An Introduction to Artificial Intelligence and Law

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1. Overview of AI and Law - Goals

- Contribute to jurisprudence/cognitive science/AI
- Improve legal reasoning and argumentation skills of attorneys
- Improve the quality of legal decisions, including the quality of justifications of decisions in court opinions.
- Improve the training and skill of lawyers
  - More careful reading of legal materials
  - More precise drafting of legal documents
  - More rational management of risk
  - More efficient management of information
- Provide a fairer and more efficient system of justice
  - Reduce high transaction cost of legal services
  - Make it easier to treat like cases alike
  - Facilitate alternative dispute resolution
  - Advance public understanding of the law and legal system
- Avoid potential for abuse:
  - Computer programs as tools for legal decision makers, not as decision-makers.

Definitions

Artificial Intelligence:

- Getting a computer to behave in a way we call "intelligent" when done by humans.
- The study of cognitive systems that use information purposefully (recognizing, understanding, reasoning, planning, communicating) to achieve their goals.
- Making computers reason symbolically with concepts.
- The Turing test (modified)

Legal Reasoning:

Judgmental reasoning
Reasoning with precedents
Planning and drafting
Interpreting complex legislation
Reasoning with uncertain evidence
Arguing and persuading
Justifying legal decisions

Artificial Intelligence - Grand Challenges

- Creating a knowledge base of commonsense concepts (*acquisition* and *memory organization*)
- Recognizing exemplars of concepts (*interpretation*)
- Manipulating concepts to draw conclusions, make predictions, achieve goals (*inference*, *planning*)
- Natural language communication (*understanding*, *generation*)

Artificial Intelligence and Law - Grand Challenges

- Representing legislation for both inference and maintenance
- Representing and reasoning with open-textured concepts
- Representing and reasoning with normative concepts
- Simulating the process of expert legal prediction/advising
- Reasoning and arguing using examples as well as rules
- Understanding and generating legal texts

Note: AI & Law challenges are not restricted to legal reasoning!

Artificial Intelligence and Law - Applications

- Decision support
  - Computerized statutes and regulations
  - Legal expert systems (advisory)
- Legal Drafting
  - Tools to support drafting in normalized form
  - Document assembly/generation systems
- Legal Research and Litigation Support
  - Legal document management and retrieval systems
  - Legal research assistant/expert systems
- Legal Argumentation and Negotiation
  - Argumentation support systems
  - Mediation systems, online dispute resolution
- Intelligent tutoring systems, e-learning
- E-commerce
  - Represent/enforce security rules, e-contracts, digital rights

2. Formalizing Legislation using Logic

Pre-history: Statutory Normalization [Allen]

Syntactic vs. semantic ambiguity

Sad state of legal draftmanship - syntactic ambiguity is almost always present and unintentional

Example:

No person shall engage in or institute a local telephone call . . . of an anonymous nature and therein use obscene, profane, vulgar, lewd, lascivious or indecent language, suggestions or proposals of an obscene nature and threats of any kind whatsoever. (from State v. Hill 245 La 119 (1963) [Allen and Engholm])

To be in violation, must the call include obscene language AND threats??

Process:

1. Identify "atomic" substantive propositions and replace with variables (S1, S2 . . .)
2. Use propositional logic to clarify the syntax
3. Restore the text of the substantive propositions

Formalizing Legislation (cont.)

Technical issue: "scope" of a logical operator

AND	vs.	NOT
NOT use obscenity		AND
NOT make threats		use obscenity
		make threats

Normalized version: If

1. S1 (anon. phone call) AND
2. A. S2 (obscene) OR
   B. S3 (threats)

Then

3. S4 (violation)

Today - a normalized statute is "runnable"! By asking the user whether each substantive proposition is true or false, the logic of the statute is automated.

Logic Programming (Horn Clause Logic)

"Vehicles are not permitted in this park"

famous example [H.L.A. Hart 1958]

violation -: vehicle (X) , park(Y), in (X, Y).
vehicle (X) -: motorcycle (X).
vehicle (X) -: ten_speed_bike (X).

Can't take a motorcycle into the park.
Can't take a ten speed bike into the park.
Can't take anything else into the park if it qualifies as a vehicle.

Horn clause logic implements most (but not all) of standard mathematical logic (predicate calculus), permitting the content of substantive propositions to be expressed as well as the overall logical syntax.

The British Nationality Act as a Logic Program

[Sergot et. al.]

1-(1) A person born in the United Kingdom after commencement shall be a British Citizen if at the time of birth his father or mother is:

(a) a British Citizen, or

(b) settled in the United Kingdom.

This is represented in the computer as:

Rule1: X acquires british citizenship on date Y

IF X was born in the u.k.
AND X was born on date Y
AND Y is after or on commencement of the act
AND X has a parent who qualified under 1.1 on date Y.

Rule2: X has a parent who qualifies under 1.1 on date Y

IF X has a parent Z
AND Z was a british citizen on date Y

Rule3: X has a parent who qualifies under 1.1 on date Y

IF X has a parent Z
AND Z was settled in the u.k. on date Y.

Major Problems for Formalized Legislation

1. Open Textured concepts:

"Vehicles are not permitted in this park"

Are baby carriages prohibited?
Are tricycles prohibited?
Are 10 speed bikes prohibited?
Are 1000 cc Harley Davidson motorcycles prohibited?
Is a functioning tank prohibited for Patriot's Day celebration?

Hart - core vs. penumbra theory
Fuller: Consider *purpose* of the law: limit noise, promote safety
If noise is the issue, 10 speed bike should be permitted

Formal Approaches to Open Texture

Large database covering all known vehicles (MBR/CBR)

Use "deep structure rules" to represent purpose of the law

vehicle (X) -: noisy (X) OR dangerous (X).

Approximation

noisy (X) :- decibels (X) > 20.
dangerous (X) :- mph (X) > 20.

Fuzzy Logic

degree of "vehicle-ness" (M) depends on degree of noisiness and degree of dangerousness.

vehicle (X, M) :- noisy (X,M1), dangerous (X,M2),
M = M1 + M2 or
M = AVG (M1, M2)
M = MAX(M1, M2)

Major Problems for Formalized Legislation (cont.)

2. Mismatch between logical and text structure

US Internal Revenue Code [Allen and Engholm]:
Sec. 354 Exchanges in Stock and Securities in Certain Reorganizations

(a) General Rule

. . .

(b) Exception

(1) In General - Subsection (a) shall not apply to an exchange in pursuance of a plan or reorganization within the meaning of Sec. 368 (a) (1) (D) unless:

(A) ...

(B) ...

(2) Cross Reference -- for special rules for certain exchanges within the meaning of Sec. 368 (a) (1) (D), see Sec. 355.

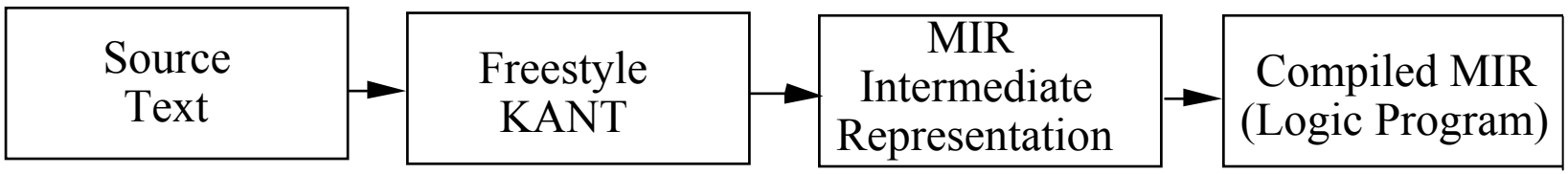
(c) . . Notwithstanding any other provisions of this subchapter, subsection (a)(1) shall apply with respect to a plan of reorganization for a railroad . . .

Faithful Representation ("Isomorphism")

[Bench-Capon and Coenen]

Advantages:

Encoding made easier by divide and conquer methodology
Validation aided by precise text-KB links
Updating ("maintenance") can be done in a localized fashion
Decision aids (commentary, cases) linked to text fragments



KANT development environment

Disadvantages:

Multiple representations require large complex software
Statutes so convoluted that faithful representation unhelpful

3. Representing Legal Concepts with Ontologies

Ontology 1: ("ontological framework")

- specifies the fundamental types of things that exist
- specifies relations (isa, part-of)
- defines a conceptual syntax for representing complex concepts (sometimes missing from ontologies)

Ontology 2: ("domain ontology")
a task-independent conceptualization of a domain

- objects
- predicates and relations
- constraints (e.g. sex = XOR (male, female))

Goals: facilitate knowledge sharing and re-use
overcome brittleness of expert systems
make assumptions about knowledge explicit

The E-court Ontology*: Concept Hierarchies

*From [Breuker et. al, 2002]

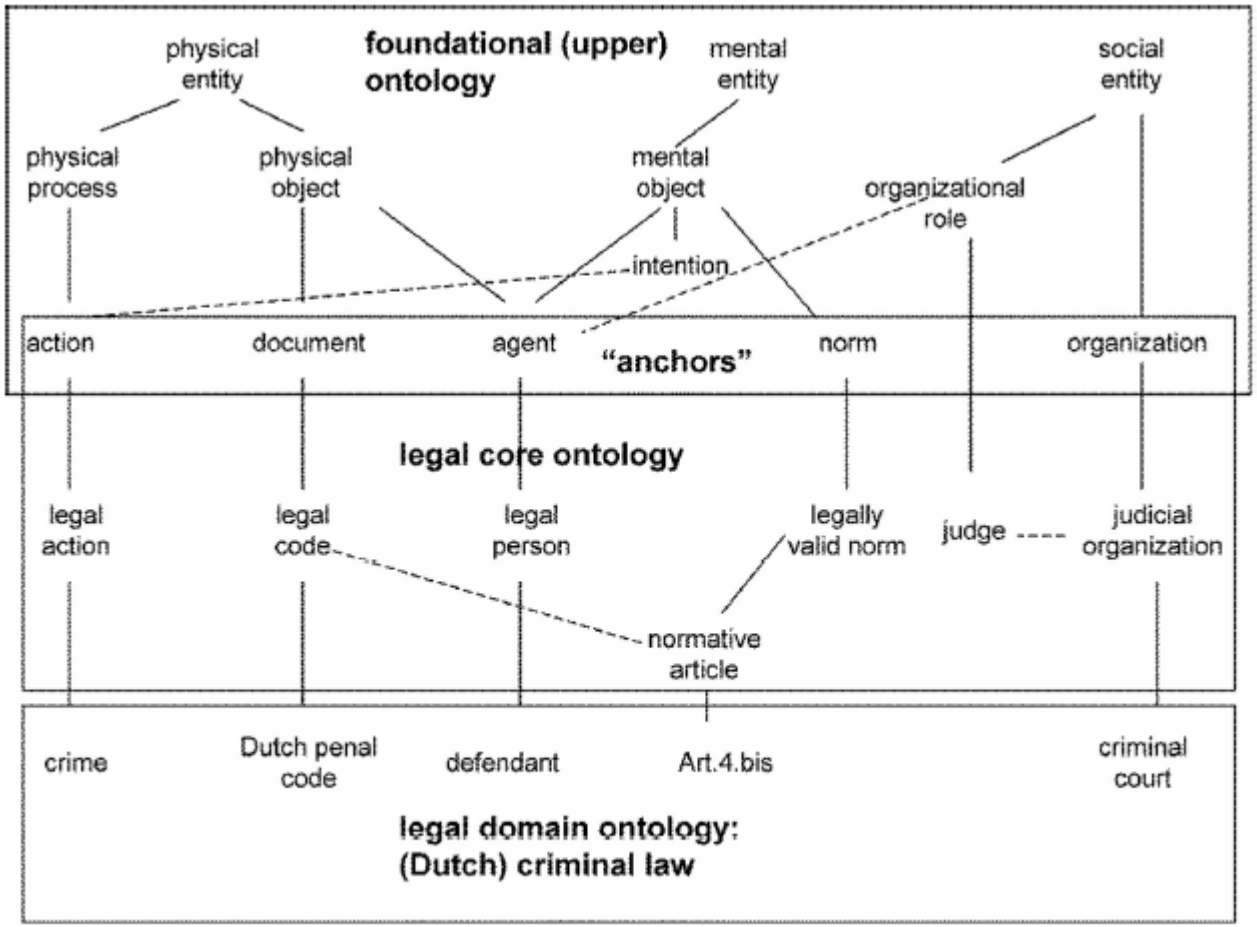


Figure 3: The structure of "cascading" ontologies

Where do ontologies come from? Hand-crafted / dictionaries and encyclopedias / experiments

