Cognitive Systems
Argument & Cognition

- Realization of Argumentation in Practice
- Preference-based argumentation suitable for cognition?
- Aim: Argue the case for (preference-based) argumentation for Cognitive Reasoning
  - Case for dialectical acceptability semantics

AL-Dialectic Argumentation in Practice

- **Reasoning about Actions and Change**
  - Frame, Ramification and Qualification problems
  - Narrative Text Comprehension
    - STAR System: **http://cognition.ouc.ac.cy/star**

- **Non-monotonic learning (from 1995)**
  - Learning **argumentation theories of** defeasible concepts – associations
    - Knowledge from Data Analytics
    - Commonsense Knowledge from associations in text.
  - **Induction produces arguments (not strict rules)**

AL Dialectic Argumentation

Reasoning about Actions and Change

Comprehension: "The power cut had turned the house into darkness. Bob came home and turned on the light switch. …"

- {power_cut@T^0, darkness@T^0, turn_on_switch@T}

- **Arguments** {a1,a2,a3}
  - a1={turn_on_switch $\rightsquigarrow$ light_on ; light_on $\rightsquigarrow$ $\neg$ darkness}
  - a2={power_cut $\rightsquigarrow$ $\neg$ electricity ; $\neg$ electricity $\twoheadrightarrow$ $\neg$ light_on}
  - a3={darkness@T $\rightsquigarrow$ darkness@T^+}

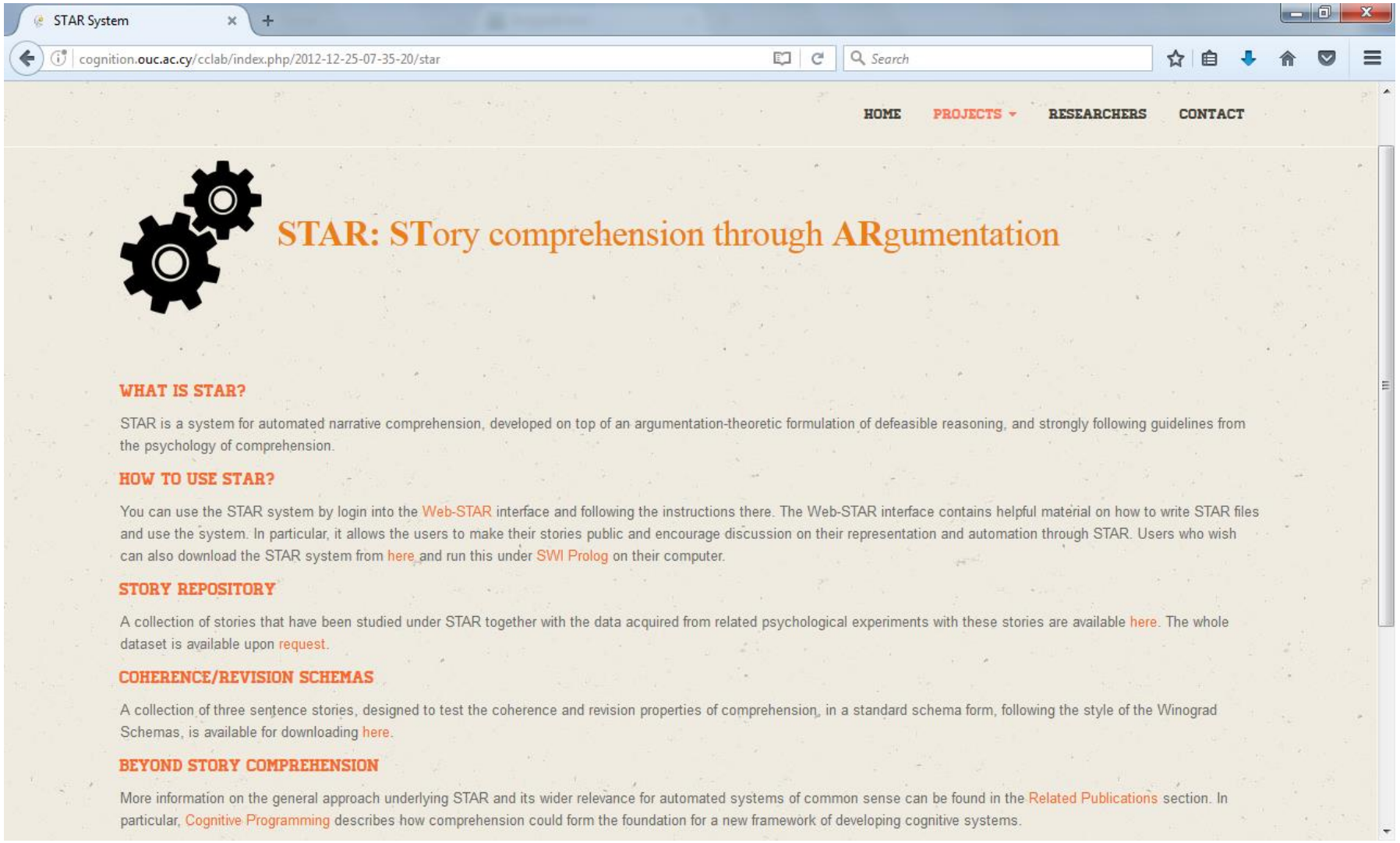
- a1 **supports** $\neg$ darkness@T^+ ; a3 **supports** darkness@T^+

