Programming Abstractions

CS106B

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Today's Topics

Introducing C++

- Finish in-class string exercise
- Hamilton example (continued)
  › Style, defining constants
  › Testing
- Parameter passing in C++
  › Pass by value semantics
  › Pass by reference
  › const

- TODO this week:
  › Sign ups for section are open at cs198.stanford.edu. They will **close on Sunday**, September 26th at 5PM PT. Section meetings start week 2.
  › Assignment 0 is **due today, Friday**, September 24th at 11:59PM. There is a 48-hour grace period for assignment 0.
  › Assignment 1 will go out today and be due in 1 week.

Go to
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to join class practice
questions

Go to
edstem.org
to join live lecture
Q&A with Julie

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C++ standard `string` object member functions (3.2)

`#include <string>`

Member function name	Description
s.append(*str*)	add text to the end of a string
s.compare(*str*)	return -1, 0, or 1 depending on relative ordering
s.erase(*index, Length*)	delete text from a string starting at given index
s.find(*str*) *s*.rfind(*str*)	first or last index where the start of *str* appears in this string (**returns `string::npos` if not found**)
s.insert(*index, str*)	add text into a string at a given index
s.length() or *s*.size()	number of characters in this string
s.replace(*index, len, str*)	replaces *len* chars at given index with new text
s.substr(*start, length*) or *s*.substr(*start*)	the next *length* characters beginning at *start* (inclusive); if *length* omitted, grabs till end of string

Exercise: Write a line of code that pulls out the part of a string that is inside parentheses, assuming input variable **str** has the form "(`blahblah`)" where `blahblah` is any pattern of characters.

`string insidePart = _____;`

Exercise solutions:

Exercise: Write a line of code that pulls out the part of a string that is inside parentheses, assuming variable **str** has the form "(`blahblah`)" where `blahblah` is any pattern of characters.

```
string insidePart = _____;
```

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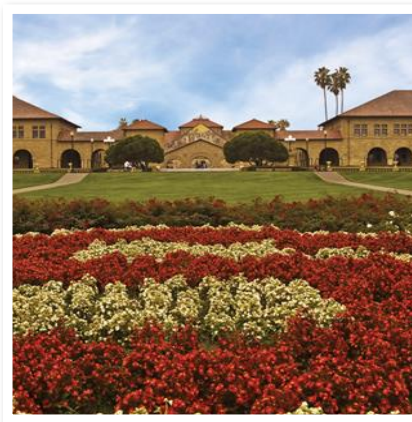# Stanford library helpful string processing (*read* 3.7)

```
#include "strlib.h"
```

- Unlike the previous ones, these take the string as a <u>parameter</u>.
  - › C++ string class example: `str.substr(0, 2);`
  - › Stanford string library example: `endsWith(".jpg");`
- That's because we here at Stanford wrote these functions, and they are not official C++ string class methods.

Function name	Description
endsWith(***str, suffix***) startsWith(***str, prefix***)	returns true if the given string begins or ends with the given prefix/suffix text
integerToString(***int***) realToString(***double***) stringToInteger(***str***) stringToReal(***str***)	returns a conversion between numbers and strings
equalsIgnoreCase(***s1, s2***)	true if s1 and s2 have same chars, ignoring casing
toLowerCase(***str***) toUpperCase(***str***)	returns an upper/lowercase version of a string
trim(***str***)	returns string with surrounding whitespace removed

Hamilton Code (continued): Style and Testing

JUST AS IMPORTANT AS WRITING THE CODE IS WRITING IT WELL AND WRITING GOOD TESTS

Hamilton Code Style Notes

- Descriptive function and variable names
  - › Even someone who doesn't know code would have a pretty good idea what a function called "generate lyrics" does!
- Proper indentation
  - › *Even though* C++ relies on the {} and not indentation (!)
  - › Pro tip: in Qt Creator, select all then do `CTRL-I` (PC) or `Cmd-I` (Mac)
- One space between operators and variables
  - › Write `i < 3`, *not* `i<3`
  - › Coders were social distancing before it was cool
  - › Again, we do this even though C++ doesn't rely on it for parsing
- Define constants at the top of your file for any special values
  - › Example: `const int DAT_FREQ = 3;`
  - › Helps the reader understand what the value means or where it comes from
  - › If you use the value in several places, only need to change it in one place

