EPL680: Lecture 5 Addendum CONTEXT for Common Sense

OVERVIEW

- **Context in Knowledge Representation**
- **Recognizing Context**
- **Context in Cognitive Assistants**

Properties of CONTEXT

- Context refers to a situation
- Context generalizes/groups into one a situation
- Often Context is linked to an explanation of the explicit input
- Context is related to action affordances – links to actions opportunities afforded (in the situation)
- Context is an assumed entity – hence defeasible

Recognizing CONTEXT

- Context is recognized from glues
- Glues are not all equally strong.
- Positive and negative glues – Induction and Inhibition
- Recognition through a connectionist/threshold model
- In language Context is indexed by a Bag of Words
  - Not equally important

Example of failed CONTEXT

- (<effect>, (<agent>, <(entity, action/behaviour)>))
  - (<in-hand>, (<robot>, <(saw, grasp>))
  - (<in-hand>, (<human>, <(saw, grasp>))
  - (<in-hand>, (<robot>, <(canister, grasp>))
  - …

- ist(c,ϕ): The formula “φ”is true in context “c”

Using/Acting on CONTEXT

- Complete the situation
- Decide on canonical action –action affordances
- Common sense knowledge on actions
  - Typical actions that people do in a situation/context
  - Typical preconditions for actions
  - Typical effects of actions
  - Typical actions that explain observations

Argumentation for Human Reasoning
(Reasoning in a single Context)

- **Example Context: "birds, wings and flying" in LPP (LpwNF)**

- **LPP: Default-Association Rules and Relative Priorities over Rules**
  - **r1(X):** $bird(X) \rightsquigarrow flies(X)$
  - $r2(X)$: $brokenwings(X) \rightsquigarrow \neg flies(X)$
  - **r3(X):** $brokenwings(X) \rightsquigarrow bird(X)$ **(Why not a plane?)**

- **What happens if "lightlybrokenwings(t)" holds?**
  - **r4(X):** $lightlybrokenwings(X) \rightsquigarrow flies(X)$
    - **BUT is this an argument for flying?**
  - $\neg lightlybrokewings(X) \rightsquigarrow r2(X) > r1(X)$
    - **BUT in the scenario {brokenwings(t)} we will NOT conclude ¬flies(t)**
    - **Only in the full scenario {brokenwings(t), lightlybrokenwings(t)}**
    - **WHY? Because the priority is also a default – Normally, r2(X) > r1(X).**

Argumentation for Human Reasoning

(Reasoning in a single Context)

- **Example Context: "birds, wings and flying" in LPP (LpwNF)**

- **What happens if "lightlybrokenwings(t)" holds?**

  - **This is an Exception to the Default Priority of rule r2 over r1.**
    - **A bird with lightly broken wings continues to have the property of flying.**
  - **One way to encode this in LPwNF is:**
    - $R1(X)$: $true \rightsquigarrow r2(X) > r1(X)$
    - $R2(X)$: $lightlybrokenwings(X) \rightsquigarrow r1(X) > r2(X)$
    - **C1(X):** $true \rightsquigarrow R2(X) > R1(X)$

- **Reflects/Encodes the scenario based inferences:**
  - **Fly** {bird(t)}
  - **¬Fly** {bird(t), brokenwings(t)}
  - **Fly** {bird(t), brokenwings(t),lightlybrokenwings(t)}

Argumentation for Human Reasoning

(Reasoning in a single Context)

- **Example Context: "birds, wings and flying" in LPP (LpwNF)**

  - **r1(X):** $bird(X) \rightsquigarrow flies(X)$
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  - **r3(X):** $brokenwings(X) \rightsquigarrow bird(X)$ **(Why not a plane?)**
  - **r4(X):** $lightlybrokenwings(X) \rightsquigarrow brokenwings(X)$

