RoboJackets

CAT®

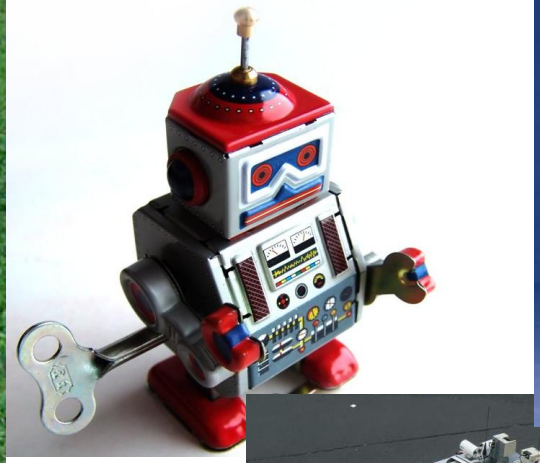
THE ARTHUR M. BLANK FAMILY FOUNDATION

TE Sessions – Programming

November 13, 2007

www.robojackets.org

What is a Robot?



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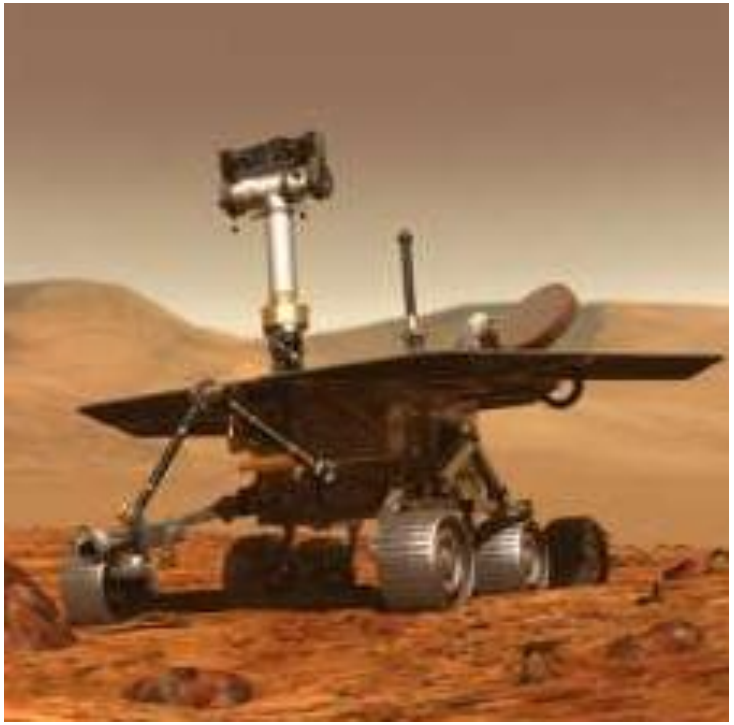
What is a Robot?



Autonomous v. Teleoperated

A Robot is

An agent which interacts intelligently with its environment to perform a task.

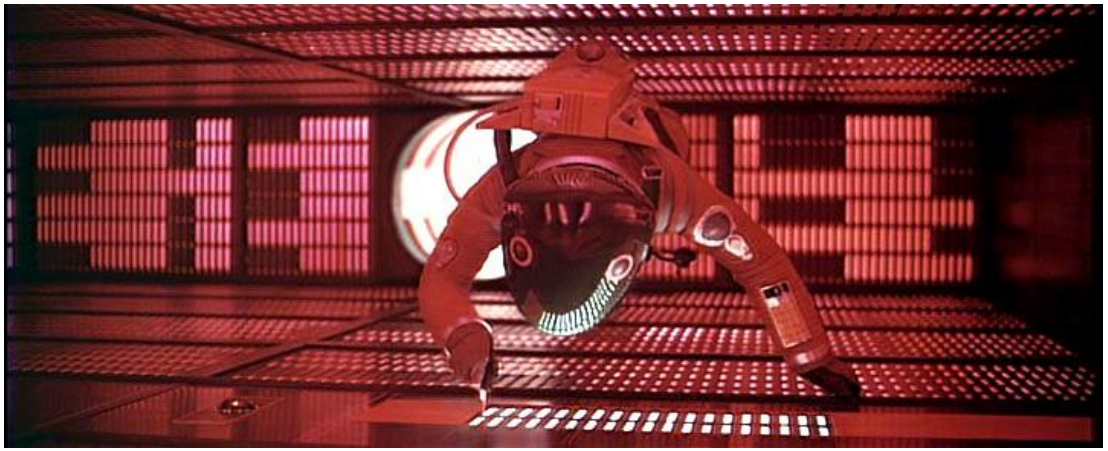
Acting intelligently may involve mapping user input to actuators (see teleoperation).

