MICHIGAN STATE UNIVERSITY

LAIR

Playing a Naming Game with Darwin: Towards Human-Robot Dialog

Presented by Kenneth Hanson

Language and Interaction Research Group (LAIR),
Dept. of Computer Science and Engineering

MICHIGAN STATE UNIVERSITY

LAIR

Introduction

- LAIR's areas of research:
  - Natural language processing
  - Human-robot interaction
- Project Collaborators:
  - Joyce Chai (director)
  - Changsong Liu
  - Rui Fang
  - Lanbo She
  - Caitlin McDonald

DARwIn-OP

- Produced by Robotis, Inc.
- Components:
  - FitPC main controller
  - CM-730 sub-controller
  - 20 Dynamixel actuators
  - Integrated camera, microphone, speakers, and wireless networking

http://www.youtube.com/watch?v=tJpvahsOkRM

MICHIGAN STATE UNIVERSITY

LAIR

Current Project

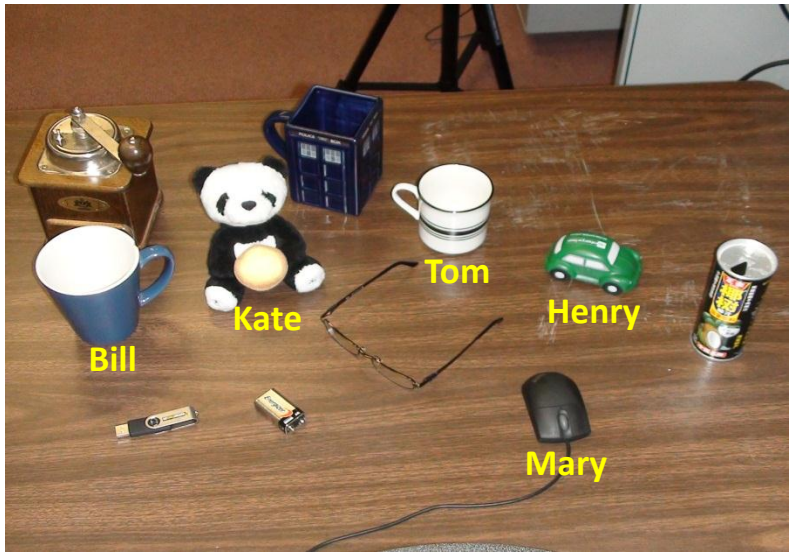
- Research problem: situated human-robot dialog
- Example task: a naming game

MICHIGAN STATE UNIVERSITY

LAIR

Current Project

- Research problem: situated human-robot dialog
- Example task: a naming game



Semantic Processing

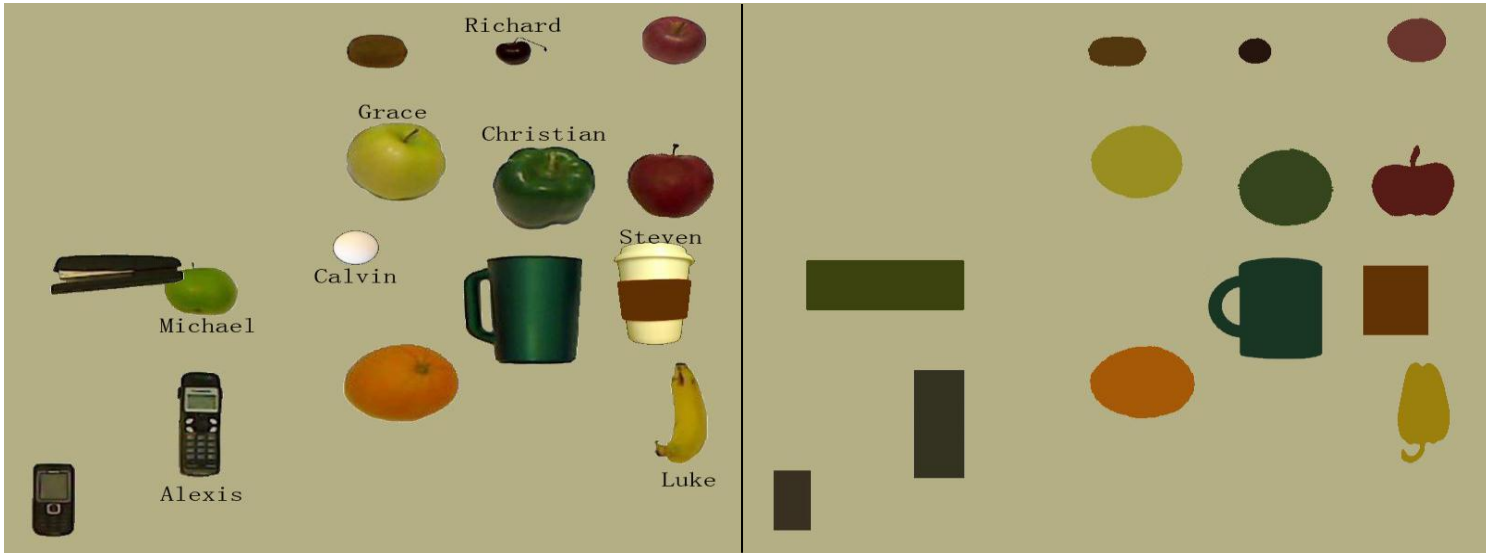
- Need to define a formal representation for the meaning of an utterance.
- Our model uses two subcomponents: *intention* and *attention*.
- Ex. “The blue cup to the left is called Bill.”
  - Intention:
    - Function: statement
    - Subcategory: describe object properties
  - Attention:
    - Entities: x
    - Constraints: isa(x, “cup”), color(x, “blue”), location(x, “left”), name(x, “Bill”)

