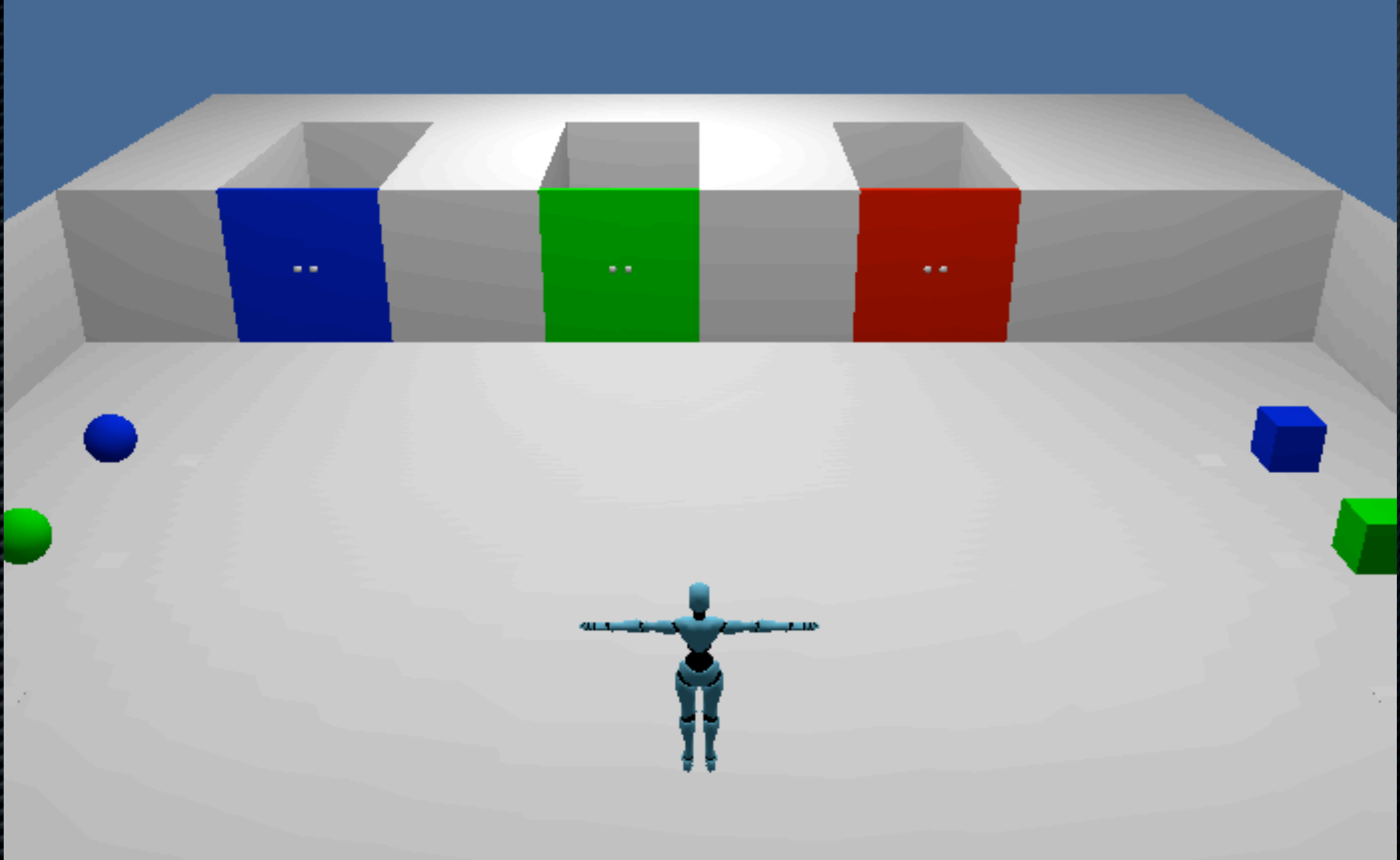


Using Spatial Context and Clarification Questions to Interpret Natural Language Commands

