AI potential to Uncover Criminal Modus Operandi

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Motivation & goal

Research Lines

Strategische Agenda
Politieacademie
2018-2022

Verstevigen
en vernieuwen:
voor wendbare
en weerbare
politiemensen

Eight themes for research

1. What are we facing?
2. Police in connection with local-web-world
3. New safety coalitions
4. **State of the art technology and intelligence**
5. Active transparency
6. Healthy and versatile
7. Learning organisation
8. Legitimacy and trust

Uncover Modus Operandi

1. ? Steps and skills required to commit crime

2. Modus operandi knowledge enables timely detection of crime trends and to develop effective counter strategies

3. But modus operandi knowledge is not always easy to access and keep updated due to the criminal adaptation pace

And thus…

1. Can AI offer some support?

2. What is the potential of AI to extract criminal modus operandi from unstructured open text sources?

3. Use case: court sentence rulings

   ✓ These text sources are a reliable information source including detailed validated information on the criminal activities in a given country

   ✓ Alternative to the examination of classified police information which facilitates cross-country comparisons

   – Biased sample

   – Not real-time information

4. If this approach works, it could be applied to different information systems (e.g. police systems)

Research question & goal

What is the potential of AI methods to extract criminal modus operandi from unstructured open text sources like law court sentences?

- How to match modus operandi questions and AI methods in a meaningful manner?

- Can a pipeline be developed to support the development and updating of a Modus Operandi database?

- What are the caveats and opportunities of such an approach?
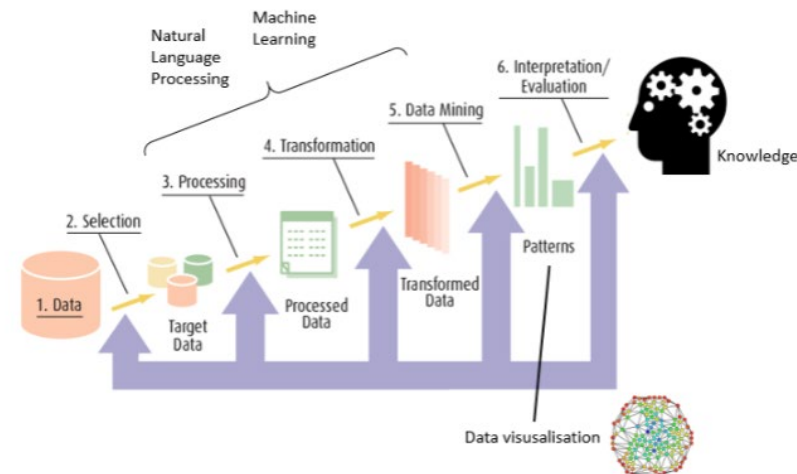
2

Inspiration

Inspiration

1. Some interesting examples that underline the need for articulation of the research question before applying AI

2. Most court ruling related examples are on the potential of AI to support sentencing (e.g. Stobbs et al (2017)) or to predict rulings (Medvedeva et al (2020)) or to analyse sentencing (Wenger et al (2021), Soh et al (2019),….)

Text as Data for Conflict Research: A Literature Survey

Seraphine F. Maerz and Cornelius Puschmann

Artificial Intelligence and Law (2020) 28:237–266
https://doi.org/10.1007/s10506-019-09255-y

ORIGINAL RESEARCH

Using machine learning to predict decisions of the European Court of Human Rights

Masha Medvedeva[1,2] · Michel Vols[2] · Martijn Wieling[1]

Published online: 26 June 2019
© The Author(s) 2019

NATO OTAN   S&T organization

Making sense of evolving threats: A novel AI approach to monitor violent organisations and their defining characteristics over time from open sources

Thomas Powell   Anne Merel Sternheim   Ioannis Tolios   Koen van der Zwet   Freek Bomhof
Netherlands Organisation for Applied Scientific Research (TNO)
TNO Defence, Safety & Security

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Journal of Computational Science
Volume 36, September 2019, 101024

ELSEVIER

An approach for understanding offender modus operandi to detect serial robbery crimes

Yu-Sheng Li [a, b], Ming-Liang Qi [a, b]

Birks et al. Crime Sci   (2020) 9:18
https://doi.org/10.1186/s40163-020-00127-4

Crime Science

RESEARCH   Open Access

Unsupervised identification of crime problems from police free-text data

Daniel Birks[1,2*], Alex Coleman[2] and David Jackson[3]

