Parsing Natural Language commands to Robot control System

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Objective

- Convert natural language instructions into RCL.
- Language will be Hindi
- Grid navigation system.
- To analyze the success rate of the parser.
Previous Work

- By chen and money [6]
- By Shimizu and Hass [7].
Robot Control Language (RCL)

- Locations: room, junction, hallways
- Movement: move to, turn left / right
- Logic: and / or
- Loops: while, do n times, repeat until
- Verify
- Do sequentially
Example

sequentially

• Go left to the end of the hall

Go left to the end of the hall.”

(do sequentially
  (turn left
  (do until
    (or
      (not
        (exists forward loc))
      (room forward loc))
    (move to forward loc))))
Take a left, then the next right

Instruction

(Do-sequentially (turn-left) (turn-right))

Intent (abstract meaning)

Context (perceivable world state)

Grounding
Pairs of `<"NL command", (RCL-expression)>`

Training

Experiments
Parsing

- UBL (unification based learner)
- A probabilistic model of CCG
- CCG (combinatory categorical grammar)
- \(<x_i, y_i>\)
- where \(x_i\) : natural language
- And \(y_i\) : corresponding semantic language sentence.
Softwares to be used

- KRISP (open source) for natural language parsing
- This converts languages strings into CFG (context free grammar)
- GridSim (for grid simulator)
Example

- Go to the second junction.
- S/NP NP/NP NP/N
- (move-to-forward) (null) (do n times 2x)
- Finally do-seq(do-n-times 2 until junction current loc))
Data sets and maps

- Maps would be created by a grid navigation software (GridSim).
- \( S_{\text{base}} = 150 \) sentences (30 participants)
- \( S_{\text{enriched}} \) : 20 complex ones (having avg. 4 or more NL instructions).
- \( S_{\text{test}} \) : selecting any 10 (including at least 4 complex NL) and their combinations.
- \( S_{\text{training}} = S_{\text{enriched}} - S_{\text{base}} \)
Success Rate

- Success rate of [1] is 49 % for complex NL instructions.

- And 66 % for simple NL instructions.
References

1. Learning to Parse Natural Language Commands to a Robot Control System Cynthia Matuszek, Evan Herbst, Luke Zettlemoyer, Dieter Fox


5. Luke Zettlemoyer and Yoav Artzi Learning to Recover Meaning from Unannotated Conversational Interactions


7. Learning to Follow Navigational Route Instructions Shimizu and Hass
Questions ?
• Learning a lexicon:
• Algorithm:
  – (e1, p1) ........... (en, pn)
    where e1 = navigation instruction
  – Where p1 = navigation plan
• W → (e1 , ............en)
• Keep taking top k elements and add it to
• Meanings(w).