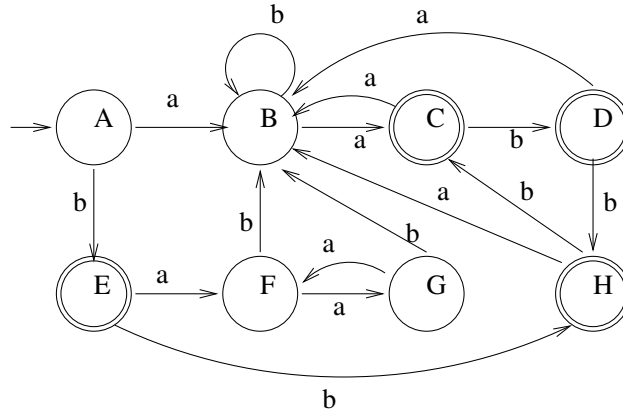


The answers must be the original work of the author. While discussion with others is permitted and encouraged, the final work should be done individually. You are not allowed to work in groups. You are allowed to build on the material supplied in the class. Any other source must be specified clearly.

1. (40 points) Consider the DFA below.



(a) Construct a two dimensional table where the row and column headers are the states of the above DFA. Mark each cell with a '1' if the states are "different." Unmarked cells will represent indistinguishable states.

(b) Construct a minimized DFA by collapsing (groups of) indistinguishable states into single states.

Please turn the page over.

2. (30 points) Consider the following grammar G_1 :

$$\begin{aligned} S &\rightarrow aSb \mid A \\ A &\rightarrow cA \mid d \mid \lambda \end{aligned}$$

- (a) Give a derivation for a **terminal string** such that the $S \rightarrow aSb$ rule is used exactly twice, the $A \rightarrow cA$ rule is used exactly three times, and the $A \rightarrow d$ rule is used once during the derivation.
- (b) Give a derivation for a **terminal string** such that the $S \rightarrow aSb$ rule is used exactly once, the $A \rightarrow cA$ rule is also used exactly twice, and the $A \rightarrow \lambda$ rule is used once during the derivation.
- (c) Use set notation to define the language generated by the grammar.

3. (30 points) Consider the following grammar G_1 :

$$\begin{aligned} S &\rightarrow Sab \mid bba \mid A \\ A &\rightarrow cdA \mid ccd \end{aligned}$$

- (a) Give a derivation for a **terminal string** such that the $S \rightarrow Sab$ rule is used exactly three times, the $S \rightarrow bba$ rule is used exactly once during the derivation.
- (b) Give a derivation for a **terminal string** such that the $S \rightarrow Sab$ rule is used exactly once, the $A \rightarrow cdA$ rule is also used exactly twice during the derivation.
- (c) Use set notation to define the language generated by the grammar.