1. (3 marks) Using the method described in Section 9.1 (and in class), convert the following regular expression into a state diagram:

\[(01)^+ (0 + (01)^+ )\]

Your answer should indicate how you arrived at the result:

- As intermediate steps write down the state diagrams that you construct for subexpressions of the given regular expression, and for each intermediate step clearly indicate which subexpression it corresponds to.
- Please do not simplify the state diagrams.

2. (3 marks) Using the method described in Section 9.2 (and in class), convert the state diagram given in Figure 1 into an equivalent regular expression. Here \(\Sigma = \{a, b, c\}\).

Your answer should include the intermediate step(s) used in the construction.

![Figure 1: State diagram for Question 2.](image)

3. Are the following languages \(A\) and \(B\) over the alphabet \(\Sigma = \{a, b, c, d\}\) regular or nonregular?

- For a language that is regular, give a regular expression that defines it.
- For a nonregular language, prove that it is not regular using the pumping lemma.

(a) (2 marks) \(A = \{a^i b^i \mid i \geq 1\} \cup \{a^j b^k \mid j \geq 3, \ k \geq 4\}\)
(b) (2 marks) \( B = \{c^i d^i \mid i \geq 1\} \cup \{a^j b^k \mid j \geq 3, \ k \geq 4\} \)

Regulations on assignments

- **The assignments may be done in groups consisting of one, two, three or four students.** If more than one student are collaborating on an assignment, they must submit a single **joint solution**.
- Clearly print (or type) the name(s) and student number(s), and course number, at the top of the first page. Additionally each student collaborating on an assignment must sign the top of the first page.
- If the submission consists of more than one page, the pages must be stapled together.
- **Note:** You are asked to write your solutions using non-erasable pen (or to type the solutions). Solutions written in pencil or erasable ink will be marked, but they will not be considered for remarking after the assignments are returned.