Telling a robot how to behave

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COS 116: Spring 2012

Today: Understanding a simple robot
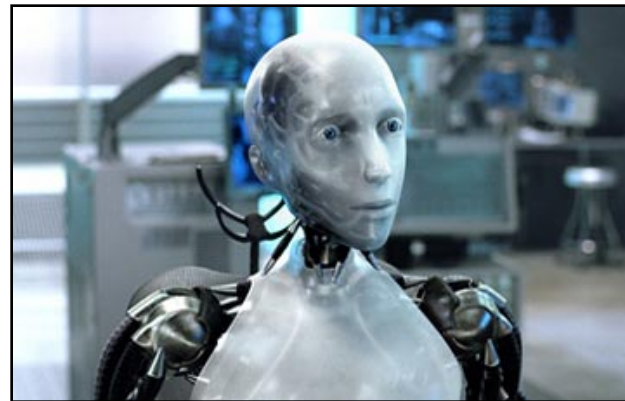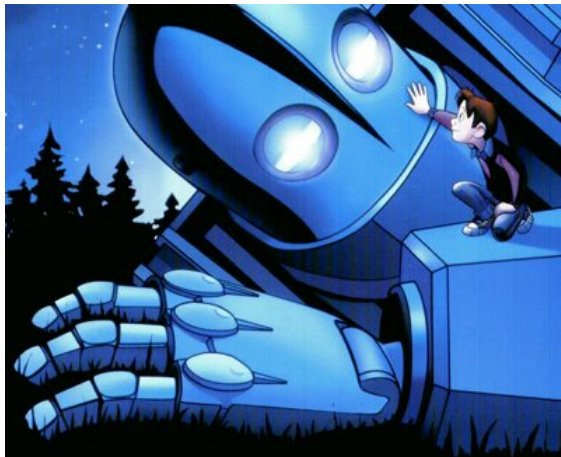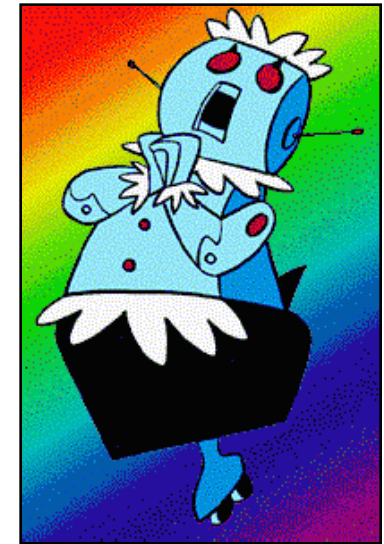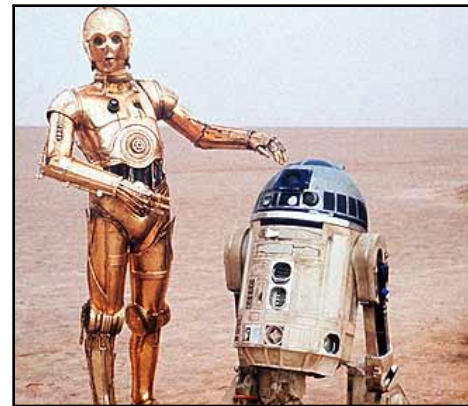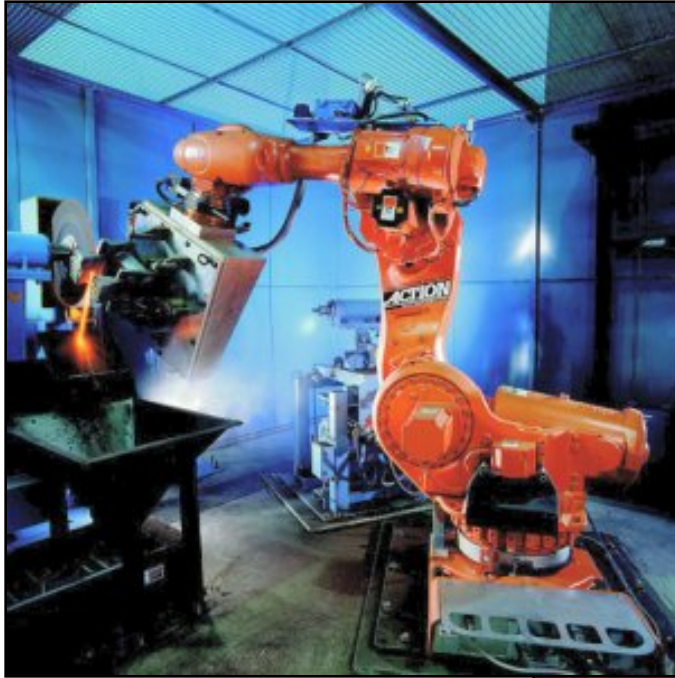
Why?

