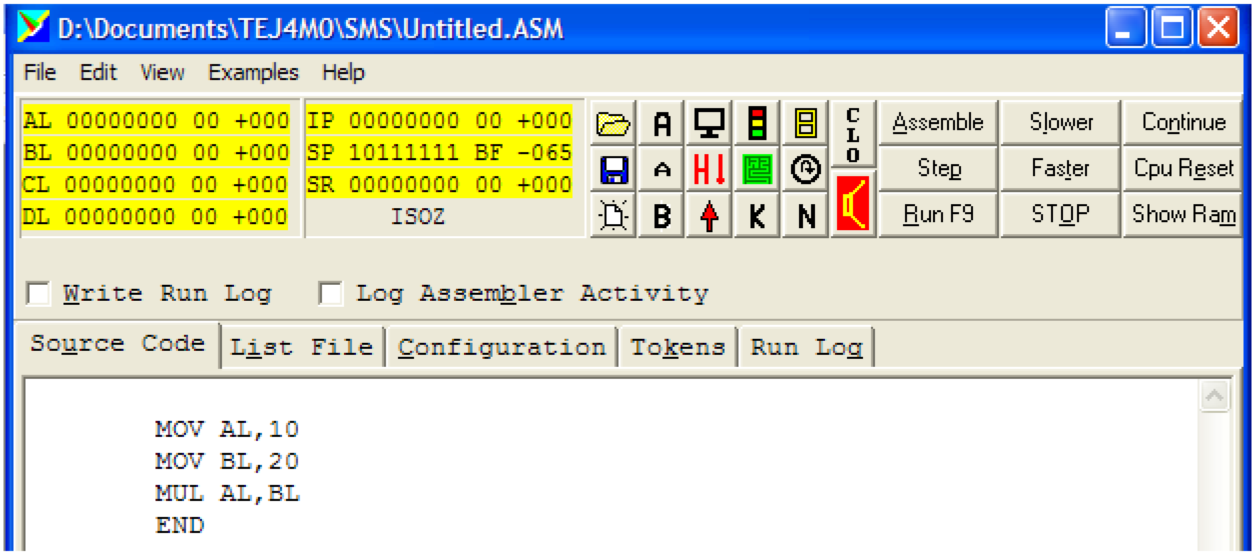
Microprocessor Simulator

Complete Tutorials (Examples) 1 through 11.As you complete each tutorial, save your work in the G:\ drive and in the C:\TEMP directory, then answer the following questions.

Tutorial 1



```
AL 00000000 00 +000   IP 00000000 00 +000
BL 00000000 00 +000   SP 10111111 BF -065
CL 00000000 00 +000   SR 00000000 00 +000
DL 00000000 00 +000         ISOZ
```

□ Write Run Log   □ Log Assembler Activity

```
        MOV AL,10
        MOV BL,20
        MUL AL,BL
        END
```

1. Enter the code shown above into the simulator, then assemble the code and run the program.

   A) What are AL and BL? ______________________________

   B) Where are the instructions stored when the program is assembled?

   ____

   C) What is the binary code for the instruction MUL? __________

   D) Where is the result of the operation stored? _______________

   E) What is the result displayed in the simulator?

   Binary _____________ Hex ________ Decimal _________

   F) Why does the simulator give an incorrect answer?

   ____

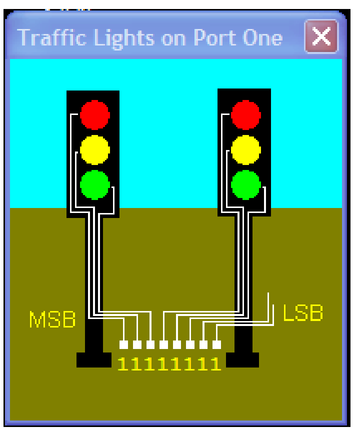
   ____

   G) What type of numbering system is being used in this simulator?

   H) How are negative numbers indicated in this numbering system?

   I) What is the purpose of the IP register?______________________________

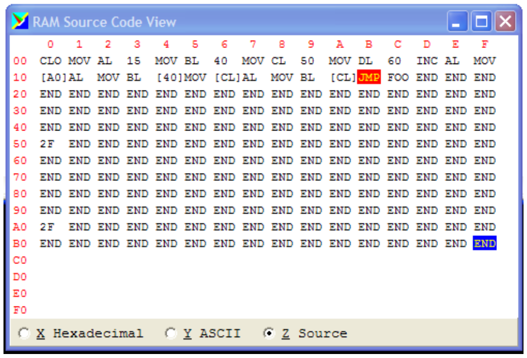
Tutorial 2



1. What is the *binary* code needed to turn on only the green light on the left traffic light, and the red light on the right? ____________
2. Which lights would be tuned on if the Hex code 88 is sent to output port 1?
3. Why does the word start have a colon after it the first time it is used in the program?
4. What type of programming technique is used to make the program repeat itself?
5. Which line(s) of code would you delete from the example in order to ensure that at least one light is on at all times?
6. Why would the program in the example be useless for programming real traffic lights?

