CS 5 Not-Quite-Daily News

Cheating Penguin

Claremont (Antarctic News Service): A disgraced penguin left a local college after being caught violating the institution's honor code.

The bird had been working on a computer science game project when a fellow student discovered that the game's animated fish were in fact live animals trapped in his laptop.

"Apparently he couldn't get the animation to look right, so he thought he could take a shortcut and nobody would notice," said a professor. "But when water started leaking from his screen, it was pretty obvious that something was going on. By then the fish had died, and the smell was so bad we had to evacuate the lab."

The penguin will be punished with a one-year suspension and a ban on all future contact with marine life forms.

Homework 12

- Building finite-state machines
  - Mathematical foundations of CS
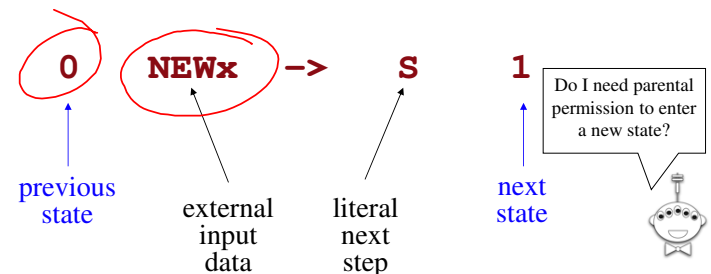
- Project milestone ("progress report")

Labs in Weeks 12-13

- Tue and Wed, 2:45 PM and 6 PM

- Entirely optional
  - Work on FSMs (HW 12)
  - Work on final project milestone

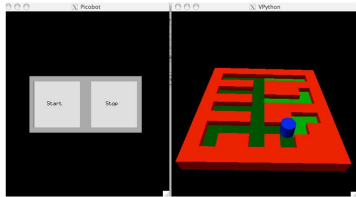- Note: you won't get quick feedback on milestone, so *join us for lab!*

State?

The *state* of a computation (or computer) is

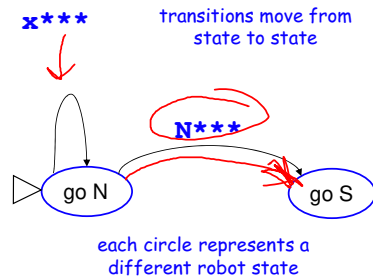*all the internal information* needed to take the next step

0   NEWx   ->   S   1
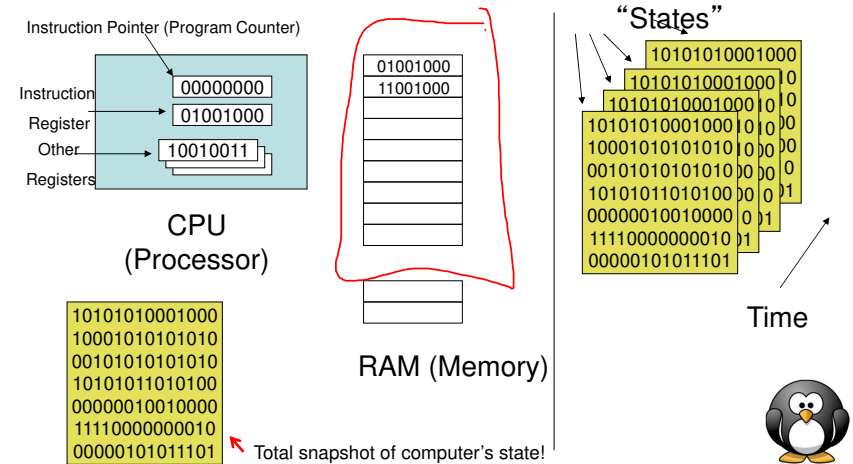
previous state

external input data

literal next step

next state

Do I need parental permission to enter a new state?

Picobot == *State* Machine

state pattern –> move   new state

```
0 x*** -> N 0
0 N*** -> S 1
1 ***x -> S 1
1 ***N -> N 0
```

x***

transitions move from state to state

N***

go N   go S

each circle represents a different robot state

Computer == State Machine

Instruction Pointer (Program Counter)

Instruction
Register

Other
Registers

00000000
01001000

10010011

CPU
(Processor)

01001000
11001000

RAM (Memory)

10101010001000
10001010101010
00101010101010
10101011010100
00000010010000
11110000000010
00000101011101

Total snapshot of computer's state!