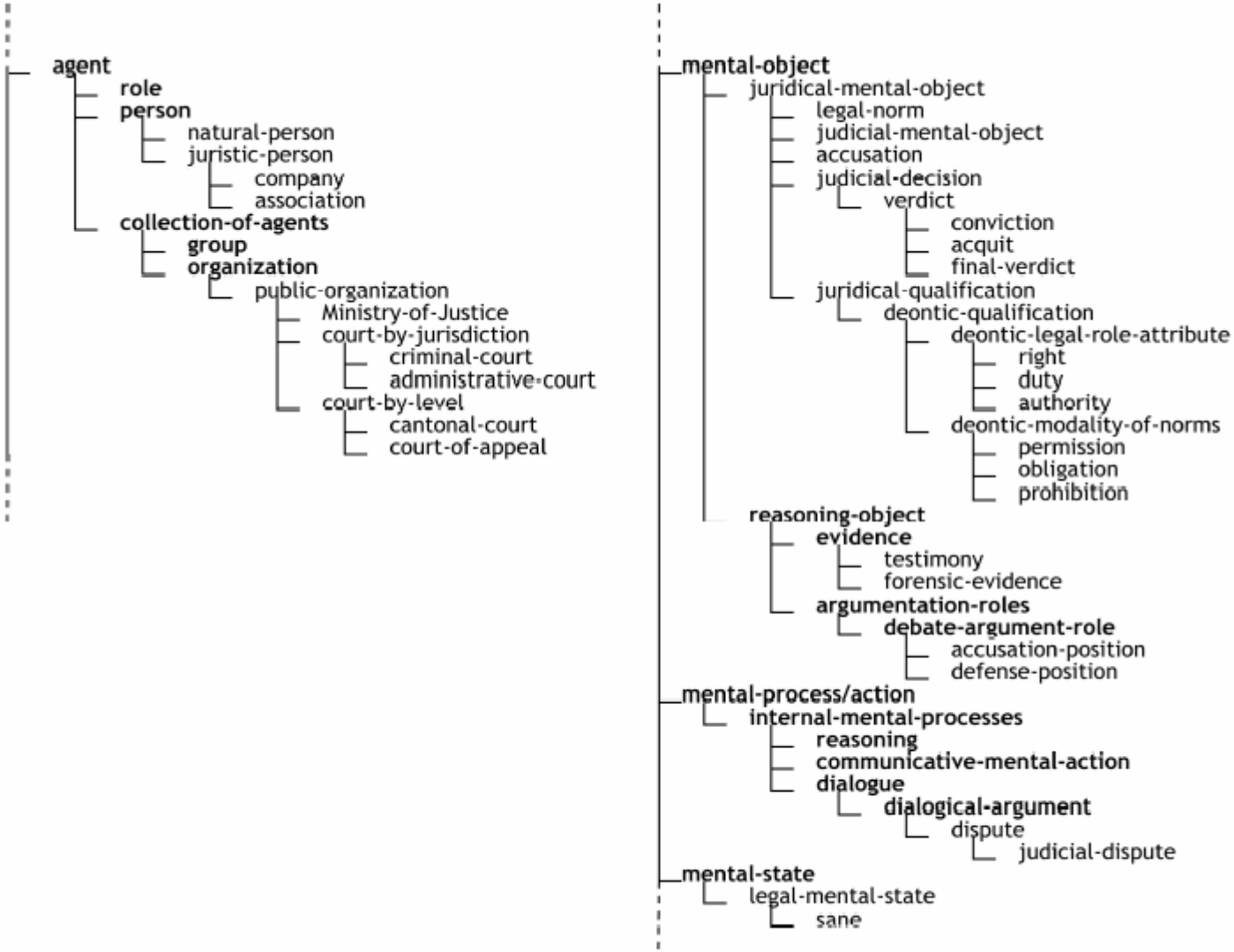


Figure 2: Some agents, mental objects, processes and states in Dutch Criminal Law (OCL.NL) (excerpt)

From [Breuker et. al, 2002]

Legal Concept Ontologies: Frame-based Representations

Description Logics

Definitions:

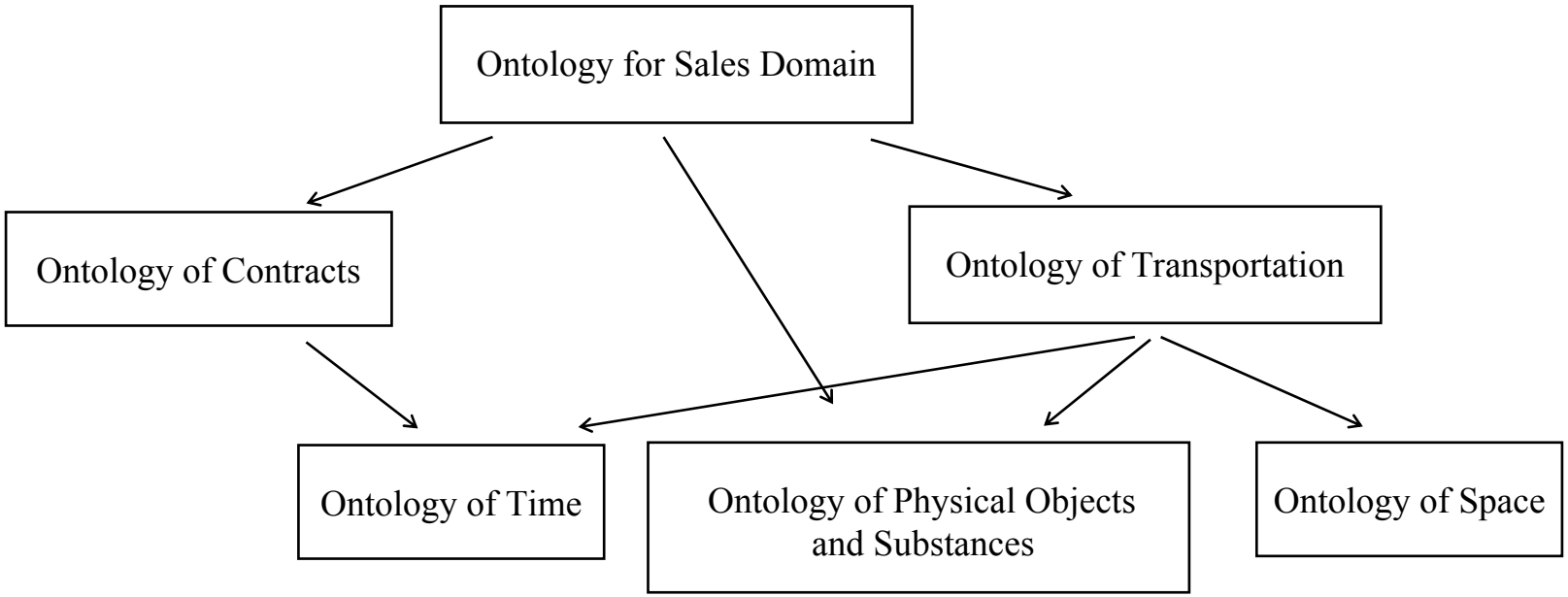
Define ownership (KINDOF relation)
(owner = actor)
(owned = property)
Define physical-injury (KINDOF event)
(injuror = actor)
(injured = actor)
(harm = physical-harm)

Descriptions (CD's) -- "a pet injured its owner"

Event: physical-injury:(injuror X (isa X pet))
(injured Y (isa Y person))
(ownership (owner X) (owned Y))

Toward a Legal Semantic Web

- The knowledge acquisition bottleneck: $10^{?}$ concepts and facts

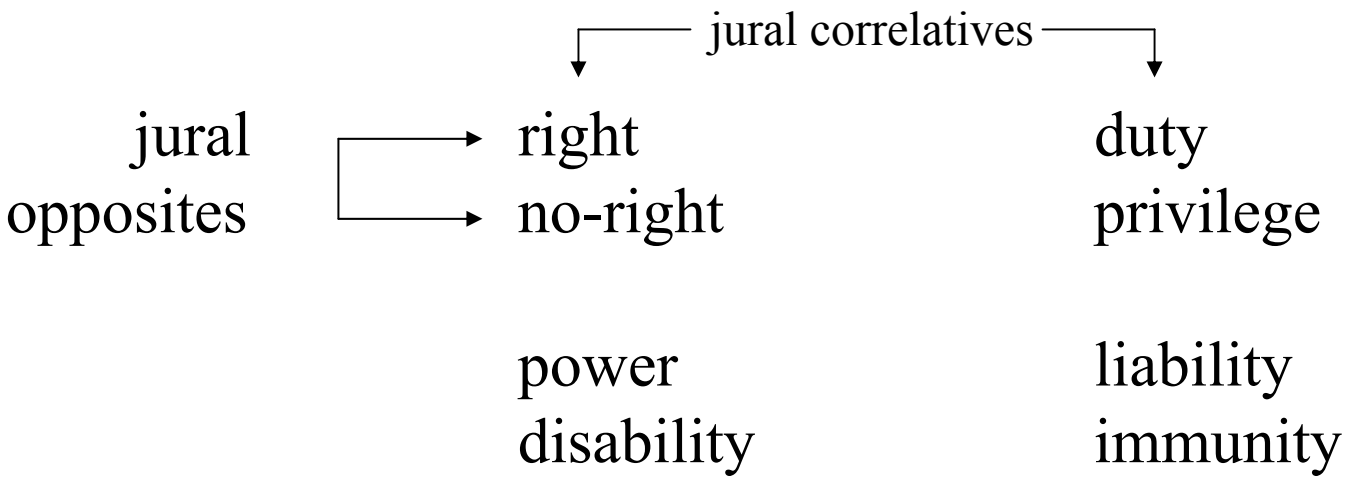


- OWL (Web Ontology Language) facilitates machine interpretation of Web content
  - Improves on XML, RDF, and RDF Schema (RDF-S)
  - Provides formal semantics and additional vocabulary for describing properties and classes.
  - Relations between classes (e.g. disjointness), cardinality (e.g. "exactly one"), equality, richer typing of properties, characteristics of properties (e.g. symmetry), and enumerated classes.

Some Ontological Frameworks for Law

Allen's LEGAL RELATION logic

based on Hohfeld's legal relations [1913]



Goal: describe all possible legal states of affairs and account for changes in such states.

LR logic takes DUTY and POWER as primitives, defines other relations in terms of these, and provides a conceptual syntax.

