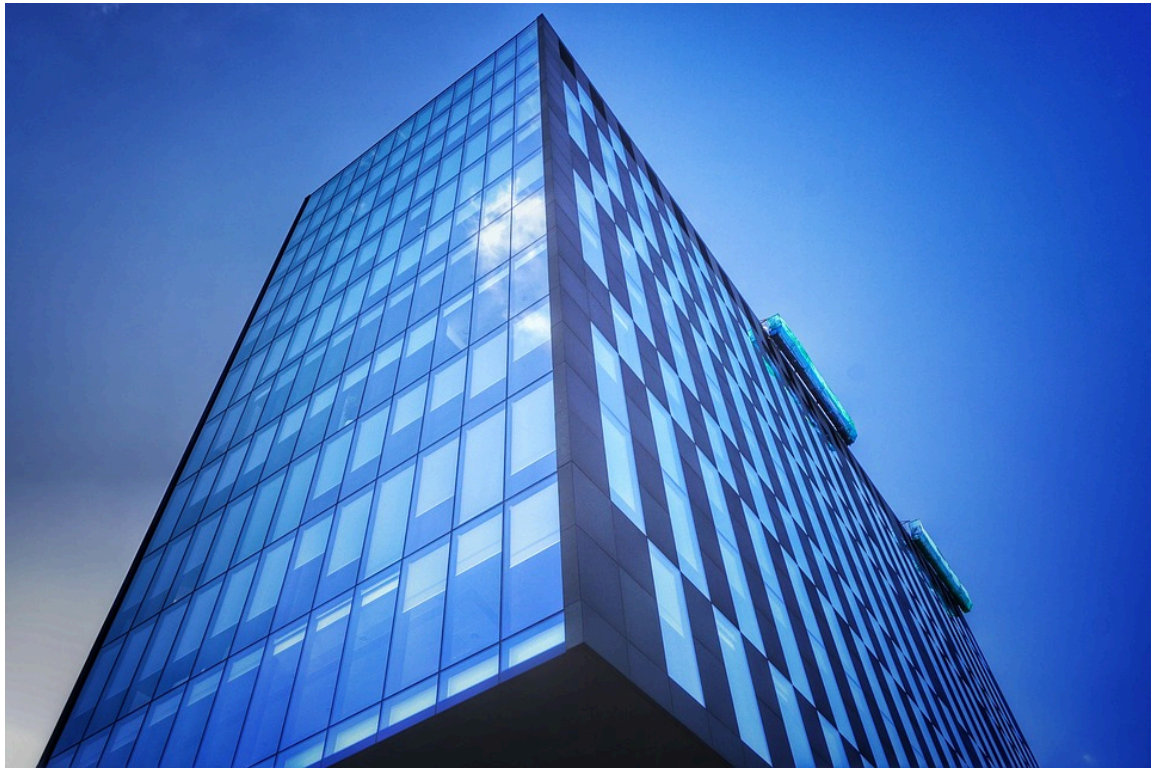
CS 161
Introduction to CS I
Lecture 17

- Creating static arrays
- How to pass arrays to functions
- Working with C-style strings



Warning

- Incidents involving plagiarism, of English and of code, have occurred in this class
  - Penalties for academic misconduct are severe
- Ensure that you submit your own work!
  - You can discuss the assignment with other students
  - You cannot:
    - Look at another student's code
    - Copy another student's code
    - Submit a modified version of another student's code
    - Show another student your code
    - Include code you found on the Internet in your program

Review

- What is the purpose of the heap?
  - Allow the amount of memory used to dynamically change during runtime
  - E.g. operating systems, web servers, anything with user interaction

Real-life examples of arrays

- Seats in the classroom
- Keys on a keyboard
- Rooms in a dormitory
- Houses in a subdivision

