

iRobot Roomba

A top-down view of a black iRobot Roomba vacuum robot on a light-colored carpet. A hand is pointing at the top of the robot, which has two large drive wheels and a central sensor hub.

- ▶ An everyday “appliance” robot that does a simple job:
 - ▶ Vacuum the entire room it’s placed in
 - ▶ Don’t run into things or fall down stairs
 - ▶ Recharge as necessary
- ▶ Over 10 million sold!
- ▶ Flash back to 2000...
 - ▶ Your startup company has a machine with motorized wheels and a vacuum
 - ▶ How do you *automate* it to perform the Roomba job?
 - ▶ What choices does it need to make?
 - ▶ How does it decide what to do next?

Strategy: Simplify by Abstraction

- ▶ A strategy to approach any problem
- ▶ Abstraction
 - ▶ *Choosing the right level of detail to work at*
 - ▶ Vacation planning: destinations, routes, activities
 - ▶ Sports: moves, techniques, strategies
 - ▶ Presentations: ideas, sections
 - ▶ (As an aside, this is what computers cannot do on their own)



Strategy: Simplify by Abstraction

▶ Applied to the Roomba Problem

- ▶ Abstract from *continuous* to *discrete*
 - ▶ Grid squares (checkboard) rather than real space
 - ▶ Moving from square to square instead of freely
- ▶ Solve this problem first, then go to a more detailed level

▶ Group Discussion: Handout

▶ Group Rules

- ▶ Three people (no, not four or two)
- ▶ Move so you're not sitting in a straight line
- ▶ Talk briefly, get everyone's input
- ▶ Take turns writing (when writing is required)



Strategy: Example Cases

- ▶ One of many general-purpose problem-solving strategies
- ▶ Example Cases
 - ▶ Human brains work better with *concrete* examples than abstract ideas
 - ▶ We're good at predicting what will happen in specific cases
 - ▶ Imagine you start here, then move up, then left, then up, etc.
 - ▶ Come up with specific scenarios
 - ▶ An empty room, a room with a few obstacles, a room with dividing walls
 - ▶ Different starting positions
 - ▶ Work through enough cases to see the *general* solution
 - ▶ This is exactly how you learn, too



Talk to the Machine

- ▶ The instructions you came up with are called an *algorithm*
 - ▶ A specific, detailed step by step process
 - ▶ If it's specific enough, even a machine can perform it
- ▶ How do you communicate those instructions or rules to the robot?
 - ▶ What are some ways we communicate instructions or rules to other people?



Talk to the Machine

- ▶ **Assume a set of lines in a simple, made-up language**
 - ▶ The machine must be able to understand each line
 - ▶ What are some characteristics of a good language for this task?



Talk to the Machine

- ▶ **Assume a set of lines in a simple, made-up language**
 - ▶ The machine must be able to understand each line
 - ▶ What are some characteristics of a good language for this task?
 - ▶ Unambiguous, concise, minimal, consistent, accessible, self-explanatory...

- ▶ **Group Discussion: Handout**



Programmable Machines

- ▶ **Computers rule the world!**
 - ▶ They are *programmable*
 - ▶ They replace many single-purpose machines
 - ▶ They can perform an entirely new job tomorrow that we haven't even thought of yet
 - ▶ ...but only if we can tell them how to do it

