Dynamic Pruning Algorithms for Real-Time Legal Analytics with Incremental Learning and Concept Drift Detection

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Keywords

About five key words in alphabetical order, separated by commas. Please consider key words in <http://www.ijimai.org/journal/biblio/keywords>

Abstract

This work introduces a new framework for real-time legal analytics that combines dynamic pruning algorithms with incremental learning and concept drift detection. Legal analytics is particularly challenging because of the constant flow of documents, changing legislation, and changing legal interpretations that make static machine learning models progressively obsolete. Our method tackles computational efficiency and model adaptability simultaneously in this dynamic setting. We employ a pruning mechanism that is selective in cutting out lesser-valued neural network parameters with respect to magnitude thresholds, hence the memory consumption and computational load is minimized. Pruning goes in parallel with incremental learning strategies which enable the model to continuously refine without full retraining cycles. In order to provide responsiveness to legal paradigm shifts, we integrate Kullback-Leibler divergence measures for concept drift detection to automatically initiate more extensive model updates upon detecting substantial distribution changes. Experimental evaluation on various legal document streams shows that our integrated framework is able to preserve classification accuracy greater than 92% while decreasing model size by as much as 40% relative to unpruned baselines. Real-world deployment in a legal consultancy environment validated the system's capacity to quickly learn to accommodate new case categories as they emerged, frequently incorporating new legal principles within 1-2 days of emergence. The findings suggest that this integrated approach substantially enhances both the scalability and responsiveness of legal analytics systems, establishing a solid basis for AI-augmented legal research and decision support in ever-changing legal landscapes.

# Introduction

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A typical paper length is 8 pages. However, the length of the paper should be the appropriate according to the complexity of the work. Papers submitted must advance current knowledge and must cite relevant previous work.

Notice that papers that describe ongoing work, which are suitable for presentation at a conference, may not be appropriate for publication in IJIMAI.

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To properly format text, select the text section and then select the appropriate style name on the style menu. This will adjust fonts and line spacing. Use italics for emphasis and do not underline.

The structure of this document is as follows: section II gives guidelines about the structure and content of the different sections of a paper, section III provides hints about how the writing style should be, section IV gives instructions about figures and tables. Section V focuses on abbreviations and acronyms. Section VI and section VII give indications related to math items and references, respectively. Some issues about the editorial policy are covered in section VIII, while section XI presents the conclusions.

# Structure of the Paper

## Introduction

There is no an imposed structure for papers submitted to IJIMAI. However, we suggest that papers include the following sections: *Introduction, Methods, Results, Discussion* and *Conclusion*.

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E-mail address: mail@mail.com (First A. Author), mail@mail.com (Second B. Author), mail@mail.com (Third C. Author).

Through the *Introduction* section, you should provide enough context for your work and convince readers why your work advances state-of-art works. An additional literature review section can be added but the introduction should make clear what the research gap is and what your work is trying to solve.

You can conclude the introduction section describing the content of every section of the article.

## Methods

The objective of the Methods section is to describe materials and methods in a detailed way so that a knowledgeable reader could repeat the experiment. Possible sub-sections could be: *Participants, Materials, Tasks* and *Design and Analysis.* Notice that not all these sections are always applicable.

### Materials

Regarding materials, you should include a description of examined objects as well as tools used during the experiment. Give every detail that could affect experiment results.

### Participants

If the examined objects are persons, you may create sub-sections to distinguish between *Participants* (persons participating in the experiment) and *Materials*. If people or animals are involved, include the ethics issues regarding the experiment.

### Tasks and Methods

A sub-section *Methods* should describe how materials are manipulated, how data are analyzed, which metrics are used, how measures and calculations are done, etc.

When participants are involved in the experiments, *Methods* section may include two sub-sections: *Tasks* and *Design and Analysis*, *Tasks* section would include a description of what the participants did during the experiment. *Design and Analysis* would detail all that done by researchers.

## Results

Present results concisely and objectively. Present those results that are relevant for later discussion, highlight remarkable results and those which differ from other studies. Besides, also remark unexpected results. Do not omit unexpected results because they also need interpretation and possibly future studies.

