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M&A Practical 6

Aim : Introduction to Microcontroller Programming using Keil. Learning programs based on various Addressing modes of 8051.

1. Demonstrate Assembly Language Program for microcontroller-8051 to store last two digits of your Registration Number (as 8-bit data) in R3 using all addressing modes.

Code :

```
MOV R3,#12H    // IMMEDIATE ADDRESSING MODE
MOV R3,#00H

MOV A,#12H     // REGISTER ADDRESSING MODE
MOV R3,A      //
MOV R3,#00H

MOV A,#12H     // DIRECT ADDRESSING MODE
MOV 03H,A     //
MOV R3,#00H

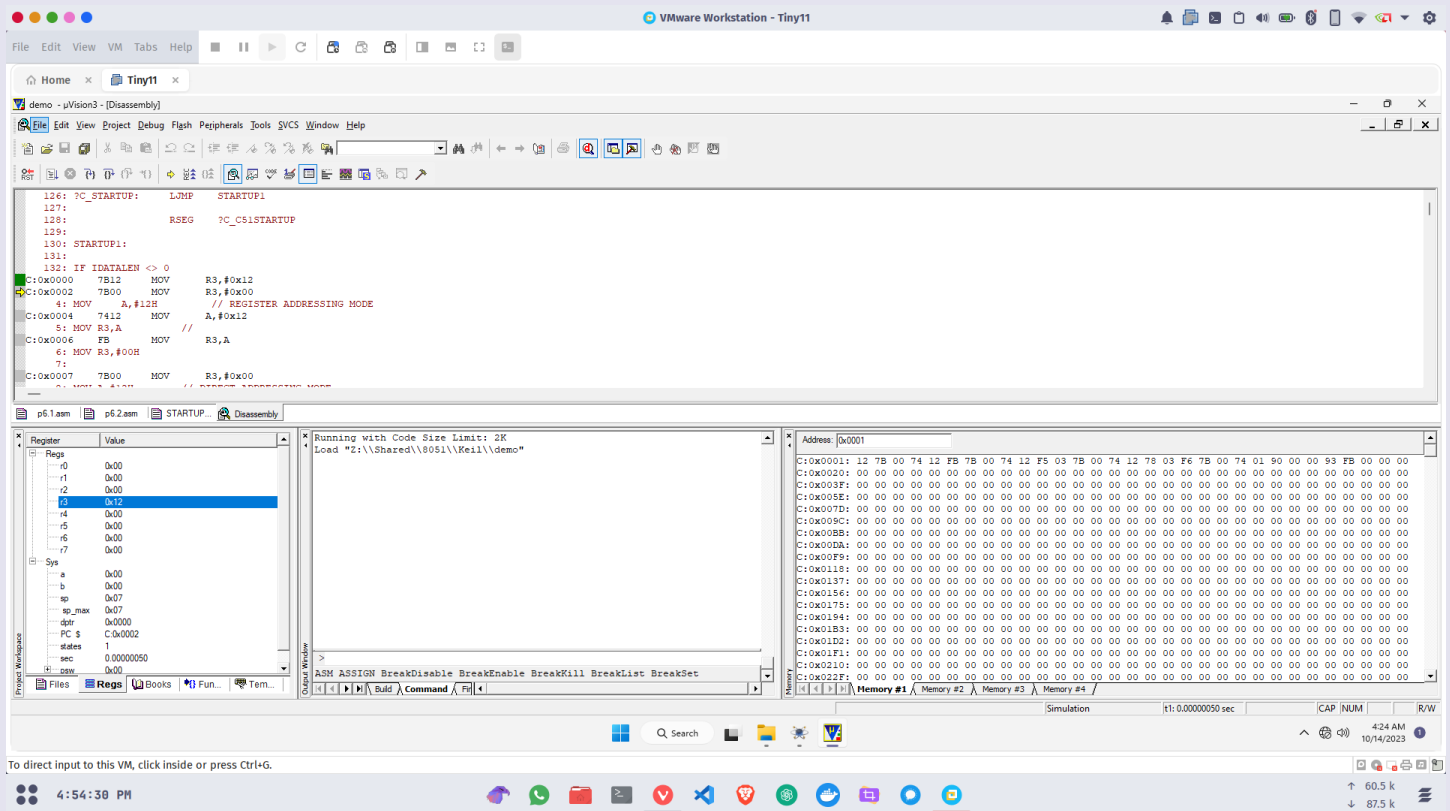
MOV A,#12H     // INDIRECT ADDRESSING MODE
MOV R0,#03H    //
MOV @R0,A     //
MOV R3,#00H

MOV A,#01H     // INDEXED ADDRESSING MODE
MOV DPTR,#0000H //
MOVC A,@A+DPTR //
MOV R3,A      //

END
```

