1: DFA

(a) (12pts) Give state diagrams of DFA's recognizing the following languages. The alphabet is $\{x, y\}$.

- $L_1 = \{w|\ w$ has length 5 and its third symbol is a $x\}$
- $L_2 = \{w|\ w$ begins with y ends with $x\}$
- $L_3 = \{w|\ w$ the length of w is at most $4\}$
- $L_4 = \{w|$ has at least 2 x's and at most 2 $y's\}$

(b) (4pts) Write the formal definition of L_2

(c) (4pts) Construct a DFA that accepts strings over alphabet $\{x, y, z\}$ whose symbols are in alphabetical order (for example: $xxyzz$, yz and xzz are accepted but not xzy or $xyzx$).

(d) (8pts) Give state diagrams of DFA's recognizing the following languages. That alphabet is $\Sigma = \{x, y\}$

- $L_5 = \{w|\ w$ any string that does not contain the substring $xyy\}$
- $L_6 = \{w|\ w \in A$ where $A = \Sigma^* - \{x, xx, y\}\}$. ($\Sigma^*$ denotes all strings in the alphabet)

(e) (4pts) Give state diagrams of DFA's recognizing the following
$L_7 = \{w|\ w$ is **not** divisible by 6$\}$ The alphabet is $\{0, 1\}$.

2: NFA

(a) (3pts) Construct an NFA that accepts binary strings over alphabet $\{x, y\}$ that have y as the second-to-last symbol.

(b) (8pts) Give the state diagrams of NFAs with the specified number of states recognizing each of the following languages. The alphabet is $\{x, y\}$.

- $L_8 = \{w|\ w$ contains the substring $yxyx\}$ (5 states or less)
- $L_9 = \{w|\ w$ contains an even number of $x's$ or contains exactly two $y's\}$ (6 states or less)

(c) (7pts) Convert the following NFA to a DFA. Show your work for full credit.