Writing Good Tests

- "Good" means thorough: covers all code paths and cases
- But don't just add loads of tests for the sake of having many—each should have a purpose

- Be extra attentive to unusual circumstances
- These will vary, specific to the function you are testing, but common examples include:
  - Integer inputs: negative numbers, zero, very large numbers
  - String inputs: very short strings (length 0 or 1), very long strings

Writing Good Tests

Brenan Keller
@brenankeller

A QA engineer walks into a bar. Orders a beer. Orders 0 beers. Orders 99999999999 beers. Orders a lizard. Orders -1 beers. Orders a ueicbksjdhd.

First real customer walks in and asks where the bathroom is. The bar bursts into flames, killing everyone.

1:21 PM · Nov 30, 2018 · Twitter for iPhone

- *A QA engineer is a software developer who specializes in writing tests and finding bugs in other engineers' code*

CS106B Testing Framework

- We provide a framework for testing your code in this class

- More details on the website →
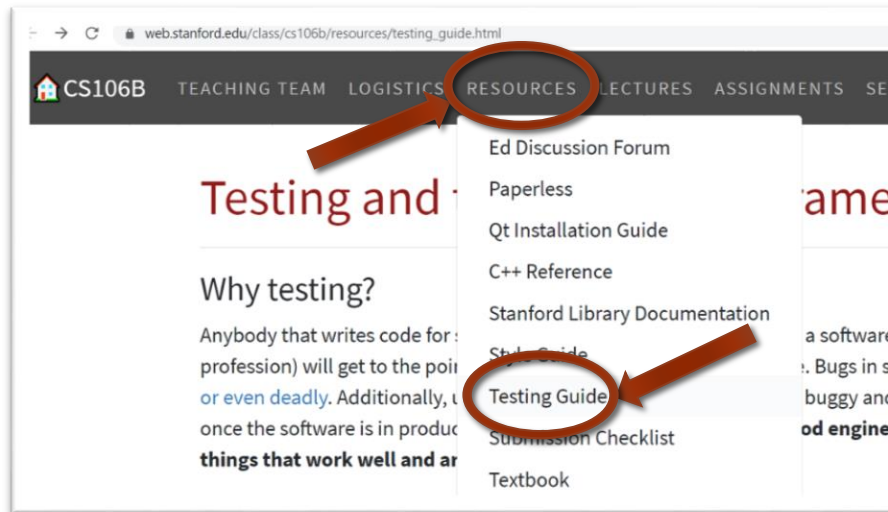

- **Quick version:**

- In `main()`, write:
  - › `runSimpleTests(SELECTED_TESTS);`

- Write tests as:
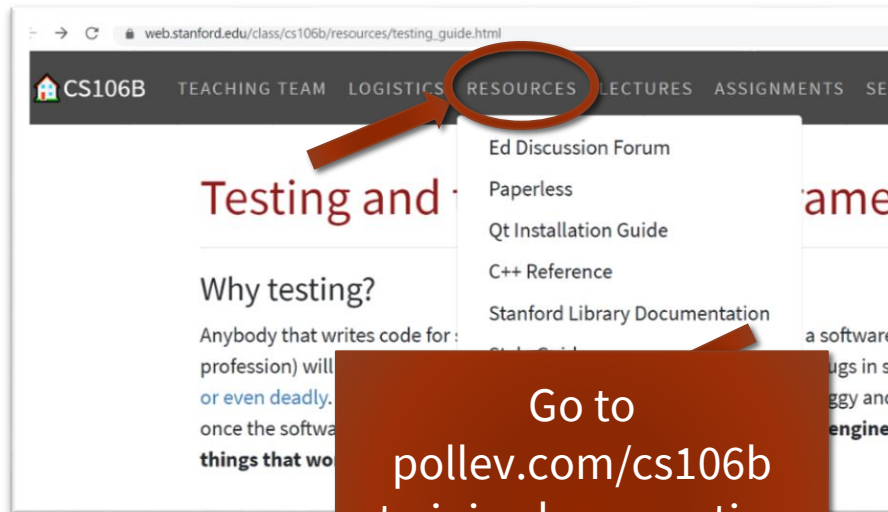 - › `EXPECT_EQUAL(`*`functionBeingTested`*`(`*`input`*`), `*`expectedOutput`*`);`
  - › `EXPECT_EQUAL(generateLyrics(2), "Da Da ");`

