HACETTEPE UNIVERSITY COMPUTER SCIENCE ENGINEERING DEPARTMENT

BBM234 ADVANCED COMPUTER ARCHITECTURES

PROJECT

Advisors: Assoc. Prof. Dr. Süleyman TOSUN

Subject : MIPS ASSEMBLY
Due Date : 23/10/2017 (23:29)

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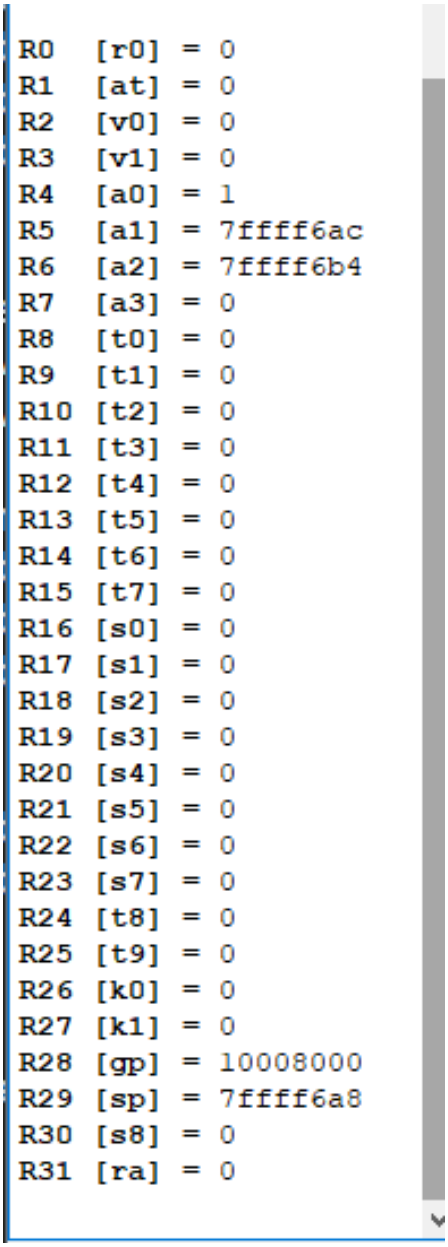
MIPS, Microprocessor without Interlocked Pipeline Stages is a reduced instruction set type microprocessor architecture developed by the company MIPS Technologies in 1985. MIPS assembly is much more useful and simple than other assemblies. Intel 80x86 is a logical structure that follows the design in comparison to the complicated structure of the assembly language.

Firstly I worked on array. My aim is calculate the unique elements in a given sorted arrays.

My first array is A={2,2,3,3,3,5,5,6,7,10} so i have 6 unique elements here. Let's check it.

Initial registers for test1:



Final registers for test1:

```
R0   [r0] = 0
R1   [at] = 0
R2   [v0] = a
R3   [v1] = 0
R4   [a0] = 1
R5   [a1] = 7ffff6ac
R6   [a2] = 7ffff6b4
R7   [a3] = 0
R8   [t0] = 9
R9   [t1] = 10010024
R10  [t2] = 7
R11  [t3] = 0
R12  [t4] = a
R13  [t5] = 0
R14  [t6] = 0
R15  [t7] = 0
R16  [s0] = 6
R17  [s1] = 9
R18  [s2] = 0
R19  [s3] = 0
R20  [s4] = 0
R21  [s5] = 0
R22  [s6] = 0
R23  [s7] = 0
R24  [t8] = 0
R25  [t9] = 0
R26  [k0] = 0
R27  [k1] = 0
R28  [gp] = 10008000
R29  [sp] = 7ffff6a8
R30  [s8] = 0
R31  [ra] = 400018
```

We saw that [s0] register has value of 6.

My second array is A={1,2,3,4,5,6,7,8,9,10}} so i have 10 unique elements here. Let's check it.

