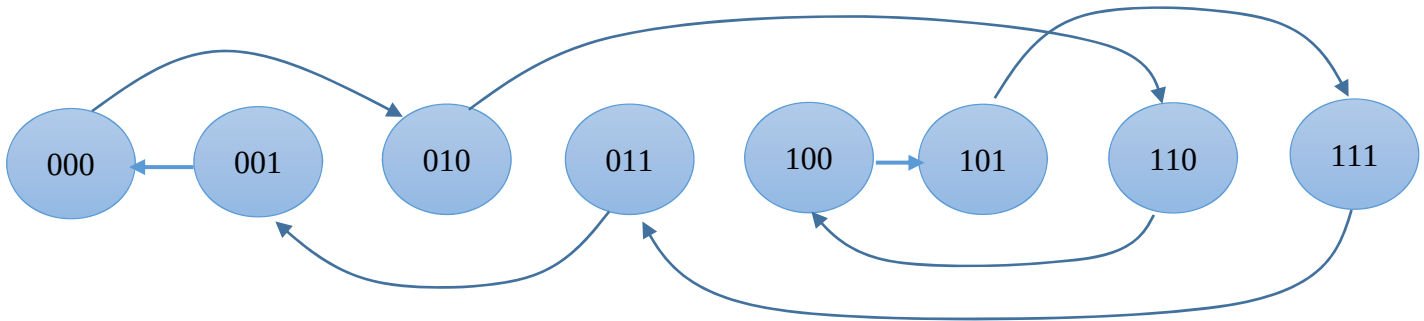


Homework 10 - Solution

Due at the beginning of your scheduled lab period

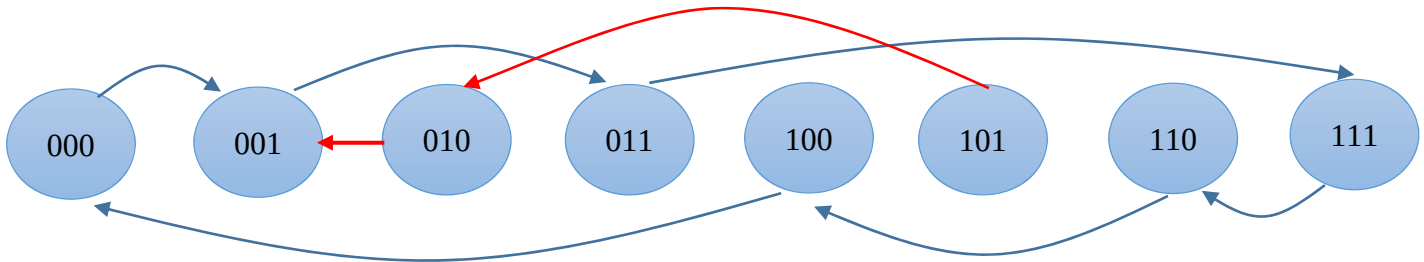
1. [8 pts] Draw a state transition diagram for a 3-bit Gray code counter and write the next state equations for each counter bit (**note that there are numerous possibilities**).



```
next_Q[2] = Q[1]&~Q[0] | Q[2]&~Q[1];
next_Q[1] = ~Q[2]&~Q[0] | Q[2]&Q[0];
next_Q[0] = Q[1]&Q[0] | Q[2]&~Q[1];
```

Q2	Q1	Q0	Q2*	Q1*	Q0*
0	0	0	0	1	0
0	0	1	0	0	0
0	1	0	1	1	0
0	1	1	0	0	1
1	0	0	1	0	1
1	0	1	1	1	1
1	1	0	1	0	0
1	1	1	0	1	1

2. [8 pts] Draw a state transition diagram for a 3-bit self-correcting Johnson (switchtail) counter and write the next state equations for each counter bit.



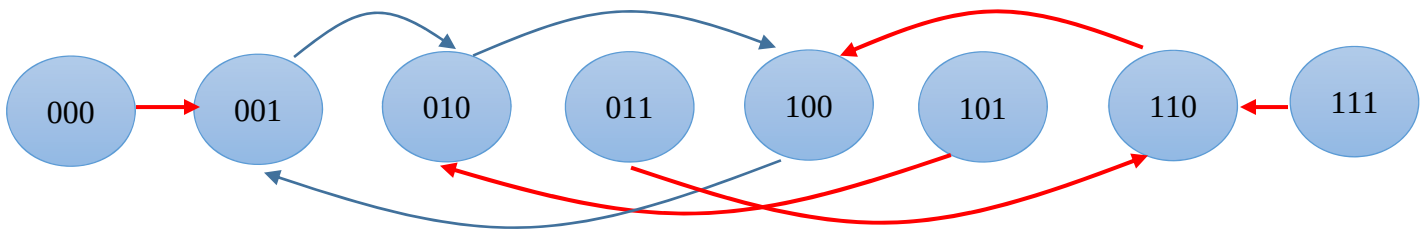
```

next_Q[2] = Q[1] & (Q[2] | Q[0]);
next_Q[1] = Q[0];
next_Q[0] = ~Q[2];

```

Q2	Q1	Q0	Q2*	Q1*	Q0*
0	0	0	0	0	1
0	0	1	0	1	1
0	1	0	0	0	1
0	1	1	1	1	1
1	0	0	0	0	0
1	0	1	0	1	0
1	1	0	1	0	0
1	1	1	1	1	0

3. [8 pts] Draw a state transition diagram for a 3-bit self-correcting ring (“one hot”) counter and write the next state equations for each counter bit.



