22.8.2025

FSA

PDA

TM

M

$\langle \Sigma, Q, \delta, q_0, F \rangle$

transitions, start

$\Sigma \subseteq \Gamma - \{Z_0\}$

$\langle Q, \Sigma, \Gamma, \delta, q_0, Z_0, F \rangle$

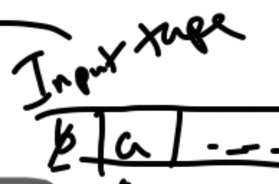
input tape symbol, empty, stack symbols, bottom of stack

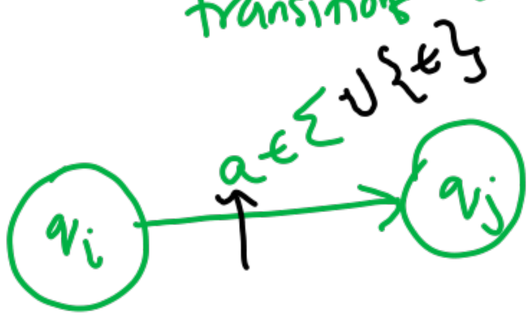
$\Sigma \subseteq \Gamma - \{\emptyset\}$

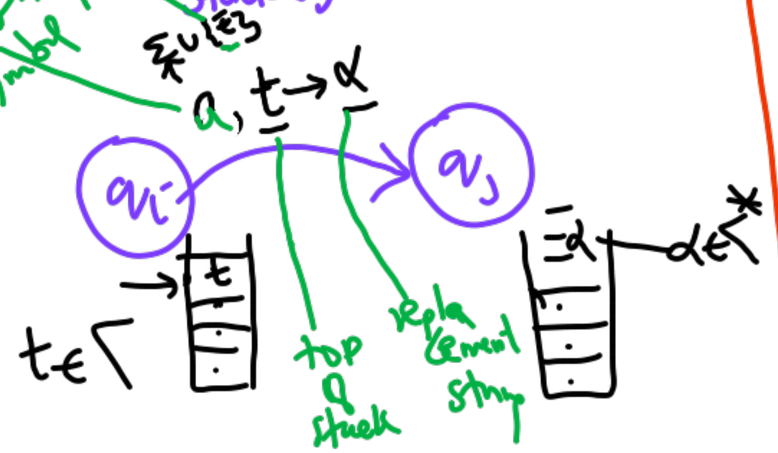
$\langle Q, \Sigma, \Gamma, \delta, q_0, \emptyset, F \rangle$

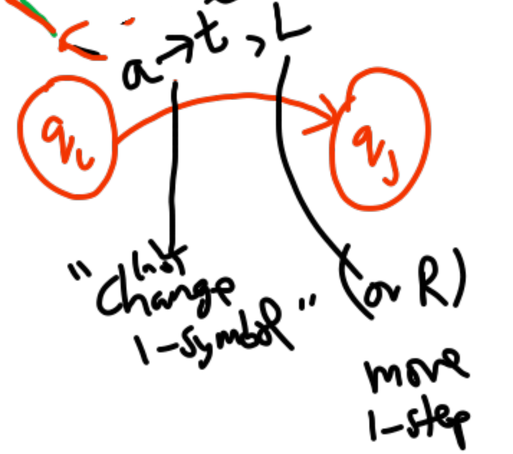
tape symbols, blank

Input tape









Systematic

NFA+ϵ

NFA

DFA

$\delta: Q \times \Sigma \cup \{\epsilon\} \to 2^Q$

any subset incl. $\emptyset$

No ϵ-transitions

function $Q \times \Sigma \to Q$

exactly one next state

$\delta: Q \times \Sigma \cup \{\epsilon\} \times \Gamma \to 2^{Q \times \Gamma^*}$