Initial registers for test2

```
R0   [r0] = 0
R1   [at] = 0
R2   [v0] = 0
R3   [v1] = 0
R4   [a0] = 1
R5   [a1] = 7ffff6ac
R6   [a2] = 7ffff6b4
R7   [a3] = 0
R8   [t0] = 0
R9   [t1] = 0
R10  [t2] = 0
R11  [t3] = 0
R12  [t4] = 0
R13  [t5] = 0
R14  [t6] = 0
R15  [t7] = 0
R16  [s0] = 0
R17  [s1] = 0
R18  [s2] = 0
R19  [s3] = 0
R20  [s4] = 0
R21  [s5] = 0
R22  [s6] = 0
R23  [s7] = 0
R24  [t8] = 0
R25  [t9] = 0
R26  [k0] = 0
R27  [k1] = 0
R28  [gp] = 10008000
R29  [sp] = 7ffff6a8
R30  [s8] = 0
R31  [ra] = 0
```

Final registers for test2:

```
HI        = 0
LO        = 0

R0  [r0] = 0
R1  [at] = 0
R2  [v0] = 10
R3  [v1] = 0
R4  [a0] = 1
R5  [a1] = 2147481252
R6  [a2] = 2147481260
R7  [a3] = 0
R8  [t0] = 9
R9  [t1] = 268501028
R10 [t2] = 9
R11 [t3] = 0
R12 [t4] = 10
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 10
R17 [s1] = 9
R18 [s2] = 0
R19 [s3] = 0
R20 [s4] = 0
R21 [s5] = 0
R22 [s6] = 0
R23 [s7] = 0
R24 [t8] = 0
R25 [t9] = 0
R26 [k0] = 0
R27 [k1] = 0
R28 [gp] = 268468224
R29 [sp] = 2147481248
R30 [s8] = 0
R31 [ra] = 4194328
```

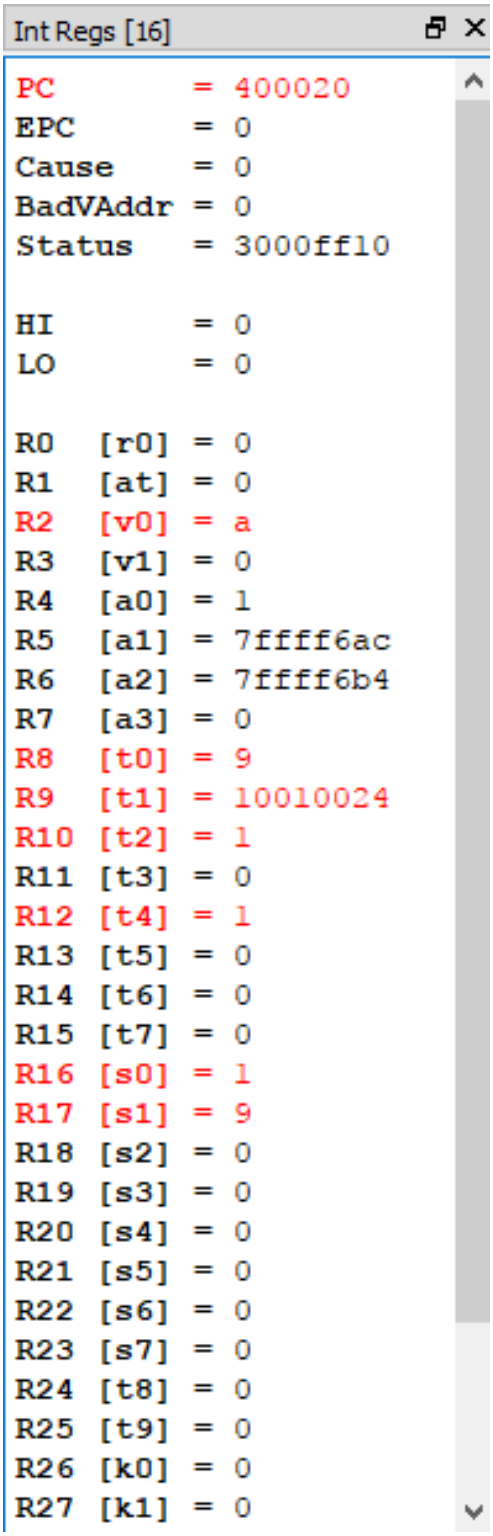
We saw that [s0] register has value of 10.

My third array is A = {1,1,1,1,1,1,1,1,1,1}so i have 1 unique element here. Let's check it.

