Welcome (back) to IST 338!

Homework 0

due Sun. night (11:59pm)

Problem 0: Already complete!

Problem 1: Four-fours program: Can be done for lab...

Problem 2: Rock-paper-scissors program (*Maybe* done already!)

Problems 3-5: Picobot! empty room (3) maze (4) + extra (5)

Problem 6: Reading + response...

Wow – I see the resemblance

Average of these two?
Welcome (back) to IST 338!

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Problems 3-5: Picobot! empty room (3) maze (4) + extra (5)

Problem 6: Reading + response...
Welcome back (from) Baltimore!

world's expert on badge-based incentive systems for education...
Extreme RPS!?

They call *that* an alien?

Spock *mind-melds* three-eyed aliens!

Try RPS-101!

this is definitely worth a badge!

Provably.

http://www.youtube.com/watch?v=iapcKv7DdY
http://www.youtube.com/watch?v=yuEZEyDdmvQ
Last time...

What is CS?

CS is the study of complexity

How can it be done?
How well can it be done?
Can it be done at all?

CS's 6 big questions are here.

But only one is programming.
Do you see which?

Can you solve this problem?
Can you create a process to solve such problems?

How quickly can you find solutions?
Do you have the “best” solution?
Is every problem solvable?
Is there a way to tell?

There isn’t always!

CS != Programming
What about the *Python* programming language?
Python?

One possible relationship... vs.
Happy co-existence…

Python!

One possible relationship... vs.

Happy co-existence...

*It can even be comfy!*
Exclusive Choices

if ... elif ... else

```python
if perc > .95:
    print 'A'

elif perc > .90:
    print 'A-

elif perc > .70:
    print 'Pass'

else:
    print 'Aargh!'
```

4 mutually exclusive blocks in a single control structure

When using if . elif ... . else at most one block will run: the first whose test is True. If all fail, the else will run

elif and else are optional
## What's the difference?

<table>
<thead>
<tr>
<th>mutually exclusive blocks</th>
<th>nonexclusive blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>if</strong> perc &gt; .95:</td>
<td><strong>if</strong> perc &gt; .95:</td>
</tr>
<tr>
<td>print 'A'</td>
<td>print 'A'</td>
</tr>
<tr>
<td><strong>elif</strong> perc &gt; .90:</td>
<td><strong>if</strong> perc &gt; .90:</td>
</tr>
<tr>
<td>print 'A-'</td>
<td>print 'A-'</td>
</tr>
<tr>
<td><strong>elif</strong> perc &gt; .70:</td>
<td><strong>if</strong> perc &gt; .70:</td>
</tr>
<tr>
<td>print 'Pass'</td>
<td>print 'Pass'</td>
</tr>
</tbody>
</table>

What if `perc == .99`? (How would we set it?)

How many separate *control structures* does each side have?
What will this do?

```python
comp = 'rock'
user = 'paper'

if comp == 'paper' and user == 'paper':
    print 'We tie. Try again?'

elif comp == 'rock':
    if user == 'scissors':
        print 'I win! *_*'
    else:
        print 'You win. Aargh!'
```

does this program print the correct RPS result this time? Does it always?

try it: RPS example #1
comp = 'rock'
user = 'rock'

if comp == 'rock':
    if user == 'paper':
        print 'I win *_*!'
    elif user == 'scissors':
        print 'You win.'
    else:
        print 'Tie.'
        print 'Ties go to the runner.'
        print ' - and I am running!'

try it: RPS example #2
What does this print?

comp = 'rock'
user = 'rock'

if comp == 'rock':
    print 'I win *_*!'

if user == 'paper':
    print 'You win.'

else:
    print 'An awful tie'

try it: RPS example #3
What does this print?

```python
comp = 'rock'
user = 'rock'

if comp == 'rock':
    print 'I win *___*!

if user == 'paper':
    print 'You win.'

else:
    print 'An awful tie'
```

How many possible “input cases” are there?
For how many is this program correct?

... how efficiently can RPS be represented by program?
- Fewest number of blocks?
- Fewest number of tests?
This week: hw0pr1

get Python running on your own machine

Python source code, a plain-text file
(here, edited by the Sublime text editor)

shell prompt > or $

shell or command-line or terminal
(the execution environment)
Commanding the command-line

**in Windows' plain cmd**

- `cd .`  
- `dir`  
- `cd`  
- `..`  
- `.`

**Mac/Linux/Windows Powershell**

- `pwd`  
- `ls`  
- `cd`  
- `..`  
- `.`

- `move`  
- `mv`  
- `copy`  
- `cp`  
- `mkdir`  
- `make dir`
Mental model ...

usual picture ~ a **window** into the underlying structure
a couple of shortcuts...

