

Legal Citation Machine

AI-powered precedent mapping and citation-strength analysis with human-style reasoning

December 10th, 2025

UC Berkeley School of Information



Agenda

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- 01 Problem Space

 - 02 Capabilities & Prototype

 - 03 Technical Approaches

 - 04 Knowledge Graph

 - 05 Citation Classifier

 - 06 Case Classifier

 - 07 Conclusion
-



Team Members



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Problem Space

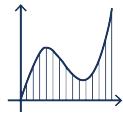
Problem Statement, Existing Solutions, Users and Impact

Problem

Lawyers **rely on citations** to build arguments and persuade courts

... But today's citator tools are often **proprietary, expensive, and built on dated infrastructure.**

Impact and Opportunity



Targets a **fast-growing, multi-billion-dollar legal tech and research market** where firms are actively adopting AI.



Targets the legal research market, where major platforms like Westlaw and LexisNexis serve **thousands of law firms and generate billions annually**



Real value is in demonstrating that **LLM-based systems can deliver citation analysis with the same (or better) accuracy, and transparency as traditional tools.**

What Makes this Different?

Existing Solutions



Unstructured Search Results

Long keyword lists force researchers to open case after case to find useful facts or context.



Shallow treatment labels

Fixed tags like “followed” don’t capture the court’s actual reasoning.



Hard-to-read citation safety

Determining whether a case is safe to cite requires lengthy manual effort.



Complex workflows

Tools require manual digging and their interfaces take too long to master

WK <> Berkeley Solution

Structured, scannable snapshots

Single search present critical details in a structured layout.

Human-like rationales

LLM explains how later courts relied on or limited the case with paragraph-level reasoning.

Transparent citation-strength

Simple formula turns full treatment history into a single, reliable signal.

Intuitive interface

Key information surfaces instantly with evidence visible for quick validation.

The Value of Our Solution

Accurate citation analysis that **lawyers can rely on**.
Our system demonstrates that modern LLMs can serve
the same purpose as traditional citators while showing
reasonable rationale.

Capabilities & Prototype

Capabilities, Demo

Interactive Case Lookup & Chatbot Interface

Case Lookup



- Easy-to-use, targeted search across cases
- Immediate case classification with rationale
- Key case metadata
- Full list of citing cases with treatment labels and rational, exportable to CSV

Chatbot



- Ask any ADA-related questions, see citation history, and surface related facts stored in Neo4j
- Explore citation patterns and precedent
- Compare cases and treatments
- Get step-by-step reasoning in plain English

Capabilities & Prototype

Demo

5. Circuit Selection Strategy

Type: Infrastructure Open Source

Description:
Selects which circuit to take in case of a failure. It checks if the circuit is still available and if it has been modified recently.

Help:
- Selects which circuit to take in case of a failure.
- Checks if the circuit is still available.
- Checks if the circuit has been modified recently.

6. Label Priority Order

Type: InfraCloud Open Source

Description:
Selects the priority order for labels. It can be configured to prioritize specific labels or use a random order.

Help:
- Priority order for labels.
- Random order for labels.

Submit

Cancel

Chatbot – Types of Questions You Can Ask

Orientation: “*What kinds of cases are in your database?*”



Single case: “*Summarize Access Now v. Southwest Airlines.*”

Citation treatment: “*Show citing cases that criticize Access Now and explain how.*”

Compare cases: “*Compare [Case A] and [Case B] on ‘major life activity’.*”

ADA concepts: “*What is a ‘qualified individual with a disability’ under the ADA?*”

Scenarios: “*Given this fact pattern, which ‘Good’ precedents support the employee?*”

Patterns / research: “*Show ADA cases on remote work as a reasonable accommodation.*”

Technical Approaches

Technical Approaches

Capabilities

HOW TO UNDERSTAND THE LABEL QUICKLY

Visualize the case information, citation relationship and case labels, and interact with user to deliver a comprehensive solution.

HOW IS THE CITED CASE TREATED OVERALL BY THE CITING CASES?

Roll up all citation treatments into a clear, formula-driven score showing whether a case is strong, weak, or mixed precedent.



HOW TO UNDERSTAND THE CITED CASE

QUICKLY? Find any case fast and surface key facts (court, date, summary, and link) at a glance.

HOW TO CONNECT CASES AND CITATIONS?

Visualize every citing case in a clean, structured map that's easy to scan.

HOW DOES THE CITING CASE TREAT THE CITED CASES?

Label each citation as positive, neutral, or negative with paragraph-level reasoning that tracks real legal analysis.

A 4-Step Process to Realize the Capabilities

Step 4: Deploy to end user with interactive search machine and chatbot design

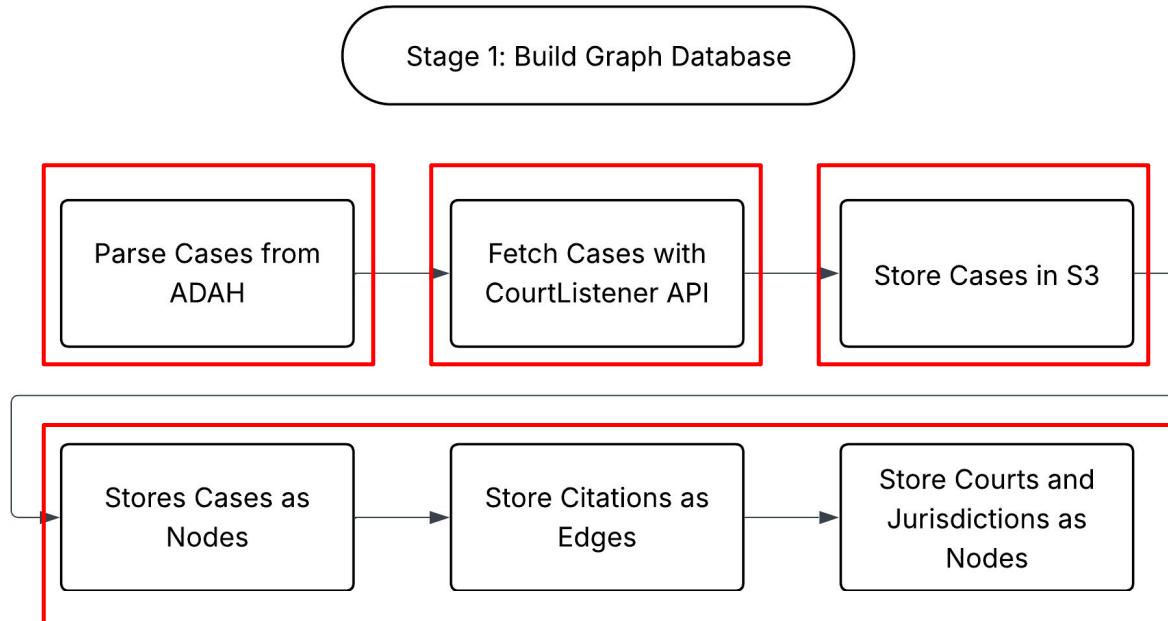
Step 3: Develop computational algorithm to classify individual case Label the Case



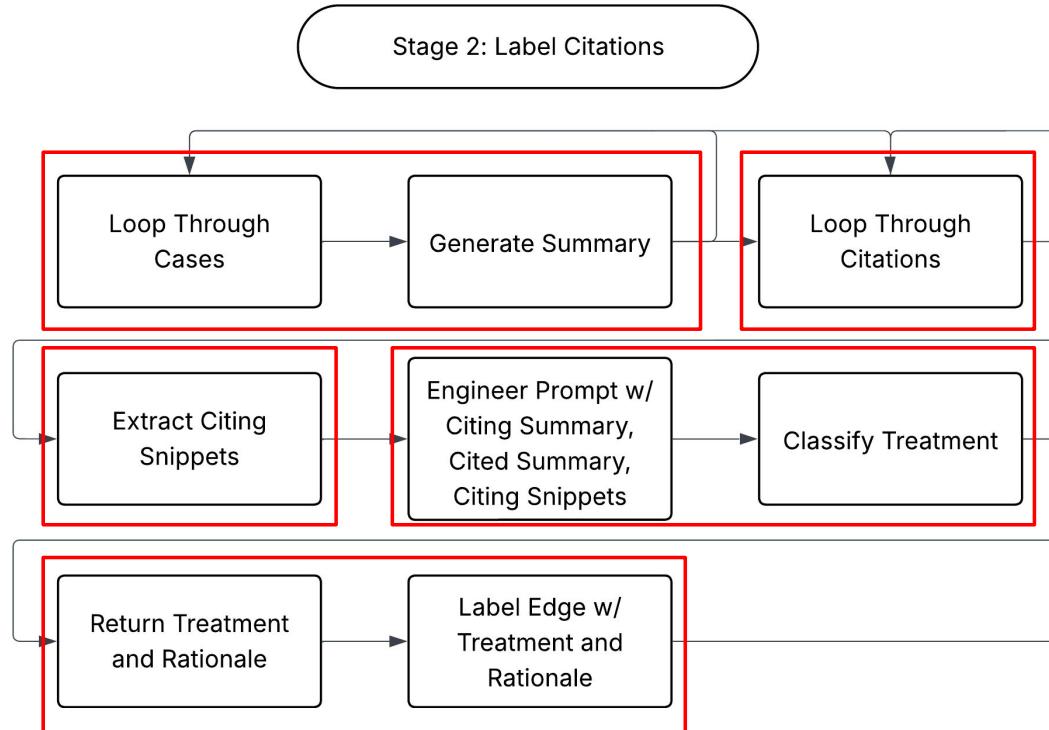
Step 1: Develop a semantic layer of cases, using knowledge graph to capture attributes such as name, decision date, court, jurisdiction, summary, and URL

Step 2: Develop classifier for each single citation

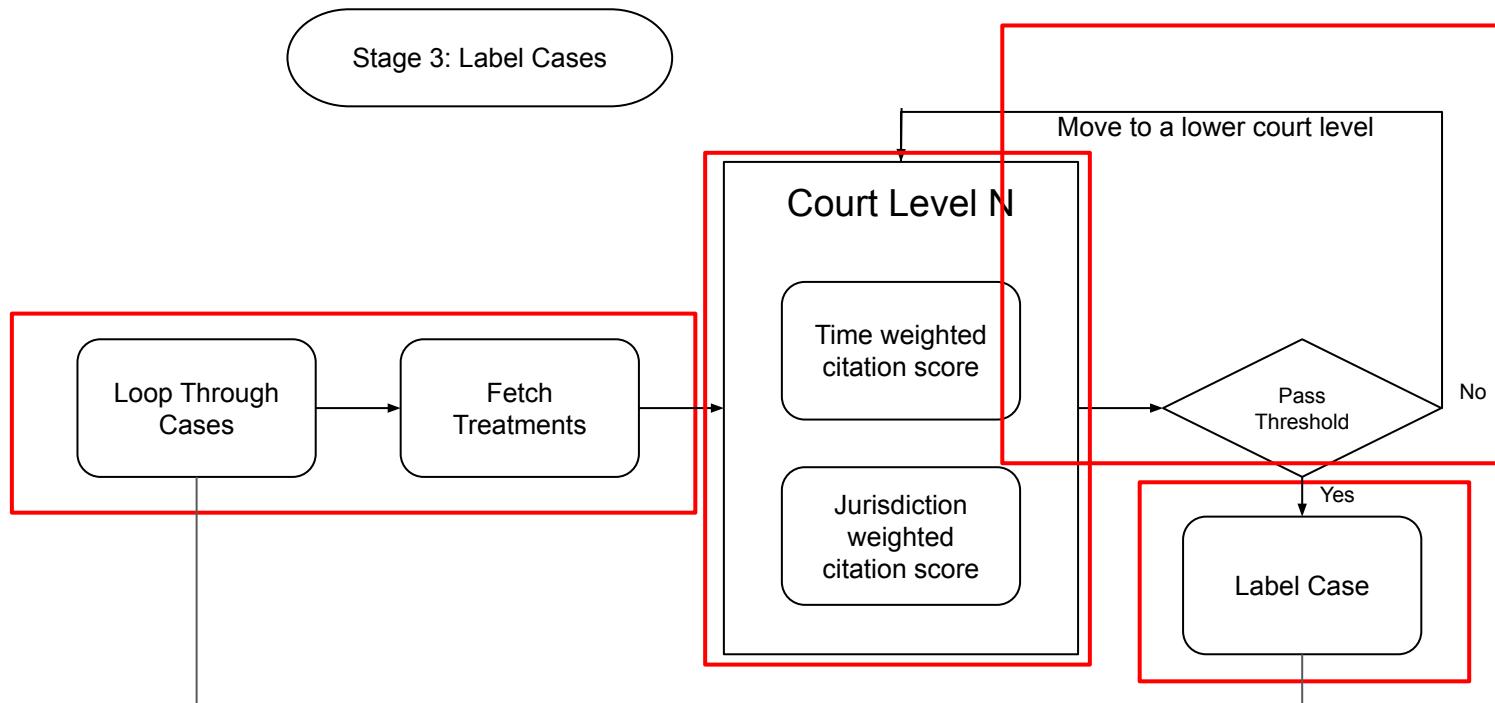
Stage 1: Build a Graph Database for Case Search and Mapping



