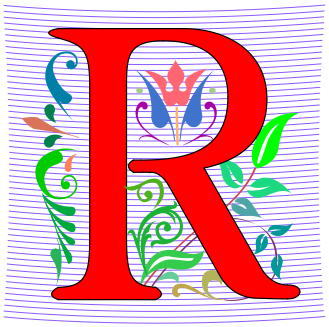
Compsci 101
Clever Hangman, Problem Solving

Group/Template	Size of Group
_ a _ _ _ _ _ _	587
_ a _ a _ _ _ _	63
_ _ a _ _ _ _ _	498
_ _ _ a _ _ _ _	406
_ _ _ _ _ _ _ _	3,475

Susan Rodger

March 28, 2023

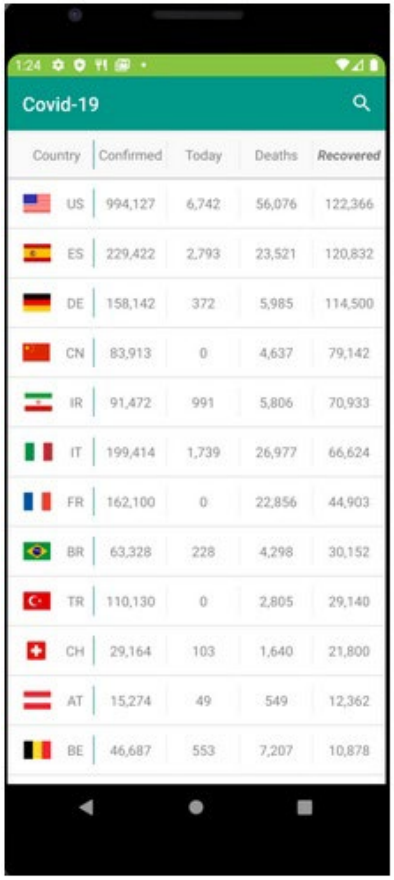
`R` is for …



- **Random**
  - **`.choice`, `.shuffle`, `.seed`, `.randint`**
- **R**
  - Programming language of choice in stats
- **Refactoring**
  - A way to rename your variable, function name

Esther Brown

- **Duke Alum 2020, IDM CS/Cult. Anth.**
- **Harvard MS Data Sci**
- **Now PhD in CS at Harvard!**
- **At Duke, as Senior did I.S. creating five Apps**
  - Covid tracker
  - Movie App



Announcements

- **APT 5 due Thursday!**
- **Assignment 5 due Thursday, April 6**

- **No lab this Friday**

- **Reading and Sakai Quizzes due Thursday**

- **APT Quiz 2 Thursday 1:15pm through 11pm Monday**
  - Must complete by 11pm

PFTD

- **APT Quiz 2**
- **APT Family**
- **Clever Guess Word**
  - Focus on the dictionary
- **Problem solving with lists, sets and dictionaries**

- **Next time: More on Sorting**

APT Quiz 2 March 30-April 3

- **Opens March 30, Thursday, 1:15pm**
- **Closes at 11pm Mon 4/3 – must finish all by this time**
- **There are two parts based on APTs 1-5**
  - Each part has two APT problems
  - Each part is 3 hours – more if you get accommodations
  - Each part starts in Sakai under tests and quizzes
  - Sakai is a starting point with countdown timer that sends you to a new apt page just for each part
  - Could do each part on different day or same days
- **Old APT Quiz so you can practice (not for credit) – on APT Page**

APT Quiz 2

- **Is your own work!**
  - No collaboration with others!
  - Use your notes, lecture notes, your code, textbook
  - DO NOT search for answers!
  - Do not talk to others about the quiz until grades are posted
- **Post private questions on Ed Discussion**
  - We are not on between 9pm and 9am!
  - We are not on all the time, especially weekends
  - Will try to answer questions between 9am – 9pm
    - About typos, cannot help you in solving APTs
- **See 101 APT page for tips on debugging APTs**

APT Quiz

There will be two APT Quizzes that are just like APTs but are your own work and are timed. Start the APT quiz on Sakai under quizzes, but not until you are ready to take the quiz.