Research on Legal Ontologies

- Valente's Functional Legal Ontology [Valente 1995]
  - Norms ("Normative knowledge")
  - Things, events, etc. ("World knowledge")
  - Obligations ("Responsibility knowledge")
  - Legal remedies ("Reactive knowledge") -- penalites, compensation
  - Rules of legal reasoning ("Meta-legal knowledge") -- *lex specialis*
  - Legal powers ("Creative Knowledge")
- Van Kralingen's Frame-Based Ontology [Van Kralingen 1995, Visser et. al. 1997]
  - Legal norms
  - Acts
  - Concept Descriptions -- definitions, factors, meta-concepts
  - What is a norm?
  - <subject> - person who is obligated or permitted
  - <legal modality> - obligation, permission, power
  - <act description> - state-of-affairs or action
  - <conditions> - where and when
- Evaluating Ontologies [Visser and Bench-Capon 1998]
  - Epistemological adequacy
  - Operational Adequacy
  - Re-usability

4. Lessons Learned from Formalizing Legal Rules

1. Normalization:
   - Make choices explicit re syntactic ambiguities.
     - scopes of logical connectors.
     - what is an exception to what.
2. Semantic ambiguity:
   - Supplement term meanings extensionally with cases and examples.
   - Techniques for generalizing cases to new scenarios.
3. Unstated conditions:
   - Rule would not be unconstitutional, preempted, or contravene fundamental legal principles.
   - Right rule under choice of law.

Lessons Learned (cont.)

4. Conflicts among legal rules:
   - Case may fall under multiple rules with contradictory results.
5. Hierarchical structure of statutes and regulations in a code:
   - "Essential content ... in organization of the text as well as meaning."
6. Need for explicit specifications of domain conceptualizations:
   - Ontologies help to:
     - acquire / verify/ share knowledge bases
     - mediate storage of legal rules
     - manage distinctions between concept types
     - coordinate physical and legal institutional descriptions of events
     - generate natural language explanations

Lessons Learned (cont.)

7. Explanation:
   - Audit trail or proof of conclusions.
   - Needs ability to:
     - summarize the important provisions.
     - explain with real and hypothetical examples.
8. Expressiveness versus efficiency:
   - Inefficiency of theorem provers
   - Decidability and computational complexity issues
   - Negative conclusions and counterfactual conditionals
     - All ways under statute to "fail to show 'not P'".
     - All ways a conclusion would have held but for an event.
9. Reasoning about rules, not just with them.
   - Testing rules with hypotheticals.

Lessons Learned References

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5. CBR Approach to Legal Concepts & Rules

1. Normalization
2. Semantic ambiguity
3. Unstated conditions
4. Conflicts among legal rules
5. Hierarchical structure of statutes and regulations
6. Need for explicit specifications of domain conceptualizations
7. Explanation
8. Expressiveness versus efficiency
9. Reasoning about rules

Apply cases where rules "run out". (Gardner, Rissland).

Past applications of rules in cases reveal conditions. (Berman & Hafner).

Resolve conflicts in same way as in past cases. (Ashley, Branting)

Apply cases as examples/reference points in explanations (Rissland, Ashley).

Use cases to reason about rules.
Not just logical proofs but analogical arguments comparing problems, cases, hypotheticals (McCarty, Rissland, Ashley).

TAXMANII: Concepts and Cases

[Thorne McCarty, 1981]

Facts: *Eisner v. Macomber*

Macomber has 2200 shares of Standard Oil common stock. She gets 50% stock dividend. She ends up with 3300 shares. IRS imposes tax on distribution.

Issue: Is stock dividend **taxable income** under 16th Amendment?

If not, tax is unconstitutional.

Precedents:

1. Lynch: Distribution of corp.'s cash is taxable.

2. Peabody: Distribution of stock of another corp. is taxable.

3. Appreciation Hypothetical: Appreciation in value of stock w/o transfer of shares is not taxable.

Form of argument:

>> Taxpayer: define taxable income so *Eisner* facts and *Appreciation Hypothetical* are excluded but *Lynch* and *Peabody* are included.

<< IRS: define taxable income so *Eisner*, *Lynch* and *Peabody* are included but *Appreciation Hypothetical* is excluded.

TAXMAN II: Prototypes and Deformations

> J. Pitney argues stock dividend is not taxable:

– Since Eisner's proportional share of the stock after the dividend remained constant, the value of her shares did not appreciate. If an appreciation in value is not taxable (hypothetical case), then, **a fortiori**, Eisner's stock dividend should not be taxable?

Mapping: From *Appreciation Hypothetical* prototype to *Eisner*

Invariant: Preserves shareholder's proportionate corporate ownership

< Argument that distribution is taxable (J. Brandeis in dissent):

Distributions of cash, bonds, preferred stock and common shares all confer on recipient an expected return of corporate earnings.

They differ only in how much return at what risk. If one is taxable, so should all.

Mapping: From *Lynch,* taxable distribution of cash, to distribution of corp.'s bonds to distribution of preferred stock to distribution of common stock.

Invariant: Each confers on recipient some tradeoff between expected return of corporate earnings and risk.

• Query: Why does invariant matter?

HYPO [Ashley, *Modeling Legal Argument*, 1990]

Task: Analyze trade secrets disputes

Plaintiff π claims defendant δ gained unfair competitive advantage with confidential info.

Input: description of dispute. Outputs: 3-Ply arguments

Cites cases for/against plaintiff and suggests hypotheticals to strengthen / weaken argument

Knowledge Sources:

Case base of 30 legal cases indexed by 13 Dimensions.

Dimensions represent *factors* (stereotypical factual strengths / weaknesses).

Criteria for partially evaluating arguments.

Heuristics for posing meaningful hypothetical variations of problem.

Process:

Compare problem (current fact situation or "cfs") to cases

Select best cases to cite

Make/Respond to legal arguments citing cases,

Pose hypothetical what if...'s to strengthen / weaken argument.

Secrets-Disclosed-Outsiders Dimension

Claims: Trade Secrets Misappropriation

Prerequisites:

There is a corporate plaintiff
There is a corporate defendant
Plaintiff makes a product
Plaintiff and defendant compete
Plaintiff has product information
Plaintiff made some disclosures to outsiders

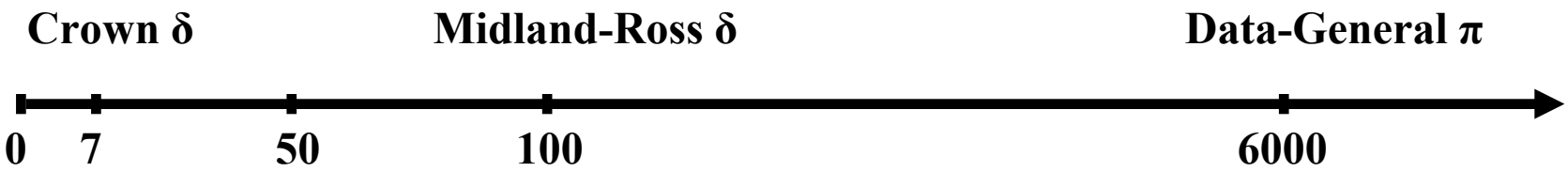
Focal Slot Prerequisite: Plaintiff made some disclosures to outsiders

Focal Slot: Plaintiff's Product Knowledge: Number-disclosees

Range: 0 to 10,000,000

Comparison Type: Greater-than versus Less-than

Pro Plaintiff Direction: Less-than



3-Ply Argument in HYPO

==> Point for Defendant as Side-1: (analogize case)

WHERE: Plaintiff's product information could be learned by reverse-engineering.

DEFENDANT should win a claim for Trade Secrets Misappropriation.

CITE: Midland-Ross Corp. v. Yokana 293 F.2d 411 (3 Cir. 1961)

<== Response for Plaintiff as Side-2: (distinguish case; cite counterexamples)

Yokana is distinguishable, because: In Yokana, plaintiff disclosed its product information to outsiders. Not so in Mason.In Mason, plaintiff adopted security measures. Not so in Yokana. In Mason, plaintiff was the only manufacturer making the product. Not so in Yokana. In Mason, defendant knew that plaintiff's information was confidential. Not so in Yokana.

COUNTEREXAMPLES: American Precision Vibrator Company, Jim Guy, and Shirley Breitenstein v. National Air Vibrator Company 764 S.W.2d 274 (Tex.App.-Houston [1st Dist.] 1988) is more on point and held for PLAINTIFF where it was also the case that:Defendant knew that plaintiff's information was confidential.

==> Rebuttal for Defendant as Side-1: (distinguish counterexamples)

American Precision is distinguishable, because: In American Precision, plaintiff's former employee brought product development information to defendant. Not so in Mason. In Mason, plaintiff disclosed its product information in negotiations with defendant. Not so in American Precision.

(pose hypotheticals to strengthen/weaken argument)

CABARET [Rissland & Skalak 1991]

- Case-based arguments re legal rules' open-textured concepts.
  - Deals with Home Office Tax Deduction
- Rule-Based, Case-Based Modules and Agenda Mechanism
  - RBR Module: Represents rules from IRS provisions

    Forward chains from facts to goals

    Backward chains from goals to facts
  - Case-Based Module based on HYPO:

    Associates Dimensions & cases with statutory concepts
  - Agenda Mechanism:

    Control heuristics integrate case- and rule-based modes.

Samples of CABARET's Control Heuristics

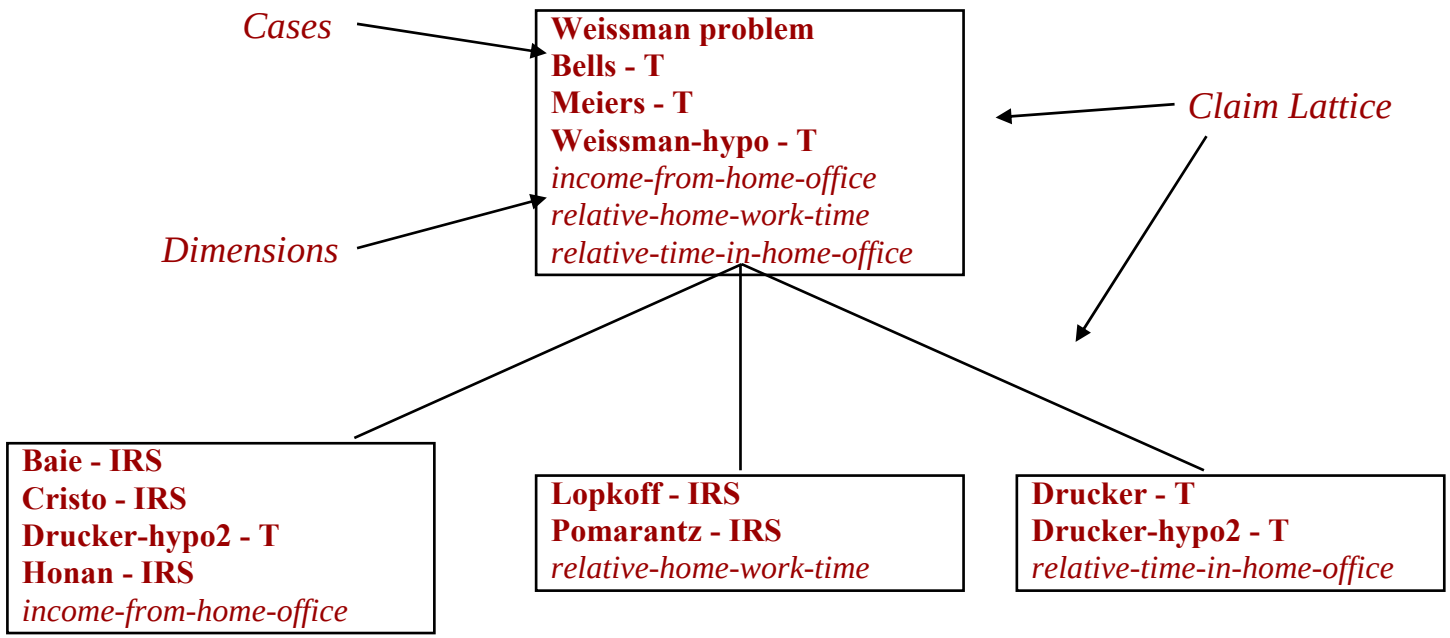
- Try other:
  - If CBR fails then switch to RBR (and vice versa)
- Sanity check:
  - Test conclusion of RBR with CBR (and vice versa)
- RBR Near-miss:
  - If all rule's antecedents established but one, use CBR to broaden application of rule wrt missing antecedent
  - Broaden Missing Antecedent: Use CBR to establish missing antecedent
  - Broaden-1: Use CBR to show there are cases where conclusion is true but rule did not fire
- Open Texture:
  - Use CBR on open textured statutory concepts
- Match statutory concepts:
  - Find case that has failed and succeeded on same statutory concepts

CABARET Example

Problem: CCNY Philosophy professor Weissman maintained a home office (2 rooms and bath) in his 10-room apartment. He spent only 20% of his time at the CCNY office where it was not safe to leave equipment and materials. IRS challenged his home office deduction of $1540 rent and expenses because, among other things, it was not his "principal place of business" (p-p-b)

1. Taxpayer needs to show p-p-b.

   Perform HYPO-style Dimensional Analysis on cases indexed under p-p-b concept. Conclude it's satisfied.



