

# CS 161

## Introduction to CS I

### Lecture 6

- How can we represent words?
- Repeating the same behavior using loops
- How can we track down bugs in our programs?



# Warning!

- A very sad tale – has this happened to you?
  - `g++ -o assignment2.cpp assignment2`
- Workarounds
  - Use a very different executable name (like `my_program`)
    - `g++ -o my_program assignment2.cpp`
    - Then this mistake would not overwrite your C++ file:
    - `g++ -o my_program.cpp assignment2`
    - (As long as `assignment2` does not exist)
  - Inside vim, use `<ctrl>-Z` (in command mode) to “suspend” it
    - Then compile and run your program
    - If you accidentally overwrite your .cpp, go back into vim (with “`fg`”) and re-save it

## Also...

- Do not sign up for multiple demo slots (one per assignment)
- If you will miss a lab, attend another lab that week to complete the activities and receive credit
- If you submit a Revision Plan for Assignment 1, you must email the TA who graded your assignment to have your Revision Plan considered (else nothing happens)
- Questions about Assignment 2?



# Finally... letters and words!

- Letters/symbols: `char`
- Words: `string`
  - This is not a C++ primitive type, but instead a special class of objects
- Escape sequences
  - `\n`: newline
  - `\t`: tab
  - `\"`: double quote
  - More: <https://en.cppreference.com/w/cpp/language/escape>

```
string favorite_color = "red";  
  
/* Query the user */  
cout << "What is your favorite color? " << endl;  
cin >> favorite_color;  
  
cout << "You like " << favorite_color << endl;  
  
/* You can use \n instead of endl */  
cout << "You like " << favorite_color << "\n";  
cout << "Longer code" << endl;  
cout << "Shorter code\n";
```



# String operations: concatenation

```
string favorite_color = "red";  
  
/* Query the user */  
cout << "What is your favorite color? " << endl;  
cin >> favorite_color;  
cout << "You like " << favorite_color << endl;  
  
/* String concatenation, version 1 */  
string two_colors = favorite_color + " and pink";  
cout << "How about " << two_colors << "?" << endl;  
  
VS.  
/* String concatenation, version 2 */  
favorite_color += " and green";  
cout << "How about " << favorite_color << "?" << endl;
```



# Decision making with random chance

```
int dice_roll = 0;  
  
/* Roll the dice */  
dice_roll = rand()%6 + 1;  
cout << "You rolled " << dice_roll << endl;  
if (dice_roll < 3)  
{  
    cout << "You lose..." << endl;  
}  
else /* Rolled 3 or higher */  
{  
    cout << "You win!" << endl;  
}
```





# Seeding the random number generator

```
#include <iostream>
#include <cstdlib> /* include to allow rand() to be used */
#include <ctime>    /* include to allow time() to be used */

using namespace std;

int main()
{
    int dice_roll = 0;

    /* Seed the generator with the current time,
     * so it's different each time */
    srand(time(NULL));

    /* Roll the dice a few times */
    dice_roll = rand()%6 + 1;
    cout << "You rolled " << dice_roll << endl;
```

Only once





# Switch statement

- Improves readability when there are many choices (**menus**)

## If/then/else if/then/else

```
if ((user_feeling == 'y') ||
    (user_feeling == 'Y'))
{
    cout << "Today is a great day!" << endl;
}
else if ((user_feeling == 'n') ||
          (user_feeling == 'N'))
{
    cout << "Today is not going well." << endl;
}
else /* user_feeling is not 'y'/'Y' or 'n'/'N' */
{
    cout << "Invalid choice." << endl;
}
```

Can only  
check equality

Must be an expression

## Switch

```
switch (user_feeling)
{
    case 'y': /* fall through to case 'Y' */
    case 'Y':
        cout << "Today is a great day!" << endl;
        break;
    case 'n': /* fall through to case 'N' */
    case 'N':
        cout << "Today is not going well." << endl;
        break;
    default: /* user_feeling is not 'y'/'Y' or 'n'/'N' */
        cout << "Invalid choice." << endl;
}
```

# If-then “short-circuiting”

- What does this evaluate to?
  - `(3 > 4) && (27 > 3)`
  - Computer: `(3 > 4)` is **false** so the entire expression is **false**.  
Stop here!
- Likewise:
  - `(3 < 4) || (27 < 3)`
  - Computer: `(3 < 4)` is **true** so the entire expression is **true**.  
Stop here!

