Practice Exam
Semester: Fall 2019

Show work when needed, it can be used for partial credit! Also note that these questions are a rough estimate and are compiled by TA's who have not seen the exam. Topics covered in class are fair game even if they are not on this exam.

Name:
Andrew ID:

Unit 1

1. Identify if there is an error in the following statements. If there is, identify the type of error.

   a)
   ```
   print("2 + 2 = 5")
   ```

   b)
   ```
   for i in range(6):
       print(5 / i)
   ```

   c)
   ```
   a = [1, 2, 3]
   a.append([4])
   ```

   d)
   ```
   while x < len(L):
       if x = 2:
           return False
       return True
   ```

2. You are processing the responses to a survey, and would like to store them in the **least** number of bits possible. One of the questions allows the respondent to select any multiple of 10 between 0 and 100 (inclusive on both sides). Your colleague claims that you need to allocate at least 7 bits, since 7 bits are required to represent 100 in binary. Is your colleague correct? If not, how many bits would you allocate, and why?

   Hint: Do you need to represent numbers like 2,3,4,5? How many numbers do you need to represent?

3. Given the following function, will this function return a value of 200 at the very end? Why or why not?

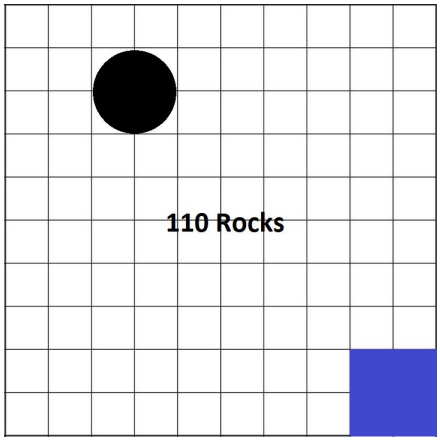
```
def loops():
    for i in range(10):
        counter = 0
        for j in range(20):
            counter += 1
    return counter
```

4. Code Tracing: Write the expected output in the box under the code

```
def ct1(s):
    n = 0
    w = 'AEIOU'
    i = 0
    while i < len(s):
        if not s[i].isalpha():
            n += 1
            s = s[:i] + s[(i+1):]
        else:
            if s[i].isupper() and s[i] in w:
                return s[:i]
            i += 1
    return s
print(ct1('1L1keT034tapplE5!!x'))
```

Unit 2

5. We have the following 10x10 grid with a black circle, blue rectangle, and a text that says “110 Rocks” in the center of the canvas. Write the code that will reproduce this. You may assume that the canvas has already been created and passed to your function in the variable 'canvas', and that the window is 400px x 400px.



6. Write a function removeMultiples(L, e) that takes in a list L of integers and removes all of the elements in L that are a multiple of e.

7. Write the expected output of the following code in the box below the code.

```
def ct1():
    x = [1, 2, 3]
    y = [4, 5, 6]
    z = y
    y = x
    x.append(4)
    y.extend([5])
    x = x + [6]
    print(x)
    print(y)
    print(z)
ct1()
```

8. Write the recursive function numLength(num) that recursively finds how many digits a positive integer contains.

   Input: `num = 15110`

   Output: `5`

9. Give the reduced big-O runtime of the following functions:

`def f(s):`
`  for i in range(len(s)):`
`  for j in range(i, len(s)):`
`  print(s)`	

`def f(n):`
`  for i in range(10**10):`
`  print("hello")`	

`def f(L):`
`  for n in L:`
`  if n % 2 == 0:`
`  return`	

`def f(L):`
`  for i in range(len(L)):`
`  if i % 2 == 0:`
`  return`	

10. What is the worst-case complexity of linear search, and when does it occur?

11. What does the following code do? Do we have a special name for this algorithm?

```
def mystery(M, val):
    if len(M) == 0:
        return False
    n = len(M)//2
    if M[n] == val:
        return True
    elif M[n] > val:
        return mystery(M[:n], val)
    elif M[n] < val:
        return mystery(M[n+1:], val)
```

12. In less than 3 sentences, define hash collision and describe a way that we can handle it.

13. Given a dictionary mapping a professor to a list of their students, write a function numProfs(d) that returns a dictionary mapping each student to the number of professors they have.

    Example Input:

```
d = { "Prof A" :
["Gayatri","Tina","Alice","Brittney","William"],
      "Prof B" : ["Enock","Tina","Marie","Brittney"],
      "Prof C" : ["Gayatri","Tina","Alice"] }
```

    Example Output:

```
{ 'Gayatri': 2, 'Tina': 3, 'Alice': 2, 'Brittney': 2,
  'William': 1, 'Enock': 1, 'Marie': 1}
```

14. A 3-tree is a tree where each parent node has **at most three** children. Draw 2 distinct 3-trees and label parents with P, children with C, and the root with R. Note that some nodes might be labeled with more than one of P, C, R.

