

## BT3051-Data Structures and Algorithms for Biology

### Self Assessment Problems-2

1. Create a 'Circle' class and initialize it with radius. Define two methods 'Area' and 'Circumference' inside this class.
2. Create a Student class and initialize it with name and roll number. Define functions to :
  - a. setAge - It should assign age to student
  - b. setMarks - It should assign marks to the student.
  - c. Display - It should display all the details pertaining to the student.
3. **Solve a maze (Stacks):** Write a function that takes in 3 arguments- a) matrix of 1's and 0's representing a maze, where 1 => dead-end/wall, 0 => acceptable route point, b) a tuple with the row and column indices of the start position, c) a tuple with the row and column indices of the end position, and prints a solution path as a list of tuples with row and column indices of the points in the path. Use a stack to store indices of positions you visit and move along. (Assume the maze has only one solution. Future concepts taught in the course will help you find the shortest solution.)
4. What is the output of this code? (Assuming ArrayStack and ArrayQueue are classes implementing stacks and queues using arrays in python)

```
stack=ArrayStack()
queue=ArrayQueue()

[stack.push(i) for i in range(1,11)]
[queue.enqueue(i) for i in range(1,11)]

while (not stack.is_empty()) and stack.top()>=5:
    queue.enqueue(stack.pop())
while (not queue.is_empty()) and queue.first()<=5:
    stack.push(queue.dequeue())

while not queue.is_empty():
    print(queue.dequeue())
print('\n')
while not stack.is_empty():
    print(stack.pop())
```

5. **(Queues and Classes):** In queueing theory, an **M/D/1 queue** represents the queue length in a system having a single server, where arrivals are determined from a random distribution, and job service times are fixed (deterministic). Take the example of students waiting in line to place their order at a food court. The arrival of students is a Markov process (M)- rate of arrival of students is given by parameter lambda representing an exponential distribution, and 1/lambda is the mean time between arrivals. The time to

serve each student is deterministic (D). The rate of service is given by parameter  $\mu$ , and the service time is exactly  $1/\mu$  per student. There is only 1 service counter.

- a. Create a class Student with attributes RollNumber, EntryTime, and ExitTime, and a method to return WaitingTime (time a student has to wait in the line).
  - b. Write a function to simulate an M/D/1 queue for the above situation, where the arguments are  $\lambda$ ,  $\mu$ , [list of student roll numbers], and MaxTime. It should return the list of tuples of students (roll numbers) served and the time they waited in line, and a similar list of tuples of students not served at the end of MaxTime (maximum time the counter functions). Use a defined Queue data structure to simulate this problem.
6. Write a function to convert binary numbers to decimals (without using in-built functions).
- a. Estimate the time complexity mathematically as a function of number of bits. (What would it be as a function of the final decimal answer?)
  - b. Verify your answer empirically by plotting the time taken to convert binary numbers of  $n$  bits to decimal numbers, as  $n$  goes from 1 to 1000.
7. **Postfix notation** is a notation for writing arithmetic expressions in which the operands appear before their operators.

Example:  $(3-2)/5$

Postfix: 3 2 - 5 /

Write a function to evaluate a postfix expression.

Input: 4 5 + 7 2 - \*

Output: 45

8. Create a Time class and initialize it with hours and minutes.
- a. Make a method addTime which should take two time object and add them. E.g.- (2 hour and 50 min)+(1 hr and 20 min) is (4 hr and 10 min)
  - b. Make a method displayTime which should print the time.
  - c. Make a method DisplayMinute which should display the total minutes in the Time. E.g.- (1 hr 2 min) should display 62 minute.