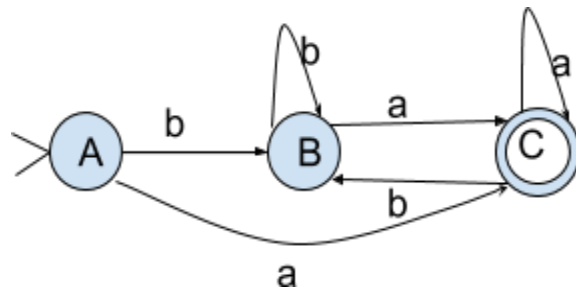


## Tutorial - 4 -> CS21004

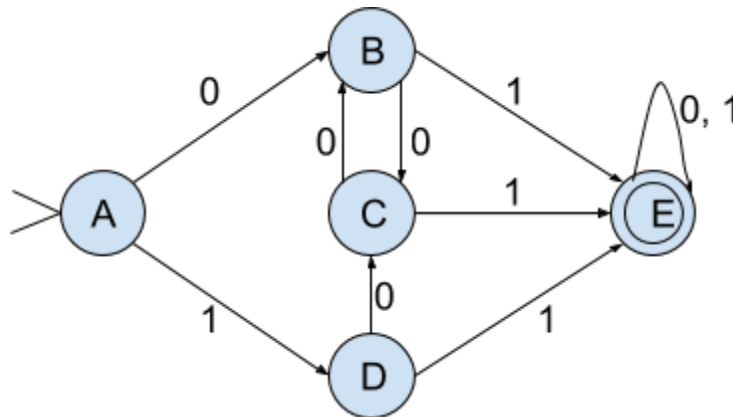
February 5 , 2016

- 1) Prove the following for Regular Languages
  - a)  $L = \{ a^n \mid n \geq 0 \}$  is non-regular using Pumping Lemma
  - b)  $L = \{ ww \mid w \in \Sigma^* \}$  is non-regular using Pumping Lemma
  - c)  $L = \{ a^n b^n a^n \mid n > 0 \}$  is non-regular using closure properties
- 2) Prove that regular languages are closed under inverse homomorphism. That is, if  $L$  is regular, and let  $h$  be a homomorphism and  $L$  be a language whose alphabet is the output language of  $h$ , then  $h^{-1}(L) = \{w \mid h(w) \text{ is in } L\}$  is also regular..
- 3) Minimize the following DFAs :

a)



b)



- 4) Construct Context Free Grammars for  $L$  where
  - a)  $L = \{ a^m b^n c^p \mid p \neq m+n \}$
  - b)  $L = \{ 0^i 1^j 2^k \mid k \leq i \text{ or } k \leq j \}$
  - c)  $L = \{ w \in \{a,b,c\}^* : |w| = 3n_a(w) \}$