

ECED 3204 Microprocessor

Assignment #1 Reference Solution

<http://www.jasongu.org/3204/assignments.html>

Assignment #1 contains the following problems:

E2.1 Write an instruction sequence to swap the contents of registers r0 and r1. A third register such as r2 or other can be used to facilitate the swap operation.

Solution: The following instruction sequence will perform the swap operation:

```
mov  r2,r0          ; save the contents of r0 in r2
mov  r0,r1          ; r0 gets the value of r1
mov  r1,r2          ; r1 gets the value of r0
```

E2.4 Write an instruction sequence to store 1, 3, and 5 at data memory locations at 0x2000, 0x2005, and 0x200A, respectively.

Solution: The following instruction sequence will perform the specified initialization:

```
ldi  YL,0x00        ; use Y to point to data memory location 0x2000.
ldi  YH,0x20        ; "
ldi  r16,1          ; store 1 in data memory location 0x2000
st   Y,r16          ; "
ldi  r16,3          ; store 3 in data memory location 0x2005
std  Y+5,r16        ; "
ldi  r16,5          ; store 5 in data memory location 0x200A
std  Y+10,r16       ; "
```

E2.7 Write a sequence of instructions to add the three numbers stored in 0x2000, 0x2001, and 0x2002 and store the sum at data memory location at 0x2010.

Solution: The following instruction sequence can perform the specified operation:

```
ldi  YL,0x00        ; use Y to point to data memory location 0x2000
ldi  YH,0x20        ; "
ld   r0,Y           ; fetch data memory location 0x2000
ldd  r1,Y+1         ; fetch data memory location 0x2001
add  r0,r1          ; add data memory locations 0x2000 and 0x2001
ldd  r1,Y+2         ; fetch data memory locations 0x2002
add  r0,r1          ; add 0x2000, 0x2001, and 0x2002
std  Y+16,r0        ; store at 0x2010
```

E2.10 Write a sequence of instructions to copy the three bytes from program memory locations 0x2000~0x2002 to data memory locations at 0x2000~0x2002, respectively.

Solution: We need one pointer to point to data memory and another pointer to point to program memory. The following instruction sequence will copy data from program memory to data memory:

```
ldi  YL,0x00        ; use Y to point to data memory location 0x2000
ldi  YH,0x20        ; "
```

```

0x2000    ldi    ZL,0x00        ; use Z to point to program memory location
          ldi    ZH,0x20        ; "
pointer   lpm    r0,Z+          ; fetch program memory at 0x2000 and move
          st     Y+,r0          ; store program memory contents in data memory
pointer   lpm    r0,Z+          ; fetch program memory at 0x2001 and move
          st     Y+,r0          ; store in data memory
          lpm    r0,Z          ; fetch program memory at 0x2002
          st     Y,r0          ; store at data memory

```

E2.13 Write an instruction sequence to subtract the value stored at data memory location 0x2000 from the sum of the values stored at data memory locations 0x2010 and 0x2011 and leave the difference in r0.

Solution: The instruction sequence that can perform the specified operation is as follows:

```

          ldi    YL,0x00
          ldi    YH,0x20
          ldd    r0,Y+0x10      ; fetch data memory location 0x2010
          ldd    r1,Y+0x11      ; fetch data memory location 0x2011
          add    r0,r1          ; add these two bytes
          ld     r1,Y           ; fetch data memory location 0x2000
          sub    r0,r1          ; leave the difference in r0

```