CS 173, Fall 17 Examlet 11, Part B

Name: _____

NetID: _____ **Lecture:** A B

Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

(15 points) Check the (single) box that best characterizes each item.

$T(1) = d$
$T(n) = 3T(n/2) + n$

$\Theta(n)$	☐	$\Theta(n \log n)$	☐	$\Theta(n^2)$	☐	$\Theta(n^3)$	☐
$\Theta(n^{\log_3 2})$	☐	$\Theta(n^{\log_2 3})$	☑	$\Theta(2^n)$	☐	$\Theta(3^n)$	☐

$T(1) = d$
$T(n) = 2T(n/2) + c$

$\Theta(n)$	☑	$\Theta(n \log n)$	☐	$\Theta(n^2)$	☐	$\Theta(n^3)$	☐
$\Theta(n^{\log_3 2})$	☐	$\Theta(n^{\log_2 3})$	☐	$\Theta(2^n)$	☐	$\Theta(3^n)$	☐

Adding element to head of linked list

$\Theta(1)$	☑	$\Theta(\log n)$	☐	$\Theta(n)$	☐	$\Theta(n \log n)$	☐
$\Theta(n^2)$	☐	$\Theta(n^3)$	☐	$\Theta(2^n)$	☐	$\Theta(3^n)$	☐

Problems in class NP (as in P vs. NP) can be solved in polynomial time

true ☐ false ☐ not known ☑

The solution to the Tower of Hanoi puzzle with n disks requires $\Theta(2^n)$ steps

true ☑ false ☐ not known ☐

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(15 points) Check the (single) box that best characterizes each item.

$T(1) = d$
$T(n) = 3T(n/2) + d$

$\Theta(n)$	☐	$\Theta(n \log n)$	☐	$\Theta(n^2)$	☐	$\Theta(n^3)$	☐
$\Theta(n^{\log_3 2})$	☐	$\Theta(n^{\log_2 3})$	☑	$\Theta(2^n)$	☐	$\Theta(3^n)$	☐

The running time of binary search is recursively defined by $T(1) = d$ and $T(n) =$

$T(n/2) + c$	☑	$T(n/2) + cn$	☐
$2T(n/2) + c$	☐	$2T(n/2) + cn$	☐

Algorithm A takes $\log_2 n$ time. On one input, A takes x time. How long will it take if I double the input size?

$x + 1$	☑	$2x$	☐	2^x	☐	x^2	☐

The Towers of Hanoi puzzle can be solved in polynomial time.

true	☐	false	☑	not known	☐

Problems in class NP (as in P vs. NP) can be solved in exponential time

true	☑	false	☐	not known	☐

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Discussion: Thursday Friday 9 10 11 12 1 2 3 4 5 6

(15 points) Check the (single) box that best characterizes each item.

$T(1) = c$
$T(n) = 4T(n/2) + n$

$\Theta(n)$ ☐	$\Theta(n \log n)$ ☐	$\Theta(n^2)$ ☑	$\Theta(n^3)$ ☐
$\Theta(n^{\log_3 2})$ ☐	$\Theta(n^{\log_2 3})$ ☐	$\Theta(2^n)$ ☐	$\Theta(3^n)$ ☐

Adding element to start of array (array gets longer)

$\Theta(1)$ ☐	$\Theta(\log n)$ ☐	$\Theta(n)$ ☑	$\Theta(n \log n)$ ☐
$\Theta(n^2)$ ☐	$\Theta(n^3)$ ☐	$\Theta(2^n)$ ☐	$\Theta(3^n)$ ☐

Algorithm A takes 2^n time. On one input, A takes x time. How long will it take if I double the input size?

$x + 2$ ☐ $2x$ ☐ 2^x ☐ x^2 ☑

Deciding whether an input logic expression be made true by appropriate choice of input values.

polynomial ☐ exponential ☐ in NP ☑

For a problem to satisfy the definition of co-NP, a "no" answer must have a succinct justification.

true ☑ false ☐

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(15 points) Check the (single) box that best characterizes each item.

