This homework, on Sections 2.1 through 2.3, is due on Wednesday, October 7.
(There will also be a programming assignment, due after Fall break.)

1. Let $A = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$; $B = \{2, 4, 6, 8, 10, 12, 14, 16, 18\}$; $C = \{n \in \mathbb{Z} \mid -5 \le n \le 5\}$. Find the following sets. (For this exercise, you do **not** need to justify your answers.)

a) $A \cup B$ **b)** $A \cap B$ **c)** $A \smallsetminus B$ **d)** $B \smallsetminus A$

e) $A \cap C$ **f)** $\mathbb{N} \cup C$ **g)** $\mathbb{N} \smallsetminus C$ **h)** $\mathbb{Z} \smallsetminus A$

2. Let $A = \{a, b\}$ and $B = \{c, d, e\}$. Find the following sets. (For this exercise, you do **not** need to justify your answers.)

a) $A \times B$ **b)** $B \times C$ **c)** $\mathcal{P}(B)$

3. Let S be the set $S = \{\, \emptyset,\ s,\ \{s\}\,\}$. Find the power set, $\mathcal{P}(S)$. (You do not have to justify your answer.)

4. True or false: For any sets A and B, if $A \subseteq B$, then $\mathcal{P}(A) \subseteq \mathcal{P}(B)$. Justify your answer.

5. Just as there are distributive laws for propostional logic, there are distributive laws for sets. Verify the following distributive law, using one of the techniques that we used in class to veriry DeMorgan's laws for sets: For any sets A, B, and C,

$$A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$$

6. (Exercise 2.1.7 from the textbook.) In the English sentence, "She likes men who are tall, dark, and handsome," does she like an intersection or a union of sets of men? How about in the sentence, "She likes men who are tall, men who are dark, and men who are handsome"? Explain.

7. Find the exact condition on the sets A and B that make the given equation true. You don't need to give a formal proof for your answer, but you should explain why your answer works. (The point of this exercise is to make you think about the meanings of the operations on sets.)

a) $A \cup B = A$ **b)** $A \cap B = A$ **c)** $A \smallsetminus B = A$ **d)** $A \cup (A \cap B) = A$

8. Consider the two 32-bit integers n and m shown below. Compute the three 32-bit integers $\tilde{}n$, and $n\ \&\ m$, and $n \mid m$. What subset of $\{0, 1, 2, \ldots, 31\}$ does each of the integers n, m, $\tilde{}n$, $n\ \&\ m$, and $n \mid m$ correspond to? (Write out each set in full.)

$$n = 0011\ 0111\ 1000\ 0010\ 1001\ 1101\ 1111\ 0101$$
$$m = 0111\ 0001\ 0011\ 1100\ 0111\ 1001\ 1100\ 0111$$

9. Let A and B be 32-bit integers, and let M be the 32-bit integer that is given in hexadecimal as `0xFFFF0000`. Consider the assignment statement:

```
C = (A & M) | (B & ~M);
```

Carefully explain how the value of C is obtained from the values of A and B. Give several examples, with specific values for A and B. Express A, B, and C in hexadecimal.

10. What is computed by the following method? (Hint: Write N in binary.) Explain your answer.

```
int countSomething( int N ) {
    int ct = 0;
    for (int i = 0; i <= 31; i++) {
        if ( (N & 1) == 1 ) {
            ct++;
        }
        N = N >> 1;
    }
    return ct;
}
```