Telling a robot how to behave

Adam Finkelstein

COS 116: 2/8/2007

Survey results

- Class break-down
  - Freshmen: 15
  - Sophomore: 17
  - Juniors: 8
  - Seniors: 3
- Majors
  - 9 ECO
  - 5 POL
  - 4 ENG
  - 2 PSY
  - 2 PHI
  - 2 NES
  - 2 COM
  - 1 FRE
  - 1 ANT

- Own a:
  - PC: 35
  - Mac: 10
  - Game console: 18
  - Palm: 6
  - iPod: 34
- Have a web page:Yes:8 No: 35
- Ever posted on blog: Yes: 24; No: 19
- Programming: None: 31 ; Some: 12
- College:
  - 11 Forbes
  - 10 Mathey
  - 9 Butler
  - 7 Wilson
  - 6 Rocky

Today: Understanding a simple robot

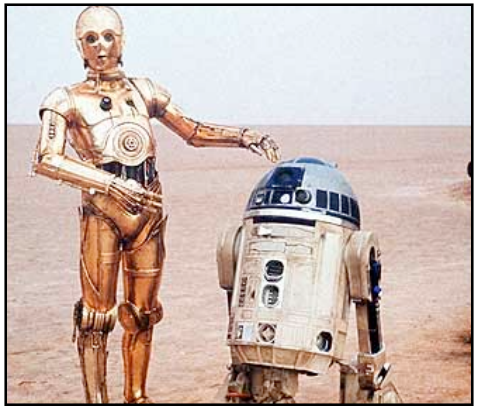
Why?

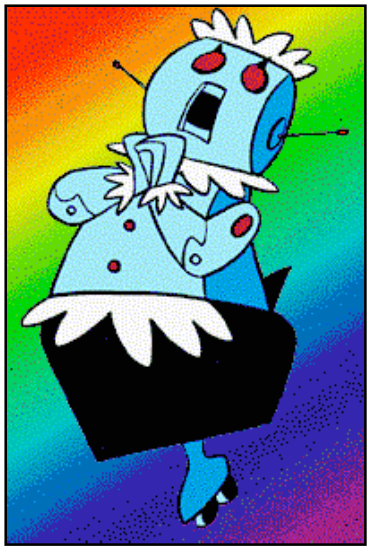
- Larger goal: seek an answer to

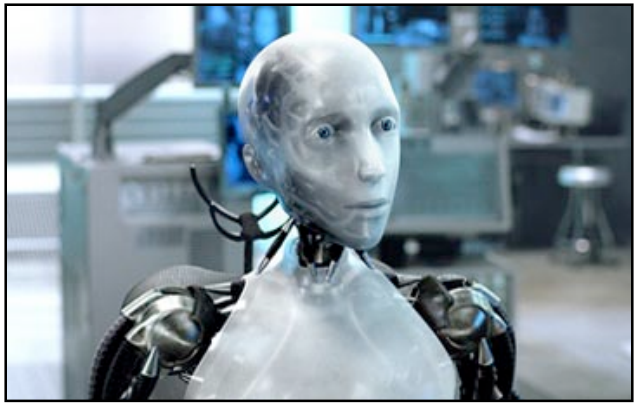
  "What is Computation?"

