Robot Basics

WW II produced

- Code breaking algorithms
- Autopilots
- Control systems

Which led to …

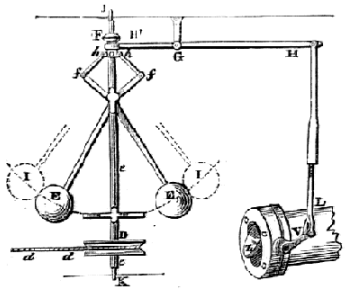
- Code breaking algorithms
- Information processing
  - Symbolic representation
  - Formal operations (math-like)
- Autopilots
- Control systems
- Cybernetics
  - Adaptive response to an environment
  - Analog representations

Which led to …

- Code breaking algorithms
- Information processing
- Artificial Intelligence
  - Internal models of the world
  - Cognition = logical process
  - Sense, think, act
- Autopilots
- Control systems
- Cybernetics
- Control Theory
  - Negative feedback
  - Continuous coupling with environment
  - Dynamical systems

The Watt Governor

(to control the speed of a steam engine)



Which was taken as a model of …

- Code breaking algorithms
- Information processing
- Artificial Intelligence
- Brain
- Autopilots
- Control systems
- Cybernetics
- Control Theory
- Brain, body and world embodiment

Geographic difference (until the 1990s)

North America	Europe
• Code breaking algorithms	• Autopilots
	• Control systems
• Information processing	
	• Cybernetics
• Artificial Intelligence	
	• Robotics
• Brain	
	• Body and world

The attribution problem in Cognitive Science

- If mind is caused by something inside of us, what exactly is it that one must assume is IN THERE in order to account for the organized behavior one can observe?

A new synthesis (1990s – present)

- A shift from seeing cognition as a logical procedure to seeing cognition as a biological process… The embodiment of cognition
  - Challenges traditional AI, perhaps no need for internal representations
  - Opens the door for cybernetics again
  - Makes possible new links between robotics and cognitive science.

What is the brain doing?

The brain is revealed not as an engine of reason or quiet deliberation, but as an organ of environmentally situated control.
(Andy Clark, *Mindware*: 95)

What is a robot?

- A robot is an autonomous system which exists in the physical world, can sense its environment, and can act on it to achieve some goals. (Mataric, pg 2)

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- And the actions respond to (are contingent on) the sensory input.

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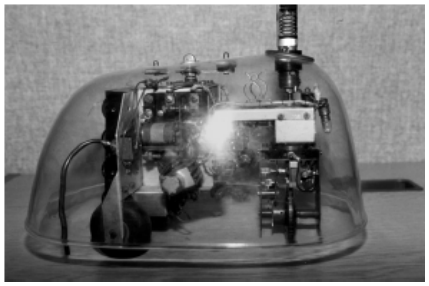
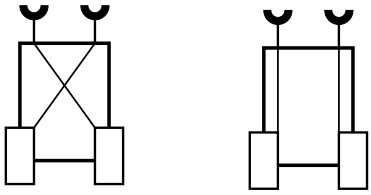
Grey Walter's Tortoise



