Beijing National Day School
Department of Mathematics

AP Computer Science Principles

Test 4: Algorithms

English Name: _____

Pinyin Name: _____

Mr. Alwin Tareen, Spring 2019

Exam Record
Part1 _____ / 30 pts
Total: _____ / 30 pts
Grade: _____

AP Computer Science Principles | Test 4: Algorithms | Mr. Alwin Tareen
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Part I: Multiple Choice (30 points)

- Determine the answer to each of the following questions, using the available space for any necessary scratchwork.
- Decide which is the best of the choices given, and select the correct answer by placing an "**X**" in the corresponding box.

(1pt) **1.** While algorithms can be analyzed mathematically, what information does the empirical testing process provide?

- ☐ It provides the best case, worst case, and average case information about the algorithm.
- ☐ It provides the maximum size dataset that the algorithm can handle.
- ☐ It provides the validity of the algorithm.
- ☐ It provides the clarity of the algorithm.

1 pt

(1pt) **2.** Why is there a need to find different algorithms for problems that already have a solution?

- ☐ Different algorithms could use heuristics, rather than precise values.
- ☐ Different algorithms could be more efficient.
- ☐ Different algorithms could use frequency analysis.
- ☐ Different algorithms could provide intractability.

1 pt

(1pt) **3.** Algorithms can be written with a combination of what three statements?

- ☐ Sequence / Selection / Iteration
- ☐ Series / Procedural / Functional
- ☐ Connection / Collection / Recursive
- ☐ Selection / Sorting / Searching

1 pt

(1pt) **4.** What does it mean if a program runs in less time than another?

- ☐ It is efficient.
- ☐ It is correct.
- ☐ It has been verified.
- ☐ It provides economies of scale in processing.

1 pt

(1pt) **5.** Which two measures are used to determine the efficiency of an algorithm?

- ☐ The time needed to compile, and the size of the dataset.
- ☐ The duration of time for the program to run, and the memory usage.
- ☐ The number of lines of code, and the size of the dataset.
- ☐ The number of procedures, and the number of loops used.

1 pt

5 pts

(1pt) **6.** What is a benefit of combining algorithms?

- ☐ It saves time.
- ☐ It minimizes complexity.
- ☐ It increases flexibility.
- ☐ All of the above.

1 pt

(1pt) **7.** How are algorithms and programs related?

- ☐ They have a hierarchical relationship.
- ☐ Programs implement algorithms.
- ☐ Algorithms implement programs.
- ☐ They can both be run on a computer.

1 pt

(1pt) **8.** Why does a computer playing a chess game use a heuristic algorithm?

- ☐ It ensures that the computer only wins a certain number of times, making it a more enjoyable experience for everyone.
- ☐ It ensures that humans only win a certain percentage of times, based on statistics.
- ☐ It takes too long to analyze all possible moves, so the computer takes the next best move.
- ☐ It checks each possible combination of moves, for the best move.

1 pt

(1pt) **9.** Determining that an algorithm is **intractable** means that it runs in:

- ☐ An acceptable amount of time, even for large data sets.
- ☐ Less time for worst-case scenarios, than average scenarios.
- ☐ An exponential amount of time, possibly even for small data sets, making it unable to run for large data sets.
- ☐ A fractional amount of time for fractional values.

1 pt

(1pt) **10.** When should a **heuristic** algorithm be used?

- ☐ When a problem is intractable, but a "close enough" solution is acceptable.
- ☐ When the data is not sorted, and cannot be placed in the order needed.
- ☐ When a problem is undecidable, because not enough information is known.
- ☐ When searching is needed, but efficiency is a requirement.

1 pt

(1pt) **11.** Each of the following choices can make an algorithm more readable, except for:

- ☐ Well-named variables and procedures.
- ☐ Consistent formatting within the code.
- ☐ Procedures that have one purpose.
- ☐ Minimizing the use of loops, so the program flow will be clearer.

1 pt

6 pts

(1pt) **12.** An algorithm has been developed to compute the sum of all the elements in a list of integers. Which of the following programming structures must be added to the existing algorithm so that the new algorithm computes the sum of only the even integers in the list?

1 pt

- ☐ Iteration
- ☐ Searching
- ☐ Selection
- ☐ Sequencing

(1pt) **13.** Which of the following programs is most likely to benefit from the use of a heuristic?

