Which way do I go?: Virtual Characters following Directions

Jan M. Allbeck
Understanding

- Human language assumes some common understanding
- Concepts
- Situated understanding
- Relationships
  - Between objects
  - Between actions
  - Between actions and objects
- Representations and processes
  - Trade off between memory and computation
Projects

• Spatial relations
• Navigational instructions
• Semantic representations
• Learning and memory
MODELING AGENT DETERMINATION OF SPATIAL RELATIONSHIPS

JOHN MOONEY
Object-Specific Spatial Data
Determining an Object

1. Search for all [base] - **Cups** - within the Agent's perceived list of Objects
2. Search for all [qualified] - **big blue Cups** - within the perceived Cups
3. Search for all [located] - **Top the Table** - within the big blue Cups
4. Select [quantified] - **any Cup** - within the list of big blue Cups
   Top every Table
The Locator

Top the green Table and Front the Computer or Under any Desk

Determining an Object
- The Action
- The Object Description
- The Spatial Relation

1. Search for all [base] - Cups - within the Agent’s perceived list of Objects
2. Search for all [qualified] - big blue Cups - within the perceived Cups
3. Search for all [located] - Top the Table - within the big blue Cups
4. Select [quantified] - any Cup - within the list of big blue Cups
   Top every Table

Diagram:
- OR
  - AND
    - Cups Top the green Table AND Front the Computer
    - Cups Under any Desk
  - OR
    - Cups Top the green Table
    - Cups Under any Desk
    - Front the Computer

Arrows:
- Top the green Table
- the Computer
- any Desk
Spatial Regions

- Local to the object
  - Can be scaled, rotated, translated, and will still produce correct results.
Future Work

• Determining position for Object Placement
  o Almost Done! Just needs additional testing

• Increase Vocabulary
  o Add functionality for more Quantifiers, Qualifiers, and Locators

• Extend functionality of Relation Tree
  o Add further ambiguous resolvement, nearest-point determination, and 'not on Table' capability

• Improve Animation and Visuals
  o Looking nicer is always better
NAVIGATIONAL INSTRUCTIONS

ROHAN GANDHI
Concept

• Construct representations and processes that allow a virtual character to follow navigational instructions
• No prior knowledge of the environment
• Limited perception
• Able to handle ambiguous instructions (and mistakes)
• Memory of earlier options
• Knowledge and understanding of failures
Start
End of hall
Left doorway
Red fox statue
Turn right
Destination

Option Tree
Results

Roughly:
• Exit the room
• Go left
• Enter hallway on right
• Continue through doorway straight ahead
• Turn right
• Enter room on left
Results

Roughly:
- Exit the room
- Go through the door on the wall in front of you
- Go to the crates
Results

Roughly:
- Exit the room
- Go through the door on the wall in front of you
- Go to the crates
- Go to the sink
Future Work

- More accurate perception
- Ask for clarifications
- Reverse process: generating directional instructions from a path
  - Identify appropriate landmarks and spatial relationships between them
SEMANTIC REPRESENTATIONS
WEIZI LI AND JOHN T. BALINT
Parameterized Action Representation

- Objects, actions, and their interactions
- Commonsense knowledge bases
- Affordances
Explanation-Based Learning (EBL)

- An *analytical* learning method, based on *prior* knowledge, through *observation* and *explanation*, expand the information provided by *training examples*, and eventually *learn* new knowledge and concepts.
EBL Components

- **Goal Concepts**: a target concept with a set of relevant features.

  - Goal Concept: $MailToProfA(x)$

- **Training Example**: a typical positive example of a concept to be learned.

  - Training Example: A positive example, $MailToProfA(Obj1)$
    
    Inside($Obj1$, Office_1)
    Inside($Obj1$, $Obj2$)
    Type($Obj1$, Mail)
    Type($Obj2$, Container)
    Color($Obj1$, White)
    Color($Obj2$, Red)
EBL Components (cont.)

- **Domain Theory**: prior knowledge which can be used to analyze, or explain why the training example could satisfy the goal concept.
  
  - Domain Theory:
    
    \[
    \text{MailToProf} A(x) \leftarrow \text{Location}(x, \text{Office}_1) \land \text{Inside}(x, y) \land \text{Type}(x, \text{Mail}) \land \\
    \text{Type}(y, \text{Container}) \land \text{Color}(y, \text{Red}) \\
    \text{Location}(x, \text{Office}_1) \leftarrow \text{Inside}(x, \text{Office}_1)
    \]

- **Learned Rule**:
  
  - Learned Rule:
    
    \[
    \text{MailToProf} A(x) \leftarrow \text{Inside}(x, \text{Office}_1) \land \text{Inside}(x, y) \land \text{Type}(x, \text{Mail}) \land \\
    \text{Type}(y, \text{Container}) \land \text{Color}(y, \text{Red})
    \]
Results

Virtual Humans: Evolving with Common Sense

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Memory Model

Virtual World
- Objects (with properties)
- Agents (with actions)
- Events (time, location)

Environment

Agent
- Body
- Central Control
- Perception
- Cue Register

Main Memory
- Working Memory
- Long-term Memory
  - Semantic Memory
  - Episodic Memory
  - Procedural Memory

STORE
RETRIEVAL
Future Work

• Optimizations
• Inclusion of additional phenomenon
• Learning of roles from a games environment (e.g. Pragbot 2)
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