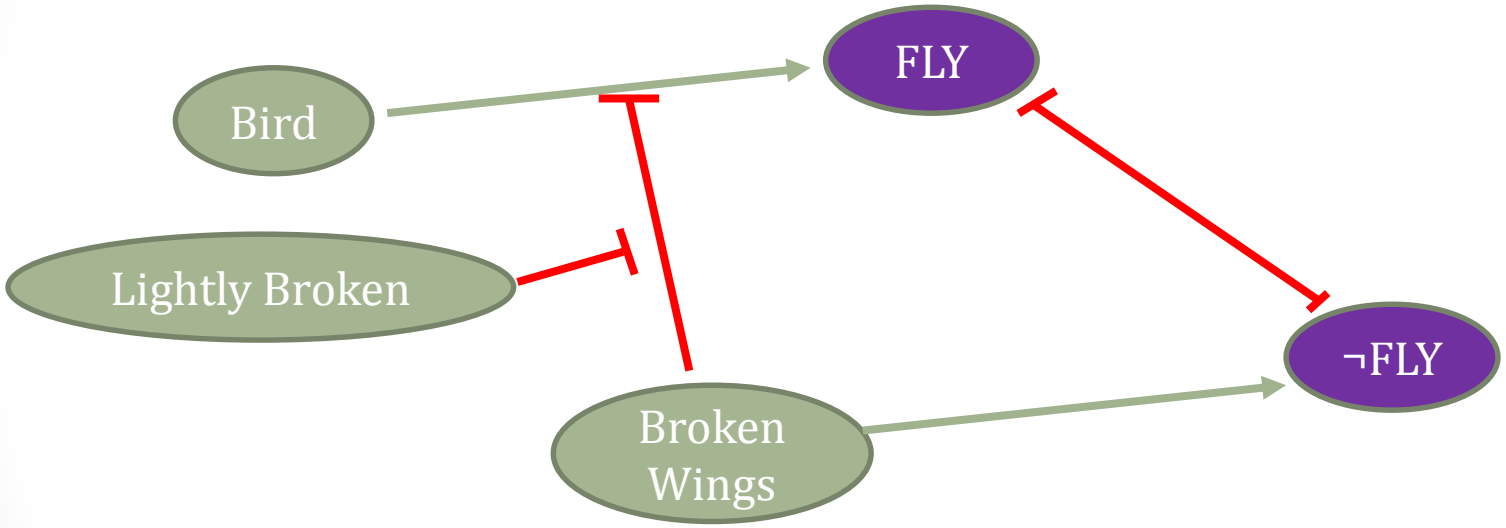
  - $R1(X)$: $true \rightsquigarrow r2(X) > r1(X)$
  - $R2(X)$: $lightlybrokenwings(X) \rightsquigarrow r1(X) > r2(X)$
  - **C1(X):** $true \rightsquigarrow R2(X) > R1(X)$

- **Representing directly the scenarios as rules will not work.**
  - **Fly** {bird(t)}
  - **¬Fly** {bird(t), brokenwings(t)}
  - **Fly** {bird(t), brokenwings(t),lightlybrokenwings(t)}

Argumentation for Human Reasoning

(Reasoning in a single Context)

- **Example Context: "birds, wings and flying" in LPP (LPwNF)**



- **Is this an accurate reflection of the mind?**
- **Is this an accurate reflection of the brain and its neural circuits?**

- **Compare with Genetic and Signal Pathways in Molecular Biology**

Argumentation for Human Reasoning

(Reasoning in a single Context)

- **Example Context: "birds, wings and flying" in LPP (LpwNF)**

  - **r1(X):** $bird(X) \rightsquigarrow flies(X)$
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  - **r3(X):** $brokenwings(X) \rightsquigarrow bird(X)$ **(Why not a plane?)**
  - **r4(X):** $lightly brokenwings(X) \rightsquigarrow brokenwings(X)$

  - $R1(X)$: $true \rightsquigarrow r2(X) > r1(X)$
  - $R2(X)$: $lightlybrokenwings(X) \rightsquigarrow r1(X) > r2(X)$
  - **C1(X):** $true \rightsquigarrow R2(X) > R1(X)$

- **Can we generate this Internal Cognitive Programming code for automatically from the scenarios?**
  - **Fly** {bird(t)}
  - **¬Fly** {bird(t), brokenwings(t)}
  - **Fly** {bird(t), brokenwings(t),lightlybrokenwings(t)}

Argumentation for Human Reasoning

(Reasoning in a single Context)

- **Example Context: "birds, wings and flying" in LPP (LpwNF)**
  - **r1(X):** $bird(X) \rightsquigarrow flies(X)$
  - $r2(X)$: $brokenwings(X) \rightsquigarrow \neg flies(X)$
  - **r3(X):** $brokenwings(X) \rightsquigarrow bird(X)$ **(Why not a plane?)**
  - **r4(X):** $lightlybrokenwings(X) \rightsquigarrow brokenwings(X)$
  - $R1(X)$: $true \rightsquigarrow r2(X) > r1(X)$
  - $R2(X)$: $lightlybrokenwings(X) \rightsquigarrow r1(X) > r2(X)$
  - **C1(X):** $true \rightsquigarrow R2(X) > R1(X)$
- **FURTHER SPECIFICITY: New information: "bird has just been born"**
  - **The state of the wings does not matter. Have we changed context at some level?**
    - $r5(X)$: $newborn(X) \rightsquigarrow \neg flies(X)$
    - $R3(X)$: $true \rightsquigarrow r5(X) > r1(X)$
  - **Note the high-level of Modularity of this INTERNAL CODE for CP.**

Argumentation for Human Reasoning

(Reasoning in a single Context)

