This is a “closed book” exam. The parts add up to 50 points, the grade is obtained by dividing the total number of points by 5. Motivate your answers!

Assignment 1 . Consider the language of all strings over the alphabet \{a, b\} that contain at most two a’s.

a. Draw an automaton that accepts this language. (6 points)
b. Give a linear recursive specification for this automaton. (5 points)
c. Give an iteration expression for this automaton. (6 points)

Assignment 2 . Given is the following iteration expression:

\[ r = (a.1)^* \cdot (b.1)^* + (b.1)^* \cdot (a.1)^* \]

Use the operational rules to find the automaton for this expression. In every state, give the derived iteration expression. (7 points)

Assignment 3 . In this assignment, we use alphabet \( \mathcal{A} = \{a, b\} \). Given is the recursive specification

\[
S \quad \equiv \quad a.T + b.U + a.1 + b.1 \\
T \quad \equiv \quad a.T + b.1 \\
U \quad \equiv \quad b.U + a.1
\]

Draw a deterministic automaton that accepts the language generated by this specification. (10 points)

Assignment 4 . Show, by using the pumping lemma, that the language \( \{a^n b^k \mid 0 < n < k \} \) is not regular. (16 points)