Computer Architecture
CPSC 321, Fall Semester 2004
Lab Assignment #3
Due: One week after your lab session – Complete by yourself.

1   Objective

This lab assignment will make you familiar with number conversions, such as decimal to hexadecimal. A small matrix multiplication routine allows you to become familiar with the equivalent of two-dimensional arrays in MIPS assembly language. The third problem is designed to reinforce your understanding of these conventions.

2   Assignment

[**Base conversion - 40 points**] For this part of the assignment, you are required to write a MIPS assembly program to convert an unsigned integer u in base b into its base d equivalent.

The following are the tasks to complete this part:

1. Accept a base b as an input.

2. Accept an unsigned integer u in base b.

3. Accept a target base d as an input.

4. Convert u into its base d equivalent.

5. Display the base d number onto the console.

Example.

```
Input base:  12
Input number in base 12:  12ab85
Convert to base?  16
Base 16 equivalent:  ...
```

Assume that all inputs are well-formed, i.e. all numbers are within their legal ranges.

[**Array Multiplication - 40 points**] Write a MIPS assembly program to multiply two 3x3 matrices, A and B, and store the result into a matrix C.

Note: Memory for the matrices should be defined statically in the `.data` section of your code and the data should be stored in a *row major* format, i.e. the matrix

$$\begin{pmatrix} a_{00} & a_{01} & a_{02} \\ a_{10} & a_{11} & a_{12} \\ a_{20} & a_{21} & a_{22} \end{pmatrix}$$

is stored as the sequence $(a_{00}, a_{01}, a_{02}, a_{10}, a_{11}, a_{12}, a_{20}, a_{21}, a_{22})$.

The following are the tasks to complete this part:

1. Multiply the two matrices A and B, store the result in C.

2. Display the product matrix C on the console. (Verify the result by working out the solution.)

[**Function calls/register convention - 20 points**]
Implement the following C program fragment in MIPS assembly language, and run it on SPIM.

```
int S, A, B, C, D;

/* Function f(a, b, c, d)  */
int f( int a, int b, int c, int d )
{
  int S;
  S = sum(diff(a,b),diff(c,d)); /*a - b + c - d;*/
  return ( S );
}

/* sum fn */
int sum( int a, int b)
{
  int s;
  s = a + b;
  return s;
}

/* diff fn */
int diff( int a, int b)
```

```
{
  int d;
  d = a - b;
  return d;
}

int main( void )
{
  A = 10; B = 20; C = 100; D = -2;
  S = f(A, B, C, D);
  /* Print out integer S here */
  exit(0);
}
```

Use the parameter passing and call/return sequences discussed in class for functions with less than four arguments.

Note: For this assignment, please use the following register assignments:
In function main, $s1=A, $s2=B, $t1=C, $t2=D, $t3=S.
In function sum, $t1 = s.
In function diff, $s2 = d.

3 Dishonesty

Make sure that you complete the assignment by yourself. Do not copy the code from others, nor provide others with your code. Refrain from copying and modifying the code from other sources.