Joe Plaus

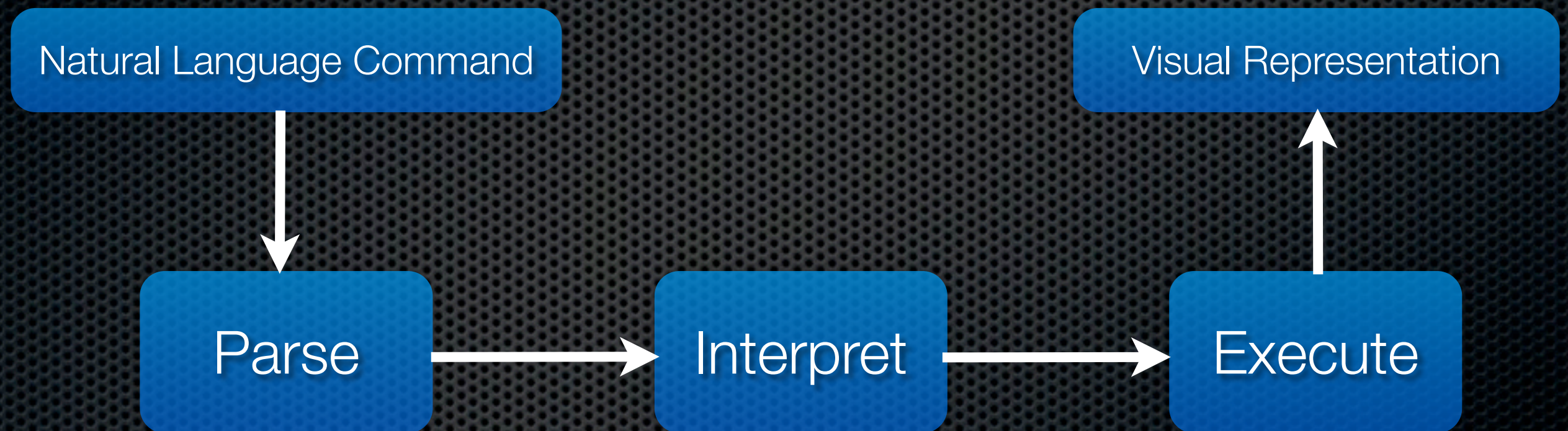
Advisor: Prof. Striegnitz



Background

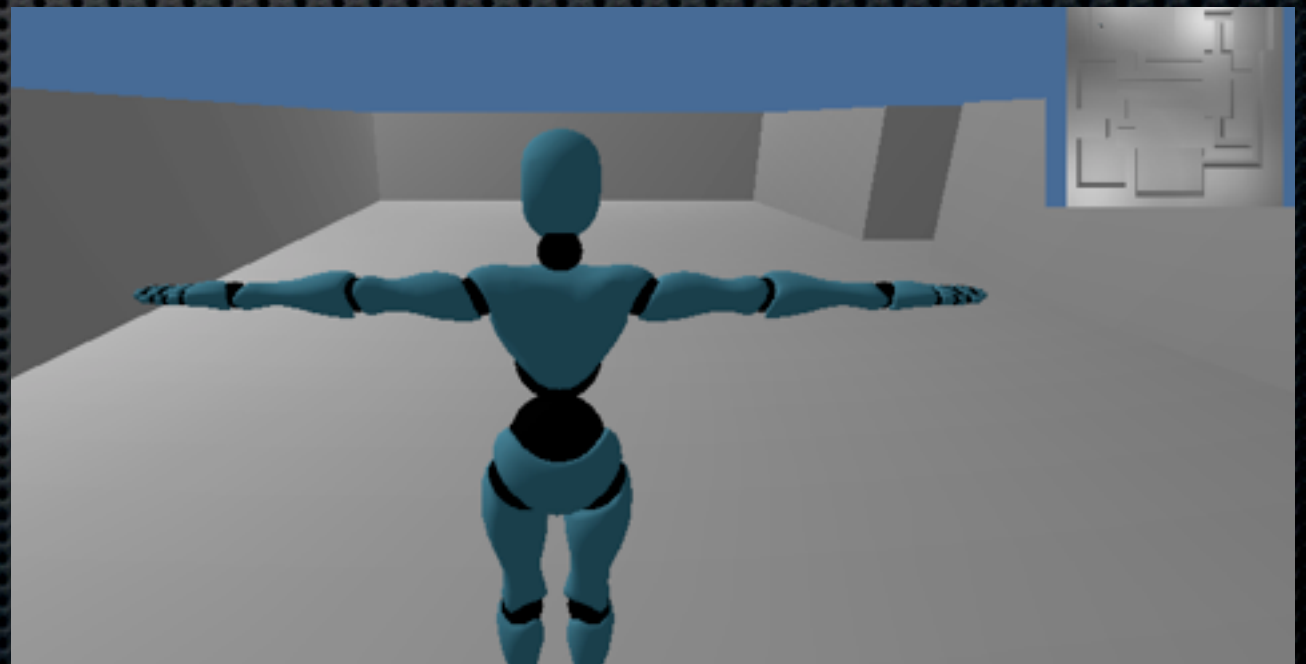
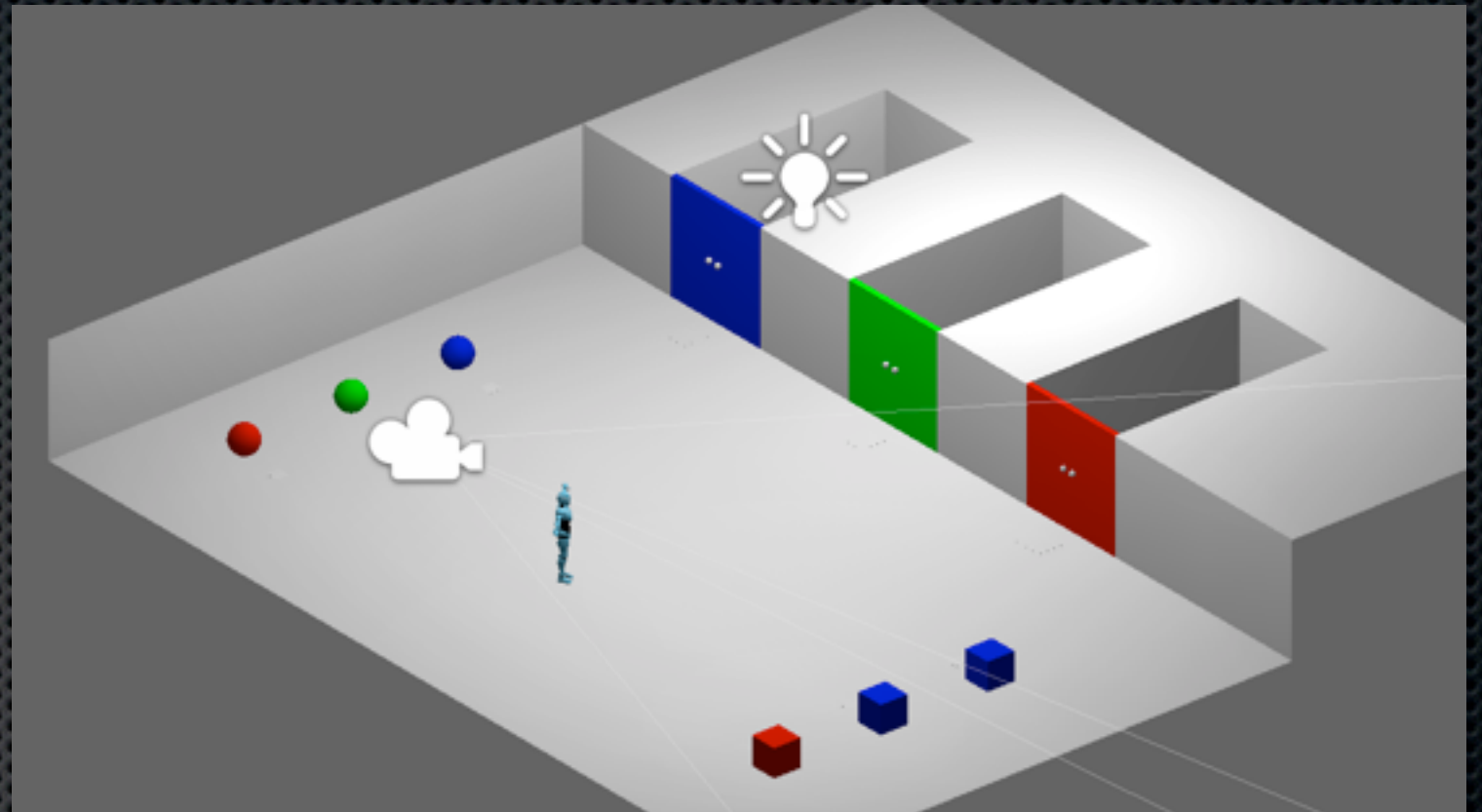
- ✦ Natural Language Command Systems
- ✦ Previous Systems
 - ✦ *“Understanding Natural Language Commands For Robotic Navigation and Mobile Manipulation”*
by **Stefanie Tellex**
- ✦ Explicit vs. Ambiguous Commands
- ✦ How should a system interpret ambiguity?
- ✦ Why is this important?