"States"

10101010001000
10101010001000
10101010001000
10101010001000
10001010101010
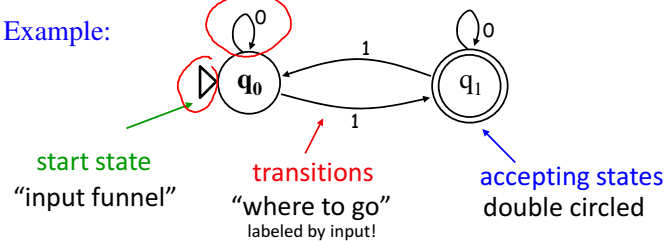00101010101010
10101011010100
00000010010000
11110000000010
00000101011101

Time

Our Model of Computation: FSMs

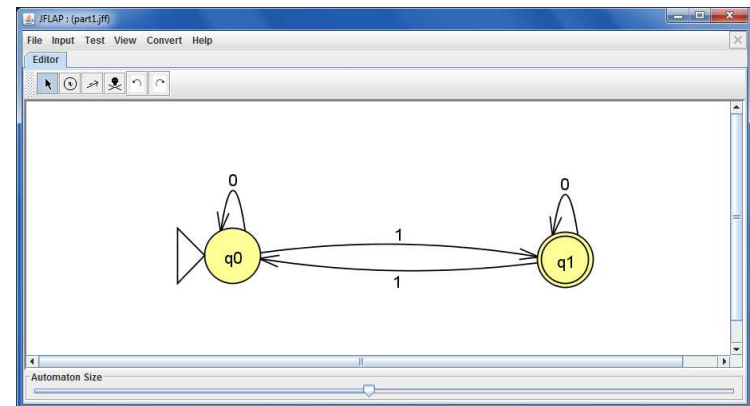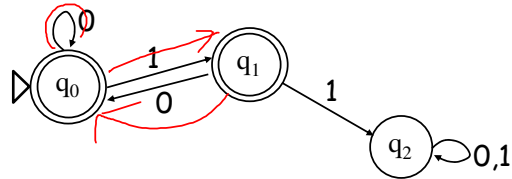FSM or *Finite State Machine* (also called a *Deterministic Finite Automaton*)

Example:

q_0 0   1 q_1 0   1

start state
"input funnel"

transitions
"where to go"
labeled by input!

accepting states
double circled

What does each state "mean"?

What does this FSM do overall?

How it runs:

input sequence   **100101**
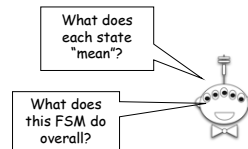
JSFLAP!

Graphical state-machine builder for HW12

JFLAP : (part1.jff)

File Input Test View Convert Help

Editor

0   1   0

q0   q1

1

Automaton Size

Another Example

1. What are three inputs this machine accepts?

2. How about three it rejects?

3. In English, what inputs are accepted?
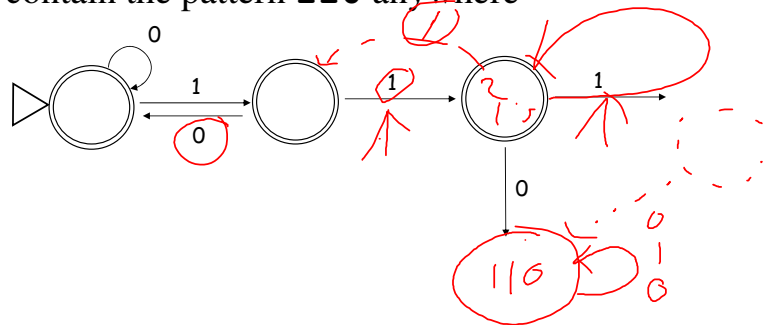
4. What does each state *mean?*

The Alien's Life Advice

Faculty talk among themselves about two kinds of students

Don't be the second kind

No Occurrences of `110`

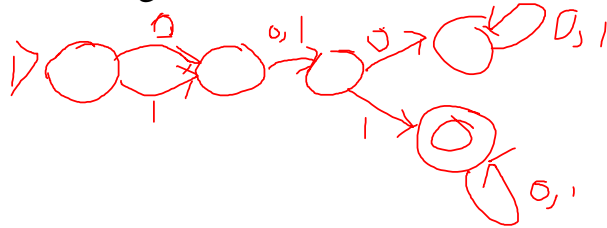Draw an FSM accepting strings that do *NOT* contain the pattern `110` anywhere

The *minimum possible* number of states?

