Model-Based Default Refinement of Partial Information within an Ambient Agent

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Introduction

Motivation

- Ambient Intelligence (AmI) applications:
  - high level context awareness
  - sensor information from environment
    - ➔ often incomplete
- Analysis of information with computational models
  - ➔ action of application depends on reasoning methods

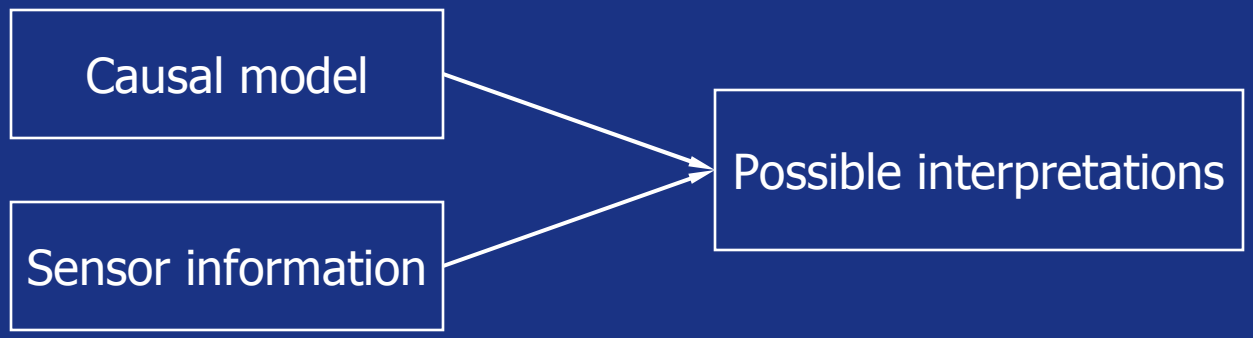
Introduction

Aim of the Research

Reasoning method to generate possible interpretations using non-monotonic logic

new knowledge → fewer consequences

Generic model-based default reasoning method



Modelling Approach

Causal Models

State property I leads to J after duration D:

leads_to_after (I:INFO_EL, J:INFO_EL, D:REAL)

I holds at time T:

at (I:INFO_EL, T:TIME)

Modelling Approach

Multiple Interpretation

* Engelfriet, J., and Treur, J. (2003), Multi-Interpretation Operators and Approximate Classification. *Int. Journal of Approximate Reasoning*, vol. 32, pp. 43-61

Modelling Approach

Representation in Default Logic

- Default theory: <D, W>

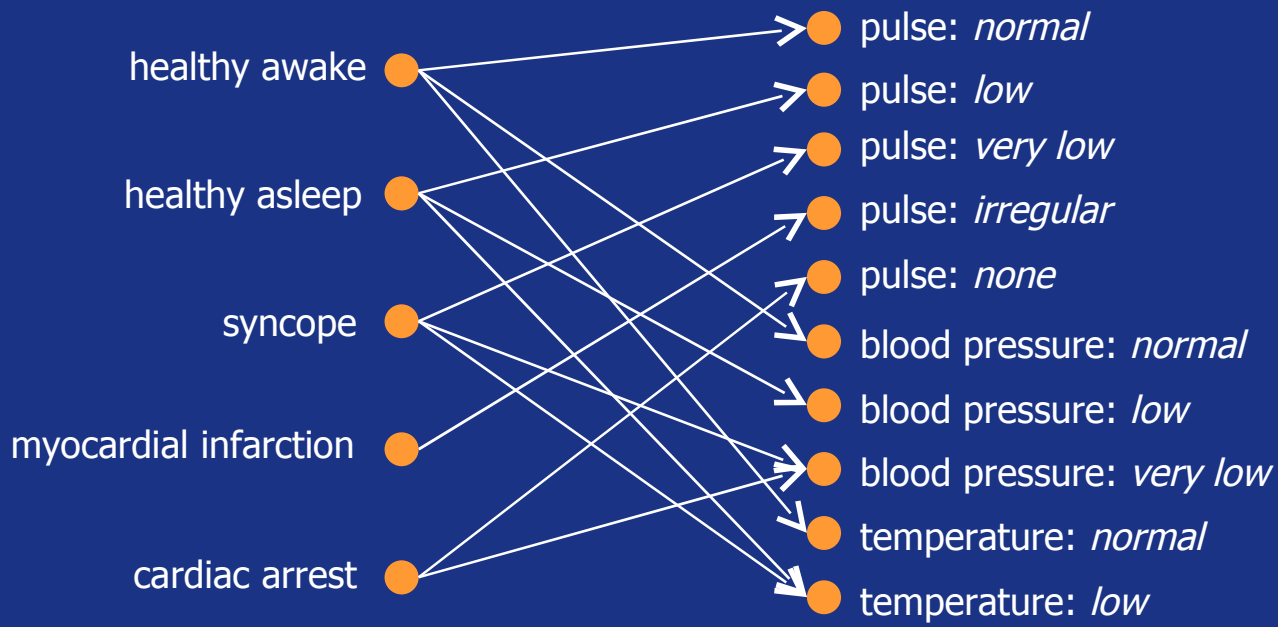
  Default rule: $\alpha : \beta / \gamma$