System Overview



3D Environment

- ✧ Unity Game Engine
- ✧ Room Layout
- ✧ Robot
- ✧ Moveable Objects
- ✧ C# Behavior Scripts



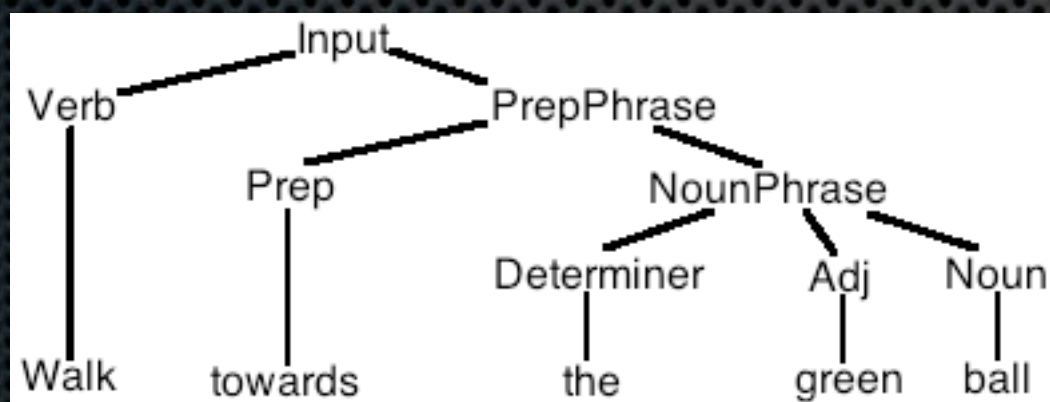
Parsing the Command

- ✦ Three types of commands
- ✦ Why parse the command?
- ✦ Context-Free Grammars and the Natural Language ToolKit for Python
- ✦ Semantic vs. Syntactic Parsing
- ✦ What is the result?

