on Document, and Answers to Research Questions. While our prototype attempted to address these concerns, after conducting a search the next screen brought them straight to data analysis whether or not the user wanted to see the analytics. This initial approach did not fit our users' needs. Our current design has all of the search results displayed first in order for people to view their results, verify their searches, and make modifications to the filters until they are happy with their search results. At that time they can query the data further and ask questions based on the current context they are in. This context can be saved and later accessed again. Below we discuss each of the four user needs, with the features that address them in the implementation:

Intuitive Search Interfaces

Our largest category of users were Basic Searchers who were comfortable with basic keyword searching and reading graphs and figures. However, they did not have the technical skills to conduct analyses themselves. Our system primarily addresses their needs. These users acknowledged that the existing interface for using PACER was awkward and hard to use, even when conducting basic searching. Prior research mentions the limited searching options in PACER (Martin, 2018). Furthermore, though some of the users mentioned finding other tools (such as LexisNexis and Westlaw) easier to search with, they still found it costly and limiting. For example, a journalist mentioned in their survey not being

able to afford or have training in LexisNexis searches. The primary purpose of our design was centered on modern and easy-to-use filtering of data such as judge name and location. To do this we leveraged inspiration from Jupyter Notebooks as they are easy to read and share [22].

Clarity on Documents

We included a highlighting feature in the dockets. As a user enters a keyword search, the dockets that appear will have those keywords highlighted in it, in order to narrow their search in the docket itself and to demonstrate why that docket appeared. This component was one mentioned as desirable by users as they often found the raw dockets confusing. This feature helps Basic Searchers, who were often confused with the court dockets themselves. Even Advanced Searchers, while their programming skills may allow them to conduct their own analysis, their legal background was more limited. Future work will look to include a summarization feature, summarizing the data.

Access to Data

A few of the more technically savvy users requested access to the data in order to conduct analyses themselves. These users mentioned not trusting a system. Research has shown that with the expansion of big data and visual analytics, users have uncertainties and a lack of trust in artificial intelligence and visual analytics [36, 37]. Therefore, after assisting the user in filtering the court records using a dynamic set of search parameters, we allow the user to take a snapshot of the filtered docket set using a download button. This feature may be beneficial for our Advanced Users.

Answers to Research Questions

A unique aspect of our research design was being able to answer questions users have without them having to manually conduct data analysis, which many of our users did not know how to do. Even those users who we refer to as our Legal Analysts, while they had legal expertise, and could conduct advanced searches or create their own visualizations, their programming skills to extract information directly from data or construct complex queries were more limited. Judicial Analytics is defined as "big data meets court dockets," and referred to as "the next wave in legal research" [4]. McGill and Salyzyn [25] point out that one benefit of judicial analytics is the transparency into the work of judges. Our goal supports this effort as we design an interface for asking legal questions and obtaining analytical answers. The overall goal of our design is to show what can be possible for legal scholars, journalists, and even the public with regard to court transparency and asking questions about judges and viewing trends over time.

While some products (for a fee) provide court docket data searching, they are still limited due to the cost as well as other constraints (see Figure 10). Through user surveys, interviews, observations, and prototypes we have discovered features that our users want in their system. Therefore, version one of our site provides a free, easy to use search interface to search entities and their attributes, perform analysis, and highlight searched keywords in the dockets. Future work will incorporate additional dockets and other datasets in order to answer more types of questions. In addition, we will keep track of users' search history and create a summarization of the analysis.

Furthermore, we created a separate web-based tagging tool where lawyers and law students tagged motions in dockets and classified them using machine learning. We plan to create a similar generic tagging tool, which will allow users to tag any item of interest in the docket entries, such as orders, notices and affidavits, and use machine learning to recognize these tagged items so that they can also be included as searchable items in the future.

ACCESSING COURT RECORDS	PACER	BLOOMBERG LITIGATION ANALYSIS	LEXISADVANCE & WESTLAW LITIGATION	LEX MACHINA	[OMITTED]
Basic search by case feature	✓	✓	✓	✓	✓
Keyword searches	x	✓	✓	✓	✓
Search by judge attributes	x	x	x	x	✓
Search by motions	x	✓	✓	✓	✓
User tagging capabilities	x	x	x	x	✓
User search history	x	✓	✓	x	✓
Docket highlight keywords	x	x	x	x	✓
Open access	x	x	x	x	✓
Data analysis	x	✓	✓	✓	✓
Summarization of analysis	x	x	x	x	✓
Includes all types civil suits	✓	✓	✓	x	✓
Includes all criminal cases	✓	✓	✓	x	✓

Fig. 10. Comparison chart of our design (name omitted for blind review) with similar tools out there

7 CONCLUSION

Based on human-centered design research, we interviewed, observed, and surveyed potential users and designed an application that provides an easy method for searching and finding answers to questions on federal court records. Legal scholars, journalists, policy makers and social scientists can use the system to answer questions they have about the U.S. legal system despite any lack of data analytics skills. Future research will expand on the interface to include additional features such as summarization and custom tagging of data.

8 ACKNOWLEDGMENTS

Omitted for blind review.

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