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

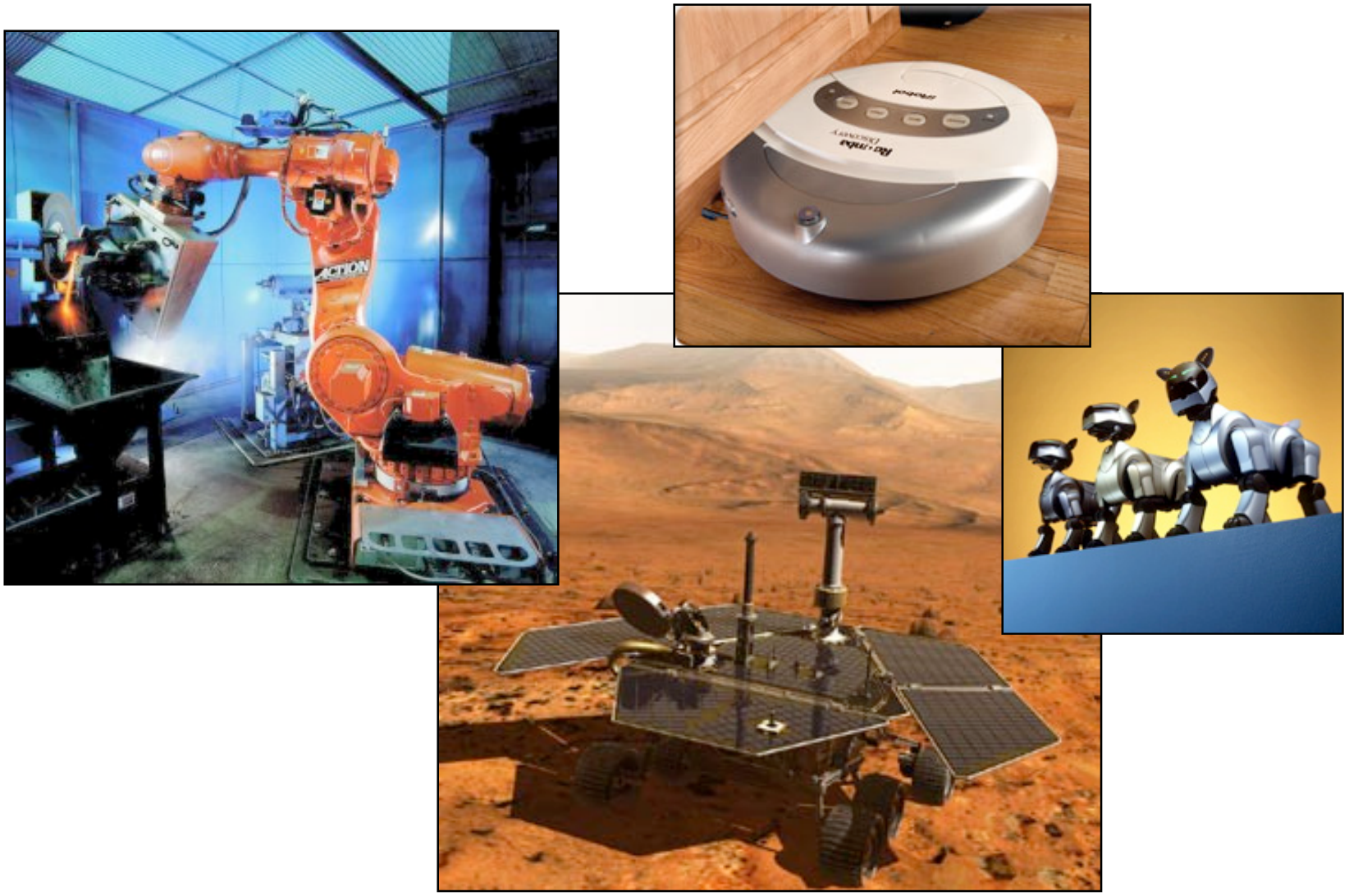
Robots in culture







Real robots



Definition of “Robot”:

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

- Keyword: programmed
  - As opposed to cars, televisions, which are operated by people