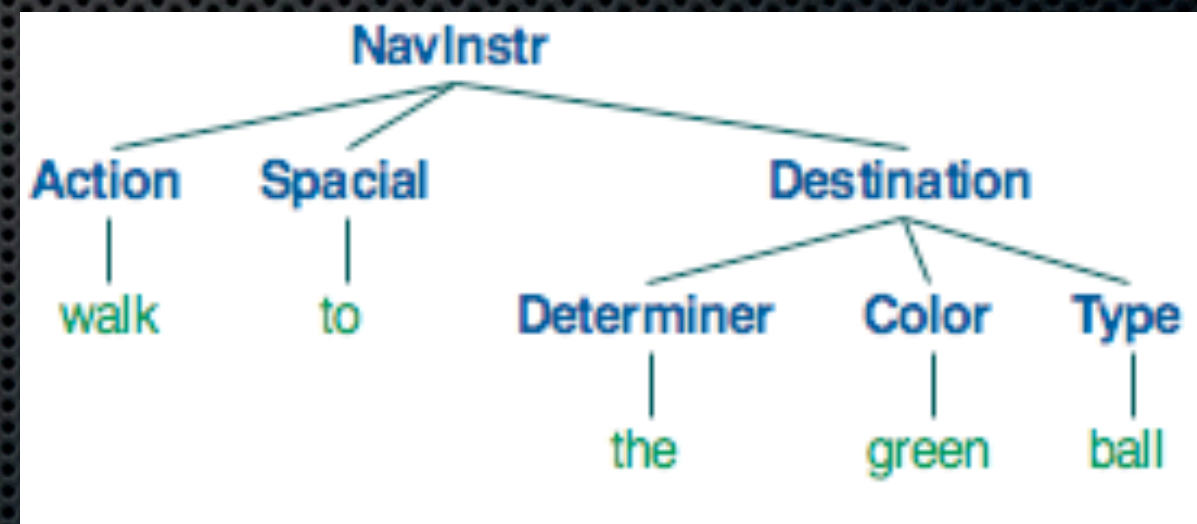
Parsing the Command

Basic Command: *“Walk towards the green ball”*

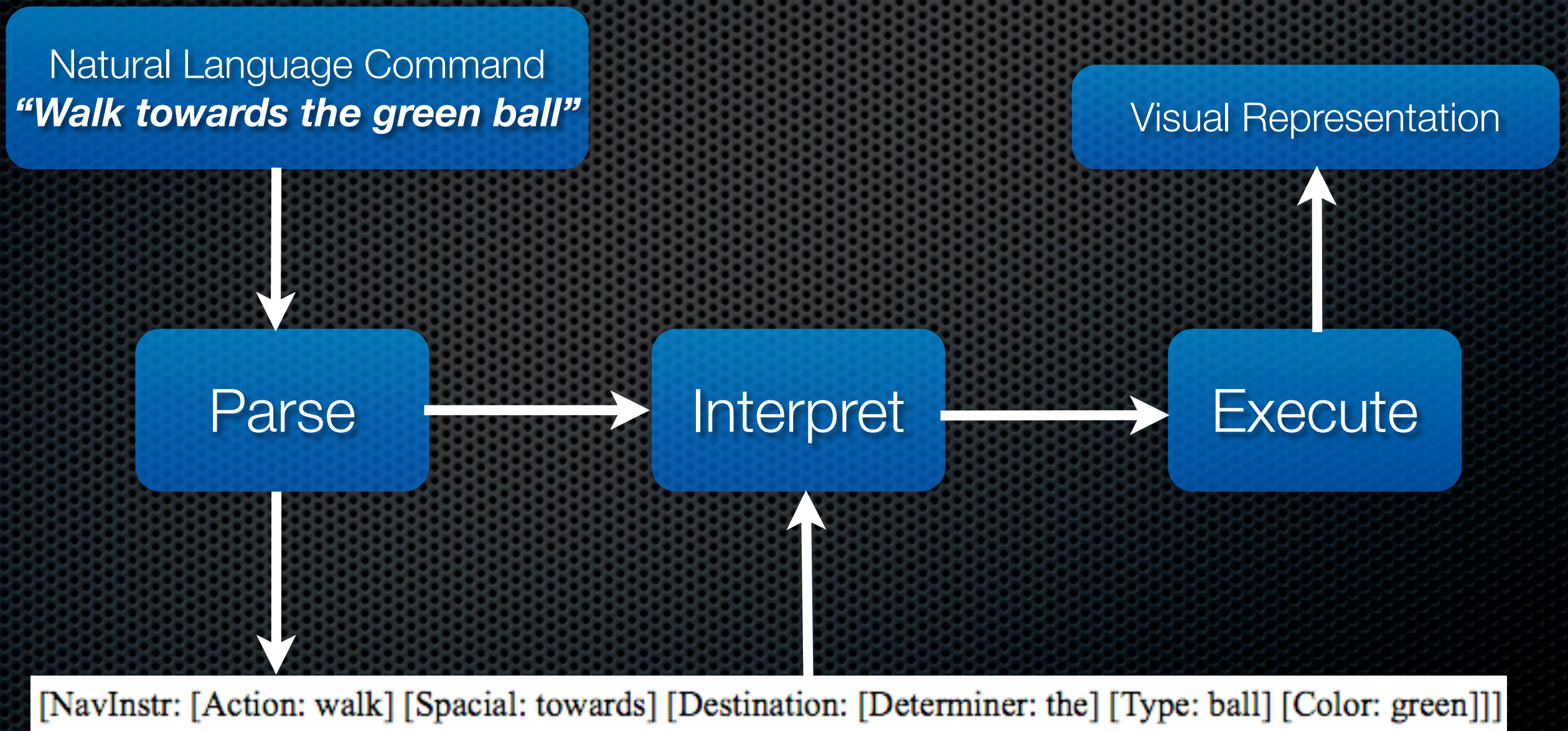
Syntactic Approach



Semantic Approach



System Overview



Interpreting the Parsed Command

- Three Main Components:

- Command object

- Command Manager

- Command Processor

- Navigational, Operational, or Response command?

- Explicit or Ambiguous?

Where are we going?

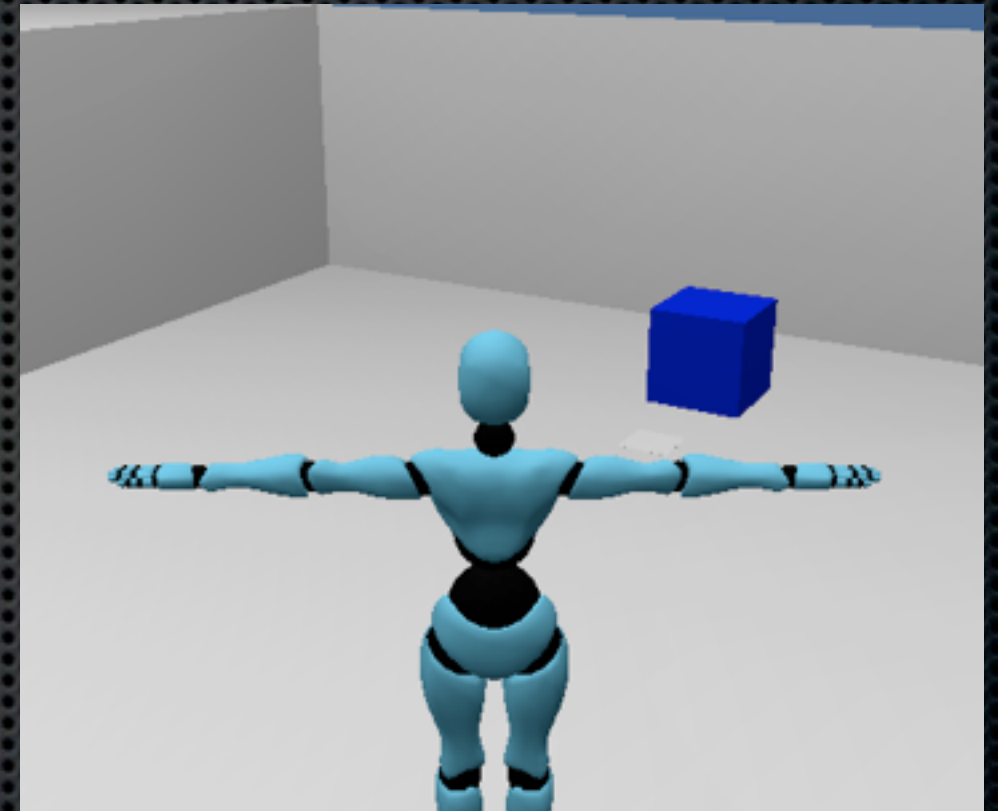
What is the operation?

What object to manipulate?

What was the previous command?