at most one next state

no choice $\Rightarrow$ deterministic

no arrow for a, t is ok

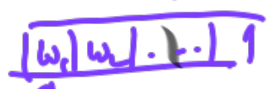
can replace only top symbol

$\delta: Q \times \Gamma \to Q \times \Gamma \times \{L, R\}$

crash if no move

$\emptyset$ = possible

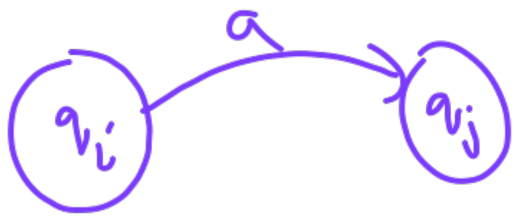
FSA M



ID $\langle q_i, w \rangle$

Move $\vdash$ $ID_1 \vdash ID_2$

① $\langle q_i, aw \rangle \vdash \langle q_j, w \rangle$



② $\langle q_i, aw \rangle \vdash \langle q_j, aw \rangle$

③ $\langle q_i, \epsilon \rangle \to \langle q_j, \epsilon \rangle$ q_i ϵ q_j

Run is $\vdash^*$ any number of steps

$L(M) = \{ w \mid M \text{ accepts } w \}$

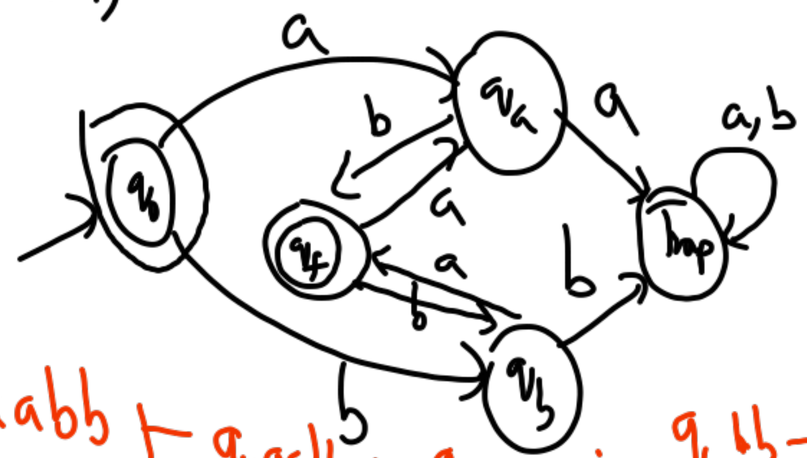
there is a run

$\langle q_0, w \rangle \vdash^* \langle q_f, \epsilon \rangle$

try all for non-det M

$q_f \in F$

$(ab+ba)^*$

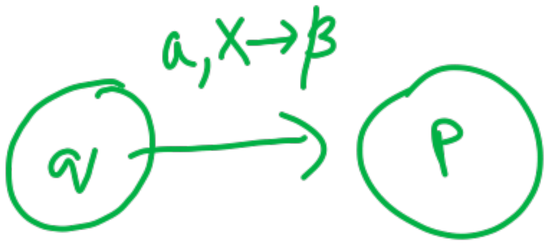


$q_b baabb \vdash q_b aabb \vdash q_f abb \vdash q_a bb \to q_f b \vdash q_b$

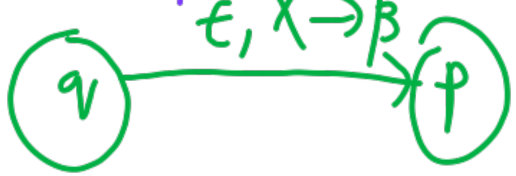
PDA M

ID $\langle q, w, \alpha \rangle$ — $\epsilon \in \Sigma^*$, $\epsilon \in \Gamma^*$

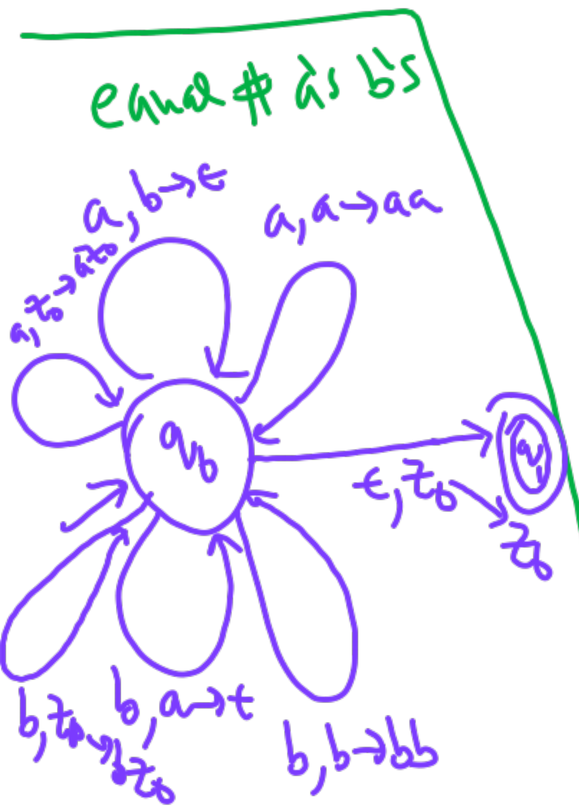
(1) $\langle q, aw, X\alpha \rangle \vdash \langle p, w, \beta\alpha \rangle$ — input symbol, top of stack



