Talking to Robots

Speech-Directed Motion Planning

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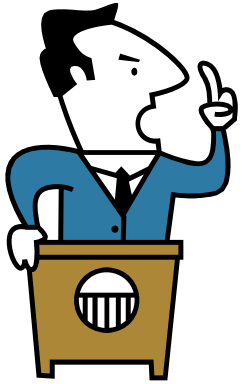
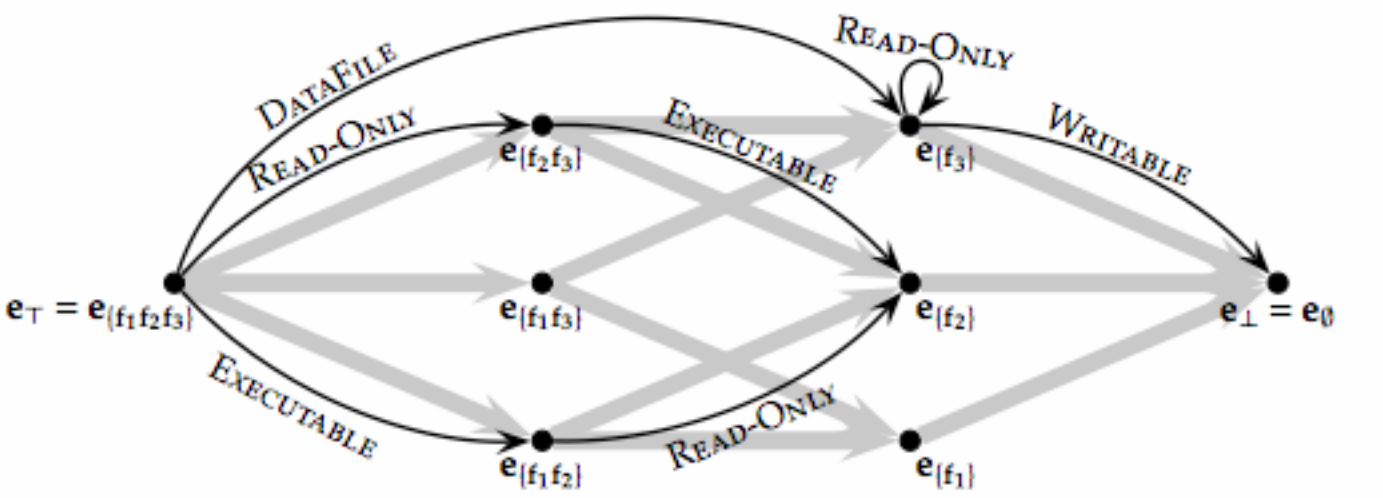
SUNFEST 2008

Project Goals

- Economy of spoken commands
- Customization with little programming



- Spoken Language Understanding Shell (SLUSH)
- Interactive language model
- No training or learning



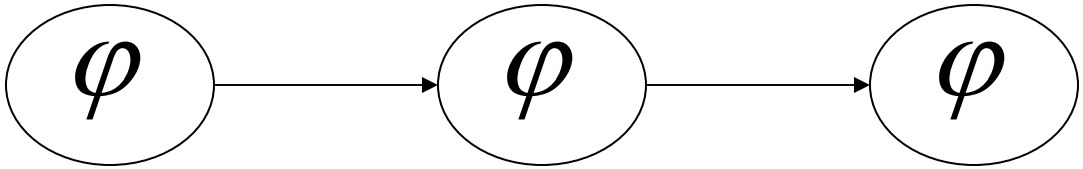
What SLUSH does

- Most Likely Sequence (MLS) output every 10ms

```
[GO,den.office]STA/N_PP;[IDENT,e0]N/den;;/N_SIL? 5
```

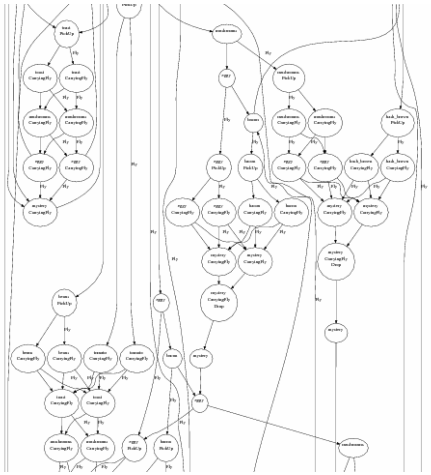
1 2

Linear Temporal Logic

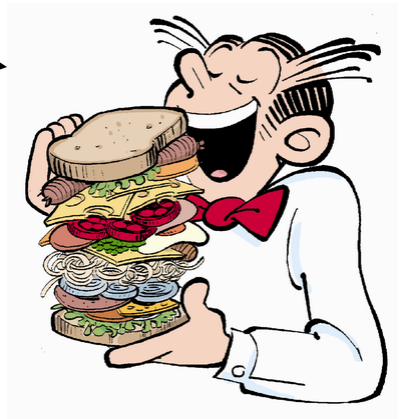


$\bigcirc\varphi$	True if φ is true in the next state
$\varphi_1 \mathcal{U} \varphi_2$	True if φ_1 is true until φ_2 becomes true
$\Diamond\varphi$	True if φ is true in some next state
$\Box\varphi$	True if φ is true in every next state