APTs

See below for hints on what to do if your APT doesn't run.

For each problem in an APT set, complete these steps by the due date

- first click on the APT set below to go to the APT page.
- write the code, upload the file, select the problem, and click the **Submit** link
- **check your grade** on the grade code page by clicking on **check submissions**

In solving APTs, your program should work for all cases, not just the test cases we provide. We may test your program on additional data.

APT	Due Date
APT-1	January 26
APT-2	February 9
APT-3	February 23
PRACTICE FOR APT QUIZ 1	NOT FOR CREDIT
APT-4	March 9
REVIEW YOUR APT QUIZ 1 Problems	NOT FOR CREDIT
APT 5	March 30
PRACTICE for APT Quiz 2	NOT DUE

We may do some APTs partially in class or lab, but you still have to do them and submit them. There will usually be extra apts listed. You can do more than required to challenge yourself. We do notice if you do more APTs than those required. If you do extra APTs, they still have to be turned in on the due date.

Regrades

If you have concerns about an item that was graded (lab, apt or assignment), you have one week after the grade is posted to fill out the regrade form here.

Problems Running an APT? Some Tips!

APT Family

APT: Family

Problem Statement

You have two lists: `parents` and `children`. The ith element in `parents` is the parent of the ith element in `children`. Count the number of grandchildren (the children of a person's children) for the person in the `person` variable.

Hint: Consider making a helper function that returns a list of a person's children.

Step 1: work an example by hand

```
parents = ['Junhua', 'Anshul', 'Junhua', 'Anshul', 'Kerry']
children = ['Anshul', 'Jordan', 'Kerry', 'Paul', 'Kai']
person =  'Junhua'

Returns 3
```

Assignment 5 - How to play Guess Word Cleverly

- **Make it hard for the player to win!**
- **One way: Try hard words to guess?**
  - "jazziest", "joking", "bowwowing"
- **Another Way: Keep changing the word, sortof**

Clever GuessWord

- **Current GuessWord: Pick random secret word**
  - User starts guessing

- **Can you change secret word?**
  - Yes, but must have letters in same place you have told user
    - Change consistent with all guesses
  - Make the user work harder to guess!

Programming A Clever Game

- **Instead of guessing a word, you're guessing a *group, category*, or *equivalence class* of words**

  Ex: `_ _ _ _ _` and user guesses 'a'

- **`["asked", "adult", "aided", … "axiom"]`**
  - *209 words 'a' as first letter and the only 'a'*
- **`["baked", "cacti", "false", … "walls"]`**
  - *665 words 'a' as second letter and the only 'a'*
- **`["beets", "humor", … "spoof"]`**
  - *2,431 words with no 'a'*
- **What should our secret word be? "asked" ,"baked" or "beets“?**

Sometimes there will be letters

- **The letter “u” has been guessed and is the 2nd letter**
  Ex: `_ u _ _ _` and user guesses ‘r’

- **`["ruddy", "rummy", "rungs", … "rusty"]`**
  - *5 words start with “ru” and no other “r” or “u”*
- **`["burch", "burly", "burns", … "turns"]`**
  - *17 words only ‘u' as second letter and only ‘r’ third letter*
- **`["bucks", "bucky", … "tufts"]`**
  - *98 words with only “u” second letter and no ‘r'*
- **What should our secret word be? "ruddy" ,"burch" or "bucks“?**

More Details on Game

- **Current secret 8-letter word at random is *catalyst***
  - User guesses 'a', what should computer do?
  - Print `_ a _ a _ _ _ _` and continue?

