**CPS310 – COMPUTER ORGANIZATION II**

**LAB 2**

**ARC, ARC ASSEMBLY, ARC SIMULATOR**

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**Submission instruction:**

**Labs will be done individually. Students have <u>two weeks</u> to complete this lab and should present their solution to the TA during the lab session of the second week. Each student should present their written work and the results of the simulations. Please note that Lab 2 will be graded based on attendance, and correct completion, and answers to the TA's questions.**

**Note: Arc Simulator program requires an added empty line at the bottom of the code to assemble.**

**PART 1:**

1. Please add comments for each line.
    a. Explain what the program intends to do.
    b. Assemble the code by hand.
2. Run the program through the simulator
3. What is the content of %r4 after this program is executed?

```
! Program 1
! Hint: op3 for subcc is 010100
        .begin
        .org            2048
dstart  .equ            4000
        ld              [a], %r1
        ld              [b], %r2
        ld              [c], %r3
        addcc           %r2, %r3, %r0
        addcc           %r1, %r0, %r4
        subcc           %r2, %r4, %r2
        st              %r0, [a]
        st              %r2, [y]
        jmpl            %r15 + 4, %r0
        .org            dstart
a:      15
b:      54
c:      -29
y:      0
        .end
```

**PART 2:**

1. Please add comments for each line.
    a. Explain what the program intends to do.
    b. Assemble the code by hand.
2. Run the program through the simulator
3. What is the content of %r3 after this program is executed?

```
! Program 2
            .begin
            .org        2048
m_start:    ld          [x], %r1
            ld          [y], %r2
            subcc       %r1,  %r2, %r0
            bneg        else
            andcc       %r1,  %r2,  %r3
            ba          done
else:       orcc        %r1,  %r2,  %r3
done:       st          %r3, [a]
            jmpl        %r15+4, %r0
x:          30
y:          48
a:          0
            .end
```

**PART 3:**

1. Please add comments for each line.
    a. Explain what the program intends to do.
    b. Assemble the code by hand.
2. Run the program through the simulator
3. What is the content of %r1 after this program is executed?

```
! Program 3
        .begin
        .org        2048
main:   ld          [x],  %r2
top:    subcc       %r1,  4,  %r0
        be          done
        srl         %r2,  1, %r2
        addcc       %r1,  1,  %r1
        ba          top
done:   st          %r3, [y]
        jmpl        %r15+4, %r0
        .org        3000
x:      800
y:      0
        .end
```

**PART 4:**

1. Please add comments for each line.
    a. Explain what the program intends to do.
    b. Assemble the code by hand.
2. Run the program through the simulator
3. What is the content of %r4 after this program is executed?

```
! Program 4
            .begin
            .org        2048
main:       ld          [a],  %r1
            ld          [b],  %r2
            ld          [c],  %r3
top:        subcc       %r4,  3,  %r0
            be          done
            subcc       %r5,  %r6,  %r0
            bneg        else
            orcc        %r1,  %r2,  %r1
            addcc       %r6,  1,  %r6
            ba          bottom
else:       andcc       %r1,  %r3,  %r1
            addcc       %r5,  1,  %r5
bottom:     addcc       %r4,  1,  %r4
            ba          top
done:       st          %r3, [y]
            jmpl        %r15+4, %r0
            .org        3000
a:          0xa0
b:          0x33
c:          0x52
y:          2
            .end
```