Up arrow

• Brings back previously-typed commands
• Down arrow ~ scrolls the other way

Tab key

• Completes the file or folder name you start
• Cycles through possibilities (older versions would pause...)
Mental model ...

```
$ cd ..
cd $ pwd
dir $ ls
$ cd C
$ mkdir BotFiles
$ cd B
$ cp ../pico3.txt .
$ start
cd

$ cd ..
move $ mv p .
```

Desktop

CS5 (folder)

- pico3.txt (file)
- pico4.txt (file)
Mental model ...

```bash
$ cd ..
cd  $ pwd
dir  $ ls
$ cd C
$ mkdir BotFiles
$ cd B
$ cp ../pico3.txt .
$ move $ mv p ..
$ cd..
```

Desktop
- pico3.txt (file)
- CS5 (folder)

CS5
- pico4.txt (file)
- BotFiles (folder)

BotFiles
- pico3.txt (file)
Try it!

$ mkdir Week0
$ cd W
$ mv ../h .
$ cd ..
$ mkdir Week1
$ cd W
$ cp ../h .

Extra #2: What line here would copy the `hw0pr0.py` file to the current location? *See if you can use tabs*...

Extra #1: What is the current folder here?
Not to mention...

```
python
```

where

```
which
```

type

```
cat
```

tree

```
find .
```

```
ping
```

may need

to install

```
curl or wget
```

This is a window into the directory tree...
1479: Troubleshooting

WAIT, WHY CAN'T I CLICK ANYWHERE?
I DON'T... UGH, IT OPENED
A DIALOG BOX OFFSCREEN.
WHY IS THAT EVEN POSSIBLE?
IT REALLY SHOULDN'T BE. BUT
YOU CAN FIX IT BY CHANGING
YOUR SCREEN RESOLUTION TO
TRIGGER A WINDOW CLEANUP.
SERIOUSLY?
I KNOW, I KNOW...

TO BE HONEST, I CAN'T WAIT FOR THE
DAY WHEN ALL MY STUPID COMPUTER
KNOWLEDGE BECOMES OBSOLETE.

guest@xkcd:/$ cat welcome.txt
Welcome to the unixkcdn console.
To navigate the comics, enter "next", "prev", "first", "last", "display", or "random". Use "ls", "cat", and "cd" to navigate the filesystem.
guest@xkcd:/$
Command line?!?

The Operating System's Window Manager

Consume

Computational interactions (files, folders, data...)

Compose

Physical interactions (arithmetic and storage)

Crazy!

not really fair...
Command line?!?

The Operating System's Window Manager

Consume

Computational interactions (files, folders, data...)

Compose

Physical interactions (arithmetic and storage)

Commoditized!
Useful? Consuming Composing
Hey Prof. Dodds,

Hope you're doing well and your semester is off to a good start! I began working for E3, a top energy and environmental economics firm in the country, in June. While technically my title is Analyst, there is a ton to learn in the energy sector, so I'm primarily feeling like a student these days!

As one of the few people in the office with real programming experience, I have helped a few of my coworkers with various tasks. You'll be happy to hear that I've used Python exclusively for all of the things people needed help with: converting XML files to CSVs, running outlier detection on a massive weather data set, I even built an optimizer for our office volleyball team to figure out what our starting configuration should be!

Thus, I'm writing, as usual, with a Python question. I'm doing work for a colleague in which we want to submit a web query to a particular website, which then gives us back a prompt to download a CSV with a bunch of pertinent data that we can use. The CSV represents one day’s worth of info, but my colleagues want to be able to download several days (as much as a month) of data quickly. However, the only argument that the web query takes is the day you would like to look at. So, in short, I want to put together a tool that will take a start and end date as arguments, and will then iterate through each day between the two, assemble the corresponding URL, "click" it to initiate the download, and then compile all of the resulting files into one nice CSV.

I can definitely compile all of the CSVs into one nice one once all of the downloads have taken place, and it shouldn't be very hard to write something that will iterate through the given dates and create each URL. My problem comes when I try to figure out how to "click" a URL and initiate a download/determine where the download should be saved, all within a Python script.

I was hoping you'd maybe have an entirely different language that would be a better task for an outcome.

Everything at the command line is automatable and programmable...
Useful!

Consuming  Composing

Python question

Brendan Schneiderman <brs02010@mymail.pomona.edu>
to Zachary

Hey Prof. Dodds,

Hope you're doing well and your semester is off to a good start! I began working for E3, a top energy and environmental economics firm in the country, in June. While technically my title is Analyst, there is a ton to learn in the energy sector, so I'm

Brendan Schneiderman <brs02010@mymail.pomona.edu>
to Zachary

Hey Zach,

Just wanted to write to you and let you know that, with your help on CURL, I've developed a tool that is now being used office-wide to access some otherwise elusive data from a crash-prone website. I'm having colleagues drop by literally daily to ask for help in accessing the data.