Creating Groups/Categories

- **For each of 7,070 words (8 letters), given word and ‘a’, find its group, represented by a template**
- **Use dictionary**
  - Template is KEY, the VALUE is a list of matching words
- **Choose biggest list**
- **Repeat**
- **# words smaller over time**

Group/Template	Size of Group
_ a _ _ _ _ _ _	587
_ a _ a _ _ _ _	63
_ _ a _ _ _ _ _	498
_ _ _ a _ _ _ _	406
_ _ _ _ _ _ _ _	3,475

Changes to Regular GuessWord

- **List of words from which secret word chosen**
  - Initially this is all words of specified length
    - User will specify the length of the word to guess
  - After each guess, word list is a new subset
- **Keep some functions, modify some, write new ones**
- ***Changes go in another function* to minimize changes to working program**
  - Minimizing changes helps minimize introducing bugs into a working program

Play a game

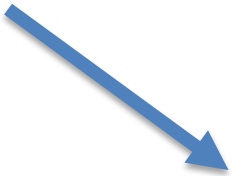
- `_ _ _ _ _ _ _`
- Secret word is:
  - **`flamer`**
- User guesses:
  - a
- Possible words:
  - 6166

```
_______ : 3441
______a : 80
_____a_ : 233
____a__ : 316
____a_a : 11
___a___ : 549
___a__a : 19
___a_a_ : 10
___aa__ : 1
_a_____ : 962
_a____a : 39
_a___a_ : 57
_a_a___ : 40
_a_a_a : 12
_a_aa_ : 3
a______ : 273
a_____a : 21
a____a_ : 30
a___a__ : 32
a___a_a : 3
a_a____ : 26
a_a___a : 7
aa_____ : 1
```

Consider “_ _ _ a _ a” : 11

- **Means “_ _ _ a _ a” is key in dictionary**
- **The value is a list of 11 words**
  - have “a’ in 4th and 6th position

“_ _ _ a _ a”



['cicada', 'errata', 'guiana', 'guyana', 'ithaca’, 'lusaka', 'nevada', 'ottawa', 'sonata', 'tirana', 'urbana']

Play a game

- _ _ _ _ _ _
- Secret word is:
  - mounds
- User guesses:
  - o
- Possible words:
  - 3441

```
______ : 2105
_____o : 23
____o_ : 147
____oo : 1
___o__ : 148
___o_o : 1
___oo_ : 4
__o___ : 228
__o__o : 2
__o_o_ : 8
__oo__ : 32
_o____ : 528
_o___o : 6
_o__o_ : 41
_o_o__ : 15
_o_o_o : 1
_o_oo_ : 1
_oo___ : 77
_oo_oo : 1
o_____ : 60
o___o_ : 3
o__o__ : 8
o__oo_ : 1
```

Play a game

- `_ _ _ _ _ _`
- Secret word is:
  - **`burkes`**
- User guesses:
  - u
- Possible words:
  - 2105

```
_______ : 1441
______u : 2
_____u_ : 36
____u__ : 84
____u_u : 1
___u___ : 107
_u_____ : 362
_u__u_ : 13
_u_u___ : 11
u______ : 37
u____u_ : 5
u__u__ : 5
u_u___ : 1
```

Play a game

- `------`
- Secret word is:
  - **`wilted`**
- User guesses:
  - i
- Possible words:
  - 1441

```
_______ : 503
______i : 2
_____i_ : 54
____i__ : 158
___i_i_ : 2
__i____ : 225
__i__i_ : 1
__i_i_i : 7
__ii___ : 2
_i_____ : 355
_i__i_i : 28
_i_i___ : 56
_i_i_i_ : 2
i______ : 28
i__i___ : 16
i_i____ : 2
```

Play a game

- `_ _ _ _ _ _`
- Secret word is:
  - **`served`**
- User guesses:
  - e
- Possible words:
  - 503

```
_____ : 2
____e : 5
___e_ : 13
__e__ : 9
__e_e : 2
__ee_ : 5
_e___ : 42
_e__e : 12
_e_e_ : 23
_ee__ : 36
_ee_e : 9
e____ : 13
e___e : 13
e__e_ : 160
e__ee : 2
```

```
_e_e__ : 59
_e_e_e : 7
_e_ee_ : 3
_ee___ : 6
_ee__e : 5
_ee_e_ : 34
e____e : 1
e___e_ : 5
e__ee_ : 2
e__e__ : 20
e_ee__ : 2
e_e___ : 9
e_e__e : 1
e_e_e_ : 3
```

