

Name:

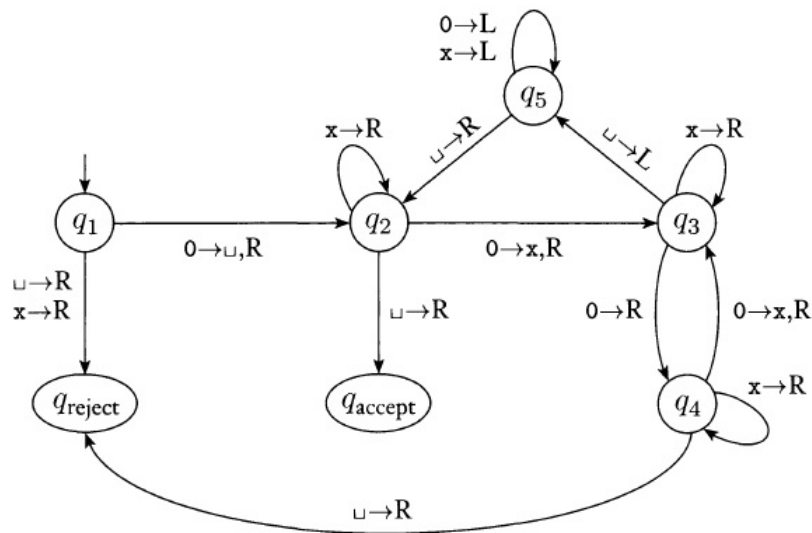
**BBM402: Midterm Exam**

**16.4.2019**

**Time: 13:30-15:30**

|           |    |    |    |    |    |    |       |
|-----------|----|----|----|----|----|----|-------|
| Question: | 1  | 2  | 3  | 4  | 5  | 6  | Total |
| Points:   | 20 | 15 | 15 | 15 | 15 | 20 | 100   |
| Score:    |    |    |    |    |    |    |       |

1. (20 points) In each part, give the sequence of configurations that  $M_2$  enters when started on the given input string.



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2. (15 points) The running time for the mergesort algorithm is given as

$$T(n) = T(\lceil n/2 \rceil) + T(\lfloor n/2 \rfloor) + O(n).$$

Use a recursion tree, to show that  $T(n) = O(n \log n)$ . Show all your work.

3. (15 points) Show that the independent set problem can be reduced to the vertex cover problem in polynomial time? How big is this polynomial in the worst-case?

4. (15 points) In the conflict-free class-scheduling problem,
- a) prove that at least one maximal conflict-free schedule includes the class that finishes first.
  - b) prove that the greedy algorithm that picks the non-conflicting class that finishes first from the available classes outputs an optimal schedule (with maximal number of classes).

5. (15 points) Show that the maximum independent set problem is in NP.

6. (20 points) a) Write a recursive relation to calculate Fibonacci number  $n$ .

b) In the recursion tree to calculate Fibonacci number  $n$  using this relation, give the number of leaves in this tree and prove that it is correct by induction.