# Quiz 1

Started: Feb 8 at 10:20pm

# Quiz Instructions

## Question 1

10 pts

Run the BUBBLE-SORT algorithm discussed in class on the array A = <7, 3, 6, 2, 4, 12, 8, 9>. Write the array A at the start of the iteration i=5 of the **for loop**.

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2, 3, 4, 6, 7, 8, 9, 12

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## Question 2

10 pts

Consider the BUBBLE-SORT algorithm that we discussed in class. Which of the following is the correct **loop invariant** for the ***for loop*** in line 3?

- At the start of each iteration j of the for loop (line 3), A[j] has the smallest value in A[1..n].
- At the start of each iteration j of the for loop (line 3), A[j] has the smallest value in A[1..j+1].
- At the start of each iteration j of the for loop (line 3), A[j] has the smallest value in A[j+1..n].
- At the start of each iteration j of the for loop (line 3), A[j] has the smallest value in A[j..n].
- (selected) At the start of each iteration j of the for loop (line 3), A[j] has the smallest value in A[1..j].

## Question 3

10 pts

What is the running time for the pseudocode below? Express the running time using Θ - notation as a function of *n*.

```
for i =1 to n
```

for j = 1 to lgn

x=x+1

for k = 1 to n

x=x+2

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$\Theta\left(n^2\right)$

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## Question 4

10 pts

Select all the statements below which are TRUE:

- [ ] $n^5 \lg n + n^3 + 2^n = \Theta\left(n^5 \lg n\right)$
- [x] $n^2 \lg^2 n + n + \left(\frac{1}{2}\right)^n = o\left(n^3\right)$
- [x] $n^3 - n - 500 = \Omega\left(n^2\right)$
- [x] $n^3 - 100 = O\left(n^3\right)$
- [ ] $2n^3 + n - 100 = \Theta\left(n\right)$
- [ ] $\left(\frac{1}{2}\right)^n = \Omega\left(n\right)$
- [ ] $5n + 100 = \omega\left(n\right)$

## Question 5

10 pts

What is the Θ - notation for the expression below? Select the correct answer.

$$\left(\frac{1}{3}\right)^n + n^3 \lg n + 3^n + 729^{\log_3 n}$$

- $\Theta\left(\left(\frac{1}{3}\right)^n\right)$
- $\Theta\left(729^{\log_3 n}\right)$
- $\Theta\left(n^3 \lg n\right)$
- $\Theta\left(3^n\right)$ (selected)

## Question 6

10 pts

Find $\Theta$ - notation for the expression:

$$\left(1^3 + 2^3 + \ldots + n^3\right) + n^3 \lg n + \left(\frac{1}{3}\right)^n + 729^{\log_3 n}$$

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$\Theta\left(n^6\right)$

p

## Question 7

10 pts

Arrange the following functions in ascending order of growth rate. That is, if function g(n) immediately follows function f(n) in your list, then it should be the case that f(n) = O(g(n)).

$f_1(n) = 729^{\log_3 n}$

$f_2(n) = n!$

$f_3(n) = n^5\sqrt{n}$

$f_4(n) = 5^n$

$f_5(n) = n^5 \lg n$

$f_6(n) = \left(\frac{1}{5}\right)^n$

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$f_6(n)$, $f_5(n)$, $f_3(n)$, $f_1(n)$, $f_4(n)$, $f_2(n)$

p

## Question 8

10 pts

Use formal definitions to show that:

$3n^3 - 7n + 500 = O(n^4)$

$3n^3 - 2n + 10 = \omega(n^2)$

Show your work, similar to the examples from the notes.

Upload a file with your solution.

Upload Quiz01-8.pdf

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## Question 9

10 pts

1. Solve the following recurrence using **backward substitution:**

T(n)=2T(n-1)+3 for n>1, T(1)=4.

Show your work similar to the example from the notes. You do not need to prove the correctness.

2. Solve the following recurrence using the **change of variable** method:

$T(n) = T\left(\sqrt[4]{n^3}\right) + 5$. Use the change of variable m=lg(n).

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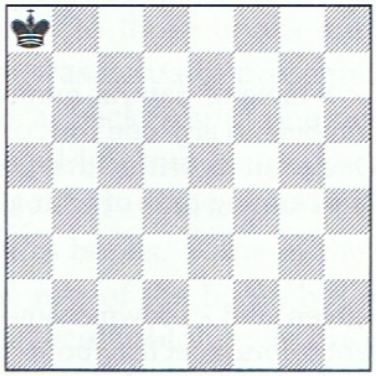
## Question 10

10 pts

A king stands on the upper left square of the chessboard. Two players make turns moving the king either one square to the right or one square downward or one square along a diagonal in the southeast direction. The player who can place the king on the lower right square of the chessboard wins. Who will win? Describe the winning strategy.



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