  (if α is true, and β is consistent, γ can be believed)

- Supernormal default rule: $true : \beta / \beta$

Case Study: Wristband for Elderly

Causal model / Background Theory



Case Study: Wristband for Elderly

Background Theory / Default Rules

- Background theory

  inconsistent_values(pulse, normal, low)

  has_value(y, x1) $\wedge$ inconsistent_values(y, x1, x2) $\rightarrow$ $\neg$ has_value(y, x2)

- Default rules (true : β / β)

  has_value(condition, healthy_awake) / has_value(condition, healthy_awake)

  has_value(pulse, normal) / has_value(pulse, normal)

  has_value(blood_pressure, normal) / has_value(blood_pressure, normal)

  has_value(temperature, normal) / has_value(temperature, normal)

  …

Case Study: Wristband for Elderly

11 Possible Extensions

#	Condition	Symptoms
1	healthy asleep	pulse, low temperature, low blood pressure, low
2	syncope	pulse, very low temperature, low blood pressure, very low
3	myocardial infarction	pulse, irregular temperature, normal blood pressure, normal
4	myocardial infarction	pulse, irregular temperature, low blood pressure, very low
5	myocardial infarction	pulse, irregular temperature, normal blood pressure, low
…	…	…

Case Study: Wristband for Elderly

Extensions with Partial Information

X = {temperature, normal; pulse, irregular}

#	Condition	Symptoms
1	myocardial infarction	pulse, irregular temperature, normal *blood pressure, normal*
2	myocardial infarction	pulse, irregular temperature, normal *blood pressure, low*
3	myocardial infarction	pulse, irregular temperature, normal *blood pressure, very low*

