Quiz 1: Complexity Analysis and Correctness of Algorithms

Started: Oct 19 at 9:12pm

Quiz Instructions

Instructions

This quiz will test your understanding of the material covered in week 1.

This is an online quiz. There will be no time limit to the quiz. You can attempt the quiz just once.

Note that this test cannot be taken past the due date for any credit.

Grading Criteria

This quiz is worth 30 points.

Question 1 — 5 pts

Prove by contradiction that $n^3 \notin O(\sqrt[3]{n})$.

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12pt Paragraph

Proof by Contradiction

To prove :-

$n^3 \notin O(\sqrt[3]{n})$

Let's do the following

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54 words

Question 2 — 4 pts

Find the time complexity of the following foo2 function.

```
foo2(n):
    sum = 0
    for i in range(n):
        for j in range(n):
            if( i == j):
                for k in range(n*n):
                    sum = i + j + k
```

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```
for i in range(n):
        for j in range(n):
            if( i == j):
```

The following condition exists inside the inner loop: ***if(i == j):***. This requirement can only be met if **i** and **j** are equal. The condition will be true **n** times in total (one for each iteration of the outer loop) since **i** and **j** both run from **0 to n-1.**

Inside this condition, there is another loop:

```
for k in range(n*n):
```

pre 116 words

Question 3 — 5 pts

Assume A is a list of integers. What is the correct loop invariant for the code provided below:

```
for i in range(len(A)): # in pseudo-code for i=0,...,len(A)-1
    answer += A[i]
return answer
```

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Loop Invariant:
At the end of each iteration ***i***, the variable ***answer*** holds the sum of first ***i + 1*** elements of list **A**.

Initialization:

At the end of the first iteration (***i = 0***), the variable ***answer*** holds the value of the first element ***A[0]***, therefore the loop invariant is true for ***i = 0***.

Maintenance:

Assume that the loop variant is true for some arbitrary iteration ***k***, then for iteration ***k + 1***, the value **A[k + 1]** gets added to the variable **answer**, therefore answer holds the sum of first **k + 2** (because array A is 0 indexed) elements of array **A**. Therefore the loop invariant holds true for iteration **k + 1**

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Question 4 — 16 pts

Assume a is a list of integers. Consider the following pseudocode.

```
def mystery (a):
  temp = 5
  for i in range(len(a)):
    # Assertion 1: temp =
    if a[i] > temp:
       temp = a[i]
  # Assertion 2: temp =
```

(a) (6 points) Fill in the Assertion 1 which holds in the ith iteration and Assertion 2 which holds after the For loop exits.

(b) (10 points) Give an inductive proof that the Assertion 1 holds in all iterations.

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Part 1:

Assertion 1:
At the start of each iteration **i**, `temp` holds the value ***max(5, a[:i])***.

Assertion 2:
After the loop exits, **temp = max(5, max(a))**

Part 2:

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264 words

No new data to save. Last checked at 9:27pm

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