WINOGRAD’S SHRDLU

Introduction

The Block World

Sample Dialogue

Specification of SHRDLU

Limitations of SHRDLU
INTRODUCTION

The process when we chitchat
- We use three kinds of knowledge: syntactic knowledge, semantic knowledge, and heuristic knowledge.

The significance of SHRDLU
- The head and shoulders above contemporary systems when it comes to intelligent conversation.

The component of SHRDLU
- A robot which has a hand, eye and the ability to manipulate toy blocks.
THE BLOCK WORLD
SAMPLE DIALOGUE

1. Pick up a big red block.
   OK.

2. Grasp the pyramid.
   I DON’T UNDERSTAND WHICH PYRAMID YOU MEAN.

10. Can a pyramid be supported by a block?
    YES

20. Grasp the block which support the pyramid.
    YES

21. Why did you put the pyramid on the table?
    To get rid of it.

22. Why did you get rid of it?
    To grasp the block.
SPECIFICATION OF SHRDLU(1/7)

The Representation of Meaning

- Not in spatial or analog terms, but a symbolic description.
- There is a data base of simple facts which is composed of the concepts.

<table>
<thead>
<tr>
<th>&lt;description&gt;</th>
<th>&lt;meaning&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>(IS B1 BLOCK)</td>
<td>→ B1 is a block</td>
</tr>
<tr>
<td>(SUPPORT B1 B2)</td>
<td>→ B1 supports B2</td>
</tr>
<tr>
<td>(CLEARTOP B2)</td>
<td>→ Clear off B2</td>
</tr>
<tr>
<td>(COLOR-OF B1 RED)</td>
<td>→ The color of B1 is red</td>
</tr>
<tr>
<td>(CAUSE EVENT27 EVENT29)</td>
<td>→ Event27 causes Event29</td>
</tr>
</tbody>
</table>
SPECIFICATION OF SHRDLU(2/7)

Procedural Description of Concept ‘CLEARTOP X’

- Go
- Does X support an object Y?
  - Yes: Get-rid-of Y
  - No: Assert that X is cleartop
SPECIFICATION OF SHRDLU(3/7)

Procedural Description of ‘GRASP X’

<Goal Stack>

(Grasp B1)
(Get-rid-of B2)
(Puton B2 Table1)
(Put B2 (453 201 0))

Is X manipulable?

- Yes
  - Are you already grasping X?
    - Yes: Succeed
    - No: Get-rid-of Y
  - No: Move to the top center of X

- No: Fail

Are you grasping another object Y?

- Yes: Get-rid-of Y
- No: Assert (grasping X)
Dictionary Definitions

- There must be ways to interpret the meanings of individual words and the syntactic structures. → *semantic markers*
- The program incorporates a variety of heuristics for deciding what part of the context is relevant.

(CUBE
  (NOUN (OBJECT
    (MANIPULABLE RECTANGULAR)
    (IS ? BLOCK)
    (EQUIDIMENSIONAL ?))))))

(CONTAIN
  (VERB((TRANSITIVE(RELATION
    ((CONTAINER)) ((PHYSICAL-OBJECT))
    (CONTAIN #1 #2))
    ((CONSTRUCT)) ((PHYSICAL-OBJECT))
    (PART-OF #2 #1))))))

*Pick up the cube*
*The box contains three pyramids*
*The stack contains a cube*
Syntactic Units Play a Primary Role in Determining Meaning.
SPECIFICATION OF SHRDLU(6/7)

Simple Grammar in Replacement Rule Form

\[
S \rightarrow NP + VP \\
NP \rightarrow \text{DETERMINER} + \text{NOUN} \\
VP \rightarrow \text{VERB}/\text{TRANSITIVE} + \text{NP} \\
VP \rightarrow \text{VERB}/\text{INTRANSITIVE}
\]

- Parse a NP
  - Yes
  - No
    - Parse a VP
      - Yes
      - No
        - Any words left?
          - Yes
          - No
            - Return success
    - RETURN failure

- Parse a VERB
  - Yes
  - No
    - Is it TRANSITIVE?
      - Yes
      - No
        - Parse a NP
          - Yes
          - No
            - Is it INTRANSITIVE?
              - Yes
              - No
                - Return success
    - RETURN failure

RETURN success
SPECIFICATION OF SHRDLU(7/7)

Program Organization
- The data base for heuristic, semantic analysis, syntactic structure
- The most important element is the interaction between these components.
- In SHRDLU, these three activities go on concurrently.

Ex) “Put the blue pyramid on the block in the box”
→ The parser first comes up with <the blue pyramid on the block>
→ A check is made in the data base for <the>
→ When fail, the parsing is redirected to find the NG <the blue pyramid>
→ If succeed, it will go on to find <on the block in the box>
LIMITATIONS OF SHRDLU

The Differences from Human Language Use
- We can interpret utterances which aren’t syntactically well formed. Ex) “terror, crash, hospital”
- We can interpret sentences syntactically even when they do not know the meanings of the individual words.

SHRDLU makes only the Most Primitive Use of Deduction.
- The heuristics in SHRDLU touch only the tiniest bit of the relevant knowledge.

Any attempt to model human language with simple semantic rules and heuristics is a bit like an attempt to model a complex system by using unrelated mathematical formula whose results are a general approximation to its output.