



HKU Al Lawyer Sentencing Predictor for Drug Trafficking

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Summary of the Impact

- developed the first AI-assisted Sentencing Predictor for drug trafficking in Hong Kong
- provides a convenient tool to the public to find out the likely legal consequences of committing drug trafficking offence
- helps social workers to make confident predictions at early stages of advising
- relieves stress from arrestees and families arising from the uncertainty of legal consequence
- benefits lawyers by reducing time and cost
- aids deterring crime
- More than 5,100 users benefitted and 7900 predictions made within one year (19 May 2021 to 10 May 2022)

HKU Sentencing Predictor http://wwwnew2.hklii.hk/predictor

Background

- Drug trafficking is a prevalent problem in Hong Kong but many, especially the youth, may not know the full legal consequence
- Social workers often took great pains to obtain the sentencing information from news which is an unreliable source of information
- Lawyers can spend much time to cross-check sentencing information

Aims

- design a reliable AI-powered sentencing predictor for layman and professionals (social workers and lawyers) to be familiar with sentencing guidelines and consequences
- provide a convenient tool for lawyers to cross-check legal information and cases

HKU Sentencing Predictor http://wwwnew2.hklii.hk/predictor

- Users answer 4 questions:
 - 1. Drug type and amount
 - 2. Guilty plea
 - 3. Aggravating factors
 - 4. Mitigating factors to generate predictions of the length of imprisonment
- the effect of individual selected features (e.g. mitigating factor) on the overall predicted sentence is explained
- a list of relevant court decisions based on the user's input information will be provided



Desktop version



Research Outputs

Book Chapter

 Tien-Hsuan Wu, Ben Kao, Anne SY Cheung, Michael MK Cheung, Chen Wang, Yongxi Chen, Guowen Yuan & Reynold Cheng, <u>Integrating</u> <u>Domain Knowledge in AI-assisted</u> <u>Criminal Sentencing of Drug</u> <u>Trafficking Cases</u>, in *Legal* <u>Knowledge and Information</u> <u>Systems: JURIX 2020: The Thirtythird Annual Conference</u>, pp.174-183 (Serena Villata et al. eds., IOS Press, 2020) Legal Knowledge and Information Systems © 2020 The Authors, Faculty of Law, Masaryk University and 10S Press. This article is published online with Open Access by 10S Press and distributed under the terms of the Creative Commons Attribution Non-Commercial License 4.0 (CC BY-NC 4.0), doi:10.3237FAI.200861

Integrating Domain Knowledge in AI-Assisted Criminal Sentencing of Drug Trafficking Cases

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Abstract. Judgment prediction is the task of predicting various outcomes of legal cases of which sentencing prediction is one of the most important yet difficult challenges. We study the applicability of machine learning (ML) techniques in predicting prison terms of drug trafficking cases. In particular, we study how legal domain knowledge can be integrated with ML models to construct highly accurate predictors. We illustrate how our criminal sentence predictors can be applied to address four important issues in legal knowledge management, which include (1) discovery of model drifts in legal rules, (2) identification of critical features in legal judgments, (3) fairness in machine predictions, and (4) explainability of machine predictions.

Keywords. judgment prediction, prison term prediction, domain knowledge, fairness, explainability

1. Introduction

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With recent advances in machine learning (ML) and AI technology, one of the fastest growing areas in legal technology is the adoption of AI to assist lawyers and judiciaries in handling, processing, and discovering legal knowledge that is embedded in various legal documents such as judgments and ordinances. Works in this area have led to much interesting research, notably in *judgment prediction*, which is the task of predicting or determining various aspects of a legal case given a textual description of a litigation. Early works in judgment prediction (e.g., [1,2]) aim at predicting a certain outcome of a judgment by finding statistical correlations between a set of variables and possible outcomes from historical judgments. In recent years, researchers apply natural language processing (NLP) techniques and tackle the judgment prediction problem by formulating it as various text classification problems. Among them, the following four tasks have attracted much attention lately: [**Outcome prediction**]: to predict the outcome (e.g., set tled, dismissed, etc.) of a case [3,4]; [**Article prediction**]: to predict the charges of which a defendant should be convicted based on a description of the defendant's criminal activi-