Automated Extraction of Sentencing Decisions from Court Cases in the Hebrew Language

Mohr Wenger[◇*]   Tom Kalir[◇*]   Noga Berger[♠]
[♠†]Carmit Klar Chalamish   Renana Keydar[♠♡]   Gabriel Stanovsky[◇]
[◇]School of Computer Science and Engineering [♣]Faculty of Law [♡]Digital Humanities
The Hebrew University of Jerusalem, Jerusalem, Israel
[♠] The Association of Rape Crisis Centers in Israel
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Bar-Ilan University, Israel
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Approach

Approach

1. Complexity of modus operandi demands a careful articulation of the modus operandi question
2. Unstructured character of law court sentences

Data & Source:
- criminal law
- court cases in the Netherlands
- www.uitspraken.rechtspraak.nl

Approach

1. Complexity of modus operandi demands a careful articulation of the modus operandi question

2. Also the unstructured character of law court sentences

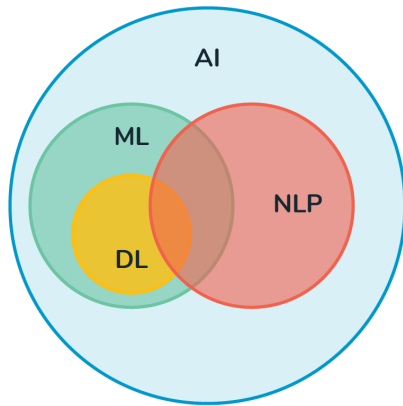3. Modus operandi types of questions
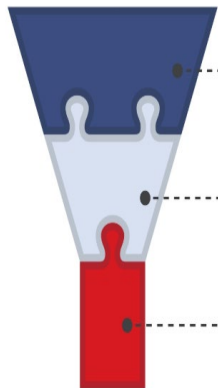
Exploration, e.g. create overview of the means / locations

Detection, e.g. recognize specific types of use of means/locations

Categorisation, e.g. comparison of / detection of trends in specific types of means/locations use

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Text mining / AI ?
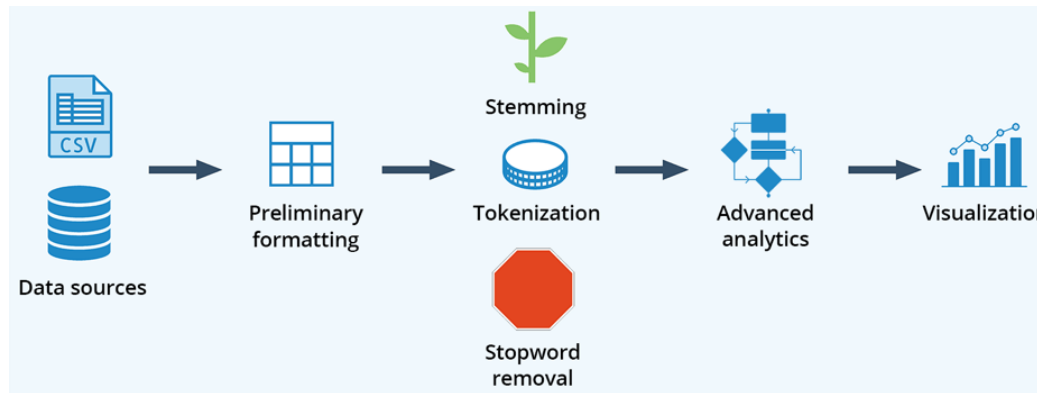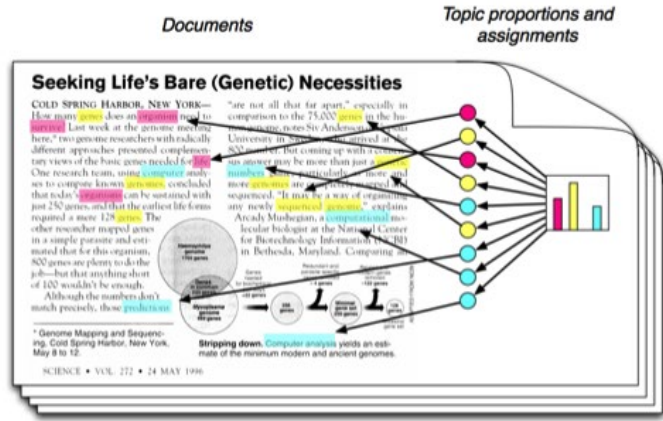
Stepwise Approach

