Decider TM for $L = \{w \in \{a,b\}^* \mid n_a(w) = n_b(w)\}$

a / a R
X / X R
Y / Y R

$q_{searchB}$

X / X R
Y / Y R

b / Y L

a / X R

q_0 ⟨ / ⟨ R q_{scan} □ / □ L q_{acc}

b / Y R

$q_{searchA}$

⟨ / ⟨ R

a / a L
b / b L
X / X L
Y / Y L

q_{ret}

a / X L

b / b R
X / X R
Y / Y R
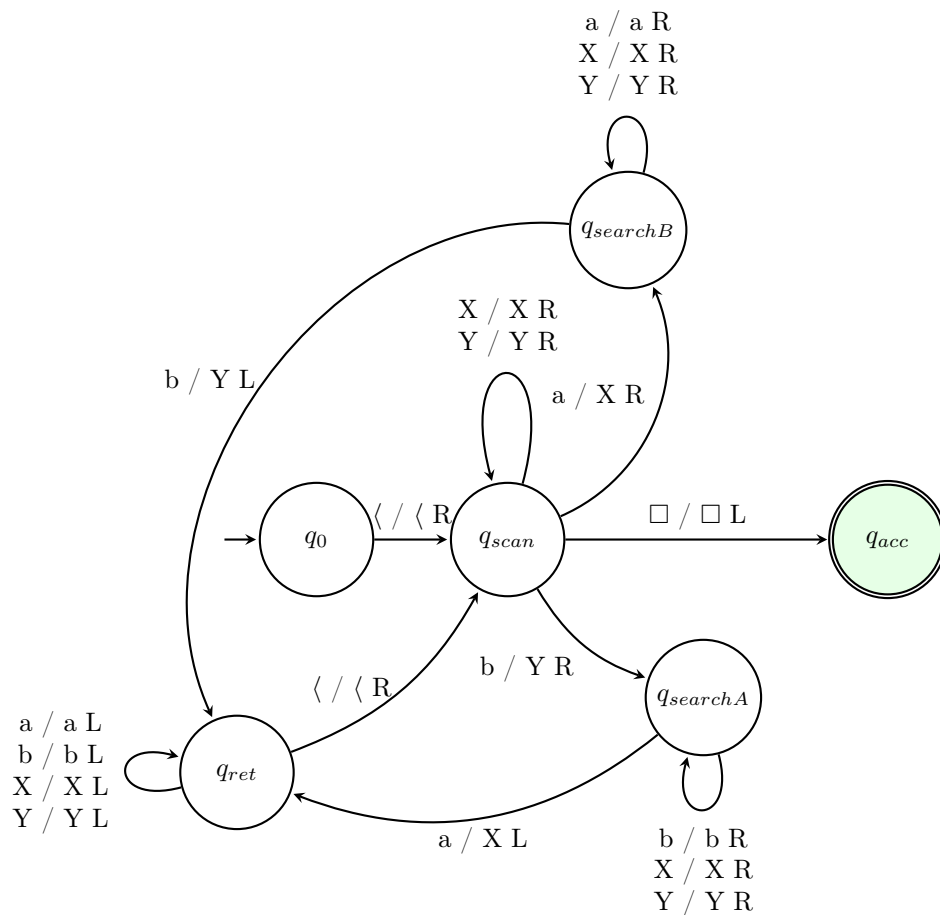
Machine Strategy
1. q_{scan}: Read next unmarked symbol.
2. If 'a', search for 'b'. If 'b', search for 'a'.
3. Mark both and return (q_{ret}).
4. q_{ret} goes back to ⟨ and restarts.
5. Accept if tape is empty (□).
Alphabet: $\Sigma = \{a, b\}$ | Tape: $\Gamma = \{a, b, X, Y, \square, \langle\}$