### (5 pts) Exercise 3-1

- Assume we have 4 bits. Convert the given decimal numbers to the stated binary representations.

<table>
<thead>
<tr>
<th></th>
<th>5</th>
<th>-7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsigned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sign Magnitude</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One’s Comp.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two’s Comp.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### (5 pts) Exercise 3-2

- Convert the given decimal numbers to the stated binary representations.

<table>
<thead>
<tr>
<th></th>
<th>-3 (using 4 bits)</th>
<th>-3 (using 6 bits)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sign Magnitude</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One’s Comp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two’s Comp.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(5 pts) Exercise 3-3

- Assume the following is in binary two’s complement form. What do they represent in decimal?
  
  001011

  111011

- Now negate these numbers and show the new binary form:
  
  -(001011) =

  -(111011) =

(10 pts) Exercise 3-6

- Suppose we use 8 bits to represent a two’s complement binary number. What is the largest number that can be represented (give answer in binary AND decimal)

- What is the smallest number that can be represented (give binary AND decimal)
(5 pts) Exercise 3-11

- Do the following assuming 6 bit, two’s complement numbers. Circle YES if overflow occurs or NO if not.

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>010101</td>
<td>YES</td>
<td>111111</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ 001101</td>
<td>NO</td>
<td>+ 111101</td>
<td>NO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>010011</td>
<td>YES</td>
<td>010011</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ 001110</td>
<td>NO</td>
<td>+ 111110</td>
<td>NO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(5 pts) Exercise 3-12

- Do the following assuming 6 bit, two’s complement numbers. When does overflow occur? (note subtraction here)

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>011101</td>
<td>YES</td>
<td>111111</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 100101</td>
<td>NO</td>
<td>- 111101</td>
<td>NO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>010011</td>
<td>YES</td>
<td>010011</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 001110</td>
<td>NO</td>
<td>- 111110</td>
<td>NO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(10 pts) Exercise 3-16

(You COULD use a calculator for these. But recommended not – you should be able to do this by hand on an exam, where calculators are not permitted).

Convert $269_{10}$ into a 32-bit two's complement binary number.

- Convert $-45_{10}$ into a 32-bit two’s complement binary number.
(10 pts) Exercise 3-17

(You COULD use a calculator for these. But recommended not – you should be able to do this by hand on an exam, where calculators are not permitted).

What decimal number does this two’s complement binary number represent?

1111 1111 1111 1111 1111 1111 1000 0110_{two}

What decimal number does this two’s complement binary number represent?

0000 0000 0000 0000 0000 0101 0110_{two}
(5 pts) Exercise 3-21

- Convert the following C code to MIPS:
  ```c
  float pick (float G[], int index) {
    return G[index];
  }
  ```

(5 pts) Exercise 3-22

- Convert the following C code to MIPS:
  ```c
  float max (float A, float B) {
    if (A > B) return A / B;
    else return B / A;
  }
  ```
(5 pts) Exercise 3-23

- Convert the following C code to MIPS:
  ```c
  float sum (float A[], int N) {
    int j;
    float sum = 0.0;
    for (j=0; j<N; j++)
      sum = sum + A[j]
    return sum;
  }
  ```
(10 pts) Exercise 3-25

- Convert the following C code into MIPS.

```c
float function2 (float x, float y) {
    if (x > y)
        return x + y;
    else
        return x - y;
}
```
(20 pts) Exercise 3-26

- Convert the following C code into MIPS. A C float is stored as a MIPS single precision floating point value.

```c
float dotproduct(float A[], float B[]) {
  float sum = 0;
  int ii;
  for (ii = 0; ii < 10; ii++) {
    sum = sum + A[ii] * B[ii];
  }
  return sum;
}
```
(10 pts) Exercise 3-27

- Convert the following C code into MIPS. ASSUME that the result of multiplying g by h will always fit in just 32 bits.

  NOTE 1: using integers, not floats, here!
  NOTE 2: Use the integer “mult” instruction that we learned in class (that takes just 2 arguments) NOT a pseudo-instruction that takes 3 arguments

```c
int function6 (int g, int h) {
    int prod = g * h;
    if (prod < 0)
        prod *= -1;
    return prod;
}
```

(3 pts EXTRA CREDIT) Exercise 3-31

- Convert the following C code to MIPS:
  ```c
  float average (float A[], int N) {
      int j;
      float sum = 0.0;
      for (j=0; j<N; j++)
          sum = sum + A[j];
      return sum / N;
  }
  ```