... together a tool that will take a start and end date as arguments, and will then iterate through each day between the two, assemble the corresponding URL, "click" it to initiate the download, and then compile all of the resulting files into one nice CSV.

I can definitely compile all of the CSVs into one nice one once all of the downloads have taken place, and it shouldn't be very hard to write something that will iterate through the given dates and create each URL. My problem comes when I try to figure out how to "click" a URL and initiate a download/determine where the download should be saved, all within a Python script.

I was hoping you'd maybe chime in... Everything at the command line is automatable and programmable...
Another language already?

Python

*General-purpose language*

you might see 50% by the end of the term

even then, <1% of its libraries!

Picobot

*Special-purpose language*

you'll see 100% in the next 10 minutes

The Picobot simulator

www.cs.hmc.edu/picobot
HW problems 3 and 4: Picobot!

**Goal**: full-room coverage with only *local sensing*...

\[ \text{Inspiration?} \]
HW problems 3 and 4: Picobot!

**Goal:** full-room coverage with only *local sensing*...

Roomba!
can't tell "vacuumed" from "unvacuumed" area

Let's see it!
Surroundings

Picobot can only sense things directly to the N, E, W, and S

For example, here its surroundings are

\[ \text{N x W x X} \]

Surroundings are always in NEWS order.
What are these surroundings?

Surroundings are always in NEWS order.

Wow - this one is disgusting!
Surroundings

How many distinct surroundings are there?
How many distinct surroundings are there?

\[2^4 = 16\] possible

Surroundings

xxxx
Nxxx
xxEx
xxWx
xxxx
NExx
NxWx
NxxS

xExWx
xEoS
xxWS
NEWx
NEoS
NxWS
xEWS
NEWS
(won't happen)
Picobot's memory is a single number, called its state. State is the internal context of a computation, i.e., the subtask. Picobot always starts in state 0.

State and surroundings represent everything Picobot knows about the world.
Picobot acts through a **set of rules**:

<table>
<thead>
<tr>
<th>state</th>
<th>surroundings</th>
<th>direction</th>
<th>new state</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>xxWS</td>
<td></td>
<td>N</td>
</tr>
</tbody>
</table>

**Notes**

- Picobot checks its rules from the top each time.
- When it finds a matching rule, that rule runs.
Rules

Each rule expresses your intent for Picobot!

I am in state 0. My surroundings are xxWS.

Picobot acts through a set of rules

*Each rule expresses your intent for Picobot!*

<table>
<thead>
<tr>
<th>state</th>
<th>surroundings</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>xxWS</td>
</tr>
</tbody>
</table>

*If I'm now in state 0 seeing xxWS,*

<table>
<thead>
<tr>
<th>direction</th>
<th>new state</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>0</td>
</tr>
</tbody>
</table>

*Then I move North, and "change" to state 0.*

Let's try it! (on board)
Wildcards

Asterisks * are wild cards. They match walls or empty space:

N must be empty

EWS may be wall or empty space

I only care about NORTH being EMPTY
(A) A rule that sends Picobot to the North as far as it can go:

<table>
<thead>
<tr>
<th>state</th>
<th>surroundings</th>
<th>direction</th>
<th>new state</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>x***</td>
<td>N</td>
<td>0</td>
</tr>
</tbody>
</table>

(B) What does this next rule do?

<table>
<thead>
<tr>
<th>state</th>
<th>surroundings</th>
<th>direction</th>
<th>new state</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>N***</td>
<td>W</td>
<td>1</td>
</tr>
</tbody>
</table>

(C) What about this one?

<table>
<thead>
<tr>
<th>state</th>
<th>surroundings</th>
<th>direction</th>
<th>new state</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>***x</td>
<td>S</td>
<td>1</td>
</tr>
</tbody>
</table>

(D) How could we stop at the bottom and return up through the same column?
**The Rule:**

One step per rule

---

One rule to rule them all? Precious!

---

**Picobot's world**

---

Extra! What additional rules would be needed in order to ensure that Picobot fully explores the empty room (not this crazy room) from any starting spot?

*(this is problem 3...)*
Picobot hw problems

problem 3

problem 4

Extra! (#5)

Your rules must work *regardless* of Picobot's starting position...!
Your rules must work *regardless* of Picobot's starting position...!
(1) How many times does the 1st rule run? _______
(2) How many times does the 2nd rule run? _______
(3) How many times does the 3rd rule run? _______
(4) In English, what does state 0 do?
(5) How could this help clear the empty room? ...
   just a thought experiment
(6) Add 2-3 rules that will, in state 1, get Picobot to the top of the stalagmite, then stop.
(Extra!) What approach could get Picobot to travel around the whole outer edge?
Maze strategies?
Maze solving algorithm

From Wikipedia, the free encyclopedia

There are a number of different maze solving algorithms, that is, automated methods for the solving of mazes. The random mouse, wall follower, Pledge, and Trémaux algorithms are designed to be used inside the maze by a traveler with no prior knowledge of the maze, whereas the dead-end filling and shortest path algorithms are designed to be used by a person or computer program that can see the whole maze at once.

