



RoboJackets




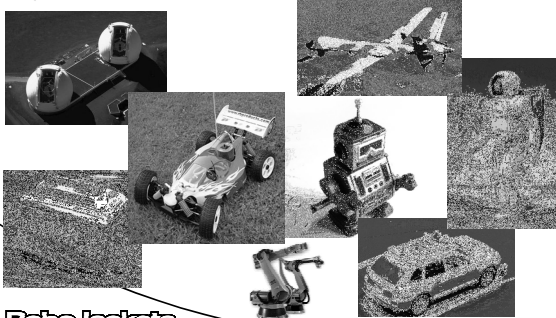
CAT
THE ARTHUR M. BLANK
FAMILY FOUNDATION

TE Sessions – Programming
November 13, 2007




What is a Robot?







RoboJackets




What is a Robot?






Autonomous v. Teleoperated

RoboJackets





A Robot is




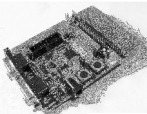

An agent which interacts intelligently with its environment to perform a task.

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







Robot Controller






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

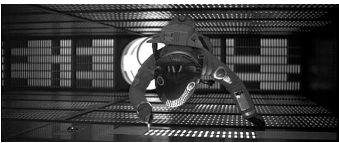






Telling the Robot What To Do




- 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









Language Elements




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


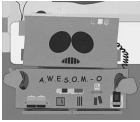






Variables




- 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 than 1000






Instructions: Logic




- **Logic** (descending order of operations)
 - NOT (!)
 - AND (&&)
 - OR (||)




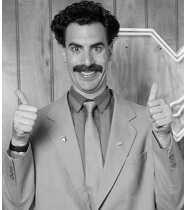


"my logic is undeniable..."



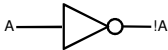
Logic: NOT







A	!A
TRUE	FALSE
FALSE	TRUE

A	!A
1	0
0	1




A —  — !A

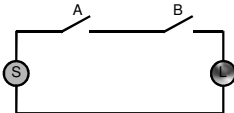
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Logic: AND




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






A —  B — A && B

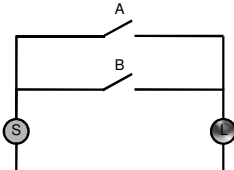
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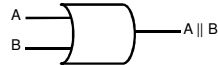



Logic: OR




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






A —  B — A || B

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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:

```


graph LR
    OFF((Light OFF)) -- "Switch:TRUE" --> ON((Light ON))
    ON -- "Switch:FALSE" --> OFF
    
```



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

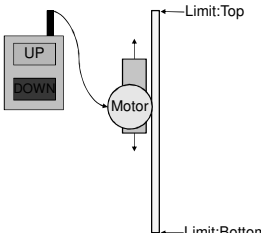


State Machines



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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