Tutorial 3

1. `MOV CL,50` is an example of which addressing mode? ____________
2. What instruction can be used to add 1 to the contents of a register? ____________
3. How are RAM addresses written in this version of Assembly Language?
4. What is the difference between `MOV [A0],AL` and `MOV AL,[A0]` ?
5. What is the difference between `MOV [A0],AL` and `MOV [CL],AL` ? (Specify the addressing mode being used in each example.)



```
    0   1   2   3   4   5   6   7   8   9   A   B   C   D   E   F
00  CLO MOV AL  15  MOV BL  40  MOV CL  50  MOV DL  60  INC AL  MOV
10  [A0]AL  MOV BL  [40]MOV [CL]AL  MOV BL  [CL]JMP FOO END END END
20  END END END END END END END END END END END END END END END END
30  END END END END END END END END END END END END END END END END
40  END END END END END END END END END END END END END END END END
50  2F  END END END END END END END END END END END END END END END
60  END END END END END END END END END END END END END END END END
70  END END END END END END END END END END END END END END END END
80  END END END END END END END END END END END END END END END END
90  END END END END END END END END END END END END END END END END
A0  2F  END END END END END END END END END END END END END END END
B0  END END END END END END END END END END END END END END END END
C0
D0
E0
F0
○ X Hexadecimal   ○ Y ASCII   ● Z Source
```

6. In the example on the left, why are the memory locations from C0 to FF shown as blank?
7. What are these addresses reserved for?
8. How many bytes of RAM are in the range C0:FF?

Tutorial 4

Note: If you have difficulty with the Fibonacci sequence, move on to the next tutorial and return to this problem if you have time later.

1. What is an overflow? ____

2. What is the purpose of the Status Register? ---

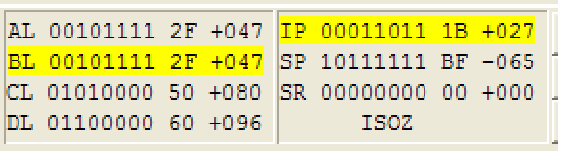
   ____

3. Which bit changes in the status register when the operation results in an overflow?__________

4. What do the letters ISOZ below the status register mean?

   ____

   ____



```
AL 00101111 2F +047  IP 00011011 1B +027
BL 00101111 2F +047  SP 10111111 BF -065
CL 01010000 50 +080  SR 00000000 00 +000
DL 01100000 60 +096         ISOZ
```

5. Which bit in the status register will be set (changed to 1) when the result of an operation is negative?

Tutorial 5

1) Run the example program *05KEYBIN.ASM*. Why does the instruction `CMP   AL,0D` cause the program to end if you press enter? ____________________________________

   ____

2) Write a program that meets the criteria for task (12). Run the program and enter 66 characters without pressing the Enter key. Why does the program crash?

   ____

   ____

3) What instruction(s) could you use to end the program before it crashes?

   ____

   ____

4) The tutorial suggests using the Stack to complete task (14). The reason for this is that the Stack operates using the principle LIFO. What does LIFO mean?

   ____

5) Enter the following program in the simulator, omitting the blank comments:

```
      CLO               ;____________________________________________
      MOV   BL,C0       ;____________________________________________
Rep:                    ;____________________________________________
      IN    00          ;____________________________________________
      PUSH  AL          ;____________________________________________
      CMP   AL,0D       ;____________________________________________
      JNZ   Rep         ;____________________________________________
display:                ;____________________________________________
      POP   CL          ;____________________________________________
      MOV   [BL],CL     ;____________________________________________
      INC   BL          ;____________________________________________
      JMP   display     ;____________________________________________
END                     ;____________________________________________
```

6) Run the program in the simulator. When the Keyboard Input window appears, enter the numbers from 0 to 9, then press Enter. Record the contents of the Video Display Unit. ________________

7) Why do the numbers on the display appear in a different order than you entered them?

____

8) Enter comments beside each line of code in step 4 to explain what it means.

9) What is the Stack?

____

____

Tutorial 6

1. Find the Help page titled *Instruction Set Summary*. Are there any Instructions for timer, delay, pause or similar concepts? ____________________

2. Describe the method of creating a time delay introduced in Tutorial 6.

____

____

____

____

____

3. Redo the traffic light simulation using delays. Real-world traffic lights are green for about 2 minutes, yellow for about 20 seconds, and then the signals are red in both directions for about 5 seconds, before the other light turns green. Try to make your delays proportional.

4. What makes the ORG directive different than most other terms in the instruction set?

____

____

____

5. How does the CALL instruction differ from the JUMP instructions?

____

____

____

6. If you use the instruction RET to return from a procedure, how does the program know what point in the program to return to?

____

____

____

Tutorial 7

7. What is the difference between HALT and END?

8. What is the risk of using the ORG instruction to determine where the program code will be stored?

9. Are there any advantages to using the ORG instruction to place the code where you want it?

Tutorial 11

Run the sample code for tutorial 11. The microcontroller in this example is controlling two devices. One device (the stepper motor) needs constant output from the microcontroller, but the other device (the traffic lights) needs only occasional, but immediate attention. In the simulator the hardware interrupts are generated by a timer, not by actual hardware. You can adjust the interval of the timer by clicking on the Configuration tab above the code window.

10. What is a hardware interrupt?

11. Give three examples of devices which might use interrupts in a PC.

12. In the simulator, what happens when the Interrupt is received?

13. How does the processor determine where to resume when the interrupt program is ended (IRET)?

14. How would interrupts be useful in programming a device like a robot?