Play a game

- `_e__e_`
- Secret word is:
  - **`tested`**
- User guesses:
  - s
- Possible words:
  - 160

```
_e__e_ : 100
_e__es : 16
_e_se_ : 11
_e_ses : 3
_es_e_ : 13
_esse_ : 5
_esses : 1
se__e_ : 7
se__es : 2
se_se_ : 1
se_ses : 1
```

Play a game

- `_e__e_`
- Secret word is:
  - **`kepler`**
- User guesses:
  - r
- Possible words:
  - 100

```
_e__e_ : 45
_e__er : 32
_e_re_ : 1
_er_e_ : 8
_er_er : 6
_erre_ : 1
_errer : 1
re__e_ : 3
re__er : 2
re_re_ : 1
```

Play a game

- `_e__e_`
- Secret word is:
  - **wedded**
- User guesses:
  - d
- Possible words:
  - 45

```
_e__e_  : 11
_e___ed : 20
_e_de_  : 2
_e_ded  : 4
_ed_e_  : 1
_ed_ed  : 2
_edded  : 2
de__e_  : 1
de__ed  : 2
```

Play a game

- **_e__ed**
- Secret word is:
  - **belted**
- User guesses:
  - l
- Possible words:
  - 20

```
_e__ed : 10
_el_ed : 4
_elled : 5
le__ed : 1
```

Play a game

- **_e__ed**
- Secret word is:
  - **vented**
- User guesses:
  - t
- Possible words:
  - 4

```
_e__ed : 4
_e_ted : 1
_etted : 4
te_ted : 1
```

Greedy Algorithms

- **"Choosing largest group" -> *greedy algorithm***
  - Make a locally optimal decision that works in the long run
  - Choose largest group to make game last …

- **Greed as in "it chooses the best current choice every time, which results in getting the best overall result"**

- **Canonical example? Change with coins**
  - Minimize # coins given for change: 57 cents

Making change for 57 cents

- **When choose next coin, always pick biggest**
- **With half-dollar coins**

- **With quarters and no half dollars**

When greedy doesn't work

- **What if no nickels? Making change for 31 cents:**

Woto-1 Clever GuessWord
http://bit.ly/101s23-0328-1

More Problem Solving with Dictionaries, Sets and lists

Movie Actors

Each list in datalist has 5 strings:
Movie, Actor, Year of movie, minutes total, minutes Actor in movie

```
datalist = [
['Saving Mr. Banks', 'Tom Hanks', '2016', '125', '65'],
['Saving Mr. Banks', 'Emma Thompson', '2016', '125', '84'],
['Enough Said', 'James Gandolfini', '2013', '93', '52'],
['Captain Phillips', 'Catherine Keener', '2013', '134', '22'],
['The Da Vinci Code', 'Tom Hanks', '2006', '149', '85'],
['Saving Mr. Banks', 'Colin Farrell', '2016', '125', '25'],
['Forrest Gump', 'Sally Field', '1994', '142', '56'],
['Mrs. Doubtfire', 'Robin Williams', '1993', '125', '94'],
['Captain Phillips', 'Tom Hanks', '2013', '134', '110'],
['Enough Said', 'Catherine Keener', '2013', '93', '21'],
['The Da Vinci Code', 'Ian McKellen', '2006', '149', '60'],
['Hello, My Name is Doris', 'Sally Field', '2015', '95', '84'],
['Alone in Berlin', 'Emma Thompson', '2016', '103', '70'],
['Forrest Gump', 'Tom Hanks', '1994', '142', '110'],
['Mrs. Doubtfire', 'Sally Field', '1993', '125', '45'] ]
```

Movie Actors

```
['Saving Mr. Banks', 'Tom Hanks', '2016', '125', '65'],
```

- **For example in first list:**
  - Movie is 'Saving Mr. Banks'
  - Actor is "Tom Hanks"
  - The movie was released in 2016
  - The movie is 125 minutes long
  - Tom Hanks is on screen for 65 minutes

Woto-2 ActorsNotIn
http://bit.ly/101s23-0328-2

Woto-3 dictActorsToMovies http://bit.ly/101s23-0328-3