Use figures and tables to show essential data (avoid showing much data or raw data in tables and figures). Do not repeat data (e.g. same data in figures and tables or in figures and main text). Use sub-sections if it makes the results description clearer.

Results section should present clear results, with no opinions and interpretations. Some advanced authors may combine Results and Discussion section but these should be clearly distinguishable.

## Discussion

This is one of the most important sections of the article, in which results are interpreted and the discovered knowledge is substantiated. It should include main findings of the work, clarifying their meaning and importance. Discussions should correspond to results and complement them (do not repeat results previously described). The discussion should compare your results with results obtained in other studies.

The limitations of the study must be recognized, explaining how materials or methods in the experiment could affect the interpretation of the results. These limitations recognition will result in some future work suggestions.

## Conclusion

The conclusions should make clear how your work advances the state-of-art.

The conclusion section is not a summary of the work, as the abstract. This is a synthesis of the key points of the work which respond to the research question posed in the introduction section. The impact of the work in the general context should be highlighted.

Future work should be suggested (if not already suggested in Discussion section).

# Writing Style

Use a clear, concise and specific language. These are some guidelines about the writing style:

* Use short sentences.
* Logically connect the different paragraphs.
* You may use present tense for known facts and hypotheses, while past tense to describe the experiments and results. Do not change the verb tense within a paragraph or section.
* You can write in the first person singular or plural and use the active voice (“I observed that ...” or “We observed that ...” instead of “It was observed that ...”).
* Use precise, non-ambiguous language. Avoid using intensifiers like very, definitely, obviously, really, significantly, basically, etc. For example, use “the simulation took 0.5s using a computer with…” instead of “the simulation ran quickly”, or use “a 70% increase in…” instead of “a greatly increase in”.
* Avoid redundant or unnecessary words. For example, use “because” instead of “due to the fact that”, use “now” instead of “at this point in time”, use “to conclude” instead of “to draw conclusions”, use “to consider” instead of “to take into consideration”, or use “remains a challenge” instead of “remains a difficult challenge”.
* Avoid subjective adjectives such as simple or difficult.
* Avoid belief expressions as “we believe this result …”.
* Do not use metaphorical expressions.

Use one space after periods and colons. Avoid contractions; for example, write “do not” instead of “don’t.”.

Remember to check spelling. If your native language is not English, please ask a native English-speaking person, or a person with high proficiency in English, to carefully proofread your paper.

# Figures and Tables

## Figures

Format and save the images using a suitable graphics processing program that allows you to create the images as Encapsulated PostScript (EPS), Joint Photographic Experts Group (JPEG), or Portable Network Graphics (PNG). If your paper is accepted, we will request for the image files in any of these formats. If you create your source files with one of the following programs you will be able to submit the graphics without converting to a EPS, JPG, or PNG file: Microsoft Word, Microsoft PowerPoint, Microsoft Excel, or Portable Document Format (PDF). In the case of using these programs to edit images or graphics, these should be included in the article using “paste special” to maintain the original formatting, and the source files of these graphics should be also kept because these will be required if the paper is accepted.

Name files in the form “fig1.jpg” or “table1.jpg”.

### Sizing of Graphics

Most charts graphs and tables are one column wide (3 1/2 inches or 8.89 cm) or two-column wide (7 1/16 inches or 17.93 cm). We recommend that you avoid sizing figures less than one column wide, as enlargements may distort your images and result in poor reproduction. Therefore, it is better if the image is slightly larger, as a minor reduction in size should not have an adverse effect on the quality of the image. Is size is changed, keep the proportion so that images and graphics do not distort.

### Size of Author Photographs

The preferred size of an author photograph is 1 inch (2.54 cm) wide by 1 1/4 inches (3.17 cm) long. Please ensure that the author photographs are proportioned. JPEG or PNG files are accepted for author photos.

