CS 161, Lecture 14: Different Ways to Pass Parameters
How We Have Been Passing -> By Value

• Also referred to as Call by Value
• Copies the value into the formal parameter

```cpp
void swap (int a, int b) {
    int temp = a;
    a = b;
    b = temp;
}
```

```cpp
int main () {
    int a = 1, b = 2;
    swap(a, b);
    cout << "a: " << a << "b: " << b << endl;
}
```
Alternate: Pass By Reference

• Takes both the value and the address of the passed in variable
• Does not exist in C
• References can’t be null

```c
void swap (int & a, int & b) {
    int temp = a;
    a = b;
    b = temp;
}

int main () {
    int a = 1, b = 2;
    swap(a, b);
    cout << “a: “ << a << “b: “ << b << endl;
}
```
Alternate: Pass By Pointer

• Pointer is a memory address
• Can be changed to hold different memory addresses
• Pointers need to be dereferenced to get to the value stored at that address

```c
void swap (int* a, int* b) {
    int temp = *a;
    *a = *b;
    *b = temp;
}

int main () {
    int a = 1, b = 2;
    swap(&a, &b);
    cout << "a: " << a << "b: " << b << endl;
}
```
Pointer Cheat Sheet

• *
  • If used in declaration (which includes function parameters), it creates the pointer
    • Ex: int *p; // p will hold an address to where an int is stored
  • If used outside a declaration, it dereferences the pointer
    • Ex: *p = 3; //goes to the address stored in p and stores a value
    • Ex: cout << *p; //goes to the address stored in p and fetches the value

• &
  • If used in a declaration (which includes function parameters), it creates and initializes
    the reference
    • Ex: void fun(int &p); //p will refer to an argument that is an int by implicitly using *p
      (dereference) for p
    • Ex: int &p = a; //p will refer to an int, a, by implicitly, using *p for p
  • If used outside a declaration, it means “address of”
    • Ex: p=&a; //fetches the address of a (only used as rvalue) and store the address in p
```cpp
#include <iostream>

using namespace std;

void swap(int a, int b) {
    cout << "Values at START of swap(): a = " << a << " b = " << b << endl;
    int temp = a;
    a = b;
    b = temp;
    cout << "Values at END of swap(): a = " << a << " b = " << b << endl;
}

int main() {
    int a = 1, b = 2;
    cout << "Before swap: a = " << a << " b = " << b << endl;
    swap(a,b);
    cout << "After swap: a = " << a << " b = " << b << endl;
    return 0;
}
```
```cpp
#include <iostream>

using namespace std;

void swap(int& a, int& b) {
    cout << "Values at START of swap(): a = " << a << " b = " << b << endl;
    int temp = a;
    a = b;
    b = temp;
    cout << "Values at END of swap(): a = " << a << " b = " << b << endl;
}

int main() {
    int a = 1, b = 2;
    cout << "Before swap: a = " << a << " b = " << b << endl;
    swap(a,b);
    cout << "After swap: a = " << a << " b = " << b << endl;
    return 0;
}
```
#include <iostream>

using namespace std;

void swap(int* a, int* b) {
    cout << "Values at START of swap(): a = " << a << " b = " << b << endl;
    int temp = *a;
    *a = *b;
    *b = temp;
    cout << "Values at END of swap(): a = " << a << " b = " << b << endl;
}

int main() {
    int a = 1, b = 2;
    cout << "Before swap: a = " << a << " b = " << b << endl;
    swap(&a,&b);
    cout << "After swap: a = " << a << " b = " << b << endl;
    return 0;
}
flip3 ~/teaching/cs161/lectures/week_6 160% a.out
Before swap: a = 1 b = 2
Values at START of swap(): a = 0x7ffcd15ff40c b = 0x7ffcd15ff408
Values at END of swap(): a = 0x7ffcd15ff40c b = 0x7ffcd15ff408
After swap: a = 2 b = 1
flip3 ~/teaching/cs161/lectures/week_6 161% vim pass_by.cpp
flip3 ~/teaching/cs161/lectures/week_6 162%