

# 6.01

## Lecture 14: Wrap-Up

Lecturer: Adam Hartz ([hartz@mit.edu](mailto:hartz@mit.edu))

### As you come in...

- Grab one dhounat  
(if you have filled out your subject evaluation)

<http://mit.edu/subjectevaluation/>

## 6.01: A Look Back

---

The **intellectual themes** in 6.01 are recurring themes in engineering:

- design of complex systems
- modeling and controlling physical systems
- augmenting physical systems with computation
- building systems that are robust to uncertainty

In short, 6.01 is about **engineering design**.

system

behavior

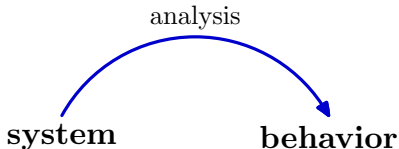
## 6.01: A Look Back

---

The **intellectual themes** in 6.01 are recurring themes in engineering:

- design of complex systems
- modeling and controlling physical systems
- augmenting physical systems with computation
- building systems that are robust to uncertainty

In short, 6.01 is about **engineering design**.



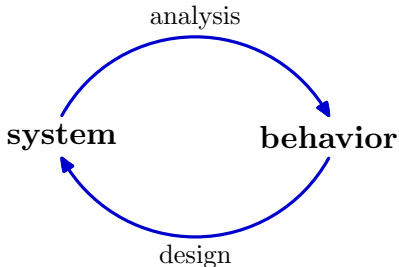
## 6.01: A Look Back

---

The **intellectual themes** in 6.01 are recurring themes in engineering:

- design of complex systems
- modeling and controlling physical systems
- augmenting physical systems with computation
- building systems that are robust to uncertainty

In short, 6.01 is about **engineering design**.



## 6.01: A Look Back

---

6.01 is organized into four modules:

- Signals and Systems
- Circuits
- Probabilistic Reasoning
- AI / Algorithms

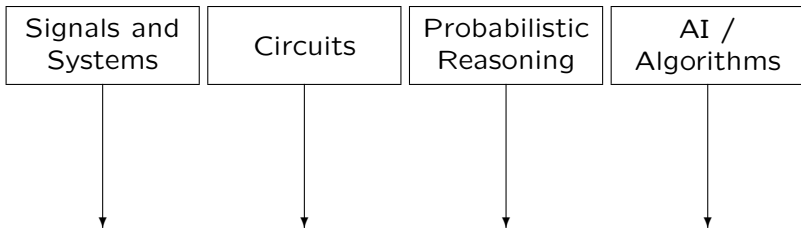
## 6.01: A Look Back

---

6.01 is organized into four modules:

- Signals and Systems
- Circuits
- Probabilistic Reasoning
- AI / Algorithms

Approach: focus on **key concepts** to pursue **in depth**



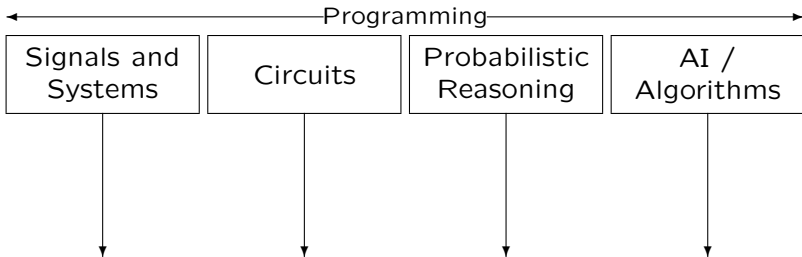
## 6.01: A Look Back

---

6.01 is organized into four modules:

- Signals and Systems
- Circuits
- Probabilistic Reasoning
- AI / Algorithms

Approach: focus on **key concepts** to pursue **in depth**

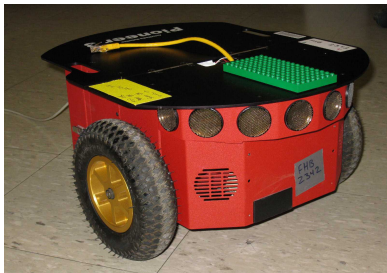


## 6.01 Pedagogy

---

Most of the learning is in the lab!

