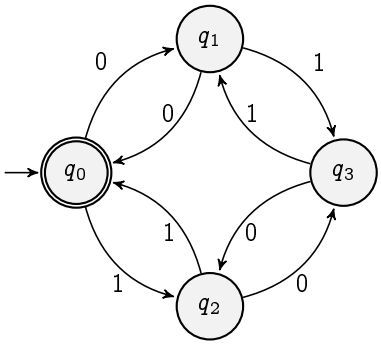
CSC236 tutorial exercises, Week #12
best before Friday afternoon

1. Consider the language EVENEVEN $= \{x \in \{0,1\}^* \mid x$ contains an even number of 0's and 1's$\}$. Below is a 4-state DFSA that accepts EVENEVEN:



   Prove that it is impossible to construct a DFSA for this language with fewer states than this.

2. Consider the language SPLIT consisting of strings of the form $x\#y$ where $x, y \in \{0,1\}^*$ and $|x| = |y|$. Prove that SPLIT is not regular. You may use the pumping lemma, or directly apply the pigeonhole principle.

3. Which of the following languages are regular? (You don't need to provide proofs, though you should think about how you *would* prove each answer if you had to.)

   (a) DOUBLEZEROS: strings in $\{0,1\}^*$ having twice as many zeros as ones

   (b) PHONES: the language of 7-digit telephone numbers, e.g. '555-5555'.

   (c) PAN: the language of 'pangrams', i.e. strings that contain at least one of every letter from a-z. e.g. 'the quick brown fox jumps over the lazy dog'.

   (d) PYTHON: the language of valid Python programs. e.g. 'print(1+1)' is in the language, but 'print(1+)' is not, because it raises a SyntaxError.

   (e) SMALLPRIMES: strings of the form 1^n where n is a prime number less than 1000.