15-453 Homework # 2

1. Pumpin'
(10 Points)

Show that the following sets are not regular:

1. $\{s \in \{a, b, c\}^* \mid$ the length of s is a square$\}$.
2. The set PAREN of balanced strings of parentheses ( ). For example, the string ((()())()) is in PAREN, but the string)(() is not.

2. Minimizing DFAs
(10 Points)

Minimize the following DFAs. Indicate clearly which equivalent class corresponds to each state of the new automaton.

1.

	a	b
$\rightarrow 1$	6	3
2	5	6
3 F	4	5
4 F	3	2
5	2	1
6	1	4

2.

	a	b
$\rightarrow 1$	2	3
2	5	6
3 F	1	4
4 F	6	3
5	2	1
6	5	4

3. Proofs
(60 Points)

This problem is designed to help you learn how to write mathematical proofs. Therefore, we will pay careful attention to how you write your proofs. Make sure you are clear, correct, and justify all your assertions.

1. Prove that for any m, there exists an NFA with m states such that any equivalent DFA has at least 2^{m-1} states.
2. Prove that every regular language is accepted by a *planar* NDA. A finite automaton is planar if its transition diagram can be embedded in the plane without any crossings.