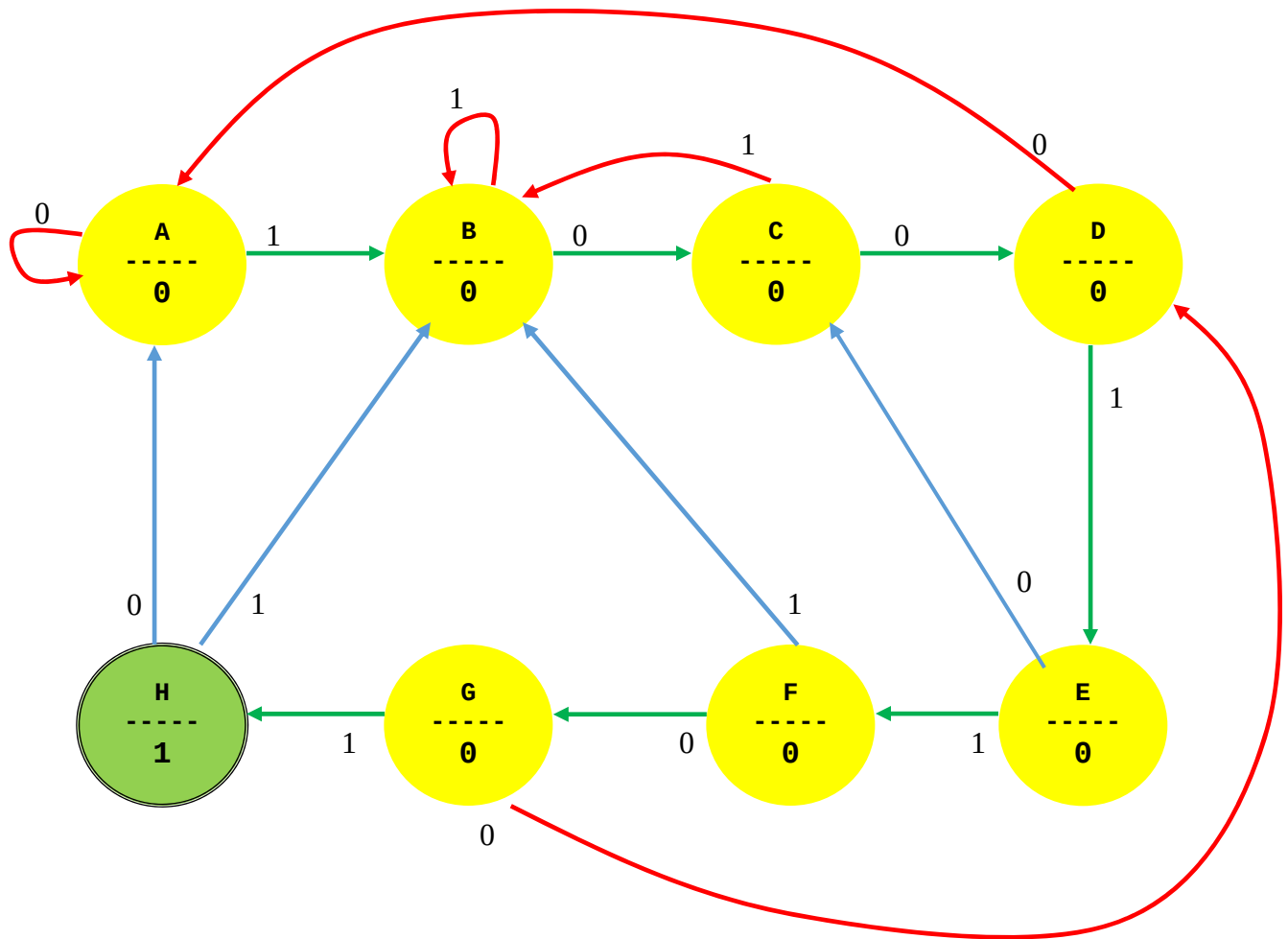
```

next_Q[2] = Q[1];
next_Q[1] = Q[0];
next_Q[0] = ~(Q[1] | Q[0]);

```

Q2	Q1	Q0	Q2*	Q1*	Q0*
0	0	0	0	0	1
0	0	1	0	1	0
0	1	0	1	0	0
0	1	1	1	1	0
1	0	0	0	0	1
1	0	1	0	1	0
1	1	0	1	0	0
1	1	1	1	1	0

4. [8 pts] Draw a state transition diagram for a state machine that recognizes the embedded binary sequence "1001101" (i.e. outputs a "1" whenever that sequence appears in a continuous stream of binary data bits). Write the next state equations for each register bit.



State	Q2	Q1	Q0	D	Q2*	Q1*	Q0*	Out
A	0	0	0	0	0	0	0	0
	0	0	0	1	0	0	1	0
B	0	0	1	0	0	1	0	0
	0	0	1	1	0	0	1	0
C	0	1	0	0	0	1	1	0
	0	1	0	1	0	0	1	0
D	0	1	1	0	0	0	0	0
	0	1	1	1	1	0	0	0
E	1	0	0	0	0	1	0	0
	1	0	0	1	1	0	1	0
F	1	0	1	0	1	1	0	0
	1	0	1	1	0	0	1	0
G	1	1	0	0	0	1	1	0
	1	1	0	1	1	1	1	0
H	1	1	1	0	0	0	0	1
	1	1	1	1	0	0	1	1

$$Q2^* = Q2 \cdot Q0' \cdot D + Q2' \cdot Q1 \cdot Q0 \cdot D + Q2 \cdot Q1' \cdot Q0 \cdot D'$$

$$Q1^* = Q1' \cdot Q0 \cdot D' + Q2 \cdot Q1 \cdot Q0' + Q1 \cdot Q0' \cdot D' + Q2 \cdot Q0' \cdot D'$$

$$Q0^* = Q1 \cdot Q0' + Q2 \cdot D + Q2' \cdot Q1' \cdot D$$