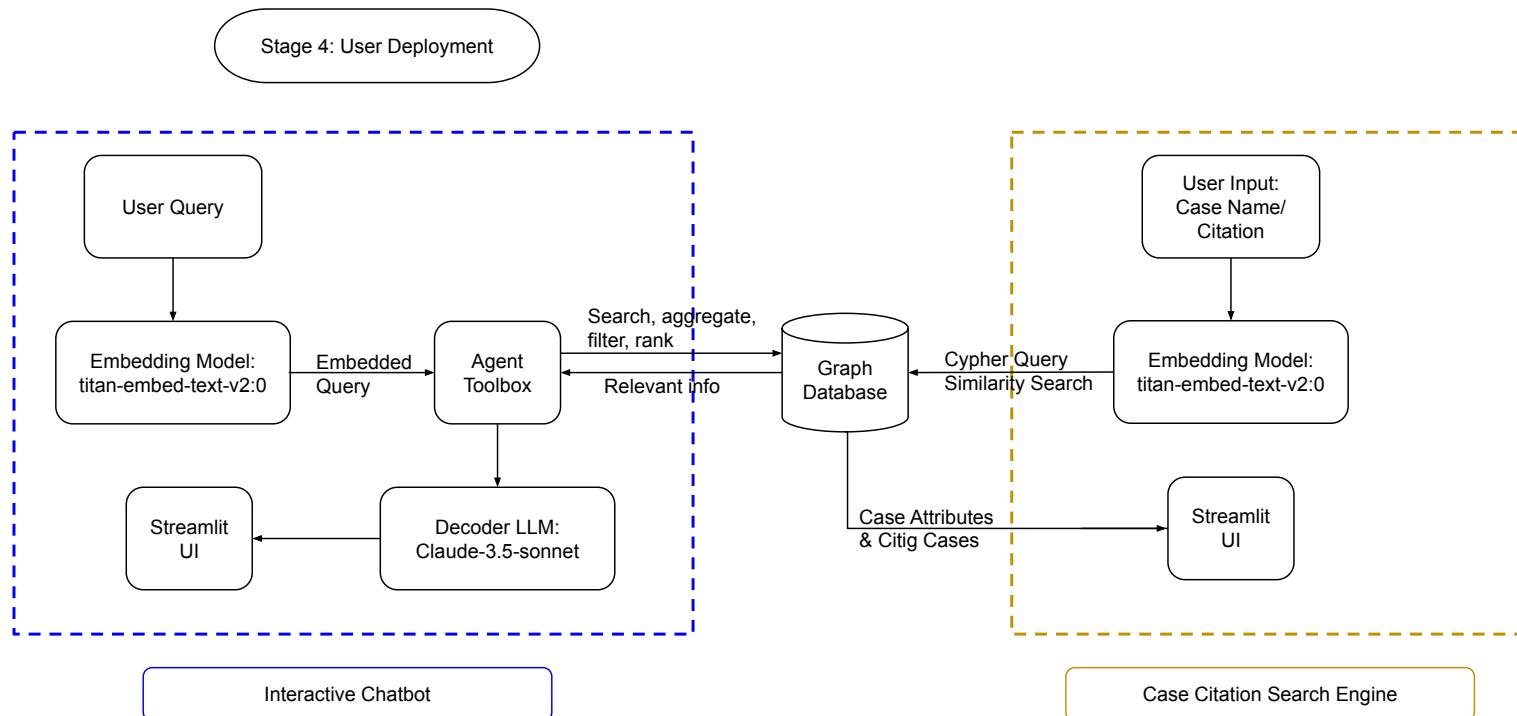
Stage 2: Develop Classifier for Single Citation for Label with Rationale



Stage 3: Develop Computational Algorithm for Case Classification



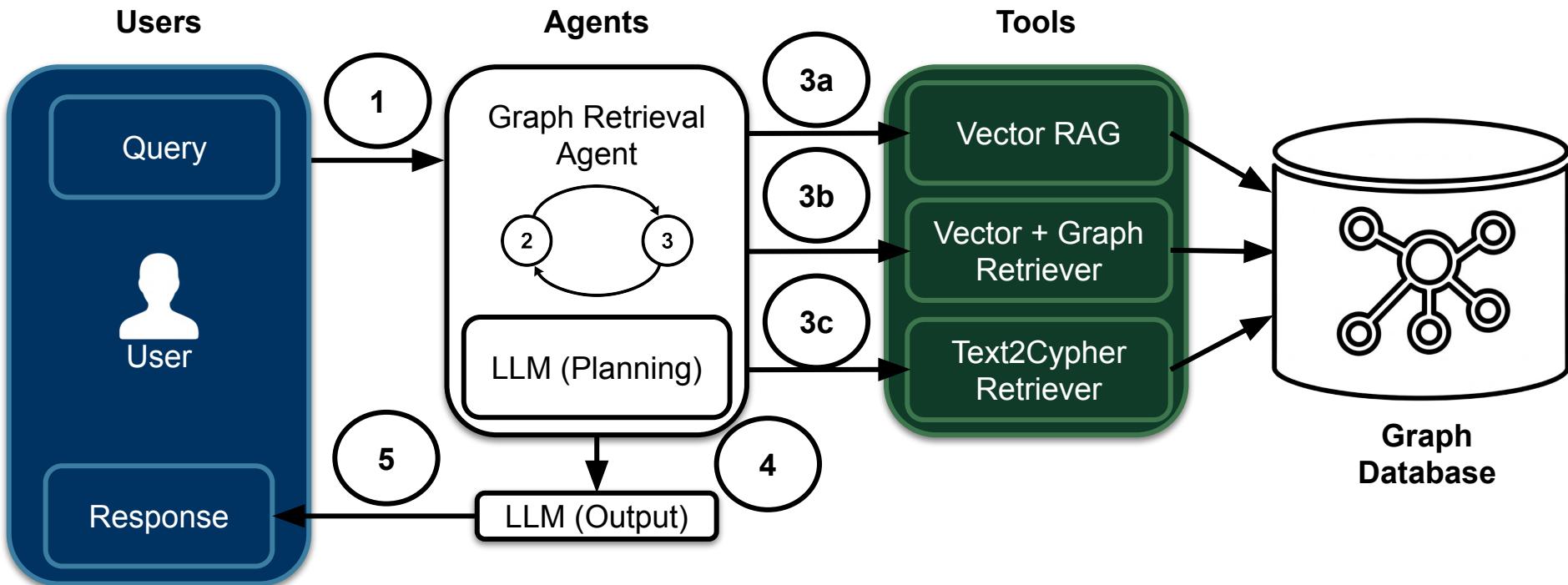
Stage 4: Deploy to end user with interactive search machine and chatbot design



Building an Interactive Chatbot

LLM = Claude 3.5 Sonnet
Embedder = Amazon Titan
Text Embeddings V2

Agentic GraphRAG Framework



Knowledge Graph

Dataset, EDA, ETL Pipeline, Knowledge Graph

Knowledge Graph

Dataset

Stage 1: Build a Graph Database for Case Search and Mapping

Source

- Americans with Disabilities Act Handbook (ADAH)
- CourtListener

Case Range: Cases in ADAH and cases citing ADAH cases



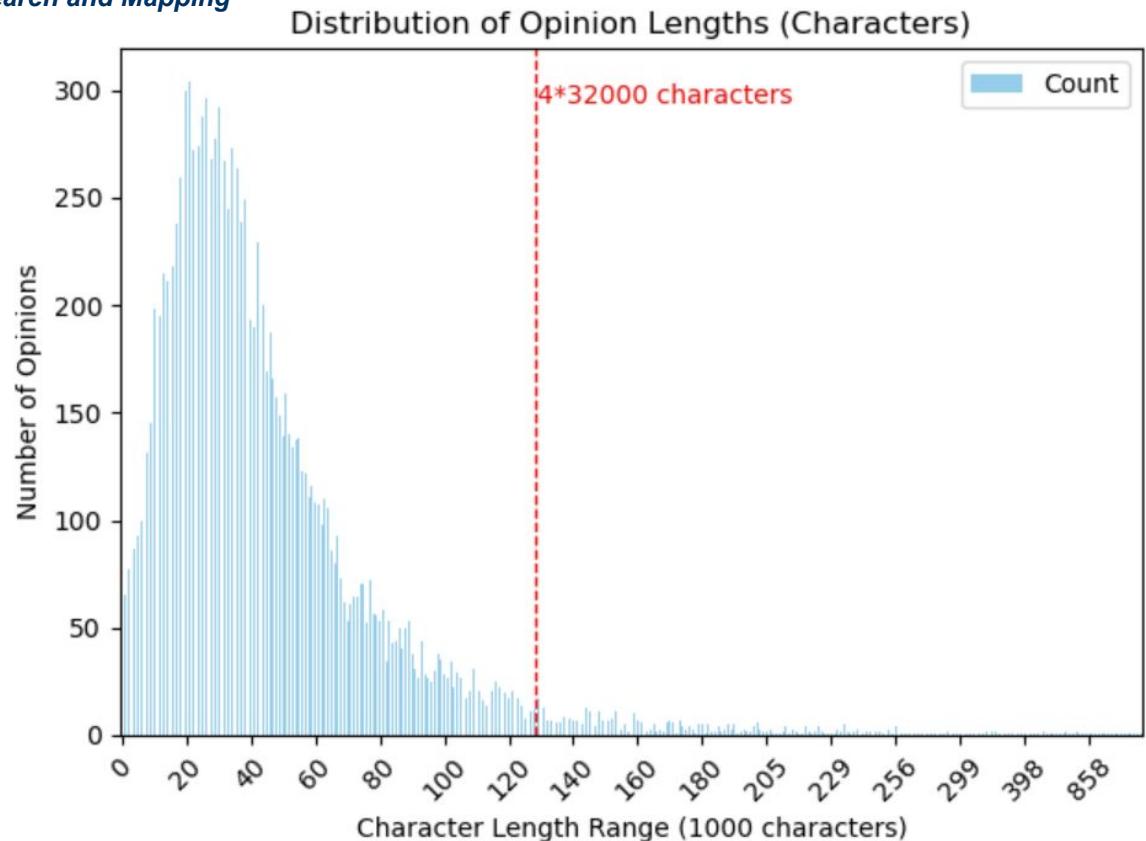
The screenshot shows the homepage of the CourtListener website. At the top, there is a navigation bar with links for "Case Law", "RECAP Archive", "Oral Arguments", "Judges", and "Financial Disclosures". There is also a "Donate" button and a "Sign In / Register" link. The main search area features a search bar with placeholder text "Search millions of legal decisions by case name, topic, or citation." and a "Search" button. Below the search bar, it says "470 Jurisdictions. Sponsored by the Non-Profit Free Law Project." A "Latest Opinions" section lists recent cases like "White v. Commissioner of Correction (Conn. App. Ct. 2025)" and "Lisboa v. Commissioner of Correction (Conn. App. Ct. 2025)". Another section, "About CourtListener", provides information about the project's mission and its role in providing free legal research tools. The "About Free Law Project" section details the project's goals and its work on building an open access, open access, legal research ecosystem. The bottom of the page shows a "Latest Oral Arguments" section with entries for "Ramona Milam v. Selene Finance (7th Cir. 2025)" and "Randy Talev v. Carl Gledoe (7th Cir. 2025)". Other sections include "Berkey International, LLC v. U.S. Environmental Protection Agency (1st Cir. 2025)", "People v. Smith (Ill. App. Ct. 2025)", and "United States v. Ricco Saine (6th Cir. 2025)".