1. Exploration
   - Open questions to assess potential value of extracted information
   - E.g. Topic modelling or other unsupervised methods
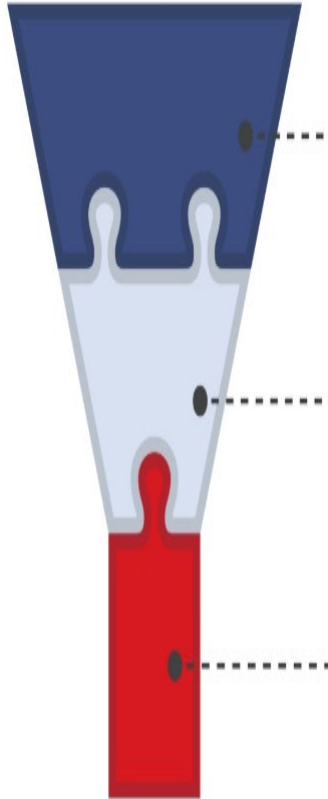
2. Detection
   - Detect specific modus operandi characteristics and enrich these (links)
   - E.g. Name-Entity Recognition

3. Categorisation
   - Combine methods of detection and clustering to compare differences in modus operandi characteristics.
   - E.g. Naïve Bayesian classifier or other supervised methods
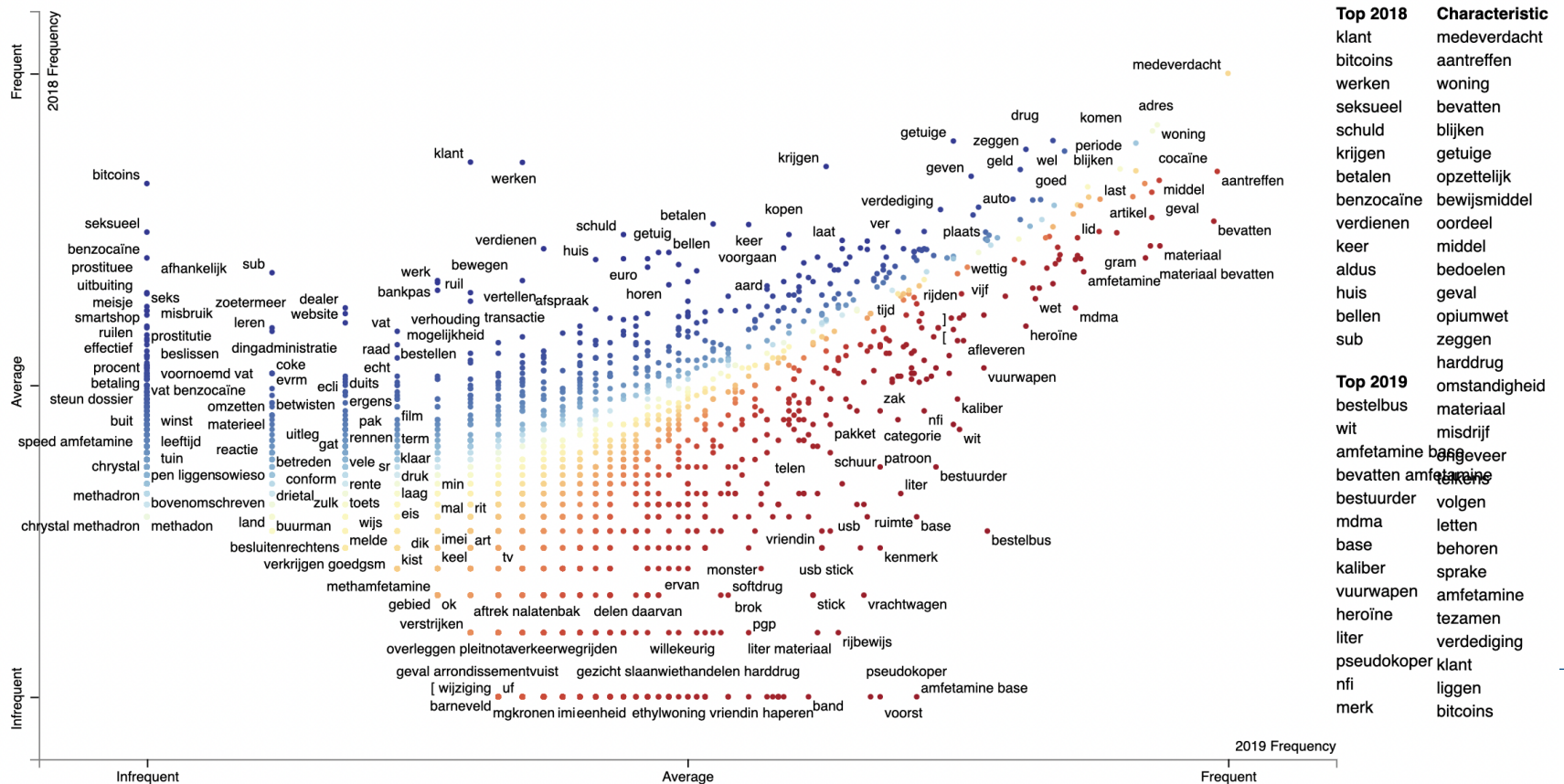
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Findings so far