Referential Grounding

- Problem: How to match referents in the discourse with the objects in the scene?
- An extra challenge: object recognition is often imperfect.

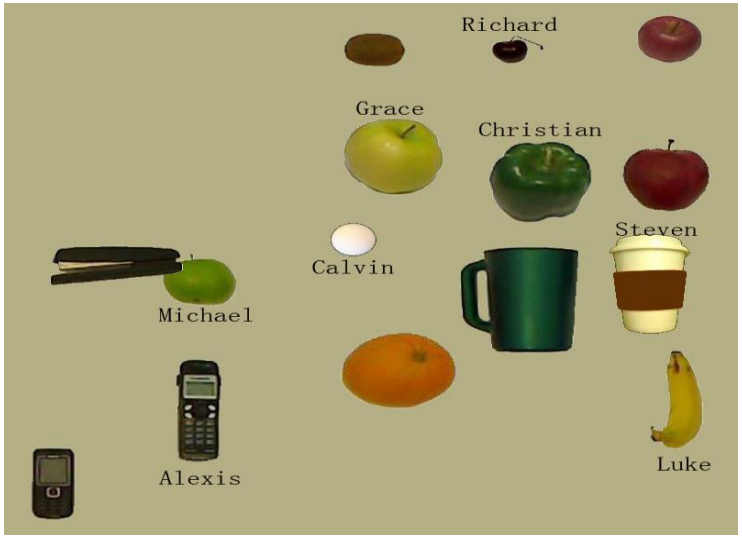
Original Scene

Robot's View



Language Graph

D: the very top right hand corner, there is a red apple
M: ok
D: and then to the left of that red apple on the top of the screen is a red or black cherry
M: ok
D: and then to the left of that is a brown kiwi fruit
M: ok
D: and the, the red cherry is called Richard

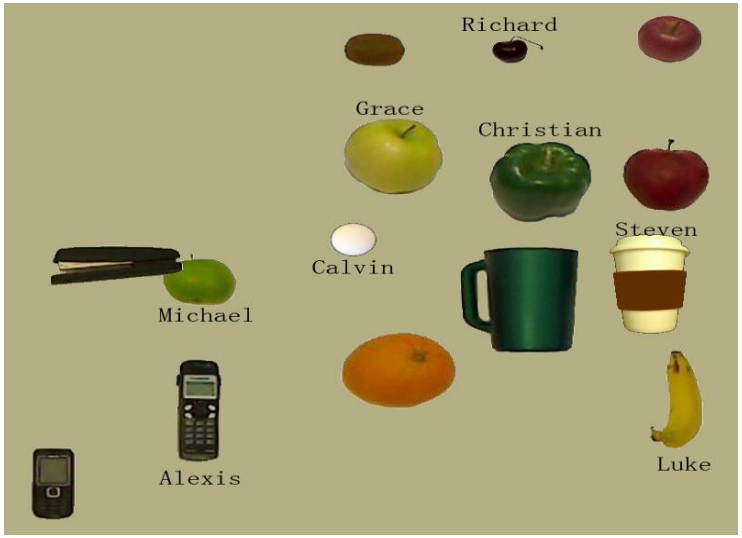


Language Graph

D: the very top right hand corner, there is a red apple
M: ok
D: and then to the left of that red apple on the top of the screen is a red or black cherry
M: ok
D: and then to the left of that is a brown kiwi fruit
M: ok
D: and the, the red cherry is called Richard