- Larger goal: seek an answer to

  "What is Computation?"

- Acquire insight into technology that will become pervasive within the next decade.

- First encounter with many themes of the course.
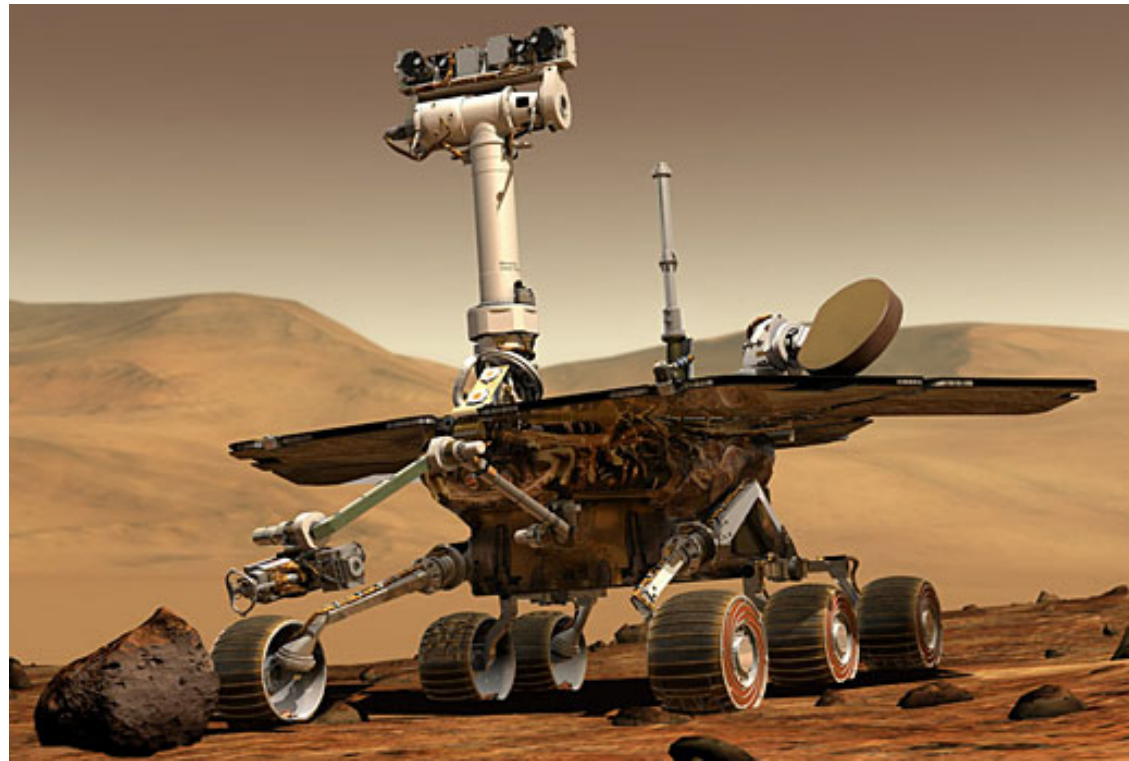
Robots in pop culture

Real robots

Discussion…

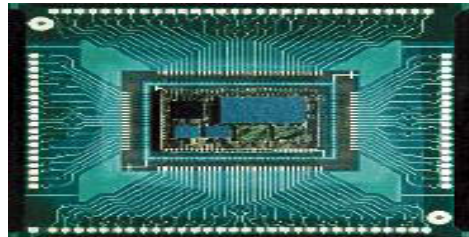- Mars rover: what are the design principles?