Robot Controller

- Can follow instructions
  - Math
  - Reason
- Inexpensive
- Reconfigurable
- Small

Telling the Robot What To Do

- Some language....
  - Sign Language? Pictionary?
  - English - “I'm afraid I can't do that.”
  - Language tailored for easy computer comprehension – not so easy for humans



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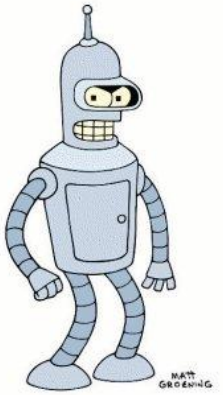
Language Elements

- Variables store data
  - Boolean - TRUE/FALSE
  - Numbers – 20, -102.6, 3.14159...
  - Strings - “cat”
- Instructions manipulate variables
  - Math - + , - , / , *
  - Logic - &, ||, !
  - Conditional - >, <, => ...



Variables

- Booleans – T or F
- Numbers
  - int
    - Counting numbers
    - Number of people
  - float
    - Decimals
    - sqrt(2), pi, exp(1) ...
- Strings - names, words

Variables

- *X* is the number of apples in a barrel
- *Y* is whether or not the light is green
- *Z* is your height in angstroms
- *N* is your name
- *P* is the number of people confused
- *A* is the answer to life, the universe and everything.

Instructions: Math

- Math (descending order of operations)
  - Multiplication (*), Division (/)
  - Modulus (%)
  - Addition (+), Subtraction (-)
- () groups instructions

Instructions: Math

- 2 * 8 + 4
- 2 * (8 + 4)
- 24 / 4 % 4
- 3 * 2 + 4 % 2
- 3 * 2 + 4 % 2 * 6 +17
- The largest prime number less then 1000

Instructions: Logic

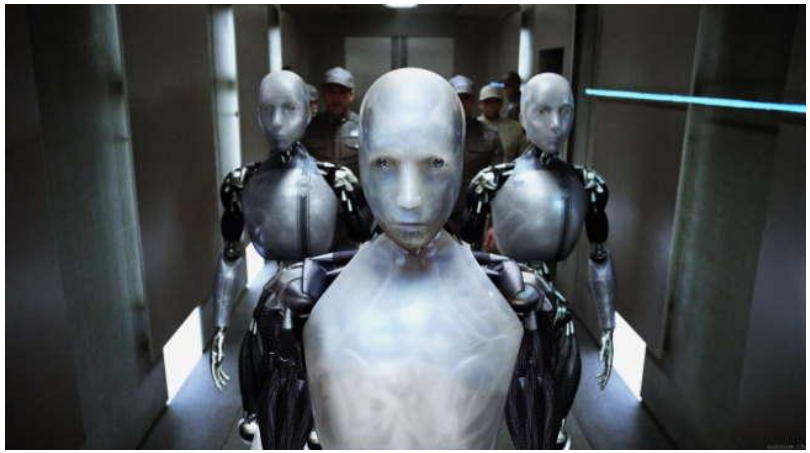
- Logic

  (descending order of operations)

  – NOT (!)

  – AND (&&)

  – OR (||)

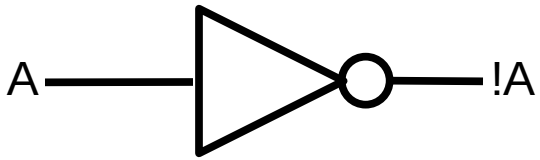


“my logic is undeniable...”

