1 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.

<table>
<thead>
<tr>
<th>0xFFFFFFFF</th>
<th>...</th>
<th>0xFFFFFFFF</th>
<th>...</th>
</tr>
</thead>
<tbody>
<tr>
<td>0xF93209B0</td>
<td>x=0x61C</td>
<td>0xF93209B0</td>
<td>0x61C</td>
</tr>
<tr>
<td>0xF93209AC</td>
<td>0x2A</td>
<td>0xF93209AC</td>
<td>0x2A</td>
</tr>
<tr>
<td>0xF9320904</td>
<td>p</td>
<td>0xF9320904</td>
<td>0xF93209AC</td>
</tr>
<tr>
<td>0xF9320900</td>
<td>pp</td>
<td>0xF9320900</td>
<td>0xF9320904</td>
</tr>
<tr>
<td>0x00000000</td>
<td>...</td>
<td>0x00000000</td>
<td>...</td>
</tr>
</tbody>
</table>

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.
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 + 1;
   }

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. /* Increments the value of an int outside of this function by one. */
   void plus_plus( ) {
   }
3. /* Returns the number of bytes 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++)
         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)++;
   }

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

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