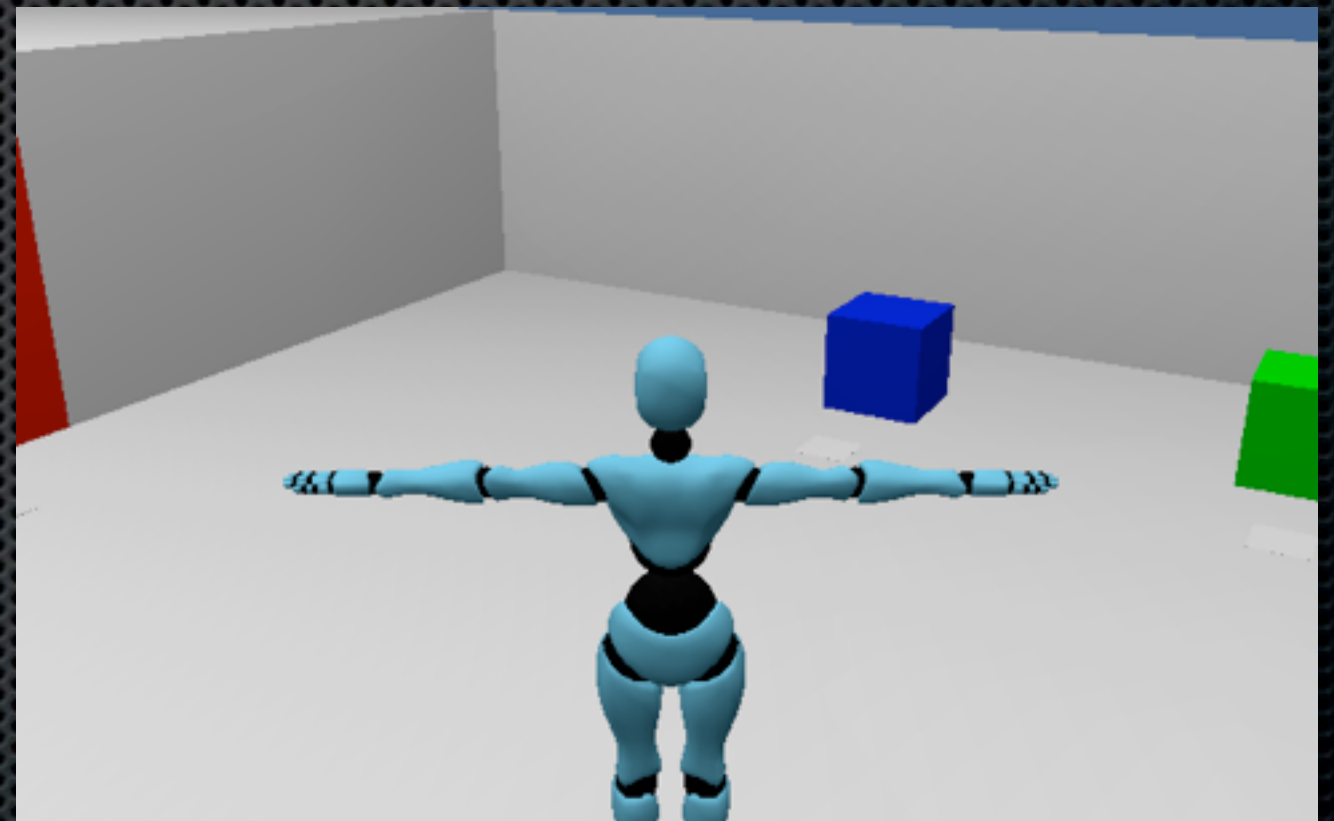
Interpreting Explicit Commands

- ✦ Basic Commands
- ✦ Complex Commands
 - ✦ Destination or Object is determined
 - ✦ Type?
 - ✦ Color?
 - ✦ Can the user see only one object that fits the description?
 - ✦ Is it the only object of that configuration in the environment?