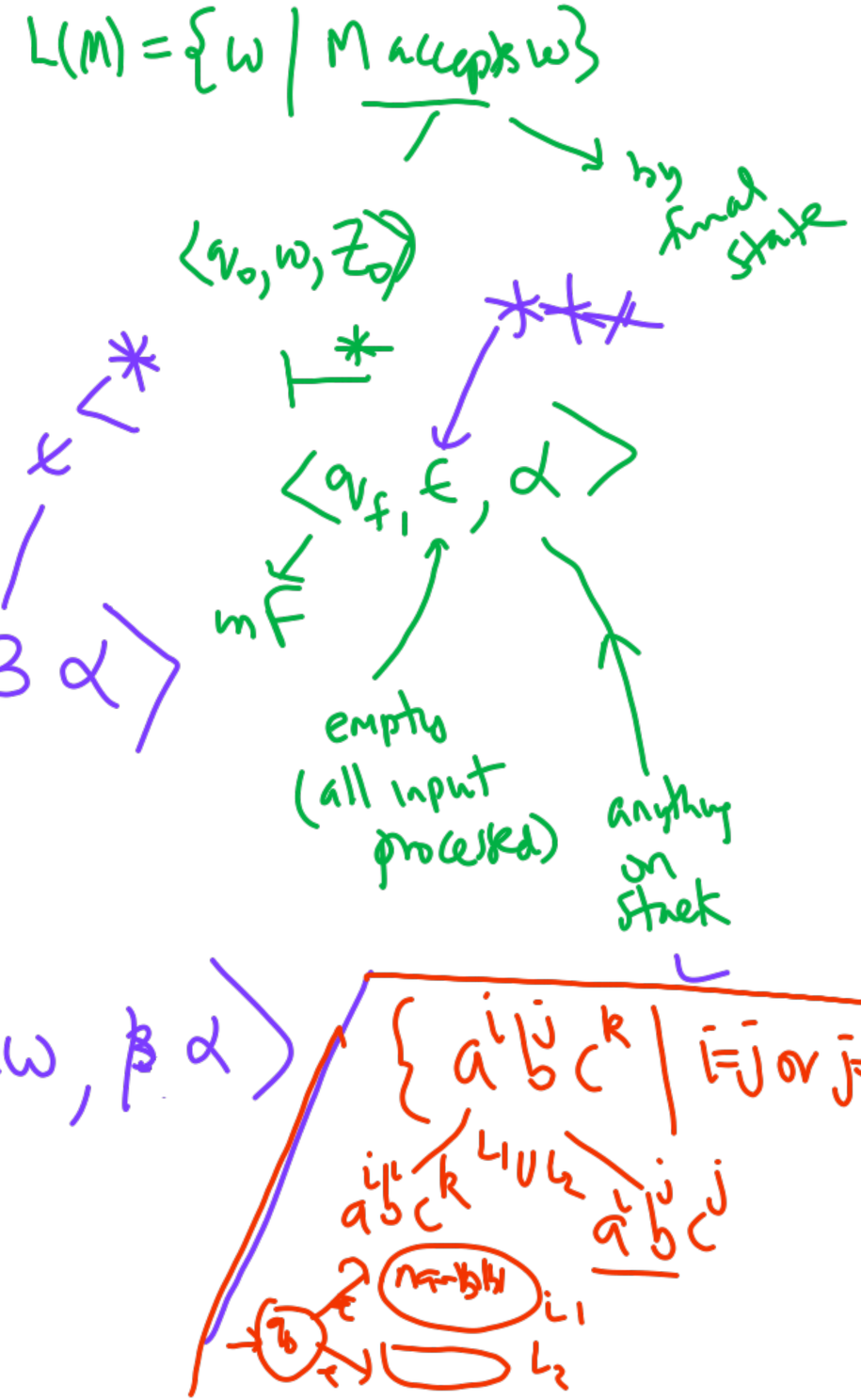
(2) $\langle q, aw, X\alpha \rangle \vdash \langle p, aw, \beta\alpha \rangle$