EDA

Stage 1: Build a Graph Database for Case Search and Mapping

Case Length

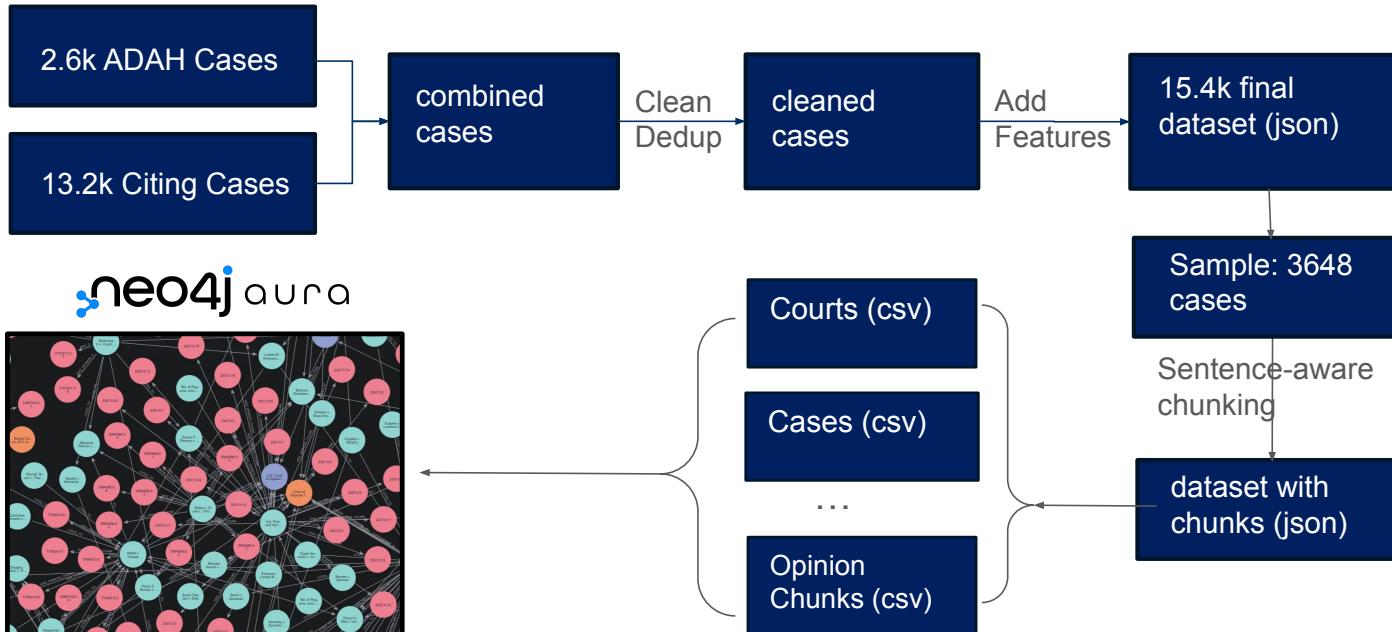
A model with context length > 32,000 tokens will cover 95% of the cases from total dataset.



Knowledge Graph

ETL Pipeline

Stage 1: Build a Graph Database for Case Search and Mapping

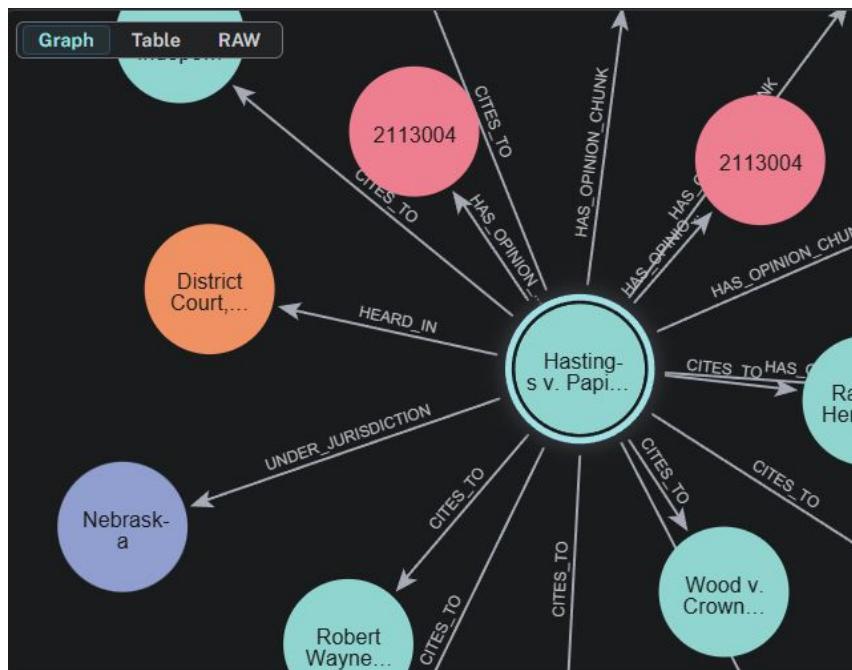


- Standardize white space, remove control characters
- Add court level, jurisdiction
- Sentence-aware chunking method

Knowledge Graph

Knowledge Graph for Case Search and Citation Mapping

Stage 1: Build a Graph Database for Case Search and Mapping



Cases: 3,648

- ADAH cases: 410

- Non-ADAH cases: 3,238



Courts: 241

Jurisdictions: 116

Opinion chunks: 56,347

:CITES_TO Relationships: 5,491

**13.4 chunks per cases/
40k characters per chunk**

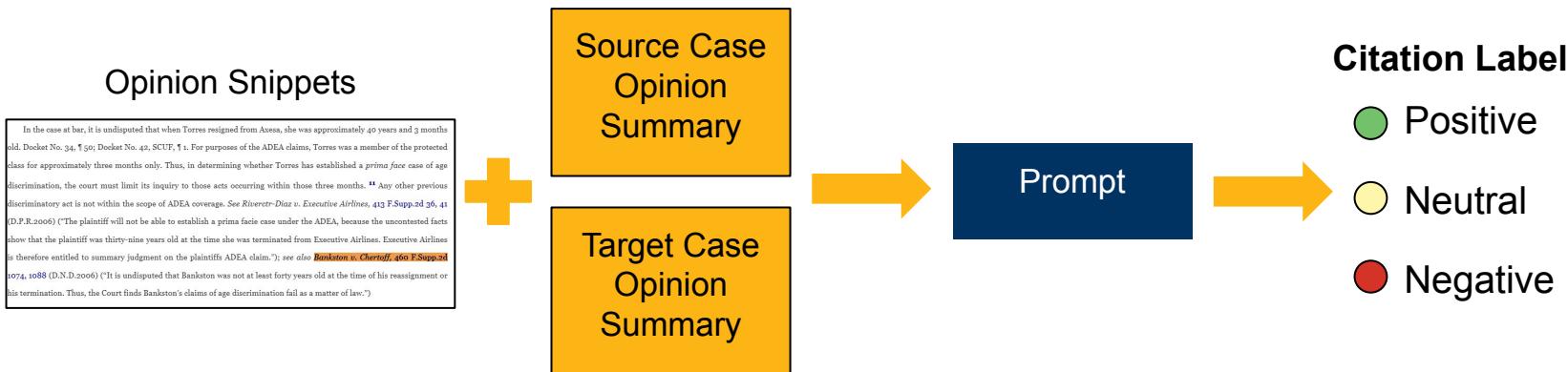
Citation Classifier

Feature Extraction & LLM Prompt Engineering

Stage 2: Develop Classifier for Single Citation for Label with Rationale

Goal: Accurately capture how a citing case treats a cited case.

Approach: Summarize source case and target case opinions. Engineer prompt to classify citation with positive, neutral, and negative labels.



DEFINITIONS:

- Positive: The citing court relies on, follows, or agrees with an earlier decision. The cited case serves as authoritative support for the citing court's reasoning or holding.
- Neutral: The citing court mentions, describes, or explains an earlier case without expressing approval or disapproval. The reference may provide procedural context, general background, or illustrate a contrasting outcome without evaluating authority.
- Negative: The citing court rejects, limits, criticizes, or overrules an earlier decision's reasoning or holding. The cited case is treated as weakened or incorrect authority, indicating that its doctrine should not be relied upon in the same way.

Conducted Experiments from Baseline while Balancing Performance and Tradeoffs

Stage 2: Develop Classifier for Single Citation for Label with Rationale

	Experiments to Tune Classifier	Strength	Weakness
1	Use full opinions rather than summary for LLM prompt	Has full context and helps with reasoning through text	Tends to label most cases as neutral (possible hallucination / overgeneralization)
2	Change classification sequence for LLM - example 1: Positive, Negative, Neutral - example 2: Negative, Positive, Neutral	The first label listed has disproportionate influence. Can shift the model toward identifying more of that label	Causes bias toward whichever label appears first. Reduces reliability across classes.
3	Impose strict rules for LLM to follow for Positive citation classification	Increases the model's sensitivity to positive cues. Helps catch more true positives	Still struggles to separate neutral vs. positive cleanly
4	Add more examples for LLM to learn	Gives clearer reference points for the model	Did not significantly improve performance

Final Citation Classification via 3-Model Ensemble

Stage 2: Develop Classifier for Single Citation for Label with Rationale

Evaluation Set: 36 Instances (17 positive, 10 neutral, 9 negative)

LLMs	Accuracy	Precision
Mistral 7B	36%	57%
Claude 3.5 Sonnet	67%	71%
LLaMA 3 (70B)	61%	56%
Ensemble	67%	70%

Final Selection: Ensemble with “Majority Voting”

- Using all three models and assign each citation a label based on majority agreement across the models.

Key Takeaways for using Ensemble

- Provides a **safeguard** by reducing dependence on any single model and its biases.
- Offers a **more conservative**, panel-style decision by using three independent “reviewers” and taking the majority vote.
- Produces a final citation label that **reflects broad model agreement**.

Ensemble: Illustrating how majority vote works

Stage 2: Develop Classifier for Single Citation for Label with Rationale

Method: Each model picks a citation label, the final label is chosen by the majority vote

Model	Predicted Label
Mistral 7B	Neutral 
Claude 3.5 Sonnet	Neutral 
LLaMA 3 (70B)	Positive 
Final Ensemble Label	Neutral 

Cited Case: *Frazier v. Simmons*

Citing Case: *Acevedo v. City of Philadelphia*

Takeaway: Ensemble voting reduces single-model bias and improves label stability.

