

Mobile Robots

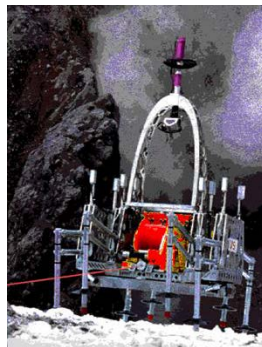
Why do robots need to move?

What defines a robot?

- **Sense** – a robot has to take in information about its environment
- **Plan** – a robot has to use that information to make a decision
- **Act** – a robot needs moving parts to carry out commands

What ways do robots move?

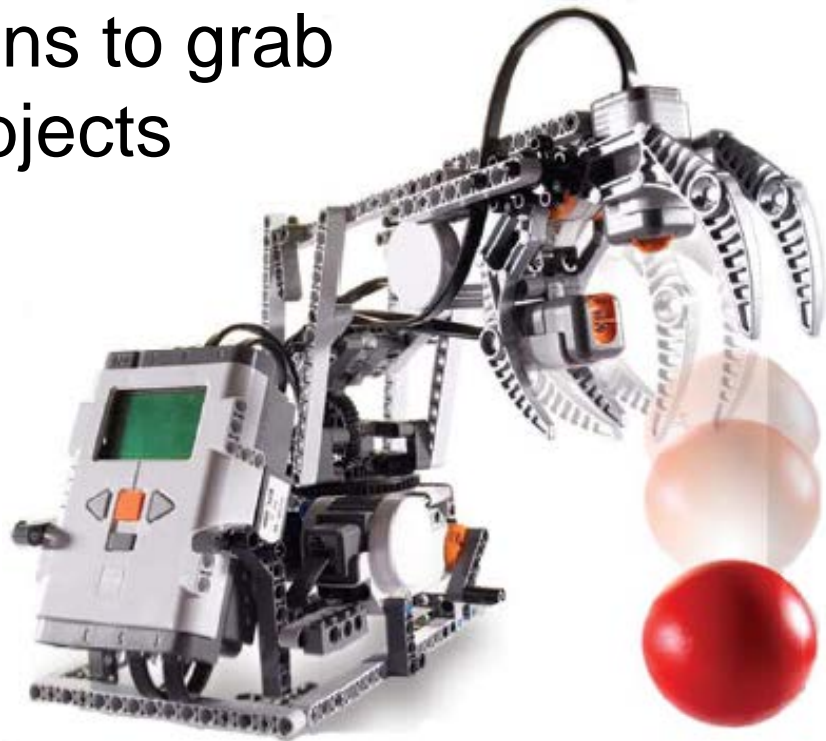
- Rotate
- Convey
- Walk
- Swim
- Fly
- Reach
- Bend
- Poke
- Roll



Snake Robot

Manipulative Movement

- Robots that use an arm, belt or other means to grab and maneuver objects



Mobile Movement

- Robots that can move from place to place



Why go from place to place?

- Transport goods and materials
- Carry messages
- Get there faster
- Do a task while you're getting there or when you get there
- Collect information about what's there
- Get away from something
- See if you can!

Most robots get around by rolling

- **Walking** is hard – it requires balancing
- **Swimming** only works in water
- **Flying** requires a lot of speed and energy
- Wheels and treads make moving over ground easier
- They provide stability with multiple points that touch the ground

How do rolling robots work?

- Sensors
- Motors
- Wheels
- Programming!



Main Components of Robotics

- **Build** – Mechanics, Mathematics, Physics
- **Program** – Building behaviors
- **Test** – Multiple trials
- **Communicate** – What did you work on or accomplish? What conclusions did you come to?

