Wrapping Up The STL

Bad Dad Joke of the Day:

- How did the hamburger introduce his wife?
- Meat patty.

Creds: Julie

Game Plan

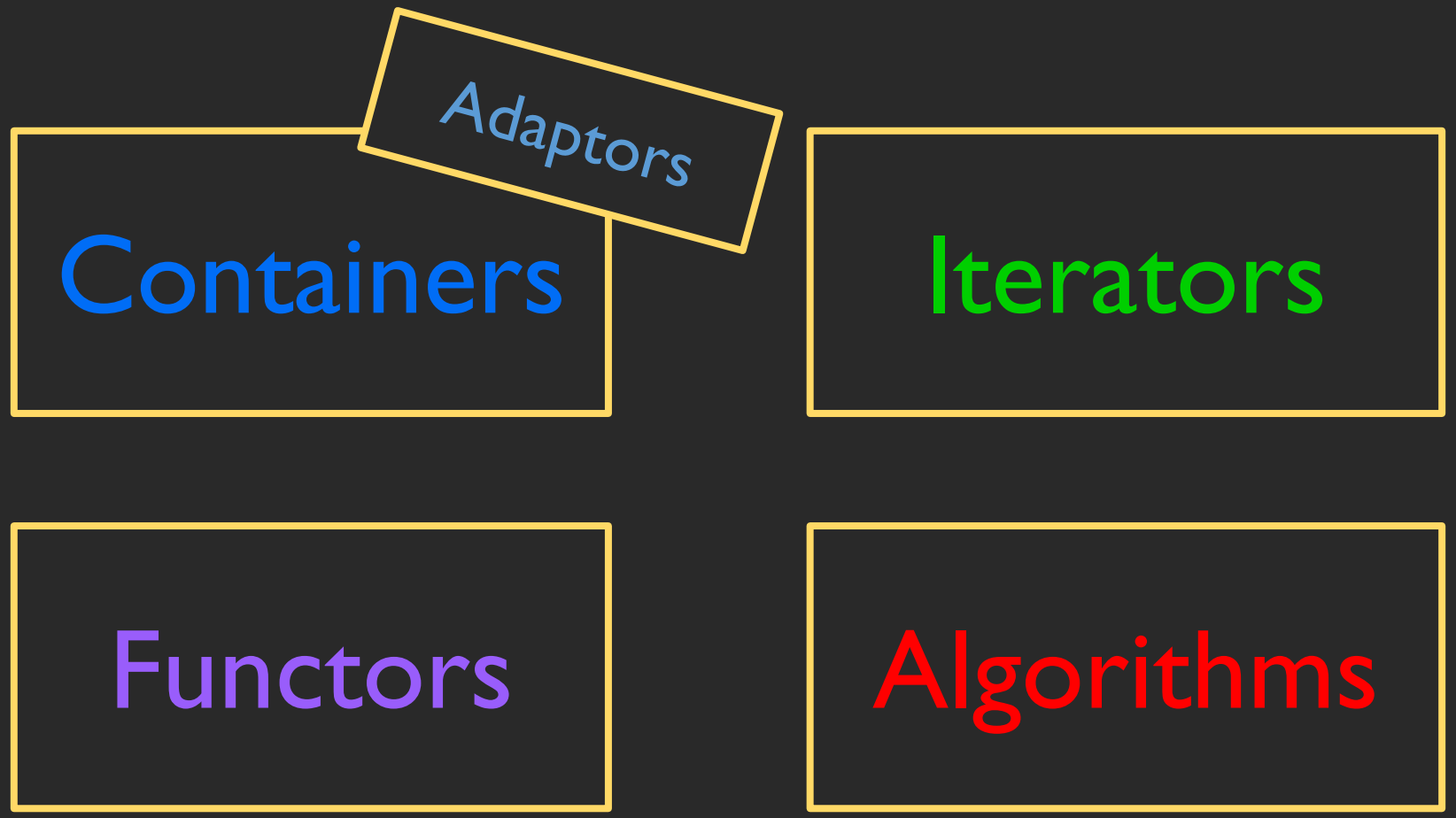
- Assignment 2 Preview
- BIG STL RECAP and Mystery Activity
- Let’s Put It All Together!