Note: If all three models have different labels, then global label is Neutral

Comparison to Industry Models

Stage 2: Develop Classifier for Single Citation for Label with Rationale

Model	Accuracy
Google Gemini Pro 3	69%
OpenAI GPT-5	67%
Claude Sonnet 4.5	56%
Final Ensemble Label	67%

Takeaway: Ensemble method performs on par with best-in-class performance from models like GPT-5 and Gemini Pro 3

Case Classifier with Computational Algorithm

Feature Engineering for Case Classification

Stage 3: Develop Computational Algorithm for Case Classification

Goal:

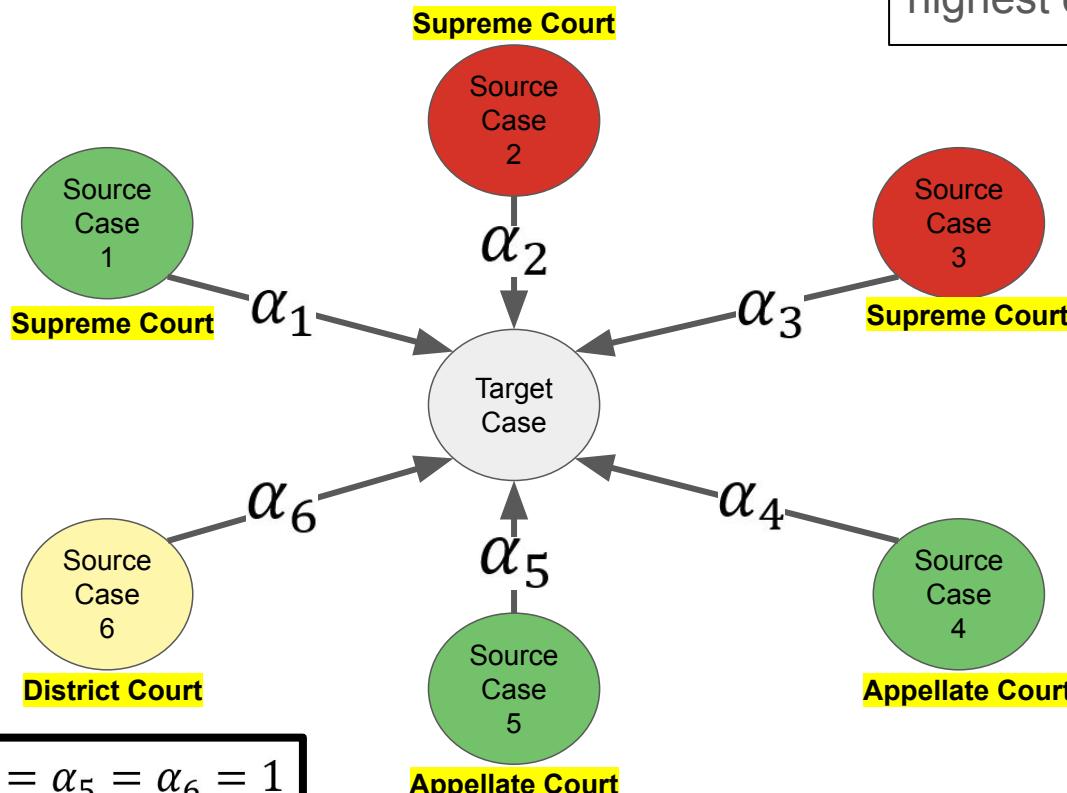
- Assign each case a label: **Good**, **Bad**, **Moderate**, or **Unknown**.

Important features:

- **Court Level (1, 2, 3, 4, 5)**
 1. Federal Supreme and Appellate
 2. Federal Appellate Courts (Court of Appeals)
 3. Federal District/Trial Courts
 4. State Courts
 5. No court available from CourtListener API
- **Citation Classification**
- **Case Decision Date**
- **Jurisdiction**

Case Classification - Example #1

Stage 3: Develop Computational Algorithm for Case Classification



Step 1: Start with the highest court level

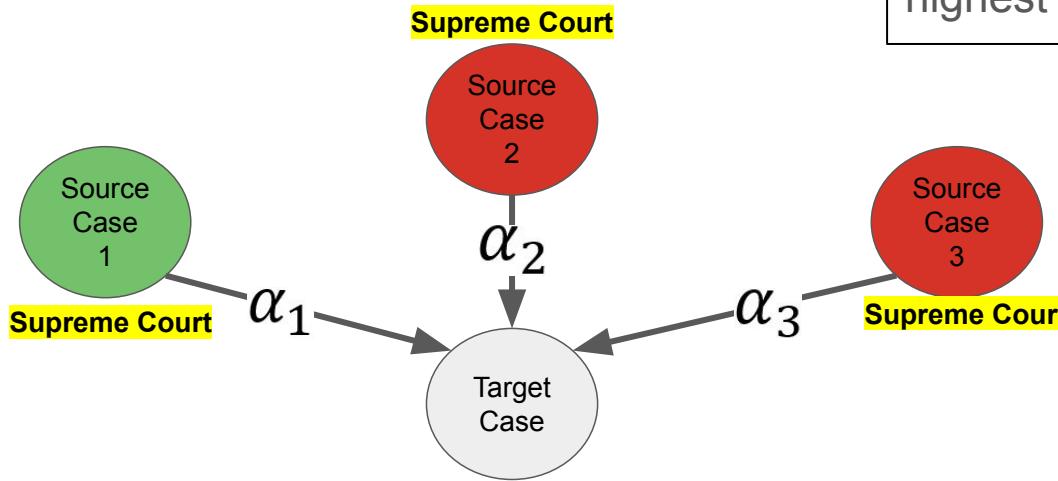
Citation Classification

- Positive
- Neutral
- Negative

Case Classification - Example #1

Stage 3: Develop Computational Algorithm for Case Classification

Step 1: Start with the highest court level



Citation Classification

Positive

Neutral

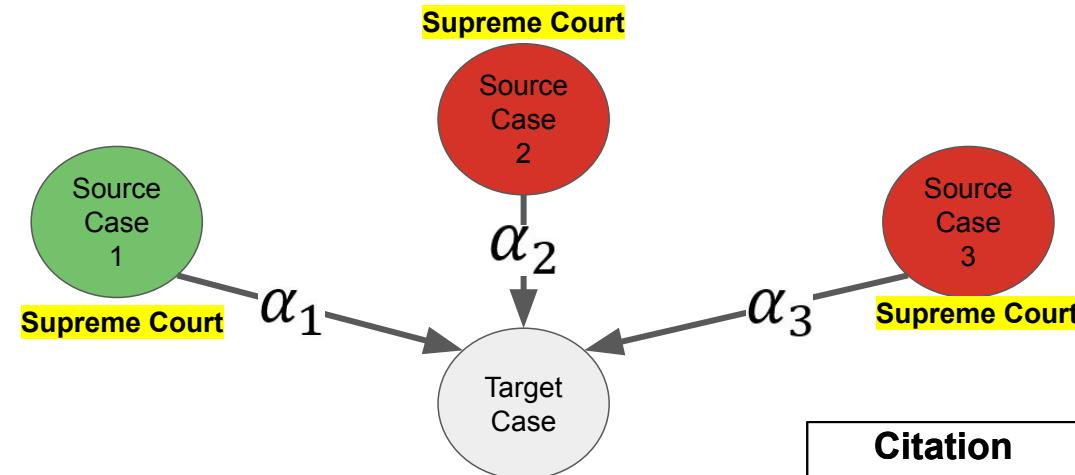
Negative

$$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 1$$

Case Classification - Example #1

Stage 3: Develop Computational Algorithm for Case Classification

Step 2: Compute Label Proportions



Citation Classification

- Positive
- Neutral
- Negative

$$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 1$$

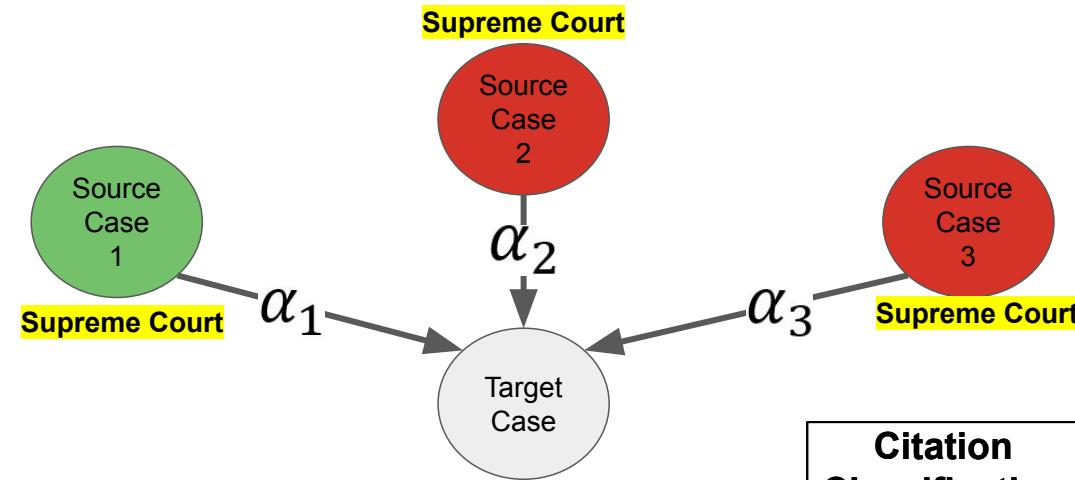
$$p_{Pos} = \frac{1}{3} = 0.33$$

$$p_{Neg} = \frac{2}{3} = 0.67$$

Case Classification - Example #1

Stage 3: Develop Computational Algorithm for Case Classification

Step 3: Decide the dominant treatment



$$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 1$$

Citation Classification

- Positive
- Neutral
- Negative

$$p_{pos} \geq threshold_{pos} = 0.50$$

$$p_{Neg} \geq threshold_{Neg} = 0.50$$

$$p_{Neu} \geq threshold_{Neu} = 0.50$$

$$p_{Unk} \geq threshold_{Unk} = 0.50$$

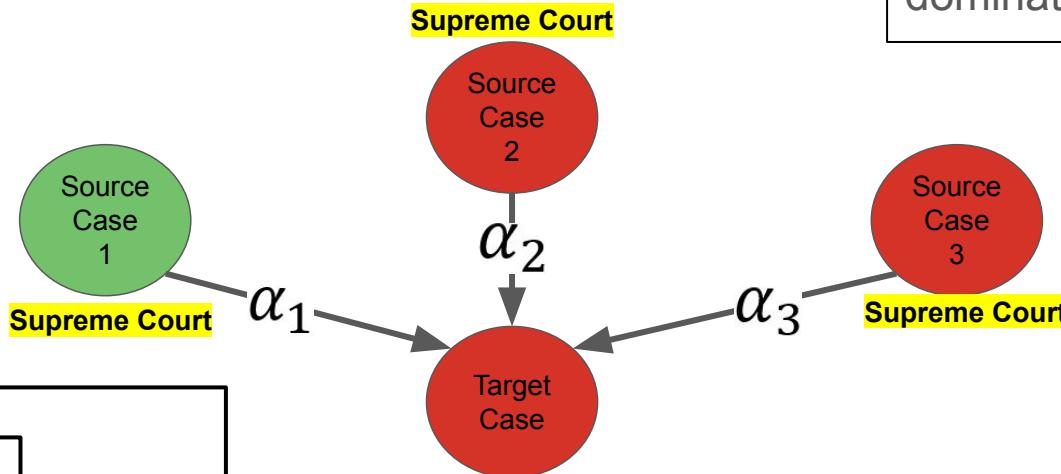
$$p_{Pos} = \frac{1}{3} = 0.33$$

$$p_{Neg} = \frac{2}{3} = 0.67$$

Case Classification - Example #1

Stage 3: Develop Computational Algorithm for Case Classification

Negative
Treatment
Dominates



Map Treatment to Case Label:
Positive → **Good**
Negative → **Bad**
Neutral → **Moderate**
Unknown → **Unknown**