15. **True** or **False** - if we are able to find a solution to a problem in NP-Complete in polynomial time, then we can solve all NP-Complete problems in polynomial time.

16. **True** or **False** - An algorithm that runs in O(n!) is tractable.

Unit 3

17. A cafe has three stations: cashiering, food, and beverages. Three employees are on staff, each at one station. Give one example of pipelining in this situation. In contrast, what would happen if there was no pipelining?

    Hint: Does the person behind you in line have to wait for your order to be served before they make their order?

18. What's one thing an IP address can tell you and one thing it cannot?

19. Give the name of each of the following security attacks:

    a. You're doing your homework at a Starbucks connected to the public wifi and are messaging your friends. Someone also connected to the same wifi is reading all of your messages.

    b. You find a USB stick in one of the Gates clusters and decide to plug it into your laptop to try and figure out who to return it to. After you do this, you cannot access any of the data on your laptop unless you pay someone.

    c. Everyone goes to check their final grades at the same time. SIO's servers can't handle that many people trying to login, so no one can access SIO.

20. Describe 2 characteristics of cloud computing.

Unit 4

21. You are given a CSV file of Pittsburgh bus lines (e.g., 59U, 61C, 28X) and how late they were in minutes on average to arrive at the Morewood Ave stop.

    61A, 5.2\n
    61C, 2.1\n
    59U, 0.3\n
    28X, 10.5\n

    First: draw an appropriate plot to visualize the data.

    Suppose you are given the code so that the variable line equals one line of text from the CSV. For example line = "61A, 5.2\n" Write code that would get the lateness from line and convert it to a float.

22. Read the simulation code below, then answer the following questions.

```
def makeModel(data):
    data["x"] = 0
    y = 0

def makeView(data, canvas):
    y = 0
    canvas.create_text(200, 100, text="X: " + str(data["x"]))
    canvas.create_text(200, 300, text="Y: " + str(y))

def runRules(data, call):
    data["x"] = data["x"] + 1

def keyPressed(data, event):
    y = 0
    if event.keysym == "Space":
        y = y + 1
```

What will make the value printed next to X change?

What will make the value printed next to Y change?

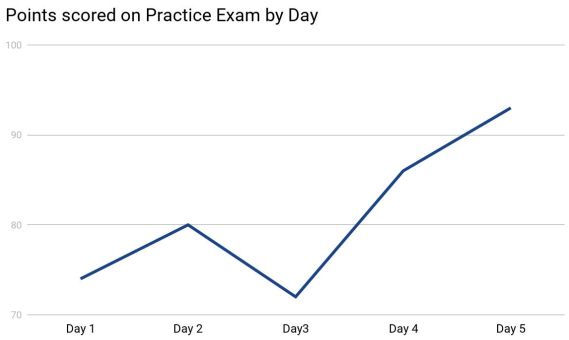
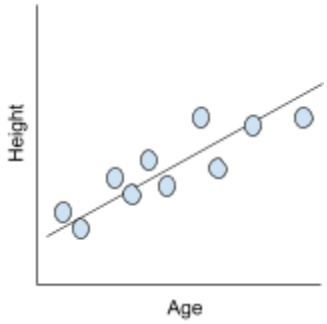
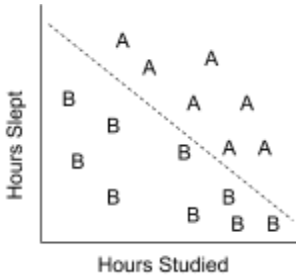
23. Write a short function that takes no input and runs a single trial of a Monte Carlo simulation. The trial should simulate flipping two coins, and should return True if the two coins show the same result, and False otherwise. Once you finish writing the code, answer the questions below.

Assume you run your function many times using the Monte Carlo method.

What will happen to the accuracy of your result as the number of trials goes up?

What will happen to the time that the function takes as the number of trials goes up?

24. For each of the graphs below, is it depicting a classification, a regression, or a time-series algorithm?

	❏ Classification ❏ Regression ❏ Time-series
Predict Height of a Person by their Age 	❏ Classification ❏ Regression ❏ Time-series
Predict Final Exam Grade (A or B) based on Hours Slept and Hours Studied 	❏ Classification ❏ Regression ❏ Time-series

25. What algorithm do we use to search an AI graph of nodes as states and edges as actions?

Unit 5

26. Name the three hardware components that helped transition computers from large devices that only corporations and governments could use to smaller, personal devices.

27. Describe an example of bias in machine learning that we discussed in class. Where did the bias come from in this example?

28. Define the term 'deepfake' and briefly explain the potential ramifications of the technology.