CS5's view from here...

I've got all my eyes on this view!

What's next?

Final Projects

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Due 4/29: Final project "milestone" (6-7 functions)

Due Fri., 5/3 (8pm): Final project (final version)

Final project: milestone/final

Homework 12

(1) project milestone ~ "progress report"

For the milestone, you’ll submit a new .py file:

milestone.py

worth 25 points

(2) Building finite-state machines

50 assigned points; up to +30 ex. cr. pts; due by 4/29

Labs!

are optional meeting times:

Labs: Tuesdays 1:10-3:10 and 3:15-5:15 pm

• to work on projects: start/milestone/final
• to work on hw 12’s finite-state machines

we won’t be able to get you graded feedback on the milestone before the final project is due – so join us for lab!

CS 5 final exam review materials

The final exam for CS 5 takes place on Tuesday, May 14th, 2019 at 2pm (Section 1) or 7pm (Section 2)

• The review session will be Thursday, May 9th, 2019 at our usual class time (8:10am or 9:35am).

Both are in Shan B442, our usual room.

There will be nearby rooms for extended/distraction-minimized exam-taking.

Final project: milestone/final

Final project: milestone/final

CS Practice

Picobot vPool C4 TextID

Labs!

are optional meeting times:

Labs: Tuesdays 1:10-3:10 and 3:15-5:15 pm

• to work on projects: start/milestone/final
• to work on hw 12’s finite-state machines

we won’t be able to get you graded feedback on the milestone before the final project is due – so join us for lab!
**CS Foundations**

What can we compute... ... and how well?

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**Computers ~ State Machines**

What is *this* state machine?

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**Unifying idea:** State

The *state* of a computation is *all the internal information* needed to take the next step.

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**"Theocomp"**

1. define "computer" precisely
2. define "compute" precisely
3. see what computers *provably* can't compute
4. go back to step (1) and define things better...
5. ... *until* time runs out...

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**CS Practice**

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**Final Projects**

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**CS Theory**

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**CS Applications**

- simulation + analysis/algorithms
- graphics / media / games...
- feature-based modeling + classification
- other state-machines + fun stuff

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**CS Foundations**

What's next?

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**CS 5**

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**CS Theory**

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**CS Practice**

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**CS Applications**

- circuits and memory
- data: classes and objects
- recursion
- variables
- loops
- functions
- CS 5

---

Aargh!
states ~ **subtasks**

**Computation** is a deliberate sequence of state-changes

State Machine:
- each oval represents a different Picobot state

```
state   pattern   move   new state
0 x***  ->  N  0
0 N***  ->  X  1
1 ***x  ->  S  1
1 ***S  ->  X  0
```

**Finite state machine**

- *an input* `001011`

```
State 0
```

```
transition on 0
```

```
State 1
```

```
transition on 0
```

```
transition on 1
```

**FSM:** *Finite state machine*

- *an input sequence* `001011`

```
State 0
```

```
transition on 0
```

```
State 1
```

```
transition on 0
```

```
transition on 1
```

**Output for this input: 001011**

What does each state MEAN? What does this FSM do overall?
what does this state machine do?

empty string, '', or λ

In general, what English phrase describes the rejected inputs?

Extra Could fewer states produce the same accept-and-reject behavior here? What’s the minimum #?

Hint: which strings have to be in separate states?

This machine rejects strings with ...

Label each state with 1-2 inputs that "land" there...

Name(s) ______________________

FSMs are everywhere!

mechanical vending machine

penny, fifty cent piece, silver dollar, Canadian currency, CS 5 Euro, ….

quarter
dime
nickel

nickel
dime
nickel

nickel
dime
nickel

(some transitions not shown)
FSM ~ Game AI

The state-machine that controls Quake's Shambler monsters...

I'm Quaking in my AstroBoots

All robots use FSM control

What states can you "factor out" from watching this towel-folding?

towelFull.mp4
towel.mp4

Build-your-own FSMs

Draw a FSM accepting strings with at least two 1s (anywhere). Others are rejected.

Accepted examples: 0101, 0010110, 1110111, 11
Rejected examples: 0100, 1000, 000000, 0, 1

More stuff needed!

Draw a FSM that accepts strings that don't contain the pattern 110 anywhere.

Accepted: 1010001, 01 Rejected: 10100110, 0111

Draw a FSM accepting strings in which the number of 0s (0s) is a multiple of 3, so there are 0, 3, 6, ... zeros. Is don't matter!

Accepted: 11010110, 11, 0000010
Rejected: 101, 0000, 11011111

Hint: Is never change the state!
Another Hint: make a triangle!

What's the minimum number of states needed?

10

Draw a FSM accepting strings in which the third digit (3d from the left) is a 1.

Accepted: 1010001, 01
Rejected: 11000100, 11, 0

What's the minimum number of states needed?

8

Extra: Draw a FSM accepting strings whose third-to-last digit (3d from the right) is a 1.

Accepted: 0100 and 01101
Rejected: 10101 and 11
All robots use FSM control

An autonomous vehicle's FSM

State-machine limits?

Are there limits to what FSMs can do?

But are there any binary-string problems that FSMs can't solve?

Let's build a FSM that accepts strings with any # of 0s followed by the same # of 1s

accepted
000111
0011
01
λ
State-machines are limited.

**FSMs can't count**
at least not arbitrarily high...

We need a **more powerful model** than FSMs...

What do we need to add?

**Thursday: Turing Machines**

State machines w/ memory!

**Lab sessions this week:** State machines + final projects...
Label each state with 1-2 inputs that "land" there...

Extra Could fewer states produce the same accept-and-reject behavior here? What's the minimum #?

Hint: which strings have to be in separate states?

In general, what English phrase describes the rejected inputs?

This machine rejects strings with ...