Target Case is Labeled: **"Bad"**

$$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 1$$

Step 4: If treatment dominates, label case

Citation Classification

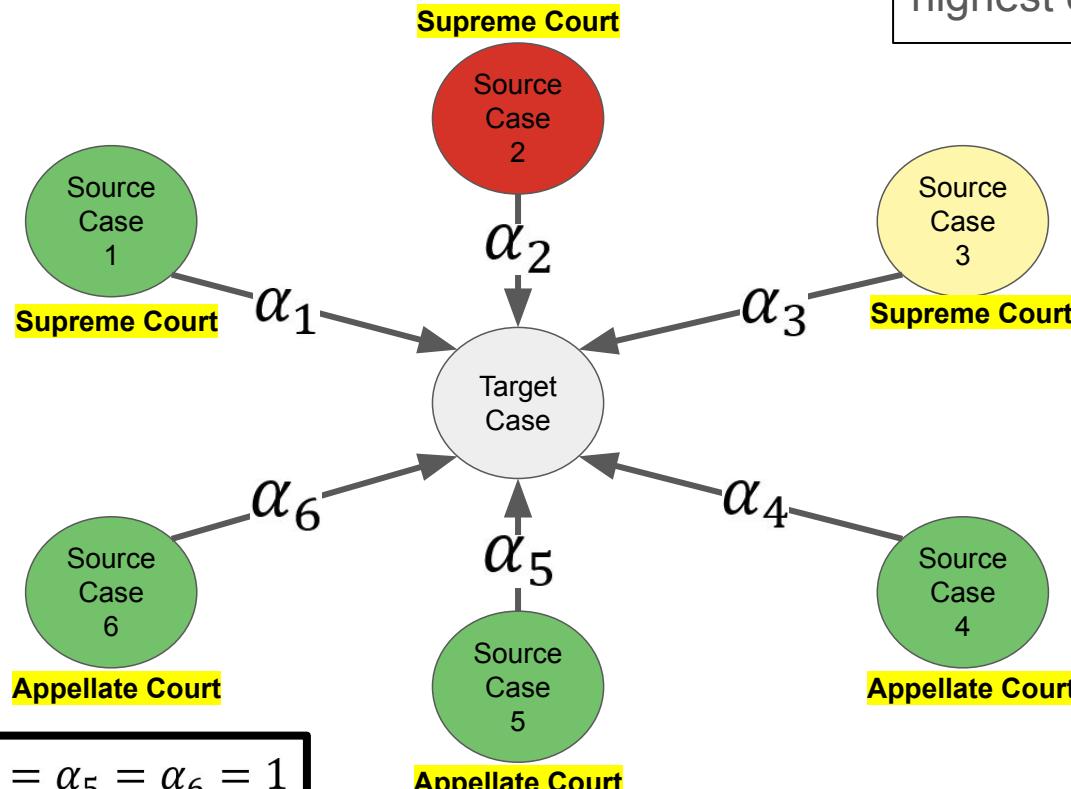
- Positive
- Neutral
- Negative

Case Classification - Example #2

Stage 3: Develop Computational Algorithm for Case Classification

What if?

Step 1: Start with the highest court level



Citation Classification

- Positive
- Neutral
- Negative

Case Classification - Example #2

Stage 3: Develop Computational Algorithm for Case Classification

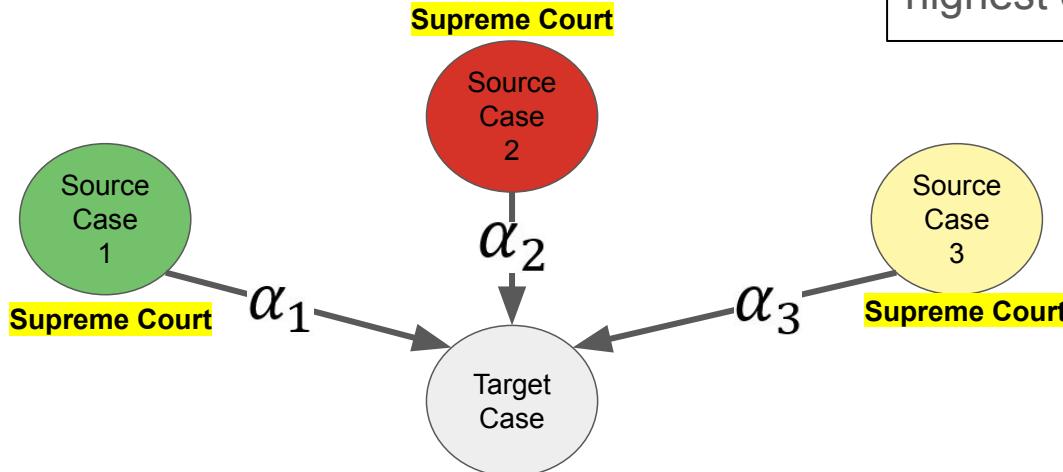
What if?

$$p_{Pos} = \frac{1}{3} = 0.33$$

$$p_{Neg} = \frac{1}{3} = 0.33$$

$$p_{Neu} = \frac{1}{3} = 0.33$$

$$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 1$$



$$p_{Pos} \geq threshold_{pos} = 0.50$$

$$p_{Neg} \geq threshold_{Neg} = 0.50$$

$$p_{Neu} \geq threshold_{Neu} = 0.50$$

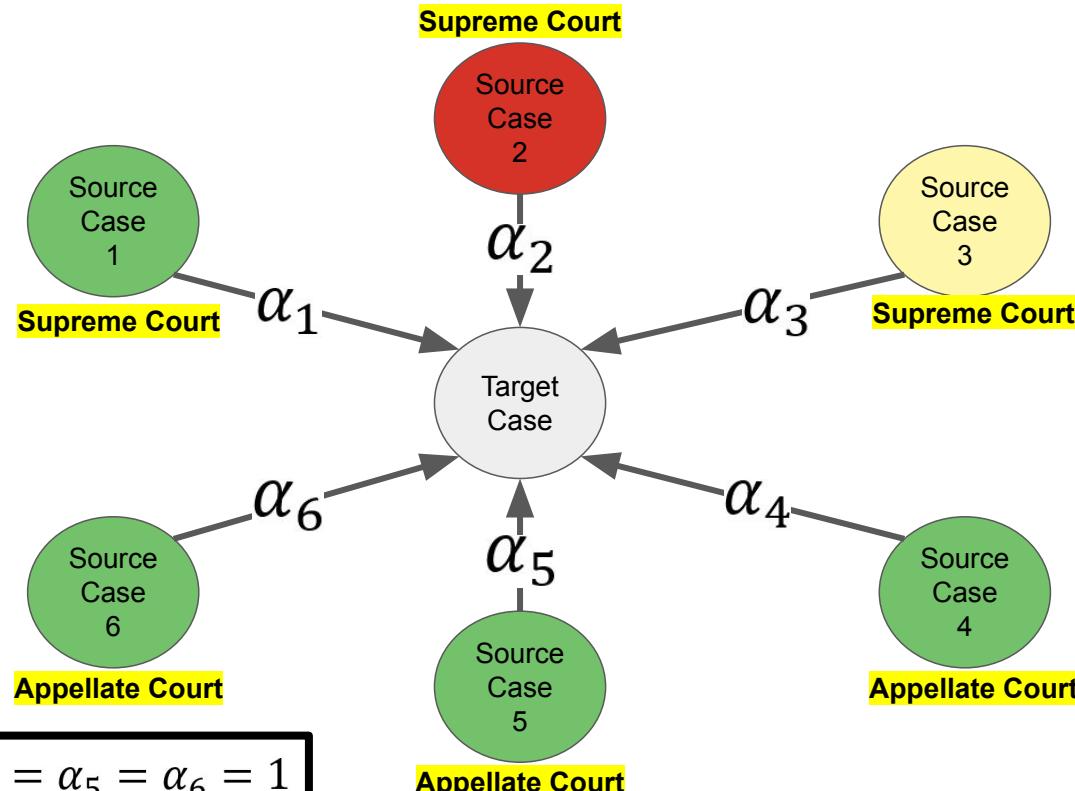
Step 1: Start with the highest court level

- Citation Classification**
- Positive
 - Neutral
 - Negative

Case Classification - Example #2

Stage 3: Develop Computational Algorithm for Case Classification

No dominant treatment at higher court, then analyse lower courts



$$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 1$$

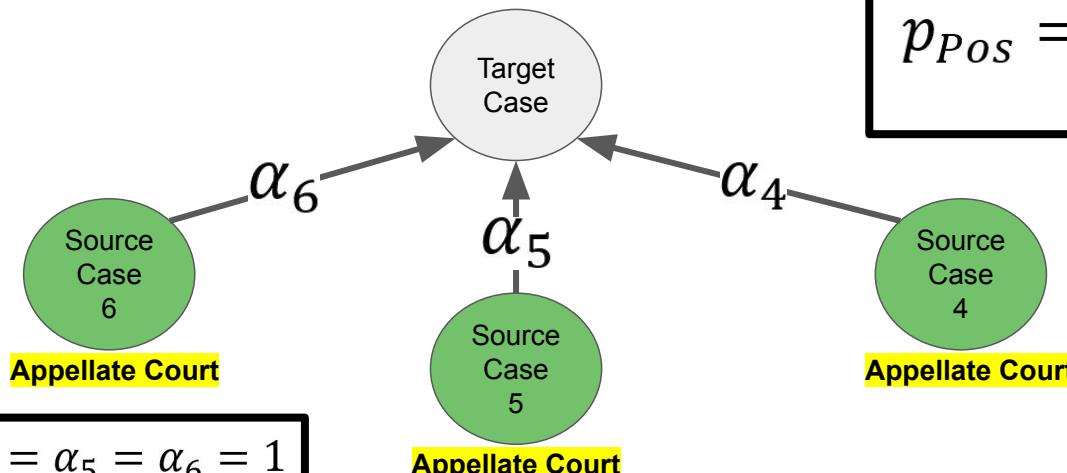
Citation Classification
Positive
Neutral
Negative

Case Classification - Example #2

Stage 3: Develop Computational Algorithm for Case Classification

Step 2: Compute Label Proportions
Step 3: Decide the dominant treatment

Positive
Treatment Dominates



$$p_{pos} \geq threshold_{pos} = 0.50$$

$$p_{Pos} = \frac{3}{3} = 1.0$$

Citation Classification

- Positive
- Neutral
- Negative

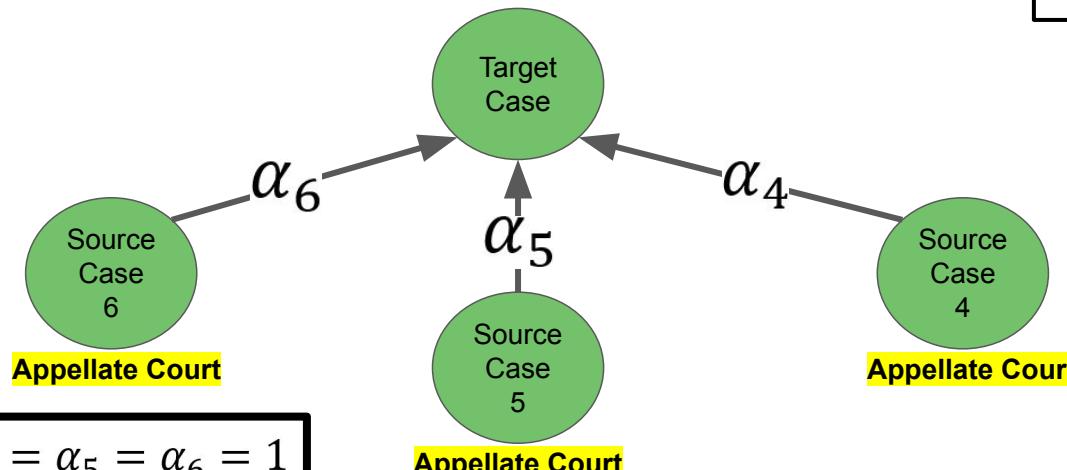
Case Classification - Example #2

Stage 3: Develop Computational Algorithm for Case Classification

Step 4: If treatment dominates, **label case**

Target Case is Labeled: “**Good**”

Map Treatment to Case Label:
 Positive → **Good**
 Negative → **Bad**
 Neutral → **Moderate**
 Unknown → **Unknown**



