CMSC201
Computer Science I for Majors

Lecture 15 – Program Design (cont)

Last Class We Covered

- The **`range()`** function
- Using **`for`** loops
  - Using **`for`** loops and **`range()`**
  - Difference between **`for`** and **`while`** loops

Any Questions from Last Time?

Motivation

- We've talked a lot about certain 'good habits' we'd like you all to get in while writing code
  - What are some of them?

- There are two main reasons for these habits
  - Readability
  - Adaptability

“Good Code” – Readability

Readability

- Having your code be readable is important, both for your sanity and anyone else's
  - Your TA's sanity is *very*, *very*, ***very*** important
- Having highly readable code makes it easier to:
  - Figure out what you're doing while writing the code
  - Figure out what the code is doing when you come back to look at it a year later
  - Have other people read and understand your code

Improving Readability

- Improving readability of your code can be accomplished in a number of ways
  - Comments
  - Meaningful variable names
  - Breaking code down into functions
  - Following consistent naming conventions
  - Programming language choice
  - File organization

Readability Example

- What does the following code snippet do?

```
def nS(p,c):
    l=len(p)
    if l>=4:
        c+=1
        print(p)
        if l>=9:
            return p
    #FUNCTION CONTINUES...
```

- There isn't much information to go on, is there?

Readability Example

- What if I used meaningful variable names?

```
def nS(p,c):
    l=len(p)
    if l>=4:
        c+=1
        print(p)
        if l>=9:
            return p
    #FUNCTION CONTINUES...
```

Readability Example

- What if I used meaningful variable names?

```
def nextState(password,count):
    length=len(password)
    if length>=4:
        count+=1
        print(password)
        if length>=9:
            return password
    #FUNCTION CONTINUES...
```

Readability Example

- And replaced the magic numbers with constants?

```
def nextState(password,count):
    length=len(password)
    if length>=4:
        count+=1
        print(password)
        if length>=9:
            return password
    #FUNCTION CONTINUES...
```

Readability Example

- And replaced the magic numbers with constants?

```
def nextState(password,count):
    length=len(password)
    if length>=MIN_LENGTH:
        count+=1
        print(password)
        if length>=MAX_LENGTH:
            return password
    #FUNCTION CONTINUES...
```

Readability Example

- And added horizontal space?

```
def nextState(password,count):
    length=len(password)
    if length>=MIN_LENGTH:
        count+=1
        print(password)
        if length>=MAX_LENGTH:
            return password
    #FUNCTION CONTINUES...
```

Readability Example

- And added horizontal space?

```
def nextState(password, count):
    length = len(password)
    if length >= MIN_LENGTH:
        count += 1
        print(password)
        if length >= MAX_LENGTH:
            return password
    # FUNCTION CONTINUES...
```

Readability Example

- And added vertical space?

```
def nextState(password, count):
    length = len(password)
    if length >= MIN_LENGTH:
        count += 1
        print(password)
        if length >= MAX_LENGTH:
            return password
    # FUNCTION CONTINUES...
```

Readability Example

- And added vertical space?

```
def nextState(password, count):
    length = len(password)


    if length >= MIN_LENGTH:
        count += 1
        print(password)


        if length >= MAX_LENGTH:
            return password
    # FUNCTION CONTINUES...
```

Readability Example

- Maybe even some meaningful comments?

```
def nextState(password, count):
    length = len(password)


    if length >= MIN_LENGTH:
        count += 1
        print(password)


        if length >= MAX_LENGTH:
            return password
    # FUNCTION CONTINUES...
```

Readability Example

- Maybe even some meaningful comments?

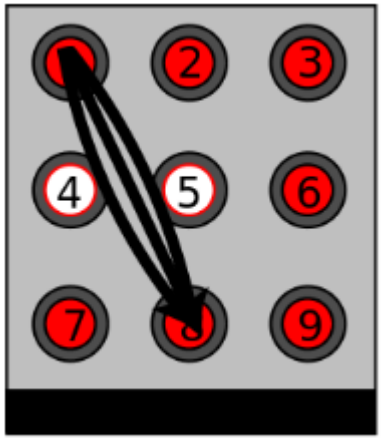
```
def nextState(password, count):
    length = len(password)

    # if long enough, count as a password
    if length >= MIN_LENGTH:
        count += 1
        print(password)

        # if max length, don't do any more
        if length >= MAX_LENGTH:
            return password
    # FUNCTION CONTINUES...
```

Readability Example

- Now the purpose of the code is a bit clearer!
  - You can see how small, simple changes increase the readability of a piece of code



- This is actually part of a function that creates a list of the possible passwords for a swipe-based login system on an Android smart phone
  - Dr. Gibson co-wrote a paper on this, available here

Commenting

Commenting is an "Art"

- Though it sounds pretentious, it's true

- There are NO hard and fast rules for when a piece of code should be commented
  - Only guidelines
  - NOTE: This doesn't apply to **required** comments like file headers and function headers!

General Guidelines

- If you have a complex conditional, give a brief overview of what it accomplishes

```
# check if car fits customer criteria
if color == "black" and int(numDoors) > 2 \
        and float(price) < 27000:
```

- If you did something you think was clever, comment that piece of code
  - So that "future you" will understand it!