Mazes containing no loops are known as "standard", or "perfect" mazes, and are equivalent to a tree in graph theory. Thus many maze solving algorithms are closely related to graph theory. Intuitively, if one pulled and stretched out the paths in the maze in the proper way, the result could be made to resemble a tree.\[1\]

Contents [hide]

1 Random mouse algorithm
Maze strategies?

_Right Hand Rule_

Keep your "right hand" on the wall, Picobot!

Why might this be difficult for Picobot?
Maze strategies?

**Right Hand Rule**

We'll need to use state to represent the direction Picobot is facing.

State 0
State 1
State 2
State 3

Keep your "right hand" on the wall, Picobot!
(A) Here is a single rule that tells Picobot:

*If you're facing N with a wall at right and space ahead then go forward* 

\[
\begin{array}{cccc}
0 & xE** & \rightarrow & N & 0 \\
\end{array}
\]

(B) Let's write a single rule that tells Picobot:

*If you're facing North and lose the wall, then get over to the wall now!*

\[
\begin{array}{cccc}
0 & \rightarrow \\
\end{array}
\]

(C) *(for HW)* Write 1 or 2 rules to tell Picobot to do the right thing if it hits a dead end.

Repeat this IDEA for all four states, representing all four *facing directions.*
Problem 6 this week...

Typically an article on CS or an application...

Submit a one-paragraph response { A few sentences that raise or address questions, using the article as a guide.

Small part (5 pts) { 5 – insightful, careful
4 – thoughtful
3 – complete, on topic
0-2 – less than complete

Does Your Language Shape How You Think?

This week's article might not seem like CS at first...
Seventy years ago, in 1940, a popular science magazine published a short article that set in motion one of the trendiest intellectual fads of the 20th century. At first glance, there seemed little about the article to augur its subsequent celebrity. Neither the title, “Science and Linguistics,” nor the magazine, M.I.T.’s Technology Review, was most people’s idea of glamour. And the author, a chemical engineer who worked for an insurance company and moonlighted as an anthropology lecturer at Yale University, was an unlikely candidate for international superstardom. And yet Benjamin Lee Whorf let loose an alluring idea about language’s power over the mind, and his stirring prose seduced a whole generation into believing that our mother tongue restricts what we are able to think.

and I thought my language was alien!
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**But then** a remote Australian aboriginal tongue, Guugu Yimithirr, from north Queensland, turned up, and with it came the astounding realization that not all languages conform to what we have always taken as simply "natural." In fact, Guugu Yimithirr doesn't make any use of egocentric coordinates at all. The anthropologist John Haviland and later the linguist Stephen Levinson have shown that Guugu Yimithirr does not use words like "left" or "right," "in front of" or "behind," to describe the position of objects. Whenever we would use the egocentric system, the Guugu Yimithirr rely on cardinal directions. If they want you to move over on the car seat to make room, they'll say "move a bit to the east." To tell you where exactly they left something in your house, they'll say, "I left it on the southern edge of the western table." Or they would warn you to "look out for that big ant just north of your foot." Even when shown a film on television, they gave descriptions of it based on the orientation of the screen. If the television was facing north, and a man on the screen was approaching, they said that he was "coming northward."
CS ~ complexity science

problem 3

Shortest Picobot program:

6 rules

complexity is deeper than simply the # of rules...

problem 4

Shortest Picobot program:

8 rules

Extra! (5)

Shortest Picobot program:

? rules

Can it simply be done?
As you head northwards...

You are not alone!

Lead on! I will follow.

Tutoring hours all weekend in the LAC lab - also, weekday evenings @ LAC lab, too

I can attest to that!

Happy Picobotting!
Each week's lab...

0) Feel free to stay for the final hour...

1) ... to work on the problems

2) Also, you can use the CS5 lab and tutoring times, linked from the site

Encouraged: *bring your laptop*
Seek help!

Tutoring schedule...

every day there are tutoring hours in the **LAC** computer lab

this link:
HMC office + tutoring locations

Enter through Olin building
Beckman B163 ~ office location
west-side entrance

Tutoring hours are in the Linde Activities Center computer lab (LAC lab)
Each week's lab...

0) Feel free to stay for the final hour...

1) ... to work on the problems.

2) Also, you can use the CS5 lab and tutoring times, linked from the site.

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Thanks, everyone!