Preview of Assignment 2

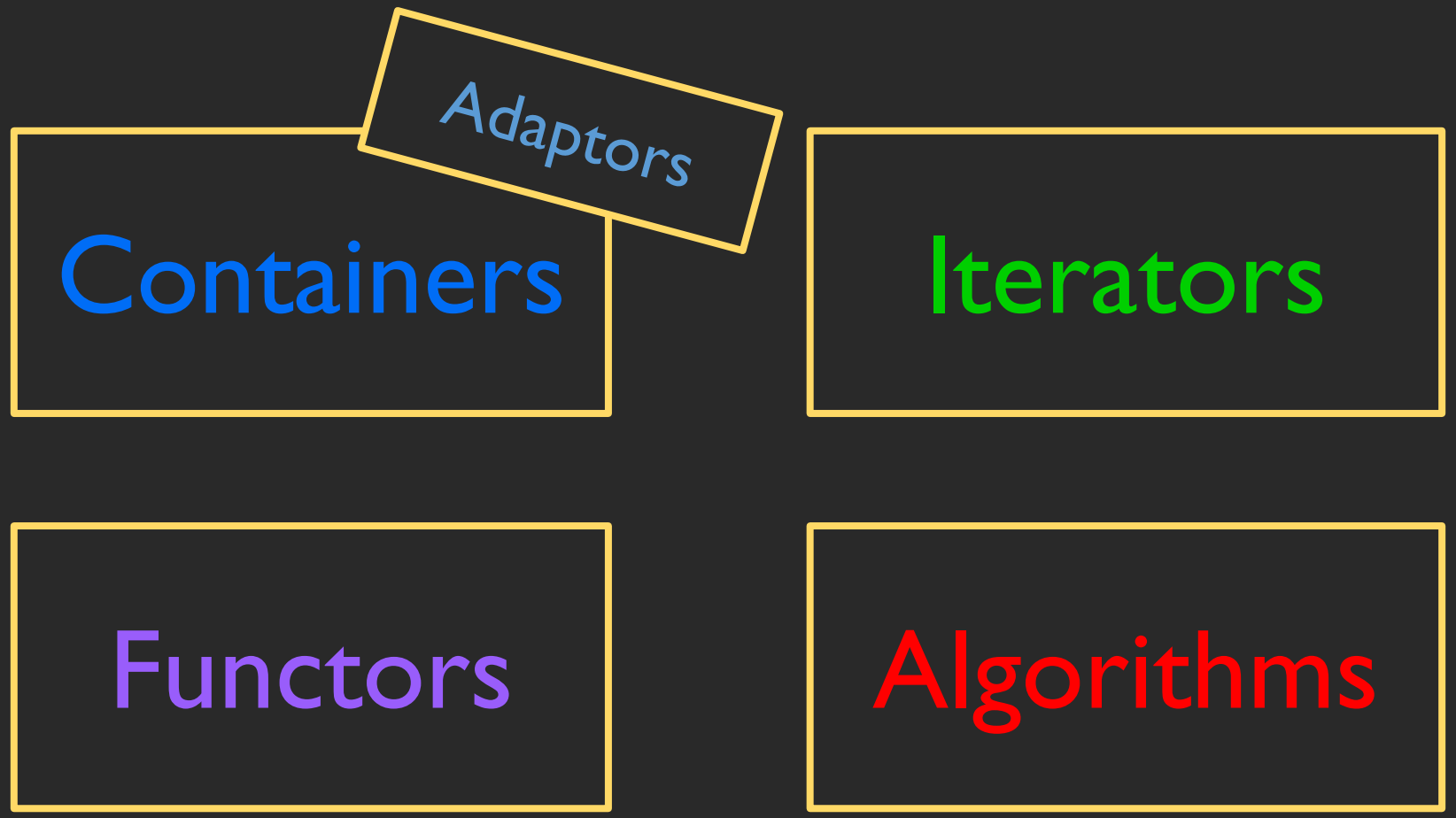
Part A: due Friday, February 7 (no more than 2 hours)
Part B: due Thursday, February 13

https://en.wikipedia.org/wiki/Wikipedia:Wikirace

Overview of STL



You've now seen it all!



