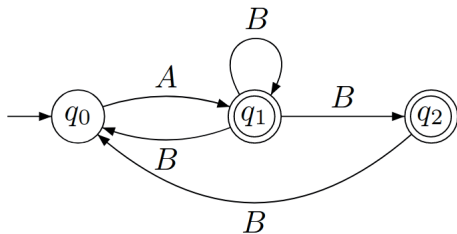


CS 60030: Formal Systems  
Spring Semester: 2018-2019  
Tutorial 3  
Linear Temporal Logic (LTL)

Indian Institute of Technology, Kharagpur

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1. Construct an NBA for the following properties.
  - 1.1 Every 'a' has aboccurring some where to its right.
  - 1.2  $((b + c)^\omega a.(a + c)^* b)^\omega$
  - 1.3  $aUb$
  - 1.4  $GFp$
2. Convert the following GNBA to an NBA.  $\mathcal{F} = \{F_1, F_2\}$ ,  
 $F_1 = \{q_1\}$ ,  $F_2 = \{q_2\}$ .



### 3. Express the following in LTL.

- 3.1 No more than one processor (in a 2-processor system) should have a cache line in write mode.
- 3.2 The grant signal must be asserted at some time after the request signal is asserted.
- 3.3 Every request signal must receive an acknowledge and the request should stay asserted until the acknowledge signal is received
- 3.4 If something is attempted/requested infinitely often, then it will be successful/allocated infinitely often.
- 3.5 There is atleast one execution on which eventually process(1) enters the critical section.

4. Express the following in LTL. The alphabet is  $\Sigma = \{A, B, C\}$ .
- 4.1 An A is followed by B's ad-infinitum or until C.
  - 4.2 Between any two neighboring A's there is at least one B.
  - 4.3 Never is it that an A is followed by a B unless the A is preceded by a C.
  - 4.4 If an A occurs and within the next 3 symbols a B occurs, then after the B in 2 symbols a C occurs.
  - 4.5 If an A occurs and is thereafter followed at some time by a B, then eventually thereafter a C occurs.