CS 161
Intro to CS I
Functions (Pass by Reference)
Chap. 4
Timing – Assign #4

```cpp
#include <iostream>
#include <sys/time.h>
#include <cstdlib>

int main() {
    int x = 5, i, j;
    struct timeval stop, start;

    gettimeofday(&start, NULL);

    for (i = 0; i < 100000; i++)
        for (j = 0; j < 10000; j++)
            x*x=x;

    gettimeofday(&stop, NULL);

    if (stop.tv_sec > start.tv_sec)
        std::cout << "Seconds: " << stop.tv_sec - start.tv_sec << std::endl;
    else
        std::cout << "Microseconds: " << stop.tv_usec - start.tv_usec << std::endl;

    return 0;
}
```

"timing.cpp" 24L, 459C
How do we change values?
Pass by Value vs. Pass by Reference

• Value Semantics
  – Values stored directly
  – Copy of value is passed
  ```
  int i, j=2;
  i=j;
  ```

• Reference Semantics
  – References to the value are stored
  – Copy of address is passed
  ```
  int *i, j=2;
  i=&j;
  ```
C/C++ Pass by Value

```c
void swap(int, int);

int main() {
    int a=5, b=10;
    swap(a, b);
    printf("a: %d, b: %d\n", a, b);
}

void swap(int x, int y) {
    int temp = x;
    x = y;
    y = temp;
}
```

• What if we didn’t have temp?
C++ Pass by Reference

```c++
void swap(int &, int &);

int main() {
    int a=5, b=10;
    swap(a, b);
    printf("a: %d,  b: %d\n", a, b);
}

void swap(int &x, int &y) {
    int temp = x;
    x = y;
    y = temp;
}
```

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What does this do?

void func(int x, int & y)
{
    int t = x;
    x = y;
    y = t;
}

int main()
{
    int u = 3; v = 4;
    // ...
    cout << u << " " << v << endl;
    func ( u, v );
    cout << u << " " << v << endl;
    // ...
}
What does this do?

```cpp
void doStuff(int parValue, int& parRef) {
    parValue = 100;
    cout << "parValue in call to doStuff = " << parValue << endl;
    parRef = 222;
    cout << "parRef in call to doStuff = " << parRef << endl;
}

int main() {
    int n1 = 1, n2 = 2;
    doStuff(n1, n2);
    return 0;
}
```
Why does this fail?

```c
void swap(int & lhs, int& rhs)
{
    lhs = rhs;
    rhs = lhs;
}
```
What is j and k after One(j, k)?

void One( int first, int & second )
{
    first = 17;
    second = first + 1;
}

int main()
{
    // other code ...
    int j = 4;
    int k = 3;
    One(j, k);
    // other code ..
}
Quiz #5

```cpp
#include <iostream>

using std::cout;
using std::endl;

int main() {
    int *x;       // x variable holds pointer to int value
    int y=10;     // y variable holds int value, and gets 10

    x=&y;          // assign contents of x the address of y
    cout << "\nY Addr: " << &y << " Value: " << y << endl;
    cout << "\nX Addr: " << &x << " Value: " << x << endl;
    cout << "\n*X Value: " << *x << " Address of *x" << &x << endl;

    *x=20;        // assign pointer value

    // What if we assign address to pointer?
    // */x=&y;

    // What if we assign the contents to the variable?
    // x=y;

    return 0;
}
What if we don’t have the y?

• We need to create the address space.
• How do we do this?
  – `new` type;
• For example:
  ```
  int *x;
  x = new int;  //new returns an address
  *x = 10;
  ```
• [http://cslibrary.stanford.edu/104/](http://cslibrary.stanford.edu/104/)