Building

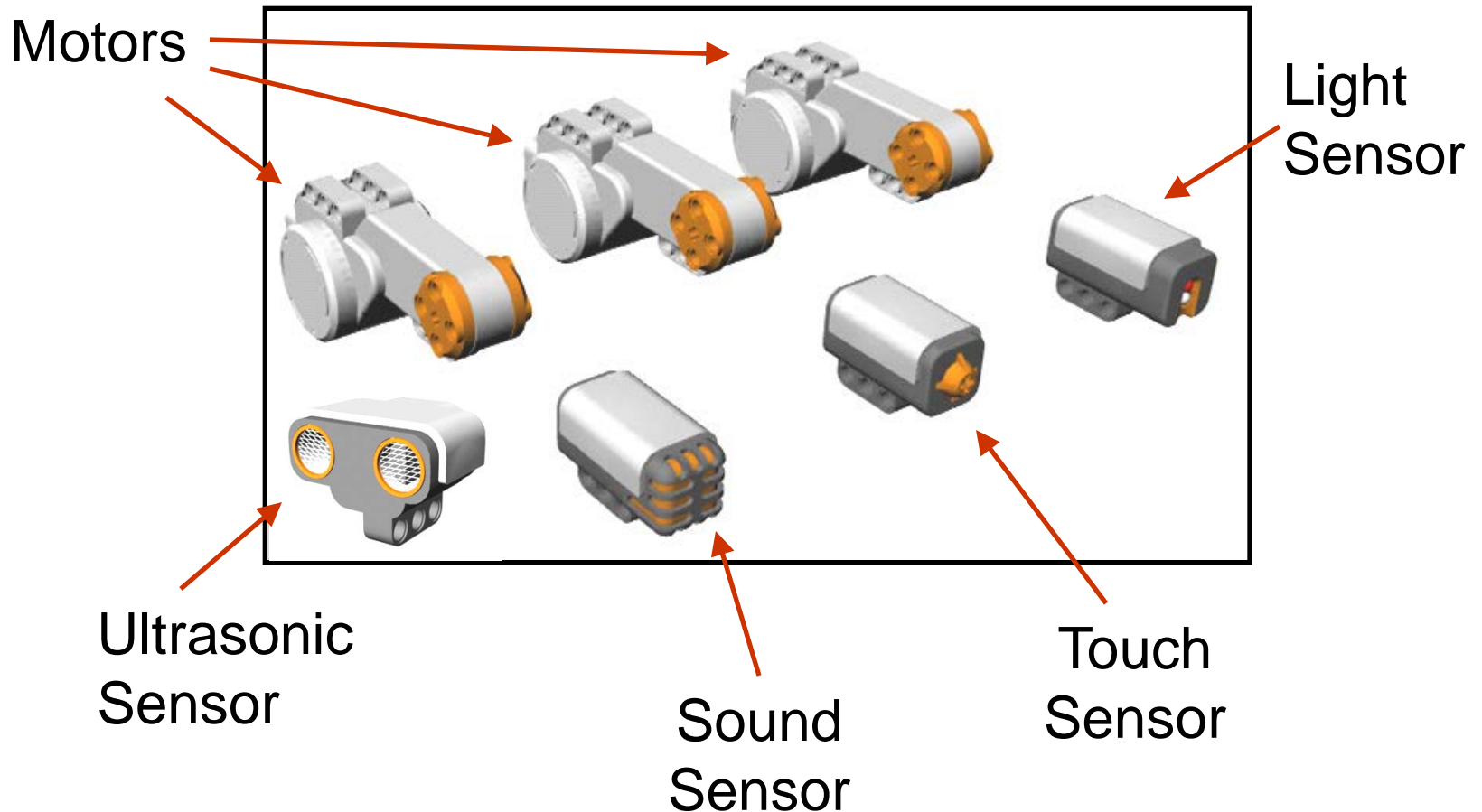
We will be using LEGO® pieces
to build our robots

- Gears and axles
- Beams and connectors
- Motors and wheels
- Sensors and wires
- NXT programmable brick