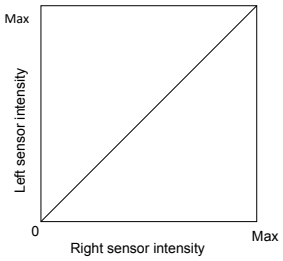
Braitenberg's Vehicle 2



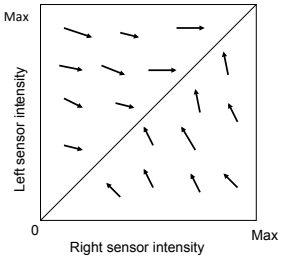
Photophilic:
Loves Light

Photophobic:
Hates Light

Vehicle #2 sensor state space

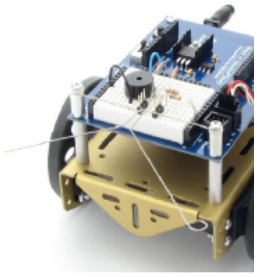


Vehicle #2 sensor state flow field

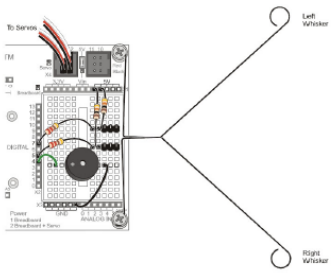


Whisker Navigation Bot

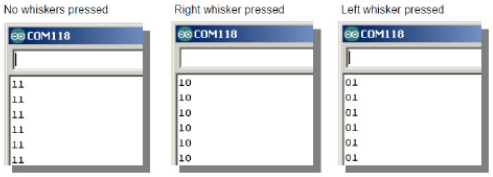
- A physical body, so it can exist and do work in the physical world
- Sensors, so it can sense/ perceive its environment
- Effectors and actuators, so it can take actions
- A controller, so it can be autonomous.



Whiskers are sensors



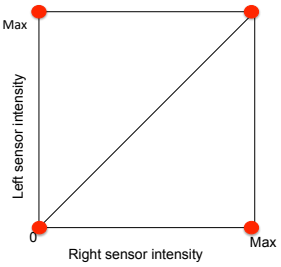
Whisker Sensor States



Analog, Discrete, and Digital Signals

- An **analog** signal is one that is continuous in time and amplitude (amount of wave oscillation, for example).
- A **discrete** signal is discontinuous in time and amplitude. It can assume a limited number of values.
- A **digital** signal is a two-value discrete signal. It is either ON of OFF, never any value in between.

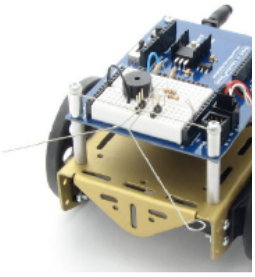
Whisker Bot sensor state space



Whisker Navigation Bot

• What external state does the bot sense?

Does it sense any internal states?

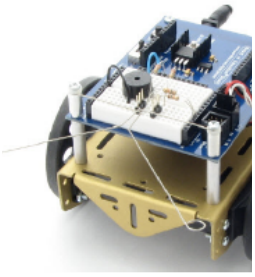


Whisker Navigation Bot

• Which components are the effectors for this robot?

Which components are the actuators?

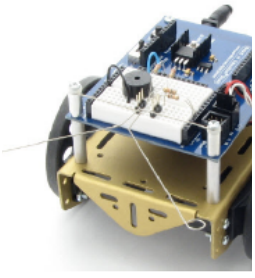
What components are the power source?

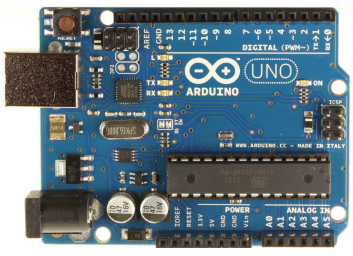


Whisker Navigation Bot

• What component is the Controller for this bot?

Does this bot have autonomy?





Next up in BOE

- Simple math
- Flow of control
  - if
    - Check a condition. If it is true, do something.
    - (optional) if it is not true, do something else
  - for
    - Repeat some action through a specified range of values
  - while
    - Monitor a condition. Do something as long as that condition is true.

For Tuesday

- The Robotics Primer Ch 4
- BOE Ch1.4-7
- Be sure you can answer Ch1.Challenges

BOE Ch 1 questions

- 1. What device will be the brain of your BOE Shield-Bot?
- 2. When the Arduino sends a character to your PC/laptop, what type of numbers are used to send the message through the programming cable?
- 3. What is the difference between the setup and loop functions?
- 4. What's the difference between a variable name and a variable type?
- 5. What's the difference between global and local variables?
- 6. What are the arithmetic operators? What does each one do?
- 7. What variable type will the Arduino editor apply to 21.5 if it appears in your code? Why?
- 8. What three elements are included between parentheses in a for loop?
- 9. What's the difference between a block comment and a line comment?