Logic: NOT

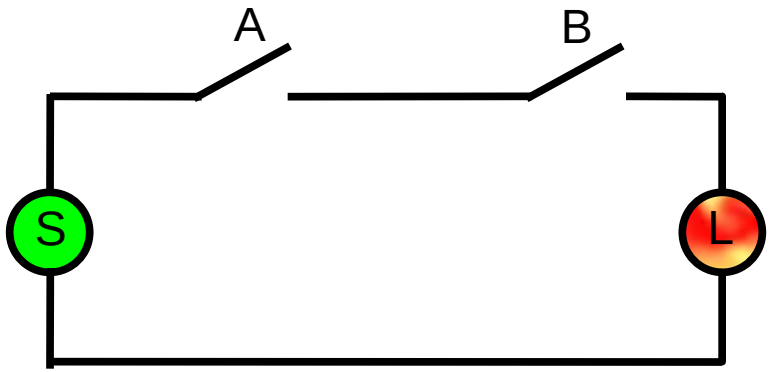
A	!A
TRUE	FALSE
FALSE	TRUE

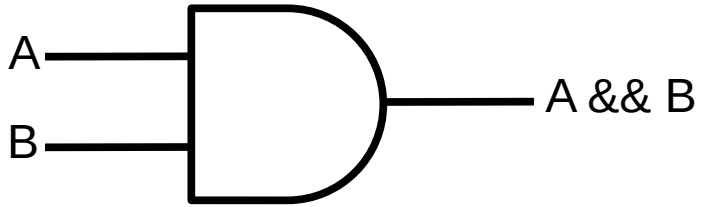
A	!A
1	0
0	1



Logic: AND

A	B	A && B
0	0	0
0	1	0
1	0	0
1	1	1





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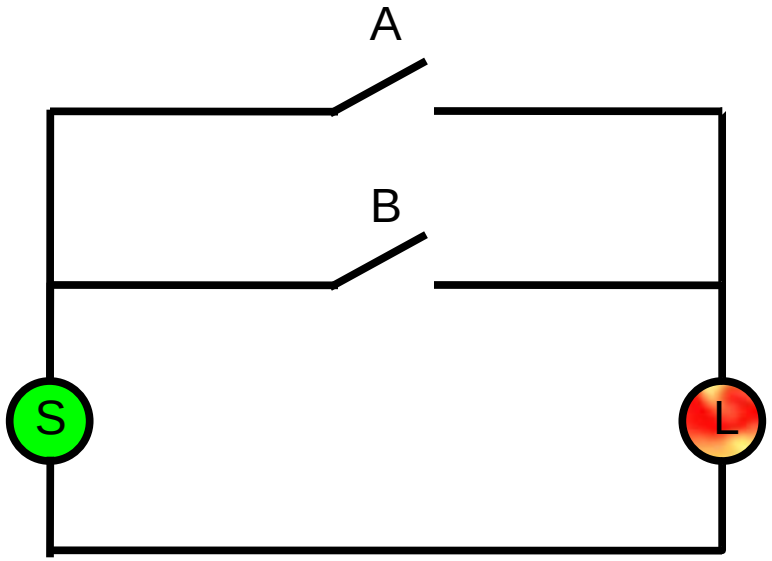
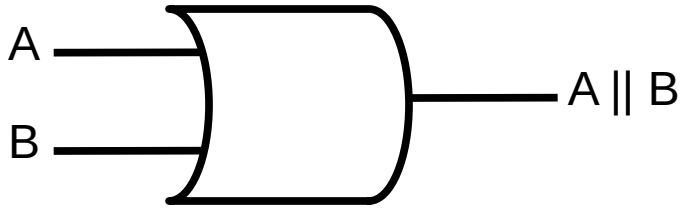
Logic: OR