Components of a robot

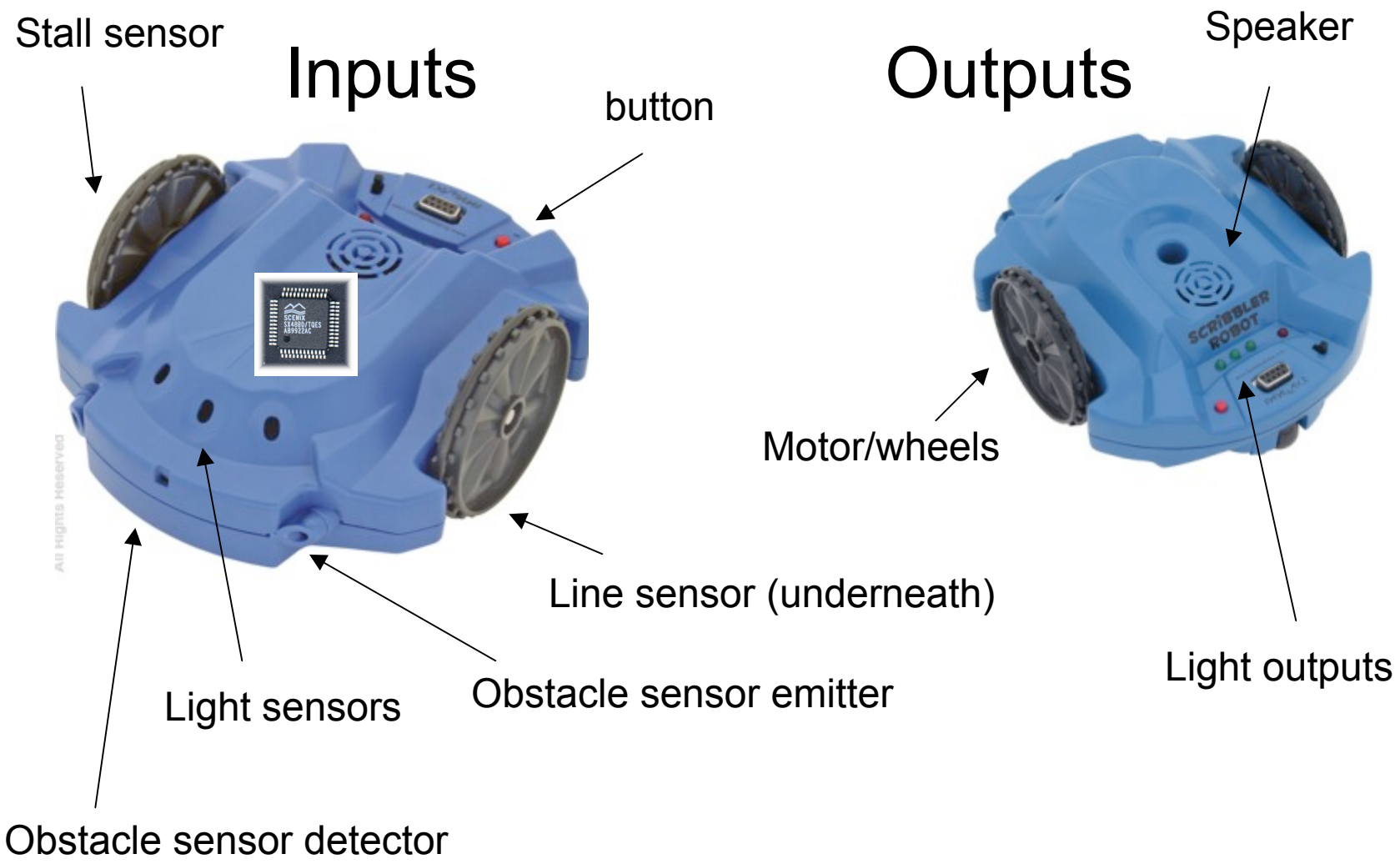
Three stages:

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

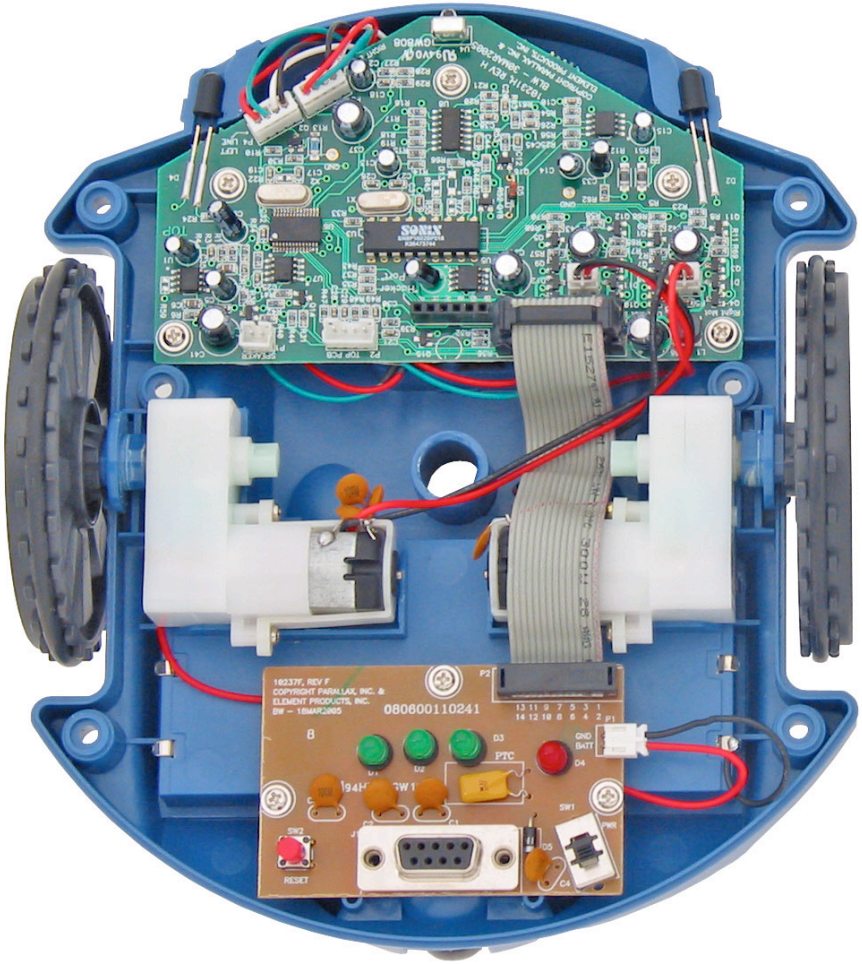
2. Computing Hardware

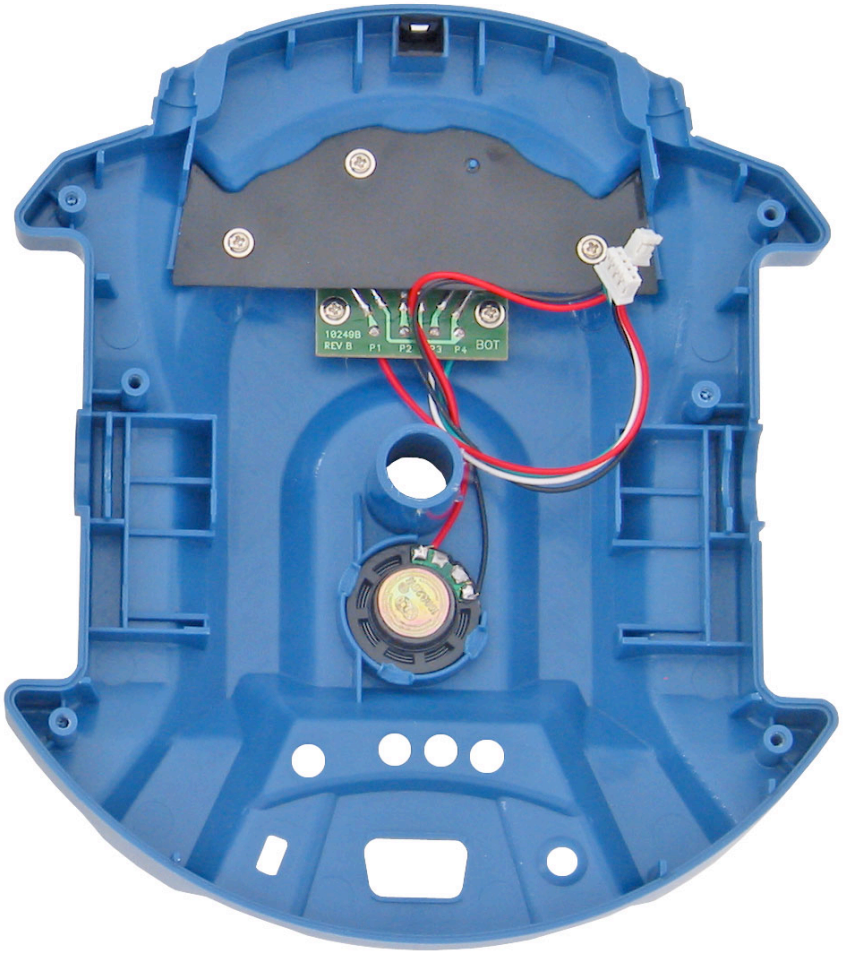
3. Outputs/Actions: motors, lights, speakers…