AI for Exploration

What are the differences of relevant terms in court sentences in the Netherlands between 2018 and 2019?
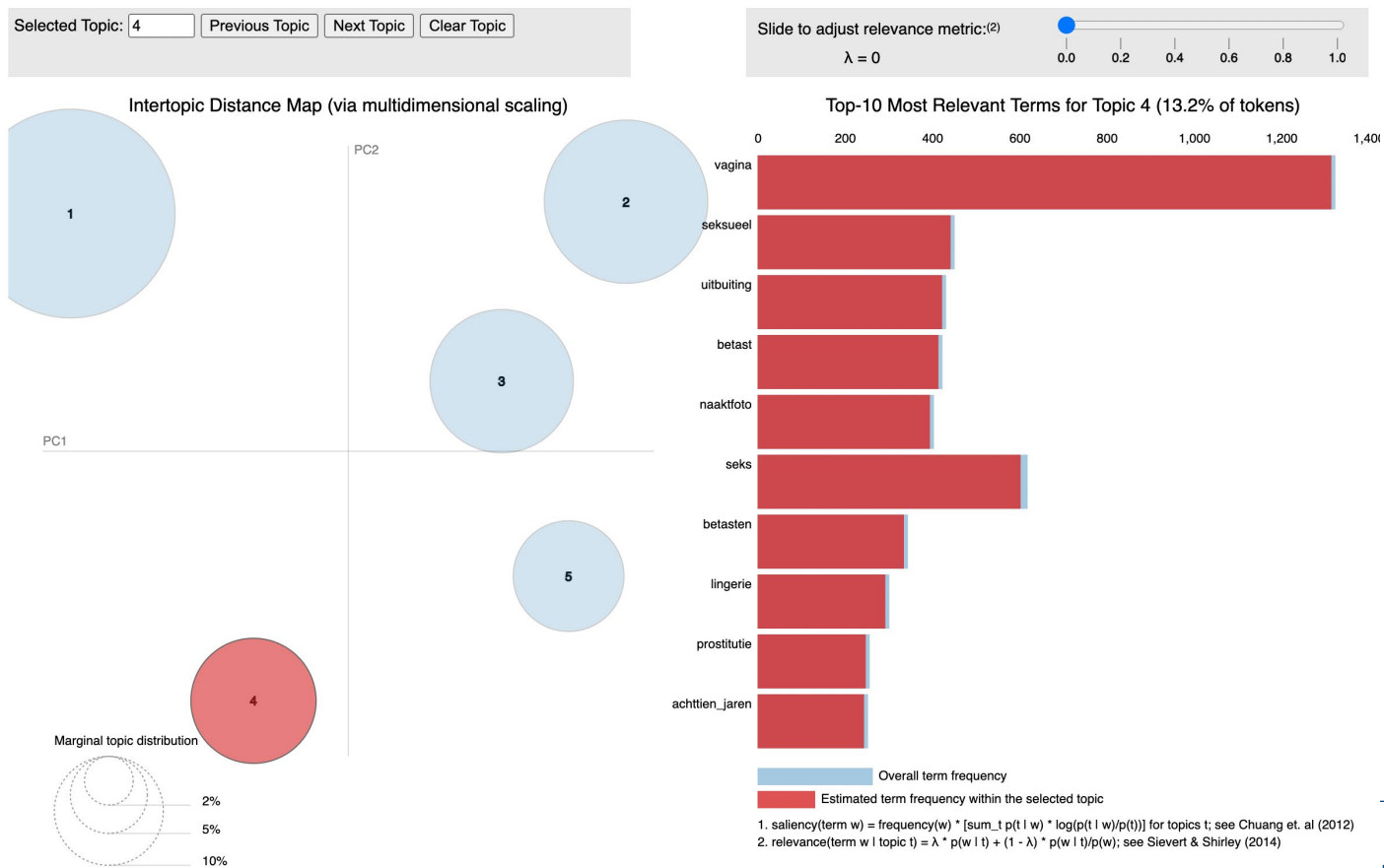
1. *Scattertext SpaCY*

2018 document count: 53; word count: 54,236
2019 document count: 79; word count: 36,679

AI for Exploration

What are different types of rape crimes in the Netherlands?

