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Author(s)	Nitta, Katsumi
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Logical Representation of Legal Knowledge

Katsumi Nitta
Tokyo Institute of Technology

Contents

- Model of Legal Reasoning
  - Legal reasoning = Deductive reasoning?
  - Analysis of legal reasoning
  - How to represent legal knowledge.
  - How to use legal knowledge.

What is Legal Knowledge?

- System of Law
  - The Constitution of Japan
  - Penal Code
  - Civil Code
  - Commercial Code
  - Code of Civil Procedure
  - Code of Criminal Procedure

Legal Knowledge & Provisions

- Legal knowledge = provisions ?

"Don't enter this park with a dog"

Deductive Reasoning

rule: prohibited_to_enter(X,Y,P)
                    person(X), dog(Y), park(P).
facts: person(tom). dog(blackie). park(hibiya)

Conclusion: prohibited_to_enter(tom,blackie,hibiya)

Problems of Legal Rules

- The deductive reasoning is too simple to solve actual legal problems.
  - Legal rules are <u>ambiguous.</u>
    Scope of rules.
  - Legal rules are <u>not consistent</u>.
    Conflicting rules.
  - Legal rules don't contain commonsense knowledge.

Example of a Hard Case

prohibited_to_enter (X)   vehicle(X)

Can an ambulance enter the park?
        ==> Ambulance Case
Can a baby carriage enter the park?
        ==> Baby Carriage Case

Interpretation of Ambulance Case

- Two Interpretations
  - (A) This rule is always effective.
    So, an ambulance is prohibited to enter the park.
  - (B) In the case of emergency, the rule is ineffective.
    So, an ambulance is allowed to enter the park.

Legal Criteria of Ambulance Case

- Which interpretation is superior to the others?
  - It depends on viewpoint (criteria).
    - (1) To keep the principle.
    - (2) To apply the rule flexibly.

  (1)>(2)?   (1)<(2)?

Interpretation of Baby Carriage Case

- Two interpretations
- (A) This rule is applied to all vehicle.
  So, the baby carriage is prohibited to enter the park.
- (B) This rule is applied only to the vehicle which runs fast.
  So, the baby carriage is allowed to enter the park.

Legal Criteria of Baby Carriage Case

- Viewpoint (criteria)
  - (1) Interpret the meaning of "vehicle" as it is.

    To keep the principle
  - (2) Interpret the meaning of "vehicle" considering the aim of the rule.
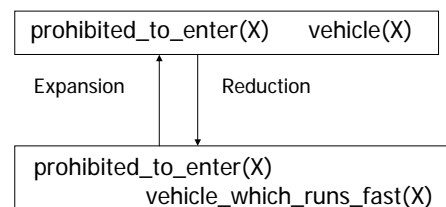
    To keep the pedestrian safe.
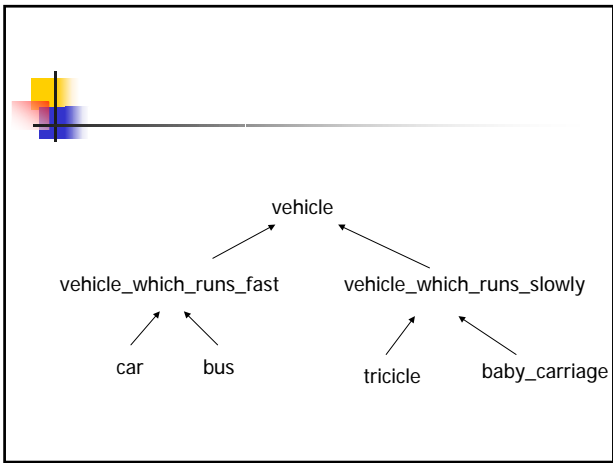
  (1)>(2)?   (1)<(2)?

Model of Legal Reasoning

1st: Interpret legal rules on various viewpoints.

      knowledge of making interpretation

2nd: Apply interpreted rules to facts and draw conclusions.

3rd: Select the best conclusion based on the value judgment.

      knowledge of value judgment

Interpretation of Legal Rules(1)

- Expansion & Reduction

prohibited_to_enter(X)   vehicle(X)

Expansion   Reduction

prohibited_to_enter(X)   vehicle_which_runs_fast(X)

Slide 1

vehicle

vehicle_which_runs_fast   vehicle_which_runs_slowly

car   bus   tricicle   baby_carriage

Interpretation of Legal Rules(2)

- Case Based Reasoning

    prohibited_to_enter(tom'_car)
                tricycle(tom's_car)
    baby_carriage   tricycle

    progibited_to_enter(mary's_carriage)
                baby_carrigae(mary's carriage)

