PFThursday

- Review Organization and Problem-Solving
  - Defining functions, calling functions
  - Return types, print, None

- Incremental construction as design pattern
  - Build programs: start small, add with confidence
  - Build new strings: append/concatenate values
  - Build lists (later, but similar to strings)

APT Pancake: http://bit.ly/pancakes101

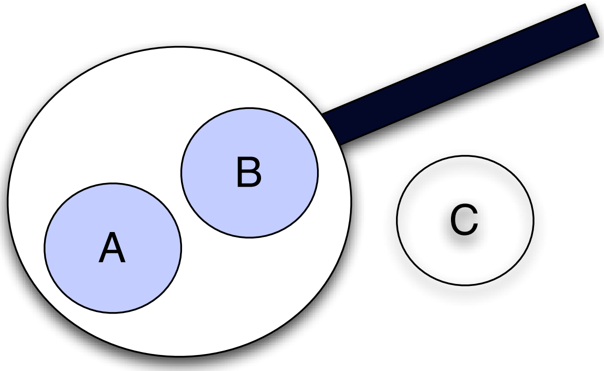
- How do you solve this problem?
  - If you have confidence you can solve for any size pan, then start programming
  - If you can't do it by hand …
    - Get some credit for APT, some dancing!

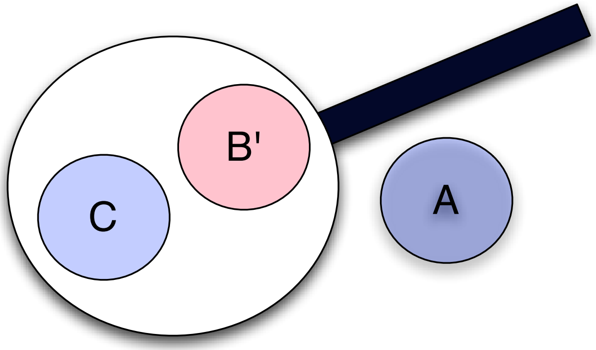
- Sometimes APTs have hard algorithms
  - Translating to code not so bad
- Sometimes APTs have easy algorthms
  - Translating to code is difficult

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

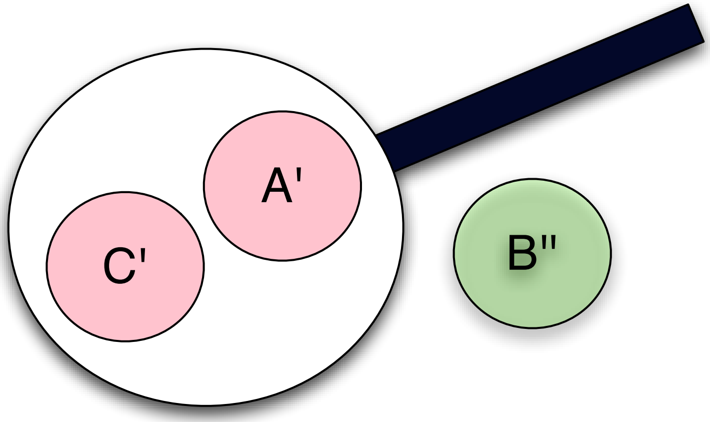


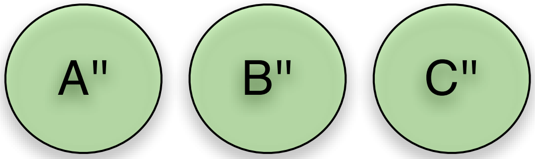


Three pancakes in a two-cake pan…

- Number of cakes in the system
  - Third 5 minutes

- How many minutes to cook all three pancakes?

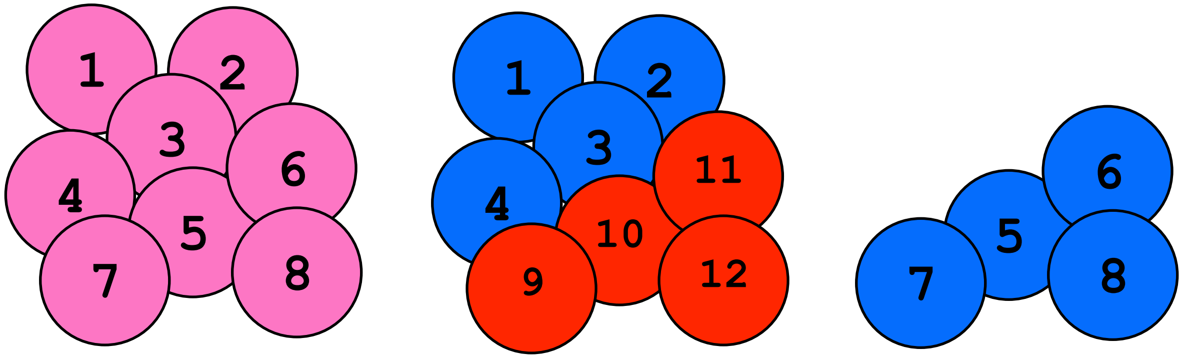




Methodically by hand, small values

- Pan has capacity 8, vary #pancakes
  - Can you cook 11 in 15 minutes? Why?
  - Can you cook 13 in 15 minutes? Why?

