This homework is due on May 23, by start of class, 12:50pm.

Some of the questions in this homework must be submitted using the automata[1] and regex[2] tools. All automata and regular expressions **must** be submitted online. In case you have trouble with either of the tools, please email *nayakne@stanford.edu*. No credit will be given for solutions that do not use the online tools.

For the remaining questions, write solutions of different problems on different sheets of paper, and put your name and student ID on each page. You can turn in the homework solutions either by using the CS103 drop box in Gates, or by emailing them to `cs103-spr1314-hw@lists.stanford.edu`, or by turning them in in class.

Problem 1

For this problem, $\Sigma = \{a, b\}$.

1. Let Let $L = \{w | w \in \Sigma^*, w \text{ does not end in } aba\}$.
   - Write a regular expression for L. (Submit this online : *HW6_1a*)
   - Give a short (1-2 sentences) justification for the logic behind the regular expression.
2. Let $L = \{w | w \in \Sigma^*, \text{the third symbol of } w \text{ is } a\}$.
   - Write a regular expression for L. (Submit this online : *HW6_1b*)
   - Give a short (1-2 sentences) justification for the logic behind the regular expression.

Problem 2

For this problem, $\Sigma = \{a, b\}$.

[1] https://www.stanford.edu/class/cs103/cgi-bin/nfa/edit.php
[2] https://www.stanford.edu/class/cs103/cgi-bin/simpleregex/edit.php

1. Let $L = \{w | w \in \Sigma^*, w$ does not contain bb as a substring$\}$.
   - What is the minimum number of states that a DFA to recognise L must have? Give a representative string from each equivalence class.
   - Write a regular expression for L. (Submit this online : *HW6_2a*)
   - Give a short (1-2 sentences) justification for the logic behind the regular expression.
2. Let $L = \{w | w \in \Sigma^*, w$ has an odd number of as and starts and ends with a $b\}$.
   - What is the minimum number of states that a DFA to recognise L must have? Give a representative string from each equivalence class.
   - Write a regular expression for L. (Submit this online : *HW6_2b*)
   - Give a short (1-2 sentences) justification for the logic behind the regular expression.

Problem 3

For this problem, $\Sigma = \{a, b\}$.

1. Let $L = \left\{a^n b^{n^2} | n \in \mathbb{N}\right\}$. Use the Myhill Nerode theorem to prove that L is not regular.
2. Let $L = \{w | w \in \Sigma^*, w = w^R\}$ [3]. Use the Myhill Nerode theorem to prove that L is not regular.

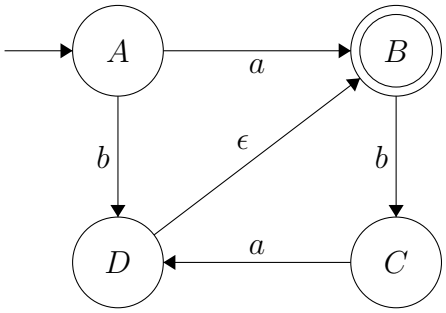
Problem 4

Let $L = \{w \in \{0, 1, 2\}^* | w$ contains the same number of copies of the substrings *01* and *10*$\}$. Is L regular? If so, give a regular expression for L (Submit this online : *HW6_4opt* - optional, of course). If not, use the Myhill Nerode theorem to prove that L is not regular.

[3] w^R is w in reverse.

Problem 5

1.
   - Convert the following NFA to a DFA using the subset construction. (Submit the resulting DFA online : *HW6_5a*)
   - List the subsets of $\{A, B, C, D\}$ that correspond to states in the constructed DFA.



2. Minimise the resulting DFA. (Submit the minimised DFA online : *HW6_5b*)