### Resolution

If you are preparing images in EPS, JPEG or PNG format, consider the following:

* High-contrast line figures and tables should be prepared with 600 dpi resolution and saved with no compression, 1 bit per pixel (monochrome).
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### Vector Art

In order to preserve the figures’ integrity across multiple computer platforms, we accept files in the following formats: .EPS/.PDF/.PS/.AI. All fonts must be embedded or text converted to outlines in order to achieve the best-quality results.

### Accepted Fonts Within Figures

When preparing your graphics IJIMAI suggests that you use of one of the following Open Type fonts: Times New Roman, Arial, Cambria, and Symbol. If you are supplying EPS, PS or PDF files, all fonts must be embedded. Without the fonts embedded, parts of the graphic may be distorted or missed.

A safe option when finalizing your figures is to strip out the fonts before you save the files, creating “outline” type. This converts fonts to artwork that will appear uniformly on any screen.

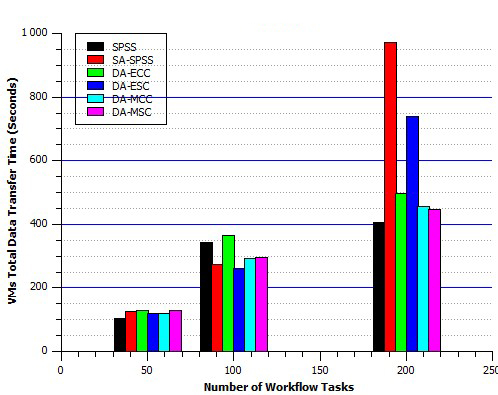


Fig. 1. Impact of the MONTAGE workflow on the virtual machines (VMs) total data transfer time. Note that “Fig.” is abbreviated. There is a period after the figure number, followed by two spaces.

## Integrating Figures and Tables into the Text

Tables and figures should be sequentially numbered in the order in which they are referred in the text body. Captions for figures and tables should be brief but self-explanatory.

When inserting the images in *Word,* please, do not insert them as “float over text”. Do not care about the positions of the figures and tables because IJIMAI will do the final formatting of your paper and will place them in the more suitable location. Therefore, do not use words as “above” or “below” when referring to figures and tables because their location can be changed during last edition steps of the paper.

Large figures and tables can span both columns. Place figure captions below the figures and table titles above the tables. If your figure has more than one part, include the labels “(a)”, “(b)” … as part of them. Do not:

* put borders around your figures.
* include captions as part of the figures.
* include captions as text boxes.

All figures and tables must be referenced from the text body with its number. Please check that all the figures and tables you mention in the text exist.

Use the abbreviation “Fig.” to mention figures. Do not abbreviate “Table.” Tables are numbered with Roman numerals as in Table I.

Figure axis labels are often a source of confusion. Use words rather than symbols. Put units in parentheses. Do not label axes only with units. As in Fig. 1, for example, write “VMs Total Data Transfer Time (Seconds)”, not just “VMs Total Data Transfer Time (s)” or “s”. Figure labels should be legible, approximately 8 to 12 point type.

# Abbreviations and Acronyms

Define the abbreviations and acronyms used in the abstract. Besides, define abbreviations and acronyms the first time they are used in the text, even although they have already been defined in the abstract. Well-known abbreviations such as RADAR do not need to be defined. If the abbreviation includes periods do not put spaces (e.g. use “U.S.A,” instead of “U. S. A.”. Do not use abbreviations in the title except in the case that they are unavoidable.