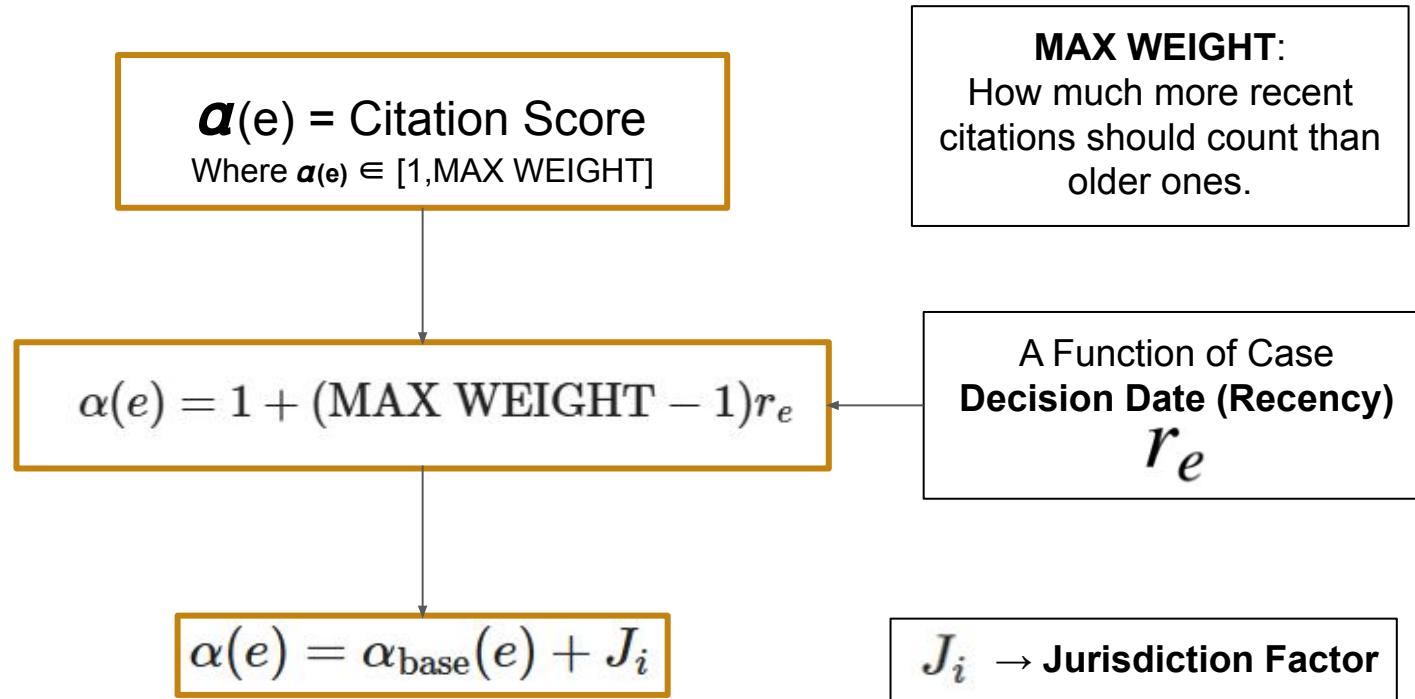
$$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 1$$

Citation Classification

- Positive
- Neutral
- Negative

Case Labeling - Scoring Mechanism with Case Recency and Jurisdiction Factor

Stage 3: Develop Computational Algorithm for Case Classification



Giving users the control of the computational algorithm

Stage 3: Develop Computational Algorithm for Case Classification

Control the Signal Strength

Adjust treatment share thresholds

$$p_{\text{label}} \geq \text{threshold}_{\text{label}}$$



Give more Weight to Recent Law

Boost recent citations or narrow the time window



Focus on Jurisdictions that Matter

Add jurisdiction weights so key courts drive the label more



Choose your Court Strategy

“Highest Court Only”
or
“Walk Down”
Strategy



Resolve close calls your way

Set a label priority order so the system breaks ties



Conclusion

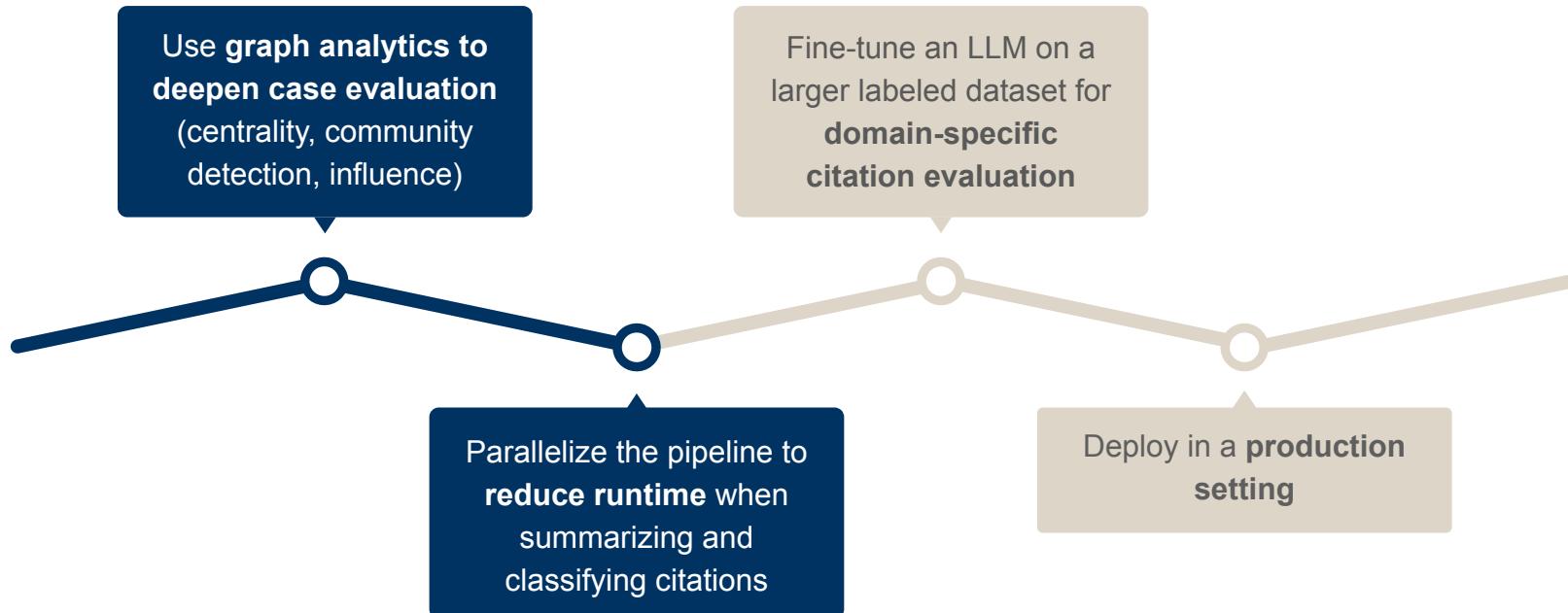
Innovations, Challenges, Roadmap

Innovations

- ▶ **Case semantics via Knowledge Graph layer** with case and citation context
- ▶ **Case snippet and opinion summaries** for rich context and noise reduction
- ▶ **3-LLM model ensemble** for reliability and algorithm transparency
- ▶ **Agent and Graph-RAG implementation** for advance conversational chatbot
- ▶ **Interactive user friendly solution** with user control prioritized

Conclusion

Roadmap



**Innovate legal research with
AI-powered citation analysis**

Thank You!

Questions?

Appendix

References

<https://tarlton.law.utexas.edu/bluebook-legal-citation/intro-signals>

[https://arxiv.org/pdf/2306.16092](https://arxiv.org/pdf/2306.16092.pdf)

[https://arxiv.org/pdf/2401.15770](https://arxiv.org/pdf/2401.15770.pdf)

<https://arxiv.org/abs/2501.00309>

<https://arxiv.org/abs/2506.02404>

<https://graphacademy.neo4j.com/courses/workshop-genai/>

<https://www.sciencedirect.com/science/article/pii/S0004370203001061>

Who Are the Users?

Primary users are **practicing lawyers**
who need confidence that the cases
they cite are still good law



Existing Solutions vs. Our Solution

Existing: Determining whether a case is safe to cite requires manually comparing positive and negative history across many decisions.

Ours: A clear citation-strength score, generated through a simple and transparent formula, consolidates the full treatment history into a reliable, customizable signal.

Existing: Research tools require heavy manual digging and are designed around expert workflows that take time to master.

Ours: A simple, LLM-supported interface surfaces the key information immediately while still showing the underlying evidence, allowing any user to review or override the analysis with confidence.

Technical Approaches

Vendors / Platforms



Cases



Amazon SageMaker Amazon Bedrock

Platforms/ LLMs

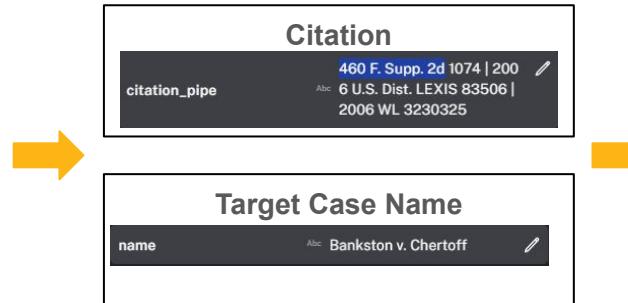
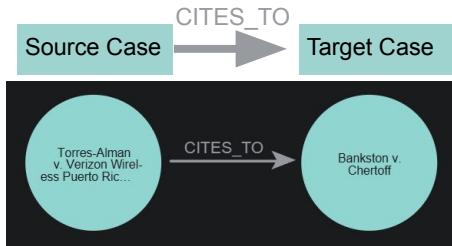


Graph Database



UI

Citation Retrieval



Input to the LLM for citation

In the case at bar, it is undisputed that when Torres resigned from Axesa, she was approximately 40 years and 3 months old. Docket No. 34, ¶ 50; Docket No. 42, SCUF, ¶ 1. For purposes of the ADEA claims, Torres was a member of the protected class for approximately three months only. Thus, in determining whether Torres has established a *prima facie* case of age discrimination, the court must limit its inquiry to those acts occurring within those three months.¹¹ Any other previous discriminatory act is not within the scope of ADEA coverage. See *Riverctr-Diaz v. Executive Airlines*, 413 F.Supp.2d 36, 41 (D.P.R.2006) ("The plaintiff will not be able to establish a *prima facie* case under the ADEA, because the uncontested facts show that the plaintiff was thirty-nine years old at the time she was terminated from Executive Airlines. Executive Airlines is therefore entitled to summary judgment on the plaintiffs ADEA claim."); see also *Bankston v. Chertoff*, 460 F.Supp.2d 1074, 1088 (D.N.D.2006) ("It is undisputed that Bankston was not at least forty years old at the time of his reassignment or his termination. Thus, the Court finds Bankston's claims of age discrimination fail as a matter of law.")

Goal: A clean snippet from the citing opinion showing the actual citation to the target case.

How we find the citation (in order):

1. **Exact Case-Citation** (case-insensitive)
2. **Relaxed Case-Citation regex** (handles additional spaces or punctuations)
3. **Exact case-name** (case-insensitive)
4. **Relaxed case-name regex** (handles punctuation/abbrevs like Dep't/Dept.)
5. **Other Case-Citation**
6. **Relaxed Other Case-Citation regex** (handles additional spaces or punctuations)

Edge Classification

Treatment	Meaning	Example Language
Positive ●	The citing court relies on, follows, or agrees with an earlier decision. The cited case serves as authoritative support for the citing court's reasoning or holding.	followed, affirmed, applied, adopted, relied, recognized, cited with approval
Neutral ○	The citing court mentions, describes, or explains an earlier case without expressing approval or disapproval. The reference may provide procedural context, general background, or illustrate a contrasting outcome without evaluating authority.	explained, cited, discussed, mentioned, interpreted, compared, noted
Negative ●	The citing court rejects, limits, criticizes, or overrules an earlier decision reasoning or holding. The cited case is treated as weakened or incorrect authority, indicating that its doctrine should not be relied upon in the same way.	overruled, reversed, vacated, abrogated, disapproved, superseded, questioned, criticized, distinguished, limited, declined to follow

Prompt Engineering - Prompt

SYSTEM_PROMPT = """Role: You are an experienced lawyer specializing in legal citation analysis.

