

Due Date: Thursday 28 March, 4pm

Please submit a **PDF** by email to: teaching@biods.org with subject “341 Assignment 1”. Make sure that your name and ID number are on the PDF called: `YourName_assignment1.pdf`

What you hand in should be all your own work.

Please note the following

- There are 22 marks in this assignment but the **maximum** you can get is **10**.
- Marks outside the set $\{0, 10\}$ are very uncommon for question 3.
- Unless we receive a correct solution to question 3, the solution will not be made available within this course.

Questions

- (a) Assume that a gene is a word over the alphabet $\{A, T, C, G\}$. Assume also that a protein is unambiguously defined by a finite set of genes and different sets of genes define different proteins. Is the set of all proteins finite or infinite? If infinite, is the set countable or uncountable? Justify your answers formally (with proofs). (**3 marks**)
 - (b) Consider F , the set of all functions $f : \{0, 1, 2\}^* \rightarrow \{0, 1, 2\}^*$ mapping from ternary numbers to ternary numbers. Is F countable or uncountable? Justify your answer formally. (**3 marks**)
2. Design an automaton for each of the following languages over the alphabet $\Sigma = \{a, b, c\}$. If your automaton is non-deterministic, provide a DFA for the same language. Explain why your DFA recognises the same language. If you decide to use the automaton determinisation algorithm, list all steps of the algorithm you make. (**2 marks each**):
 - (a) The set of strings in which every ab is immediately followed by a ac .
 - (b) The set of strings that contain aba or bab (or both) as a substring.
 - (c) The set of strings that begin with a , contain exactly two b 's and end with cc .
3. Prove that the Pumping Lemma is not a sufficient condition for a language to be automatic, that is, the Pumping Lemma is not an “if and only if” statement. (**10 marks**)