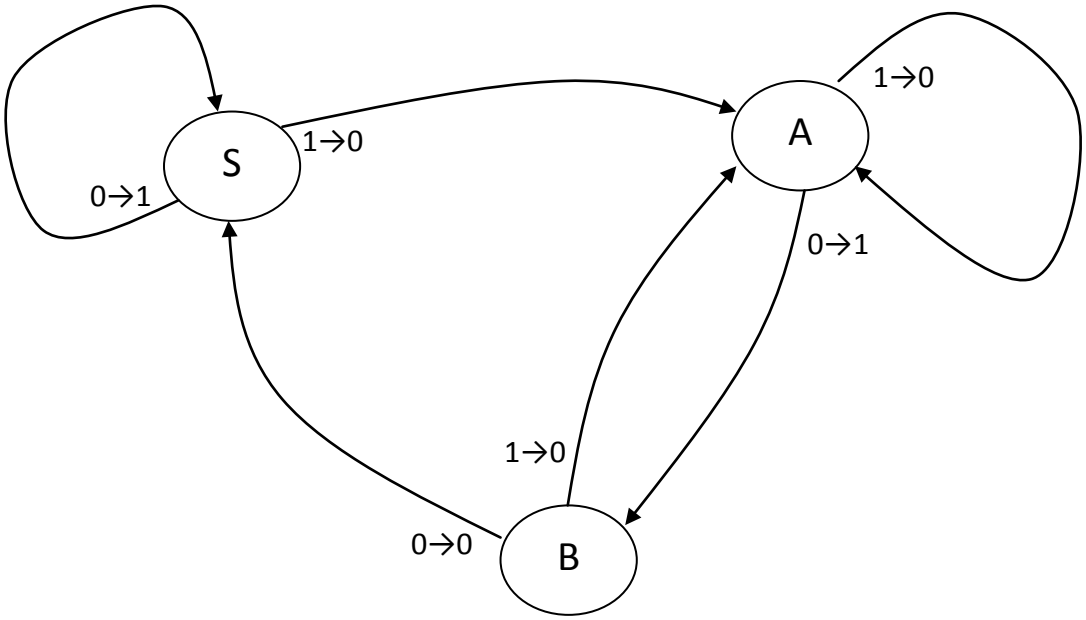
UNCA CSCI 255

Finite State Machine

1. Use the following finite state diagram for answering this problem.



First, fill in the following state transition table using the state names, S, A, and B.

Present state	Input	Next State	Output
S	0		
S	1		
A	0		
A	1		
B	0		
B	1		

Now assuming that S is encoded with the two binary bits 00, A with the binary bits 01, and B with the binary bits 10; complete the following state transition table at the binary level.

Present state		Input	Next state		Output
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			

2. Draw the Finite State Diagram for a Moore Machine that recognizes a binary input sequence containing an even number of 1s.

PIC24 Architecture

1. If a memory has 256 words, and each word contains 32 bits, how many bytes are contained in this memory?

2. How many bits are required to address 4M bytes of memory if a byte is the smallest addressable unit?

3. Answer the following questions regarding the PIC 24 architecture:

    a. What is the word size of data memory?
    b. Is data memory byte addressable?
    c. What is the word size of program memory?
    d. Is program memory byte addressable?
    e. What is the size of the WREG (i.e., how many bits does it have)? Are all working registers the same size?

4. Define the following terms:
    a. OP code
    b. Register
    c. Program counter
    d. Instruction register
    e. Machine code
    f. Assembly language
    g. ALU
    h. Bus
    i. SRAM
    j. Assembler
    k. Clock cycle vs. instruction cycle
    l. Microcontroller
    m. Literal

PIC24 Assembly Language

1. Given the PIC24 assembly language instruction summary, write a PIC24 instruction sequence that accomplishes each of the following where i, j, and k are uint16 variables
    a. k=i-j-32
    b. i=((k-j)>>4)& 0x0F
    c. if(i<=j) {
       if-body statements
       } else {
       else-body statements
       }

d. while (i != j) {
   loop-body statements
   }

2. Given the PIC24 assembly language instruction summary, write a PIC24 instruction sequence that copies data memory (RAM) locations 0x1000 through 0x1008 to locations 0x100A through 0x1013.

3. For each of the remaining problems, assume the memory/register contents shown below at the start of each instruction and give the modified memory location or register and its contents. You will have access to the PIC24 assembly language instruction summary when answering these problems.

Location	**Value**	**Location**	**Value**
W0	0x1006	0x1000	0x382A
W1	0x00BC	0x1002	0xFB80
W2	0x8345	0x1004	0x4D19
W3	0x1000	0x1006	0xE7C0
W4	0x1006	0x1008	0xFF00

a. MOV 0x1002, WREG
b. MOV #0x1002, W0
c. MOV [W3], [W4]
d. MOV [W0++], W4
e. AND W0, W1, W0
f. IOR W3, W1, W0
g. XOR W3, W4, W4

4. For each of the remaining problems, assume the memory/register contents shown below at the start of each instruction and give the modified memory location or register and its contents.

Location	**Value**	**Location**	**Value**
W0	0x0804	0x0800	0x382A
W1	0x0806	0x0802	0xFB80
W2	0xF0A2	0x0806	0x7B03
W15	0x0804	0x0808	0x0001

a. push W1
b. pop W2

5. Explain why the stack is needed to implement subroutines.

C Programming

1. Evaluate the following expressions where i, j, and k are declared as follows:

```
uint16_t  i=0, j=2, k=1;
```

a. i >> 2
b. i & 0x0F
c. i | 0x0F
d. i && j
e. !i
f. i < j < k
g. i + j || k
h. i = j