CABARET Example (cont.)

2. Apply heuristic control rule: "sanity-check-CBR-by-RBR"

   Backward chain on rule p-p-b:

   If taxpayer discharged "primary responsibility in home office" and derived "income from home office" and there is evidence as to relative time taxpayer spent in home office then home office is taxpayer's "principal place of business".

3. Rule p-p-b is a near miss:

   All antecedents satisfied but one: whether he discharges "primary responsibility in home office".

4. Heuristic control rule matches:

   If RBR near-miss then use CBR to broaden rule by finding similar cases where missing antecedent is true.

5. Retrieve similar pro-taxpayer cases:

   Case where "primary responsibility in home office" is satisfied: *Drucker* case.

6. Generate argument analogizing *Drucker* to Weissman problem:

   "To analogize *Drucker* and *Weissman*, consider the following factors possessed by them in common: there was evidence as to the frequency of usage of the home office by the taxpayer, the home office was necessary to perform the taxpayer's duties.…"

GREBE [K.Branting, 1991, 2000]

Task: Analyze workmen's compensation cases

Make arguments why individuals involved in accidents are[not] entitled to workmen's compensation under Texas statute.

Knowledge Sources:

57 statutory, common law and commonsense rules, 132 semantic rules, 16 legal precedents, 4 paradigm cases, 21 hypothetical test cases.

Case Representation:

Semantic nets represent explanation of outcome in terms of *criterial facts* judge deemed important to support conclusion.

Index cases as examples of statutory legal concepts.

Case is positive/negative example of open-textured concept.

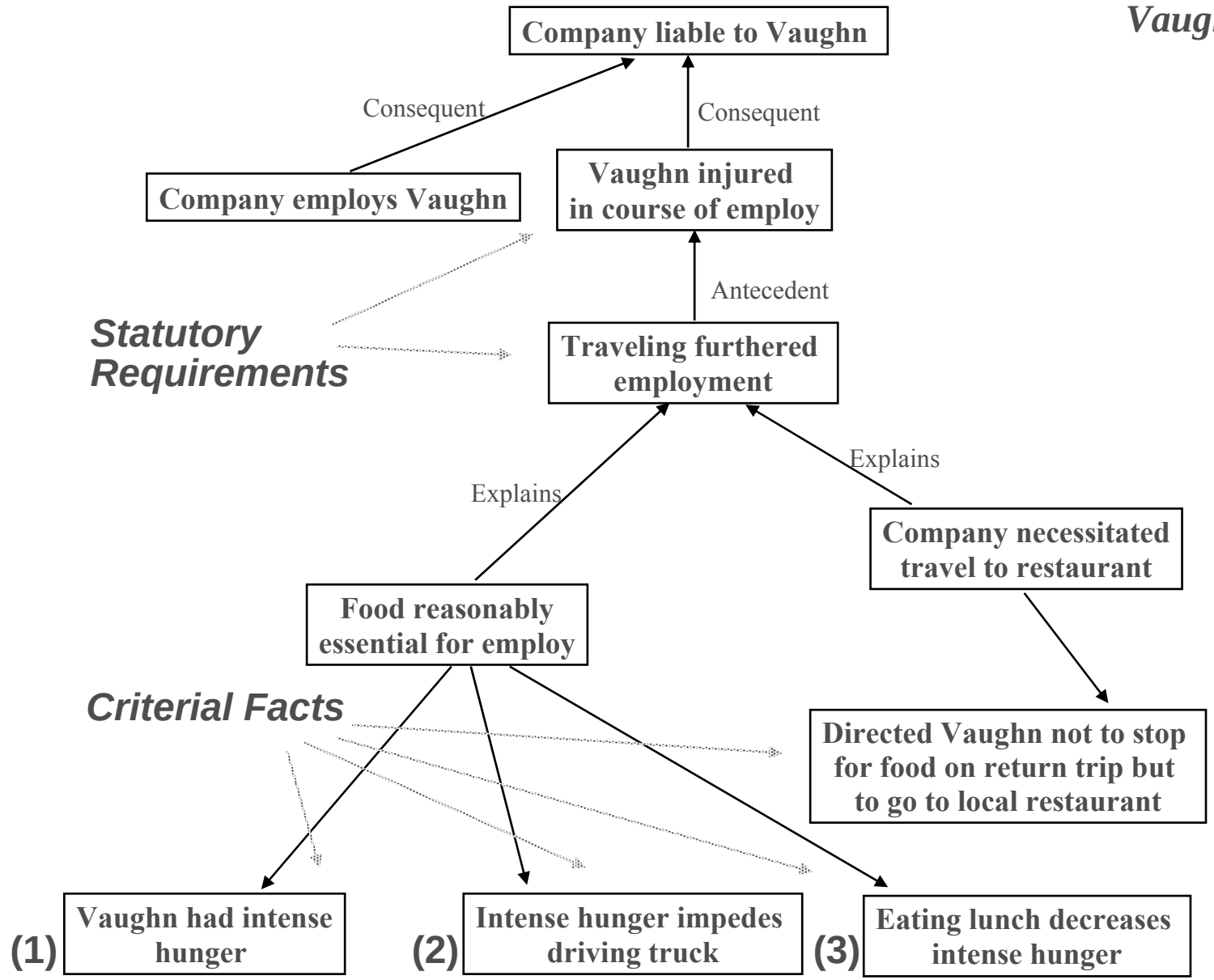
Each concept is linked to part of case's explanation that concept applies [or not].

Approach:

Retrieves similar case, maps explanation and modifies to fit problem.

Uses rules and cases to construct argument from problem facts to conclusion.

Representing Case Explanation in GREBE



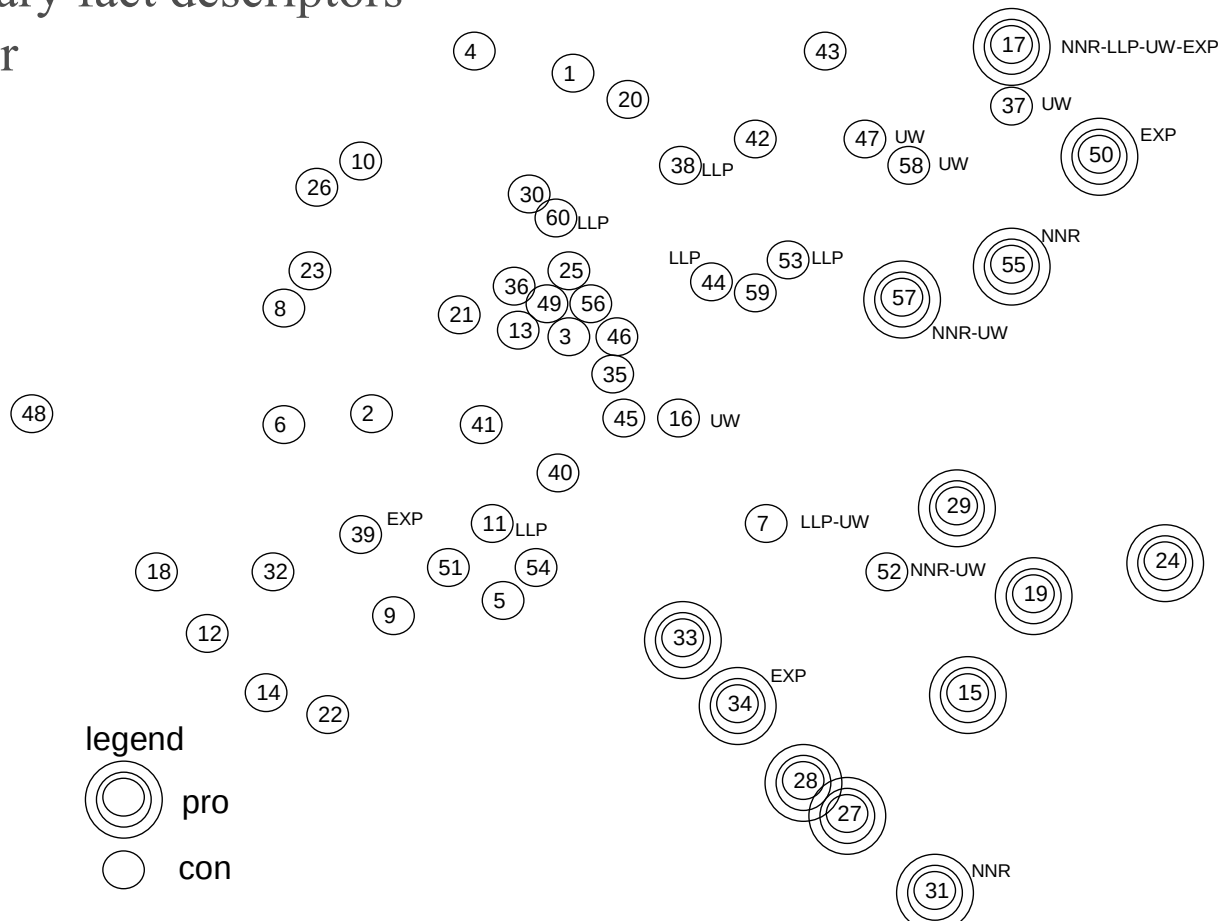
Concepts, Cases, & Purposes

- Representing Teleological Structure in Case-Based Legal Reasoning: The Missing Link. [Berman & Hafner, ICAIL-93 critique]
- Domain models relating factors to legal issues and concepts: CATO's Factor Hierarchy [Aleven, Ashley 1997]; IBP [Brüninghaus, Ashley 2003]
- Case decisions operationalize abstract normative codes/principles: SIROCCO [McLaren, Ashley 1999]
- Deep models of legal reasoning: TAXMANIII? Language for Legal Discourse (LLD) to infer, select, justify invariants. [McCarty]
- Case-based argument models with preferences among cases, rules, and values for resolving arguments. [Prakken and Sartor 1997; Sartor and Bench-Capon 2000; Bench-Capon and Sartor 2003]
  - See Alison Chorley and T. Bench-Capon, AGATHA: Automated Construction of Case Law Theories through Heuristic Search, ICAIL-05!