TABLE I. Voltages In 33-Bus Distribution System without Including SVC

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Bus** | **Analytical technique** | | **Monte Carlo** | |
|  | µ | σ | µ | Σ a |
| **2** | 0.997031 | 3.74E-05 | 0.997027 | 0.000038 |
| **3** | 0.982922 | 0.000232 | 0.982894 | 0.000236 |
| **4** | 0.975425 | 0.000318 | 0.975381 | 0.000326 |
| **5** | 0.968013 | 0.000416 | 0.967953 | 0.000426 |
| **6** | 0.949573 | 0.00068 | 0.949471 | 0.000698 |
| **7** | 0.946056 | 0.00071 | 0.945945 | 0.000729 |
| **8** | 0.932426 | 0.000886 | 0.932283 | 0.000906 |
| **9** | 0.926108 | 0.000985 | 0.92595 | 0.001006 |
| **10** | 0.920248 | 0.001089 | 0.920074 | 0.001111 |
| **11** | 0.919381 | 0.001105 | 0.919205 | 0.001129 |
| **12** | 0.91787 | 0.001136 | 0.91769 | 0.001160 |
| **13** | 0.91171 | 0.001265 | 0.911515 | 0.001290 |
| **14** | 0.909425 | 0.001318 | 0.909225 | 0.001344 |
| **15** | 0.908002 | 0.001342 | 0.907799 | 0.001368 |
| **16** | 0.906624 | 0.001371 | 0.906416 | 0.001396 |
| **17** | 0.904581 | 0.001402 | 0.904368 | 0.001429 |
| **18** | 0.903969 | 0.001413 | 0.903754 | 0.001440 |
| **19** | 0.996503 | 4.28E-05 | 0.996498 | 0.000043 |
| **20** | 0.992926 | 0.000145 | 0.992921 | 0.000143 |
| **21** | 0.992221 | 0.000173 | 0.992217 | 0.000172 |
| **22** | 0.991584 | 0.000211 | 0.991579 | 0.000210 |
| **23** | 0.979338 | 0.000326 | 0.979309 | 0.000331 |
| **24** | 0.972671 | 0.000547 | 0.972639 | 0.000553 |
| **25** | 0.969348 | 0.000655 | 0.969315 | 0.000664 |
| **26** | 0.947647 | 0.000715 | 0.94754 | 0.000734 |
| **27** | 0.945087 | 0.000765 | 0.944975 | 0.000786 |
| **28** | 0.933669 | 0.00102 | 0.93353 | 0.001048 |
| **29** | 0.925466 | 0.001218 | 0.925307 | 0.001251 |
| **30** | 0.921915 | 0.001304 | 0.921747 | 0.001339 |
| **31** | 0.917762 | 0.001366 | 0.917585 | 0.001403 |
| **32** | 0.916849 | 0.001381 | 0.916669 | 0.001418 |
| **33** | 0.916566 | 0.001383 | 0.916385 | 0.001421 |
|  | Base MVA=100 | | Base KV=12.66 | |

a This is an example of table footnote.

# Math Items

## Equations

If you are using *Word,* use the Microsoft Equation Editor for equations (Insert | Symbols | Equation). Do not used Math Editor 3.0. Then select the “Equation” markup style. Press the tab key and write the equation number in parentheses. Do not select “Float over text”. Use the same format for every equation and do not mix normal text and text introduced by the Equation Editor in the equation.

Number equations consecutively with equation numbers in parentheses right-aligned, as in (1). Separate equations when they are part of a sentence, as in

(1)

Be sure that the symbols in your equation have been defined. Use the word “Equation” only at the beginning of a sentence as “Equation (1) refers to ....”. Refer to “(1),” not “Eq. (1)” or “equation (1),” in other parts of the sentence.

## Units

For units, the International System of Units (SI) is preferable. Avoid combining different unit systems. In this case, the units for each quantity in each equation should be clearly indicated.

# References and Footnotes

Number citations consecutively in square brackets [1]. Multiple references are numbered [2] with separate brackets [1], [3]–[5]. In sentences, cite the reference number, as in [2]. Only use the word “reference” at the beginning of a sentence (e.g. Reference [5] studies …). Do not use “Ref. [5]” or “reference [5]” in other cases.

You do not need to format citations in blue, as this will be done automatically during the layout process if paper is accepted.

Number footnotes in superscripts[[1]](#footnote-1). The footnote should be at the bottom of the column in which it is cited and not at the end of the document. Use letters for table footnotes (see Table I).

The references at the end of this document are in the preferred referencing style. Include all authors’ names; do not use “*et al*.” unless there are six authors or more. Capitalize only the first word in a paper title, except for proper nouns and other words that must be capitalized, abbreviations, acronyms, etc. For papers published in non-English language, please give the title in the original language first, followed by the English translation between parentheses.