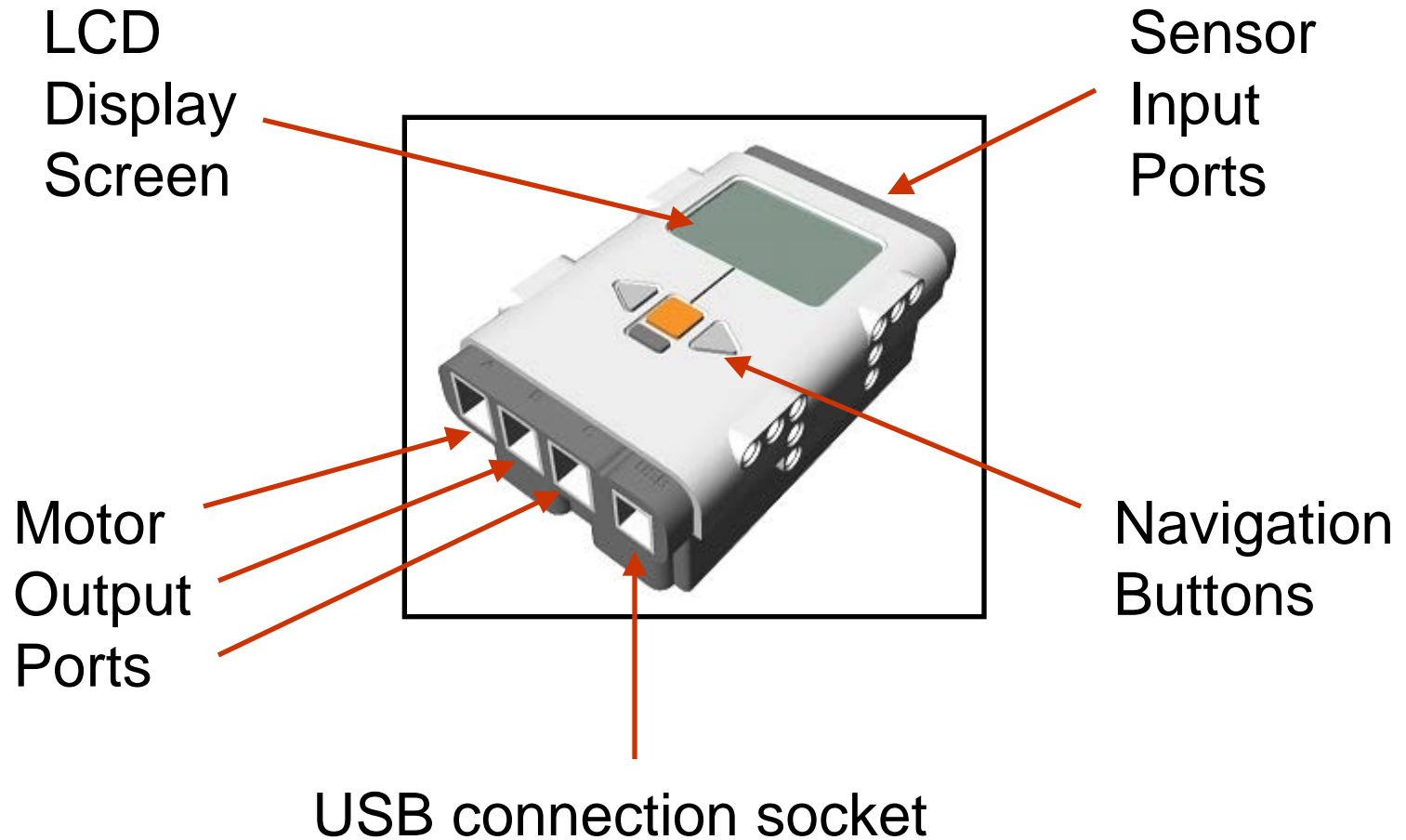
Building *LEGO® Pieces*



Building *LEGO® Motors and Sensors*



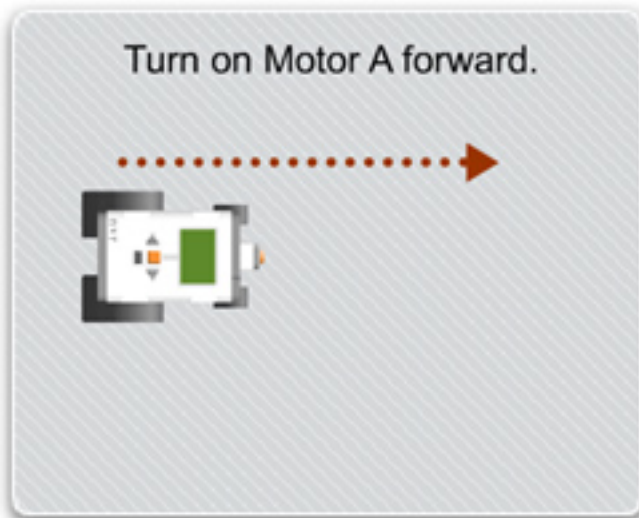
Building *LEGO® NXT*



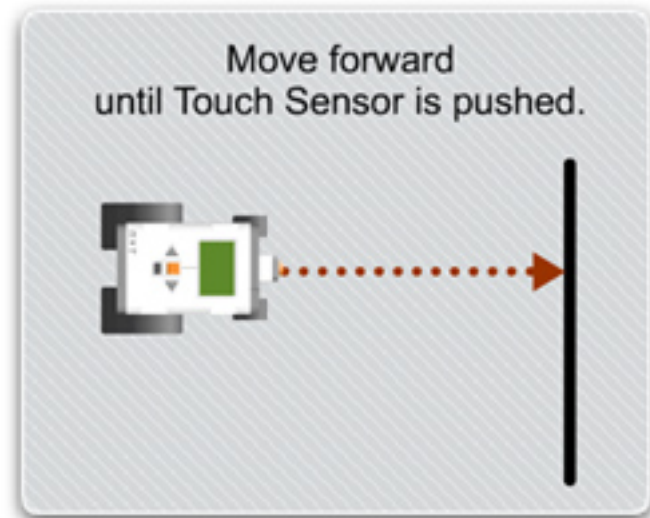