- active learning with hands-on exercises
- open-ended problems with multiple correct solutions
- multiple levels of individualized help (partners, LAs, TAs, Instructors)



Intellectual themes are developed in context of a mobile robot.



# Guiding Principles

---

## David Merrill's **First Principles of Instruction**

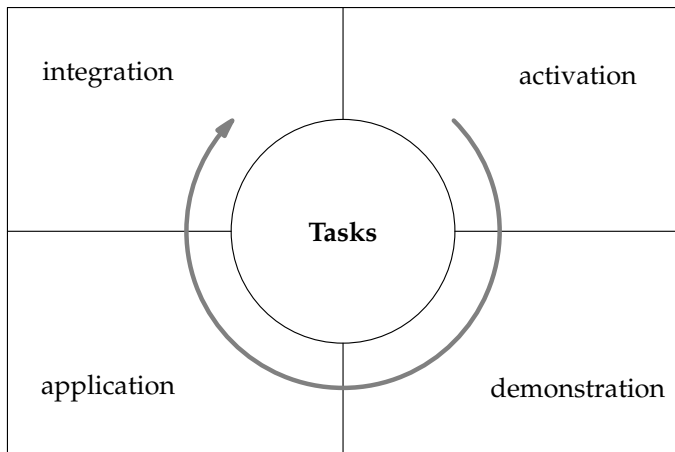
Students learn best when they...

- ▶ **task-based**  
...acquire skills in the context of solving real-world problems
- ▶ **activation**  
...activate existing knowledge and skills as a foundation
- ▶ **demonstration**  
...observe a demonstration of the skill to be learned
- ▶ **application**  
...apply newly-acquired skills to solve problems  
...receive expert feedback on their work
- ▶ **integration**  
...reflect on, discuss, and defend a newly-acquired skill

# Guiding Principles

---

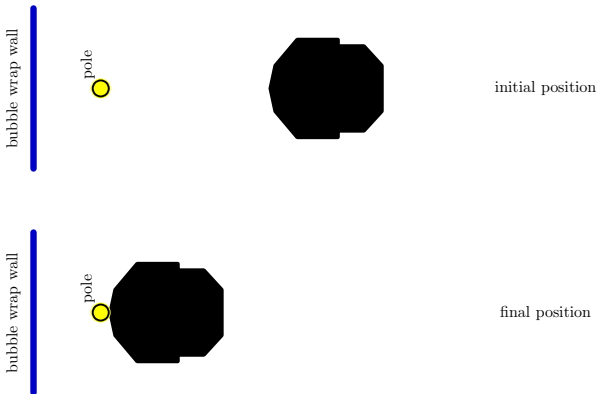
## Merrill's First Principles of Instruction



## 6.01: Day 1

---

Challenge: Get to the pole as quickly and closely as possible, without knocking the pole over.

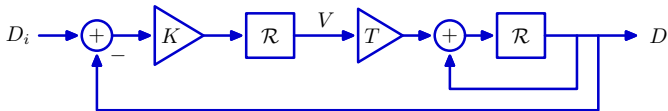


## 6.01: Day 2

---

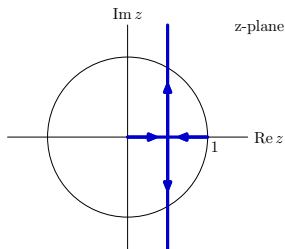
Now we are now primed to learn the theory.

Build a model:



Analyze the model:

$$\mathcal{H} = \frac{D}{D_i} = \frac{KTR^2}{1 - \mathcal{R} - KTR^2}$$



## 6.01: Projects

---

Fundamental themes taught through hands-on labs with concrete, authentic engineering applications.