A	B	A || B
0	0	0
0	1	1
1	0	1
1	1	1





Logic

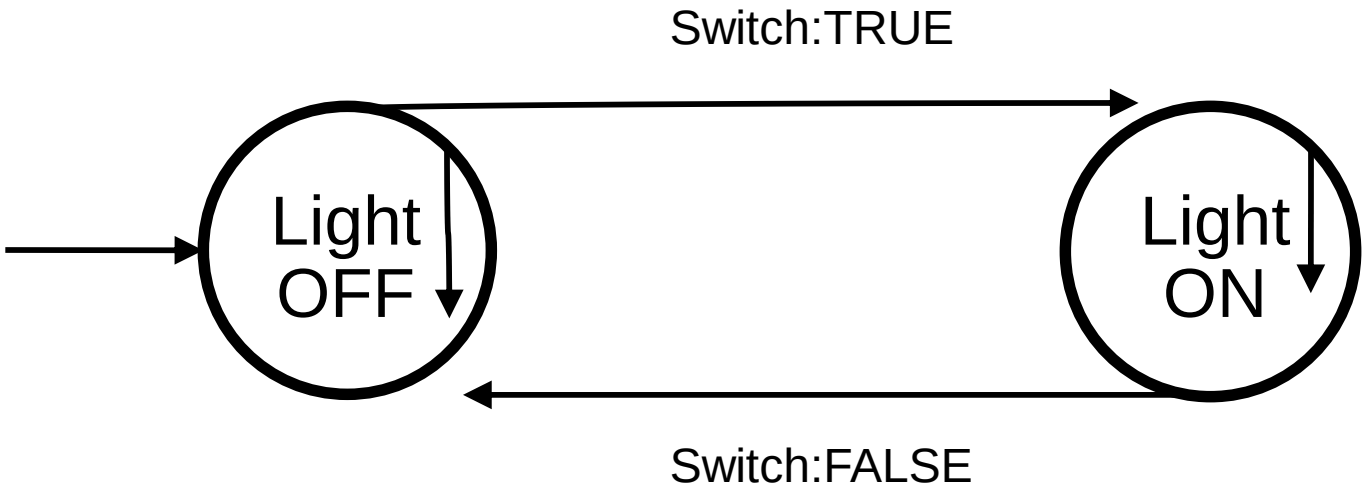
- !T || T
- T || F || F
- F && T
- F && T && T
- !F && T || T
- F && !T
- !F && T
- !!F || !!!F
- !(F && T) || F
- (F && T) || (F || T)

State Machines

- Graphical representation of the relation between variables and states.
  - States are unique configurations of a machine.
  - Unique configurations of data, sensor inputs, motor values etc...

State Machines

Light switch example:

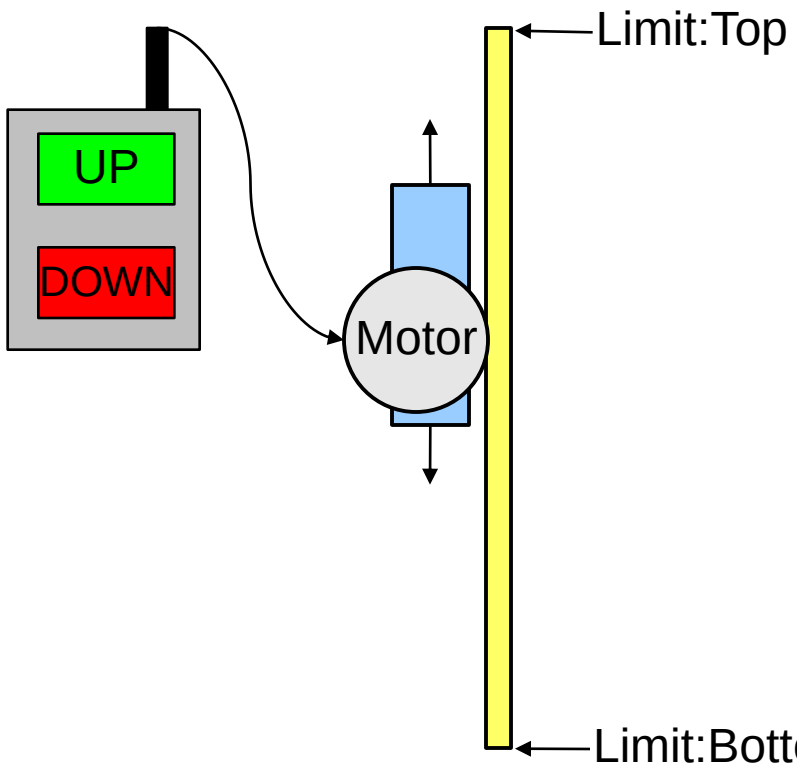


- Two States
  - Light OFF
  - Light ON
- One Variable
  - Switch

State Machines

Activity: Design a state machine for a garage door.

- States
  - Motor Off
  - Motor Up
  - Motor Down
- Variables
  - Button: Up, Down, Hi-Z.
  - Limit: Up, Bottom, Hi-Z.



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