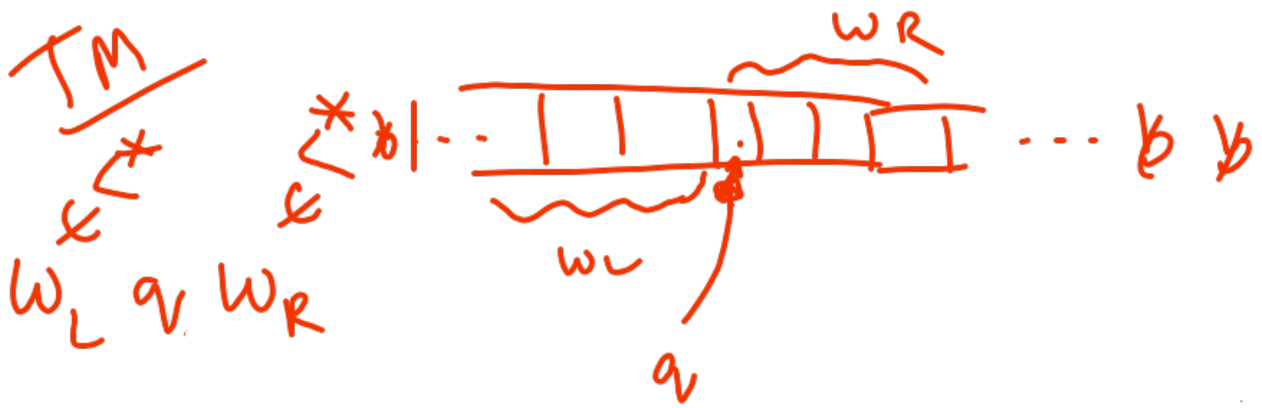
equal # a's b's



$L(M) = \{ w \mid M \text{ accepts } w \}$ — by final state



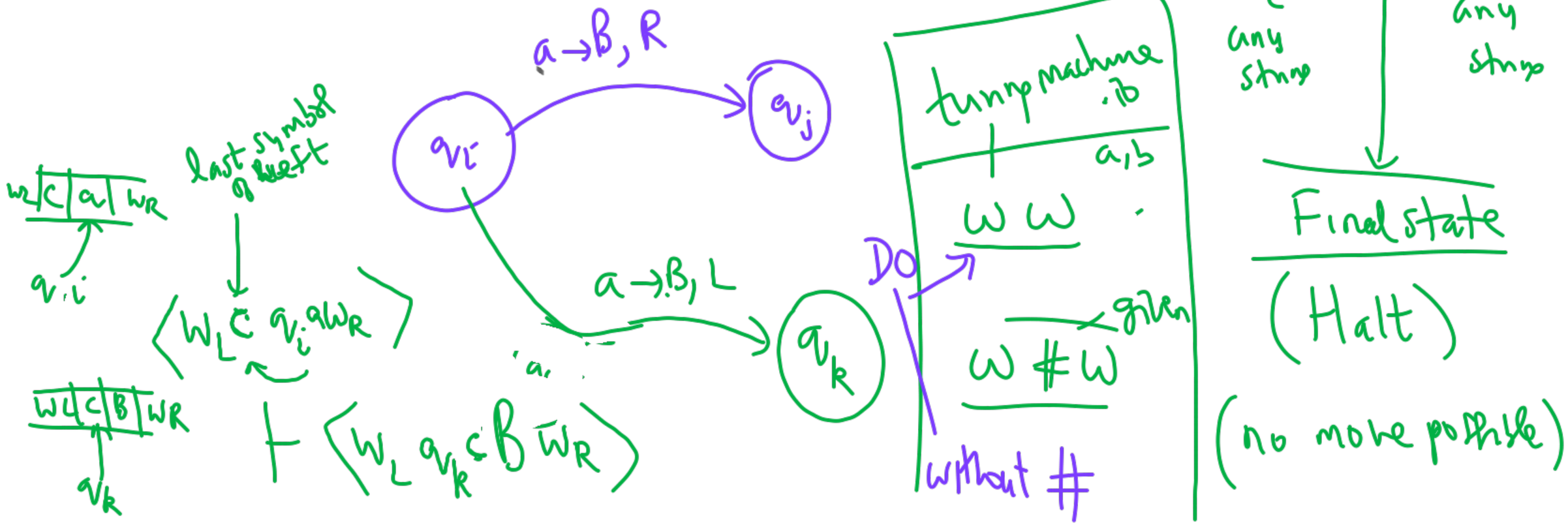
TM



ID $\quad w_L q w_R$

accepts

Move $\vdash$

$w_L q_i a w_R \vdash w_L B q_j w_R$

$q_0 w \vdash^* x_1 q_f x_2$