1. Using pyLDAvis to visualise created LDA model

AI for Exploration

Why?

1. *Scattertext SpaCY* enables to compare different terms and plot these in an easy manner
2. Topic modelling quickly provides insight into the similarities and differences in the data
3. These techniques enable analysis of different types of information sources and across time horizons

How?

1. Exploration questions should not aim to generate detailed information for specific modus operandi.
2. Requires a pre-processed dataset (but not labelled)
3. Validation requires domain expertise.
4. Data granularity can influence the results (e.g. topic clusters are too similar, or too many)

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AI for Detection

Which specific characteristics of modus operandi are present (and how are they related)?

1. *SpaCY Name-Entity Recognition (NER)* & *displayCy dependency visualiser*
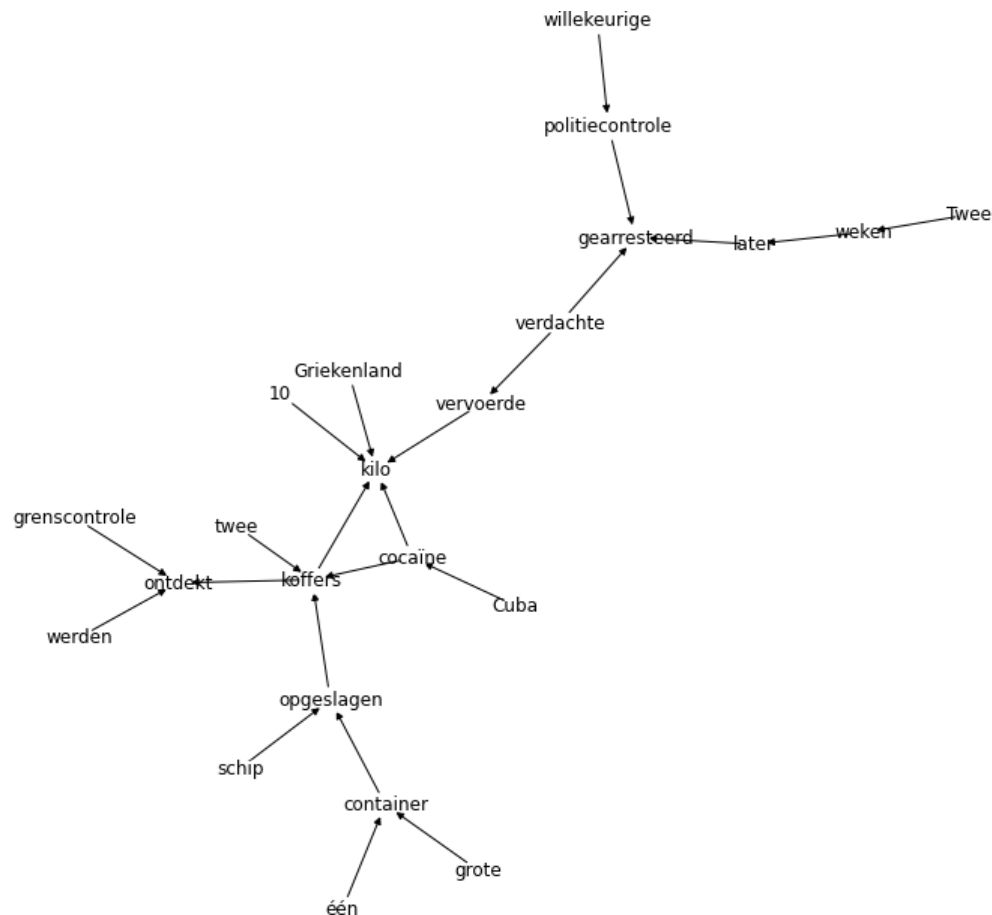
AI for Detection

Why?