cakes	5	6	7	8	9	10	11	12	13	14	15	16	17	18
time	10	10	10	?										



Methodically by hand, small values

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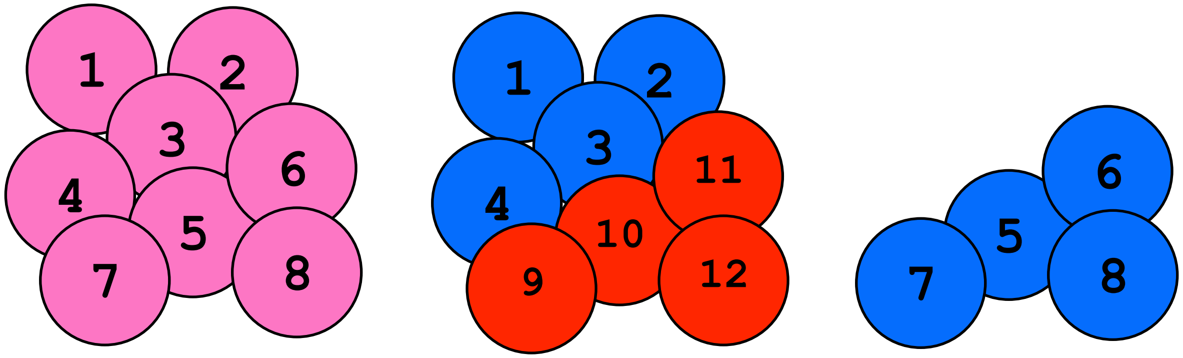
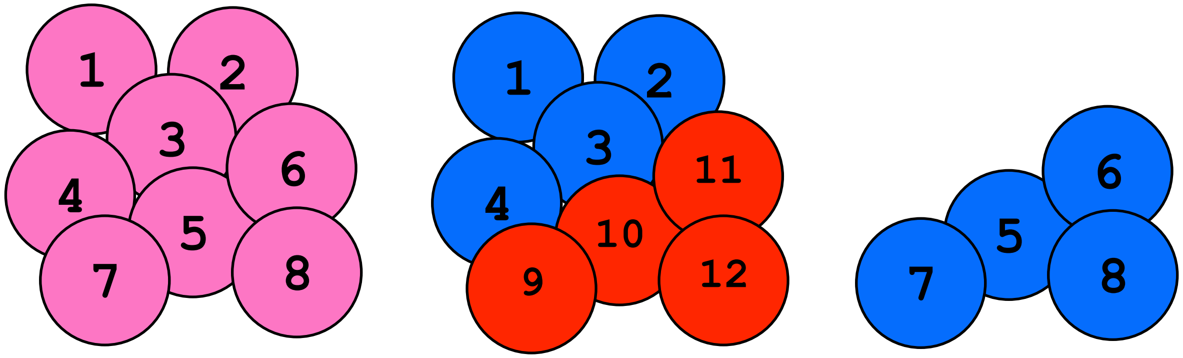
cakes	5	6	7	8	9	10	11	12	13	14	15	16	17	18
time	10	10	10	10	15	15	15							