- **Your Turn: What are some good test cases for our Hamilton code?**

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- **Quick version:**

- In `main()`, write:
  - › `runSimpleTests(SELECTED_TESTS);`

- Write tests as:
  - › `EXPECT_EQUAL(`*functionBeingTested*`(`*input*`), `*expectedOutput*`);`
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- **Your Turn: What are some good test cases for our Hamilton code?**

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C++ Parameter Passing

TWO PARADIGMS:
PASS BY VALUE
PASS BY REFERENCE

"Pass by value"
(default behavior of parameters)

```cpp
#include <iostream>
void foo(int n);

int main(){
    int n = 5;
    foo(n);
    cout << n << endl;
    return 0;
}

void foo(int n) {
    n++;
}
```

What is printed?
- A. 5
- B. 6
- C. Error or something else

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"Pass by reference"

```cpp
#include <iostream>
void foo(int &num);

int main(){
    int n = 5;
    foo(n);
    cout << n << endl;
    return 0;
}

void foo(int &num) {
    num++;
}
```

- This one prints 6!
- I like to think of the & as a rope lasso that grabs the input parameter and drags it into the function call directly, rather than making a copy of its value and then leaving it in place.

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Your turn!

```cpp
void mystery(int c, int& a, int b) {
    cout << b << " + " << c << " = " << a << endl;
    a++;
    b--;
}

int main() {
    int a = 4;
    int b = 7;
    int c = -2;

    mystery(b, a, c);
    mystery(c, b, 3);
    mystery(b, c, b + a);
    return 0;
}
```

What does this print?

Go to
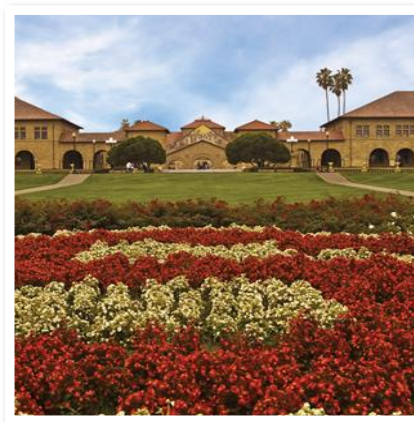https://pollev.com/cs106b
and send your answer!

Why though??

- We've looked at the *how* of pass-by-reference, but we haven't yet discussed the *why*.
- We'll see some examples of when this feature comes especially in handy next week when we learn about containers for data!

Ethics in CS106B

ETHICAL DECISION-MAKING FRAMEWORKS

ETHICS OF STRINGS!

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Ethics in CS106B

- This will be a recurring series throughout the quarter, and will tie in to your homework assignments

- **What to watch for today:**
  - › **Meet your guide, Katie Creel!** Dr. Creel has degrees in computer science, moral philosophy, and history of science in society.
  - › Learn about some philosophical **frameworks for making ethical decisions**, which we will be a formal guide for our thinking throughout the quarter
  - › Get a preview of topics in **Assignment 1**
  - › Consider the **ethical implications of C++ variable types `char` and `string`**, which you just learned about
    - *That's right, even something as simple as strings has ethical concerns!*

Ethics in CS106B

- This will be a recurring series throughout the quarter, and will tie in to your homework assignments

- **Free association question:**
  - › What words do you think of when you hear "tech ethics"?
  - › Write one word per submission (you may submit multiple times)

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