Programming *Behaviors*

- Giving the robot behaviors
- Complex behaviors are built from simple ones

The basic behavior...

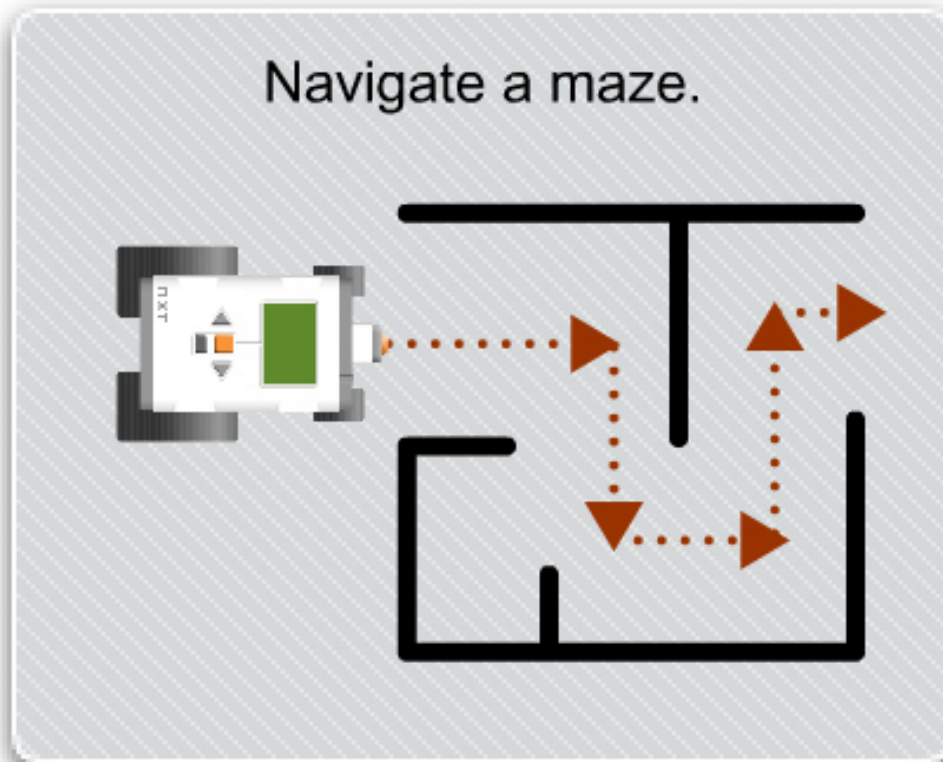


is used in the simple behavior:



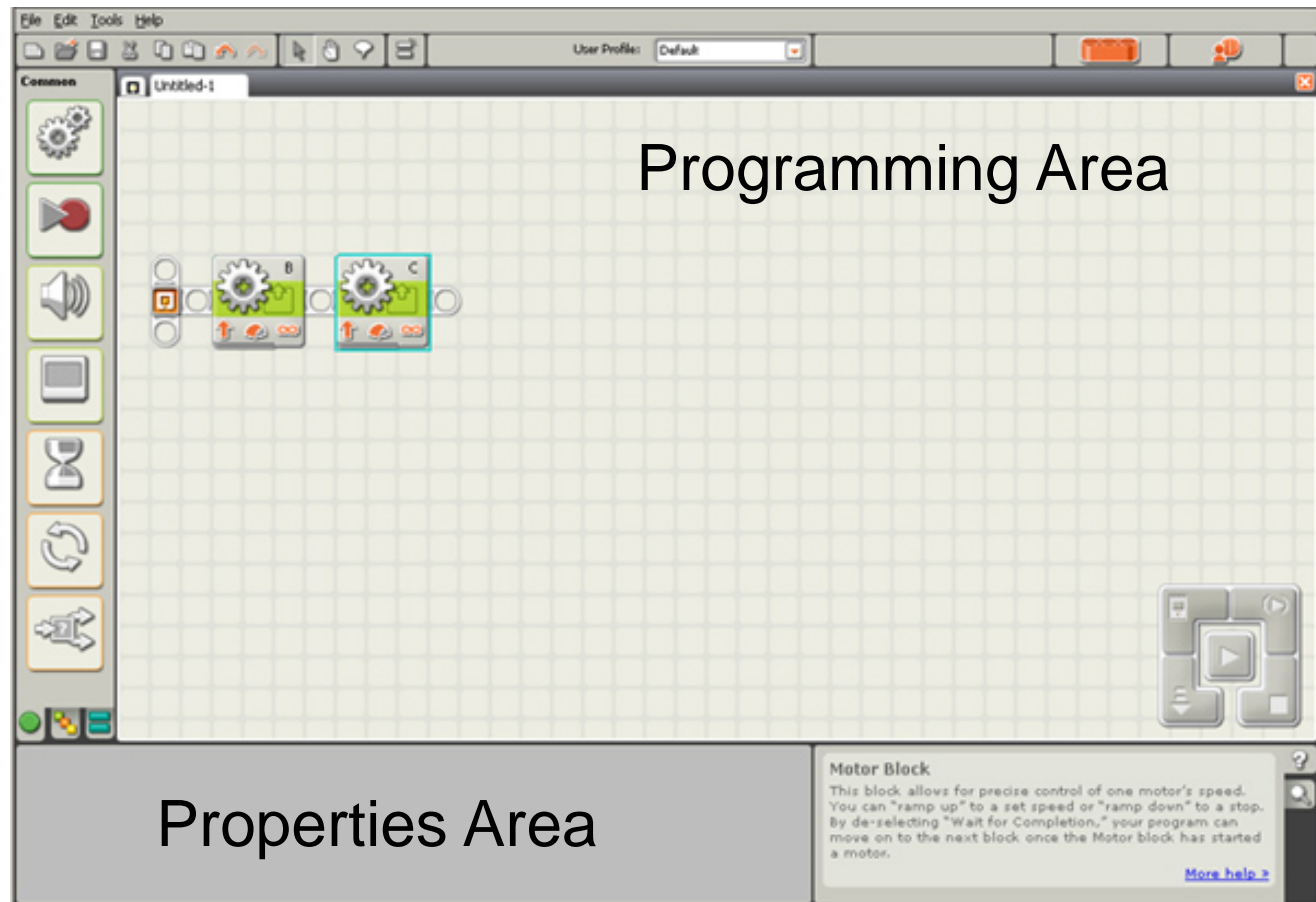
Programming

...which is used in the complex behavior:



Programming *Screen Interface*

Blocks



Programming *Blocks and Functions*



Program by dragging blocks from the menu on the left

Place them on the grid, and wire them together

Can create your own blocks called My Blocks

Testing *Why do we test?*

- Make sure it works!
- Understand what it can do
- Test everything multiple times to determine the repeatability
- Use the robot to test other phenomena

Testing

- When we test, we take data (numbers)
- We write our numbers down in organized charts
- We write down everything we can about the experiment
- Look at our data after we're finished

Communicate

Why is communicating your design so important?

- If no one knows what it is, how it works, or why it's cool, why would they want to buy it?
- When it is well-documented, other people can build on what you have started and create even cooler technologies!

Communicate

- Experiment worksheets and log books
- Presenting our work
- Sketching and describing ideas so teammates can understand too

What is Engineering?

- Problem solving
- Teamwork
- Time management
- Testing
- Doing it over if it doesn't work correctly the first time!