Goal: Your goal is to classify how a citing case treats a cited case (e.g., Positive, Neutral, Negative) when given:

1. Citing Case Name: the name of the citing case.
2. Citing Case Summary: the summary of the citing case.
3. Cited Case Name: the name of the cited case
4. Cited Case Summary: the summary of the cited case.
5. Snippets (from citing opinion where the cited case appears): List of text snippets where the cited case is cited in the citing opinion text

CRITICAL RULES (must follow):

1. **If the citing case uses the cited case to establish or support ANY legal rule, doctrine, standard, test, or conclusion, classify as POSITIVE.**

- This includes situations where the case:
 - recites a standard from the case,
 - cites the case as part of a string cite supporting a legal principle,
 - uses the case as an example consistent with its reasoning,
 - applies reasoning from the cited case.

1. **IMPORTANT: The opinion **does NOT need to use words like "follow," "adopt," "agree," or "apply."**

Any supportive or explanatory use counts as Positive.

2. Classify as NEUTRAL **only when the case is mentioned without being used as authority**.

- Examples:
 - descriptive background
 - illustrating a factual distinction
 - quoting language without using it to support a rule
 - noting procedural history

3. Classify as NEGATIVE when the citing court:

- criticizes, limits, distinguishes, rejects, or declines to follow the cited case.

4. When writing the rationale:

- Include ONE short direct quote from the citing opinion.
- The quote must illustrate why the treatment is Positive, Neutral, or Negative.
- Provide EXACTLY four sentences.

OUTPUT FORMAT (strict):

```
{  
  "classification": "Positive|Neutral|Negative",  
  "rationale": "Four sentences with one direct quote."  
}***
```

USER_PROMPT_TMPL = """Now, classify how the citing case treats the cited case. Return your answer as a json format: {{classification: "", rationale: ""}} where label is one of Positive, Neutral, or Negative and rationale is a four-sentence explanation that justifies your classification using evidence from the cited paragraph and case summaries.

Input:

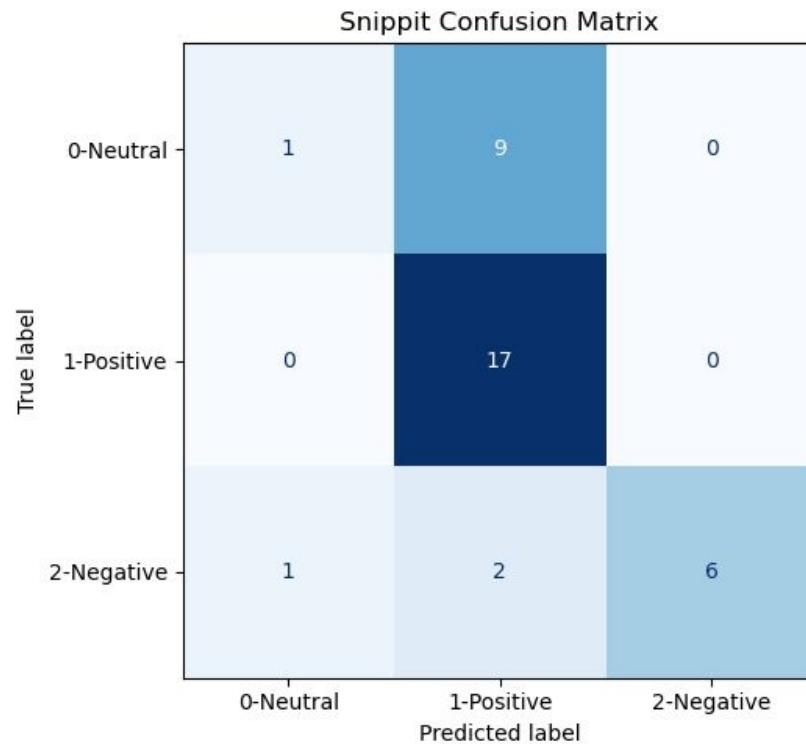
Citing Case Name: {citing_case_name}
Citing Case Summary: {citing_case_summary}
Cited Case Name: {cited_case_name}
Cited Case Citation: {cited_case_citation}
Cited Case Summary: {cited_case_summary}

Snippets (from citing opinion where the cited case appears):

```
{snippet_block}***
```

Model Performance

Ensemble method achieves: **0.6667 accuracy & 0.7023 precision**



Case Labeling - From Score Citations to a Case Label

Step 1: Compute proportions at each court level

For each court level L , we sum the scores of citation labels to compute label weights:

$$w_{\text{Pos},L} = \sum_{e \in E_{\text{Pos},L}} \alpha(e),$$

$$w_{\text{Neg},L} = \sum_{e \in E_{\text{Neg},L}} \alpha(e),$$

$$w_{\text{Neu},L} = \sum_{e \in E_{\text{Neu},L}} \alpha(e),$$

$$w_{\text{Unk},L} = \sum_{e \in E_{\text{Unk},L}} \alpha(e).$$

At each court level L , we convert the weighted sums into proportions:

$$D_L = w_{\text{Pos},L} + w_{\text{Neg},L} + w_{\text{Neu},L} + w_{\text{Unk},L},$$

$$p_{\text{Pos},L} = \frac{w_{\text{Pos},L}}{D_L}, \quad p_{\text{Neg},L} = \frac{w_{\text{Neg},L}}{D_L}, \quad p_{\text{Neu},L} = \frac{w_{\text{Neu},L}}{D_L}, \quad p_{\text{Unk},L} = \frac{w_{\text{Unk},L}}{D_L}$$

Case Label - From Score Citations to a Case Label

Step 2: Decide the dominant treatment at that court level

- The driver label is then mapped to the case label at that level:
 - Positive → **Good**
 - Negative → **Bad**
 - Neutral → **Moderate**
 - Unknown → **Unknown**

Step 3: Respect the court hierarchy

- We start with the highest court level that cites the case.
- If no label at that level meets its threshold and the “use lower courts” option is on, we move down to the next lower level.
- If no court level shows a dominant treatment, the case defaults to **Moderate**.

Case Labeling- From Score Citations to a Case Label

Step 2: Decide the dominant treatment at that court level

- Each label has a threshold (defaults: 0.55 for Positive, Negative, Neutral, and Unknown).
- A label becomes a candidate at level L if its proportion meets or exceeds its threshold

$$p_{\text{label}} \geq \text{threshold}_{\text{label}}$$

- If more than one label qualifies, we use a priority order. The default is:

Unknown > Negative > Neutral > Positive

Case Labeling - Scoring Mechanism

$\alpha(e)$ is a time-based weighting function represented as:

$$\alpha(e) = 1 + (\text{MAX WEIGHT} - 1)r_e$$

Where r_e is the **normalized recency** value for edge e , with decision date t_e :

$$r_e = \frac{t_e - t_{\min}}{t_{\max} - t_{\min}}$$

Where:

$$t_e \leq t_{\min}, \text{ then } r_e = 0$$

$$t_e \geq t_{\max}, \text{ then } r_e = 1$$

Case Labeling - Scoring Mechanism

We decided to let t_{min} and t_{max} be equal to the lower quartile (Q1) and the maximum decision date in our current ADAH Neo4j Dataset.

Decision Date Range

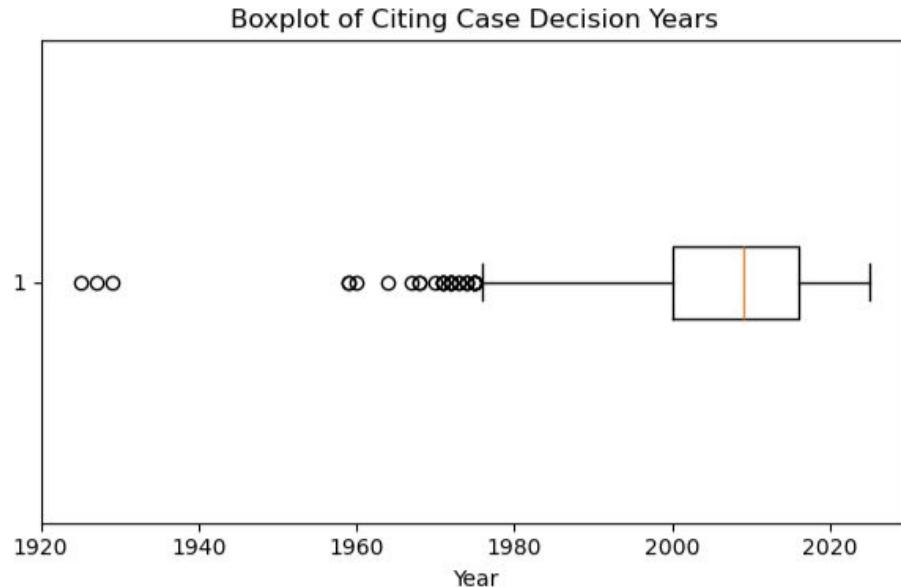
Min : 1925-06-18

Q1 : 2000-09-18

Q2 : 2009-02-09 (median)

Q3 : 2016-07-26

Max: 2025-10-08



Case Labeling - Scoring Mechanism

Jurisdiction weighting (optional):

- Certain jurisdictions can be given extra weight (for example, California or a specific federal circuit).
- This adds a fixed bonus on top of the time-based weight for citations coming from those jurisdictions.

$$\alpha(e) = \alpha_{\text{base}}(e) + J_i$$

- Default is $J_i = 0$

Case Label - Tunable settings for users

- **Proportion thresholds**
 - Default: all set to 0.55
- **Maximum time-based weight, MAX_WEIGHT**
 - Default: MAX_WEIGHT = 2.5
- **Time window**
 - Default:
 - t_{min} = Lower Quartile
 - (Q1), t_{max} = Latest Citing Date
- **Jurisdiction weights**
 - Default: $J_i = 0$ or $J_i = MAX_WEIGHT/2$
- **Court selection strategy**
 - Default: Lower courts can drive the label when the highest court is mixed

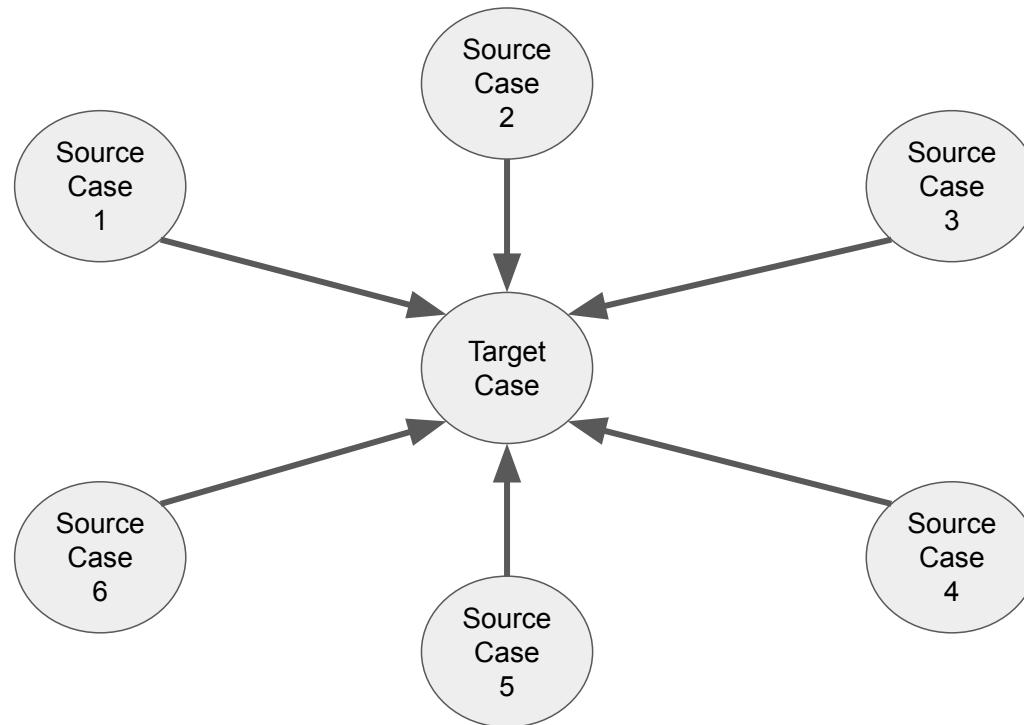
$$p_{label} \geq \text{threshold}_{label}$$