Research Outputs

Conference Paper

Yongxi Chen, Michael MK Cheung, Anne SY Cheung, Tien-Hsuan Wu, Ben Kao, Chen Wang, Guowen Yuan & Reynold Cheng, AI-Assisted Criminal Sentencing of Drug Trafficking Cases: A Model for Combining Human and Algorithmic Legal Decision-Making, in *Machine* Lawyering Conference: Human Sovereignty and Machine Efficiency in the Law, CUHK, Hong Kong, January 2021

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AI-Assisted Prediction of Sentencing in Drug Trafficking Cases in Hong Kong:

A Model for Combining Human and Algorithmic Legal Decision-Making

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1 Introduction

Recent advances in artificial intelligence (AI), largely enabled by machine learning (ML) and big data analytics, bring significant changes in society, including the administration of criminal justice. Much attention has been drawn to the use of AIpowered prediction technology to inform decisions about policing, bail, sentencing and parole. For instance, in the US, courts have been using an algorithmic risk assessment tool, the Correctional Offender Management Profiling for Alternative Sanctions (COMPAS), to predict the rate of recidivism of the defendant.¹ While the use of AIpowered tools in the legal domain may have streamlined the work processes and help legal professionals and judges to gain insights that are otherwise obscure to human analysis, questions have been raised on reasonableness and fairness in using AI. Major

^{*} Paper submitted for the conference of "Machine Lawyering: Human Sovereignty and Machine Efficiency in the Law", January 14-16, 2021, The Chinese University of Hong Kong. * Jaculty of Law, The University of Hong Kong.

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¹ Alyssa M. Carlson, The Need for Transparency in the Age of Predictive Sentencing Algorithms, 103 IOWA L. REV. 303, 310 (2017).

Underpinning Research

Background

- Recent advances in artificial intelligence (AI) and machine learning (ML) have great potentials to bring revolutionary changes to legal practice.
- AI can be used to handle, process and discover legal knowledge embedded in a vast number of legal documents.
- AI can draw insights from past judicial decisions to predict future outcomes.
- There is a potential to use AI to inform sentencing which is an essential part of the criminal justice system
- Our focus on drug trafficking sentencing

Interdisciplinary Research

Collaboration with the Department of Computer Science HKU

Law: Capturing legal domain knowledge for constructing predictor models

- Identified how human judges decide on sentences
- Identified and extracted 82 common features of 3,172 drug trafficking sentencing cases and selected 11 salient features which are determining factors of sentencing
- Examined the role of explainability, the use of explanation techniques and the explainability requirements in the field of AI and law

Computer science: Leveraging AI technologies to develop the Sentencing Predictor

- Studied how legal domain knowledge can be integrated with ML models to construct highly accurate predictors.
- Four predictor models have been constructed. These predictors differ in whether and how ML and/or substantive domain knowledge (SDK, representing the salient factors of a case)/argumentative domain knowledge (ADK, representing the reasoning process adopted by a judge) are used.

Underpinning Research

Four predictor models



RawML takes a plain text judgment (with sentencing masked) as input and returns a predicted prison term using a deep neural network.

PureDK mimics a human judge's decision by considering SDK and ADK. It calculates a prison term based on 11 salient features that are typically the determining factors of sentences of drug trafficking cases and the 3-step procedure of sentencing.

SDK+ML is constructed by building regression trees with gradient boosting using the 11 salient features as input and a prison term as output.

SADK+ML uses ADK to determine starting point and guilty-plea discount and uses ML to learn a sentence adjustment model.

Innovativeness of Knowledge

• The development of an automatic feature extractor (AFE) to extract features from judgments by using a combination of regular expression (RE) and deep learning (DL) methods.

Machine Understanding of Legal Text



Court judgment of a drug-trafficking case

Underpinning Research

Performance of four models

Predictor	RawML	PureDK	SDK+ML	SADK+ML	SDK+ML (AFE)	SADK+ML (AFE)
Accuracy (%)	73.03	91.52	91.23	<u>92.12</u>	<u>88.04</u>	<u>88.90</u>
Miss _{0.3} (%)	33.19	4.33	5.91	5.55	9.69	7.86

Accuracy = $1 - \frac{|\hat{y}-y|}{y}$, where \hat{y} is the predicted prison term and y is the ground truth Miss_{0.3}: Fraction of cases in which a predictor's error $\left(\frac{|\hat{y}-y|}{y}\right)$ is at least 0.3

- **SADK+ML** gives the best accuracy (92.12%), which is even slightly better than PureDK's (pseudo human judge). The results show that ML techniques can be effectively applied to learn an aggregated adjustment model.
- The versions of SDK+ML and SADK+ML that use AFE give very good accuracies, i.e. 88.04% and 88.90% respectively, and reasonably low bigmiss rate. They significantly outperform RawML. This shows that the AFE is very effective.