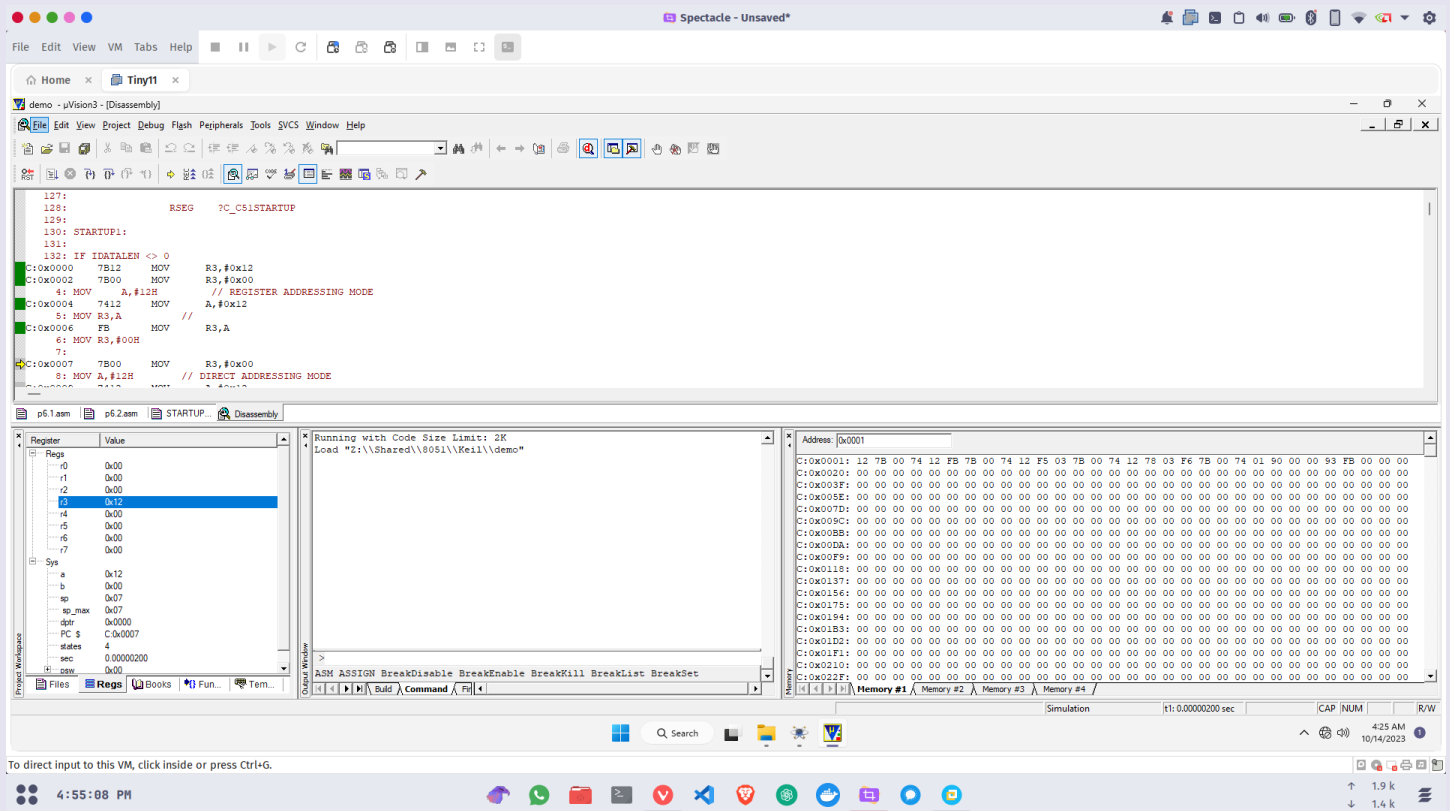
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a) Immediate addressing mode



