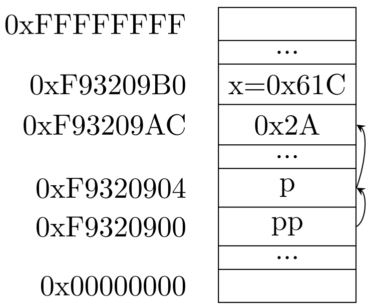
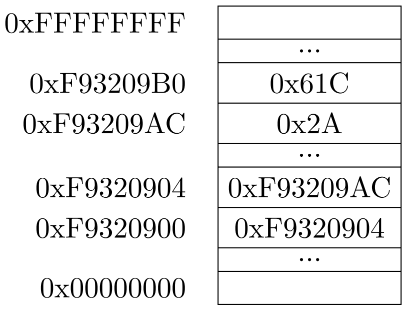
CS61C Fall 2016 Discussion 1 – C

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 aribitrarily). 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.

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. */`

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

3. `/* Returns the number of bytes in a string. Does not use strlen. */`

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[15] = ‘‘61C is awesome!’’;
       srcptr = src;
       replaceptr = replacement;
       if (srcLength >= 15) {
           for (int i = 0; i < 15; i++)
               *srcptr++ = *replaceptr++;
       }
   }
   ```