

THE UNIVERSITY OF WESTERN AUSTRALIA

MID SEMESTER EXAMINATION
April 2018

**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 statements about the worst-case complexity of Insertion Sort is wrong?

- (A) The worst-case complexity of Insertion Sort is $O(n^4)$.
- (B) The worst-case complexity of Insertion Sort is $O(n^3)$.
- (C) The worst-case complexity of Insertion Sort is $O(n \log n)$.
- (D) The worst-case complexity of Insertion Sort is $O(n^2)$.

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

- (A) The worst-case complexity of Quick Sort is $O(\log n)$.
- (B) The worst-case complexity of Quick Sort is $O(n^2)$.
- (C) The worst-case complexity of Quick Sort is $O(n \log n)$.
- (D) The worst-case complexity of Quick Sort is $O(n)$.

Q3. Suppose $f(n)$ is $O(g(n))$, $g(n)$ is $O(h(n))$, and $h(n)$ is $O(f(n))$. 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) $f(n) = n^3$, $g(n) = n^2$, $h(n) = n \log n$.
- (C) $f(n) = 5 \log n$, $g(n) = 1000 \log n$, $h(n) = \log n$.
- (D) $f(n) = n^2$, $g(n) = n^4$, $h(n) = 2^n$.

Q4. A (singly) linked implementation of a Queue contains the following instance variables:

- **front:** A reference to the front of the queue, that is, the end with the item that has been in the queue for the longest amount of time;
- **back:** A reference to the back of the queue, that is, the end with the item that has been added most recently.

The `enqueue` method can be implemented as:

```
public void enqueue (Object a) {  
    if (isEmpty()) {  
        front=new Link(a,null);  
        back=front;  
    }  
  
    <<missing code>>  
}
```

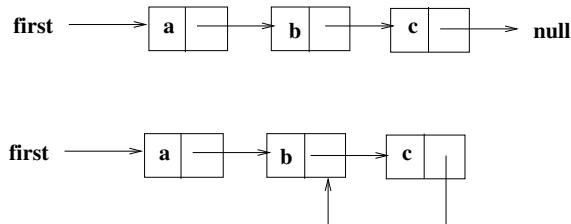
Note: All operations in the queue must be able to operate in constant time.
Which of the following is a correct implementation of the missing code?

- (A) else back.successor= new Link(a,null);
- (B) else front= new Link(a,front);
- (C)
- ```
else {
 front.successor=new Link(a,front);
 front=front.successor;
}
```
- (D)
- ```
else {  
    back.successor=new Link(a,null);  
    back=back.successor;  
}
```

Q5. Suppose $f(n) = 2^{\log n}$, $g(n) = n^2$, $h(n) = n\sqrt{n}$, $k(n) = n \log n$, $p(n) = 2^n$. 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) $f(n), k(n), h(n), g(n), p(n)$.
- (C) $h(n), k(n), f(n), g(n), p(n)$.
- (D) $p(n), k(n), f(n), g(n), h(n)$.

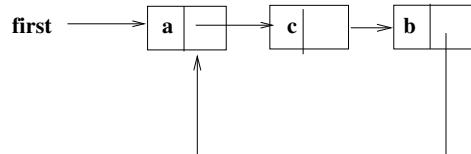
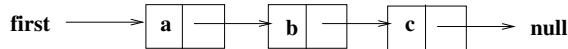
Q6. Consider the following figure:



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=first.successor`
- (B) `first.successor.successor.successor=first.successor`
- (C) `first.successor=first.successor.successor.successor`
- (D) `first.successor.successor.successor=first.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.successor.item= temp;
first.successor.item=first.successor.successor.item;
first.successor.successor.successor=first;
```

(B)

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

(C)

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

(D)

```
char temp=first.successor.item;
first.successor.item=first.successor.successor.item;
first.successor.successor.item=temp;
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 average case complexity is $O(n^2)$.
- (B) Both the worst case and the average case complexities of `quicksort` are $O(n^2)$.
- (C) The average case complexity of `quicksort` is $O(n \log n)$ and the worst case complexity is $O(n \log n)$.
- (D) The average case complexity of `quicksort` is $O(n \log n)$ and the worst case complexity is $O(n^2)$.

Q9. The correct recurrence equation for analysing the complexity of the Merge Sort algorithm is (c is a constant):

- (A) $T(n) = T(\frac{n}{2}) + cn$.
- (B) $T(n) = T(n - 1) + cn$.
- (C) $T(n) = 4T(\frac{n}{2}) + cn$.
- (D) $T(n) = 2T(\frac{n}{2}) + cn$

Q10. If there are n objects in a list, the time complexity to delete the middle object is:

- (A) $O(n \log n)$
- (B) $O(n)$
- (C) $O(n^2)$
- (D) none of the above.

END OF PAPER