$$[t_{min}, t_{max}]$$

$$J_i$$

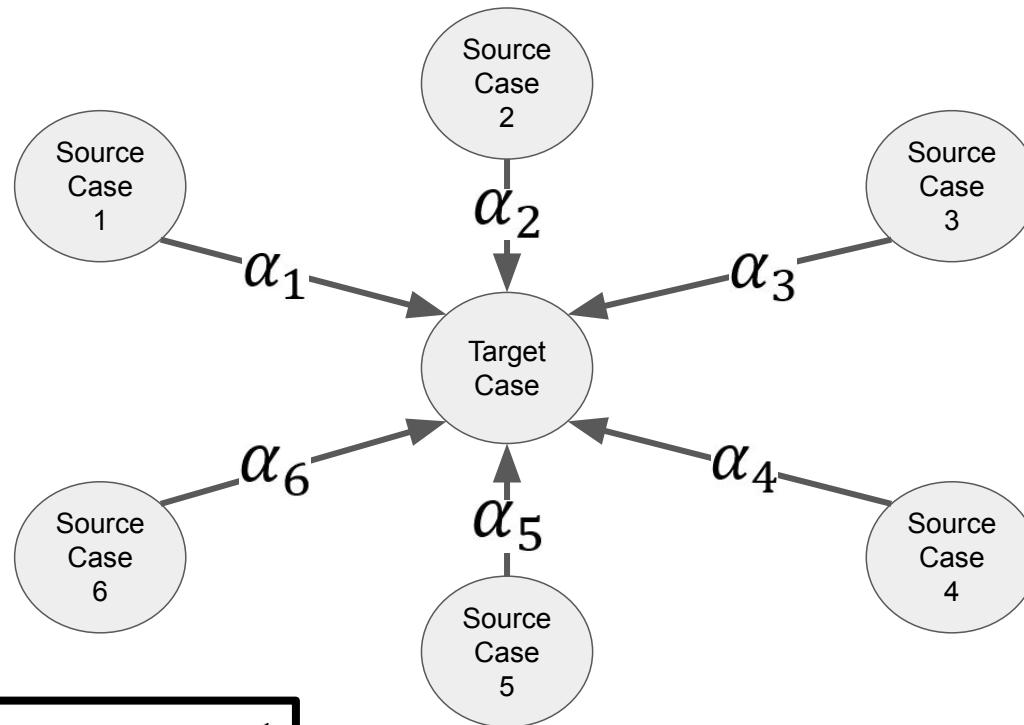
Case Classification - Example #1

Stage 3: Develop Computational Algorithm for Case Classification



Case Classification - Example #1

Stage 3: Develop Computational Algorithm for Case Classification

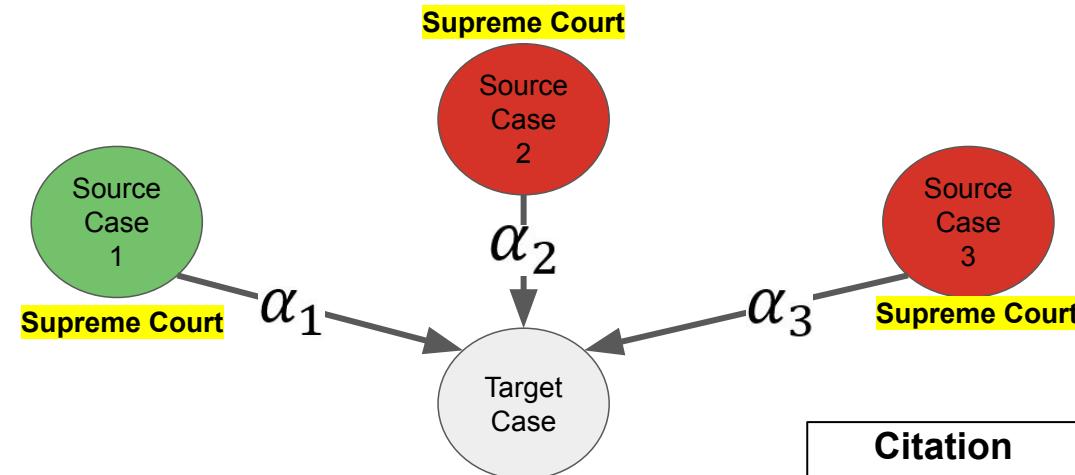


$$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 1$$

Case Classification - Example #1

Stage 3: Develop Computational Algorithm for Case Classification

Step 2: Compute Label Proportions



$$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 1$$

Citation Classification

- Positive
- Neutral
- Negative

$$w_{\text{Pos}} = \sum_{e \in \mathcal{E}_{\text{Pos}}} \alpha(e), \quad w_{\text{Neg}} = \sum_{e \in \mathcal{E}_{\text{Neg}}} \alpha(e),$$

$$w_{\text{Neu}} = \sum_{e \in \mathcal{E}_{\text{Neu}}} \alpha(e), \quad w_{\text{Unk}} = \sum_{e \in \mathcal{E}_{\text{Unk}}} \alpha(e).$$

$$w_{\text{Pos}} = 1$$

$$w_{\text{Neg}} = 2$$

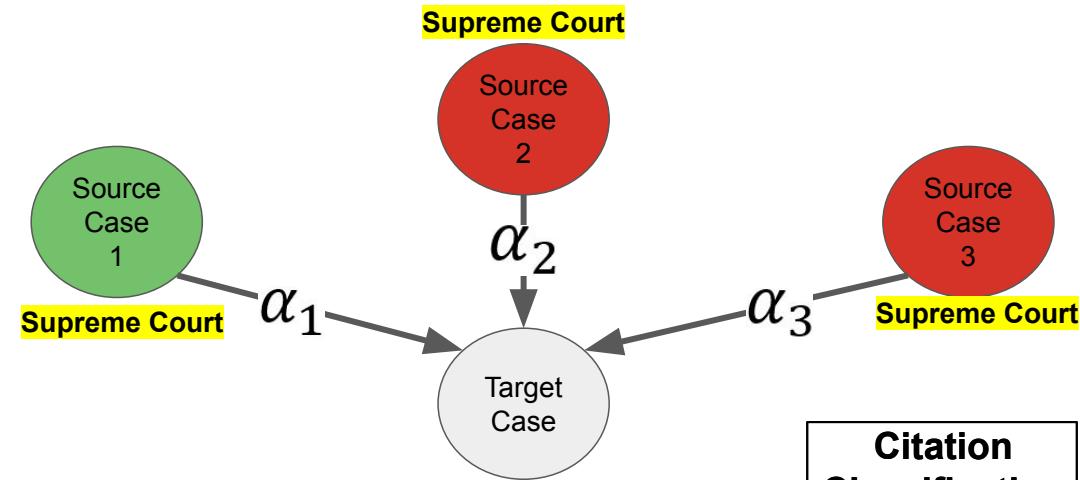
$$w_{\text{Neu}} = 0$$

$$w_{\text{Unk}} = 0$$

Case Classification - Example #1

Stage 3: Develop Computational Algorithm for Case Classification

Step 2: Compute Label Proportions



$$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 1$$

Citation Classification

- Positive
- Neutral
- Negative

$$D = w_{\text{Pos}} + w_{\text{Neg}} + w_{\text{Neu}} + w_{\text{Unk}},$$

$$p_{\text{Pos}} = \frac{w_{\text{Pos}}}{D}, \quad p_{\text{Neg}} = \frac{w_{\text{Neg}}}{D},$$

$$p_{\text{Neu}} = \frac{w_{\text{Neu}}}{D}, \quad p_{\text{Unk}} = \frac{w_{\text{Unk}}}{D}.$$

$$w_{\text{Pos}} = 1$$

$$w_{\text{Neg}} = 2$$

$$p_{\text{Pos}} = \frac{1}{3} = 0.33$$

$$p_{\text{Neg}} = \frac{2}{3} = 0.67$$

UI Tie Back

UI Tie-Back

Legal Citation Evaluation App

Roger Monette and Doris Monette v. Electronic Data Systems Corporation | 90 F.3d 1173 | 65 U.S.L.W. 2159 | 5 Am. Disabilities Cas. (BNA) 1326 | 19...

Name: Roger Monette and Doris Monette v. Electronic Data Systems Corporation

Citation: 90 F.3d 1173 | 65 U.S.L.W. 2159 | 5 Am. Disabilities Cas. (BNA) 1326 | 1996 U.S. App. LEXIS 18646 | 1996 WL 422962

Decision Date: 1996-07-30

Court: Court of Appeals for the Sixth Circuit

Summary

In Roger Monette and Doris Monette v. Electronic Data Systems Corporation, Monette, a customer service representative, claimed that Electronic Data Systems Corporation (EDS) discriminated against him on the basis of his disability in violation of the Americans with Disabilities Act (ADA) and the

Citation Evaluation: Good

Decision Level: Court of Appeals

View Rationale

The final label is determined by court level and weighted by decision time. At each court level, the evaluation score is calculated proportionally from the number of positive, negative, and neutral labels assigned by citing cases, with each label weighted by its decision date. If the score falls below the 0.55 confidence threshold, we move to the next lower court and repeat the evaluation until a final label is reached.

The case 'Roger Monette and Doris Monette v. Electronic Data Systems Corporation' is labeled 'Good' based on citations from the Court of Appeals, where the balance of weighted citations is predominantly positive. The case has 6 incoming citation(s). By court, citations are distributed as follows: Supreme Court: 0, Court of Appeals: 4, District Court: 0, State Court: 2, Unknown Court: 0. At the Court of Appeals, the label is driven by positive treatment: based on 4 citation(s) at this court, the weighted proportions are Positive=0.69, Negative=0.31, Neutral=0.00, Unknown=0.00, coming from 3 positive, 1 negative, 0 neutral, 0 unknown citation(s). At each court, the model uses time- and jurisdiction-weighted citation counts to compute the share of positive, negative, neutral (and, if included, unknown) treatment. A label can drive the case outcome at that court only if its weighted share meets its configured threshold. For this run, the share thresholds are: Positive ≥ 0.55, Negative ≥ 0.55, Neutral ≥ 0.55, Unknown ≥ 0.55. If more than one label meets its threshold, the priority order (Unknown > Negative > Neutral > Positive) is used to select the controlling label.

Target Case Retrieved from Neo4j

- Name
- Citation
- Decision Date
- Court
- Summary of Opinion
- Url

Ultimate Label Generated by LLM (Phase 2)

- Evaluation
- Traffic light icon
- Decision Level
- Rationale

UI Tie-Back

Citations: 6

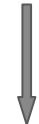
Citing Cases:

Name	Decision Date	Court Name	Treatment	Rationale	URL
Lewis v. Humboldt Acquisition Corp., Inc.	2012-05-25	Court of Appeals for the Sixth Circuit	● Negative	<p>The rationale for the second judge ('Claude 3.5 Sonnet (anthropic.claude-3-5-sonnet-20240620-v1:0)') is:</p> <p>The citing case, Lewis v. Humboldt Acquisition Corp., Inc., criticizes and rejects the standard set in Monette v. Electronic Data Systems Corporation.</p>	https://www.courtlistener.com/opinion/801002/lewis-v-humboldt-acquisition-corp-inc/



**Labels of Each Citation
in each Citing Case,
Generated by LLM
(Phase 1)**

- # of Citations
- Citing Cases
 - Name
 - Decision Date
 - Court Name
 - Treatment (label)
 - Rationale
 - URL



**Final decision of LLMs from Majority Vote +
3 rationales generated by different LLMs**

Challenges and Learning

- ▶ **Small evaluation set** of 36 examples made it hard to compare models and prompts with confidence

- ▶ Treatment definitions vary, and LLMs are sensitive to how these definitions are framed

- ▶ Distinguishing **neutral vs. positive** citations

- ▶ **Extracting consistent and relevant snippets** required careful tuning

Icon Library

Use these icons to represent different career paths, disciplines, and technologies.



Machine Learning



Coding



Cybersecurity



UX Design



Data Science



HCI



Business



Law



Library Studies



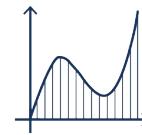
Ethics



Economics



Research



Math



Data Visualization



Program Manager



Psychology