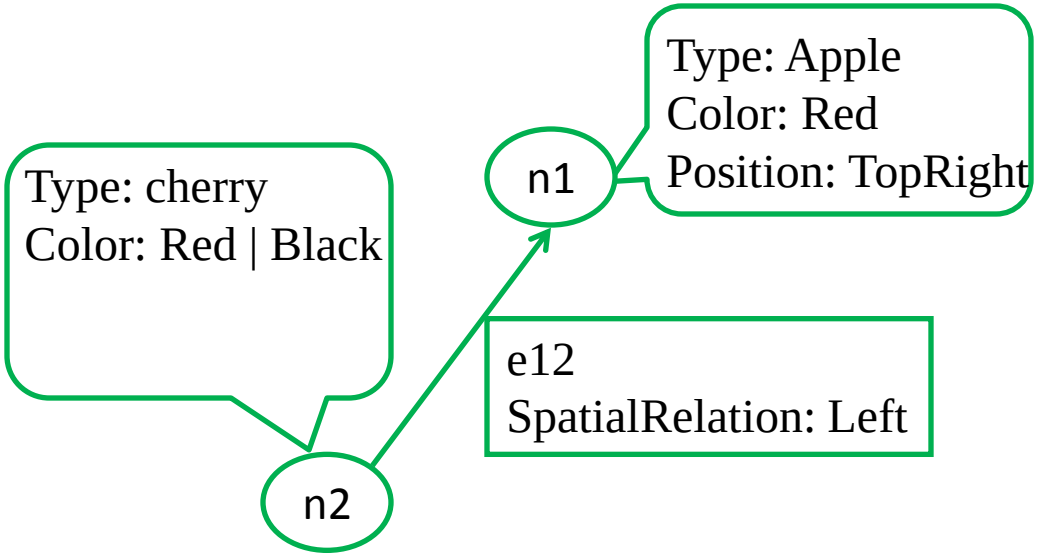
n1

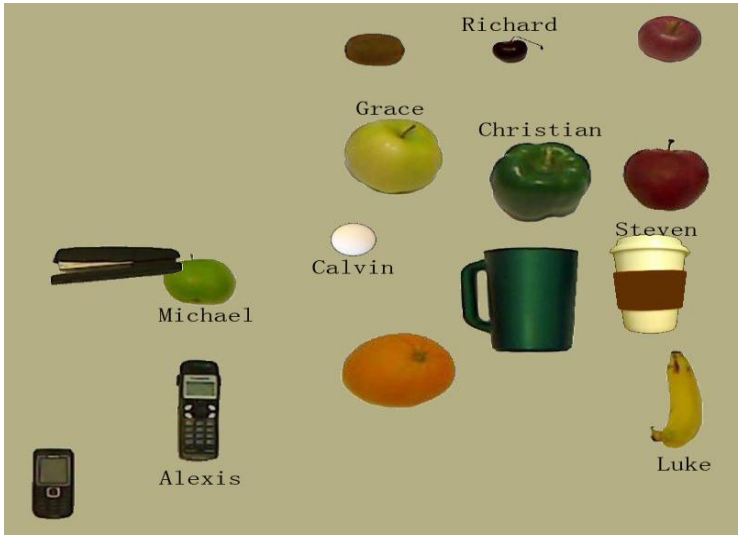
Type: Apple
Color: Red
Position: TopRight



Language Graph

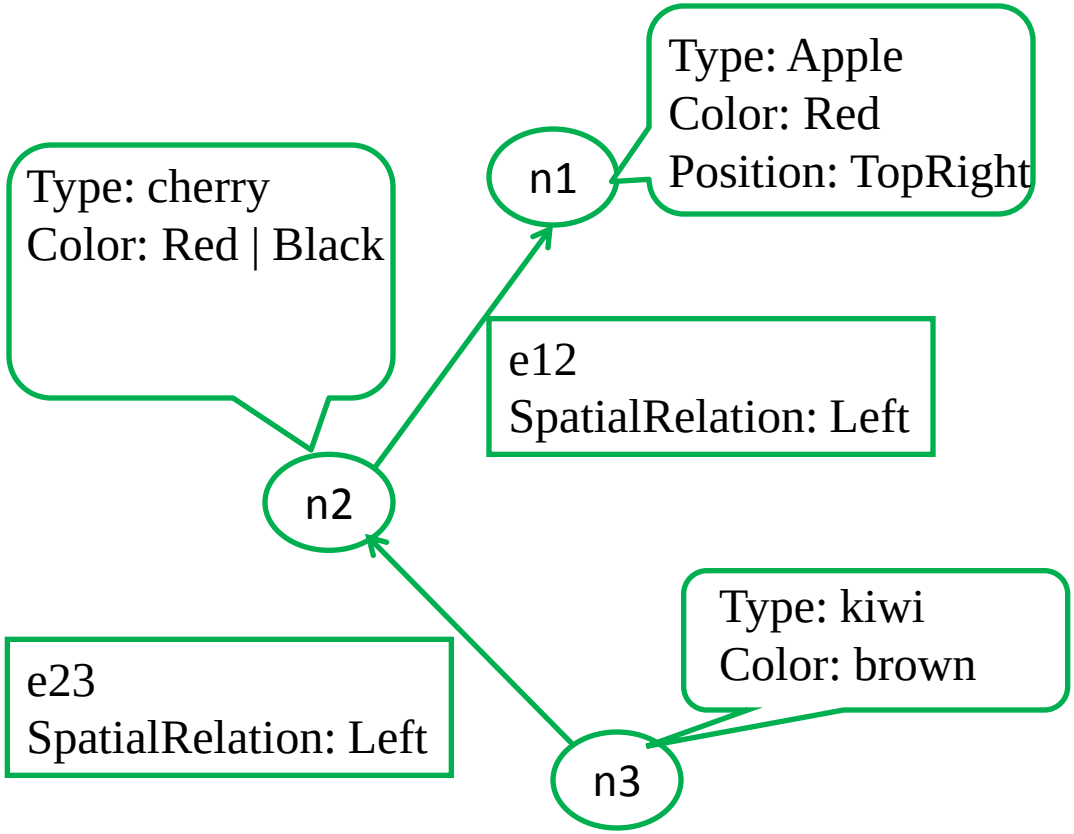
D: the very top right hand corner, there is a red apple
M: ok
D: and then to the left of that red apple on the top of the screen is a red or black cherry
M: ok
D: and then to the left of that is a brown kiwi fruit
M: ok
D: and the, the red cherry is called Richard