- **Example Context: "birds, wings and flying" in LPP (LpwNF)**
  - **r1(X):** $bird(X) \rightsquigarrow flies(X)$
  - $r2(X)$: $brokenwings(X) \rightsquigarrow \neg flies(X)$
  - **r3(X):** $brokenwings(X) \rightsquigarrow bird(X)$ **(Why not a plane?)**
  - **r4(X):** $lightlybrokenwings(X) \rightsquigarrow brokenwings(X)$
  - $R1(X)$: $true \rightsquigarrow r2(X) > r1(X)$
  - $R2(X)$: $lightlybrokenwings(X) \rightsquigarrow r1(X) > r2(X)$
  - **C1(X):** $true \rightsquigarrow R2(X) > R1(X)$
- **EXPLICIT OBSERVATION: Direct information: "bird does not fly"**
  - **Nothing else matters! Add further strong scenario information in the form:**
    - $f1(tweety)$: $true \rightsquigarrow \neg flies(tweety)$
    - $FP1(tweety)$: $true \rightsquigarrow f1(tweety) > r1(tweety)$
  - **Again Modularity of this INTERNAL CODE for CP.**

Argumentation for Human Reasoning (Changing Context)

- **Context 1:** "wings, flying, …, BIRDS"
  - **r1(X):** $bird(X) \rightsquigarrow flies(X)$
  - $r2(X)$: $brokenwings(X) \rightsquigarrow \neg flies(X)$
  - **r3(X):** $brokenwings(X) \rightsquigarrow bird(X)$ (Why not a plane?)
  - **r4(X):** $\mathbf{lightly}brokenwings(X) \rightsquigarrow brokenwings(X)$

  - $R1(X)$: $true \rightsquigarrow r2(X) > r1(X)$
  - $R2(X)$: $lightlybrokenwings(X) \rightsquigarrow r1(X) > r2(X)$
  - **C1(X):** $true \rightsquigarrow R2(X) > R1(X)$

- **Context 2:** "wings, flying, …, PLANES" in LPP (LPwNF)
  - The rule r3(.) above does not apply in Context2
  - Lightly Broken Wings does not form an exception to r2(.)

- CAN ANY KNOWLEDGE IN ONE CONTEXT BE REUSED IN ANOTHER?

Comprehension in Application Problems

- **Cognitive Web Search Assistant**
  - **“Fast way from London to Manchester not public transport”**
  - **“Survey paper on cognition”**
  - **“A recipe for success at work”**
    - **“How to be successful at work?”**

  - **By comprehending the query through common sense knowledge, we can focus the search according to the indention of the user.**
    - **By posing a new query constructed from the comprehension inferences**
      - **“London to Manchester by plane or car”**
      - **“Flights London to Manchester”**
      - **“Scientific survey paper on cognition**

  - **With local knowledge:**
    - **“Arrange dinner with Giuseppe and family”**
    - **“Giuseppe and family arrive on Thursday. Search for restaurants & music”**
      - **‘restaurant (Putney OR Hammersmith) “gluten-free” –Italian’**
      - **’25th July evening “live jazz” inner London’**

Comprehension in Application Problems

- **Cognitive Home Assistant**
  - **What is an appropriate corpus of Common sense knowledge?**
    - **Background general common sense knowledge**
      - **Opening windows freshens the house**
      - **Opening all windows causes a draft in the house**
      - **Opening windows on a windy day dirties house**
    - **Background specific common sense knowledge**
      - **Configuration of the specific house – rooms and windows**
    - **Local knowledge of needs and preferences of the user**
      - **Policy that depends on a good comprehension of the instruction of the user under the current comprehended situation.**
- **Specify in the form of informal rules, a part of the relevant common sense knowledge for a home assistant**

Cognitive Systems – Applications – From lecture1

- **Cognitive Home Assistant**
  - **Behaves similarly to a human assistant – a butler!**
  - **NOT build by detailed programming of actions to be performed under conditions:**
    - **WHEN Temp < 20 THEN Turn_on_heating**
    - **WHEN Temp = 23 THEN Turn_off_heating**

    What happens when temperature is bigger than 23? Or at 20° we say we are cold?
    What happens when there is a sick child in the house with fever?
    What happens when we have a party with the house full of people?

  - **Build by instructing it about our needs/desires and our preferences amongst them:**
    - **Keep home warm but economize.**
    - **John has a fever today.**
    - **We are having a party tonight with 10 people.**

    using common sense knowledge about home living and personal information of the specific human user (and home).

- **Similarly, Trip and Hotel Assistant**
  - **In terms of purpose of trip (business or pleasure), alone/with family, interests, etc.**

- **Define a high-level instruction language for these Cognitive Assistants?**