Selection of the Best Conclusion

r1: prohibited_to_enter(X)   vehicle(X)
r2: allowed_to_enter(X)
                vehicle_which_runs_slowly(X).
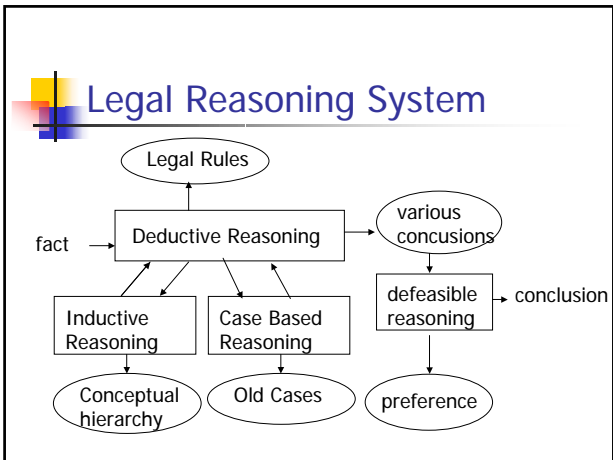r3: vehicle(X)   baby_carriage(X)
r4: vehicle_which_runs_slowly(X)
                baby_carriage(X)
fact: baby_carriage(mary's_carriage)

- r1>r2   principle>safety

Model of Legal Reasoning

- Interpretation of Legal Rules
        Inductive reasoning
        Analogical reasoning
- Deduction
        Deductive reasoning
- Selecting the Best Conclusion
        Defeasible reasoning

Legal Reasoning System

Legal Rules

fact → Deductive Reasoning → various concusions → defeasible reasoning → conclusion

Inductive Reasoning   Case Based Reasoning

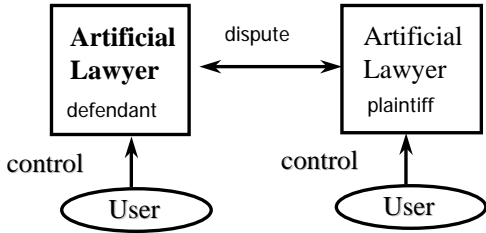Conceptual hierarchy   Old Cases   preference

Architecture of Astroboy

- Architecture of Astroboy is appropriate to realize legal reasoning.

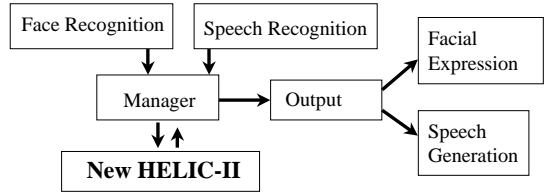   - Electronic brain   inference
    - Heart   Value Judgment

New Helic-II [Nitta]

Automatic Disputation System

| **Artificial Lawyer** defendant | ←dispute→ | Artificial Lawyer plaintiff |

control ↑ User

control ↑ User

Mr.Bengo [Nitta]

- Mr. Bengo = New Helic-II
  + Multimodal User Interface

Face Recognition	Speech Recognition
Manager	→ Output →
New HELIC-II		Facial Expression	Speech Generation

Mr.Bengo (demo)

Example of Criminal Case (1)

Baby

Mary

Example of Criminal Case(2)

Jane

Example of Criminal Case(3)

Baby

Example of Criminal Case(4)

Example of Criminal Case(5)

Example of Criminal Case(6)

Penal Code

218: crime_of_abandonment_by_a_person
　　　_responsible(X)
　　　　　a_person_responsible(X,Y),
　　　　　abandon(X,Y).

219: crime_of_abandonment_by_a_person
　　　_responsible_resulting_in_death(X)
　　　　　a_person_responsible(X,Y),
　　　　　abandon(X,Y), death(Y),
　　　　　caused(abandon(X,Y), death(Y)).

Disputation

Jane's Crime

Crime of abandonment by a person
　　responsible?

Crime of abandonment by a person
　　responsible resulting in death?

It depends on <u>causality</u> between
　　abandonment and the baby's
　　death.

Similar Old Case

- Urata Case
  Urata strangled her husband.
  He fainted away.
  Urata misunderstood he wad dead.
  She abandoned his body on the beach.
  He died from suffocation of sands.
- Prosecutor ==> crime of homicide
  Urata ==> crime of death by negligence

Similar Old Case

- Jane Case   Urata Case
            abandoned
           misunderstood
    died of unexpected reason

     traffic accident <==>   strangling

Case Based Reasoning

- As Urata case is similar to Jane case,
  there is causality between abandonment and death. As a consequent, Jane is punished by the crime of abandonment by a person responsible resulting in death.

- By referring to old case, an interpreted rule is created.

Summary

- Legal reasoning is modeled as the combination of several inference mechanism. ==> Extended LP
- Legal Knowledge
  - Provisions
  - Interpretation (Old Cases, conceptional hierarchy)
  - Value Judgment (Priorities among criteria)