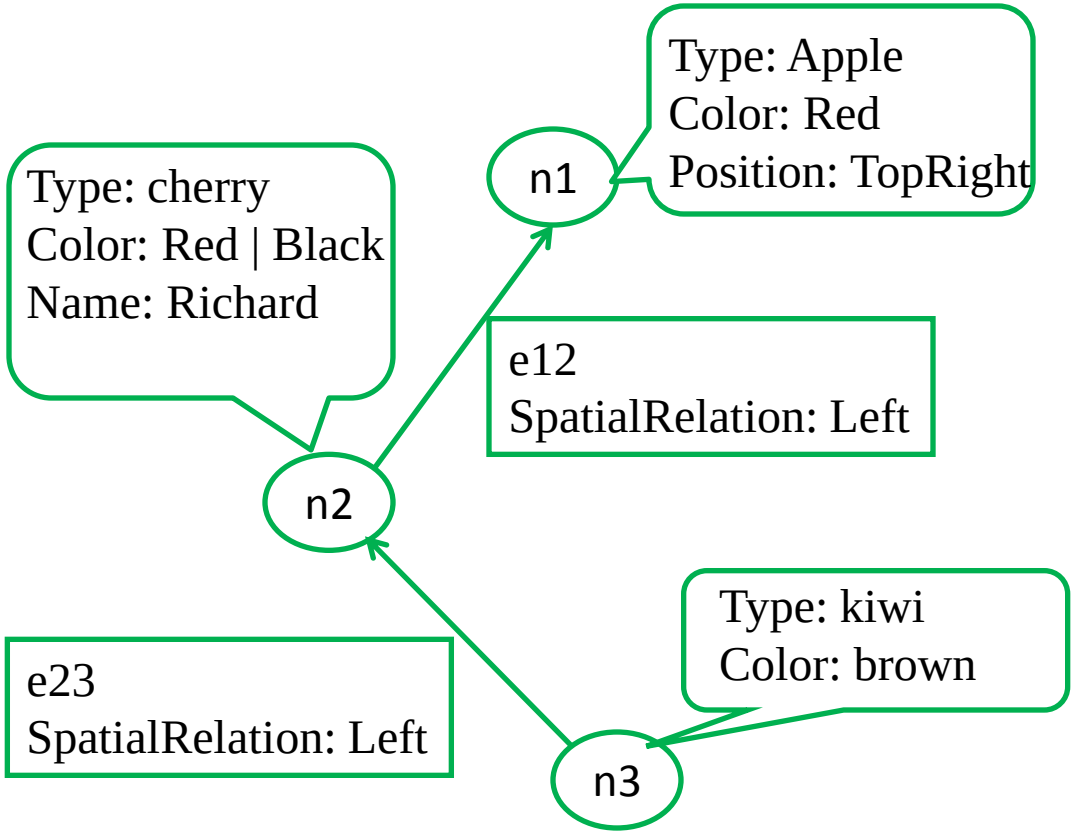
Language Graph

D: the very top right hand corner, there is a red apple
M: ok
D: and then to the left of that red apple on the top of the screen is a red or black cherry
M: ok
D: and then to the left of that is a brown kiwi fruit
M: ok
D: and the, the red cherry is called Richard



