

Lab2- Stacks and Queues

You can select and do some questions according to your ability. We would like to note you that the more questions you do the better for you in doing final practical and writing exams.

A- Writing exercises

- 1) Assume that x, y, z are integer variables and that s is a stack of integers. State the output of the following program fragment.

```
x = 3; y = 5; z = 2;
s.makeEmpty();
s.push(x); s.push(4); s.pop();
s.push(y); s.push(3); s.push(z);
s.pop(); s.push(2); s.push(x);
while(! s.isEmpty()) System.out.println(s.pop() + " ");
```

- 2) Assume that x, y are integer variables and that s is a stack of integers. State the output of the following program fragment.

```
x = 3; y = 1;
s.makeEmpty();
s.push(5); s.push(7); s.pop();
x += y;
s.pop();
s.push(x); s.push(y); s.push(2); s.pop(); s.pop();
while (! s.isEmpty()) {
    y = s.pop();
    System.out.println(y);
}
System.out.println("x = " + x);
System.out.println("y = " + y);
```

- 3) A letter means push and an asterisk means pop in the following sequence. Give the sequence of values returned by the pop operations when this sequence of operations is performed on an initially empty stack.

E A S * Y * Q U E * * * S T * * * I O * N * * *

- 4) A letter means push and an asterisk means pop in the following sequence. Give the contents of s[0], ..., s[4] after this sequence of operations is performed on an initially empty stack (the stack is implemented by array s[]).

L A * S T I * N * F I R * S T * * O U * T * * * * *

- 5) A letter means enqueue and an asterisk means dequeue in the following sequence. Give the sequence of values returned by the dequeue operation when this sequence of operations is performed on an initially empty queue.

E A S * Y * Q U E * * * S T * * * I O * N * * *

- 6) A letter means enqueue and an asterisk means dequeue in the following sequence. Give the contents of q[0], ..., q[4] after this sequence of operations is performed on an initially empty queue (the queue is implemented by circular array q[] with size 5).

E A S * Y * Q U E * * * S T * * * I O * N * * *

B- Practical exercises

Question 1. Write a Java program to implement a stack of integer values with the following operations:

- 1) boolean isEmpty() - return true if the stack is empty and false otherwise.
- 2) void clear() - clear the stack.
- 3) void push(int x) - insert a node with value x at the top of the stack.
- 4) int pop() - remove the top element on the stack and return it's value; throw EmptyStackException for empty stack.
- 5) int top() - return value of a node at the top of the stack; throw EmptyStackException for empty stack.
- 6) void traverse() - display all values in the stack from the top to the bottom.
- 7) Use a stack to convert an integer number in decimal system to binary system and display on the screen.

Note: You can write some constructors and other methods as you see they are necessary.

Question 2. Write a Java program to implement a queue of integer values with the following operations:

- 1) boolean isEmpty() - return true if the queue is empty and false otherwise.
- 2) void clear() - clear the queue.
- 3) void enqueue(int x) - insert a node with value x at the end of the queue.
- 4) int dequeue() - remove the first element on the queue and return it's value; throw Exception for empty queue.
- 5) int first() - return value of the first node of the queue; throw Exception for empty queue.
- 6) void traverse() - display all values in the queue from the front to the rear.

7) Use a queue to convert a real number less than 1 in decimal system to binary system and display on the screen.

Note: You can write some constructors and other methods as you see they are necessary.

Question 3. Modify programs in questions 1 and 2 so that elements in the stack and queue are String types and write the Main class to test them.

Question 4. Modify programs in questions 1 and 2 so that elements in the stack and queue are character types and write the Main class to test them.

Question 5. Modify programs in questions 1 and 2 so that elements in the stack and queue are Object types and write the Main class to test them (e.g. stack and queue contains computer names).