Our robot: Scribbler



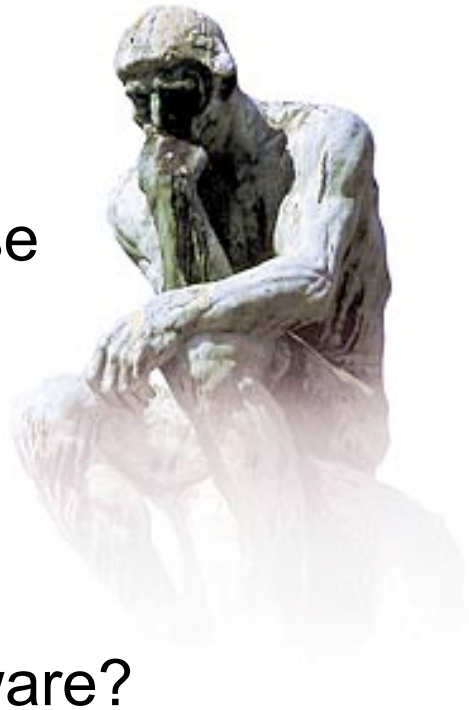
Scribbler inside





Formal specification of actions

- Fact of life in computing: hardware is “dumb”
- Forces us to make nebulous concepts precise
  - What is language? Music? Intelligence?



- Is it possible to have more “intelligent” hardware? A radically different computer?

Always remember… (esp. for Scribbler labs):

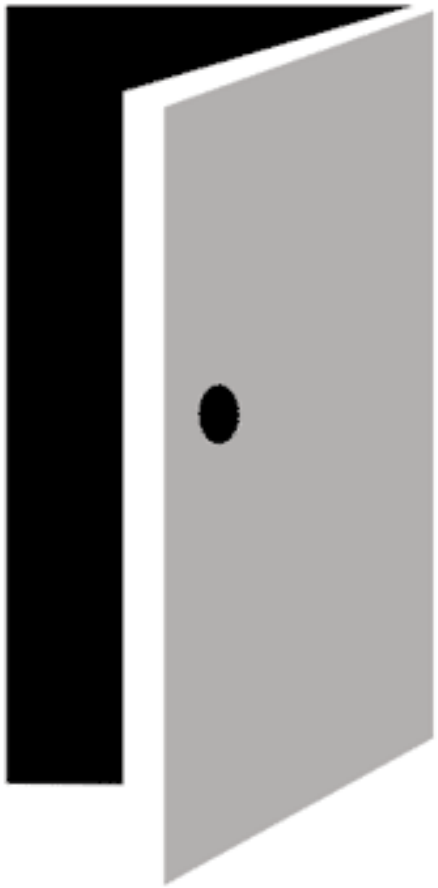
- Microprocessor can do one thing at a time
- Very fast -- 20 million operations per second!
- Sequence of instructions within { … } form a "compound instruction"

Why programmable?

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

- Main difference between computers and other technologies

Example 1: As a burglar alarm



If beam interrupted…

Beep!

