HKU AI 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
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• 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
Research Outputs

Book Chapter

Research Outputs

Conference Paper

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

**Law Student**

1. The defendant was 18 and has a clean record. Defence counsel Mr. J. submitted that the defendant used to be a good kid. Unfortunately, his parents were divorced in 2006 when he was 14. The defendant went to live with his mother and younger brother. As a result of his parents' divorce, the defendant felt lonely and could not pay attention to his studies. He got acquainted with malicious peers and became a drug addict.

2. Regarding the present offense, Mr. J. submitted that the defendant met someone in a karaoke and foolishly agreed to deliver drugs for a reward of $1,000. Mr. J further submitted that the defendant has reflected upon himself and feels sorry for what he has done, and his parents are supportive of his rehabilitation. Letters written by the defendant and his parents were placed before me, their contents are duly noted.

3. The Court of Appeal has laid down clear sentencing guidelines for trafficking in cocaine (see Attorney General v. Pedro Nel Rivas [1985] 2 MLR 40 and The Queen v. Luis Valdez & others [1994] 2 MLR 370). For 10 to 50 grams of cocaine, the sentence ranges from 5 to 8 years’ imprisonment. Sentencing guideline: 10 to 50 grams of cocaine, the sentence ranges from 5 to 8 years’ imprisonment.

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**Machine Assistant**

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**Court judgment of a drug-trafficking case**
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 big-miss rate. They significantly outperform RawML. This shows that the AFE is very effective.

\[
\text{Accuracy} = 1 - \left| \frac{\hat{y} - y}{y} \right|
\]

where \(\hat{y}\) is the predicted prison term and \(y\) is the ground truth

\[
\text{Miss}_{0.3} = \text{Fraction of cases in which a predictor’s error } \left| \frac{\hat{y} - y}{y} \right| \text{ is at least } 0.3
\]
Engagement: Workshop

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.

Demonstrated the Sentencing Predictor to more than 30 participants including entrepreneurs, executives, academics and students.
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: 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.
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

Recognition from Legal Practitioners

1. “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