Definition of "Robot":

- A machine that can be programmed to interact with the physical environment in a desired way

- Key word: *programmed*
  - As opposed to cars, televisions, which are operated by people

Components of a robot

Three stages:

1. Sensors/Inputs: light, sound, motion...

2. Computing Hardware

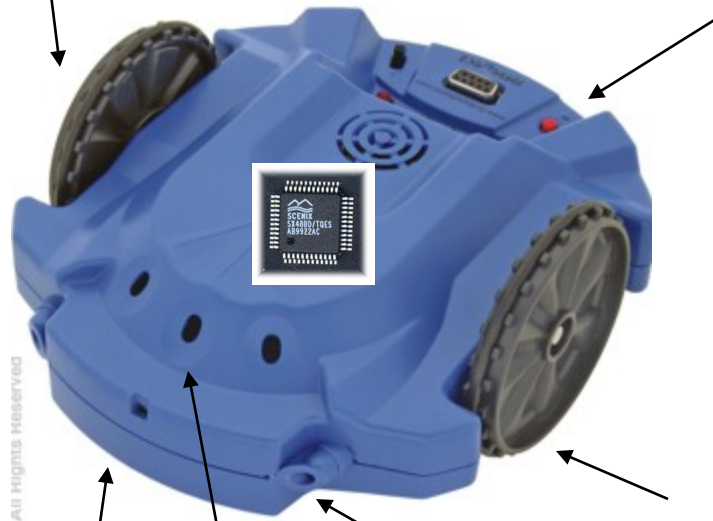3. Outputs/Actions: motors, lights, speakers…

Our robot: Scribbler

Inputs

Stall sensor

button

Light sensors

Obstacle sensor emitter

Obstacle sensor detector

Line sensor (underneath)