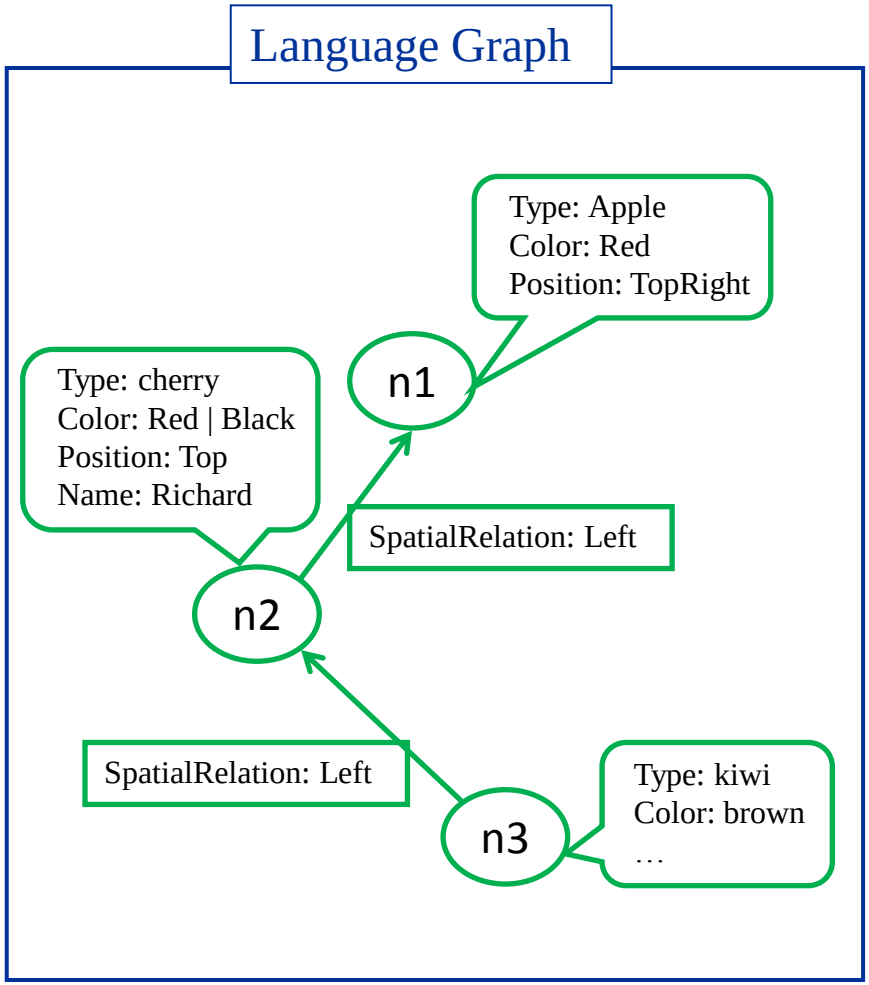
Language Graph

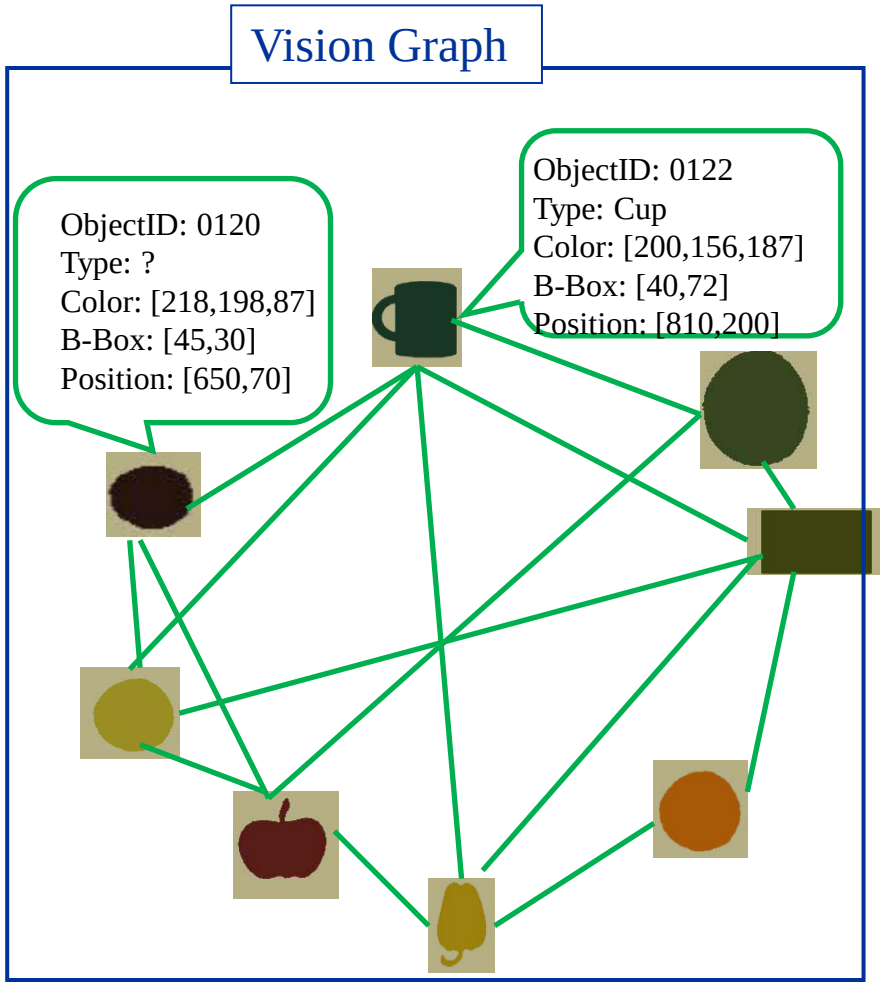
D: the very top right hand corner, there is a red apple
M: ok
D: and then to the left of that red apple on the top of the screen is a red or black cherry
M: ok
D: and then to the left of that is a brown kiwi fruit
M: ok
D: and the, the red cherry is called Richard