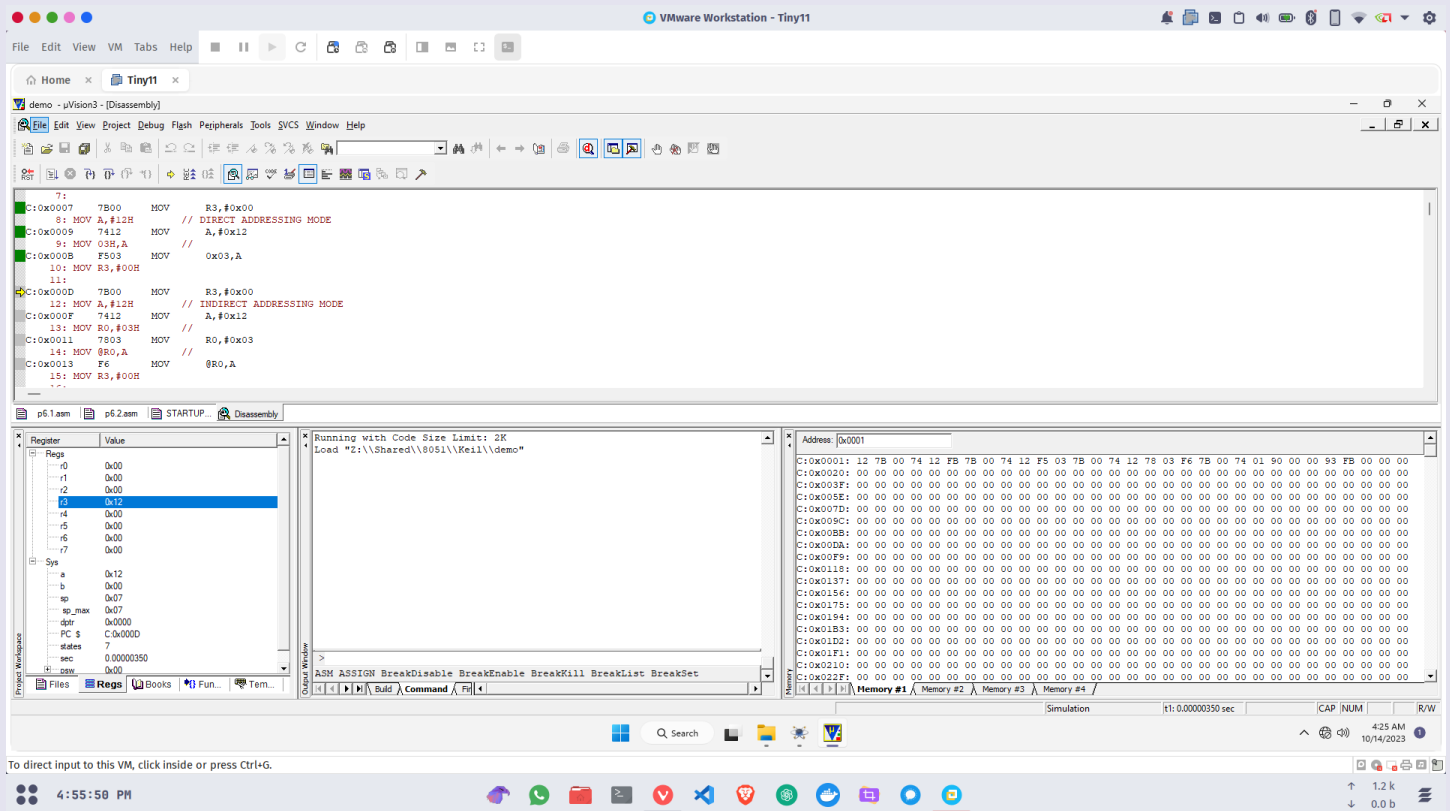
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b) Register addressing mode



