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COS 210 Worksheet 6

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

Question 1 ..... (5 marks)

Prove by contradiction that the following language is not regular.

$$L_1 = \{a^n b^m a^n : n \geq 0, m \geq 0\}$$

Make use of the Pumping Lemma in your proof and write down all steps.

Question 2 ..... (5 marks)

Prove by contradiction that the following language is not regular.

$$L_2 = \{0^n 1^m : n \neq m, n \geq 0, m \geq 0\}$$

Do NOT use the Pumping Lemma.
Instead, make use of closure properties of operations on regular languages, and make use of the fact that the language $A = \{0^n 1^n : n \geq 0\}$ is not regular (proven in Lecture 12).

Question 3 ..... (2 marks)

Is the following language over $\Sigma = \{0, 1\}$ regular or not? Prove your answer.

$$L_3 = \{w : \text{the substring 01 occurs exactly as often in } w \text{ as the substring 10}\}$$

(An example of a string in the language is 010 because there is one occurrence of the substring 01 and one occurrence of the substring 10. An example of a string NOT in the language is 0101 because there are two occurrences of the substring 01 but only one occurrence of the substring 10.)