Initial registers for test3:

```
R0  [r0] = 0
R1  [at] = 0
R2  [v0] = 0
R3  [v1] = 0
R4  [a0] = 1
R5  [a1] = 7ffff6ac
R6  [a2] = 7ffff6b4
R7  [a3] = 0
R8  [t0] = 0
R9  [t1] = 0
R10 [t2] = 0
R11 [t3] = 0
R12 [t4] = 0
R13 [t5] = 0
R14 [t6] = 0
R15 [t7] = 0
R16 [s0] = 0
R17 [s1] = 0
R18 [s2] = 0
R19 [s3] = 0
R20 [s4] = 0
R21 [s5] = 0
R22 [s6] = 0
R23 [s7] = 0
R24 [t8] = 0
R25 [t9] = 0
R26 [k0] = 0
R27 [k1] = 0
R28 [gp] = 10008000
R29 [sp] = 7ffff6a8
R30 [s8] = 0
R31 [ra] = 0
```

Final registers for test3:

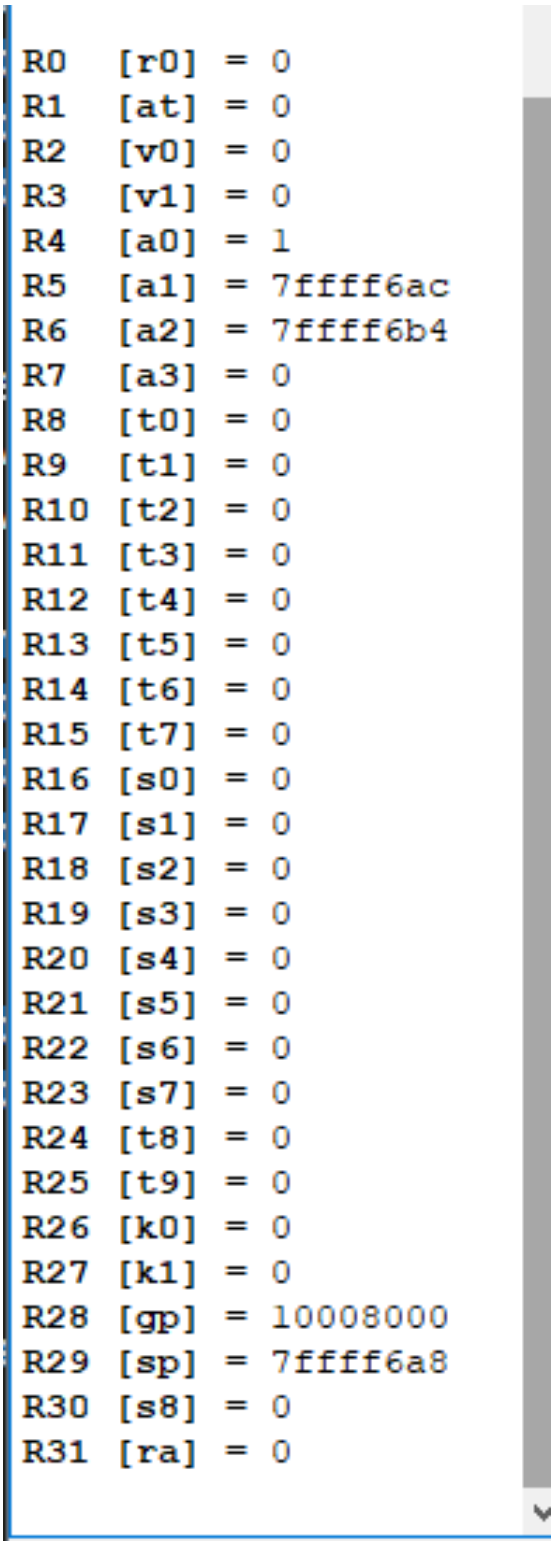


We saw that [s0] register has value of 1.

Secondly, I traslated a code from a C code to a MIPS code. And I worked on functions in this case.

My first inputs are a= 3 and b = 3. So my output should be 6. Let's check it.

Initial registers for input a =3 ($a0) and b =3 ($a1):



Final registers for input a =3 ($a0) and b =3 ($a1):

```
R0   [r0] = 0
R1   [at] = 10010000
R2   [v0] = a
R3   [v1] = 0
R4   [a0] = 3
R5   [a1] = 3
R6   [a2] = 6
R7   [a3] = 0
R8   [t0] = 0
R9   [t1] = 0
R10  [t2] = 0
R11  [t3] = 0
R12  [t4] = 0
R13  [t5] = 0
R14  [t6] = 0
R15  [t7] = 0
R16  [s0] = 0
R17  [s1] = 0
R18  [s2] = 0
R19  [s3] = 0
R20  [s4] = 0
R21  [s5] = 0
R22  [s6] = 0
R23  [s7] = 0
R24  [t8] = 0
R25  [t9] = 0
R26  [k0] = 0
R27  [k1] = 0
```

We saw that our output which is register ‘a1’ has value of 6

My first inputs are a= 3 and b = 5. So my output should be -2. Let's check it.

