Sorting Practice

• Given the following list of integers

   | 9 | 5 | 6 | 1 | 10 | 15 | 2 | 4 |

• Sort the list using **bubble sort**. Show your work!
• Sort the list using **insertion sort**. Show your work!
• Sort the list using **merge sort**. Show your work!
• Describe the best- and worst-case time and space complexity for each of these sorting algorithms as well as for **selection sort**.

Induction Practice

• Prove that merge sort time complexity is $O(n \log(n))$
• Prove for $n = 2^k$ (it is true for other $n$, but harder to prove)
• That is, show that merge sort performs at most:
  \[ n \times \log(n) \leq 2^k \times k \] comparisons of elements

Recursion Practice

• Write a recursive method that duplicates the elements in a SLL in place.

   ```java
   public void doubleList(SLL<E> list) { ... }
   ```

• Example: Given an SLL of integers:
  ```
  list = [1, 2, 3, 4]
  ```
  calling `doubleList(list)` would modify `list` to be:
  ```
  [1, 1, 2, 2, 3, 3, 4, 4]
  ```
More Recursion Practice

• Write a recursive method that multiplies two numbers, a and b, using only addition:
  public int multiply(int a, int b);
• Write a recursive method that prints the digits of a number in reverse order.
  public void reverseDigits(int num);
• Write a recursive method that replaces all instances of value a with value b in a Vector:
  public static <E> void replace(Vector<E> v, E a, E b);

Complexity Practice

• What is the running time of the following method:
  public void reduce(int n) {
    int result = 0;
    while (n > 1) {
      n = n / 2;
      result = result + 1;
    }
    return result;
  }

Complexity Practice

• True or false:
  * $n^2-10n+100$ is $O(n^2)$
  * $n^2$ is $O(n^2-10n+100)$
  * $\log_2(x)$ is $O(x)$
  * $x$ is $O(\log_2(x))$
  * $\sin(x)$ is $O(1)$
  * Note: $f(x)$ is $O(1)$ if $f(x) \leq c$ for some constant $c>0$ and all large enough $x$