PFTT (plan for this Thursday)

- **What is a Python program?**
  - In the context of what we do in Compsci 101
  - In a neuroscience lab, at a web start-up, …
  - What does "what is a program" even mean?
- **High-level and low-level Python constructs**
  - Variables and constants:
    - Names, types, and values
  - Operators and functions on Python types
- **Different approaches to code in Compsci101**

Start with Code Detective/Analysis

- Use your skill, intuition, and deductive reasoning experience to answer questions about code that may be unfamiliar

http://bit.ly/101fall15-0903-1

Results of Code Analysis

- For details on plurals: http://bit.ly/1N49u6b
- How did we call `pluralize` many times?
  - Loop. What is an alternative?
- What does the 'if' statement do?
  - Selects a code block to execute (more next week)
- If you have a question? Write and run code!

Organization matters

- https://www.youtube.com/watch?v=1ve57l3c19g

APT organization, Code organization

- You've written the BMI.py APT
  - Where is that module? How do you test it?
  - PyDev console, but then must import it
  - Adding print statements in BMI.py to test

- Putting sentences together in order…
  - "Once upon a time…" "It was the best of times…" "Aujord'hui ma maman est morte"
- Putting code together in order
  - Takes judgment and experience

Writing Functions, Calling Functions

- **After writing BMI.py, testing it (snarf)**
  - http://www.sutterhealth.org/health/bmi_calculator.html

```
import BMI

def getAdvice(name):
    print "hello",name,"how tall are you (in inches)?",
    inches = input()
    print "how much do you weigh (in pounds)",
    pounds = input()
    bmi = BMI.calculate(pounds,inches)

    if (bmi < 18.5):
        return "underweight"
    if (bmi < 24.9):
        return "healthy"
    if (bmi < 29.9):
        return "overweight"
    return "obese"
```

Examining Functions Closely

- Names of parameters in BMI.calculate?
  - What about order of parameters?
- Names of values passed to BMI.calculate?
  - Could be variables, constants: arguments
- Who wrote `math.sqrt(x)`?
  - What is name of parameter? Essential to call?
  - What is type of parameter? Essential to call?

Writing Code and Deploying Code

- **You've written code to solve an APT**
  - Written a .py module, how do you run it?
  - Use a Python interpreter, *must call function*

- **The APT testing framework calls your code**
  - Hollywood principle
    - "Don't call us, we'll call you"
    - https://en.wikipedia.org/wiki/Hollywood_principle
  - Like developing and using an API, someone writes the code, someone calls the code
    - `urllib2.urlopen(http://nytimes.com)`

Return to the Barnyard and Farm

- **Back to an example from last time**
  - Organizing code in a program
  - Refactoring code in a working program

- **Once a program works, sometimes you're not done!**
  - What does "it works" even mean?
  - What about version 2.0?
  - What about making it "better": perfect is the enemy of good. Good enough works!!!!

Toward creating functions

- **New meets old**
  - https://www.youtube.com/watch?v=0lM-NyN06rA

Old MacDonald had a farm, Ee-igh, Ee-igh, oh!
And on his farm he had a pig , Ee-igh, Ee-igh, oh!
With a oink oink here
And a oink oink there
Here a oink there a oink everywhere a oink oink
Old MacDonald had a farm, Ee-igh, Ee-igh, oh!

Creating Parameterized Function

What differs? Variable or Parameter

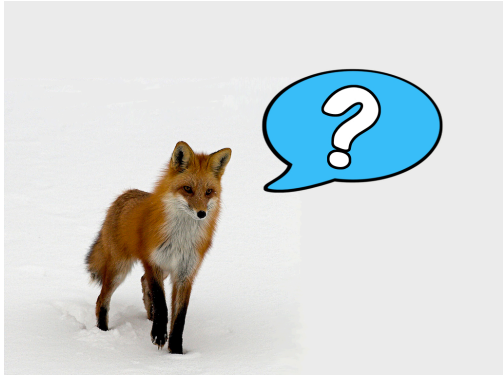
Old MacDonald had a farm, Ee-igh, Ee-igh, oh!
And on his farm he had a ***horse***, Ee-igh, Ee-igh, oh!
With a ***neigh neigh*** here
And a ***neigh*** neigh there
Here a ***neigh*** there a ***neigh*** everywhere a ***neigh neigh***
Old MacDonald had a farm, Ee-igh, Ee-igh, oh!