General Guidelines

- **Don't** write obvious comments

```
# iterate over the list
for i in range(len(myList)):
```

- **Don't** comment every line

```
# initialize the loop variable
choice = 1
# loop until user chooses to quit
while choice != QUIT:
```

General Guidelines

- **Do** comment "blocks" of code

```
# calc tip and total (set min for large parties)
percent = float(input("Enter tip percent: ")
if numGuests > LARGE_PARTY and percent < MIN_TIP:
    percent = MIN_TIP
    print("There is a minimum tip of", MIN_TIP, \
                "for large parties")
tip   = bill * percent
total = bill + tip
```

General Guidelines

- **Do** comment nested loops and conditionals

```
listFib   = [0, 1, 1, 2, 3, 5, 8, 13, 21, 34]
listPrime = [2, 3, 5, 7, 11, 13, 17, 19, 23, 29]

# check to see if each fibonacci number
# is also in the prime number list
for f in range(len(listFib)):
    for p in range(len(listPrime)):
        if (listFib[f] == listPrime[p]):
            print(listFib[f], "is both a prime",
                              "and a Fibonacci number!")
```

General Guidelines

- **Do** comment very abbreviated variables names (especially those used for constants)
  - You can even put the comment at the end of the line! As long as the comment won't wrap around

```
MIN_CH    = 1      # minimum choice at menu
MAX_CH    = 5      # maximum choice at menu
MENU_EX   = 5      # menu choice to exit (stop)
P1_MARK   = "x"    # player 1's marker
P2_MARK   = "o"    # player 2's marker
```

“Good Code” – Adaptability

Adaptability

- Often, what a program is supposed to do evolves and changes as time goes on
  - Well-written flexible programs can be easily altered to do something new
  - Rigid, poorly written programs often take a lot of work to modify
- When coding, keep in mind that you might want to change or extend something later

Adaptability: Example

- Here is an example of a poorly modular function

Bad:

```
def makeSquareGrid():
    grid = []
    row  = []
    for i in range(10):
        row.append(0)
    for i in range(10):
        grid.append( row[:] )
    return grid
```

How can we improve this function to be more modular and adaptable?

Adaptability: Example

- Let's make the size of the grid a parameter

Good:

```
def makeSquareGrid(size):
    grid = []
    row  = []
    for i in range(size):
        row.append(0)
    for i in range(size):
        grid.append( row[:] )
    return grid
```

Adaptability: Example

- And let's add the element as a parameter too

Better:

```
def makeSquareGrid(size, elem):
    grid = []
    row  = []
    for i in range(size):
        row.append(elem)
    for i in range(size):
        grid.append( row[:] )
    return grid
```

How could we adjust this to allow non-square grids?

Incremental Development

What is Incremental Development?

- Developing your program in small increments

1. Program a small piece of the program
2. Run and test your program
3. Ensure the recently written code works
4. Address any errors and fix any bugs
5. Return to step 1

Why Use Incremental Development?

- Incremental development:
  - Makes a large project more manageable
  - Leads to higher quality code
  - Makes it easier to find and correct errors
  - Is faster for large projects
    - May seem like you're taking longer since you test at each step, but faster in the long run

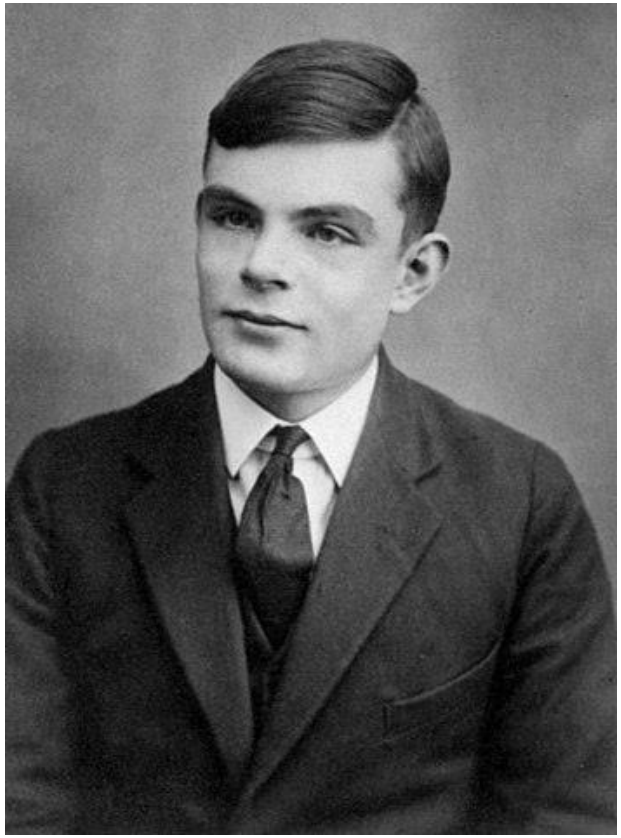
Debugging Woes

- Writing code is easy...
- Writing code that works correctly is HARD

- Sometimes the hardest part of debugging is finding out *where* the error is coming from
  - And solving it is the easy part (sometimes!)
- If you only wrote one function since the last run, start by looking there for the error

Daily CS History

- Alan Turing
  - Helped to break the German Engima cipher during WWII
  - Proposed the "Turing test" to measure artificial intelligence
  - Turing "machines"
  - Designed the first computer chess program in 1953
  - Talented long-distance runner



Announcement: Advising

- CMSC and CMPE students, sign up for an advising appointment.
  - http://advising.coeit.umbc.edu/registration/
- Select that you are in MATH 150 or higher and haven't completed the gateway.
- There are both group advising and individual advising appointments open. The earliest dates available are for group advising.

Announcements

- Project 1 is out on Blackboard now
  - Project is due by Friday (Apr 6th) at 8:59:59 PM

- Final exam is when?
  - Friday, May 18th from 6 to 8 PM
  - If you can't take the exam at that time, you need to let Dr. Gibson know via email NOW, not later

Image Sources

- Android password swipe:
  - http://static.usenix.org/events/woot10/tech/full_papers/Aviv.pdf
- Alan Turing:
  - https://en.wikipedia.org/wiki/File:Alan_Turing_Aged_16.jpg