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
```

=

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
```

“Translator” written by
Rajesh Poddar ‘08

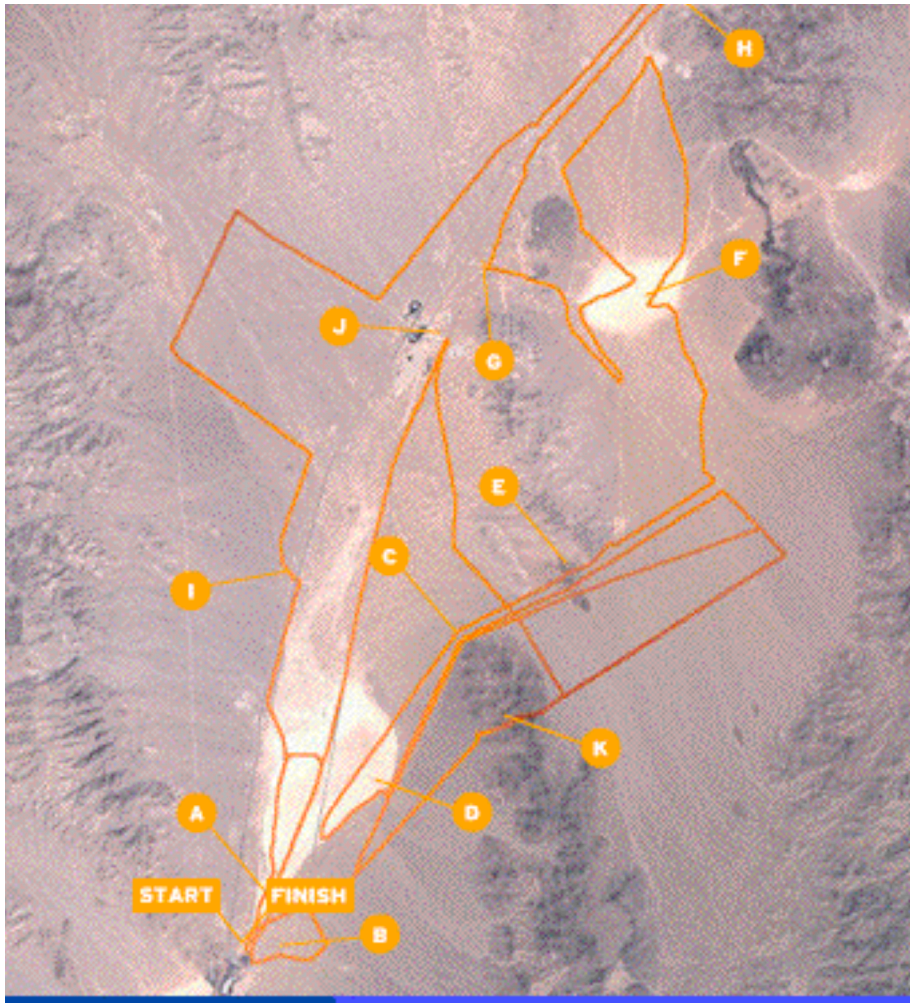
Where are things going?

- “Small cleaning agents” – Brooks

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

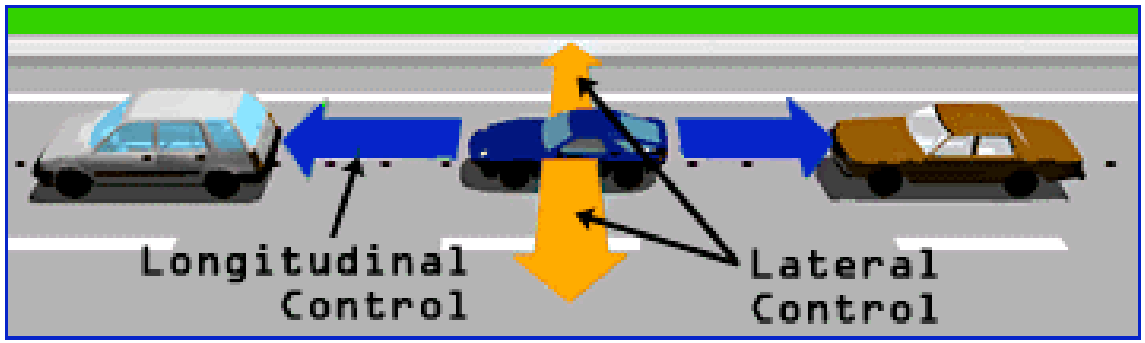
Where are we going?

Where are things going?

- Automated highways

(From Minority Report)

- Being actively researched



What is going inside us?

- “Da Vinci” Robotic surgery system

- More precise, though often still controlled by human