Theory of Computation
Sample Midterm.

This exam is closed book. Answer all questions.

1. Give DFAs or NFAs to recognize the following languages over the alphabet \{a, b\}^*.
   a. (5 points). \(A = \{w \mid w \text{ has at least two non-consecutive } b\text{'s}\}\).
      e.g. \(bbb \in A, bbbaa \notin A, babaaab \in A\).
   b. (5 points). \(B = \{w \mid \text{in every initial substring } v \text{ of } w, \text{ the number of } a\text{'s and } b\text{'s in } v \text{ differ by at most } 2\}\).
      e.g. \(aabab \in C, abbabbb \notin B, aabbb \in B\). Explain your construction.

2. Give regular expressions representing the following languages over the alphabet \{a, b\}.
   a. (5 points). \(C = \{w \mid w \text{ does not end with } a\}\).
   b. (5 points). \(D = \{w \mid w \text{ has an odd number of } b\text{'s}\}\).

3. (10 points). Show the following language is not regular.
   \(E = \{a^i b^j c^k \mid i = j \text{ or } j = k \text{ or } i = k\}\).

4. (10 points). Give a PDA to accept the language
   \(F = \{w \mid w \in \{a, b\}^* \text{ and } w \text{ has equal numbers of } a\text{'s and } b\text{'s}\}\).