COS 210 Worksheet 7

- This worksheet consists of **3 questions** for a total of **12 marks**
- Show your working for all calculations and reasoning.

Question 1 .... (4 marks)

Give a context-free grammar that generates the following language over $\Sigma = \{0, 1\}$.
You have to give all elements of the 4-tuple $G = (V, \Sigma, R, S)$.

$$L = \{w: w \text{ contains at least three 1's}\}.$$

Question 2 .... (4 marks)

Give a context-free grammar that generates the following language over $\Sigma = \{0, 1\}$.
You have to give all elements of the 4-tuple $G = (V, \Sigma, R, S)$.

$$L = \{w: \text{the length of } w \text{ is odd and its middle symbol is } 0\}.$$

Question 3 .... (4 marks)

Give a context-free grammar that generates the following language over $\Sigma = \{a, b, c\}$.
You have to give all elements of the 4-tuple $G = (V, \Sigma, R, S)$.

$$L = \{a^n b^m c^{2n+m} : n \geq 0, m \geq 0\}$$