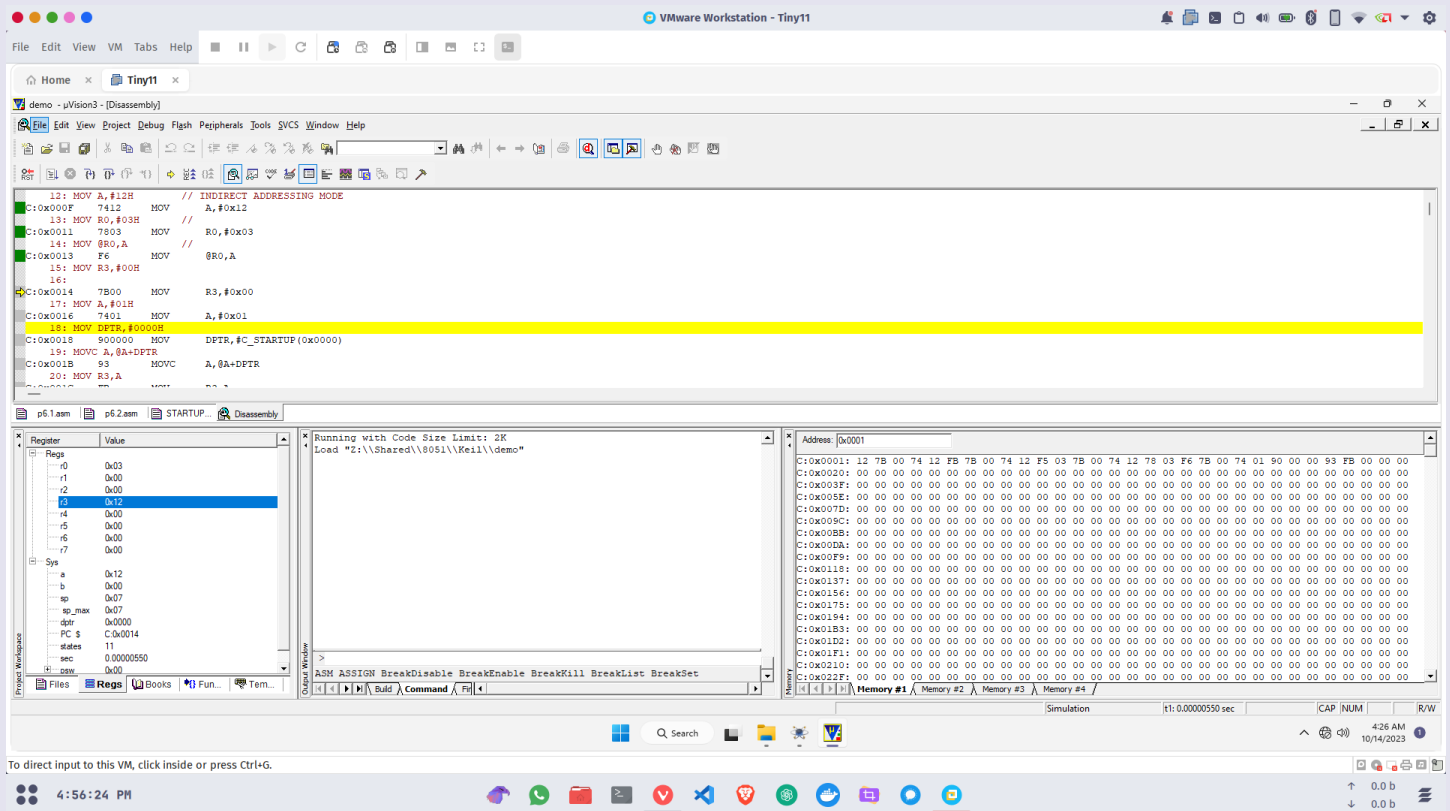
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c) Direct addressing mode



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d) Indirect addressing mode



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e) Indexed addressing mode

The screenshot displays the VMware Workstation interface with a Tiny11 VM running. The main window shows a disassembler for the assembly file 'demo - p61.asm'. The assembly code is as follows:

```
0:0x0011 7803 MOV R0,#0x03
14: MOV @R0,A
0:0x0013 F6 MOV @R0,A
15: MOV R3,#00H
16:
0:0x0014 7B00 MOV R3,#0x00
17: MOV A,#01H // INDEXED ADDRESSING MODE
0:0x0016 7401 MOV A,#0x01
18: MOV DPTR,#0000H //
0:0x0018 900000 MOV DPTR,#C_STARTUP(0x0000)
19: MOVC A,@A+DPTR //
0:0x001B 93 MOV A,@A+DPTR
20: MOV R3,A //
0:0x001C FB MOV R3,A
0:0x001D 00 NOP
0:0x001E 00 NOP
```

