C Introduction

C is syntactically very similar to Java, but there are a few key differences of which to be wary:

- C is function oriented, not object oriented. There are no objects.

- C does not automatically handle memory for you.
  - In the case of stack memory (things allocated in the “usual” way), a datum is garbage immediately after the function in which it was defined returns.
  - In the case of heap memory (things allocated with malloc and friends), data is freed only when the programmer explicitly frees it (by calling free).
  - In any case, allocated memory always holds garbage until it is initialized. **DO NOT** assume memory is zero’d unless calloc is used.
  - To specify the number of bytes required for a specific data type, use sizeof, e.g. to allocate space for 4 ints, do malloc(sizeof(int)*4)

- C uses pointers explicitly. *p tells us to use the value that p points to, rather than the value of p, and &x gives the address of x rather than the value of x. See the following example (the following addresses were chosen arbitrarily). On the left we see a diagram of pointers and memory that may help you visualize pointers. On the right, we see how those “boxes and arrows” are really represented.

```
Let's assume that int* p is located at 0xF9320904 and int x is located at 0xF93209B0. As we can observe:

- *p should return 0x2A (42).
- p should return 0xF93209AC.
- x should return 0x61C.
- &x should return 0xF93209B0.

Let's say we have an int **pp that is located at 0xF9320900. What would pp return? How about *pp? What about **pp?
```

- Pointer arithmetic: by now you should realize that pointers are nothing but just variables that hold addresses instead of data, which means we could add/subtract to pointers just as we do on normal int-valued variable. **Caveat:** syntactically, we use p+1 or p++ to move pointers, but you should understand the number of bytes added to the pointer depends on the type of the pointer. For example, if you have int* p, p++ will automatically add 4 bytes to p whereas if you have char* p, p++ will only add 1 byte. This is handled by the C compiler under the hood.

There are many other differences in C of which you should be aware of, but this should be enough for you to get your feet wet.
2  Uncommented Code? Yuck!

The following functions work correctly (note: this does not mean intelligently), but have no comments. Document the code to prevent it from causing further confusion.

1. /*
   *
   */
   int foo(int *arr, size_t n) {
       return n ? arr[0] + foo(arr + 1, n - 1) : 0;
   }
2. /*
   *
   */
   int bar(int *arr, size_t n) {
       int sum = 0, i;
       for (i = n; i > 0; i--) {
           sum += !arr[i - 1];
       }
       return sum;
   }
3. /*
   *
   */
   void baz(int x, int y) {
       x = x ^ y;
       y = x ^ y;
       x = x ^ y;
   }

3  Programming with Pointers

Implement the following functions so that they perform as described in the comments.

1. /* Swaps the value of two ints outside of this function. */
   void swap() {
   }

2. /* Returns the number of characters in a string. Does not use strlen. */
   int mystrlen() {
   }
4 Problem?

The following code segments may contain logic and syntax errors. Find and correct them.

1. /* Returns the sum of all the elements in SUMMANDS. */
   int sum(int* summands) {
   int sum = 0;
   for (int i = 0; i < sizeof(summands); i++) // ask yourself what would sizeof(summands) return
       sum += *(summands + i);
   return sum;
   }

2. /* Increments all the letters in the string STRING, held in an array of length N.
   * Does not modify any other memory which has been previously allocated. */
   void increment(char* string, int n) {
   for (int i = 0; i < n; i++)
       *(string + i)++;
   // p++ is syntactic sugar for p = p + 1
   }

3. /* Overwrites an inputted string with ‘’61C is awesome!’’ if there’s room.
   * Does nothing if there is not. Assume that srcLength correctly represents
   * the length of src. */
   void CS61C(char* src, size_t srcLength) {
   char *srcptr, replaceptr;
   char replacement[16] = ‘’61C is awesome!’’;
   replaceptr = replacement;
   if (srcLength >= 16) {
       for (int i = 0; i < 16; i++)
           *src++ = *replaceptr++;
   }
   }