Arrays enable easy iteration

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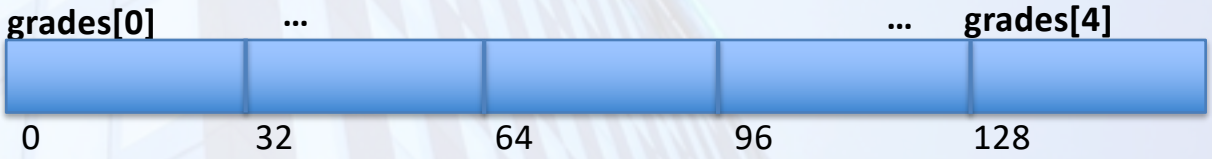
```
1. string page[1024]; /* book with 1024 pages */
2. cout << page[0] << endl;  /* print page 0  */
3. cout << page[10] << endl; /* print page 10 */

4. /* Loop over all pages */
5. for (int p = 0; p < 1024; p++)
6.   cout << page[p] << endl; /* print page p */
```

Indexing

Arrays in C++

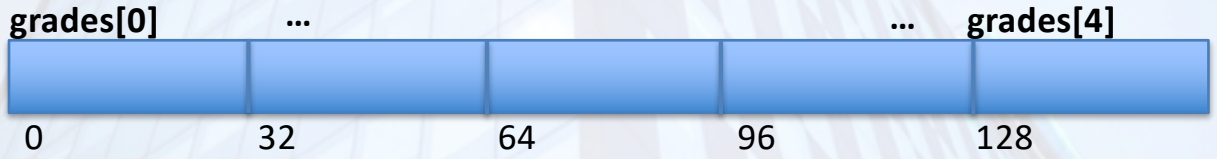
- Multiple items of the same data type
- Stored in contiguous memory locations
- Example:
  - `int grades[5];`



- Questions:
  - Stack or heap?
  - Access an item by its index: `grades[0], grades[1], …`
  - Array name = address of first element (`grades[0]`)
  - Initial values?

Static arrays in C++

- Declare but don't initialize




```
1. int grades[5];
2. for (int i=0; i<5; i++)
3.    cout << grades[i] << ", ";
4. cout << endl;
```

Static arrays in C++

- Declare and initialize


```
1. int grades[5] = {90, 80, 85, 95, 100};
2. for (int i=0; i<5; i++)
3.     cout << grades[i] << ", ";
4. cout << endl;
5. /* {}: initializer; cannot use to assign */
6. //grades = {82, 98, 87, 99, 93};
```

Static arrays in C++

- Initialization methods


```
1. int grades[5] = {0, 0, 0, 0, 0}; /* {}: initializer */
```

```
1. int grades[5] = {};     /* another way to set all 0s */
```

```
1. int grades[] = {4,3,1,7,2}; /* can omit size w/init */
```

Static arrays in C++

- Declare and initialize with loops
- Which version is better?

Both work, but version B is less clear to read, and more likely to have bugs.

A

```
1. int grades[5];
2. for (int i=0; i<5; i++)
3.    grades[i] = 0;
```

B

```
1. int grades[5];
2. int i = 0;
3. while (i < 5) {
4.    grades[i] = 0;
5.    i++;
6. }
```

Static arrays in C++

- Declare and initialize with loops
- Even better (why?):

C

```
1. const int n_people = 5;
2. int heights[n_people];
3. for (int i=0; i<n_people; i++)
4.    heights[i] = 0;
```

Your turn: User input to array

- Write a for loop to read values from the user and store them in this array:

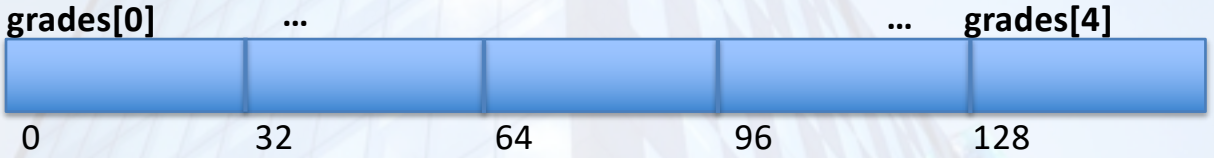
```
1. const int n_people = 5;
2. int heights[n_people];
3. for ...
```