6. Predicting Outcomes of Legal Disputes

[MacKaay & Robillard 1974]

60 Canadian tax cases
Each case: 46 binary fact descriptors
k-nearest neighbor



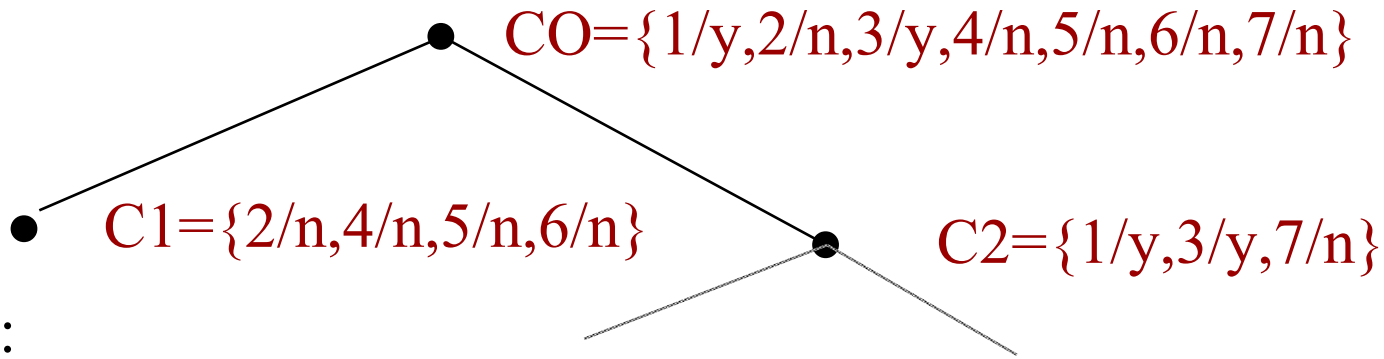
Inducing Predictive Rules

Creating Rule-Based Expert System (Knowledge Engineering)	**Induction (Alternative to K.E.)**
1) Collect examples	1) Collect large set of examples
2) Manually develop rule	2) Let computer create the rules
3) Test on more examples	
4) Refine the rules, etc.	

Induce rule to "explain" data: *Should defendant be released on bail?*

Case	Injury	Drugs	Weapon	Prior-record	Result
1	none	no	no	yes	yes
2	bad	yes	yes	serious	no
3	none	no	yes	no	yes
4	bad	yes	no	yes	no
5	slight	yes	yes	yes	no
6	none	yes	yes	serious	no
7	none	no	yes	yes	no

ID3 Algorithm Builds Decision Tree



Algorithm:

- Choose one attribute to "split"
- When Ci all have same result, stop

ID3 minimizes expected number of questions

Expert system shell may create rules based on IDC decision tree:

IF drugs=yes THEN bail=no
IF drugs =no AND weapon=no THEN bail=yes

Pro: automatic

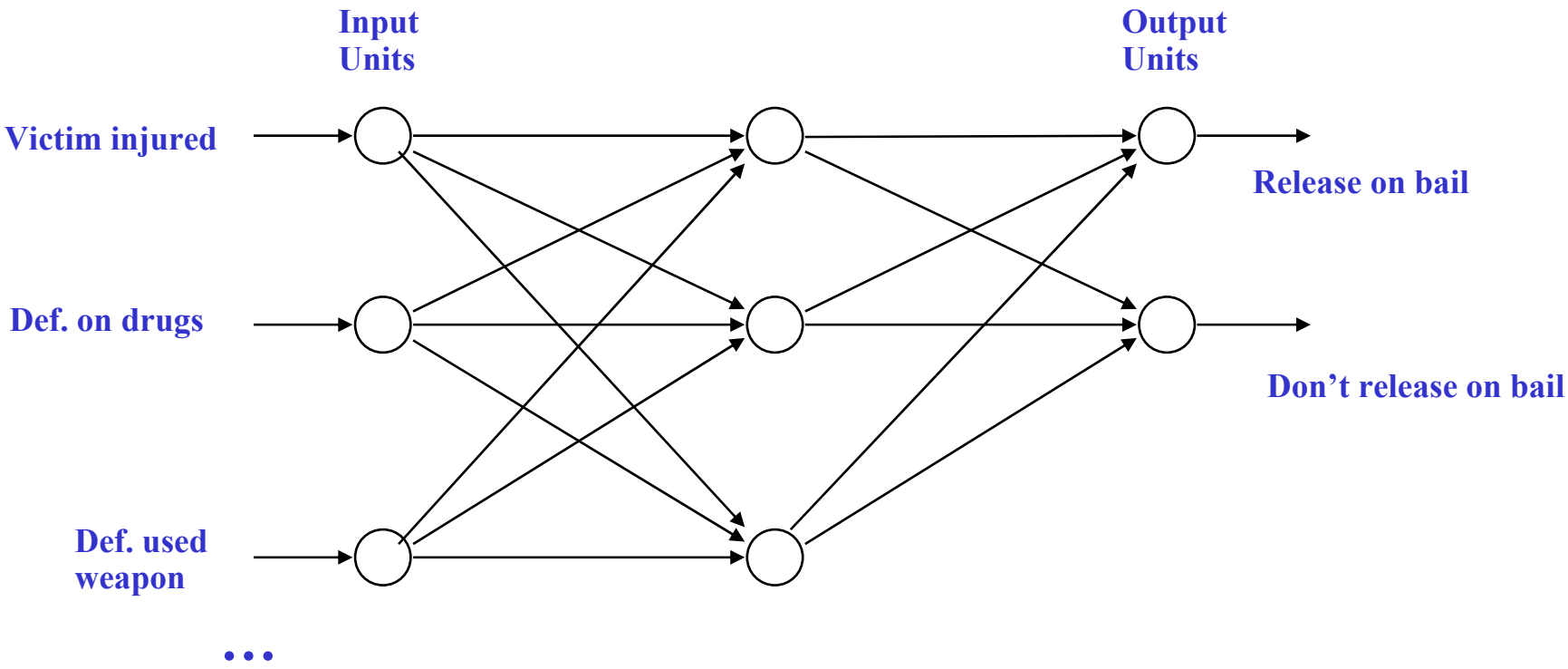
Saves knowledge engineering effort; avoids need for human interpretation of results.

Con: limitations

Can't handle contradictory data or invent new terms. No “reasons.” No common sense.

Connectionist Model of Computing

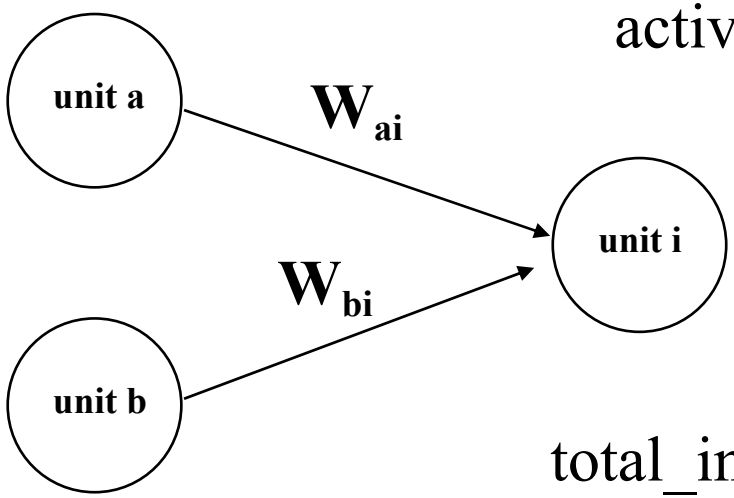
(Neural Nets)



Claims:

- Parallel
- Distributed (sub-symbolic)
- Adaptive
- Robust

How Connectionist Systems Compute



$$activation_i = f(\ total\_input_i)$$

$$total\_input = \sum_j activation_j * W_{ji}$$

The Delta Rule (learning):

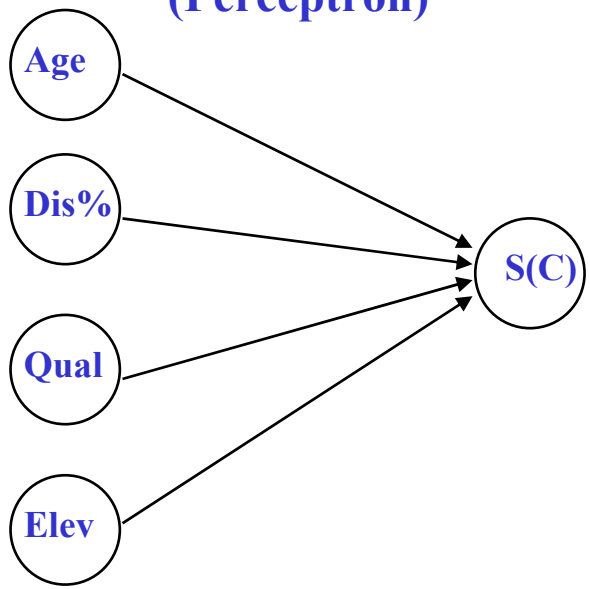
$$\Delta\ W_{ji} = const * act_j * (target_i - act_i)$$

Neural Net Approach to Open Textured Concept

[Van Opdorp and Walker, 1990]

Apartment Suitability S(C)	Threshold: 400 Weight
Age of tenant	– 10
Disability %	20
Quality of apartment	50
Presence of elevator	10

Simple Neural Net (Perceptron)



- Difficult to determine proper weights
- Use delta rule (or other learning rule) to train network on examples

Problems with Simple Neural Net

- Too restrictive

  Assumes influence of factors is linear and independent.

- Example of dependency:

  If age > 65 & no elevator then NOT Suitable

  If age < 30 and elevator then NOT Suitable

- S(C) = (w1 * age) + (w2 * dis) + (w3 * qual) ...
- No weights can be found to handle the example
- Solution:

  Use a multi-layer network

  Learning rule is more complex (back propagation)

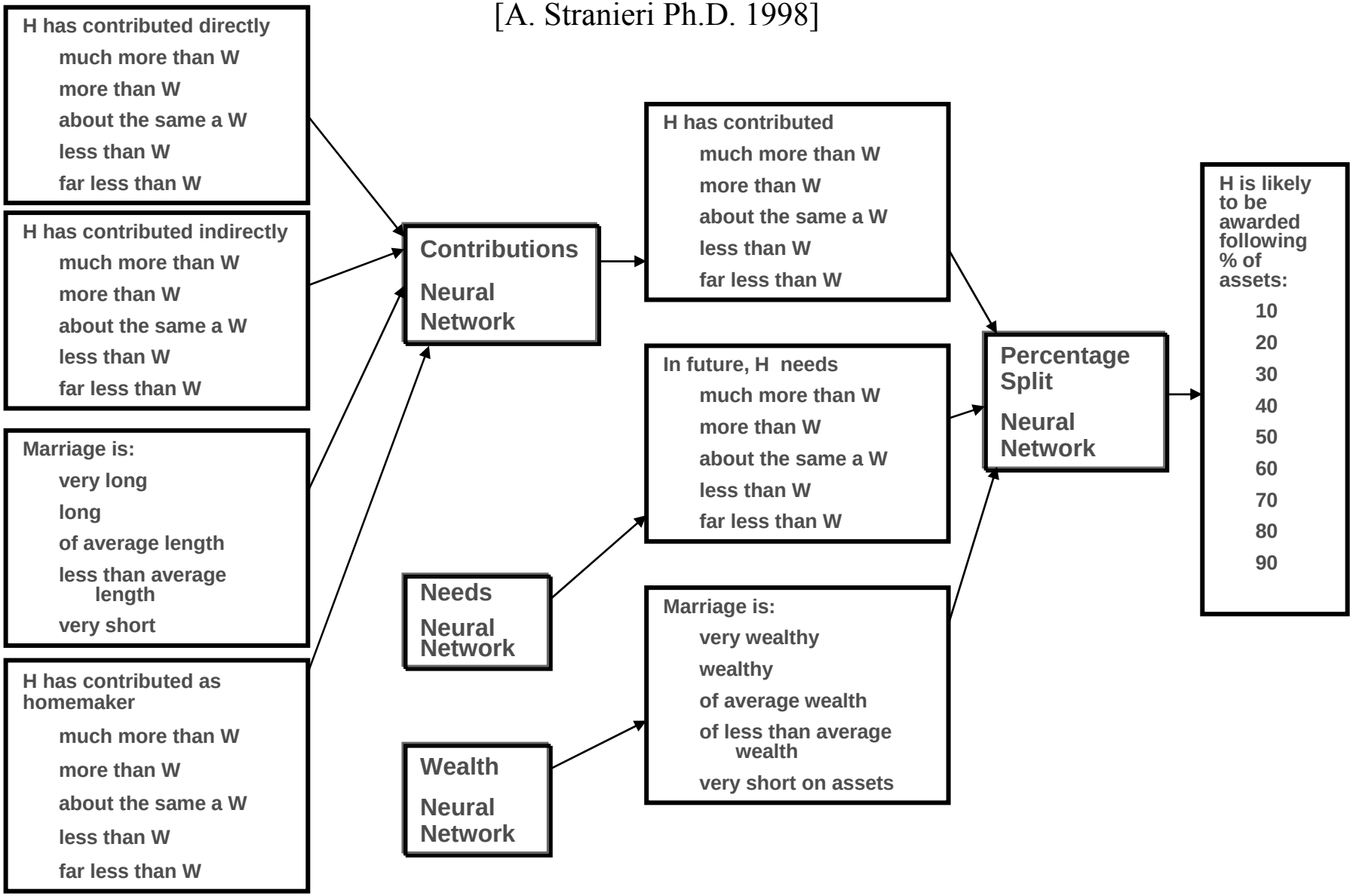
- Disadvantage: Lack of explanatory power.

