

### Activity 3

Computer scientists use an *asymptotic* approach to compare the efficiency of algorithms. This means that we look at which algorithm is more rapidly taking longer as the problem size increases. To get a feel for this approach we will try out two algorithms for sorting a deck of cards. I will give you index cards with numbers written on them and you will sort them with each of the algorithms for decks of size 4, 8, 16, and 32 cards and time your results.

The first algorithm is *Selection Sort*:

#### **Selection Sort**

You will use three positions for stacks of cards: source stack, destination stack, and the discard stack.

Initially you should put all the cards, face down, on the source stack, with the other two positions empty. Now do the following steps repeatedly:

1. Take the top card off the source stack and put it face-up on the destination stack.
2. If that makes the source stack empty, you are done. The destination stack is in numerical order.
3. Otherwise, do the following steps repeatedly until the source stack is empty:
  - a. Take the card off the source stack and compare it with the top of the destination stack.
  - b. If the source card has a larger number,
    - i. Take the card on the top of the destination stack and put it face down on the discard stack.
    - ii. Put the card you took from the source stack face up on the destination stack.
  - c. Otherwise, put the card from the source stack face down on the discard stack.
4. Slide the discard stack over into the source position, and start again with step 1.

The second algorithm is *Merge Sort*:

### **Merge Sort**

Lay out the cards face down in a long row. We will consider these to be the initial source "stacks" of cards, even though there is only one card per stack. The merge sort works by progressively merging pairs of stacks so that there are fewer stacks but each is larger; at the end, there will be a single large stack of cards.

Repeat the following steps until there is a single stack of cards:

1. Merge the first two face-down stacks of cards using Merge algorithm given below.
2. As long as there are at least two face-down stacks, repeat the merging with the next two stacks.
3. Flip each face-up stack over.

### **Merging**

You will have the two sorted stacks of cards to merge side by side, face down. You will be producing the result stack above the other two, face up.

Take the top card off of each source stack -- one in your left hand and one in your right hand. Now do the following repeatedly, until all the cards are on the destination stack:

1. Compare the two cards you are holding.
2. Place the one with the larger number on it onto the destination stack, face-up.
3. With the hand you just emptied, pick up the next card from the corresponding source stack and go back to step 1. If there is no next card in the empty hand's stack because that stack is empty, put the other card you are holding on the destination stack face-up and continue flipping the rest of the cards over onto the destination stack.

You can test out the two algorithms [here](#) to make sure you understand them.

Now take out the index cards and perform your trials.

Complete the table with all times measured in seconds. That means that a time of 1 minute 13 seconds would be recorded as 73 seconds.

Cards	Selection Sort	Merge Sort
4		
8		
16		
32		

Use Excel to graph your results. You may do this by selecting the last two columns of the table and going to the Insert tab and selecting a line chart. Your chart should give you a nice view of how the time increases and the problem size gets larger.