The Register window shows the following values:

Register	Value
r0	0x03
r1	0x00
r2	0x00
r3	0x12
r4	0x00
r5	0x00
r6	0x00
r7	0x00

The Memory window shows a hex dump starting at address 0x0001:

```
Address: 0x0001
0:0x0001: 12 78 00 74 12 FB 7B 00 74 12 F5 03 7B 00 74 12 78 03 F6 7B 00 74 01 90 00 00 93 FB 00 00 00
0:0x0002: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0003: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0004: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0005: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0006: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0007: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0008: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0009: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x000A: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x000B: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x000C: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x000D: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x000E: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x000F: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0010: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0011: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0012: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0013: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0014: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0015: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0016: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0017: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0018: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x0019: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x001A: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x001B: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x001C: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x001D: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x001E: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0:0x001F: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

The bottom status bar shows the VM is in Simulation mode, running for 0:00:00.000000000 sec, with 427 AM on 10/14/2023. The system tray shows the time as 4:57:42 PM.

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2. Demonstrate swapping of value stored at Register R3 of Bank 1 with Register R3 of Bank 3

Code :

```
// LOADING DATA
MOV PSW,#08H // SWITCHING TO RB 1
MOV R3,#64H
MOV 1BH,#32H
MOV PSW,#18H // TO SHOW CONTENTS OF REGISTERS IN BANK 3 IN KEIL
REGISTERS TAB
MOV PSW,#08H // SWITCHING BACK TO RB 1

// SWAPPING
MOV A,R3
MOV R2,A
MOV A,1BH
MOV 1BH,0BH
MOV R3,A
// SWAPPING ENDS HERE

MOV PSW,#18H // TO SHOW CONTENTS OF REGISTERS IN BANK 3 IN KEIL
REGISTERS TAB
```

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Before swapping :

a) In Bank-1 :

The screenshot shows a VMware Workstation window titled "VMware Workstation - Tiny11". Inside the VM, the Keil uVision3 IDE is open, displaying assembly code for a program. The code includes comments and instructions for switching to Bank 1, moving data, and swapping registers. The registers window shows the current state of registers, and the memory window shows the memory dump starting at address 0x0001.