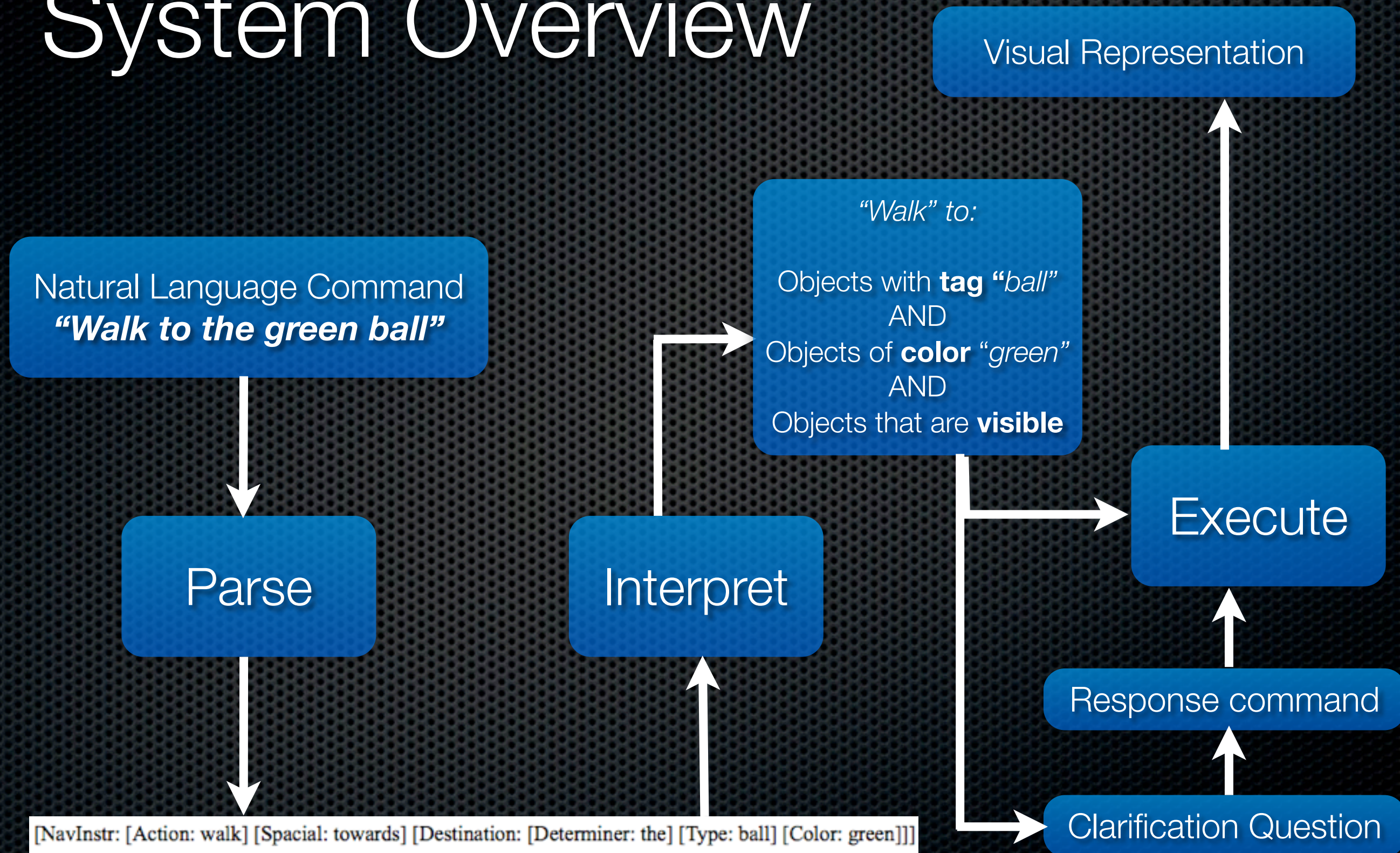


Interpreting Ambiguous Commands

- ✦ Example: *“Pick up the box”*
- ✦ Which box?
- ✦ Saliency
 - ✦ Proximity
 - ✦ Field of View location
- ✦ Clarification Question
- ✦ Response Command



System Overview



Executing the Command

- ✦ Defining Robot Behavior
- ✦ Movement functions
- ✦ Operation functions
 - ✦ Trigger Animations

Testing and Evaluation

- ✦ Testing:
 - ✦ Basic Functionality
 - ✦ How does it handle ambiguity?
 - ✦ Communication between components
- ✦ Evaluation:
 - ✦ Functionality vs. Utility
 - ✦ Is this new ability helpful?
 - ✦ System Comparison

Future Work

- ✧ Environment complexity
- ✧ Command complexity
 - ✧ Context-Free Grammar expansion
 - ✧ Multiple commands
- ✧ Additional attributes for salience calculation

Thank You