Outputs
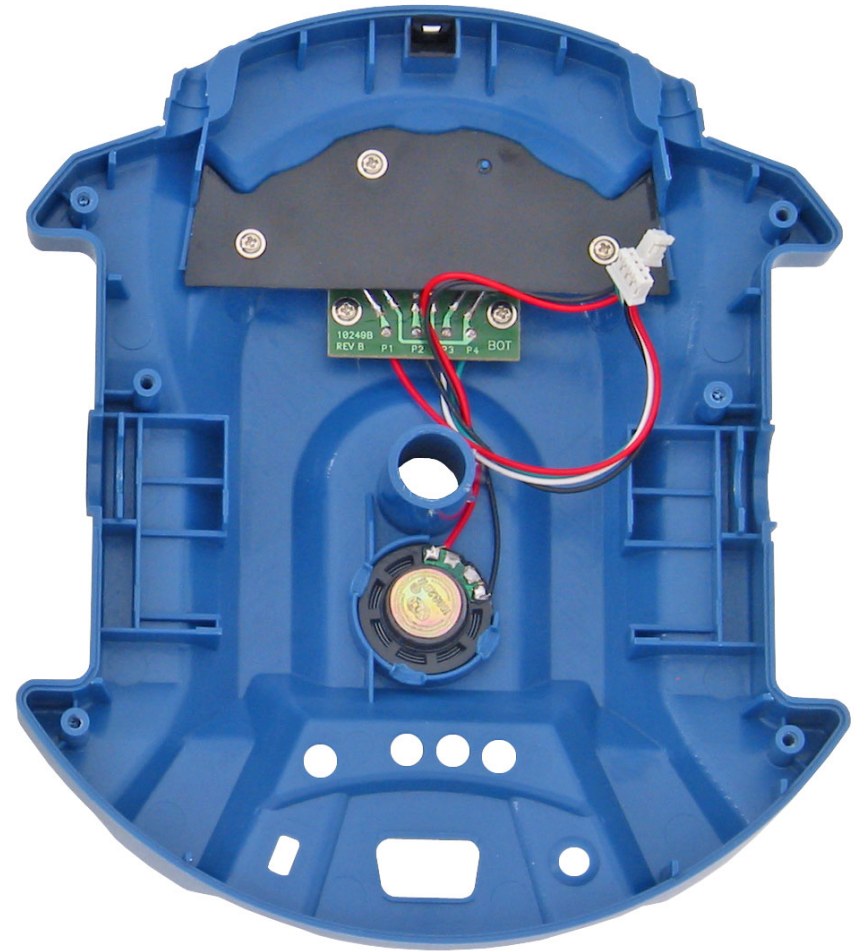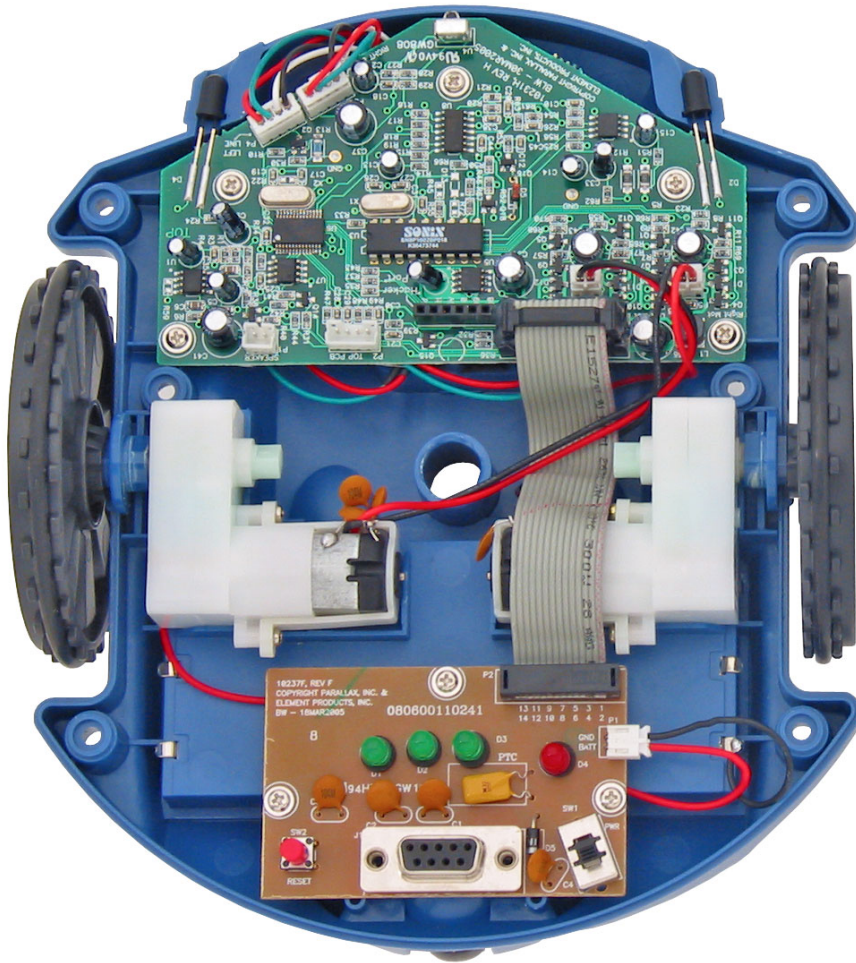
Speaker

Motor/wheels

Light outputs

Scribbler inside

Formal specification of actions

- Fact of life in computing: hardware is "dumb"

- Forces us to make nebulous concepts precise
  - What is language? Music? Intelligence?

- Running themes:
  - What is machine "intelligence"?
  - Are there limits?