Old MacDonald had a farm, Ee-igh, Ee-igh, oh!
And on his farm he had a ***pig*** , Ee-igh, Ee-igh, oh!
With a ***oink oink*** here
And a ***oink oink*** there
Here a ***oink*** there a ***oink*** everywhere a ***oink oink***
Old MacDonald had a farm, Ee-igh, Ee-igh, oh!

Abstracting over code: functions

- http://goo.gl/DfcPgI
- See snarf for class work as well

- These functions do not return values, they print
  - Illustrates problem decomposition, but …
  - Normally have each function return a value
  - Normally use the return value in function call



Part of http://goo.gl/DfcPgl (and snarf)

```
def eieio():
  print "Ee-igh, Ee-igh, oh!"

def refrain():
  print "Old MacDonald had a farm,",
  eieio()

def had_a(animal):
  print "And on his farm he had a",animal,",",
  eieio()
```

Lots of commas

Anatomy and Dissection of Print

- Print generates output to a console, window, …
  - Depends on how program invoked
  - Basically used for: help with debugging and creating output for copy/paste, view

```
print "hello,",x,"what's up",y
```

- Space inserted between comma-separated items
  - Can use string concatentation, `"hello"+str(x)`
  - If print statemen ends with comma, no newline
  - Print anything that has a string representation…

Abstraction over barnyards

- In OldMacPrint we have `pig()` and `fox()` ...
  - What's the same in these? What's different?
  - Capture differences in parameters/variables
- Create new function:
  - `def verse(animal, noise)`

- Look at pig() and fox() create new function
  - Call: `verse("horse", "neigh")`
  - Call: `verse("cow", "moo")`

http://bit.ly/101fall15-901-2

Vocabulary, grammar, rules: Python

- **Naming**
  - The power of abstraction and parameterization
  - What is abstraction?
  - What are parameters? What has them?
- **Types**
  - What's used in computing? What's used in Python?
  - Determine names of types in Python, use type(..)
- **Expressions and operators in Python**
  - Arithmetic: `+, -, *, /, %, **,` ...
  - Boolean: `<, ==, >, and, ...`
  - String: `+, *, [], [:], [::]`

Variables, Types, Values

- Variable is a name associated with "storage"
  - Assign a value: `x = 5`
  - Print value of variable: `print x`
  - Use variable in expression: `y = x * 55`

- String is a type and has a value
  - Assign: `x = "hello"`
  - Print value of variable: `print x`
  - Use in expression
    - `print len(x)`
    - `print x + " world"`

- There are more types, this is a start!

Types and values in Python

- **Numbers are important, but not everything is a …**
  - What is a number? In mathematics, in Python, in Java,
  - Integers, floating-point numbers, complex numbers, …
    - We will worry about types, not speed or storage (though these are a concern sometimes)
    - 1,2,3 compared to 3.1415, 1.75, math.pi
    - 5/2 compared to 5.0/2 compared to 5//2

- **Strings are sequences of characters, "python.org"**
  - Somewhere these are converted to numbers: 0's and 1's
  - No real need to know this now.

Expressions, Operators, Types

- Why is `3+5*4` different than `(3+5)*4`?
  - Where can you find information about precedence?
- Why is `5/3` different than `5.0/3`?
  - What will happen in Python 3? Accommodate in 2.7?

- What happens when operators go bad?
  - What is "apple" + 3? What is "apple" + "pi"?
  - What is "apple" * 3? What is "apple" * "pi" ?

- What is a variable in Python?
  - Name, Type, Value

Observations about String literals

- Sometimes the details are tricky
  - `"I " + "love " + 'Python'`
  - `"I " + "love " + '"Python"'`
  - `"I " + "love " + "'Python'"`

- When in doubt, use parentheses
  - What is `"a" + "b" * 3`
  - What is `"a" "b" * 3`

Names, Types, Values Revisited

```
name = "/data/poe.txt"
ff   = open(name)
st   = ff.read()
words = st.split()
print "# words in",name, "=",len(words)
```

- What are the *names* in the code above?
  - Why are names important?
- What are the *types* in the code above?
  - How do we get Python to help us answer this question
- How do we re-use this code more generally
  - The power of names! The power of functions!

Functions: abstractions over code

- Naming something gives you power
  - How do you read a file into a string?
  - What is length of a string? Of a list?
- We can write and call functions
  - Re-use and/or modify
  - Store in module, import and re-use functions
  - Import standard modules and use functions from them
- Functions can (should?) return a value
  - We've seen len return an int, what about file.read()?
  - Other functions return Strings, floats, or other types

Value Expert

- **Answer these questions**

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