THE UNIVERSITY OF WESTERN AUSTRALIA

MID SEMESTER EXAMINATION
April 2019

DEPARTMENT OF COMPUTER SCIENCE & SOFTWARE ENGINEERING

DATA STRUCTURES AND ALGORITHMS CITS2200

This Paper Contains:
6 Pages
10 Questions

Time allowed : **Forty five minutes**

Marks for this paper total 10.
Students should answer **ALL** Questions.

Q1. Which one of the following is the correct recurrence for the `quicksort` algorithm?

(A) $T(n) = T(\frac{n}{2})$
(B) $T(n) = 2T(\frac{n}{2}) + c\frac{n}{2}$
(C) $T(n) = T(n-1) + cn$.
(D) None of the above.

Q2. Which one of the following statements about the worst-case complexity of `quicksort` is correct?

(A) The worst-case complexity of `quicksort` is $O(\log n)$.
(B) The worst-case complexity of `quicksort` is $O(\sqrt{n}\log n)$.
(C) The worst-case complexity of `quicksort` is $O(n \log n)$
(D) None of the above.

Q3. Suppose $f(n)$ is $O(g(n))$, $g(n)$ is $O(h(n))$, and $h(n)$ is $O(g(n))$. Which of the following are possible functions for f, g and h?

(A) $f(n) = \log^2 n, g(n) = n \log n, h(n) = n^2$.
(B) $f(n) = n \log n, g(n) = n^2, h(n) = n^2 \log n$.
(C) $f(n) = 5 \log n, g(n) = 10 \log n, h(n) = 5000 \log n$.
(D) $f(n) = n^2, g(n) = n^4, h(n) = 2^n$.

Q4. Which of the following is a correct statement?
(A) $f(n)$ is $O(g(n))$ if there is a constant $c > 0$ and an integer $n_0 \geq 1$ such that, for all $n < n_0$, $f(n) \leq cg(n)$.
(B) $f(n)$ is $O(g(n))$ if there is a constant $c > 0$ and an integer $n_0 \geq 1$ such that, for all $n \geq n_0$, $f(n) \leq cg(n)$.
(C) $f(n)$ is $O(g(n))$ if there is a constant $c > 0$ and an integer $n_0 \geq 1$ such that, for all $n \geq c$, $f(n) \leq cg(n)$.
(D) $f(n)$ is $O(g(n))$ if there is a constant $c > 0$ and an integer $n_0 \geq 1$ such that, for all $n_0 \geq n$, $f(n) \leq cg(n)$.

Q5. Suppose $f(n) = 2^{5 \log n}, g(n) = n^2, h(n) = n\sqrt{n}, k(n) = n \log n, p(n) = n^2 \log n$. Which of the following is a correct ordering of these complexities in ascending order (smallest to largest)?

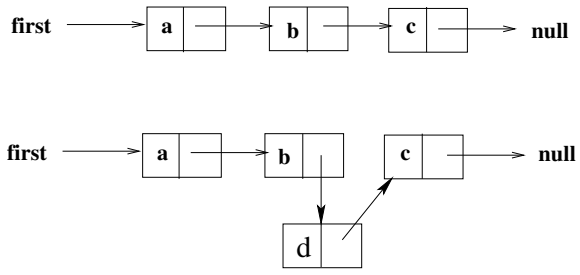
(A) $f(n), h(n), g(n), p(n), k(n)$.

(B) $k(n), h(n), g(n), p(n), f(n)$.

(C) $h(n), k(n), f(n), g(n), p(n)$.

(D) $p(n), k(n), f(n), g(n), h(n)$.

Q6. Consider the following figure:



Using the definition of the `Link` class from the lectures and labs, which one of the following codes transforms the first figure to the second figure?

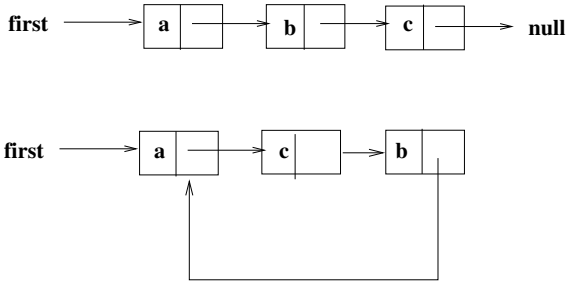
(A) `first.successor.successor=new Link(d, first.successor.successor)`

(B) `first.successor.successor.successor=new Link(d,first.successor)`

(C) `first.successor=new Link(d,first.successor.successor)`

(D)
```
first.successor.successor.successor=
new Link(d,first.successor.successor.successor)
```

Q7. Consider the following figure:



Using the definition of the `Link` class from the lectures and labs, which one of the following codes transforms the first figure to the second figure?

(A)

```
char temp=first.successor.item;
first.successor.item=first.successor.successor.item;
first.successor.successor.item=temp;
first.successor.successor=first;
```

(B)

```
char temp= first.successor.item;
first.successor.successor.item= temp;
first.successor.item=first.successor.successor.item;
first.successor.successor.successor=first;
```

(C)

```
char temp=first.successor.item;
first.successor.item=first.successor.successor.item;
first.successor.successor.item=temp;
first.successor.successor.successor=first;
```

(D)

```
char temp= first.item;
first.successor.siccessor.item= temp;
first.successor.item=first.successor.successor.item;
first.successor.successor=first;
```

Q8. Which of the following statements is true?

(A) The worst-case complexity of `quicksort` is $O(n \log n)$ and the worst-case complexity of `mergesort` is $O(n^2)$.
(B) Both `quicksort` and `mergesort` have worst-case complexities $O(n^2)$.
(C) Both `quicksort` and `mergesort` have worst-case complexities $O(n \log n)$.
(D) The worst-case complexity of `quicksort` is $O(n^2)$ and the worst-case complexity of `mergesort` is $O(n \log n)$.

Q9. Which of the following definitions of a `tree` is correct?

(A) Every internal node of a tree has two chldren;
(B) There is a unique path between a pair of nodes in a tree;
(C) The height of a tree is $O(n)$;
(D) The height of a tree is $O(\log n)$;

Q10. Which of the following statements is true?
(A) Deleting an item from a stack is an $O(n)$ operation, and deleting an item from a queue is an $O(1)$ operation.
(B) Deleting an item from a stack is an $O(1)$ operation, and deleting an item from a queue is an $O(n)$ operation.
(C) Deleting an item from a stack is an $O(n)$ operation, and deleting an item from a queue is an $O(n)$ operation.
(D) none of the above.

END OF PAPER