Controlling Scribbler
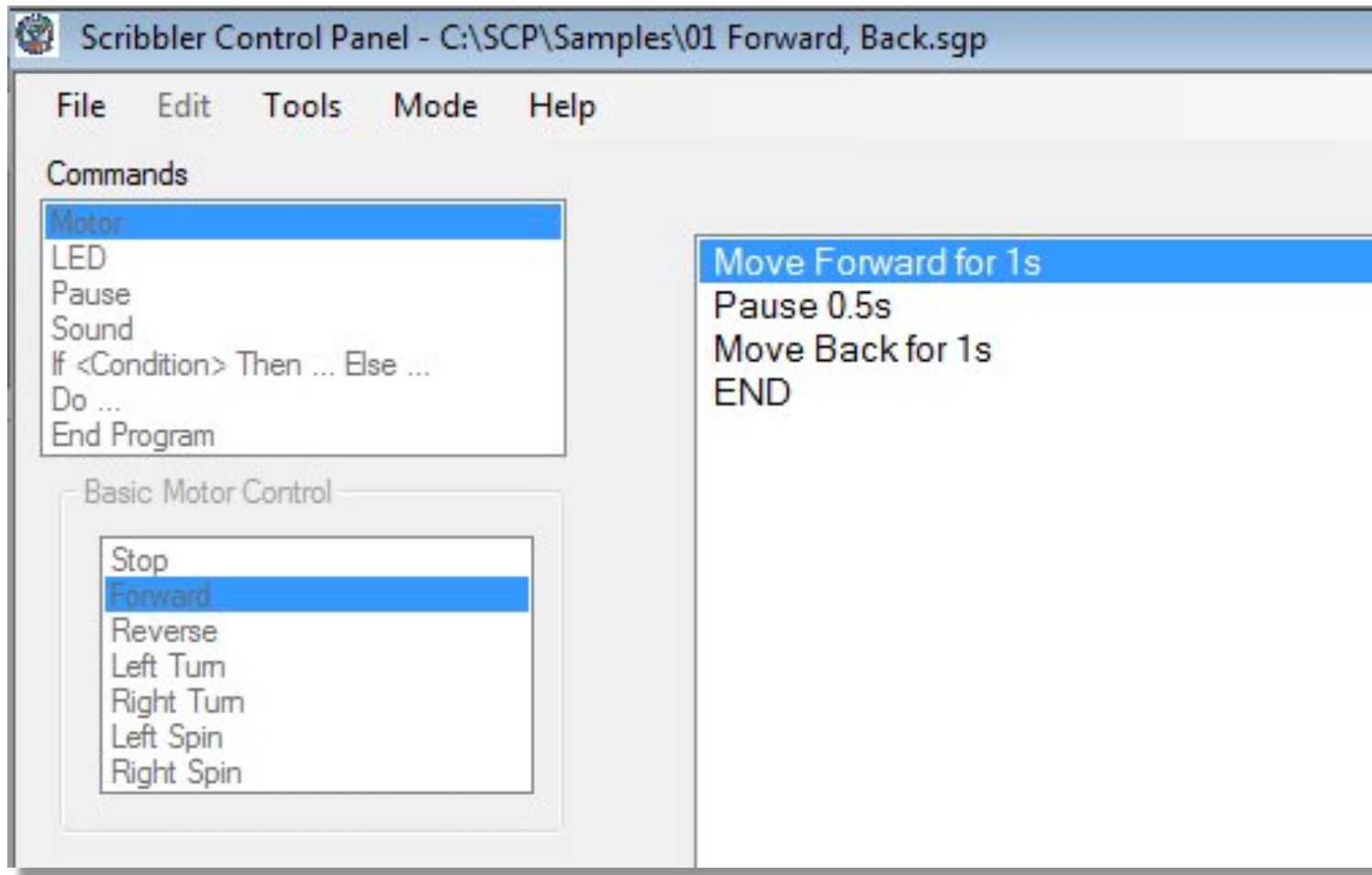
Remember (esp. for Scribbler labs):

- Microprocessor can do one thing at a time

- Very fast -- 20 million operations per second!

- Compound instructions: sequence within {…}

Why programmable?