  What do the numbers mean?

Thanks to: Don Berman

Hybrid Connectionist System

[A. Stranieri Ph.D. 1998]



Predicting Outcomes with IBP

[Brüninghaus & Ashley ICAIL-03]

Input: Current fact situation

Identify issues

Determine favored party for each issue:

- If factors favor same side, return side, else
- Scientific, evidential reasoning with cases:
  - If cases found with issue-related factors
    - Test hypothesis that majority side should win
    - Explain-away counterexamples
  - Otherwise, Broaden-Query

Combine analysis from issues

Output: Predicted outcome and explanation

IBP Domain Model

Uniform Trade Secrets Act, Restatement of Torts

Logical Structure of Trade Secrets Law

"Trade secret" means information, [...] that:

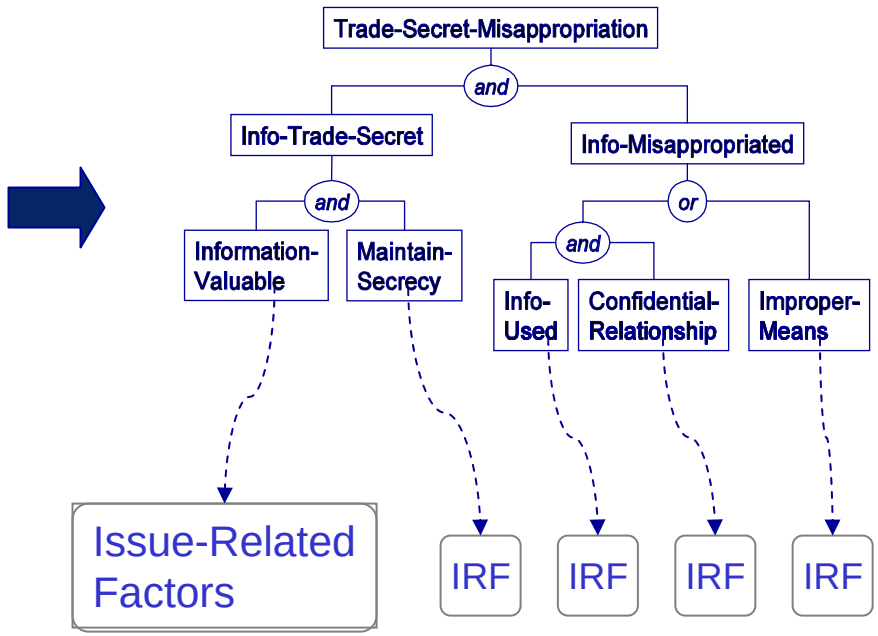
(i) derives independent economic value, [...] from not being generally known to, and not being readily ascertainable by proper means [...] and

(ii) is the subject of efforts that are reasonable under the circumstances to maintain its secrecy.

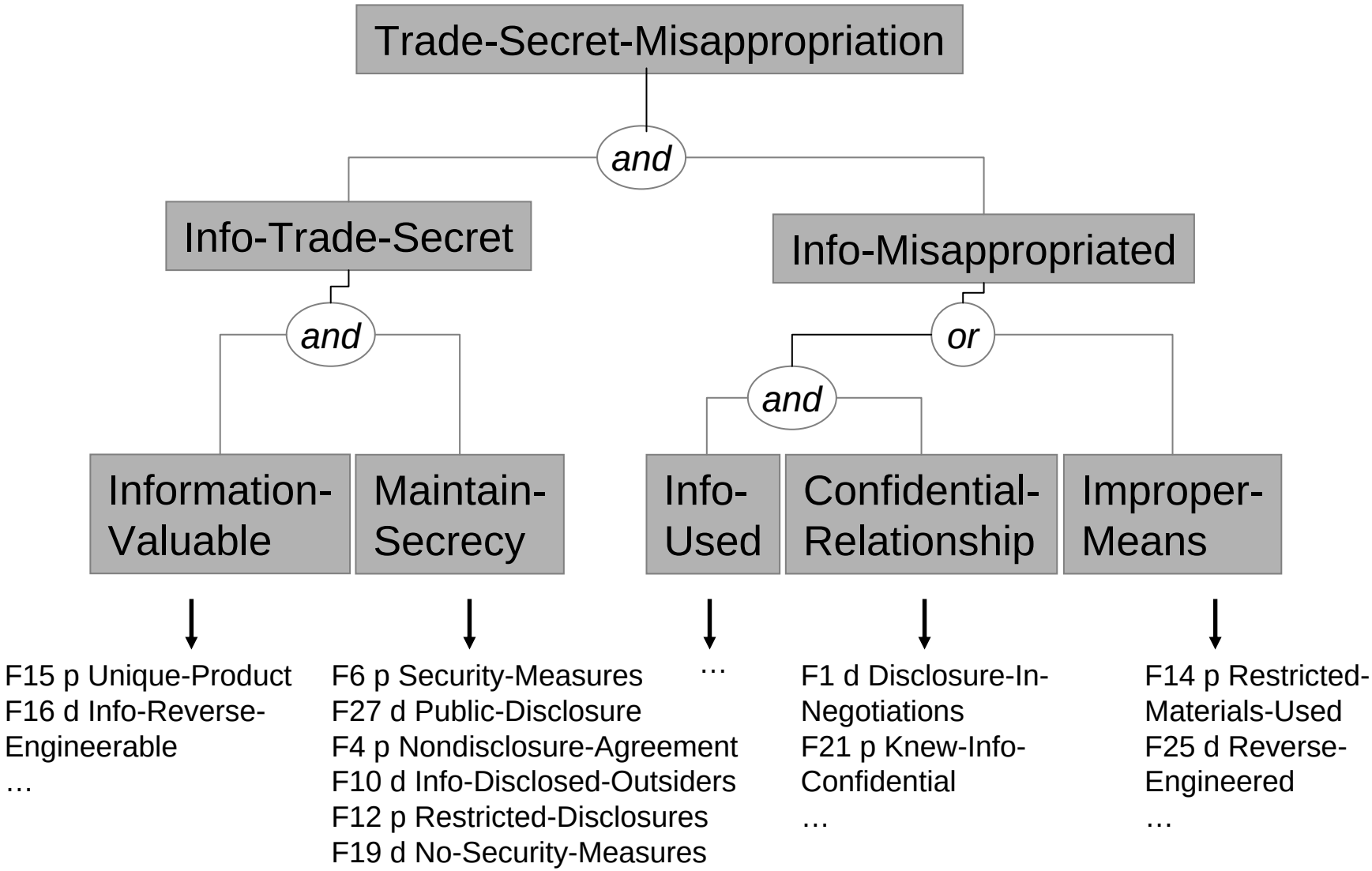
One [...] is liable for trade secret misappropriation if

(a) he discovered the secret by improper means, or

(b) his disclosure or use constitutes a breach of confidence [...]



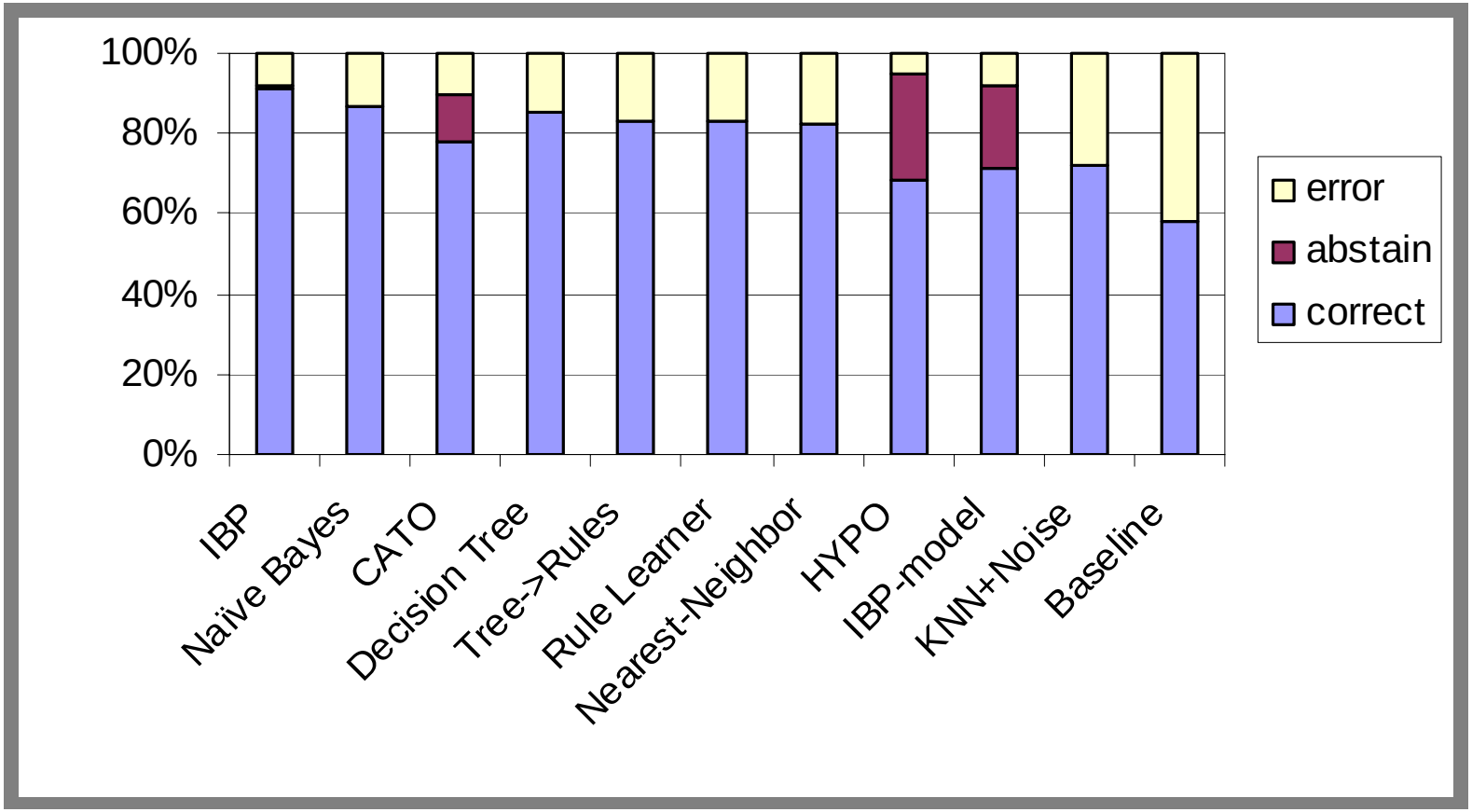
IBP Domain Model (detail)