Graph Matching

- Now apply graph matching with the vision graph.





Coreference

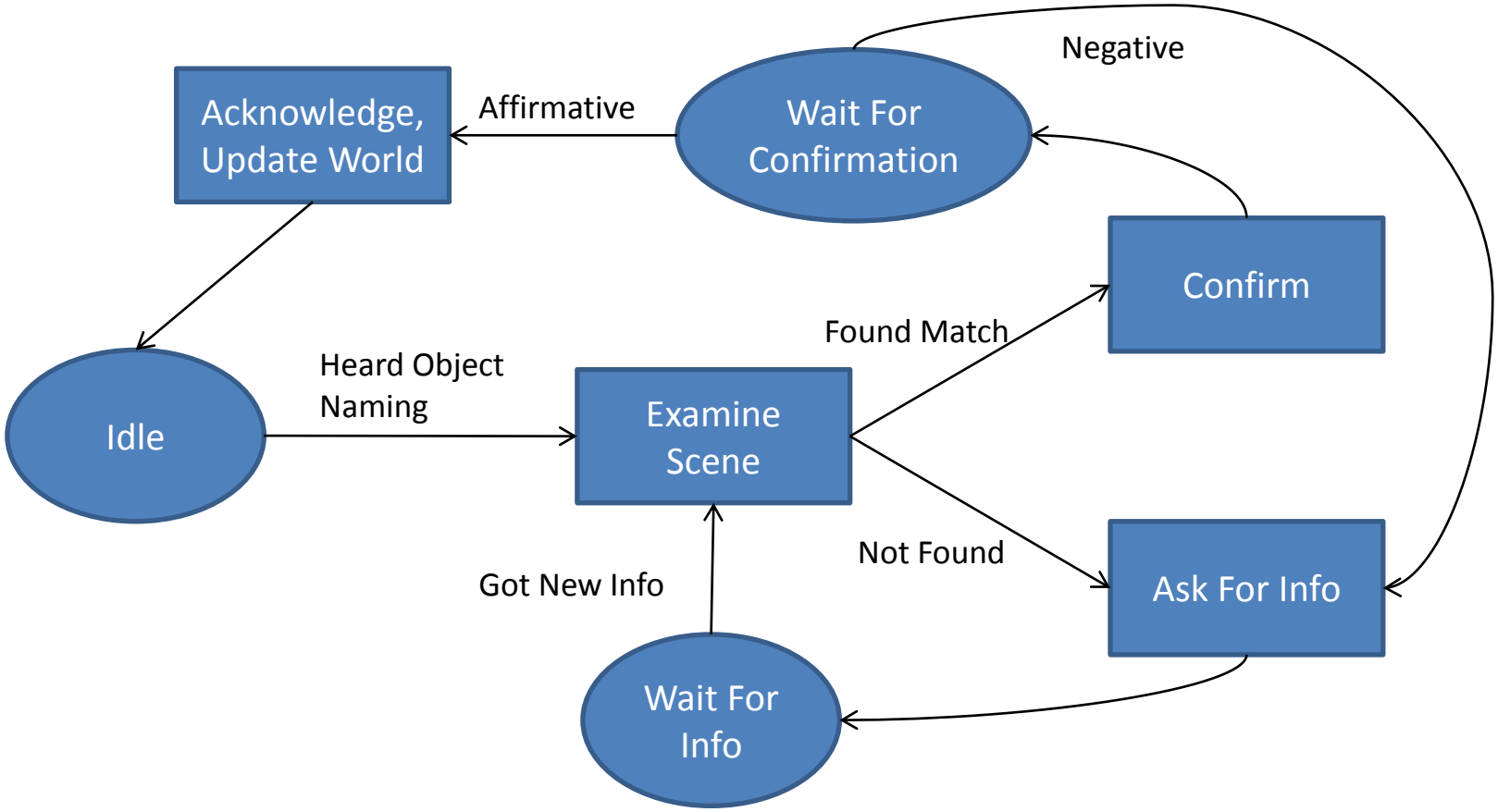
- *Coreference* – where multiple expressions refer to a single entity
- *Example:*
  1. H: **The cup** on your left is named Bill.
  2. R: I see **something** blue there.
  3. R: Is **that** a cup?
  4. H: Yes, **that**'s a cup.
  5. H: **It**'s name is Bill.
  6. R: Okay.