Methodically by hand, small values

- Pan has capacity 8, vary #pancakes

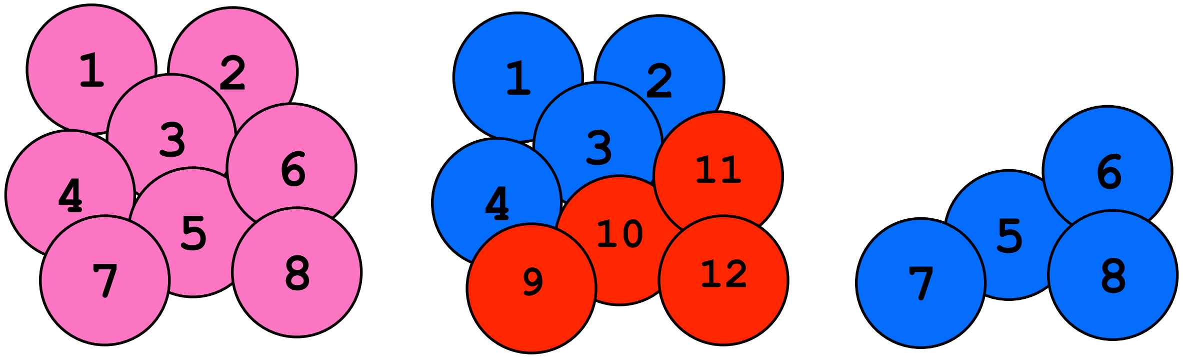
cakes	5	6	7	8	9	10	11	12	13	14	15	16	17	18
time	10	10	10	10	15	15	15	15	20	20	20	20		



Methodically by hand, small values

- Pan has capacity 8, vary #pancakes

cakes	5	6	7	8	9	10	11	12	13	14	15	16	17	18
time	10	10	10	10	15	15	15	15	20	20	20	20	25	25

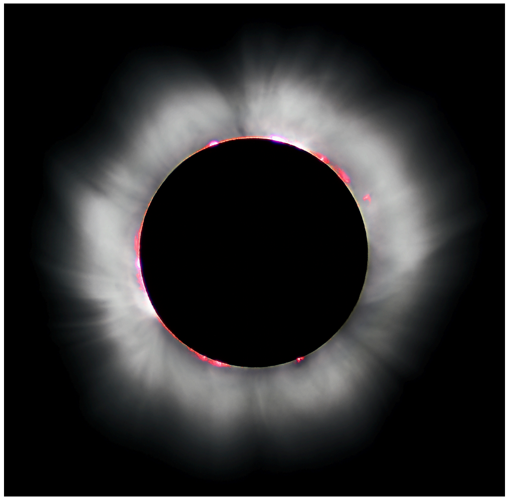


Pancake Algorithm

- If you have pan of size 17 and 34 pancakes
- If you have pan of size 17 and 43 pancakes
- Pan fits 100 pancakes, but you have 452
- Pan fits N pancakes, but you have P
  - if P <= N then time needed is …
  - X = P/N, what does this mean for time?
  - Y = P % N, what does this mean for time?

Eclipse Interlude

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



Algorithmic Problem/Program Testing

- Complete this form for two more APTs

http://bit.ly/101fall15-0910-1

How to teach pancake flipping

- http://www.youtube.com/watch?v=W_gxLKSsSIE
  - Is this computer science? http://bit.ly/zykOrh
  - For longer, more complex robotic tasks
    - http://www.youtube.com/watch?v=4usoE981e7I

- Do robots matter?
  - Do they dream?
  - Self-driving cars?
  - Machine learning?

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

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

Python if statements and Booleans

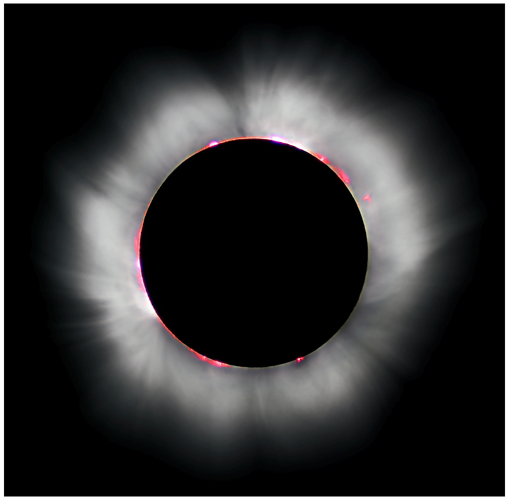
- In python we have if: else: elif:
  - Used to guard or select block of code
  - If guard is True then, else other

- 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,

- Examples with if
  - String starts with vowel (useful for APT Emphasize)

Eclipse Interlude

- **Finishing Emphasize**
  - Identifying vowels
  - Helper functions
  - Slicing strings



Software Dreams

- Translating ideas into (Python) code
  - Create interesting “heads”, “totem poles” ?
  - Create software for face recognition? Gait?
  - Create "five four" from "four five"?
  - Create "SCUBA" from "self contained underwater breathing apparatus"

- Master the syntax of the language?
  - Organization of program constructs
  - Knowledge of libraries
  - Practice and experience!