```
2: MOV PSW,#08H // SWITCHING TO RB 1
C:0x0000 75D008 MOV PSW(0xD0),#0x08
3: MOV R3,#64H
C:0x0003 7864 MOV R3,#0x64
4: MOV 18H,#32H
C:0x0005 751B32 MOV 0x1B,#0x32
5: MOV PSW,#18H // TO SHOW CONTENTS OF REGISTERS IN BANK 3 IN KEIL REGISTERS TAB
C:0x0008 75D018 MOV PSW(0xD0),#0x18
6: MOV PSW,#08H // SWITCHING BACK TO RB 1
7:
8: // SWAPPING
C:0x000B 75D008 MOV PSW(0xD0),#0x08
9: MOV A,R3
C:0x000E EB MOV A,R3
10: MOV R2,A
.....
```

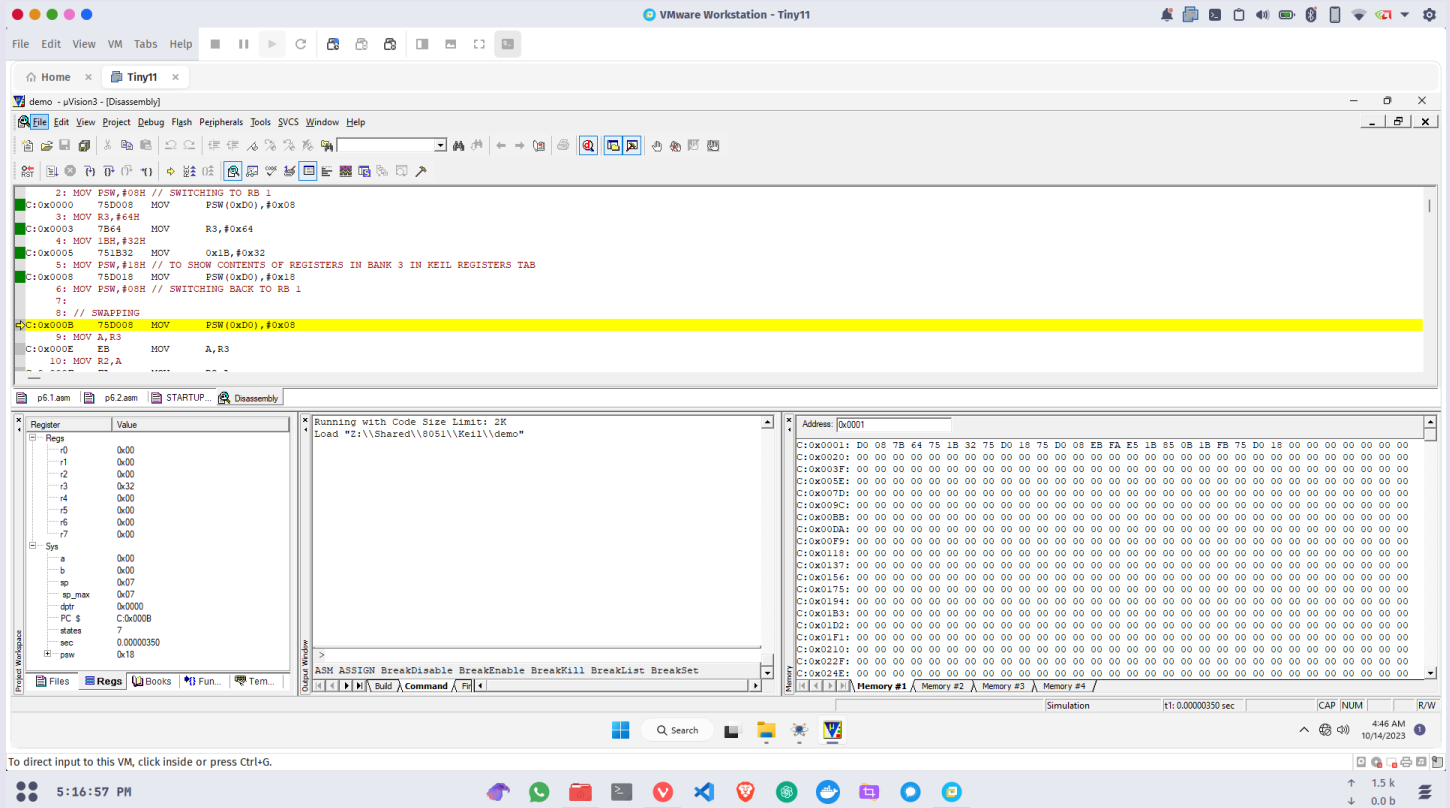
The registers window shows the following values:

Register	Value
r0	0x00
r1	0x00
r2	0x00
r3	0x64
r4	0x00
r5	0x00
r6	0x00
r7	0x00
SP	0x00
a	0x00
b	0x00
sp_max	0x07
dptr	0x0000
PC	0x0008
status	5
sec	0.00000250
psw	0x08

The memory window shows the memory dump starting at address 0x0001. The memory dump is a grid of hexadecimal values, mostly 0x00, with some non-zero values at the beginning of the dump.

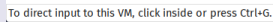
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b) In Bank-3 :



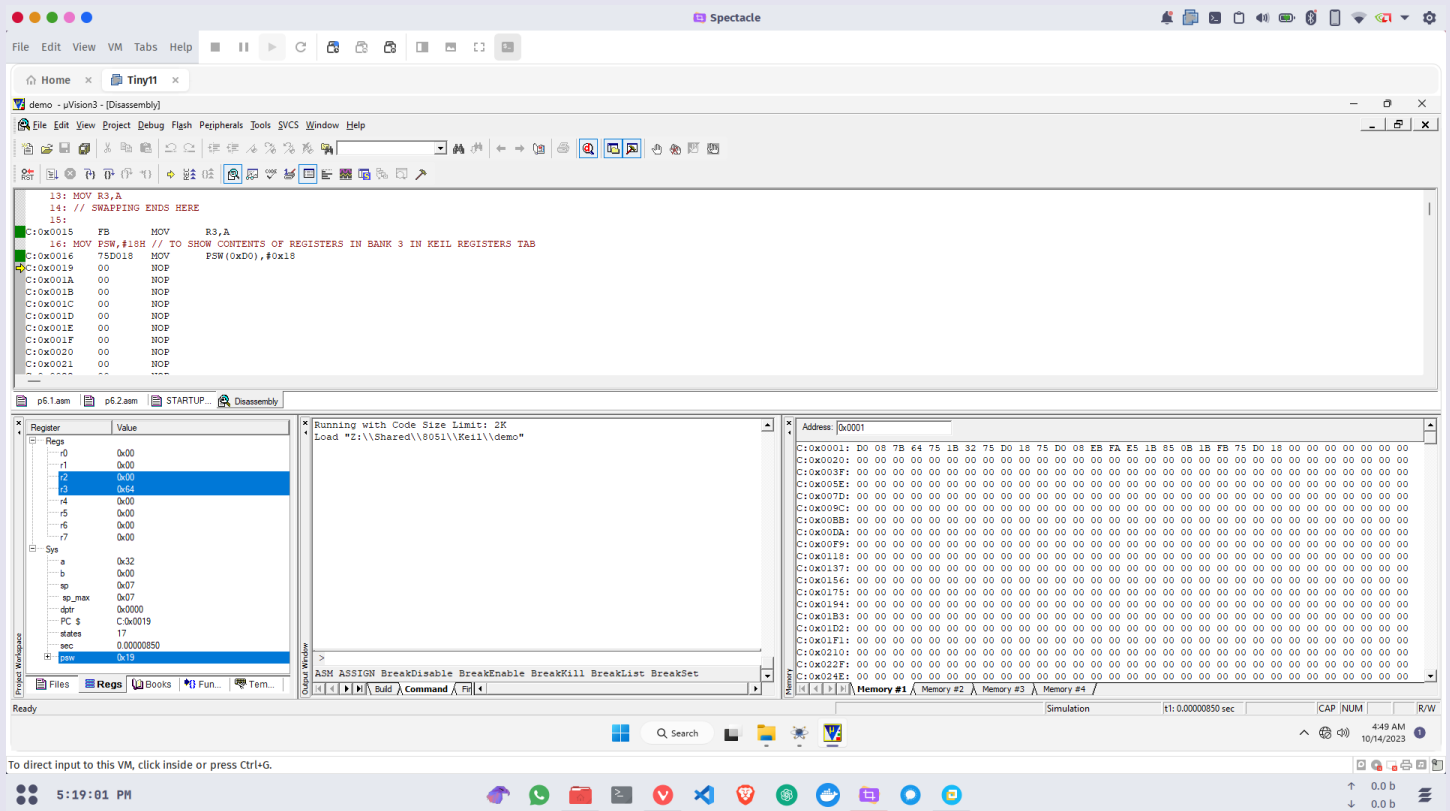
After swapping :

a) In Bank-1 :



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b) In Bank-3 :



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Exercise: (Answer the following Questions)

1. Write down the differences between microprocessor and microcontroller.