Dialog Management

- Two problems:
  - What should the robot do when he hears an utterance? (Response generation)
  - The meaning of an utterance often depends on previous discourse. (Utilizing dialog history)

Dialog Management

- Implemented as a state machine



Dialog Management

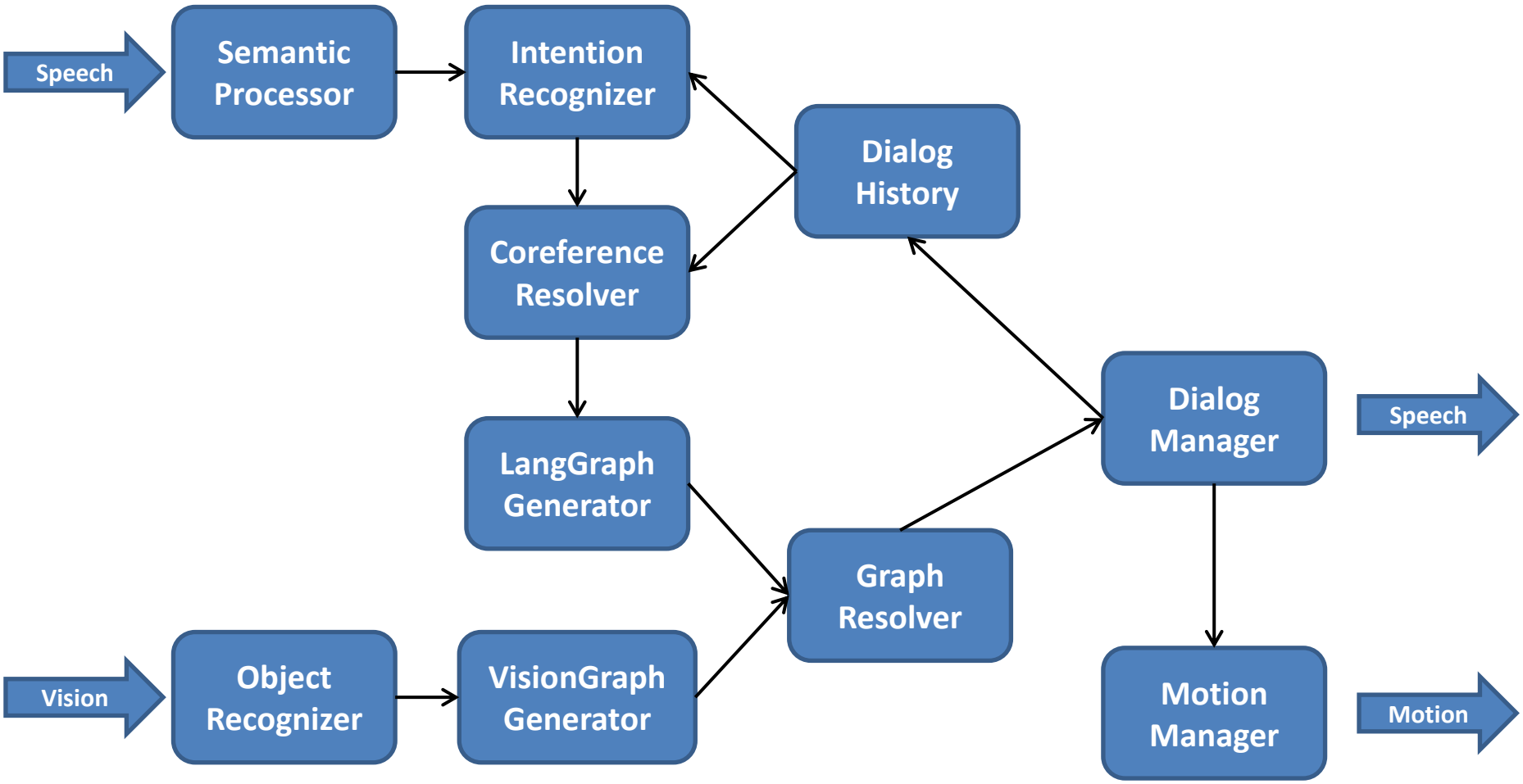
An example discourse:

