Compsci 6/101: PFTW

- Review how APTs and Python work, run
  - Good, Bad, Ugly: getting better, avoid frustration, ...
  - How do you run/test APT code, other Python code

- Control flow in Python
  - Changing order in which Python statements execute
  - Loops and if statements
    - Essential for writing real programs

- Get ready for first assignment
  - Difference between assignment and APTs?

BMI for everyone

- How do we get at the data in a Google form?
  - Why would we use a Google form?
  - Advantages of data in the cloud? Shared data?

- How do we find BMI for one person
  - Must do this before we do it for 100 people
  - What do we do about dirty data?

- Looping and accumulating values
  - The programming idiom of \( v = v + 55 \)
  - Generalized: \( \text{total} += \text{value} \)

Accumulating a value

- Variables in Python: name, type, value
  - The name is a label on an "object", "box", value
  - What does \( v = v + 52 \) do?

- Executing the assignment statement
  - Evaluate expression on right hand side
  - When done store the value of expression with label on left
  - Can this result in changing the value of the variable?
  - Does this change the name of the variable?

- Advantages of \( x += 1 \), or \( \text{cool\_value} += 1 \)

How to solve an APT

- Two very, very, very important steps
  1. How to solve the problem with Paper, Pencil, (Calculator)
  2. How to translate problem-solving to Python

- Both steps can be hard, vocabulary and language are initially a real barrier
  - The more experience you have with Python, the easier step 2 will get
  - The more you understand the idioms and power of the language the more you can let step 2 influence step 1

- Step 1 is key, without it you won't get anywhere
APT Pancake

- How do you solve this problem?
  - First steps: are there simple cases that can be solved immediately?
    - What are these for the pancake problem?
    - How will you identify with Python?
  - Sometimes it helps to know if you are on track, use Python to check your paper and pencil work

- Get specific, solve for 5, not N
  - Fix one parameter, vary the other
  - Identify the cases and continue

Three pancakes in a two-cake pan...

- Number of cakes in the system
  - First 5 minutes
- Number of cakes in the system
  - Second 5 minutes

Three pancakes in a two-cake pan...

- Number of cakes in the system
  - Third 5 minutes
- How many minutes to cook all three pancakes?

How to teach pancake flipping

- [http://www.youtube.com/watch?v=W_gxLKSsSIE](http://www.youtube.com/watch?v=W_gxLKSsSIE)
  - For longer, more complex robotic tasks [http://www.youtube.com/watch?v=4usoE981e7I](http://www.youtube.com/watch?v=4usoE981e7I)

- Back to specifics:
  - Capacity = 5
  - Numcakes = 1,2,...5?
  - Numcakes = 6,7,8,9,10?
  - Numcakes = 11,12,13,14,15?
  - Is five special? 4? 3? 2?
Eclipse Interlude

- **Finishing the Pancake problem**
  - Translating problem-solving ideas to code
  - Control with if/elif: arithmetic with / and %

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Lessons: special cases, abstractions

- **There are special cases in many, many problems**
  - Identifying them is important
  - Abstracting them away when possible is important
  - Example: SilverDistance APT
    - Instead of four quadrants/cases, reducible to two?
    - Instead of \((x,y)\) and \((z,w)\) translate to \((0,0)\) and \((z-x,w-y)\)

- **Translating ideas into (Python) code**
  - How do we create interesting “heads”, “totem poles”?
  - How do create software for identikit?
  - How do we create Facebook, Foursquare, ...

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What years are leap years?

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

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

```python
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
```

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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?**
  - \(==, \leq, <, >, \geq, \neq, \text{and}, \text{or}, \text{not}, \text{in}\)
  - Value of expression must be either True or False
  - Type \(== \text{bool}\), George Boole, Boolean,

- **Examples with if**
  - String starts with vowel
  - Rock, paper, scissors (a la Rochambeau) winner
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
  2004: Jennifer Rexford
  2008: Dawson Engler
  2010: Craig Gentry: http://www.youtube.com/watch?v=qe-zmHoPw30

How do you solve a problem like …?

- Translating English to Piglatin
  - Why is this fascinating?
  - Is this like translating English to German?
  - Is it like translating Python to bytecode?
- "downplay their unique quiet strength"
  - "ownplay-day eir-thay unique-way iet-quay ength-stray"
  - What are the rules for pig-latin? See APT

APT Piglatin

- How do you solve this problem?
  - First steps: are there simple cases that can be solved immediately?
    - What are these for the piglatin problem?
    - How will you identify with Python?
  - Words that begin with ...
    - Vowel
    - Foods that begin with the letter 'q' for 200 Alex

- Translation to Python
  - First 'q', then vowels

Three versions of is_vowel

```python
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
```

```python
def is_vowel(ch):
    c = "aeiou".count(ch)
    if c > 0:
        return True
    else:
        return False
```

```python
def is_vowel(ch):
    return "aeiou".count(ch) > 0
```
Piglatin, age-stay one-way

```python
def convert(s):
    if s[0] == 'q':
        return s[2:]+"-quay"
    if is_vowel(s[0]):
        return s+"-way"
```

- Preview of next lab: slicing, concatenation, index
  - Where does string-indexing start?
  - What does slice with a single parameter do?

Piglatin, age-stay o-tway

```python
def convert(s):
    if s[0] == 'q':
        return s[2:]+"-quay"
    if is_vowel(s[1]):
        return s[1:]+"-"+s[0]+"ay"
    if is_vowel(s[2]):
        return s[2:]+"-"+s[1:2]+"ay"
    if is_vowel(s[3]):
        return s[3:]+"-"+s[:3]+"ay"
    if is_vowel(s[4]):
        return s[4:]+"-"+s[:4]+"ay"
```

Piglatin, age-stay ee-threay

```python
def convert(s):
    if s[0] == 'q':
        return s[2:]+"-quay"
    if is_vowel(s[0]):
        return s+"-way"
    for index in range(1,len(s)):
        if is_vowel(s[index]):
            return s[index:]+"-"+s[:index]+"ay"
```

- Generalize/parameterize by what varies
  - What does a loop do? It repeats!

Dawson Engler

- ACM Hopper Award 2008
  "In his papers on automated program checking, Dawson Engler introduces and develops powerful techniques and tools for practical program analysis for finding errors in code."
- Started coverity.com
  - Very successful startup to find errors in code