# Loops

- if-then and switch enable **selection** between outcomes
- We will now move on to **repetition**
- **For loop:** repeat statements a fixed number of times

# Common `for` loop patterns

```
for (<var> = low; <var> <= high; <var>++)
{
    <statement>;
    ...
}

for (<var> = high; <var> >= low; <var>--)
{
    <statement>;
    ...
}
```

# For loops save programming effort!

```
#include <stdio.h>
int main(void)
{
    int count;
    for(count = 1; count <= 500; count++)
        printf("I will not throw paper airplanes in class.");
    return 0;
}
```

AMEND 10-3





# Predict the output

- A    int x;  
    for (x = 0; x <= 100; x++)  
        cout << "I will not throw paper airplanes\n";
- B    for (x = 0; x < 100; x++)  
        cout << "I will not throw paper airplanes\n";
- C    for (x = -100; x <= -1; x++)  
        cout << "I will not throw paper airplanes\n";
- D    for (x = 100; x >= -100; x--)  
        cout << "I will not throw paper airplanes\n";



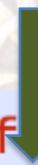
# Predict the output (more challenging)

- E**
- ```
int x;
for (x = 0; x > 100; x++)
    cout << "I will not throw paper airplanes\n";
```
- F**
- ```
for (x = 0; x <= 10; x += 5)
    cout << "I will not throw paper airplanes\n";
```
- G**
- ```
for (x = -10; x <= -1; x = x / 2)
    cout << "I will not throw paper airplanes\n";
```
- H**
- ```
for (x = 0; x < 100; y++)
    cout << "I will not throw paper airplanes\n";
```



## For loops: easy automation

Change to 10, or 100, or 10000000



```
/* Roll the dice a few times */
for (int x = 0; x < 3; x++)
{
    dice_roll = rand()%6 + 1;
    cout << "You rolled " << dice_roll << endl;
}
```



# What if we don't know how many times in advance?

- **While loop:** repeat statements while test is true

```
/* Roll the dice */
dice_roll = rand()%6 + 1;
cout << "You rolled " << dice_roll << endl;

/* Keep rolling until you get a 3 */
while (dice_roll != 3) ←
{
    dice_roll = rand()%6 + 1;
    cout << "You rolled " << dice_roll << endl;
}
cout << "You win!" << endl;
```



# A do-while loop can reduce duplicated code

## while loop

```
/* Roll the dice */
dice_roll = rand()%6 + 1;
cout << "You rolled " << dice_roll << endl;

/* Keep rolling until you get a 3/
while (dice_roll != 3) ← Test before
{
    dice_roll = rand()%6 + 1;
    cout << "You rolled " << dice_roll << endl;
}
cout << "You win!" << endl;
```

## do-while loop

```
/* Keep rolling until you get a 3 */
do
{
    dice_roll = rand()%6 + 1;
    cout << "You rolled " << dice_roll << endl;
} while (dice_roll != 3); ← Test after
cout << "You win!" << endl;
```

Semi-colon required!



## Challenge: Re-write this for loop as a while loop

```
/* Roll the dice a few times */
for (int x = 0; x < 3; x++)
{
    dice_roll = rand()%6 + 1;
    cout << "You rolled " << dice_roll << endl;
}
```

# What vocabulary did we learn today?

- String
  - Concatenation
- Random number generator
  - Seed (the random number generator)
- Conditional statement: switch
- Short-circuit for if/then
- Loops: for, while, do/while
  - Loop counter

# What ideas and skills did we learn today?

- Seed the generator only once, unless you want to get the same sequence of numbers
- Control structures
  - Selection
    - if-then
    - switch
  - Repetition – shorten the code
    - for
    - while
    - do-while

## MLK Jr. Day Extra Credit

- Write a profile of a **non-Caucasian pioneer** in Computer Science, to include:
  - Biographical sketch
  - Contributions to CS
  - References/sources
- Well written profiles will earn extra credit towards Midterm 1
- See Canvas for more details



## Week 2 nearly done!

- Attend lab (laptop required)
- Read **Rao Lesson 6** (pp. 128-142) – loops  
Rao pp. 79-81 - strings
- Finish **your Assignment 2 design** (due **Sunday, Jan. 19**)

No class Monday! See you on **Wednesday!**