- Wall-finding Robot
- Jousting Robot
- Servo Motor and Light Tracker
- Pet Robot
- Circuit Solver
- Parking Robot
- Solving Mazes
- Word Ladder
- Navigating Robot Through Known Maze
- “MapQuest”
- Navigating Robot Through Unknown Maze

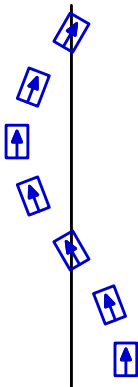
# Module 1: Signals and Systems

---

Modeling and analyzing behavior of physical systems

**Focus On:** Discrete-time feedback control systems

Wall-finder, Wall-follower, Jousting



Next Courses: 6.003, 6.011, 6.302

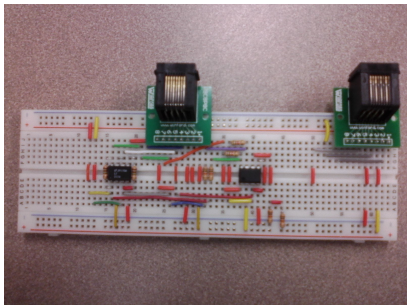
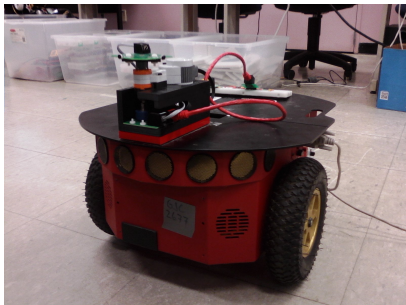
## Module 2: Circuits

---

Designing, constructing, and analyzing physical systems

**Focus On:** Resistive Networks, Op-Amps, Linearity

Design a new sensory modality for the robot



Next Courses: 6.002, 6.007, 6.012, 6.131, 6.021

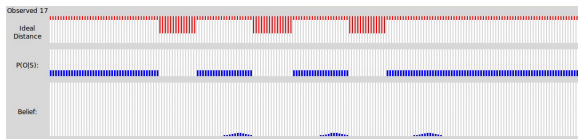
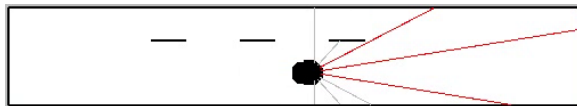
# Module 3: Probabilistic Reasoning

---

Modeling uncertainty and designing robust systems

**Focus On:** Subjective Probability, Bayesian Inference

Localization: Find location in known hallway



Next Courses: 6.008, 6.036, 6.438/6.437



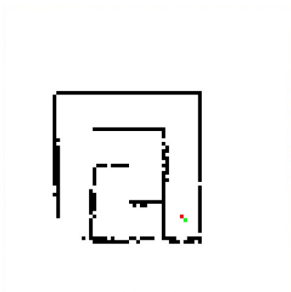
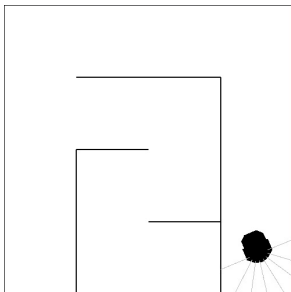
# Module 4: Software Engineering

---

Thinking about and controlling complexity

**Focus On:** Graph Search Algorithms

Robot maze solver, USA Path Planning



Next Courses: 6.034, 6.006, 6.046, 6.009

# Building and Modeling Complex Systems

---

## Modularity and Abstraction:

Primitives, Means of Combination, Abstraction

- **Data:** lists, dictionaries, objects
- **Procedures:** function composition and definition
- **Polynomials:** add, mul, ...
- **Signals:** add, scale, delay
- **Systems:** cascade, parallel, feedback,  $\mathcal{R}$
- **Circuits:** series/parallel, I-V curves, Thévenin, op-amps
- **Search:** successors, tree representation
- **Probability:** joint, condition, marginalize, Bayes' Rule
- **Distributions:** delta, uniform, triangle

# Feedback!

---

Your feedback is important to us!

Please share your feedback!

<http://mit.edu/subjectevaluation/>