Programming by Demonstration with Situated Semantic Parsing

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Programming by Demonstration

- Teaching the robot new skills
- Kinesthetic demonstrations
- Natural language interface

[Cakmak and Takayama 2014]

Semantic Parsing

at the chair, move forward three steps past the sofa

$$\lambda a.pre(a, \iota x.chair(x)) \wedge move(a) \wedge len(a, 3) \wedge dir(a, forward) \wedge past(a, \iota y.sofa(y))$$

Situated Semantic Parsing

"close left hand"

$$\lambda a.close(a) \wedge patient(a, \mathcal{A}(\lambda x.hand(x) \wedge left(x)))$$

close-left-hand

Situated Semantic Parsing

"close"

$\lambda a.close(a)$

close-right-arm
close-right-hand
close-action
close-left-hand
…

?

Situated Semantic Parsing

"close"

Use the system state to disambiguate

$\lambda a.close(a)$

close-right-arm
close-right-hand
close-action
close-left-hand
…

Situated Semantic Parsing

"close"

$\lambda a.close(a)$

close-right-arm
close-right-hand
close-action
close-left-hand
…

Use the system state to disambiguate

- The close action can only be applied to hand objects

Situated Semantic Parsing

"close"

$\lambda a.close(a)$

~~close-right-arm~~
close-right-hand
~~close-action~~
close-left-hand
…

Use the system state to disambiguate

- The close action can only be applied to hand objects

- Infer salient objects from recent actions

Situated Semantic Parsing

"close"

Bi-modal interaction

$\lambda a.close(a)$

close-right-arm
close-right-hand
close-action
close-left-hand
…

Verbal Instruction

Physical Manipulation

Robot command