Turn	Speaker	Utterance	Function	Subcategory
1	H	The cup on your left is called Bill.	Statement	DescribeObjProp
2	R	I see something blue there.	Statement	DescribePercep
3	R	Is that an cup?	Question	Y/N
4	H	Yes, that's a cup.	Answer	Yes
			Statement	DescribeObjProp
5	H	It's name is Bill.	Statement	DescribeObjProp
6	R	Okay.	Signal Understanding	--

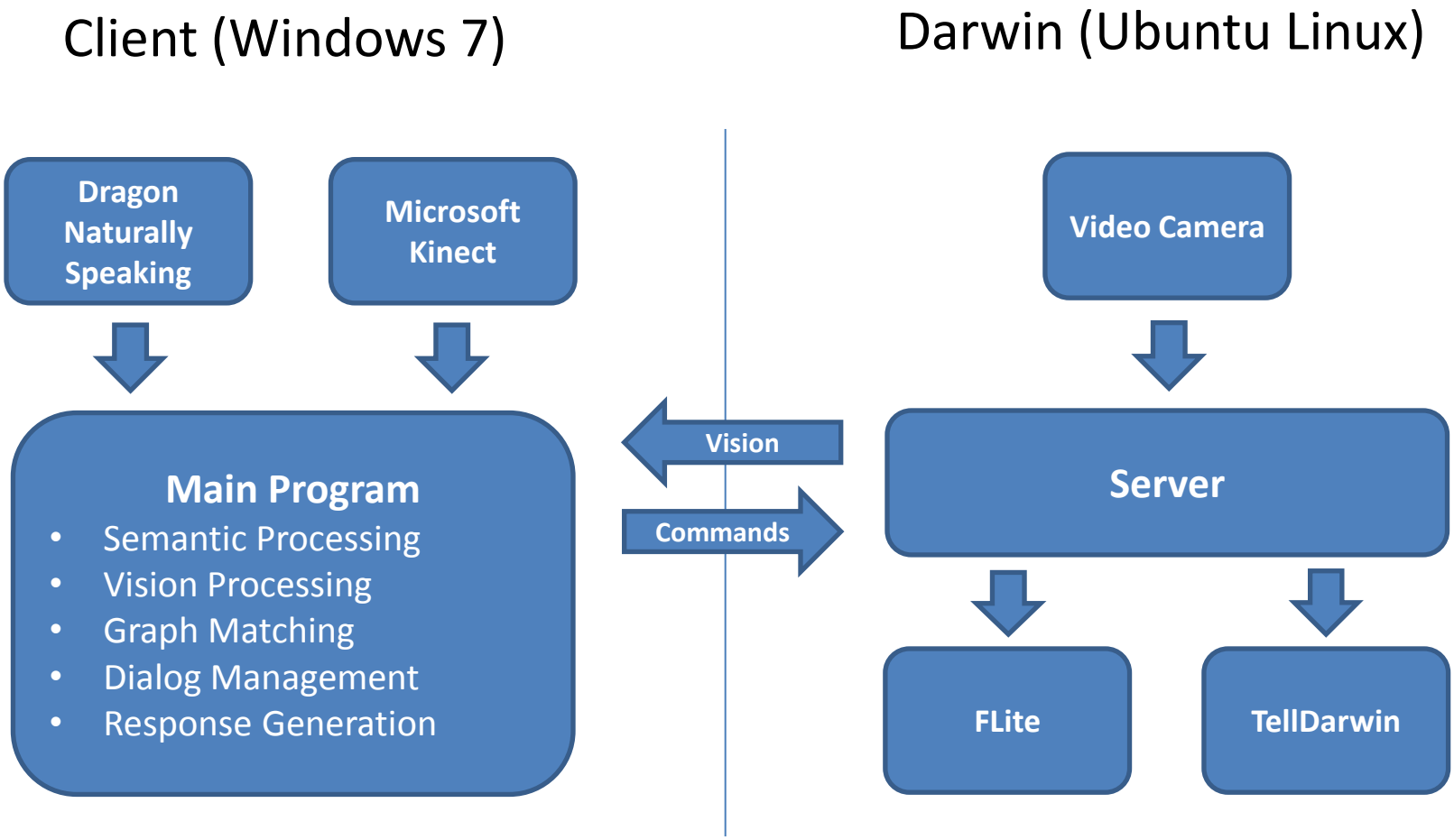
MICHIGAN STATE UNIVERSITY

LAIR

Program Design



Program Design



Future Research

- Starting in Fall 2012, we will be recruiting participants to play the naming game with Darwin. (Any volunteers?)
- We will refine our list of speech functions for tagging intention.
- The simple state machine used in the current dialog manager will likely be replaced with a probabilistic system.

Links

- LAIR website:
  http://links.cse.msu.edu/lair/
- DARwIn-OP website:
  http://darwin-op.springnote.com/