Controlled Default Reasoning

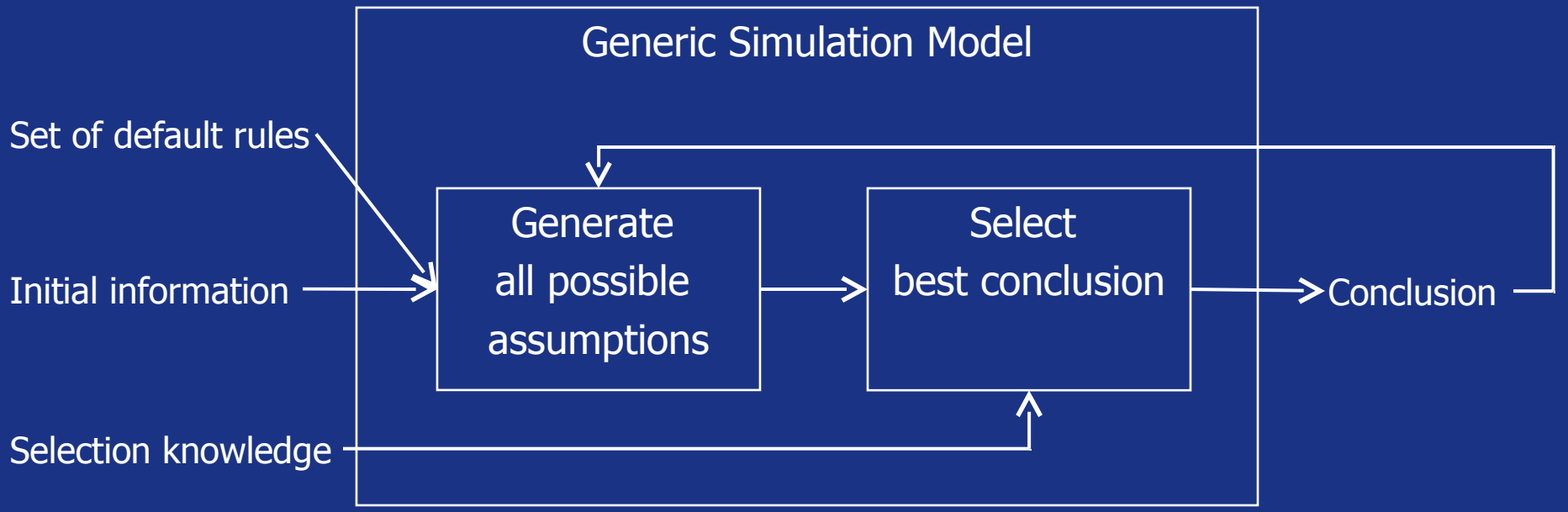
Modelling Approach

- Specification in LEADSTO:
  - high-level executable language
  - similar to executable temporal logic
- Format:

  $\alpha \rightarrow_{e, f, g, h} \beta$

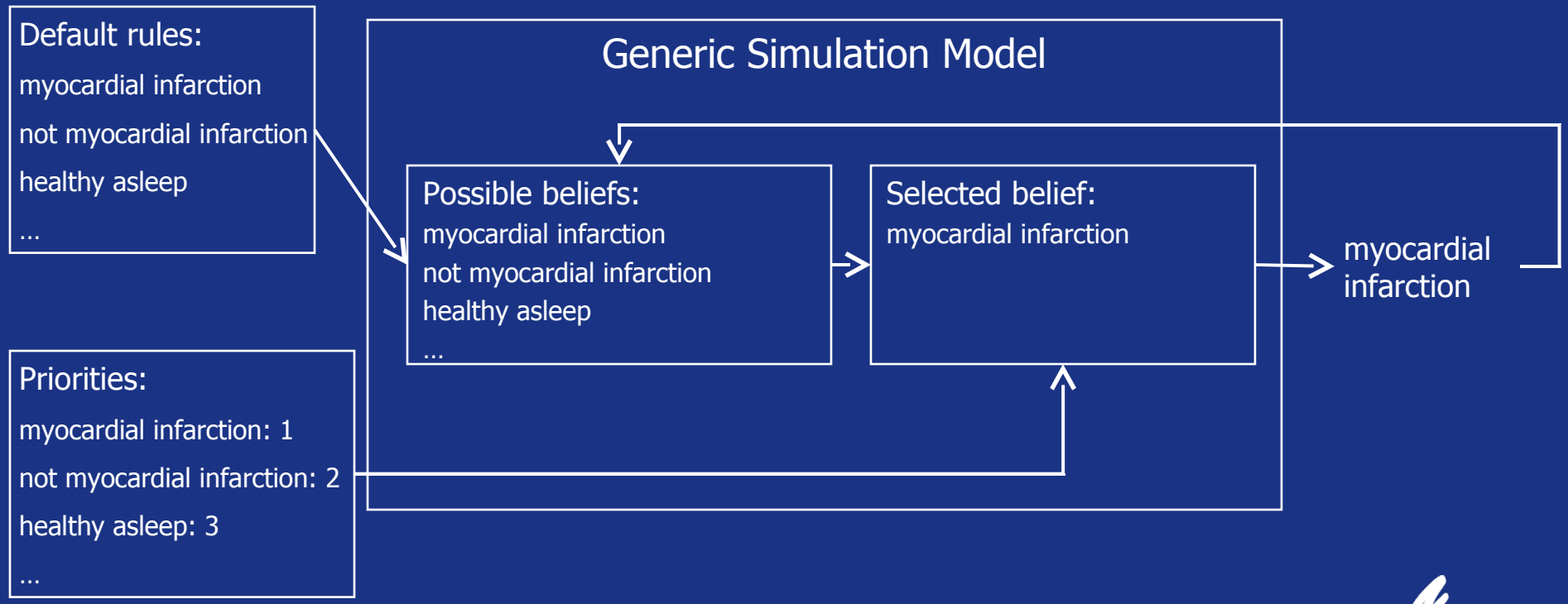
Controlled Default Reasoning

Generic Simulation Model



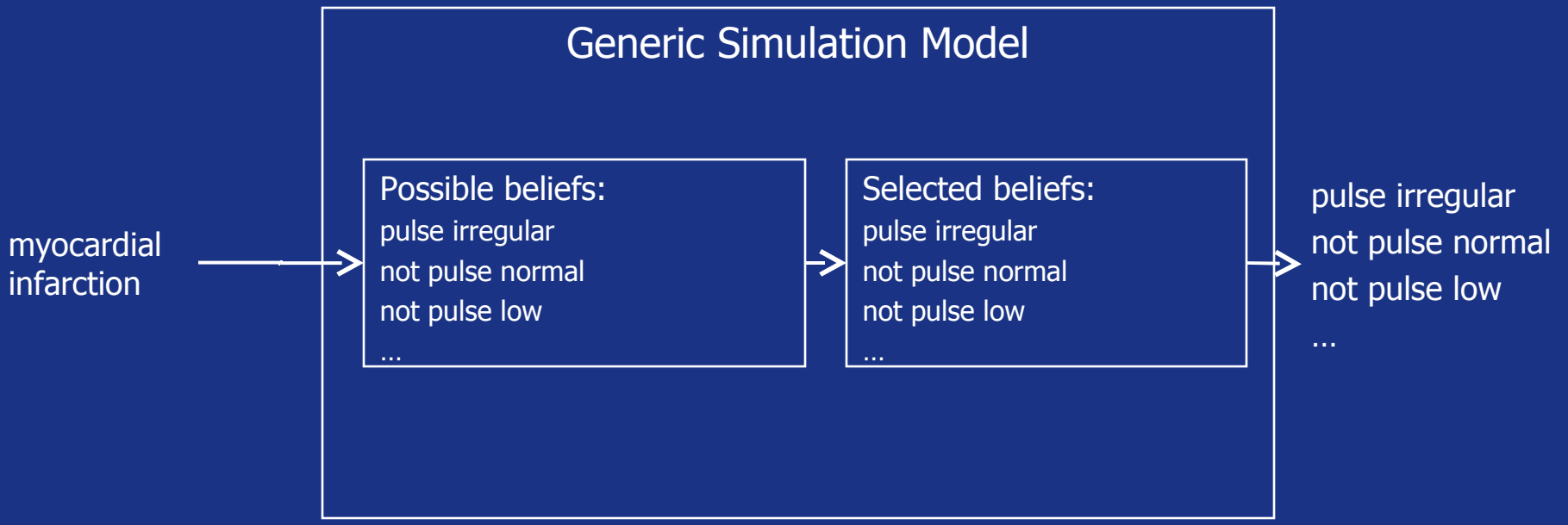
Case Study: Wristband for Elderly

Controlled Default Reasoning



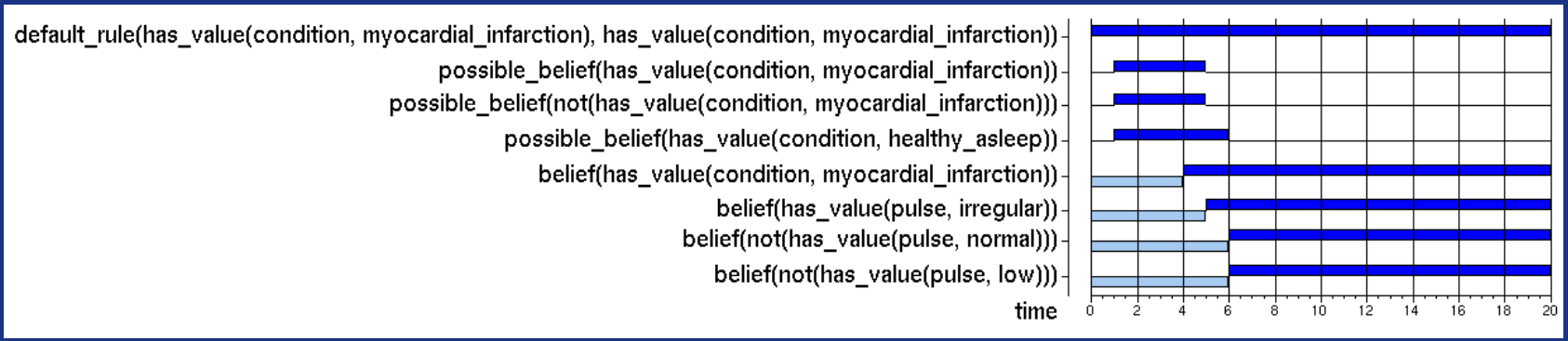
Case Study: Wristband for Elderly

Controlled Default Reasoning