Evaluation of IBP Algorithm

- 148 cases in CATO database, plus 38 new cases
- Experiments run in leave-one-out cross-validation; Relevance tested with McNemar's test

- Compare IBP with:
  - Baseline: predict majority class
  - Standard machine learning algorithms
  - Prediction based on CATO/Hypo relevance criteria



IBP Explains Predictions

- **Prediction for MBL, which was won by DEFENDANT**
  - Factors favoring plaintiff: (F13 F6 F4); Factors favoring defendant: (F27 F20 F19 F10)
- **Issue raised in this case is INFO-VALUABLE**
  - Relevant factors in case: F27(D) F20(D); All favor the outcome DEFENDANT.
- **Issue raised in this case is SECURITY-MEASURES**
  - Relevant factors in case: F19(D) F10(D) F6(P) F4(P) …
  - Theory testing with Factors (F10 F4 F6) gets the following cases:
    (TRANDES PLAINTIFF F1 F4 F6 F10 F12)
    (FMC PLAINTIFF F4 F6 F7 F10 F11 F12)
    (CMI DEFENDANT F4 F6 F10 F16 F17 F20 F27)
    (BOEING PLAINTIFF F1 F4 F6 F10 F12 F14 F21)
    Trying to explain away the exceptions favoring DEFENDANT
    CMI can not be explained away.
    The evidence from this query is INCONCLUSIVE. …
  - The result for SECURITY-MEASURES will be ABSTAIN.
- **Issue raised in this case is CONFIDENTIAL-RELATIONSHIP**
  - Relevant factors in case: F13(P) F4(P); All favor the outcome PLAINTIFF.
- **Outcome of the issue-based analysis:**
  - For issue INFO-VALUABLE, DEFENDANT is favored.
    For issue SECURITY-MEASURES, ABSTAIN is favored.
    For issue CONFIDENTIAL-RELATIONSHIP, PLAINTIFF is favored.
- **=> Predicted outcome for MBL is DEFENDANT, which is correct.**

7. Intelligent Legal Information Retrieval

Text Retrieval Models [Turtle 1995]

- Probabilistic (Westlaw WIN)
- Vector Space (Flexlaw)
- Boolean (traditional Lexis or Westlaw)
- Knowledge-Based (conceptually annotated text)
- Pattern/Rule-Based

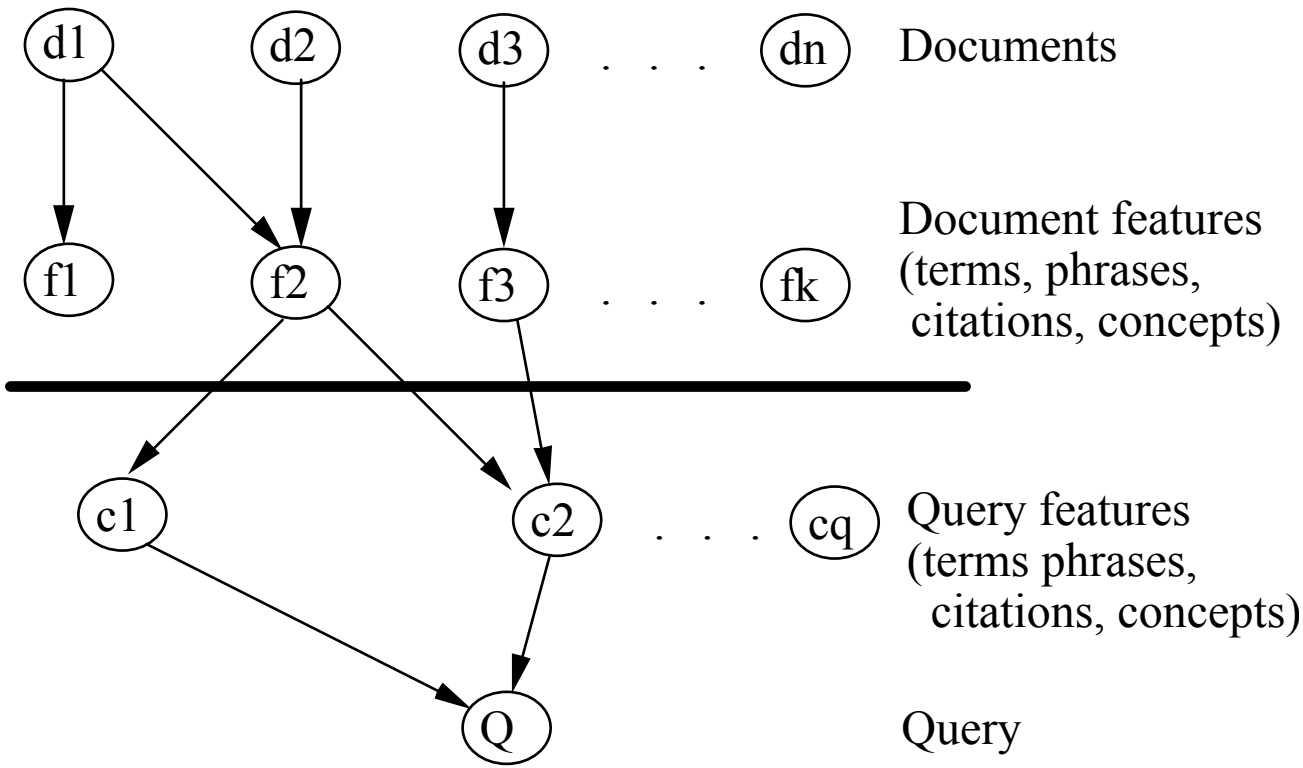
Sources of Evidence about Text Content

Words, Phrases, Dictionaries, Controlled vocabulary annotations, Citations,Thesauri, Statistical associations, Domain Ontologies

Bayesian Networks (Probabilistic)

[Turtle and Croft]

Approach used in WIN (Westlaw)

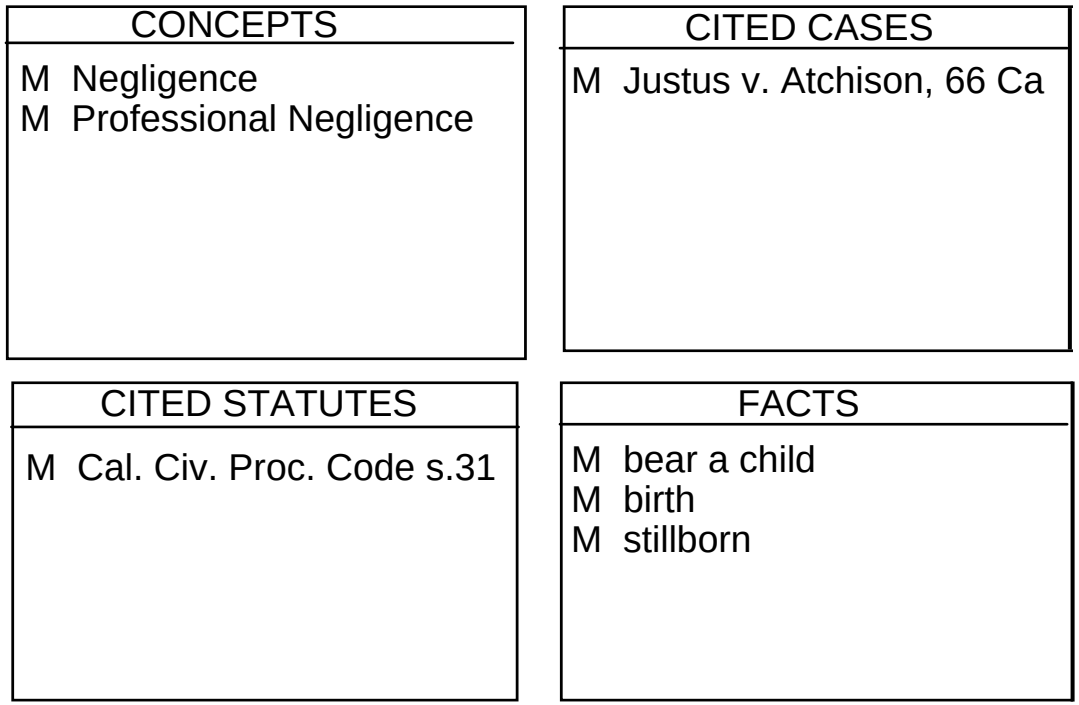


Roughly:

$$P(Q \mid d2) = P(Q \mid c1, c2)\, P(c1 \mid f2)\, P(c2 \mid f2)\, P(f2 \mid d2)$$

FlexLaw

[J.C. Smith et. al.]



Preprocessing

- Large legal concept dictionary (shallow ontology) + linguistic analysis
- Template matching for case and statute citations

FlexLaw (cont.)

- Vector space model for matching

Similarity = Weighted sum of query terms in d
(roughly) ——————————————————
Weighted sum of all terms in d (and in query)

Weight of a term T in d = Td * IDF
Td = number of occurrences of T in d
IDF = log (total # of documens / # of documents with T)

Documents (cases) returned in ranked order
FlexNote - same form as query (good for relevance feedback)
Tested on 1000 negligence cases
"Best" FlexLaw result better then "best" Boolean result.

DataLex - Hypertext + Rules + Queries

[Greenleaf, et al.]

Applications: Intellectual Property, Privacy, Insurance Law

Traditional hypertext

- hyperterms linked to their definitions in the statute
- citations linked to the document cited

Hypertext <-> knowledge base

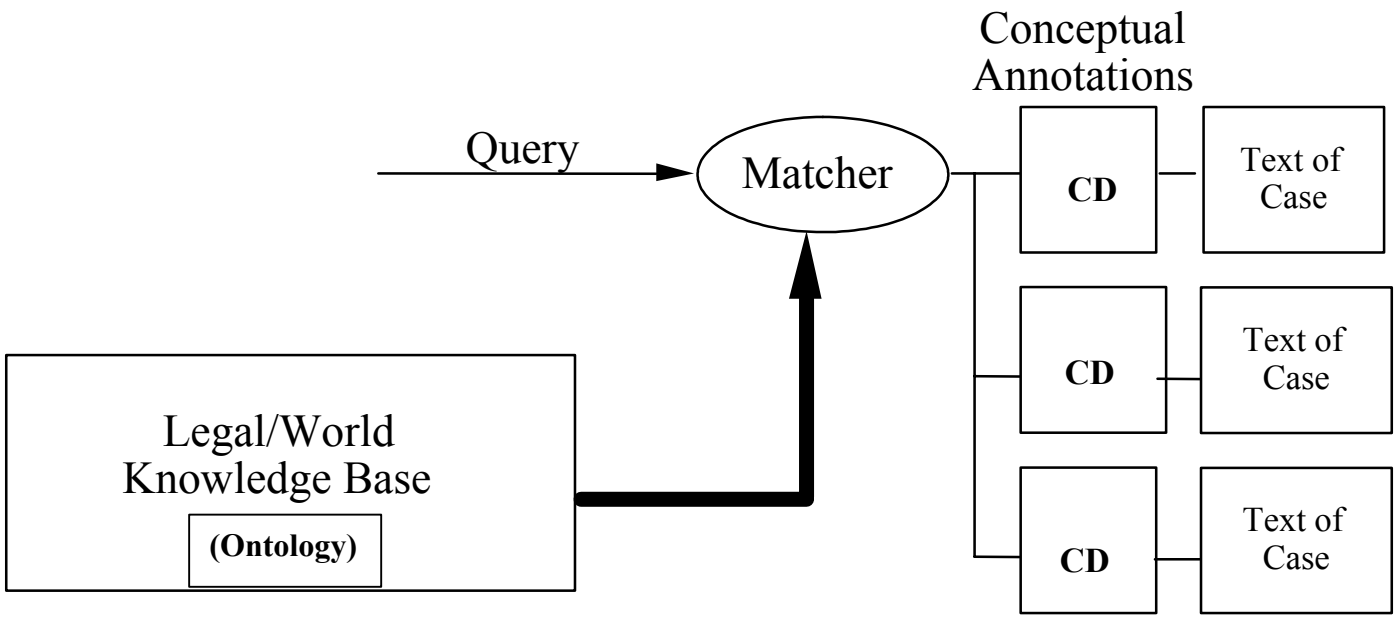
- hyperterms linked to expert system dialog with term as goal
- hyperterms in consultation questions linked back to their definitions in the statute
- citations in explanations linked to the document cited