1 pt

- ☐ A program that calculates a student's grade based on the student's quiz and homework scores.
- ☐ A program that encrypts a folder of digital files.
- ☐ A program that finds the shortest driving route between two locations on a map.
- ☐ A program that sorts a list of numbers in order, from smallest to largest.

(1pt) **14.** Which of the following is true of algorithms?

1 pt

- ☐ Algorithms are composed of commands which implement sequencing, iteration, and selection by which a task can be completed on a computer.
- ☐ When implementing a solution to a problem, there is only one algorithm which will typically complete the task.
- ☐ Algorithms are very specific to the language in which they are implemented.
- ☐ When creating an algorithm, it is perfectly acceptable to omit important steps, and leave out sections which should be obvious to the end user.

(1pt) **15.** Which of the following choices signifies that an algorithm is considered correct?

1 pt

- ☐ If the algorithm calculates the correct output for the majority of inputs, but there are cases for which it calculates incorrect outputs.
- ☐ If the algorithm is so robust, that it runs forever.
- ☐ If, for every input, the algorithm calculates the correct output. Also, it does not cause an error, and it does not run forever.
- ☐ If the algorithm is written using perfect pseudocode syntax.

(1pt) **16.** What term describes values that can only be either true or false?

1 pt

- ☐ Intractable
- ☐ Algorithmic
- ☐ Boolean
- ☐ Sequential

(1pt) **17.** What type of problem cannot currently be determined or explained by an algorithm?

1 pt

- ☐ Indefinite problem
- ☐ Unsolvable problem
- ☐ Tractable problem
- ☐ Intractable problem

6 pts

(1pt) **18.** Why is a **divide and conquer** search more efficient than a **linear** search?

- ☐ You only look at half the data set.
- ☐ You eliminate half the data set with each iteration.
- ☐ You have to search all of the values.
- ☐ It is less efficient with large data sets.

1 pt

(1pt) **19.** Which of the following properties apply to **sequential** statements?

- ☐ They run one after the other, in the order given.
- ☐ They run only when the condition is true.
- ☐ They run until a loop finishes.
- ☐ They run until the user enters: `DONE`.

1 pt

(1pt) **20.** With a problem that cannot be solved for all cases, what can sometimes be used as a close approximation?

- ☐ A travelling solution.
- ☐ A solvable solution.
- ☐ A heuristic solution.
- ☐ An intractable solution.

1 pt

(1pt) **21.** The algorithm below is used to simulate the results of flipping a coin 4 times. Consider the goal of determining whether the simulation resulted in an equal number of heads and tails.

Step 1: Initialize the variables `heads_counter` and `flip_counter` to 0.

Step 2: A variable `coin_flip` is randomly assigned a value of either 0 or 1. If `coin_flip` has the value 0, the coin flip result is heads, so `heads_counter` is incremented by 1.

Step 3: Increment the value of `flip_counter` by 1.

Step 4: Repeat steps 2 and 3 until `flip_counter` equals 4.

Following the execution of this algorithm, which of the following expressions indicates that the simulation resulted in an equal number of heads and tails?

- ☐ `coin_flip = 1`
- ☐ `flip_counter = 1`
- ☐ `flip_counter = 2`
- ☐ `heads_counter = 2`

1 pt

(1pt) **22.** A programmer is writing a program that is intended to be able to process large amounts of data. Which of the following considerations is LEAST likely to affect the ability of the program to process larger data sets?

- ☐ How long the program takes to run.
- ☐ How many programming statements the program contains.
- ☐ How much memory the program requires, as it runs.
- ☐ How much storage space the program requires, as it runs.

1 pt

5 pts

(1pt) **23.** Which of the following statements is true?

1 pt

- ☐ Every problem can be solved with an algorithm for all possible inputs, in a reasonable amount of time, using a modern computer.
- ☐ Every problem can be solved with an algorithm for all possible inputs, but some will take more than 100 years, even with the fastest possible computer.
- ☐ Every problem can be solved with an algorithm for all possible inputs, but some of these algorithms have not been discovered yet.
- ☐ There exists problems that no algorithm will ever be able to solve, for all possible inputs.

(1pt) **24.** An algorithm will be used to identify the maximum value in a list of one or more integers. Consider the two versions of the algorithm below:

1 pt

Algorithm I: Set the value of the variable `max` to `-1`. Iterate through the list of integer values. If a data value is greater than the value of the variable `max`, then set `max` to the data value.

Algorithm II: Set the value of a variable `max` to the first data value. Iterate through the remaining values in the list of integers. If a data value is greater than the value of the variable `max`, then set `max` to the data value.