- Linear Temporal Logic Motion Planner (LTLMop)
- Structured English => Controller



If you are sensing Sandwich then do Eat



Linking SLUSH and LTLMop

- Grammar and Lexicon files
- Pronunciation file
- MLS processing

Grammar and Lexicon

Go to the room.

```
G N -> (ROOM) room
G NP -> the N
G Simp -> go to NP (GO)

L GO : (source-set)
L ROOM : (set-of-all i in (source-set) s-t ((ilk of i) is (room)))
```

If-Then grammar and lexicon

If you see the sign, go to the room.

```
G Sind -> you see NP
G PPcond -> if Sind (IF)
G Simp -> PPcond Simp
G N -> (SIGN) sign

L IF : (context-set)
L SIGN : (set-of-all i in (source-set) s-t ((ilk of i) is (sign)))
```

MLS processing

- Throw away phonetic transitions
- Cross-reference in pronunciation file for words
- Extract referents and locations

```
[GO,e0.e1]STA/N_PP*;[IDENT,e0]N/room;;/R_UW_M_SIL? 2

...[IF-SEE,e12]PPcond/PP_PP*;[INPRIME,e0]PP/sil;;/S_AA_IH_N_SIL? 3
```

Linking to LTLMop

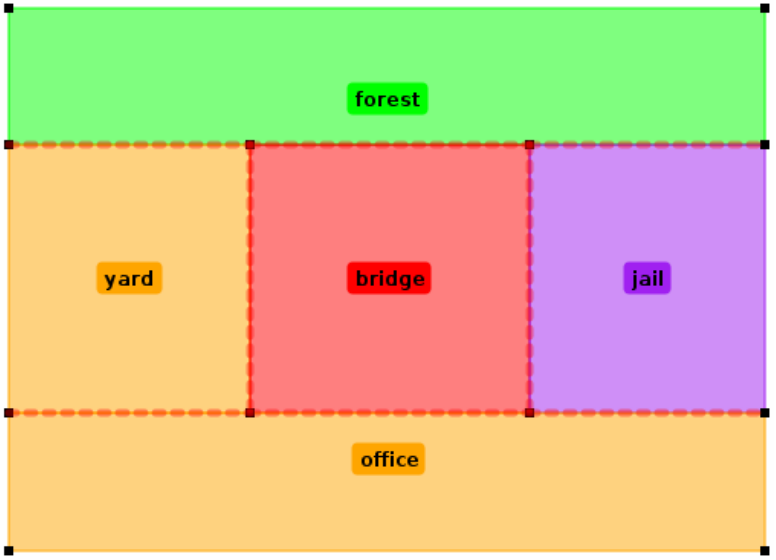
- Identify the kind of command
- Choose appropriate template sentences

If you are in Location1, go to Location2

```
1. If you are in Location1 then do Location1Flag
2. If you activated Location1Flag and you were not in Location2
   then do Location1Flag
3. {If you are activating Location1Flag then visit Location2}
4. If you were in Location2 do not Location1Flag
```

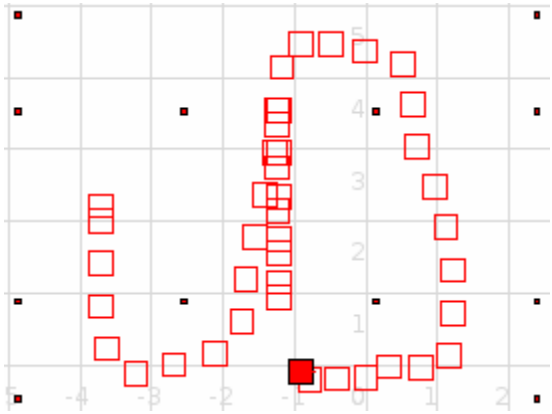
If you see the alarm in the office, catch the convict in the forest.

If you catch the convict in the forest, lock him up in the jail.



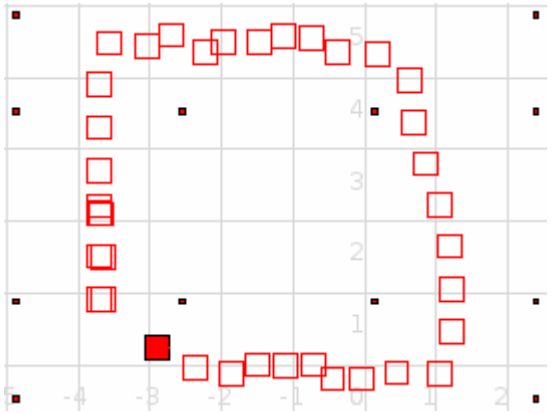

```
Environment starts with false
Robot starts with false

Visit yard
Visit forest
Visit office
Visit jail
Visit bridge
```



```
Environment starts with false
Robot starts with false

Visit yard
Visit forest
Visit office
Visit jail
Always not bridge
```



Results

- Expressivity

IF	**THEN**
SENSOR [in LOCATION_1]	go to LOCATION_2
in LOCATION_1	ACTION_2 [in LOCATION_2]
ACTION_1 [in LOCATION_1]	

- Objectives met

Acknowledgments

My advisors

William Schuler (University of Minnesota)

The SUNFEST program

Images from

http://b-bcs.com/

http://mohitdhawan.blogspot.com/2005_04_01_archive.html

http://scary-manilow.livejournal.com/