$T(1) = d$
$T(n) = 2T(n/4) + c$

$\Theta(\log n)$	☐	$\Theta(\sqrt{n})$	☑	$\Theta(n)$	☐	$\Theta(n \log n)$	☐
$\Theta(n^2)$	☐	$\Theta(n^3)$	☐	$\Theta(2^n)$	☐	$\Theta(3^n)$	☐

The running time of the Towers of Hanoi solver is recursively defined by $T(1) = d$ and $T(n) =$

$2T(n-1) + c$	☑	$2T(n-1) + cn$	☐
$2T(n/2) + c$	☐	$2T(n/2) + cn$	☐

Algorithm A takes n^2 time. On one input, A takes x time. How long will it take if I double the input size?

$x + 1$	☐	$2x$	☐	$4x$	☑	x^3	☐

Determining whether a graph with n edges is connected.

polynomial	☑	exponential	☐	in NP	☐

Problems in class NP require exponential time

true	☐	false	☐	not known	☑

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(15 points) Check the (single) box that best characterizes each item.

$T(1) = c$
$T(n) = 4T(n/2) + n$

$\Theta(n)$	☐	$\Theta(n \log n)$	☐	$\Theta(n^2)$	☑	$\Theta(n^3)$	☐
$\Theta(n^{\log_3 2})$	☐	$\Theta(n^{\log_2 3})$	☐	$\Theta(2^n)$	☐	$\Theta(3^n)$	☐

$T(1) = c$
$T(n) = 3T(n/3) + n$

$\Theta(n)$	☐	$\Theta(n \log n)$	☑	$\Theta(n^2)$	☐	$\Theta(n^3)$	☐
$\Theta(n^{\log_3 2})$	☐	$\Theta(n^{\log_2 3})$	☐	$\Theta(2^n)$	☐	$\Theta(3^n)$	☐

Changing last value in array

$\Theta(1)$	☑	$\Theta(\log n)$	☐	$\Theta(n)$	☐	$\Theta(n \log n)$	☐
$\Theta(n^2)$	☐	$\Theta(n^3)$	☐	$\Theta(2^n)$	☐	$\Theta(3^n)$	☐

In a set of n 2D points, which pair of points is closest? polynomial ☑ exponential ☐ in NP ☐

For a problem to satisfy the definition of NP, a "yes" answer must have a succinct justification. true ☑ false ☐

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(6 points) Fill in the missing bits of this recursive algorithm for returning the location of a number k in a sorted list of numbers $a_p, a_2, ..., a_q$.

search(p,q,k) \\ assume $p \leq q$

$m := \lfloor (p+q)/2 \rfloor$

if $k = a_m$ then return m

else if $(k < a_m)$ and $p < m$ then

Solution: return search(p,m-1,k)

else if $(k > a_m)$ and $q > m$ then

Solution: return search(m+1,q,k)

else return -1 \\ i.e. error, not found

(9 points) Check the (single) box that best characterizes each item.

$T(1) = c$
$T(n) = 4T(n/2) + n$

$\Theta(n)$ ☐	$\Theta(n \log n)$ ☐	$\Theta(n^2)$ ☑	$\Theta(n^3)$ ☐
$\Theta(n^{\log_3 2})$ ☐	$\Theta(n^{\log_2 3})$ ☐	$\Theta(2^n)$ ☐	$\Theta(3^n)$ ☐

Changing last value in linked list

$\Theta(1)$ ☐	$\Theta(\log n)$ ☐	$\Theta(n)$ ☑	$\Theta(n \log n)$ ☐
$\Theta(n^2)$ ☐	$\Theta(n^3)$ ☐	$\Theta(2^n)$ ☐	$\Theta(3^n)$ ☐

For a problem to satisfy the definition of co-NP, a "yes" answer must have a succinct justification. true ☐ false ☑