Zeros Are a Multiple of 3

Draw an FSM to accept strings for which the number of zeros is a multiple of 3

Third From Left Is 1

Draw an FSM to accept strings for which the
third digit from the left is a 1

This one makes me
feel loopy!

Third-to-Last Character Is a 1

Draw an FSM to accept strings for which the
third-from-last digit is a 1

Third-to-Last Character Is a **1**

Draw an FSM accepting strings whose
third-to-last digit (from the right) is a **1**.

q_{000} q_{001} q_{010} q_{011} q_{100} q_{101} q_{110} q_{111}

Where does
this go?

8 states suffice!

FSM Computability

Are there limits to an FSM's capabilities?

only 1s and 0s?   OUTPUT ?   variables, lists, memory?

Two More FSMs

What FSM accepts inputs whose first character is the same as the last character?
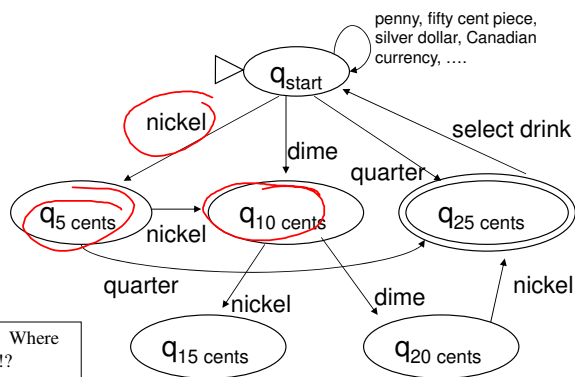
Is this even possible?

Two More FSMs
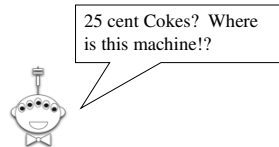
What FSM accepts inputs that are *palindromes* ?

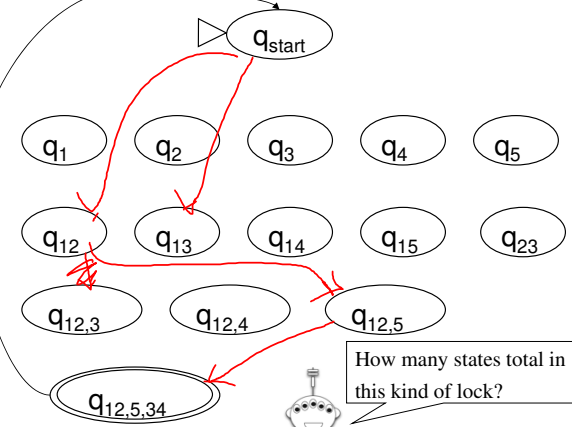Are computers more powerful than FSMs?

FSMs are Everywhere!

penny, fifty cent piece, silver dollar, Canadian currency, ….

q_{start}

nickel

$q_{5\ cents}$

nickel

$q_{10\ cents}$

dime

quarter

select drink

$q_{25\ cents}$

quarter

nickel

$q_{15\ cents}$

dime

$q_{20\ cents}$

nickel

25 cent Cokes? Where is this machine!?

(some transitions not shown)

FSMs are Everywhere!

Open Door

q_{start}

q_1 q_2 q_3 q_4 q_5

q_{12} q_{13} q_{14} q_{15} q_{23}

$q_{12,3}$ $q_{12,4}$ $q_{12,5}$

$q_{12,5,34}$

There's a lot missing here!

How many states total in this kind of lock?

FSM == FearSoMe?

The FSM controlling Quake's
Shambler monsters…

I'm *Quaking* in
my AstroBoots