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, so 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.
  - In any case, allocated memory always holds garbage until it is initialized.
• 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_{10}).
  - 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?

There are other differences in C of which you should be aware of, but this should be enough for you to get your feet wet.

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. /* Returns the sum of the first N elements in ARR. */
int foo(int *arr, size_t n) {
    return n ? arr[0] + foo(arr + 1, n - 1) : 0;
    /* Reminder syntax for ternary is: cond? true_result: false_result. */
}

2. /* Returns -1 times the number of zeroes in the first N elements of ARR. */
int bar(int *arr, size_t n) {
    int sum = 0, i;

    for (i = n; i > 0; i--) {
        sum += !arr[i - 1];
        /* Assume ! of a true value is 0 and ! of a false value is 1. */
    }
    return ~sum + 1;
}

3. /* Does nothing. */
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(int *x, int *y) {
        int temp = *x;
        *x = *y;
        *y = temp;
    }

2. /* Increments the value of an int outside of this function by one. */

    void plus_plus(int *x) {
        (*x)++; // or: x[0]++;
    }

3. /* Returns the number of bytes in a string. Does not use strlen. */
int mystrlen(char* str) {
    int count = 0;
    while(*str++) {
        count++;
    }
    return count;
}

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. */
    /* When iterating through a pointer in C it is
     * necessary to pass a size alongside the pointer. */
    int sum(int* summands) {
        int sum = 0;
        for (int i = 0; i < sizeof(summands); i++) // for (int i = 0; i < n; i++)
            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. */
   /* The ends of strings are denoted by the null terminator.
   * Simply having space for n characters in the array does not
   * mean the array is of length n. */
   void increment(char* string, int n) {
        for (int i = 0; i < n; i++) // for (i = 0; string[i] != 0; i++)
            *(string + i)++;
    }

    /* Consider the corner case of incrementing 0xFF.
     * Adding 1 to 0xFF will overflow back to 0, producing
     * a null terminator and shortening the string. */

3. /* Copies the string SRC to DST. */
   void copy(char* src, char* dst) {
        while (*dst++ = *src++);
    }

    // This code has no errors.

4. /* 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 *srcptr, *replaceptr;
char replacement[16] = ‘61C is awesome!’;
srcptr = src;
replaceptr = replacement;
if (srcLength >= 16) {
    for (int i = 0; i < 16; i++)
        *srcptr++ = *replaceptr++;
}

// “char *srcptr, replaceptr” initializes a char pointer and a char.
// Not two char pointers.
// “char *srcptr, replaceptr” is not the same as “char *srcptr, *replaceptr”.