The CS5 Times

Eager Penguins Invade CS Course

Claremont (AP): The first-day offering of Harvey Mudd’s popular CS5 course was disrupted when a large flock of penguins “Zoom-bombed” it. “They’re cute,” complained one distraught student, “but their squawking makes it impossible to hear the professor.”

Another student disagreed. “It was easier to understand the penguins than the class material. If I can figure out where they live, I’m going to mail them some fish as thanks.”

The professor eventually managed to halt the interruption by installing an aquarium screen-saver.

Office hours: see Web site
Zoom links will not be posted or included in slides. See your e-mail!

Virtual penguins? ;^)

Rules for Online Class

Let’s admit it: this is weird

1. Use your full name (nickname preferred) on Zoom
2. Don’t share or post Zoom links
3. Always have a blank sheet of paper for a worksheet
4. Keep your camera on unless your bandwidth is bad
5. Attendance (for the full session) is expected
   • E-mail me if your timezone is horrible

Can we do this inside Fortnite?

The textbook…

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Programming Languages...

- A+
- A++
- A#
- A-
- ABAP
- ABC
- ABC ALGOL
- ABLE
- ABSENT
- ABESIS
- ACR
- Acc
- ACT
- ATOLL - Acceptance, Test Or Launch Language
- Aulby
- ACS
- Actor
- Ada

2000+: languages omitted
- YAPL
- Yellow - Rejected prototype for Ada
- Yorick
- Y Language
- Z notation - A program specification language, like UML
- ZPL
- ZUG
- ZTT-esp

Python

- Relatively “nice” syntax
- Emerging as language of choice in many fields
- Packages for graphics, audio, scientific computing, …

Python

```python
print("Hello World")
```

```java
class HelloWorld {
    static public void main(String args[]) {
        System.out.println("Hello World!");
    }
}
```

Befunge

```befunge
v ,,,,"Hello"v
v ,,,,"World!"v
>25+8
```

Hello World...

```cpp
#include <iostream.h>

main() {
    cout << "Hello World!" << endl;
    return 0;
}
```

Some Things You’ll Do This Semester...

Sequence alignment

<table>
<thead>
<tr>
<th>ATTATCG</th>
<th>A</th>
<th>TATCG</th>
<th>CAT.CG</th>
<th>CATTGC</th>
<th>CATTAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTATCG</td>
<td>A</td>
<td>TATCG</td>
<td>CAT.CG</td>
<td>CATTGC</td>
<td>CATTAC</td>
</tr>
</tbody>
</table>

Distance is 4

<table>
<thead>
<tr>
<th>ATTAT.CG</th>
<th>A-CATTAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTAT.CG</td>
<td>A-CATTAC</td>
</tr>
</tbody>
</table>

Ook
Spel Cheking…

Huffman Data Compression

Connect 4 AI

Picobot!
Reading: Chapter 1 in the book (http://www.cs.hmc.edu/csforall/)

This language is not Turing-Complete. I guess that makes it "unreasonable"!

Goal: whole-environment coverage with only local sensing…
Environment in the NEWS!

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

For example, here its surroundings are

\[ \begin{array}{cccc}
  N & & & \\
  W & & E & \\
  S & & & \\
\end{array} \]

\[ \begin{array}{cccc}
  N & X & W & X \\
  \uparrow & \uparrow & \uparrow & \uparrow \\
  N & E & W & S \\
\end{array} \]

Surroundings are always in NEWS order.

State

I am in state 0. My surroundings are \( xxWS \).

State is the internal context of computation.

Picobot always starts in state 0.

State and surroundings represent everything the robot knows about the world.

Surroundings

How many distinct surroundings are there?

\[ 2^4 = 16 \text{ possible...} \]

Rules

Aha! I should move N. I should enter state 0.

Picobot moves according to 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>N</td>
<td>0</td>
</tr>
</tbody>
</table>

If I'm in state 0 seeing \( xxWS \), Then I move North, and change to state 0.
Wildcards

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

state | surroundings | direction | new state
--- | --- | --- | ---
0 | x*** | N | 0

Aha! This matches x***

and EWS may be wall or empty space

N must be empty

This Week!

Write rules that will always cover these two rooms. (separate sets of rules are encouraged…)

lab Problem

Problem 2

What’s the Point?

- Simple syntax can support “powerful” computation:
  The picobot language syntax is very simple, yet it can control a robot in a complex environment.

- Computer scientists examine limitations of languages:
  - Are there environments that the picobot language cannot navigate?
  - If so, what features could be added to give the language more “power”?

DEMO!

Your “program” can be slow but it should work for any starting location and for any wall-connected maze!

our best: 3 states, 7 rules (but Cam Zhou had 6)  our best: 4 states, 8 rules
How About “General” Rooms?

Picobot has 100 states, but the “room” could be arbitrarily big and weird!

Defining Your Own Functions!

```python
def dbl(x):
    return 2 * x
```

```python
def dbl(myArgument):
    myResult = 2 * myArgument
    return myResult
```

Docstrings!

```python
def dbl(x):
    """This function takes a number x and returns 2 * x"""
    return 2 * x
```

Python and the Command Line

Python makes it easy to experiment!
# Doubling program
# Author: Ran Libeskind-Hadas
# Date: August 27, 2011
# Time Spent: 14 hours

def dbl(x):
    """This function takes a number x
    and returns 2 * x""
    return 2 * x

Docstrings…and Comments

Multiple Arguments...

x, y  myFunc  x + 42 * y

Multiple Arguments...

Mapping with Python...

def dbl(x):
    """returns 2 * x""
    return 2 * x

def evens(n):
    myList = range(n)
    doubled = list(map(dbl, myList))
    return doubled

Alternatively....

def evens(n):
    return list(map(dbl, range(n)))

Composition of Functions

def quad(x):
    return 4 * x

That's a kind of a funky function!

Composition of Functions

def quad(x):
    return dbl(dbl(x))

Doubly cool!

Mapping with Python...

>>> list(map(dbl, [0, 1, 2, 3, 4]))
[0, 2, 4, 6, 8]
reduce-ing with Python...

```python
from functools import reduce
def add(x, y):
    """returns x + y""
    return x + y

>>> reduce(add, [1, 2, 3, 4])
10
```

---

Try This...

Write a function called `span` that returns the difference between the maximum and minimum numbers in a list...

```python
>>> span([3, 1, 42, 7])
41
>>> span([42, 42, 42, 42])
0
```

These are built in to Python!

---

Try This...

1. Write a python function called `gauss` that accepts a positive integer N and returns the sum 1 + 2 + ... + N

2. Write a python function called `sumOfSquares` that accepts a positive integer N and returns the sum 1² + 2² + 3² + ... + N²

Google’s “Secret”

This is what put Google on the map!