ECE 374 B - Summer 2025

Homework 1

- **Submit your solutions electronically on the course Gradescope site as PDF files.** If you plan to typeset your solutions, please use the LaTeX solution template on the course web site. If you must submit scanned handwritten solutions, please use a black pen on blank white paper and a high-quality scanner app (or an actual scanner, not just a phone camera). We will mark difficult to read solutions as incorrect and move on.
- **Every homework problem must be done *individually*.** Each problem needs to be submitted to Gradescope before 6AM of the due data which can be found on the course website: https://ecealgo.com/fa24/homeworks.html.
- For nearly every problem, **we have covered all the requisite knowledge required to complete a homework assignment prior to the "assigned" date.** This means that there is no reason not to begin a homework assignment as soon as it is assigned. Starting a problem the night before it is due a recipe for failure.

Policies to keep in mind

- **You may use any source at your disposal**—paper, electronic, or human—but you ***must*** cite ***every*** source that you use, and you ***must*** write everything yourself in your own words. See the academic integrity policies on the course web site for more details.
- **Being able to clearly and concisely explain your solution is a part of the grade you will receive.** Before submitting a solution ask yourself, if you were reading the solution without having seen it before, would you be able to understand it within two minutes? If not, you need to edit. Images and flow-charts are very useful for concisely explain difficult concepts.

See the course web site (https://ecealgo.com/fa24) for more information.

If you have any questions about these policies,
please don't hesitate to ask in class, in office hours, or on Piazza.

1. For each of the following languages of the alphabet$\{0, 1\}$, give a regular expression that describes that language and briefly argue why your expression is correct.

   (a) All strings that end in 1011.

   (b) All strings except 11.

   (c) All strings that contain 101 or 010 as a substring.

   (d) All strings that contain 111 and 000 as a subsequence (the resulting expression is long – describe how you got your expression, instead of writing it out explicitly).

   (e) The language containing all strings that do not contain 111 as a substring.

   (f) All strings that do *not* contain 000 as a subsequence.

   (g) Strings in which every occurrence of the substring 00 appears before every occurrence of the substring 11.

   (h) Strings that do not contain the subsequence 010.

   (i) Strings that do not contain the subsequence 0101010.

   (j) Strings that do not contain the subsequence 10.

2. Construct the DFAs in the subproblems as descibed below

   (a) Let L be the set of all strings in $\{0, 1\}^*$ that contain exactly two occurrences of the substring 001.Describe a DFA that over the alphabet $\Sigma = \{0, 1\}$ that accepts the language L. Argue that your machine accepts every string in L and nothing else, by explaining what each state in your DFA means.(You may either draw the DFA or describe it formally, but the states Q, the start state s, the accepting states A, and the transition function δ must be clearly specified.)

   (b) In certain programming languages, comments appear between delimiters such as /# and #/. Let C be the language of all valid delimited comment strings. A member of C must begin with /# and end with #/ but have no intervening #/. For simplicity, assume that the alphabet for C is $\Sigma = \{a, b, /, \#\}$. Give a DFA that recognizes C.