CS 337 **Quiz 2** **11/3//03**

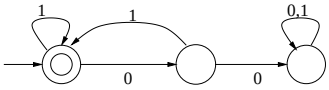
Open book and notes.

Max points = 50 Time = 50 min Do all questions.

1. (Finite State Machine; 28 points)

   (a) (Verification; 11 points) It is claimed that the follwing machine accepts a binary string in which every 0 is followed by a 1. Annotate the diagram and write the predicates which must be proven to verify this claim.

   Let $p(x)$ denote that in string x every 0 is followed by a 1. Let $q(x)$ denote that in string x the last bit is a 0, and every 0, except the very last one, is followed by a 1.



   (b) (Finite State Transducer; 11 points) Draw a finite state transducer whose input is a binary string ending with a special symbol #. It outputs a binary string ending with # according to the following rule: a contiguous sequence of 0s is replaced by a single 0 and a contiguous sequence of n 1s is replaced by a sequence of $n + 1$ 1s. Thus, 0010011# becomes 0110111#.

   (c) (Regular Expression; 6 points) Write 6 of the shortest strings of $(000 \mid 1)^*(0 \mid 11)^*$.

2. (Recursion and Induction; 22 points)

   (a) (4 points) Define a function, `between`, of three arguments, x, y and z, each a number. The output is `True` iff x falls strictly between y and z. y may be less than, equal, or greater than z. Thus
   `between 3 5 7` is `False`,
   `between 3 5 2` is `True`,
   and `between 3 2 3` is `False`.

   (b) (6 points) Define a function which has a non-empty list of numbers as argument. Its output is `False` iff all numbers are identical.

   (c) (6 points) Define function `zip` which takes a pair of lists of equal lengths as argument and returns a list of pairs of corresponding elements. So,

```
zip ([1,2,3], ['a','b','c']) = [(1,'a'), (2,'b'), (3,'c')]
```

   (d) (6 points) Define function `unzip` which is the inverse of `zip`:

```
unzip (zip (xs,ys)) = (xs,ys)
```