CSCI 250, Homework 2
Spring 2011
100 Points Total

Name: _____

1 Translating C to MIPS

The following problems deal with translating from C to MIPS. Assume that the variables f, g, h, i, and j are given and could be considered 32-bit integers as declared in a C program.

a.	f = g + h - i + j;
b.	f = (g + 5) - h;
c.	f = f + f + j;

1. For each C statement above, what is the corresponding MIPS assembly code? Use a minimal number of MIPS assembly instructions. (7 points)

a.	
b.	
c.	

2. For each C statement above, how many MIPS assembly instructions are needed to perform the C statement? (3 points)

a.	
b.	
c.	

3. If the variables f, g, h, i, and j have values 5, 4, 3, 2, and 1, respectively, what is the end value of f? (3 points)

a.	
b.	
c.	

2 Translating C (with Arrays) to MIPS

The following problems deal with translating from C to MIPS. Assume that the variables f, g, h, i, and j are assigned to registers \$$s0, \$s1, \$s2, \$s3$, and \$$s4$, respectively. Assume that the base address of the arrays A and B are in registers \$$s6$ and \$$s7$, respectively.

a.	f = g + h + A[4];
b.	f = A[B[4]+1] - g;
c.	f = -g + h + A[1];

1. For each C statement above, what is the corresponding MIPS assembly code? (10 points)

a.	
b.	
c.	

2. For each C statement above, how many MIPS assembly instructions are needed to perform the C statement? (3 points)

a.	
b.	
c.	

3. For each C statement above, how many different registers are needed to carry out the C statement? (3 points)

a.	
b.	
c.	

3 Binary to Decimal Conversions

The following problems explore conversions from signed and unsigned binary numbers to decimal numbers.

a.	$1010\ 1101\ 0010\ 0000\ 0000\ 0000\ 0000\ 0010_{\text{two}}$
b.	$1111\ 1111\ 1111\ 1111\ 1101\ 0011\ 0101\ 0011_{\text{two}}$
c.	$1110\ 1111\ 1111\ 1111\ 1111\ 1111\ 1111\ 1111_{\text{two}}$

1. For each bit pattern above, what base 10 number does it represent, assuming that it is a two's complement integer? (6 points)

a.	
b.	
c.	

2. For each bit pattern above, what base 10 number does it represent assuming that it is an unsigned integer? (6 points)

a.	
b.	
c.	

3. For each bit pattern above, what hexadecimal number does it represent? (3 points)

a.	
b.	
c.	

4 Decimal to Binary Conversions

The following problems explore conversions from decimal numbers to signed and unsigned binary numbers.

a.	2147483646_{ten}
b.	32000_{ten}
c.	65534_{ten}

1. For each base ten number above, convert to two's complement binary. (6 points)

a.	
b.	
c.	

2. For each base ten number above, convert to two's complement hexadecimal. (3 points)

a.	
b.	
c.	

3. For each base ten number above, convert the *negated* values from the table to two's complement hexadecimal. (6 points)

a.	
b.	
c.	

5 Sign Extension and Overflow

The following problems deal with sign extension and overflow. Registers $\$s0$ and $\$s1$ hold the values as shown in the table below. you will be asked to perform a MIPS operation on these registers and show the result.

a.	$\$s0 = 30000000_{\text{sixteen}}$, $\$s1 = 17\text{FFFFFF}_{\text{sixteen}}$
b.	$\$s0 = 20000000_{\text{sixteen}}$, $\$s1 = 60000000_{\text{sixteen}}$

1. For each of the contents of registers $\$s0$ and $\$s1$ as specified above, what is the value of $\$t0$ for the following assembly code? (4 points)

   ```
   add $t0, $s0, $s1
   ```

	$\$t0$ **result**	**overflow?**
a.		
b.		

   Is the result in $\$t0$ the desired result, or has there been overflow?

2. For each of the contents of registers $\$s0$ and $\$s1$ as specified above, what is the value of $\$t0$ for the following assembly code? (4 points)

   ```
   sub $t0, $s0, $s1
   ```

	$\$t0$ **result**	**overflow?**
a.		
b.		

   Is the result in $\$t0$ the desired result, or has there been overflow?

3. For each of the contents of registers $\$s0$ and $\$s1$ as specified above, what is the value of $\$t0$ for the following assembly code? (4 points)

   ```
   add $t0, $s0, $s1
   add $t0, $t0, $s0
   ```

	$\$t0$ **result**	**overflow?**
a.		
b.		

   Is the result in $\$t0$ the desired result, or has there been overflow?

6 Binary Instructions and Formats

In the following problems, the data table contains bits that represent the opcode of an instruction. You will be asked to translate the entries into assembly code and determine what format of MIPS instruction the bits represent.

a.	$1010\ 1110\ 0000\ 1011\ 0000\ 0000\ 0000\ 0100_{\text{two}}$
b.	$1000\ 1101\ 0000\ 1000\ 0000\ 0000\ 0100\ 0000_{\text{two}}$

1. For each of the binary entries above, what instruction does it represent? (4 points)

	instruction
a.	
b.	

2. What type (I-type, R-type) instruction does each binary entry above represent? (2 points)

	type
a.	
b.	

3. If the binary entries above were data bits, what number would they represent in hexadecimal? (2 points)

	hexadecimal
a.	
b.	

7 Logical Operations

In the following problems, the data table contains the values for registers $\$t0$ and $\$t1$. You will be asked to perform several MIPS logical operations on these registers.

a.	$\$t0 = 55555555_{\text{sixteen}}$, $\$t1 = 23456789_{\text{sixteen}}$
b.	$\$t0 = \text{FEEDBEAD}_{\text{sixteen}}$, $\$t1 = \text{FADEDEAD}_{\text{sixteen}}$

1. For each of the contents of registers $\$t0$ and $\$t1$ as specified above, what is the value of $\$t2$ after the following sequence of instructions? (4 points)

```
sll $t2, $t0, 4
or $t2, $t2, $t1
```

	$\$t2$ **contents**
a.	
b.	

2. For each of the contents of registers $\$t0$ and $\$t1$ as specified above, what is the value of $\$t2$ after the following sequence of instructions? (4 points)

```
sll $t2, $t0, 4
andi $t2, $t2, -1
```

	$t2 **contents**
a.	
b.	

3. For each of the contents of registers $t0 and $t1 as specified above, what is the value of $t2 after the following sequence of instructions? (4 points)

```
srl $t2, $t0, 3
andi $t2, $t2, 0xFFEF
```

	$t2 **contents**
a.	
b.	

8 Extract Bits

See Exercise 2.14 on page 192 of our textbook. Find the shortest sequence of MIPS instructions that extracts a field from $t0 for the constant values $i = 21$ and $j = 5$ and places the field into $t1 in the format shown in the data table. (9 points)

a.	
b.	