

**Due Date: Friday 29 April, 4pm**

Please submit a **PDF** by email to: teaching@biods.org with subject “341 Assignment 2”. Make sure that your name and ID number are on the PDF called: YourName\_assignment2.pdf

What you hand in should be all your own work.

Note that **marks might be deduced** if you fail to follow the above instructions. Do let us know if you find them challenging.

## Questions

1. Let  $\Sigma = \{0, 1\}$ , and for a word  $w \in \Sigma^*$  define  $\bar{w}$  to be the word obtained by exchanging 0's and 1's in  $w$  (so if  $w = 101$  then  $\bar{w} = 010$ ). Consider the language  $L$  over the alphabet  $\{0, 1, 2\}$  consisting of all words of the form  $w2\bar{w}$ , where  $w \in \Sigma^*$ .
  - (a) Is  $L$  regular? Prove it. (**2 marks**)
  - (b) Is  $L$  context-free? Prove it. (**2 mark**)
2. Design a Turing machine to compute  $f(x) = 2^x$ . Use comments (or self-explanatory state names, or both) in your code to make it readable. Both correctness and readability of your code will be marked. (**3 marks**)
3. Show that, if there is a language  $Q$  that is both in  $\mathcal{P}$  and  $\mathcal{NP}$ -complete, then  $\mathcal{P} = \mathcal{NP}$ . (**3 marks**)