Howard University
CS – Theory of Computation
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Assignment I
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1.1 **(a) What is the start state?**
q_1 is the start state in both DFAs

(b) What is the set of accept states?
$F_1 = \{q_2\}$ and $F_2 = \{q_1, q_4\}$

(c) What sequence of states does the machine go through on input aabb?
For M_1, the machine goes through q_1, q_2, q_3, q_1 , q_1.
For M_2, the machine goes through q_1, q_1, q_1, q_2 , q_4.

(d) Does the machine accept the string aabb?
M_1 does not accept the string aabb while M_2 accepts it because the end state is not the accept state in M_1, while in M_2, the end state is the accept state.

(e) Does the machine accept the string ϵ ?
M_1 doesnt accept the string ϵ but M_2 does since the start state of M_2 is also the accepting state.

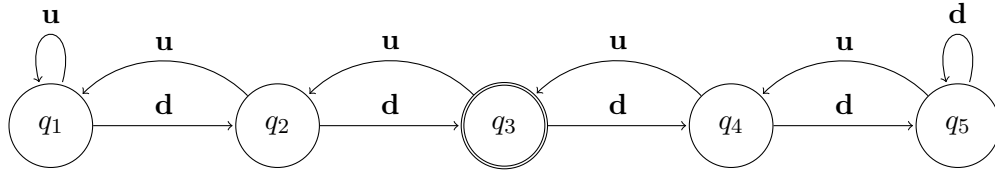**1.2 Give the formal descriptions of the machine M_1 and M_2 pictured in Exercise 1.1.**
$M_1 = \{\{q_1, q_2, q_3\}, \{a, b\}, \delta, q_1, \{q_3\}\}$
where the transition function δ is given by the following table:

State	a	b
q_1	q_2	q_1
q_2	q_3	q_3
q_3	q_2	q_1

$M_2 = \{\{q_1, q_2, q_3, q_4\}, \{a, b\}, \delta, q_1, \{q_1, q_4\}\}$
where the transition function δ is given by the following table:

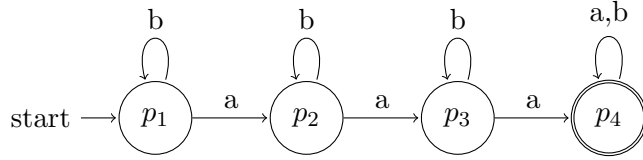| State	a	b
q_1	q_1	q_2
q_2	q_3	q_4
q_3	q_2	q_1
q_4	q_3	q_4

1.3 The formal description of a DFA M is $\{\{q_1, q_2, q_3, q_4, q_5\}, \{u, d\}, \delta, q_3, \{q_3\}\}$ where δ is given by the following table. Give the state diagram of this machine:
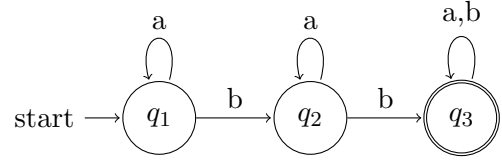
The state diagram of the machine is as follows:

u

u   u   u   u

d   d   d   d   d

q_1 q_2 q_3 q_4 q_5

1.4 Hello

(a) Here, the two DFAs are:

b   b   b   a,b

start → p_1 a p_2 a p_3 a p_4

(a) $\{w|w \text{ has at least three a's}\}$

a   a   a,b

start → q_1 b q_2 b q_3

(b) $\{w|w \text{ has at least two b's}\}$

The combined DFA is as follows:

a

start → p_1q_1 a p_2q_1 a p_3q_1 a p_4q_1

b   b   b   b

p_1q_2 a p_2q_2 a p_3q_2 a p_4q_2 b

b   b   b   b

b p_1q_3 a p_2q_3 a p_3q_3 a p_4q_3

b   b   a,b
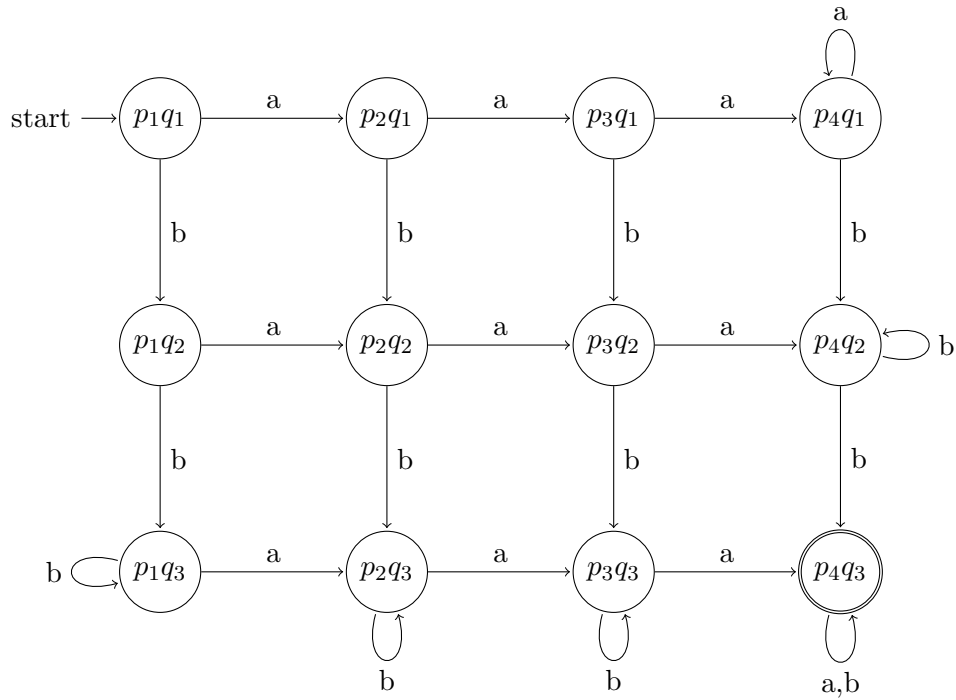
Figure 2: Combined DFA of the two Languages

(c) Here, the two DFAs are:
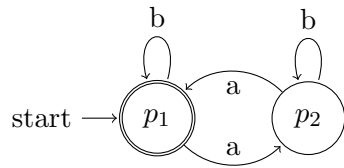
(a) $\{w|w$ has at least three a's$\}$
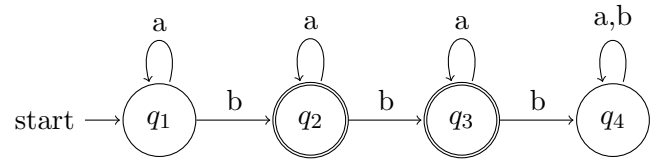
(b) $\{w|w$ has at one or two b's$\}$
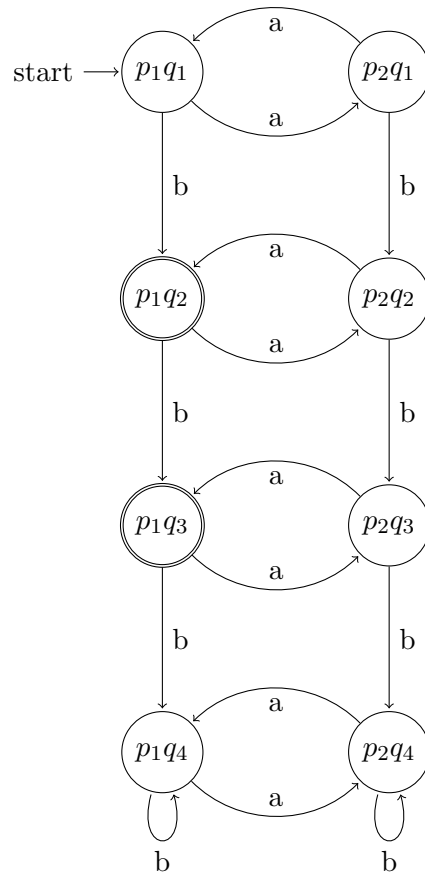
The combined DFA is as follows:
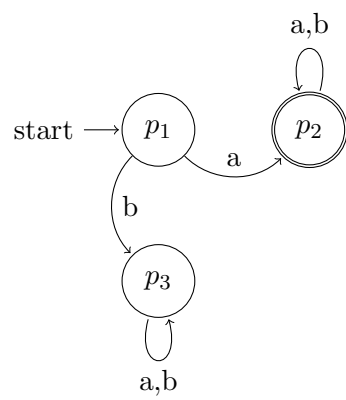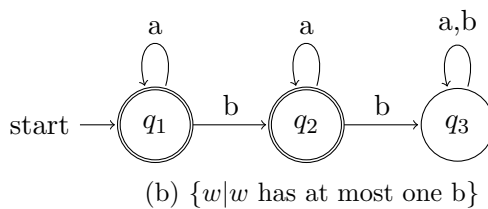