- **Benefits of a programmable device:**
  - ☐ Flexible
  - ☐ Multi-use
  - ☐ Universal

- **Main difference between computers and other technologies**

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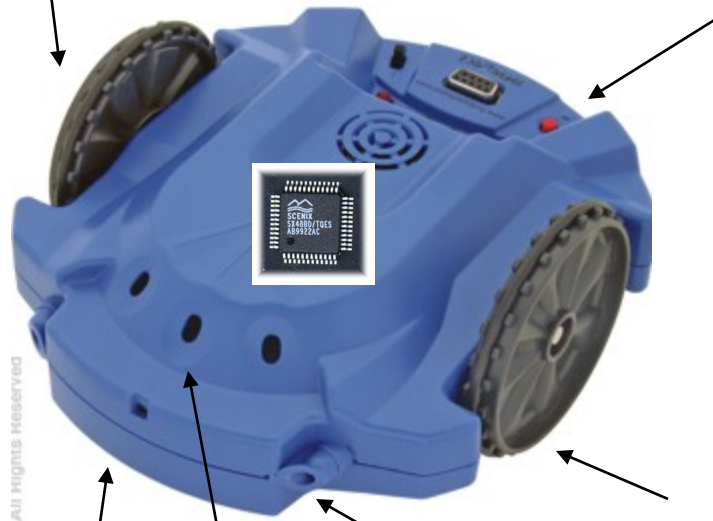
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Outputs

Speaker

Motor/wheels

Light outputs

Example 1: As a burglar alarm
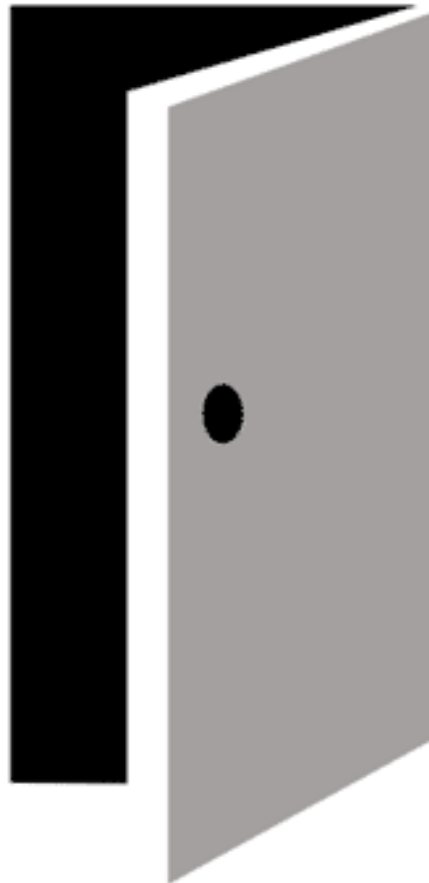
Beep!

If beam interrupted…

Example 2: As an artiste

Interesting note:
Scribbler is more stupid than you think

Do forever
{
 Move Forward for 1s
 Move back for 1s
}
END

=

"Translator" written by
 Rajesh Poddar '08

3 pages of stuff like

```
GOTO Main

SenseObs:
  FREQOUT ObsTxLeft, 1, 38500
  IF (ObsRx = 0) THEN object_left = 1 ELSE
object_left = 0
  LOW ObsTxLeft
  FREQOUT ObsTxRight, 1, 38500
  IF (ObsRx = 0) THEN object_right = 1 ELSE
object_right = 0
  LOW ObsTxRight
  RETURN

SenseLine:
  HIGH LineEnable
  line_right = LineRight
  line_left = LineLeft
  LOW LineEnable
```

Where are things going?

- "Small cleaning agents" – Brooks

Where are things going?

