CS 162
Intro to Computer Science II

Lecture 2

Review (cont.)

1D & 2D static array

1/12/24

Oregon State University

Odds and Ends

- Due Monday midnight:
  - Design exercise + Design doc
  - Quiz 1 (unlocked after today's lecture)

- Lab 1: instead of 3 additional pts, you are allowed to make up for **full points** before your lab time next week
  - Get checked off by TAs during office hours

Lecture Topics:

- Finish Review
- 1D & 2D static array

C++ If/else and switch statements

```
if (a == 0) {
  /* Do something. */
}
else if (b != 0) {
  /* Do something different. */
}
else {
  /* Do a third thing altogether.
*/
}
```

```
switch(grade) {
        case 'A' :
                cout << "Excellent!" << endl;
                break;
        case 'B' :
        case 'C' :
                 cout << "Well done!" << endl;
                break;
        case 'D' :
                 cout << "You passed!" << endl;
                break;
        case 'F' :
                 cout << "Try again!" << endl;
                break;
        default :
                 cout << "Invalid grade!" << endl;
}
```

C++ Loops

- C++:
  - for, while, do-while

```
int i;
for (i = 0; i < 32; i++) {
  /* Do something 32 times. */
}
```

```
while (i != 16) {
  /* Do something repeatedly until i is 16. */
}
```

```
do{
  /* Do something repeatedly until i is 16. */
}while (i != 16);
```

C++ Functions

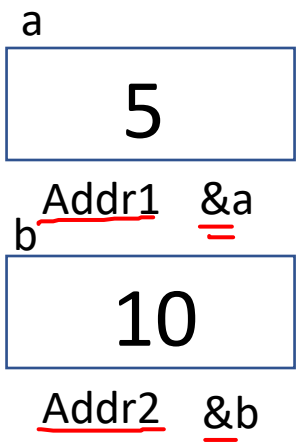
```cpp
#include <iostream>

using namespace std;

float cal_avg(float num1, float num2);

int main()
{

    float total = 0;
    float count = 0;

    cout << "Enter total: ";
    cin >> total;
    cout << "Enter count: ";
    cin >> count;

    float average = cal_avg(total, count);
    cout << "Avg.: " << average << endl;

    return 0;
}

float cal_avg(float num1, float num2){
    return num1/num2;
}
```

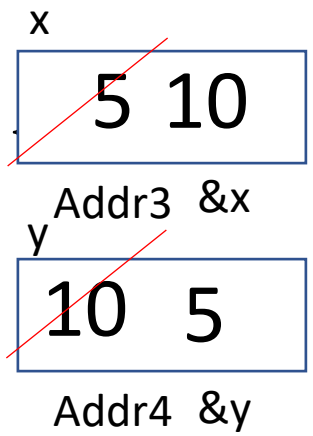
- Label:
  1. Function declaration/prototype
  2. Function call
  3. Function definition
  4. Function name
  5. Parameter(s)
  6. Argument(s)

C++ Pass by Value

var:
1. type
2. name
3. content
4. addr

```
void swap(int, int);
int main() {
    int a=5, b=10;
    swap(a, b);
 →cout << "a: " << a << "b: " << b;
}
void swap(int x, int y) {
    int temp = x;
    x = y;
    y = temp;
}
```





C++ References

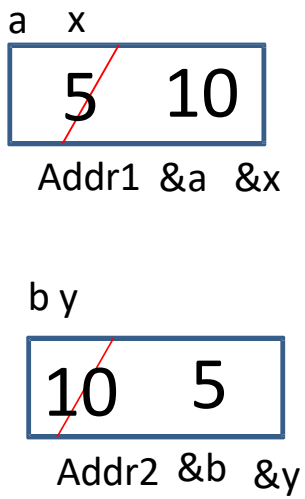
- Reference == a variable that refers to a particular memory address
- Reference declaration: `int i = 4; int &i_ref = i;`
  - A reference MUST be initialized
  - Once initialized, the memory address referred to by a reference variable can't change
    - i.e. `i_ref` above must always refer to the address of `i`.
    - Quick check: what will the following code print?

```
int a = 7, b = 2, &ref = a;
cout << a << " " << ref << endl; // prints
ref = b;
cout << a << " " << ref << endl; // prints
```

-> Trying to make a new assignment to a reference changes its value

C++ Pass by Reference

```
void swap(int &, int &);
int main() {
   int a=5, b=10;
   swap(a, b);
   cout << "a: " << a << "b: " << b;
}
void swap(int &x, int &y) {
   int temp = x;
   x = y;
   y = temp;
}
```

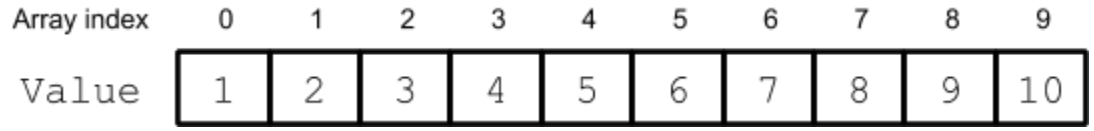


1D static Arrays

- An array is a contiguous block of memory holding values of the same data type
- Static Arrays: created on the stack and are of a fixed size, during compiling time
  - 1-dimensional static array: `int stack_array[10];`
    - You can initialize an array at the same time as you declare it:

      `int array[] = {1,2,3,4,5,6,7,8,9,10};`

      Note: you can omit the size if you initialize the array when you declare it
    - Array name: stores the starting address of the array
    - i.e., array == &array == &array[0]
    - Conceptually, the array above looks like this:



Passing a 1-D Array to functions

```
int main() {
   int array[5];
   …
   pass_1darray(array);
   …
}
void pass_1darray(int *a) {
   cout << “Array at zero: ” << a[0] << endl;
}
```

OR

```
void pass_1darray(int a[]) {
   cout << “Array at zero: ” << a[0] << endl;
}
```

Additional Resources:

- random number generation:
  - Slides 7-8: https://classes.engr.oregonstate.edu/engr/winter2023/engr103-010/slides/Lecture3.pdf
  - Code demo: https://classes.engr.oregonstate.edu/engr/winter2023/engr103-010/demo/week3/rand.cpp
  - rand(): https://cplusplus.com/reference/cstdlib/rand/?kw=rand

- Error handling:
  - Slides 3-9: https://classes.engr.oregonstate.edu/engr/winter2023/engr103-010/slides/Lecture11.pdf
  - Code demo: https://classes.engr.oregonstate.edu/engr/winter2023/engr103-010/demo/week8/error.cpp (note, you may use atoi() or stoi() instead)
  - stoi: https://cplusplus.com/reference/string/stoi/

Additional Resources:

- 1D array
  - Slides 6-12: https://classes.engr.oregonstate.edu/engr/winter2023/engr103-010/slides/Lecture13.pdf
  - Code demo: https://classes.engr.oregonstate.edu/engr/winter2023/engr103-010/demo/week9/array.cpp

Multidimensional Arrays

- data_type array_name[rows][cols];
  - int array[2][3];
  - int array[4][2][3];
  - int array[2][4][2][3];
- What are examples of these?
  - 2-D – Matrices, Spreadsheet, Minesweeper, Battleship, etc.
  - 3-D – Multiple Spreadsheets, (x, y, z) system
  - 4-D – (x, y, z, time) system

Initializing 2-D Arrays

- **Declaration:** int array[2][3] ={{0,0,0},{0,0,0}};
- **Individual elements:**

```
array[0][0]=0;
array[0][1]=0;
array[0][2]=0;
array[1][0]=0;
array[1][1]=0;
array[1][2]=0;
```

- **Loop:**

```
for(i = 0; i < 2; i++)
  for(j = 0; j < 3; j++)
    array[i][j]=0;
```

- Why do we need multiple brackets?

Reading/Printing 2-D Arrays

- Reading Array Values

```
for(i = 0; i < 2; i++) {
  for(j = 0; j < 3; j++) {
    cout << “Enter a value for ” << i << “, ” << j << “: ”;
    cin >> array[i][j];
  }
}
```

- Printing Array Values

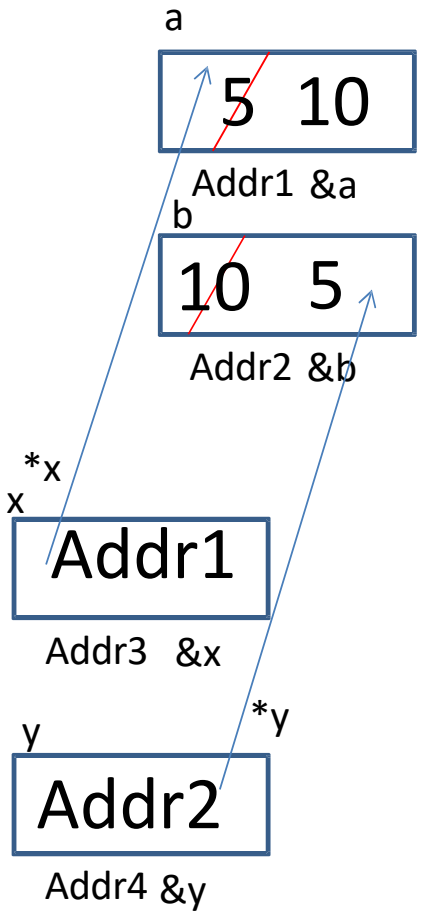
```
for(i = 0; i < 2; i++)
  for(j = 0; j < 3; j++)
    cout << “Array: ” << array[i][j] << endl;
```

C/C++ Pointers

- Pointers == variables that hold memory addresses
- Variable declaration: `int a = 5;`
  - Creates a variable on the stack of size int with the value 5
- Pointer declaration: `int *b = &a;`
  - Creates a pointer variable on the stack which can hold an address of an int and sets the value of the pointer (the address the pointer points to) to the address of `a`
- Dereferencing Pointer: `cout << *b << endl;`
  - Dereference: access the value stored in the memory address held by a pointer
  - Will print the value stored at the address which `b` points to
- Every pointer points data of a specific data type

C++ Pointers

```
void swap(int *, int *);
int main() {
    int a = 5, b = 10;
    swap(&a, &b);
    cout << "a: " << a << "b: " << b;
}
void swap(int *x, int *y) {
    int temp = *x;
    *x = *y;
    *y = temp;
}
```



Pointer and References Cheat Sheet

- &
  - 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. ptr=&a; //**fetches the address of** a (only used as rvalue!!!) and store the address in ptr. (ptr is a pointer variable)

Pointer and References Cheat Sheet

- *
  - If used **in a 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

- Check point: How to separate the following into two statements?

```
int *p = &a; //declare an int pointer and initialize it to &a
```