Notice that:

1. Not published papers should be cited as “unpublished”.
2. Papers accepted for publication, but not yet assigned to an issue should be cited as “to be published”. If an in-press version is published, they can be cited as [5].
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Below, we give some specific guidelines for different types of documents.

## Basic Format for Chapters of Books

Author, “Title of chapter in the book,” in *Title of the Book, x*th ed., Editor Ed. City of Publisher, Country: Abbrev. of Publisher, year, ch. *x*, sec. *x*, pp. *xxx–xxx,* doi: XXX.

Include DOI if available. When available online, add URL as follows:

Author, “Title of chapter in the book,” in *Title of the Book,* xth ed., Editor Ed. City of Publisher, Country: Abbrev. of Publisher, year, ch. x, sec. x, pp. xxx–xxx. [Online]. Available: http://xxx

[1] and [2] are examples of chapters of books.

## Basic Format for Journals

Author, “Name of paper,” *Title of Journal*, vol. x, no. x,pp*. xxx-xxx,* year, doi: XXX.

[3]-[5] are examples of journal papers. For articles in-press, it is important to include DOI as in [5]. [6] is an example of how to cite a paper to be published (with no in-press version available).

## Basic Format for Books

Author, *Title of the book*, *x*th ed., City of Publisher, Country: Publisher, year*.*

See an example in [7].

## Basic Format for Reports

Author, “Title of report,” Name of Company, City of Company, Abbrev. State, Country, Rep. *xxx*, year, doi: XXX.

If it is available on line:

Author, “Title of report,” Name of Company, City of Company, Abbrev. State, Country, Rep. *xxx*, year. Accessed: Date. [Online]. Available: URLXX, doi: XXX.

See an example in [8].

## Basic Format for Papers Published in Conference Proceedings

J. K. Author, “Title of paper,” in *Name of Conf.,* City of Conf., Abbrev. State, Country, year, pp. xxx-xxx, doi: XXX.

Two papers of conference proceedings are [9] and [10].

## Basic Formatfor Theses (M.S.) and Dissertations (Ph.D.):

Author, “Title of thesis/dissertation,” M.S. thesis/ Ph.D. dissertation, Dept., Univ., City of Univ., State, Country, year.

[11] is an specific example of how to cite a dissertation.

For other types of documents you can base on the guidelines of IEEE [12] but do not use abbreviations for names of journals, departments, etc. Whole words instead of abbreviations is the preferred style by IJIMAI. IEEE guidelines document shows very illustrative examples for the different types of documents and according to the available data and situation of publication.

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* Consider after Minor Changes
* Consider after Major Changes
* Reject

The decision and the reviewers’ comments will be communicated via email.

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This journal rejects papers that raise concerns about possible misconduct. The most common forms of scientific misconduct include:

* Plagiarism: The appropriation of the language or thoughts of another without crediting their true source, presenting them as one's own original work. Auto-plagiarism is not allowed, that is, presenting the own same material as original in more than one publication.
* Improprieties of authorship: inclusion of persons as authors who have not made a contribution to the work published; or not including a person who has definitely contributed to the work.
* Misappropriation of the ideas of others.
* Violation of accepted research practices: improper manipulation of experiments, analysis, or reporting of results.
* Inappropriate behavior in relation to misconduct: this includes false accusations of misconduct, not to report known misconduct, hiding information relevant to prove misconduct, etc.

More aspects of the journal policy are indicated at the journal website. Authors are requested to carefully check the “Policies” section of the website.

# Conclusion

Section II.E contains the guidelines to elaborate the Conclusion section.

Appendix

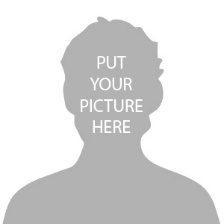
Appendixes, if needed, appear before the acknowledgment.

Acknowledgment

In this section you can thank all those who have helped in undertaking the research work. We advise to express your gratitude in a concise way and to avoid strong emotive language.

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**Name of Author**

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1. It is recommended that footnotes be avoided (except for the unnumbered footnote with the receipt date on the first page). Instead, try to integrate the footnote information into the text. [↑](#footnote-ref-1)