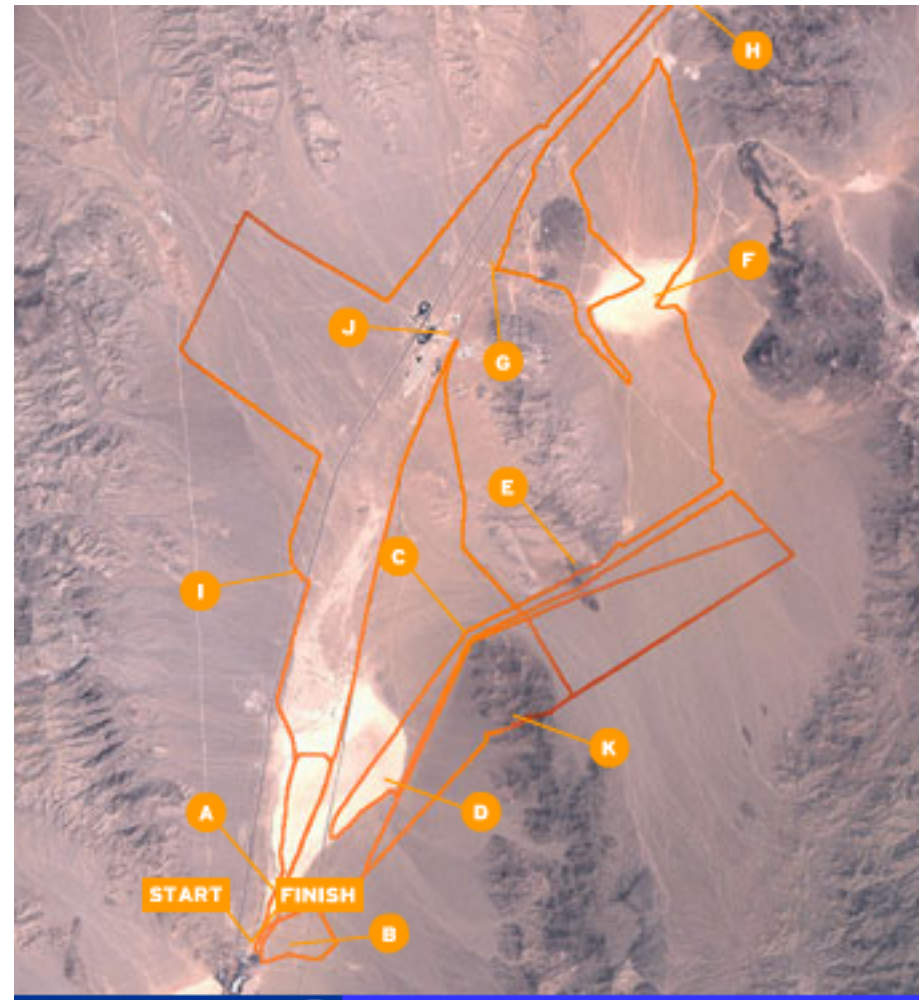- Automated highways

(From Minority Report)

- Being actively researched

Longitudinal Control   Lateral Control
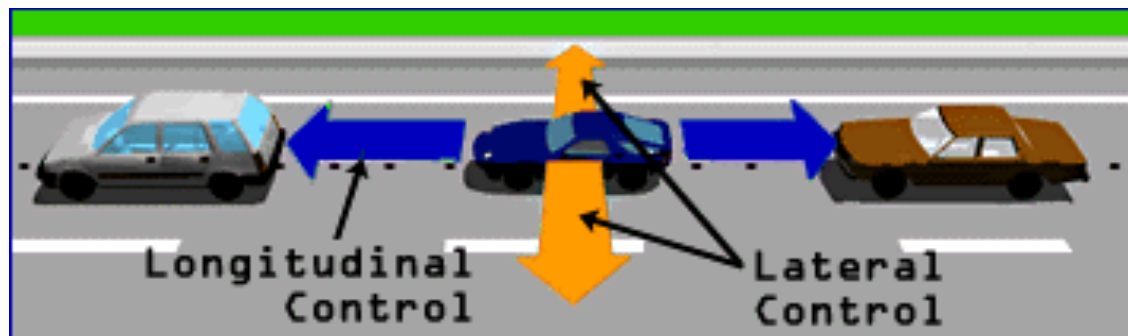
Where are things going?

DARPA Grand Challenge ($2 M prize):

☐ 132 mile race in the desert

☐ No human control!

☐ 5 teams, Stanford won in ~7 hours

The Princeton Entry

Undergraduate Project; reached the finals

Where are we going?

What is going inside us?

- "Da Vinci" Robotic surgery system

- More precise, though often still controlled by human

Why are multi-purpose robots so hard to build?

- Need precise instruments that act like: eyes, ears, hands, fingers, …

- Need smart ways to use sensor data (ex: human eyesight vs. high-res camera)

TO DO's

1. Reading: Brooks pp 12-21, pp 32-51
2. Lab: Web 2.0
3. Homework 1: Survey

(All posted on course web page.)