AL Dialectic Argumentation

Reasoning about Actions and Change

- **Arguments** = {a1,a2,a3}
- **Attacks** = {(a1,a3), (a2,a1)} U {(a3,a1), (a1,a2)}
- **Defense**= {(a1,a3), (a2,a1)}
  - **Causality Arguments** ⊐ **Persistence Arguments**
  - **Precondition Arguments** ⊐ **Causality Arguments**
- {a3} (and {a2}) are **acceptable** arguments
  - **Comprehension: "House remains in darkness" via a3**

STAR: STory Comprehension via ARgumentation



HR from Cognitive Psychology

- **Features of human reasoning compatible with argumentation:**
  - Handles conflicts / no absolute knowledge.
  - Tentative conclusions / revises when surprised.
  - Human biases influence the reasoning.
  - Justification of conclusion / decision matters.
  - Human reasoning is "on demand" / dialectical.

- Argument is **native** to human reasoning.
  - Argumentation offers **unified** perspective of empirical psychological evidence on nature of human reasoning (Mercier & Sperber).

Argument and Cognition

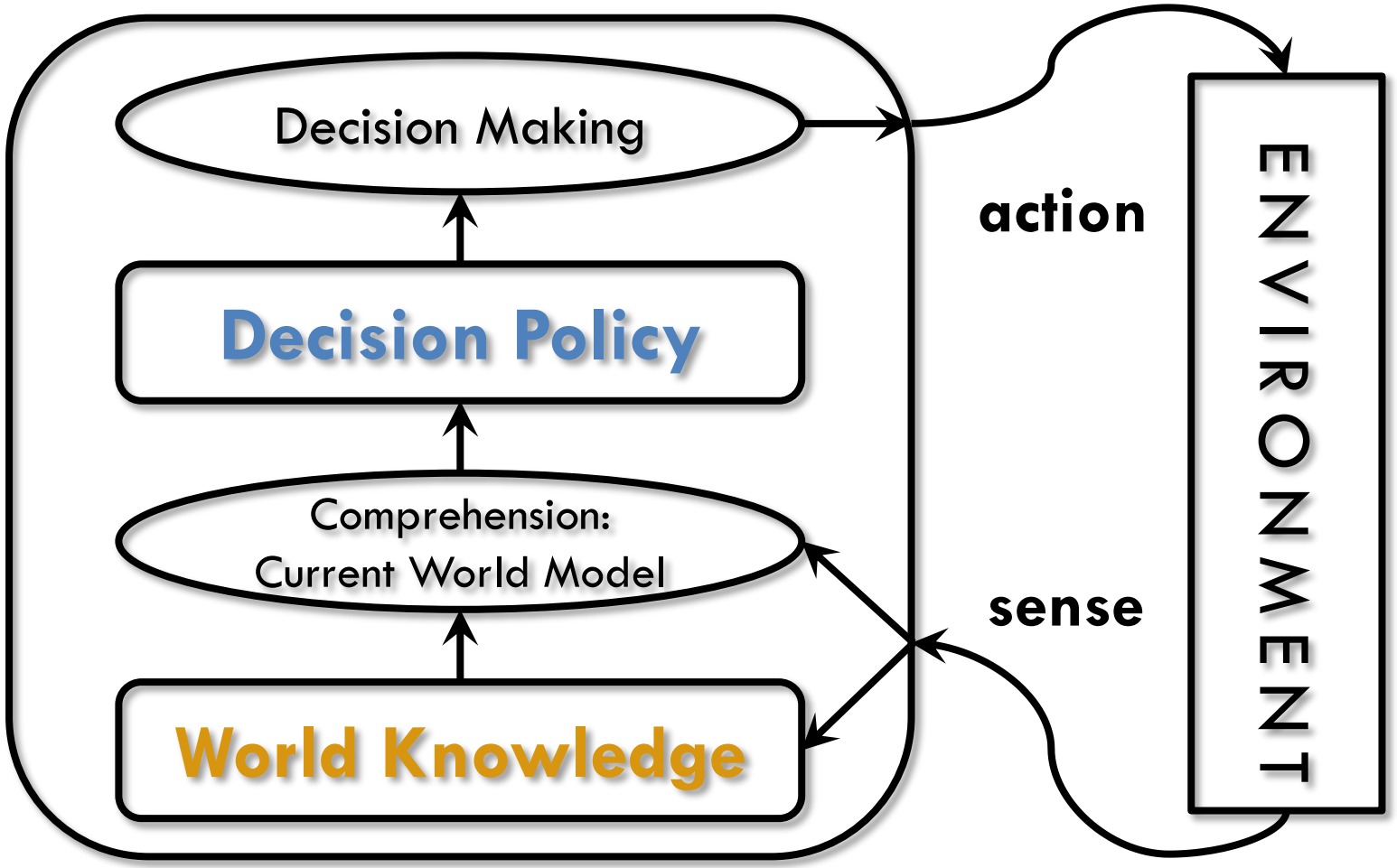
- Cognition via Preference-based Argumentation
  - Preferences come from human biases
    - Generic biases e.g. as seen in Comprehension
    - Personal interests/motivations
- Cognitive Decision Making
  - Personal preferences in argumentation
    - Personalized and adaptive decision making
- Cognitive Systems put all these preference –based argumentation elements together

