

An Application of Case-Based reasoning to Decision-Making in Dutch Administrative Law

Joep Nouwens,
AnneMarie Borg, Henry Prakken

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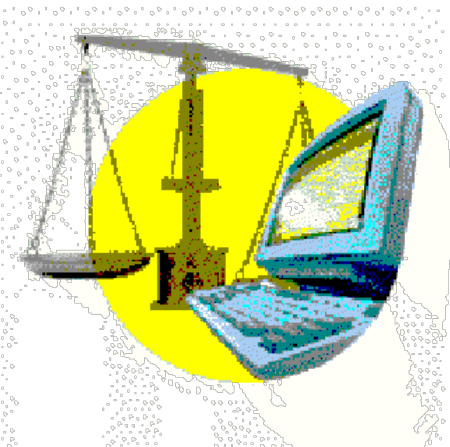


Decision support for deciding on fitness to drive

- At Dutch Central Driving License Office
 - “No machine learning”
 - Not transparent or explainable
 - “Is standard CBR useful?”
- Standard CBR:
 - assumes ‘features’ without preferences for decisions
 - applies numerical similarity measures
 - suggests decision of precedent(s) with highest similarity to current case
- **Example features:** Heart disease? Bipolar disorder? Eye sight, Epileptic attacks

Case-based reasoning in AI & Law

- Dimension values have **tendencies** towards a decision
- Sets of dimension values are weighed in **cases**, which become **precedents**
 - How do lawyers **argue** with dimensions?
 - How do precedents **constrain** new decisions?





Dimensions

- A **dimension** $d = (V, \leq_o, \leq_{o'})$ where
- V is a set
- \leq_o and $\leq_{o'}$ are two partial orders such that $v \leq_o v'$ iff $v' \leq_{o'} v$
- Given a set D of dimensions:
 - a **fact situation** F is a set of value assignments to all $d \in D$;
 - a **case** $c = (F, s)$ where F is a fact situation and $s \in \{o, o'\}$



Precedential constraint

- When is a decision in a new case ‘forced’ by a case base?
 - If the case base contains a precedent for that decision that **cannot be distinguished**:
 - All differences make the new case even stronger for the new decision

J. Horty, Rules and reasons in the theory of precedent. *Legal Theory* 17 (2011): 1-33.

...

H. Prakken, A formal analysis of some factor- and dimension-based accounts of precedential constraint. *Artificial Intelligence and Law* 29 (2021): 559-585.

...



Dimensions: Horty's result model

- For any two fact situations F and G given a set of dimensions:
 - $G \leq_s F$ iff F is for every dimension at least good for s as G .
- Deciding fact situation F for s is **forced** iff there exists a precedent with fact situation G and decided for s such that $G \leq_s F$



Joep Nouwens: Msc project AI-UU

- Dimension ordering determined with van Woerkom's tools, then validated with **experts**
- Combine and compare traditional and AI & law style CBR
 - Apply various decision rules to test cases given a case base



Experiment

- Case base: 15.843 cases, 123 dimensions
 - 80% used as precedent
 - 20% used as test case
- Four decision rules:
 - **Standard CBR**: predict decision with highest similarity
 - **Precedential constraint** with if both allowed/forced:
 - predict 'fit'
 - predict 'unfit'
 - predict decision of case with highest similarity according to standard CBR



Experiments with accuracies

- Case base: 15.843 cases, 123 dimensions
 - 80% used as precedent
 - 20% used as test case
- Four decision rules:
 - **Standard CBR**: predict decision with highest similarity (92%)
 - **Precedential constraint** with if both allowed/forced:
 - predict 'fit' (70%)
 - predict 'unfit' (64%)
 - predict decision of case with highest similarity according to standard CBR (91%)



Consistency of datasets

- A case base is **inconsistent** iff it forces opposite outcomes for the same fact situation
- **Degree** of consistency of a CB:
 - The rate of (F,s) for which a (G,s') exists such that $F \leq_s G$
- Office's case base was **45%** inconsistent



Possible practical benefits

- Awareness of inconsistencies in decision-making
 - Enforcing the logic of precedential constraint
- No overlooking of relevant cases
- ...



The value of predictive experiments

- “High predictive accuracy is evidence of legal correctness of the model”
 - Alevan, Ashley
- HP: only true if system and humans:
 - apply the same **knowledge**
 - **reason** with it in the same way
 - And different humans **decide** in the same way
- And we did not compare with **humans** or test **usefulness**