Plan for the week: Week 2, Sept 1-5

- Understanding program structure
  - Defining, testing, calling functions
  - How to run a program, how someone runs yours

- Understanding more of Python the language
  - Types: string, int, bool, float
  - Operations on these, e.g., +, %, [:], and
  - Control: conditionals and loops (Thursday)
- Course structure: APTs, labs, assignments
  - Tools for enabling structure

A-Z, Soup to Nuts, APT all the way

- Where do we find what APTs are due this week?
  - Web pages, Sakai v Google v bookmark
- Testing code for APTs supplied by 101 staff
  - Snarf the project that provides testing harnass
  - Don't call us, ETester.py will call you (your code)
- Refresh to see results.html
  - Repeat until finished
- Submit using Ambient, Duke CS Eclipse plugin

Summary of Tuesday

- Functions help in program/problem decomposition
  - Each function does one thing only
  - Functions typically return values
    - Song printing functions don't, they print

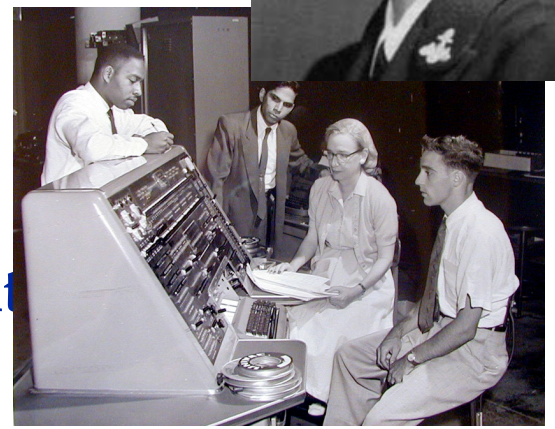
- Names, parameters, arguments, return values
  - Functions execute, return replaces call point
  - Calling code picks up and continues after call

- We'll see loops and conditionals on Thursday

Grace Murray Hopper (1906-1992)

- "third programmer on world's first large-scale digital computer"
  - US Navy: Admiral

"It's better to show that something can be done and apologize for not asking permission, than to try to persuade the powers that be at the beginning"



- ACM Hopper award given for contributions before 35
  - 2010: Craig Gentry: http://www.youtube.com/watch?v=qe-zmHoPW30
  - 2011: Luis von Ahn
  - 2013: Pedro Felzenszwalb

Duke Compsci: Grace Hopper 2013

Python review

- We have several types to store data/values
  - Different types for different purposes
  - Still need to explore how to use these types, what operations can be used with each
  - Types: int, float, string, bool, list, file

- We need to learn how to put types/values together into programs/code:
  - Function was first step toward doing this
  - Need more

Anatomy of a Python float

- A float is a floating point number
  - Internally doesn't have infinite precision,
  - Floats have arithmetic operations: *, /, +, -, **
- Floats
  - There are largest, smallest floats, expressed in terms of exponents, e.g., 1.79e+308, 2.22e-308
    - Typically not an issue in Compsci 101
  - Don't compare f == g with floats
    - Precision issues

Anatomy of a Python String

- String is a sequence of characters
  - Functions apply to sequences: len, slice [:], others
  - Methods applied to strings [specific to strings]
    - st.split(), st.startswith(), st.strip(), st.lower(), …
    - st.find(), st.count()
- Strings are *immutable* sequences
  - Characters are actually length-one strings
  - Cannot change a string, can only create new one
    - What does .upper() do?
  - See resources for functions/methods on strings
- *Iterable*: Can loop over it, *Indexable*: can slice it

Anatomy of Python List

- String is a sequence of characters
  - Immutable, cannot change, but can copy
  - Lists are mutable
- List is a sequence of values/objects
  - ['apple', 3.145, 45, True]
  - Indexable, like a string, using [:] and []
  - We'll see it's iterable too – loop over

- Simple, but powerful way to structure data
  - Internal to a program, not like a file: external

Indexable summary

- [0] is first element of string or list or indexable
  - If length of string is 7: 0,1,2,3,4,5,6 for indexes
  - History of zero-indexing in computer science
  - String access/read, List access/read/write
  - [-1] is the last element

- [:] is a slice, returns a new sequence
  - [a:b] is start at a, up-to but not including b
  - [:x] starts at 0 and [x:] goes to end
  - [a:b:c] has a stride/step of c

APT Interlude

http://bit.ly/101fall14-0902-2

Some simple computational problems

- How does calendar know it's a leap year?
  - Are all leap years hard-wired in?
  - Does each February determine "am I leap year"?

- Readability metric: what level is this story?
  - Syllables, words, sentences, …
  - http://en.wikipedia.org/wiki/Readability_test

- Student home-town data: where do you live?
  - Who is close, far, more

What years are leap years?

- 2000, 2004, 2008, …
  - But not 1900, not 2100, yes 2400!
  - Yes if divisible by 4, but not if divisible by 100 unless divisible by 400! (what?)

```
def is_leap_year(year):
    if year % 400 == 0:
        return True
    if year % 100 == 0:
        return False
    if year % 4 == 0:
        return True
    return False
```

- There is more than one way to skin a cat, but we need at least one way

Python if statements and Booleans

- In python we have if: else: elif:
  - Used to guard or select block of code
  - If guard is True then, else other

- What type of expression used in if/elif tests?
  - ==, <=, <, >, >=, !=, and, or, not, in
  - Value of expression must be either True or False
  - Type == bool, George Boole, Boolean,

- Look at more examples

Three versions of is_vowel

```
def is_vowel(ch):
    if ch =='e':
        return True
    if ch == 'a':
        return True
    if ch == 'i':
        return True
    if ch == 'o':
        return True
    if ch == 'u':
        return True
    return False
```

```
def is_vowel(ch):
    if ch in "aeiou":
        return True
    else
        return False
```

```
def is_vowel(ch):
    return "aeiou".count(ch) > 0
```

Lynn Conway

See Wikipedia and lynnconway.com

- Joined Xerox Parc in 1973
  - Revolutionized VLSI design wi
    Carver Mead

- Joined U. Michigan 1985
  - Professor and Dean, retired '98

- NAE '89, IEEE Pioneer '09

- Helped invent dynamic scheduling
early '60s IBM
  - Transgender, fired in '68

Data interlude

- Exploring what we can do with latitude and longitude, websites, APIs, simple Python scripts
  - Sometimes when data is about us it's ...
- We'll use batchgeo.com to create a visual
  - Copy/paste, see what happens?
  - Download into Excel and repeat?
- Who travels the greatest distance to Duke?
  - At least where are they from, if not who

Visualizing and Analyzing Data

- Sometimes data is dirty
  - We clean it. By hand, or with scripts/programs
  - There are data cleaning libraries (what's that?)

- For more in-depth analysis need other tools
  - Compsci course Everything Data
  - Develop your own, use Python!
  - Sometimes need statistics, sometimes need artistic/aesthetic skills

Data analyzed with Python

- Open file of data in csv format
  - Where do we get this? Why edit first?
- Loop over file, separate each line
  - Convert string to list, index to get parts

- Find code to determine distance using (lat, long)
  - Google is your friend, what's the query?

http://bit.ly/101fall14-0904-data

Simple loops, more later

```
for x in "abcdefg":
    code
for ch in ['a','b','c]:
    code
for line in file:
    code
```

- As with if, def, the : separates body
  - In Python indentation is important
  - Loop repeats body once for each IN element