Introductory Quiz: CMPT-413

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Note: This quiz is not meant to evaluate your knowledge, rather it is a mechanism to determine what prior knowledge will be assumed in the lectures, assignments and exams to come.

Set Theory The cross product operator $\times$ is defined as follows for sets L and R where (x, y) stands for a tuple with two elements x and y:

$$L \times R = \{(l, r) \mid l \in L, r \in R\}$$

List the result of taking the cross product of the following two sets: $L = \{a, b, c\}$ and $R = \{a, b\}$

Regular Expressions Write down a regular expression for the language $L = \{a^n b^n \mid n \geq 0\}$, that is, the set of all strings with equal numbers of a and b characters where all a precede all b.

Context-Free Grammars The following five context free rules:

1. $A_1 \rightarrow A_2\ A_3$
2. $A_2 \rightarrow A_3\ A_1$
3. $A_2 \rightarrow b$
4. $A_3 \rightarrow A_1 A_2$
5. $A_3 \rightarrow a$

Assuming that only these five rules exist in the grammar, list the non-terminal symbols and the terminal symbols in the grammar. Also, write down whether the following statement is true or false: it is possible to convert any context-free grammar into an equivalent grammar (generating the same language) where each rule has at least one terminal symbol.

Programming Write a function `A` in psuedo-code or a language of your choice based on the following description:

$$\begin{aligned} A(0, n) &= n + 1 \\ A(m + 1, 0) &= A(m, 1) \\ A(m + 1, n + 1) &= A(m, A(m + 1, n)) \end{aligned}$$

Probability Write down the proof of the following equality:

$$P(A \mid B) = \frac{P(A) \times P(B \mid A)}{P(B)}$$

Hint: $P(A \mid B) = \frac{P(A,B)}{P(B)}$

λ **calculus** If $(\lambda x\, x + x)\ 3 = 6$ then what does $((\lambda x \lambda y\ (x)y + (x)y)\ (\lambda z\, z + z))\ 3$ equal?

Linguistics Invent one original sentence in English that has at least two meanings. Try to construct a sentence such that nobody before you is likely to have uttered or written such a sentence.