A Brief Review of Python

COMPSCI 270 Introduction to AI

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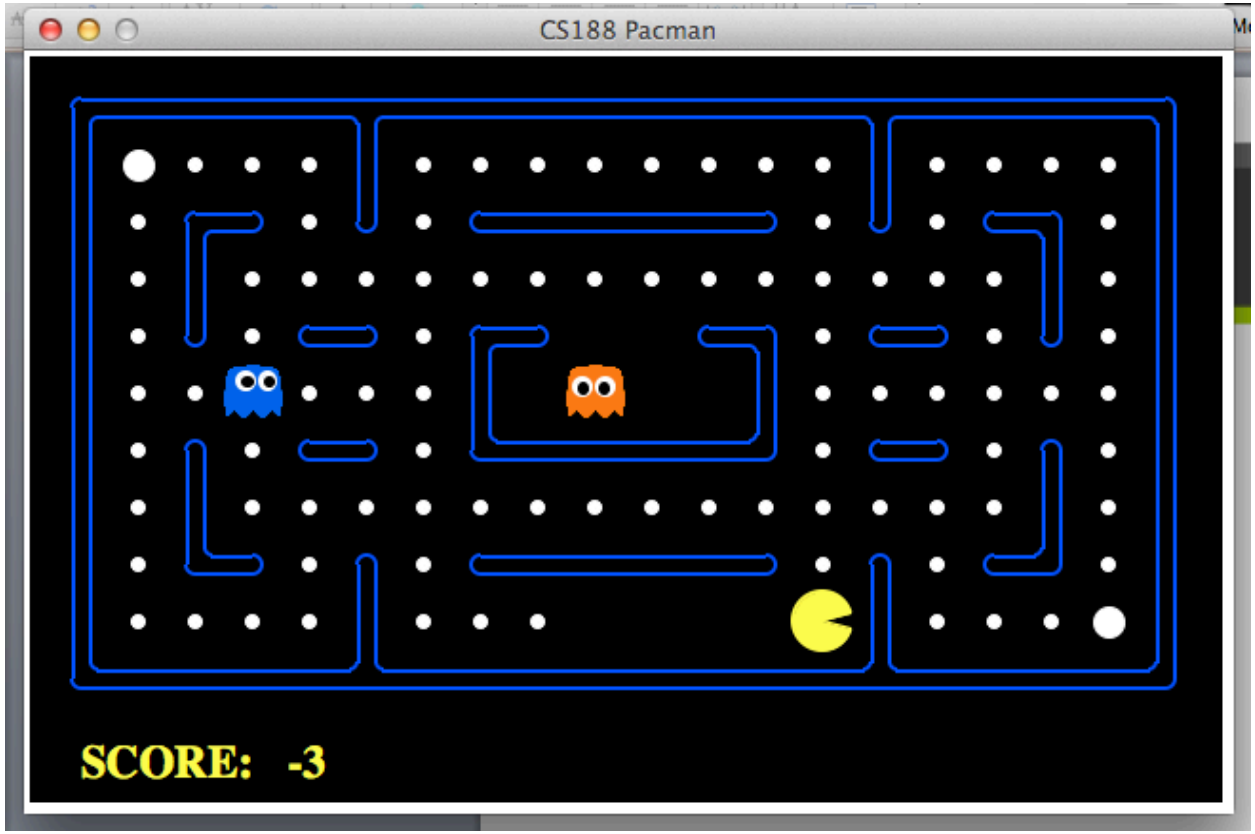
First Steps

- Go to python.org. Download and install python 2.7 on your system.
- Choose an IDE/editor that you feel comfortable with.
  - Text editor: Vim, Emacs, Sublime Text, etc.
    - (Make sure you install extension for writing python conveniently)
  - IDE: Eclipse + PyDev, Spyder, PyCharm, etc.
- Download and unzip search.zip from the course website
  - Make sure you can execute the python script from command line/terminal
    - $ python pacman.py
    - $ python pacman.py --help

First Steps

: the points that can potentially be very useful in the pacman assignments.



The Python Style

- Interpreter
  - Interactive running
  - Running a script

```
while True:
    s = input('Enter something : ')
    if s == 'quit':
        break
    print('Length of the string is', len(s))
print('Done')
```

- Program is structured by ":" and indentation
  - Options: TAB, 2 spaces, 4 spaces (usually configurable in your IDE/ Editor)
  - Be consistent throughout the program!
  - Pacman project: 2 spaces 
- Using a variable without declaration
- Dynamic typing

Basic operators

- Most are straightforward
  - + - / * %
- NOTE
  - Division: integer vs. fractional
    - 1/2 results in 0, 1.0/2 results in 0.5
    - Trick: a * 1.0 / b
  - Power: ** (not ^ as in some other languages)
  - Indexing: [ ]
    - List, dictionary

Built-in Data Structures

- **List**
  - Like an array, but can store elements with different types
    - >>> a = [] *(initialize an empty list)*
    - >>> a = [“hello”, 1, 5.5]
    - >>> listOfList = [[1,2],[3,4]]
  - Indexed from 0
  - Operations
    - a.append[x]
    - removal
      - del a[0]
      - if “hello” **in** a: a.remove(“hello”) *(first occurrence of the value)*
    - a.sort() *(in place) (do not forget the brackets, it is a method)*
    - a.reverse() *(in place)*
    - a + listOfList *(concatenation)*

Built-in Data Structures

- **Tuple**
  - x = (1,2,'ok')
  - Much like a list, but cannot be changed. *(immutable)*