1. Application of SpaCY Name-Entity Recognition (NER) enables detection of specific elements of modus operandi (entities)

2. *SpaCY displayCy dependency visualiser* enables visualisation of these entities and their relationships creating extra insights

How?

1. Pre-trained model was evaluated and optimized for specific domain usage.

2. Detection questions should be precise and scoped: validate whether output is representative.

3. Requires annotation (potential bias!), training (large datasets) & validation.

4. Expert knowledge required.

AI for Categorisation

Trends in the synthetic drugs modus operandi in the Netherlands in the last 20 years?

1. Identify relevant categories through exploration: TF-IDF
2. (Re)Train model: CountVectoriser, SMOTE and Multinomial Naïve Bayes

Trends of drugs and its ingredients appearing in Dutch court cases
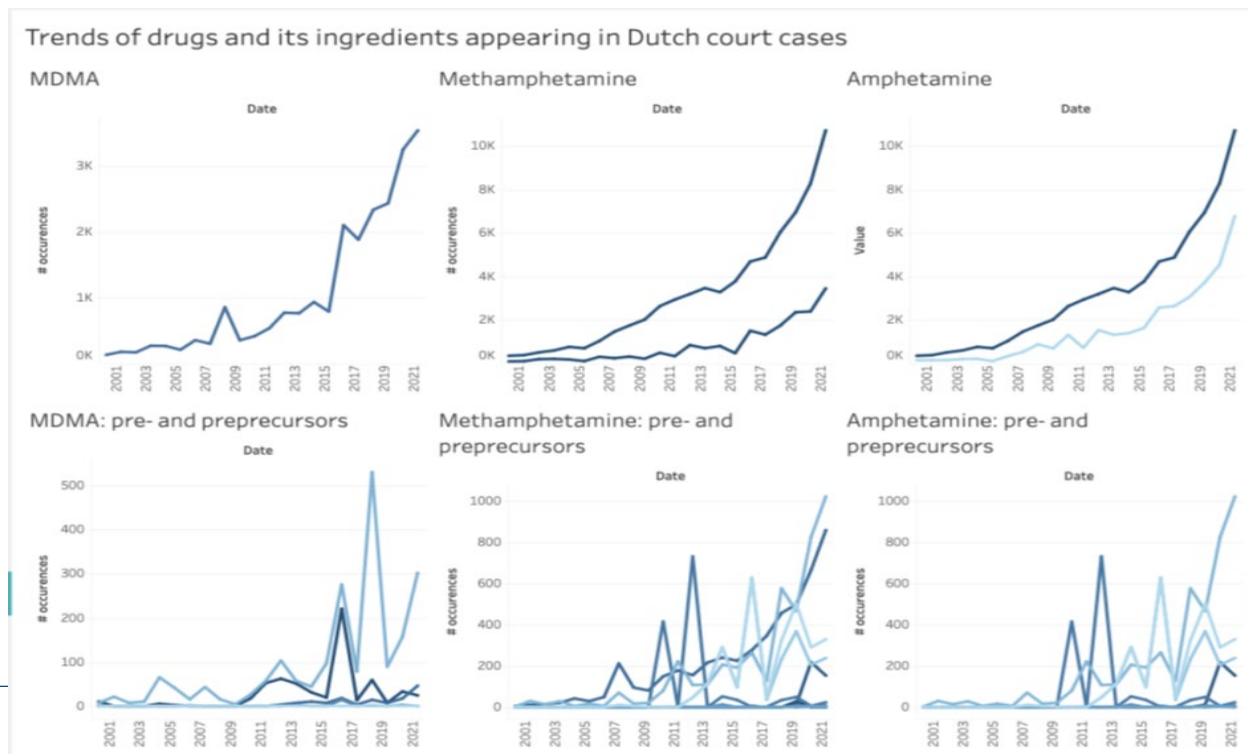
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AI for Categorisation

Why?

1. Methods enable identifying differences and similarities between specific modus operandi characteristics

2. Methods support analyse evolution of specific modus operandi characteristics over time.

How?

1. Determine specific modus operandi characteristic that yield different modus operandi

2. These should be significant differences and substantial in the text

3. Requires large corpus and manual annotation

4. Requires thorough validation process of the trained model

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Conclusion & implications

Conclusion & implications

- Modus operandi is a broad term that demands careful application of AI

- Proposed stepwise approach
  - supports effective use of AI methods
  - enables automatic extraction of relevant information from court cases for modus operandi analysis

- But its application in practice <u>requires team work</u> !

Analyst   Police experience

Criminology

Data science