Your turn: User input to array

- Write a for loop to read values from the user and store them in this array:

```
1. const int n_people = 5;
2. int heights[n_people];
3. for (int i=0; i<n_people; i++) {
4.     cout << "Enter height: ";
5.     cin >> heights[i];
6. }
```

Arrays use pointers



- Name of array holds the address of the first (zeroth) item

```
1. int grades[5] = {90, 80, 85, 95, 100};
2. cout << grades << endl;
3. cout << grades[0] << endl;
4. cout << &grades[0] << endl;
5. cout << *grades << endl;   /* same as grades[0] */
```

"Son of A Dark and Stormy Pointer": A Play

```
1. int* captain = NULL;
2. int soldier[3];
3. soldier[0] = 9;
4. soldier[1] = 7;
5. soldier[2] = 3;
6. soldier[0] = soldier[1] +
                soldier[2];
7. soldier[2]++;
```

```
8. captain = &soldier[1];
   /* address-of */
9. captain++;
10.*captain = 4;
11.soldier[1] = *captain;
   /* dereference */
12.soldier[2]++;
13.captain = soldier;
```

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C-style strings

- Existed before the C++ "string" class we have been using
- C-style string = **array of characters ending with '\0' (null)**
  - Must allocate space for #chars you want plus 1
- To access C-style string functions, `#include <cstring>`

```
1. char name[5] = {};          /* 4 characters plus '\0' */
2. cin.getline(name, 5);       /* 5 includes '\0' */
3. cout << name << ", length " << strlen(name) << endl;
```

Your new best friend

C-style strings

- Initialize with array initializer **and null terminator**

```
1. char name[5] = {'L', 'u', 'k', 'e', '\0'};
```

- Easier to read:

```
1. char name[5] = {"Luke"};  /* adds \0 for you */
```

Assignment 4: Text Surgeon

- Read in a line of text from the user, and perform analysis and manipulation of that string
  - `check_vowel_cons()`
  - `letter_swap()`
  - `flip_str()`
  - `count_chars()`
  - + your own operation: permute characters? inject random characters? doubledouble stringstring? **<creativity opportunity>**
- **You will use char arrays, not "string" objects**
- Design Document is due Feb. 16

More C-style string functions in <cstring>

http://www.cplusplus.com/reference/cstring/

- `strlen()` – length of string up to (not including) null terminator
- `strcpy()` – copy contents of one C-style string into another
  - safer: `strncpy()` – copy a specified number of characters
- `strcmp()` – compare one C-style string with another
  - return 0 if they are the same
- `strcat()` – concatenate one string to another
- `strstr()` – search for one string in another
  - return NULL if not found
- `cin.get()` – take one char from the buffer at a time
- `cin.getline()` – take an entire line of determined size

What vocabulary did we learn today?

- Array
- Index
- C-style string (char array with null terminator)

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What ideas and skills did we learn today?

- How to declare arrays on the stack
- Array initialization
- How to create C-style strings
  - Character arrays that must be null-terminated ('\0')
- Useful C-style string functions

Week 6 nearly done!

- **Minute paper: Please write down on scratch paper (leave in box):**
  1. One thing you learned today
  2. One concept you find confusing

❑ Attend lab (laptop required)

❑ Read **Rao Lesson 4** (pp. 63-71, 76-79)
Rao Lesson 7 (pp. 165-166)
C-style strings: https://www.cprogramming.com/tutorial/lesson9.html
and functions: http://www.cplusplus.com/reference/cstring

❑ **Assignment 4 Design** (due **Sunday, Feb. 16**)

See you Monday!