Engineering Process

**Determine
the problem**

Present

Research

Redesign

Brainstorm

Test

Build

**Pick the
best solution**

How can you change it to
How did you attack the
Does it fit into the scope the
problem? What challenges
original design? What did you
did you encounter? What was
your final solution? What
changes would you make?
constraints!

Personal Assistant Robot



Personal Assistant Robot

- We will be making a mobile robot to help out in the classroom
- We will run tests on the robot to determine its capabilities
- Before it can do complicated behaviors, we have to teach it simple ones
- But before we program anything, we need to build

XAVIER

Built by Carnegie Mellon University in 1993

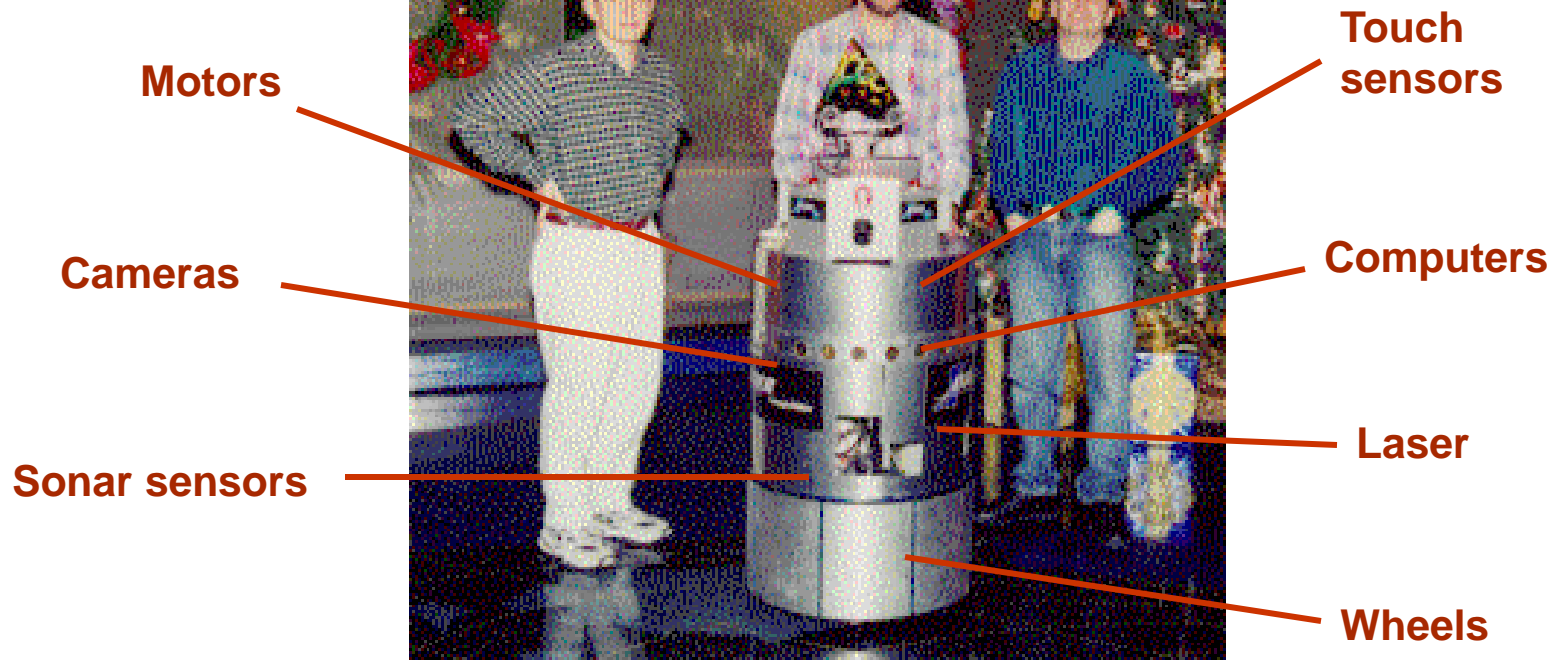


- Crane arm to pick up boxes
- Video camera to get information & take pictures
- Sonar sensors to find out position of objects in its path
- Roamed the halls on its four-wheel base
- Could be commanded over the internet
- Could be programmed to take pictures, go to various offices, tell knock-knock jokes

**2 feet in
diameter**

Xavier is big!

**More than
3 feet tall!**



You need a lot of space to fit in all that stuff!