Engagement: Workshop

Al Lawyer: Sentencing Predictor for DrugTrafficking 港大人工智能律師:販毒罪量刑估算程式

LAW & TECHNOLOGY CENTRE The University of Hong Kong

講者:

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Artificial intelligence (AI) can be used to draw insights from past judicial decisions to predict future outcomes. In the criminal justice system, one essential aspect is sentencing. The HKU's research team has developed Stage-1 model of HKU AI Lawyer, an AI-assisted sentencing predictor for the offence of trafficking in dangerous drugs in Hong Kong. It is a pragmatic tool for professionals including lawyers, social workers and teachers. It also serves to inform the public of likely legal consequences of committing drug trafficking offences. A Zoom workshop will be held on Tuesday, May 18 from 2:00pm to 3:15pm, to introduce the HKU AI Lawyer and demonstrate its use. This event will be conducted in Cantonese.

人工智能可在過往的司法裁決中發掘新知,從而預測類似案件的未來結果。在刑事 司法制度中,量刑是重要的一環。香港大學研究團隊研發出「港大人工智能律師」 的第一階段模型。該模型開創性地結合了法律領域知識和機器學習技術,以人工智 能技術輔助估算販毒罪量刑。量刑估算程式能夠幫助專業人士(包括律師、社工和 教師),還可以使公眾了解到觸犯販毒罪可造成的法律後果。

「港大人工智能律師」介紹及示範工作坊:

日期:2021年5月18日(星期二) 時間:下午2時至3時15分 語言:粤語 工作坊將以Zoom進行,請儘早報名參加。 報名方法:請掃描二維碼或瀏覽本中心網站 www.lawtech.hk/events 查詢:陳小姐 (mcgrace@hku.hk/39174727)



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陳文浩先生 香港青年協會副總幹事

Attended by about 200 audiences including legal practitioners and social workers



Knowledge Dissemination: Exhibition Booth at Science Park

• The research team was invited by Hong Kong Science and Technology Parks Corporation to showcase the Sentencing Predictor at 2021 World Artificial Intelligence Conference - Hong Kong Forum at Hong Kong Science Park attended by more than 100 participants on 8 July 2021



Engagement: Media Coverage Local & International: 11





Impacts Achieved (as of 10 May 2022)

Activity of the Sentencing Predictor Since Launch*

Unique visitors **5,173**

Predictions made

7,922

* Data collected from 19/5/2021 to 10/5/2022

Source I Google Analytics, Server logs

Engagement: External Partner

• The Hong Kong Federation of Youth Groups is a supporting partner of the project.

• The Sentencing Predictor has been widely used by HKFYG social workers to provide drug counselling services to their clients.



香港青年協會 the hongkong federation of youth groups



Endorsement from HKFYG:

"Prof. Cheung's and Prof. Kao's initiative to develop a sentencing predictor was heralded as a significant positive step towards translating obscure legal knowledge to comprehensible legal information ...

Our social workers and service users recognized the sentencing predictor is easy to use and the user interface is user friendly.

They used the sentencing information generated by the sentencing predictor to design counselling plans and sometimes they used the sentencing predictor together with our clients. .."

Evidence of Impacts Achieved and our Beneficiaries

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Recognition from Legal Practitioners

- "Provide great assistance to calculations and rough starting points" Mr. Freddy Woon, a criminal barrister of over 35 years' experience
- 2. "Give me an instant answer"

A barrister of over 10 years' experience

3. "The sentencing predictor offers an extreme easy way to provide a preliminary view of sentence which I found very useful and helpful. I would also use it to double confirm my research on sentence as well. Thank you for providing such a good work for legal practitioner."

Mr. Colin Leung, a barrister of 10 years' experience

Recommendation by NGOs

- Hong Kong Federation of Youth Groups
- Voice for Prisoners

https://www.voiceforprisoners.org/resources

Vision: Ongoing Impacts

- Continues to contribute to the development of applied AI and legal research
- Designs AI system to be deployed in the legal domain for public interest
- Enhances accessibility to legal information for the community

