

Open book and notes.

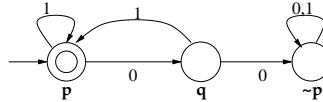
Max points = 50

Time = 50 min

Do all questions.

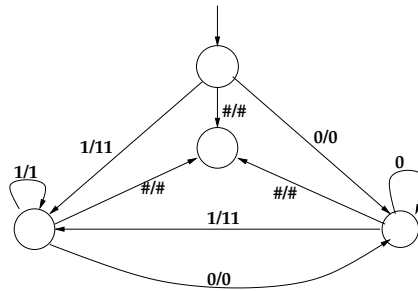
## 1. (Finite State Machine)

- (a) (Verification) The annotated machine is shown below. The predicates to be proven are, one corresponding to each transition:



$p(\epsilon)$   
 $p(x) \Rightarrow q(x0)$   
 $p(x) \Rightarrow p(x1)$   
 $q(x) \Rightarrow \neg p(x0)$   
 $q(x) \Rightarrow p(x1)$   
 $\neg p(x) \Rightarrow \neg p(x0)$   
 $\neg p(x) \Rightarrow \neg p(x1)$

## (b) (Finite State Transducer)



## (c) (Regular Expression)

$\epsilon, 0, 1, 00, 10, 11.$

## 2. (Recursion and Induction)

- (a) `between x y z = ((min y z) < x) && (x < (max y z))`  
 (b) `unequal [x] = False`  
`unequal (x: (y: xs)) = (x /= y) || (unequal (y: xs))`  
 (c) `zip [], [] = []`  
`zip ((x:xs), (y: ys)) = (x,y): zip (xs,ys)`  
 (d) `unzip [] = ([], [])`  
`unzip ((x,y): xyss) = ((x:xs), (y: ys))`  
`where (xs, ys) = unzip xyss`