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 least one a and at most one b. Draw an automaton that accepts this language. (10 points)

Assignment 2. Given is the following recursive specification:

\[
egin{align*}
S &= a.(C + D) + a.(C + E) \\
T &= a.(C + D + E) \\
C &= \tau.(D + E) \\
D &= b.d.1 \\
E &= b.e.1
\end{align*}
\]

Draw the finite automaton of S and of T separately. Are these two automata branching bisimilar? If so, show a branching bisimulation, if not, argue why not. (13 points)

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

\[
egin{align*}
S &= a.S + b.S + a.T \\
T &= a.U \\
U &= b.V \\
V &= 1
\end{align*}
\]

Draw a deterministic automaton that accepts the language generated by this specification. (13 points)

Assignment 4. Show, by using the pumping lemma, that the language

\[
\{w \in \{a, b\}^* \mid \#_a(w) < \#_b(w)\}
\]

is not regular. (14 points)