Theoretical Computer Science
CS 395 - HBD1
Department of Physics and Computer Science
Medgar Evers College
Exam 1

Instructions:

- The exam requires completing a set of tasks within 80 minutes.

- Write your solutions in the blue book provided.

- The definition of DFAs must be formal to receive full credit when required.

- Notes are not allowed.

- For Questions 1 and 2, prove exactly one of them using induction.

- Cheating of any kind is prohibited and will not be tolerated.

- **Violating and/or failing to follow any of the rules will result in an automatic zero (0) for the exam.**

TO ACKNOWLEDGE THAT YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS ABOVE, PRINT YOUR NAME AND THE DATE ON YOUR SUBMISSIONS

Grading

Section	Maximum Points	Points Earned
1	4	
2	4	
3	4	
4	4	
5	4	
Total	20	

1. **Prove**

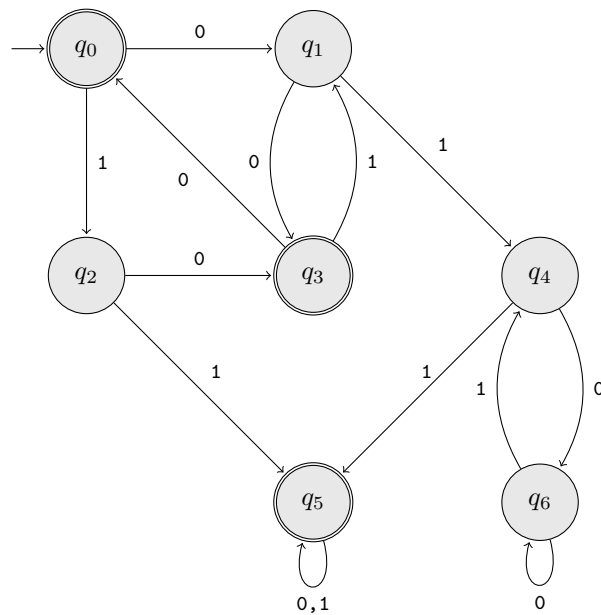$$\sum_{i=1}^{n} 4i - 3 = n(2n - 1)$$

2. **Prove**

$$\sum_{i=1}^{n} i(i + 2) = \frac{n(n + 1)(2n + 7)}{6}$$

3. **Construct a DFA that recognizes the language**

$$L = \{w : |w| = 3 \text{ and } w \text{ contains exactly one } 1\}$$

over $\Sigma = \{0, 1\}$.

4. **For each string listed, analyze the DFA below to determine whether the string is accepted. Clearly justify your answer by providing a proof or disproof.**

a. 0001	**b.** 100110	**c.** 1101	**d.** 11100
e. 10101	**f.** 101001	**g.** 00100	**h.** 000000

5. **Construct a DFA that recognizes the union of the languages**

$$L_1 = \{w : 0 \text{ is in every odd position of } w\}$$
$$L_2 = \{w : |w| \geq 2 \text{ and } w \text{ ends with } 1\}$$

over $\Sigma = \{0, 1\}$