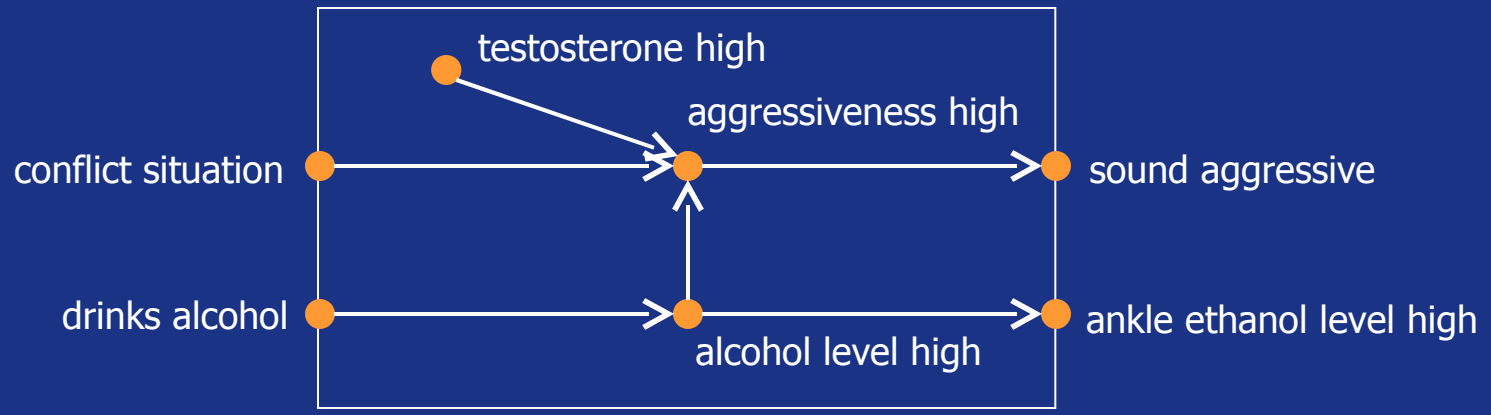
Case Study: Wristband for Elderly

LEADSTO Simulation



Case Study: Crime Case

Causal Model / Background Theory



A fight has taken place, an aggressive sound is observed
3 suspects:

3. person with high testosterone
4. person with alcohol sensitivity
5. person with Intermittent Explosive Disorder (IED)

