UT Austin Regional Tournament, Spring 2019

Algorithm Design C

Exploring the World of Science

Competitors: ______________________________

School Name: ______________________________

Team Number: ______________________________

REMEMBER:

- Copy all your answers to the answer sheet before time is called
- Be sure to put your team number at the top of every page
- Tiebreaker: first question missed

INFO:

There are 3 sections on the written exam, totalling 65 possible points. The coding portion has 3 problems, which also total 65 points, for 130 points in total. You'll have 50 minutes to complete both the written test and the programming portion. No wifi allowed, don't cheat, etc. Good Luck, Have Fun! And always remember: The Eyes of Texas Are Upon You!

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Part I: True/False (15 points)

1 point each.

1. ________ When you declare a new variable, Python requires you to specify its type (integer, boolean, etc).
2. ________ You can use the "+" operator to join two strings.
3. ________ "Float" is another name for "integer".
4. ________ Python uses curly braces to modularize code.
5. ________ Python is an interpreted (not compiled) language.
6. ________ A conditional statement serves to "branch" the execution of code into two paths.
7. ________ To loop in Python, you must specify how many times to loop.
8. ________ Functions are a way to cleanly separate parts of your code.
9. ________ Python does not support recursion.
10. ________ Python allows you to supply arguments by keywords (rather than a pre-specified ordering) in a function call.
11. ________ Classes allow you to make different instances of (a.k.a. instantiate) objects.
12. ________ It is considered bad practice to write object-oriented code.
13. ________ Classes access their own instance fields using the **self** keyword.
14. ________ "Data structure" refers to a large server that contain petabytes of data.
15. ________ Once you create a list in Python, you can only read its data, not modify it.

Part II: Multiple Choice (40 points)

2 points each.

16. Which of the following is most commonly used to represent text?
    - A. bool
    - B. int
    - C. float
    - D. string
17. In Python, the pound sign (#) is used to
    - A. Treat a numerical value as a string
    - B. Call a library function
    - C. Call a static method
    - D. Begin a single-line comment
18. All Python programs start execution at
    - A. The first class method in the file
    - B. The main function
    - C. The first executable line that isn't part of a function or method
    - D. The first executable non-commented line in the file
19. To test whether something is true, you should use
    - A. An if-statement
    - B. A while-loop
    - C. A recursive function
    - D. A for-loop
20. A major objective of object-oriented programming is to
    - A. Encapsulate data in semantically meaningful ways
    - B. Express relationships between data
    - C. Reuse code easily
    - D. All of the above
21. Which of the following best describes what an object is?
    - A. An instantiable data type with certain properties, behaviors, and operations defined on it.
    - B. A function with a variable number of parameters.
    - C. A Python library which provides a set of functions and data types to facilitate code reuse.
    - D. A data type with private internal data which supports instantiable operations.
22. Which of the following best describes inheritance?
    - A. When one object chooses to give its internal data to another.
    - B. When a function has its default implementation set by another function.
    - C. When a program uses lambda functions to pass data to data structures.
    - D. When one type of object acquires the properties/behaviors of another type.
23. A major difference between a list and a set is
    - A. Sets use key-value pairs while lists don't.
    - B. Lists are easily searchable, while sets are hard to search through.
    - C. Lists don't support duplicate entries, while sets do.
    - D. Sets are unordered, while lists are ordered.
24. A major difference between a list and a dict is
    - A. Lists are easily searchable, while dicts are hard to search through.
    - B. Dicts use key-value pairs, while lists don't.
    - C. Lists don't support duplicate entries, while dicts do.
    - D. There are no major differences.
25. A list comprehension is
    - A. A syntax to make new lists.
    - B. A technique for simplifying list data.
    - C. A way to convert lists into other data structures.
    - D. A system for documenting new list operations.
26. Time complexity refers to
    - A. The amount of time (usually in milliseconds) a program takes to run.
    - B. The number of stalls a program incurs during execution.
    - C. The timing-dependence of multi-threaded (parallelized) programs.
    - D. The runtime efficiency of an algorithm.

27. Big O analysis refers to a way to mathematically analyze
    A. The accuracy of a single-tape non-deterministic Turing machine.
    B. Recursion in complex programs.
    C. Subtype polymorphism in object-oriented design.
    D. The efficiency of an algorithm.

28. What is the runtime efficiency of indexing into a list?
    A. Constant
    B. Logarithmic
    C. Linear
    D. Quadratic

29. What is the runtime efficiency of inserting into the middle of a list?
    A. Constant
    B. Logarithmic
    C. Linear
    D. Quadratic

30. What is the runtime efficiency of binary search through an ordered list?
    A. Constant
    B. Logarithmic
    C. Linear
    D. Quadratic

31. What is the runtime efficiency of searching through a set?
    A. Constant
    B. Logarithmic
    C. Linear
    D. Quadratic

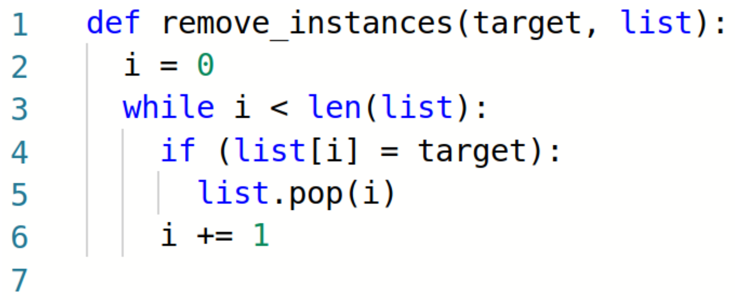
32. What is the runtime efficiency of accessing a random element of a linked list?
    A. Constant
    B. Logarithmic
    C. Linear
    D. Quadratic

33. What is the space complexity of an in-place sort (such as heapsort)?
    A. Constant
    B. Logarithmic
    C. Linear
    D. Quadratic

34. Which of the following sorts runs the fastest on average?
    A. Bubble sort
    B. Bogo bogo sort
    C. Mergesort
    D. Insertion sort

35. Big Ω analysis differs from Big O in that it's concerned with
    A. Time complexity rather than space complexity.
    B. Space complexity rather than time complexity.
    C. Tight lower bounds rather than upper bounds.
    D. Tight upper bounds rather than lower bounds.

Part III: Code Reading (10 points)



```python
def remove_instances(target, list):
    i = 0
    while i < len(list):
        if (list[i] = target):
            list.pop(i)
        i += 1

```

36. (10 points) This code is trying to remove all instances of a certain item from a list. However, there are two errors: one is a syntax error, while the other is a logical error. What are they, and how would you fix them (by changing as little code as possible)? Hint: You can fix both errors by only adding code (not removing or reordering). Hint 2: the method **list.pop(x)** removes the element at index x.

Answer Sheet

1. ______

2. ______

3. ______

4. ______

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36.