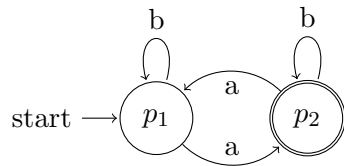Figure 4: Combined DFA of the two Languages

3

(e) The two DFAs are

(a) $\{w|w$ starts with an a$\}$

(b) $\{w|w$ has at most one b$\}$

4

(f) The two DFAs are

(a) $\{w|w$ has an odd number of a's$\}$
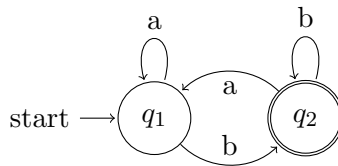
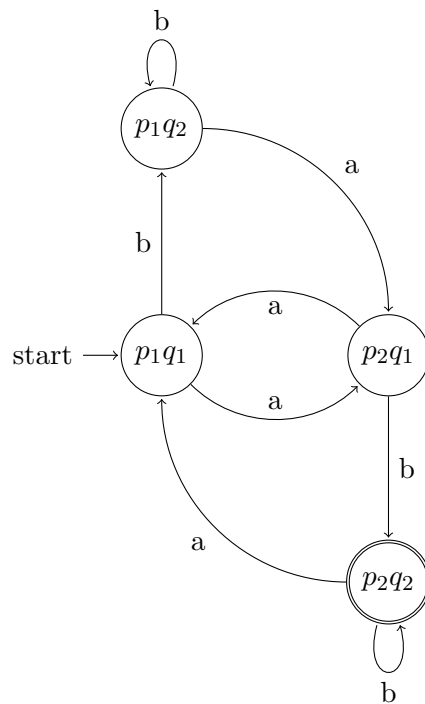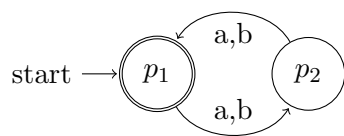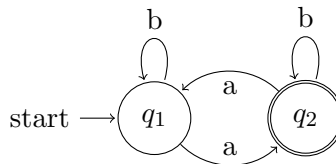(b) $\{w|w$ ends with b$\}$

The combined DFA is as follows:

Figure 7: Combined DFA of the two Languages

(g) The two DFAs are

(a) $\{w|w \text{ has even length b}\}$

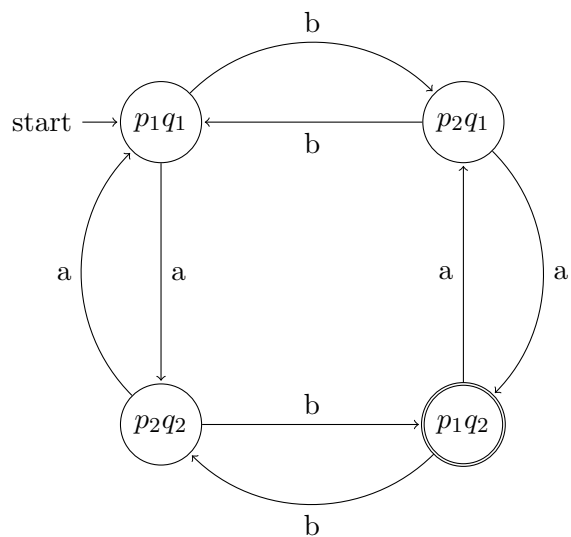(b) $\{w|w \text{ has an odd number of a's}\}$

The combined DFA is as follows:

Figure 9: Combined DFA of the two Languages

1.6 (a) The two DFAs are