Building Totem in stages/incrementally

- What functions do not return values?
  - They print strings returned by other functions
- For totem and randompole, which one first?
  - Don't do both at same time, grow the program
- Start simple
  - Next?
  - Add?
  - Questions?

```
def hair_part():
    return "xxyyzz"
def eye_crossed():
    return "123456"
def totem():
    print hair_part()
    print eye_crossed()
```

Anatomy of a Python String

- String is a sequence of characters
  - Functions we can 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

Lynn Conway

See Wikipedia and lynnconway.com

- Joined Xerox Parc in 1973
  - Revolutionized VLSI design with 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

Incremental + : numbers and strings

- Wtht vwls cn y stll rd ths sntnce?
  - Create a no-vowel version of word
  - Examine each character, if it's not a vowel …
  - Pattern of building a string

```
def noVowels(word):
    ret = ""
    for ch in word:
        if not is_vowel(ch):
            ret = ret + ch
    return ret
```

Counting vowels in a string

- Accumulating a count in an int is similar to accumulating characters in a string

```
def vowelCount(word):
    value = 0
    for ch in word:
        if is_vowel(ch):
        value = value + 1
    return value
```

- Alternative version of adding: `value += 1`

From high- to low-level Python

```
def reverse(s):
   r = ""
   for ch in s:
      r = ch + r
   return r
```

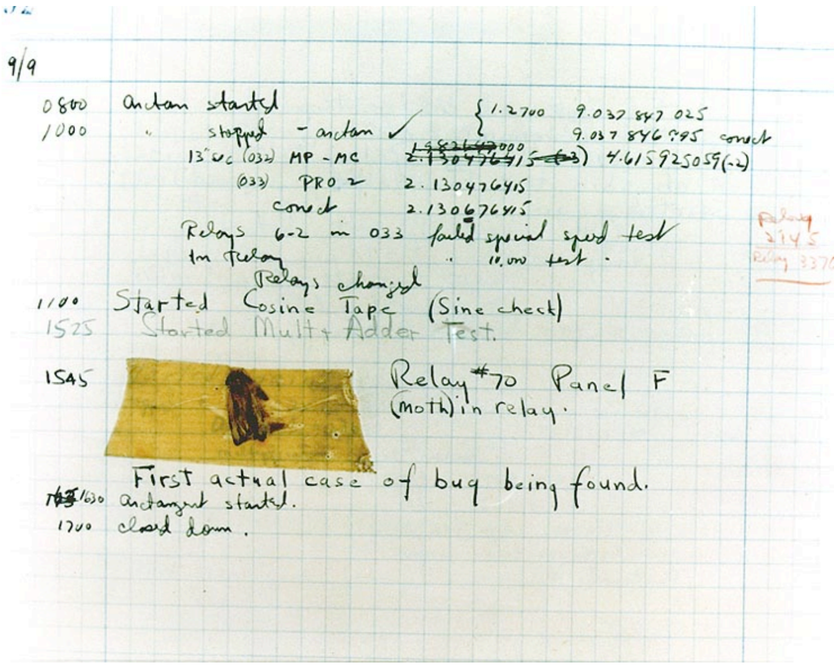
```
7           0 LOAD_CONST           1 ('')
            3 STORE_FAST           1 (r)

8           6 SETUP_LOOP          24 (to 33)
            9 LOAD_FAST            0 (s)
           12 GET_ITER
      >>   13 FOR_ITER            16 (to 32)
           16 STORE_FAST           2 (ch)

9          19 LOAD_FAST            2 (ch)
           22 LOAD_FAST            1 (r)
           25 BINARY_ADD
           26 STORE_FAST           1 (r)
           29 JUMP_ABSOLUTE       13
      >>   32 POP_BLOCK

10    >>   33 LOAD_FAST            1 (r)
           36 RETURN_VALUE
```

- Create version on the right using dissassembler

```
dis.dis(code.py)
```

Bug and Debug

- software 'bug'
- Start small
  - ➢ Easier to cope
- Judicious 'print'
  - ➢ Debugger too



9/9

0800 Arctan started {1.2700 9.037 847 025

1000 " stopped - arctan ✓ 9.037 846 995 correct

13" uc (032) MP - MC ~~1.982147000~~ ~~2.130476415~~ ~~(-3)~~) 4.615925059(-2)

(033) PRO 2 2.130476415

correct 2.130676415

Relays 6-2 in 033 failed special speed test

in relay " 10,000 test .

Relays changed

Relay 2145

Relay 3370

1100 Started Cosine Tape (Sine check)

1525 Started Mult + Adder Test.

1545 Relay #70 Panel F

(moth) in relay.

First actual case of bug being found.

~~1630~~ 1630 Arctangent started.

1700 closed down.

- Verify the approach being taken, test small, test frequently
  - ➢ How do you 'prove' your code works?