Initial registers for input a =3 ($a0) and b =5 ($a1):

```
R0   [r0] = 0
R1   [at] = 0
R2   [v0] = 0
R3   [v1] = 0
R4   [a0] = 1
R5   [a1] = 7ffff6ac
R6   [a2] = 7ffff6b4
R7   [a3] = 0
R8   [t0] = 0
R9   [t1] = 0
R10  [t2] = 0
R11  [t3] = 0
R12  [t4] = 0
R13  [t5] = 0
R14  [t6] = 0
R15  [t7] = 0
R16  [s0] = 0
R17  [s1] = 0
R18  [s2] = 0
R19  [s3] = 0
R20  [s4] = 0
R21  [s5] = 0
R22  [s6] = 0
R23  [s7] = 0
R24  [t8] = 0
R25  [t9] = 0
R26  [k0] = 0
R27  [k1] = 0
R28  [gp] = 10008000
R29  [sp] = 7ffff6a8
R30  [s8] = 0
R31  [ra] = 0
```

Final registers for input a =3 ($a0) and b =5 ($a1):

```
HI          = 0
LO          = 0

R0   [r0] = 0
R1   [at] = 268500992
R2   [v0] = 10
R3   [v1] = 0
R4   [a0] = 3
R5   [a1] = 5
R6   [a2] = -2
R7   [a3] = 0
R8   [t0] = 0
R9   [t1] = 1
R10  [t2] = 0
R11  [t3] = 0
R12  [t4] = 0
R13  [t5] = 0
R14  [t6] = 0
R15  [t7] = 0
R16  [s0] = 0
R17  [s1] = 0
R18  [s2] = 0
R19  [s3] = 0
R20  [s4] = 0
R21  [s5] = 0
R22  [s6] = 0
R23  [s7] = 0
R24  [t8] = 0
R25  [t9] = 0
R26  [k0] = 0
R27  [k1] = 0
R28  [gp] = 268468224
R29  [sp] = 2147481248
R30  [s8] = 0
R31  [ra] = 4194328
```

We saw that our output which is register ‘a1’ has value of -2

My first inputs are a= 5 and b = 3. So my output should be 15. Let's check it.

Initial registers for input a =3 ($a0) and b =5 ($a1):

```
R0   [r0] = 0
R1   [at] = 0
R2   [v0] = 0
R3   [v1] = 0
R4   [a0] = 1
R5   [a1] = 7ffff6ac
R6   [a2] = 7ffff6b4
R7   [a3] = 0
R8   [t0] = 0
R9   [t1] = 0
R10  [t2] = 0
R11  [t3] = 0
R12  [t4] = 0
R13  [t5] = 0
R14  [t6] = 0
R15  [t7] = 0
R16  [s0] = 0
R17  [s1] = 0
R18  [s2] = 0
R19  [s3] = 0
R20  [s4] = 0
R21  [s5] = 0
R22  [s6] = 0
R23  [s7] = 0
R24  [t8] = 0
R25  [t9] = 0
R26  [k0] = 0
R27  [k1] = 0
R28  [gp] = 10008000
R29  [sp] = 7ffff6a8
R30  [s8] = 0
R31  [ra] = 0
```

Final registers for input a =5 ($a0) and b =3 ($a1):

```
HI        = 0
LO        = 15

R0   [r0] = 0
R1   [at] = 268500992
R2   [v0] = 10
R3   [v1] = 0
R4   [a0] = 5
R5   [a1] = 3
R6   [a2] = 15
R7   [a3] = 0
R8   [t0] = 0
R9   [t1] = 0
R10  [t2] = 0
R11  [t3] = 0
R12  [t4] = 0
R13  [t5] = 0
R14  [t6] = 0
R15  [t7] = 0
R16  [s0] = 0
R17  [s1] = 0
R18  [s2] = 0
R19  [s3] = 0
R20  [s4] = 0
R21  [s5] = 0
R22  [s6] = 0
R23  [s7] = 0
R24  [t8] = 0
R25  [t9] = 0
R26  [k0] = 0
R27  [k1] = 0
R28  [gp] = 268468224
R29  [sp] = 2147481248
R30  [s8] = 0
R31  [ra] = 4194328
```

We saw that our output which is register ‘a1’ has value of 15