Case Study: Crime Case

Background Theory / Default Rules

- Background theory

  Closed World Assumption

  X = {has_value(sound, aggressive)}

- Default rules

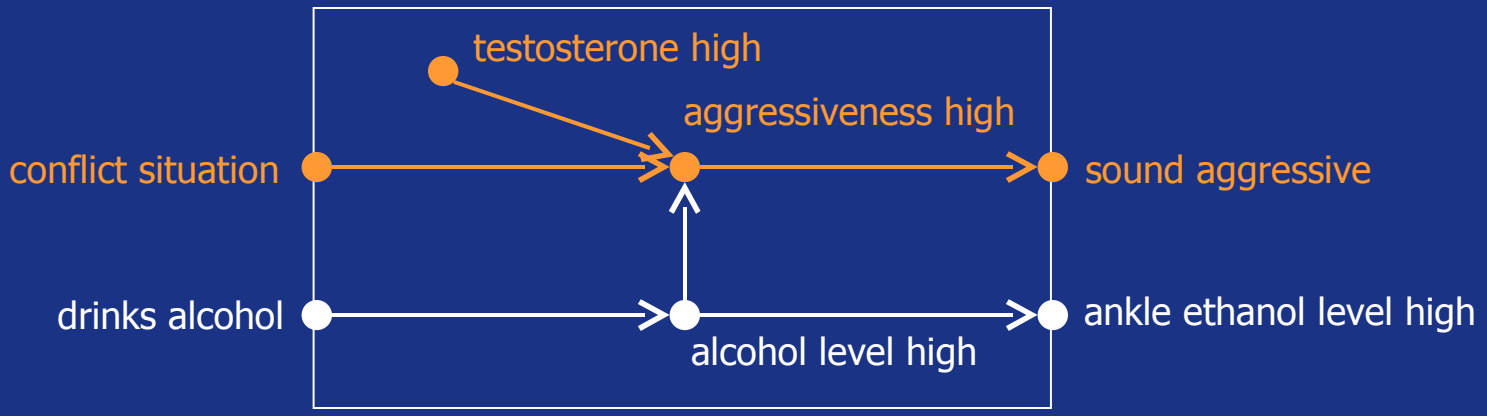
  has_value(situation, conflict) / has_value(situation, conflict)
  has_value(situation, drinks_alcohol) / has_value(situation, drinks_alcohol)
  has_value(testosterone, high) / has_value(testosterone, high)
  …

Case Study: Crime Case

Default Extensions

- 7 default extensions

suspect 1: high testosterone

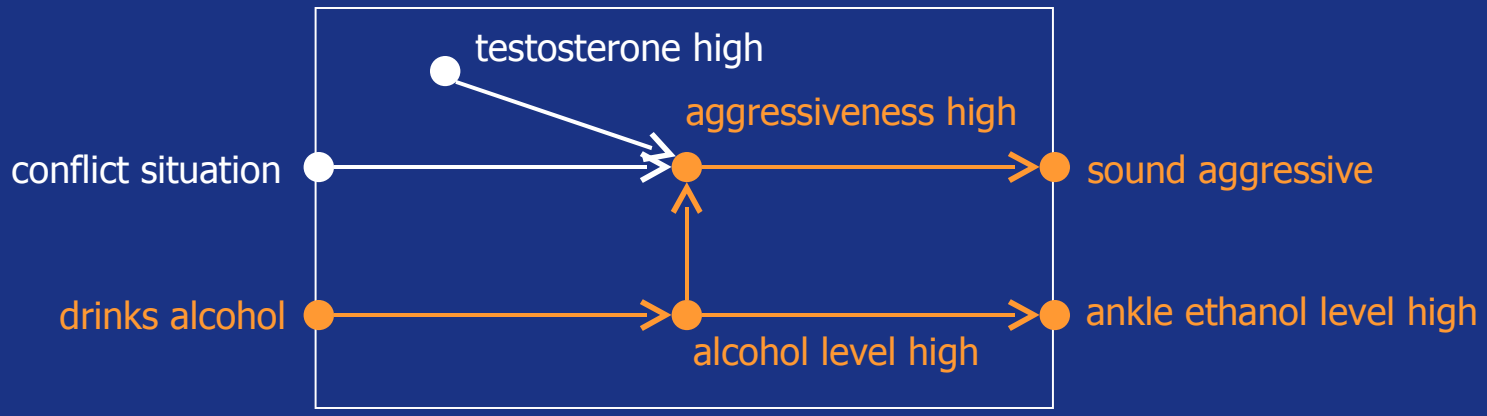


Case Study: Crime Case

Default Extensions

- 7 default extensions

suspect 2: oversensitive to alcohol



Summary

- Theoretical framework for default reasoning
- Formal techniques exploited:
  - multi-interpretation operators
  - default theory
  - temporalised default logic
- Generic specification: easily reused in other case studies
- Future work: apply framework in practical settings

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Workshop: Human Aspects in Ambient Intelligence

Thank you!