Hypertext --> Full Text

- hyperterms link to pre-stored searches of a larger database ("Noteup")

Knowledge-Based Information Retrieval

- Automated concept recognition very difficult (NL challenge)
- Manual annotation of text is time consuming (but not always impractical !)
  - See Hafner on conceptual retrieval [1981, 1987]
- Development of legal ontologies offers promise for future
  - Semantic Web and Ontology Web Language
  - E-court project [Breuker, 2002]



BANKXX – Annotated Legal Network [Rissland, et al. 1996]

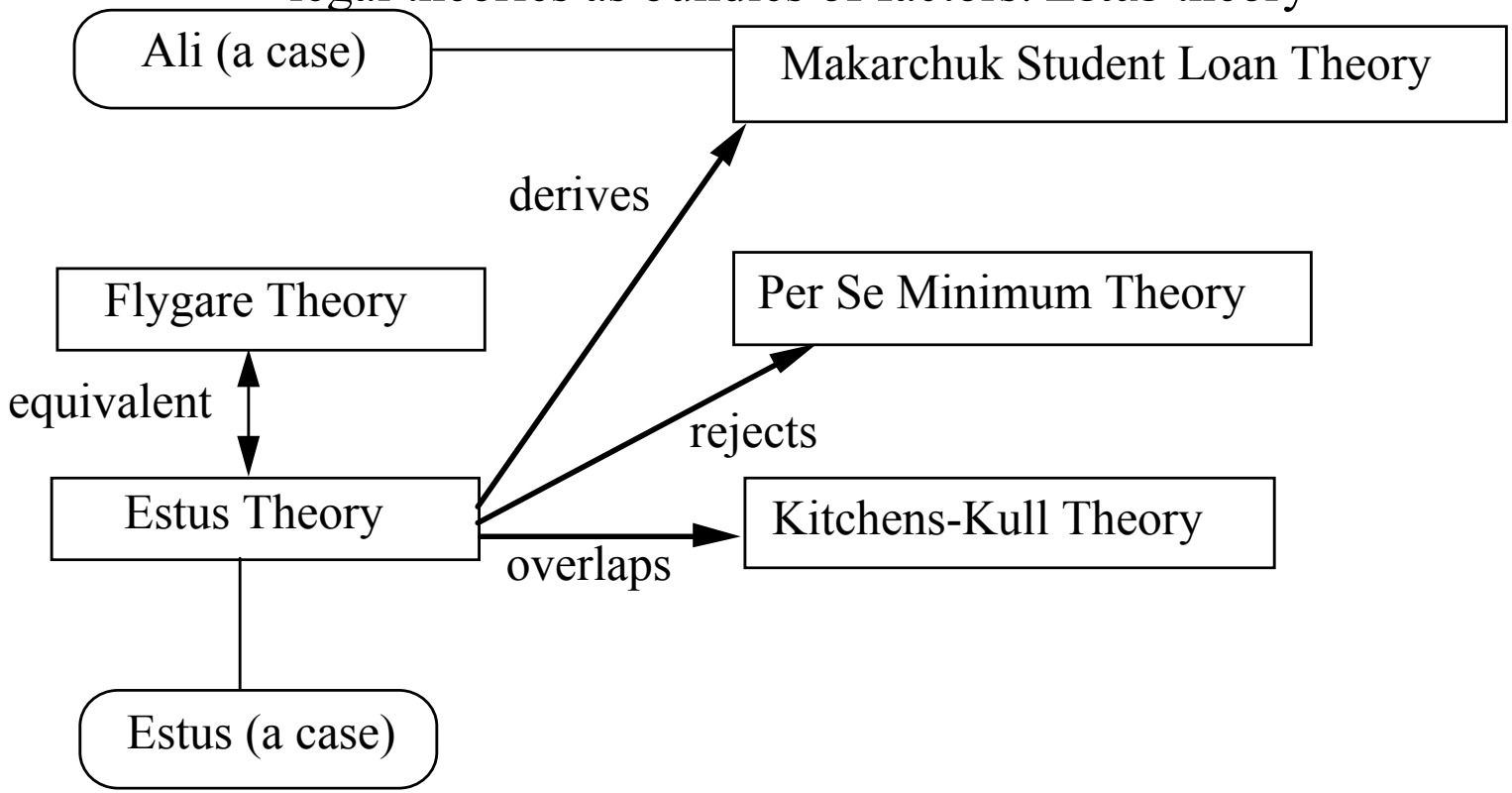
Legal knowledge network connects annotated nodes representing:

– cases as sets of dimensions

– cases as bundles of citations

– cases as prototypical stories: student loan story, dishonest debtor story

– legal theories as bundles of factors: *Estus* theory

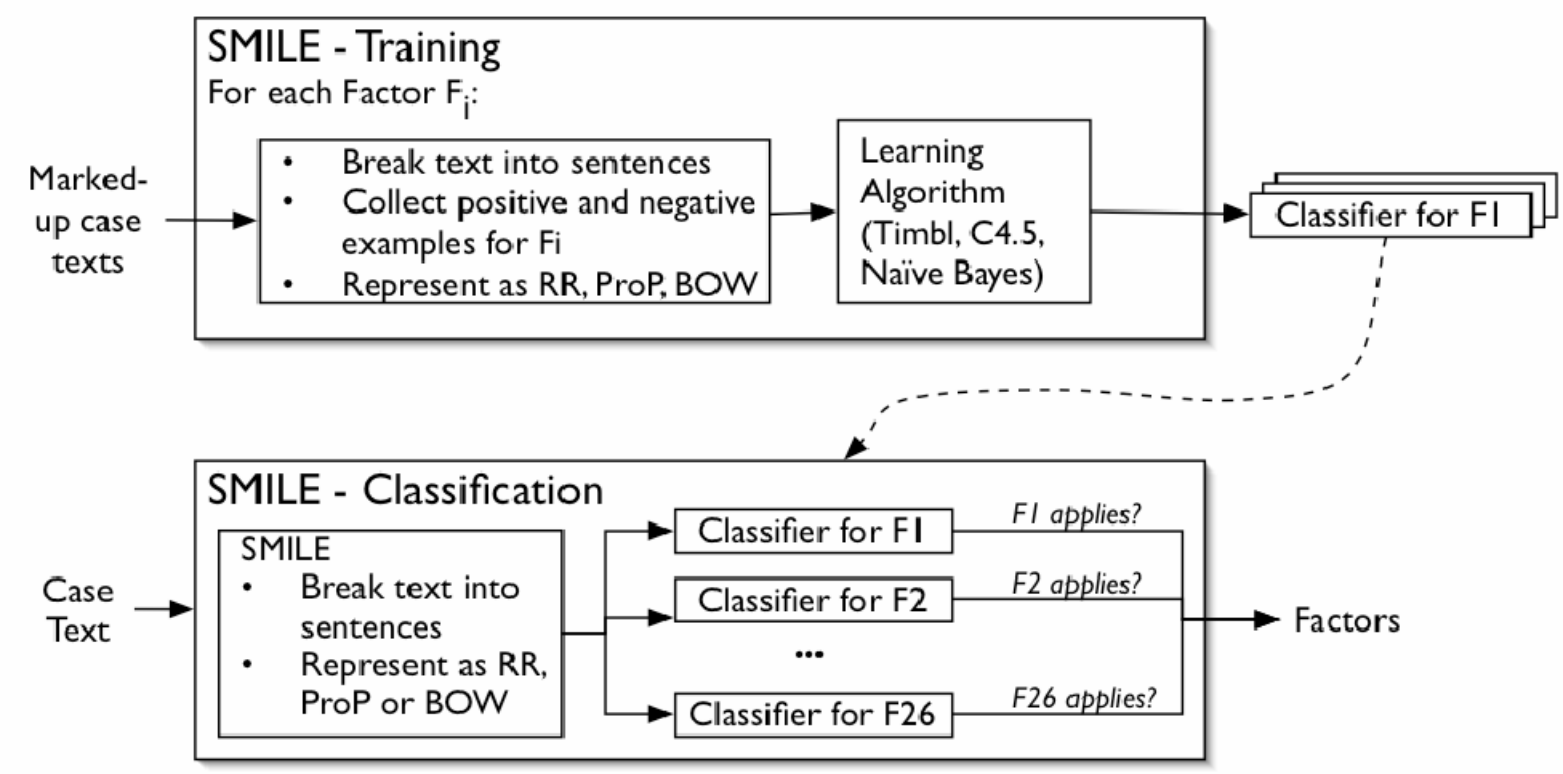


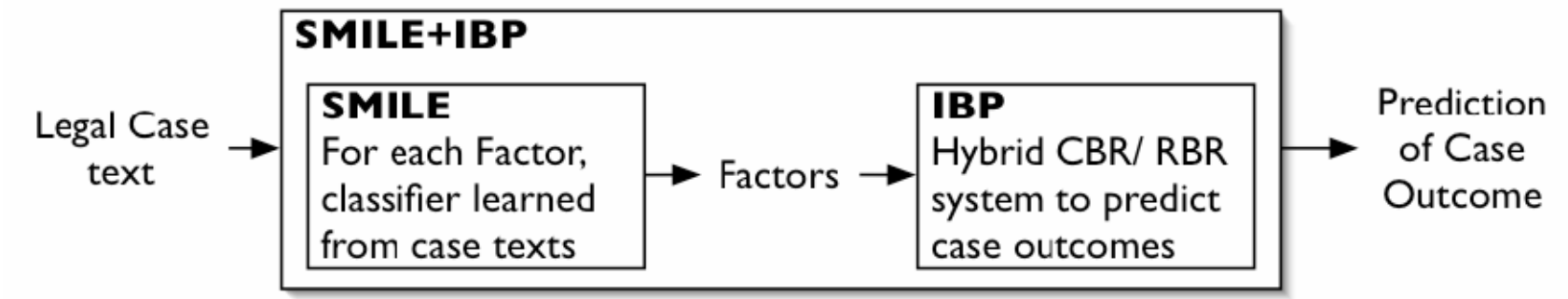
Goals of the E-court Project [Breuker 2002]

Criminal Law Information Retrieval

- Multi-media – combine audio-video of depositions and hearing with legal documents (transcripts, criminal code, indictments)
- Intelligent retrieval – statistical techniques combined with ontology-based indexing and search
- Documents are annotated and tagged in XML using terms from the ontology
- Retrieval is multi-lingual, tolerant of vagueness
- E-court documents will be available on the Web, via Semantic Web services (XML, RDF and OWL)

SMILE+IBP [Brüninghaus & Ashley ICAIL-05]





8. Conclusions

- Learned lessons from formalizing rules:
  - syntactic, semantic ambiguities, need for ontologies, reasoning about rules, not just with them, etc.
- CBR approach to semantic ambiguities
  - Look for ways to incorporate purposes of rules.
- Progress predicting outcomes of legal disputes
  - explaining predictions in terms attorneys can fathom.
- Techniques for dealing with textual legal cases in IR
  - even reasoning directly from textually described cases.
- Future ICAIL topics?
  - Robust interpretation with cases, statutes, purposes, and principles
  - Automatically indexing cases in AI/CBR to improve legal information retrieval
  - Robust machine learning from cases and examples
  - Shared legal ontologies in e-Commerce

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