Compsci 101
Clever Hangman, Problem Solving

Susan Rodger
November 8, 2022

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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
- Starting 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, Nov 17
- No lab this Friday
- Reading and Sakai Quizzes due Thursday
- APT Quiz 2 Thursday noon through 11pm Monday
PFTD

- Clever Guess Word
  - Focus on the dictionary
- Problem solving with lists, sets and dictionaries
- APT Quiz 2
- Next time: More on Sorting

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 2 Nov 10-14

- Opens 11/10 Noon
- Closes at 11pm 11/14 – 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
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"?
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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"?

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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?

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More Details on Game

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

No!
Try to change the word!
Best choice may be to tell the user there is no ‘a’

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

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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

Each value in dictionary is a list of words

These are the length of each value/list

You build a dictionary for all the possible places an a can be in a word

Keys in dictionary
23 keys

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']
Consider “__a__a__a” : 11

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

“__a__a__a”

[key in dictionary]

[value in dictionary]

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

Play a game

- ______
- Secret word is:
  - flamer
- User guesses:
  - a
- Possible words:
  - 6166
- Tell user: NO ‘a’

Pick new secret word, any letter without ‘a’

Play a game

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

This list of words becomes the "possible words" list.

That list is smaller, has 3441 words

List of words has no a’s

Pick new secret word, any letter without ‘a’
Play a game

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

Note: None of these lists have the letter ‘a’ in them. We removed all words that have ‘a’ from our list of words.

Play a game

- _______
- Secret word is:
  - mounds
- User guesses:
  - o
- Possible words:
  - 3441
  - Tell user no ‘o’

Pick new secret word, any letter without ‘o’

Play a game

- _______
- Secret word is:
  - burkes
- User guesses:
  - u
- Possible words:
  - 2105

Play a game

- _______
- Secret word is:
  - burkes
- User guesses:
  - u
- Possible words:
  - 2105
  - Tell user no ‘u’

Pick new secret word, any letter without ‘u’
Play a game

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

Play a game

- _______
- Secret word is: wilted
- User guesses: i
- Possible words: 1441
- Tell user no ‘i’

Play a game

- _______
- Secret word is: served
- User guesses: e
- Possible words: 503

Play a game

- _______
- Secret word is: served
- User guesses: e
- Possible words: 503
- Tell user ‘e’ in these two places

Pick new secret word with ‘e’ in 2nd and 5th positions

Largest category

Pick new secret word, any letter without ‘i’
Play a game

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

Play a game

- _e__e_
- Secret word is: tested
- User guesses: s
- Possible words: 160
- Tell user no ‘s’

Pick new secret word with no ‘s’ in it

Play a game

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

Play a game

- _e__e_
- Secret word is: kepler
- User guesses: r
- Possible words: 100
- Tell user no ‘r’

Pick new secret word with no ‘r’ in it

Largest category: tested

Largest category: kepler
### Play a game

1. **_e__e__**
   - Secret word is: **wedded**
   - User guesses: **d**
   - Possible words: **45**

### Play a game

2. **_e__e__**
   - Secret word is: **wedded**
   - User guesses: **d**
   - Possible words: **45**
   - Tell user last letter is ‘d’

### Play a game

3. **_e__e__**
   - Secret word is: **belted**
   - User guesses: **l**
   - Possible words: **20**
   - Tell user no ‘l’

### Play a game

4. **_e__e__**
   - Secret word is: **belted**
   - User guesses: **l**
   - Possible words: **20**
   - Tell user no ‘l’

- Pick new secret word with ‘d’ as last letter
- Pick new secret word with no ‘l’ in it

---

**Largest category**

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Play a game

• _e__e_d
• Secret word is:
  • vented
• User guesses:
  • t
• Possible words:
  • 4

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

Play a game

• _e__e_d
• Secret word is:
  • vented
• User guesses:
  • t
• Possible words:
  • 4
  • Tell user no ‘t’

Making change for 57 cents

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

• With quarters and no half dollars
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:
- Can we do better? Yes!

Woto-1 Clever GuessWord
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', '88'],
    ['Saving Mr. Banks', 'Colin Farrell', '2016', '125', '28'],
    ['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']
]

Woto-2 ActorsNotIn


• Write
  • def actors(datalist) – returns a sorted unique list of actors
  • def actorsNotIn(datalist, actorlist)
    • Actorlist is a list of favorite actors
    • Returns a sorted unique list of actors that are in actorlist but not in datalist
    • If favorite is ["Emma Watson", "Daniel Radcliffe", "Ralph Fiennes", "Tom Hanks"] then actorsNotIn returns:
      ['Daniel Radcliffe', 'Ralph Fiennes', 'Emma Watson']

- 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

Code for actors

```python
def actors(datalist):
    result = set([item[1] for item in datalist])
    return sorted(list(result))
```

Or just
```
return sorted(set([item[1] for item in datalist]))
```

Code for actorsNotIn

```python
def actorsNotIn(datalist, actorlist):
    result = set(actors(datalist))
    actorset = set(actorlist)
    diff = actorset - result
    return sorted(diff)
```

Woto-3 dictActorsToMovies

• Write
  • def dictActorsToMovies(datalist) – returns a dictionary of each actor mapped to a list of tuples, each tuple is a movie and the minutes they were in that movie
  • def actorMostMinutes(datalist)
    • Returns the actor from datalist, that was in movies the most minutes, if a tie, return any one of the tie
**def dictActorsToMovies(datalist):**

```python
    d = {}
    for item in datalist:
        if item[1] not in d:
            d[item[1]] = [(item[0],item[4])]
        else:
            d[item[1]].append((item[0],item[4]))
    return d
```

**First time, must create the list**

**Already there, append tuple to list**

---

**def actorMostMinutes(datalist):**

```python
        d = dictActorsToMovies(datalist)
        totaltime = 0
        totalactor = ""
        for (key,value) in d.items():
            time = sum([int(t[1]) for t in value])
            if time > totaltime:
                totaltime = time
                totalactor = key
        return totalactor
```

**Call function for dictionary**

**Sum all times for this actor**

**Keep track of largest time**

**Keep track of actor with largest time**