Cognitive Programming

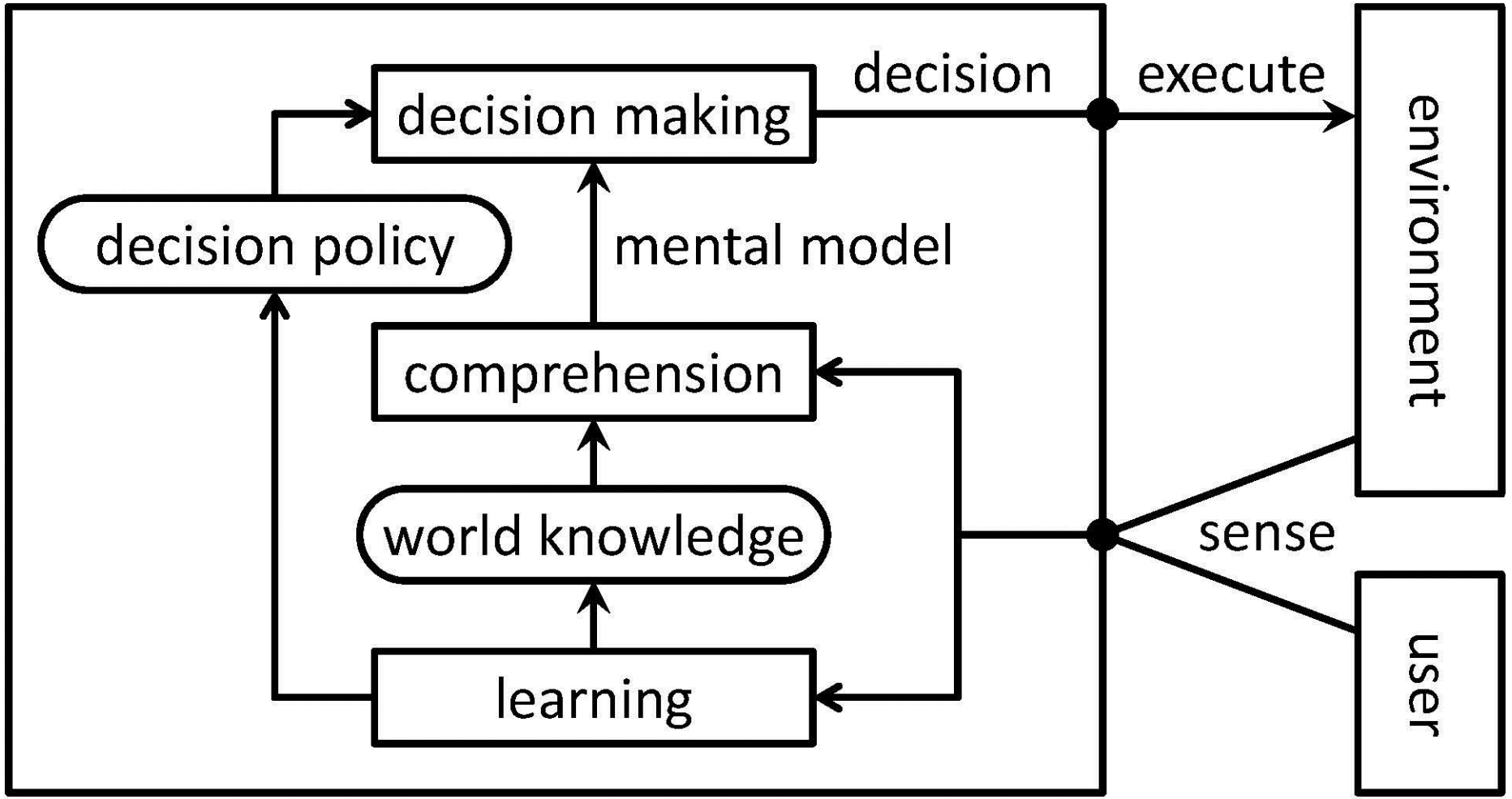
Gorgias-B: Cognitive Preferences

- **Example: Call Assistant**
  - **Generally, when working (prefer to) allow family calls**
  - **When busy prefer to hold calls**
    - **Except when there is an emergency at home.**
- **Gorgias-B:**User considers successive **scenario refinements**
  - In **SCENARIO** are there **OPTIONS generally PREFERRED?**
    - Are there **special CONTEXTS** where **ANOTHER OPTION** is **PREFERRED?**

Cognitive Assistant Bird-Eye View



Cognitive Assistant Bird-Eye View



Cognitive Programming *Challenges*

- Cognitive elicitation of user preferences.
  (How can the system help the user?)
  - More natural elicitation in natural language?
  - System proposes revised scenarios / contexts?
  - Elicitation without active user involvement?
- Acquisition though machine learning of relevant background world knowledge.
  (How can the user help the system?)
  - User proposes vocabulary / hypothesis bias?
  - User curation of the data or the knowledge?

Why is Cognition Effective? Hints for Argumentation

- Cognition is based on **default** inferences:
  - Acquired through experience. Good "bet" in stable environments. Recovery mechanism for surprises.
- Default Experience is extensionalized:
  - **Cognitive Knowledge** compiled into knowledge that can be grounded directly to external information typically coming from environment.
    E.g., conforming to our Language Vocabulary.
- Cognition is **effectively cautious**:
  - **Lazily** waits for information to ground default knowledge to past experience.

Cognition & Argumentation: Summary

- Cognition through preference-based argumentation
  - Preferences come from human biases
    - Generic biases or Personal interests/motivations
- Cognitive Programming *Challenges*
- Visit Website of:
  - Argument & Cognition: http://cognition.ouc.ac.cy/argument/