Which of the following statements best describes the behaviour of the two algorithms?

- ☐ Both algorithms work correctly on all input values.
- ☐ Algorithm I always works correctly, but Algorithm II only works correctly when the maximum value is not the first value in the list.
- ☐ Algorithm II always works correctly, but Algorithm I only works correctly when the maximum value is greater than or equal to -1.
- ☐ Neither algorithm will correctly identify the maximum value when the input contains both positive and negative input values.

(1pt) **25.** A certain computer game is played between a human player and a computer-controlled player. Every time the computer-controlled player has a turn, the game runs slowly because the computer evaluates all potential moves, and then selects the best one. Which of the following best describes the possibility of improving the running speed of the game?

1 pt

- ☐ The game's running speed can only be improved if the game is played between two human players, instead of with the computer-controlled player.
- ☐ The game's running speed might be improved by using a process that finds approximate solutions every time the computer-controlled player has a turn.
- ☐ The game's running speed cannot be improved, because computers can only be programmed to find the best possible solution.
- ☐ The game's running speed cannot be improved, because the game is an example of an algorithm that does not run in a reasonable time.

(1pt) **26.** Which of the following algorithms are considered intractable?

1 pt

- ☐ Sorting a list of integers from smallest to largest.
- ☐ Searching for an element in a list of integers.
- ☐ Computing the greatest common divisor(GCD) of two integers.
- ☐ Factoring a number into its constituent primes.

4 pts

(1pt) **27.** A programmer is developing a word game. The programmer wants to create an algorithm that will take a list of words, and return a list containing the first letter of all words that are palindromes(words that read the same, forwards or backwards). The returned list should be in alphabetical order. For example, if the list contains the words `["banana", "kayak", "mom", "apple", "level"]`, the returned list would contain `["k", "l", "m"]`, because `"kayak"`, `"level"`, and `"mom"` are palindromes. The programmer knows that the following steps are necessary for the algorithm, but they are not certain about the particular order in which they should be executed.

	1 pt

Step	**Explanation**
Shorten	Takes a list of words, and returns a new list that contains only the first letter of each word from the input list.
Keep palindromes	Takes a list of words, and returns a list that contains only the palindromes from the input list.
Sort	Takes a list of words, and returns a copy of the list in alphabetical order.

Executing which of the following sequences of steps will enable the algorithm to work as intended?

I. First shorten, then keep palindromes, then sort.

II. First keep palindromes, then shorten, then sort.

III. First sort, then keep palindromes, then shorten.

- ☐ I only
- ☐ II only
- ☐ I and III
- ☐ II and III

(1pt) **28.** An online retailer uses an algorithm to sort a list of `n` items, by price. The table below shows the approximate number of steps that the algorithm takes, to sort lists of different sizes.

	1 pt

Number of Items	Number of Steps
10	100
20	400
30	900
40	1600
50	2500
60	3600

Based on the values in the table, which of the following best characterizes the algorithm for very large values of `n`?

- ☐ The algorithm runs in reasonable time.
- ☐ The algorithm runs, but not in reasonable time.
- ☐ The algorithm attempts to solve an undecidable problem.
- ☐ The algorithm attempts to find an approximate solution, whenever it fails to find an exact solution.

	2 pts

(1pt) **29.** A student wants to create an algorithm that can determine, given any program and program input, whether or not the program will go into an infinite loop for that input. The problem that the student is attempting to solve is considered an undecidable problem. Which of the following is true?

1 pt

- ☐ It is possible to create an algorithm that will solve the problem for all programs and inputs, but the algorithm can only be implemented in a low-level programming language.
- ☐ It is possible to create an algorithm that will solve the problem for all programs and inputs, but the algorithm requires simultaneous execution on multiple CPUs.
- ☐ It is possible to create an algorithm that will solve the problem for all programs and inputs, but the algorithm will not run in reasonable time.
- ☐ It is not possible to create an algorithm that will solve the problem for all programs and inputs.

(1pt) **30.** Four independent algorithms listed below can be executed on a row of number cards(not face cards) placed on a table. There are an even number of cards, and they are placed in no particular order. Which of the following algorithms involves both selection and iteration?

1 pt

- ☐ Look over all the cards to find the smallest one, and move it to the leftmost position.
- ☐ Compare the first two cards. If the one on the left is greater, swap them.
- ☐ Swap the leftmost card with the rightmost card.
- ☐ Find the middle card, and swap it with the card in the rightmost position.

2 pts