Built-in Data Structures

- **Dictionary**
  - A hash table that stores a mapping: key -> value
    - mydict = {} *(initialize)*
    - mydict[1] = “one” *(automatically adding a new key-value pair)*
  - Keys do not have a fixed order
  - Key must be of an immutable type:
    - string, number
    - tuple
      - mydict[(-1,0)] = “west”
  - Operations
    - mydict.keys() *(in the form of a list)*
    - mydict.values() *(in the form of a list)*
    - print mydict[(-1,0)]
    - del mydict[(-1,0)]
  - How to get the keys sorted by value?
    - for w in sorted(mydict, key=mydict.get):
      - print w, mydict[w]

Built-in Data Structures

- **Set**
  - An unordered collection of unique elements
  - Efficient to test if an element is marked/visited
    - x **in** exploredSet 
  - Initialization
    - setOfShapes = set() *(empty set)*
    - setOfShapes = set([“circle”, “triangle”, “square”, “circle”])
    - setOfShapes = {“circle”, “triangle”, “square”, “circle”} (don’t get confused with dictionary)
  - Operations
    - setOfShapes.add(“hexagon”)
    - setOfShapes.remove(“circle”)
    - set1 | set2
    - set1 & set2
    - set1 – set2

Other Data Types

- **String**
  - `Z = “chem” + “is” + “try”`
- **Integer**
  - int_x = int(x)

Control Flows

- **If statement**

```
if x==0:
  print “zero”
  print “wrong input!”
elif x>0:
  print “positive”
else:
  print “negative”
```

Control Flows

- **For statement**
- **Generally**
- **for x in iterableObject**
  - Iterable: list, tuple, set, dictionary

```
myColors = [“yellow”, “blue”, “red”]
for color in myColors:
  print color

for  i in range(0, len(myColors)):
  print myColors[i]
```

Control Flows

- **While statement**
  - `i = 0`
  - `while i<100:`
  - `  i = i + 1`

Control Flows

- **Special clauses in loops**
  - **break**
  - **continue**
  - **else**
    - An optional else “block” can be written after “for” or “while” block
    - The “else” block will be executed if no “break” is executed in the loop

```
for answer in possibleAnswers:
    if isRightAnswer(answer):
        break
else:
    print “No answer found”
```

Writing a Function

- **Defining a function**
  - `def myadd(x, y):`
  - `    z = x+y`
  - `    return z` *(would return None if without this line)*

- **Calling functions**
  - `myNumbers = [2, 4]`
  - `print myadd(myNumbers[0], myNumbers[1])`
  - `print myadd(*myNumbers)` *(unpacking arguments from list or tuple)*

Object Oriented: Writing a Class

- Defining a class
  - Starting with ``def `className:`''
    - def classname(baseClassName) *(inheritance)*
  - Providing **data attributes** and **methods** with ``self''
    - `self.title = "a simple class''`
    - `def showTitle(self, repeats=1):`
      - `for t in range(0, repeats):`
        - `print self.title`
  - Initializing the class with method by providing
    - `def __init__(self, someArg):`
  - Making a variable *looking* private by naming with a leading underscore
    - Unlike C++, Python does not enforce data hiding mechanism

Example: Queue

```
class Queue:
    def __init__(self):
        self.queueList = []

    def push(self, x):
        self.queueList.append(x)

    def pop(self):
        z = self.queueList[0]
        del self.queueList[0]
        return z

    def isEmpty(self):
        return (len(self.queueList)==0)
```

- This is provided by util.py
  - `import util`
  - `myQueue = util.Queue()`
- Read util.py to learn other utilities that lessens your burden of implementation
- Try implementing a **TreeNode** class on your own
  - Parent
  - Path from root

Useful Tricks

- When you are not sure what it is/what went wrong, try printing it out
  - `print` is safe with almost every object 
- List comprehension -- mapping a list of input to a list of output with a function
  - S = [x**2 for x in range(10)]
  - S_even = [x for x in S if x%2==0]

Useful Tricks

- Looping with ease
  - Iterate with (index, value) pair
    - `for i, v in enumerate(["a","b","c"])`
      - `print i, v`
  - Iterate over two lists of the same length
    - `list_1 = [1,2,3,4]`
    - `list_2 = ["one", "two", "three", "four"]`
    - `for u, v in zip(list_1, list_2):`
      - `print u, v`
  - Changing the list while iterating
    - Make a copy at first and iterate over the copy
    - `for x in list_1[:]:`
      - `list_1.append(x**2)`

Common Pitfall

- Be careful when you make changes to a mutable object (e.g. list, dictionary, set)
  - `x = [1,2,3,4]`
  - `y = x`
  - `y.append(5)`
  - `print x` *(what would you expect?)*
- Even more careful when you pass them to a function
  - `x = [1,2,3,4]`
  - `def sumUp(z):`
    - `z.append(sum(z))`
    - `return z[-1]`
  - `print x` *(what would you expect?)*
- How to prevent?
  - Make a carbon copy when necessary
    - `y = x.copy()`

References

- Official tutorial
  - http://docs.python.org/2/tutorial/
- Python/UNIX tutorial on the course webpage
  - http://inst.eecs.berkeley.edu/~cs188/fa10/projects/tutorial/tutorial.html#Python
- A Byte of Python
  - http://swaroopch.com/notes/python/
- Python Information and Examples
  - http://www.secnetix.de/olli/Python/
- Learning Python (O'Reilly)
- Python Pocket Reference (O'Reilly)