ANS: Microprocessor is only a processing unit which needs additional peripheral devices for proper use. But, Microcontroller is an all-in-one package consisting of CPU, RAM, ROM, Clock/Timer, etc. which can also be attached to peripherals and external devices.

2. "Audi Q7 car is an example of an embedded system". State true/false with justification.

ANS: True. The Audi Q7 uses a system built entirely for itself and nothing else, meaning there's a dedicated chip built for performing specific functions and those functions only. This exact system cannot be programmed to do something else that it was not supposed to do as is the case with 'embedded systems'.

3. Which microprocessor is used in latest Samsung and Nokia mobile phones.

ANS: Samsung uses 'Qualcomm Snapdragon 8 Gen 2' as their chipset in their latest flagships 'Samsung Galaxy S23 Ultra', 'Samsung Galaxy Z Fold 5', and 'Samsung Galaxy Z Flip 5'. Similarly, Nokia flagships like 'Nokia G60 5G' are using 'Qualcomm Snapdragon 695'.

4. Write down the major limitations of microprocessor-8085 to work as complete MPU. (Microprocessor Unit).

ANS:

- > It needs external peripherals to actually be useful.
- > No internal RAM/ROM
- > Needs external crystal oscillator for Clock

5. Why Intel 8051 is known as a "Computer on Chip"?

ANS: Microcontroller 8051, in general, is called a 'Computer on a Chip' because it contains many basic features on a single chip. It has internal RAM, ROM, Clock circuit, Timers, Interrupt, I/O Ports, Serial Ports, etc.