THE BIG STL RECAP,

aka the BSTLR*

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*not an official C++ acronym

Feedback Survey #1

Thanks for filling out the feedback survey!

We’re still processing the results, but one common theme for improvement was:

- “recaps”
- “coding exercises in class”
- “a bit too fast”

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- “a bit too fast”... and “good pace”

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} The BSTLR!

The BSTLR

1. Streams
2. Sequence containers + container adaptors
3. Associative containers
4. Iterators
5. Templates
6. Lambdas
7. Algorithms

Streams Recap

Streams Recap

console &
keyboard

a string

files

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a string

stringstream:

- stringstream ss(“Hello”, stringstream::ate);
- ss << 106;
- string myString; ss >> myString;

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filestream:
- fstream fs(filename);
- string line; getline(fs, line);

Streams Recap

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filestream:
- fstream fs(filename);
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cout/cin:
- cout << “Hello” << endl;
- cin >> myInt >> myString;

Streams Recap

console & keyboard

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files

State bits:
- good, fail, eof, bad
- fail fails silently!

stringstream:
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- ss << 106;
- string myString; ss >> myString;

filestream:
- fstream fs(filename);
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cout/cin:
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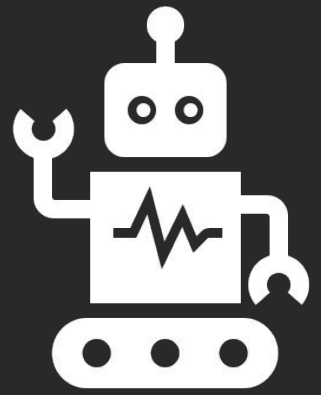
Challenge #1: Streams



string fileToString(ifstream& file)

Sequence Containers + Adaptors Recap

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Sequence Containers:

- vector
  (fast access of middle)
- deque
  (fast insert begin/end)
- list, forward_list

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- stack
  ➜ secretly a vector or deque
- queue
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vector:
- vector<int> v{1, 0, 6};
- v.push_back(-100);
- v.pop_back();
- v[3] fails silently! v.at(3) throws error

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deque:
- deque<int> d{1, 0, 6};
- same as a vector
- d.push_front(42);
- d.pop_front();

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deque:
- deque<int> d{1, 0, 6};
- same as a vector
- d.push_front(42);
- d.pop_front();

stack: stack<int> s{1, 0, 6}; s.push(5); s.pop();
queue: queue<int> q{1, 0, 6}; q.push(5); q.pop();

Associative Containers Recap

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Associative Containers:

(sorted, fast for range:)

- map
- set
- multimap
- multiset

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- unordered_map
- unordered_set
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- unordered_map
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map:
- map<int, string> m{{5, “Hi”}, {80, “Bye”}};
- m[106] = “C++”;
- m.count(106);
- m.at(99) = “Hey”; // throws error
- m[99] = “Hey”;   // creates new entry

Associative Containers Recap

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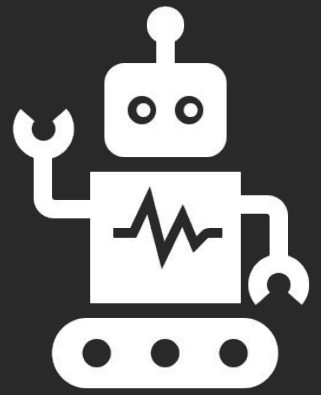
- m.at(99) = “Hey”; // throws error
- m[99] = “Hey”;   // creates new entry

set:
- set<int> s{1, 0, 6};
- really a map to 0/1, without .at() and []

Challenge #2: Containers



```
vector<int> createCountVec(const string& text)
```

Iterators Recap

Iterators Recap

Types:

- input
  (one-pass, read-only)
- output
  (one-pass, write-only)
- forward
  - (multi-pass, read and write)
- bidirectional
  (multi-pass, read and write, can decrement)
- random access
  (multi-pass, read and write, can incr/decr by arbitrary amounts)

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Basic syntax:

- set<int> s{1, 0, 6};
- set<int>::iterator it = s.begin();
- auto it2 = s.end();
- ++it;
- *it = 3;
- if (it != it2) ...
- map<int, string> m{{1, “Hi”}, {6, “Bye”}};
- auto [key, val] = m.begin();
- (m.begin())->first = 3

Iterators Recap

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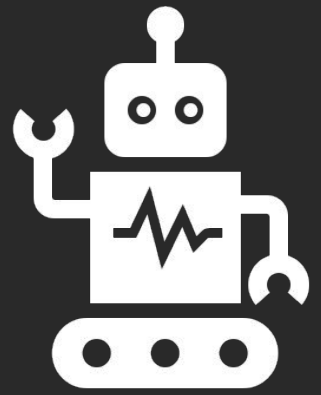
- map<int, string> m{{1, “Hi”}, {6, “Bye”}};
- auto [key, val] = m.begin();
- (m.begin())->first = 3

for-each loop:
- for (int i : s) ...
  is implemented as
- for (auto it = s.begin(); it != s.end(); ++it) ...

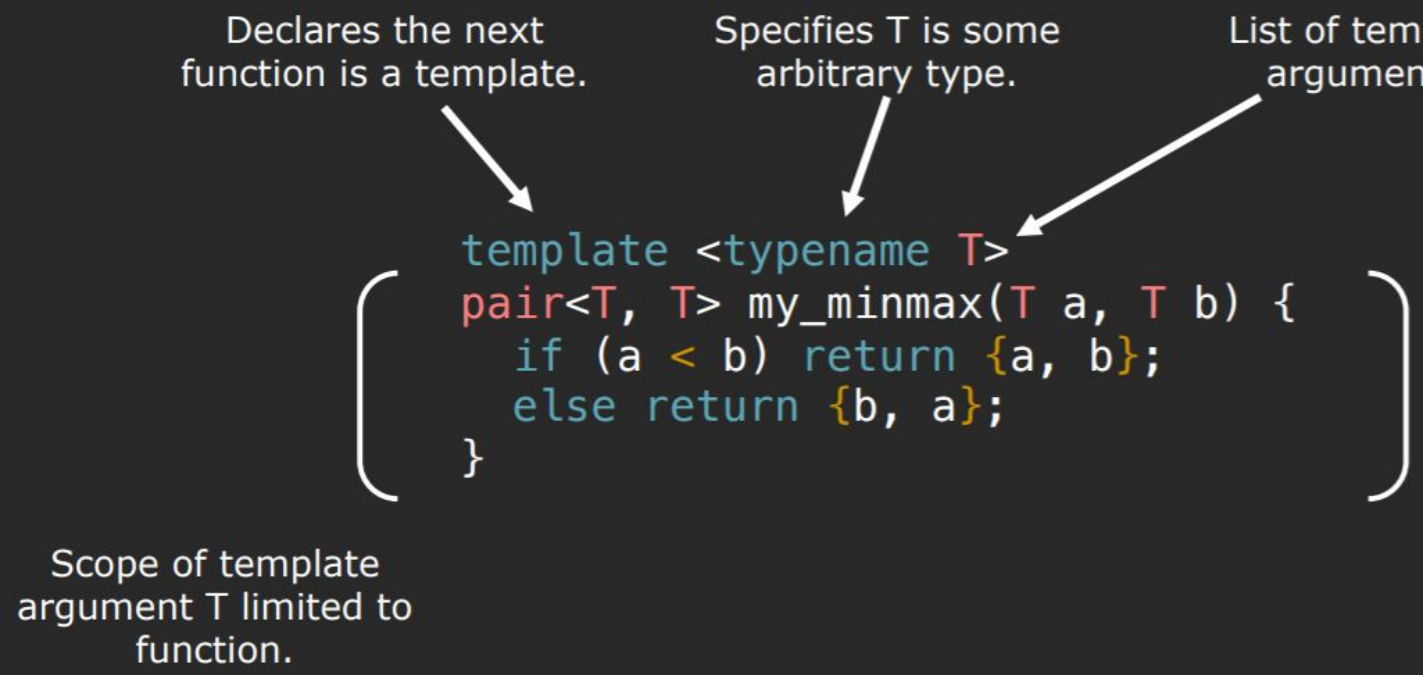
Challenge #3: Iterators



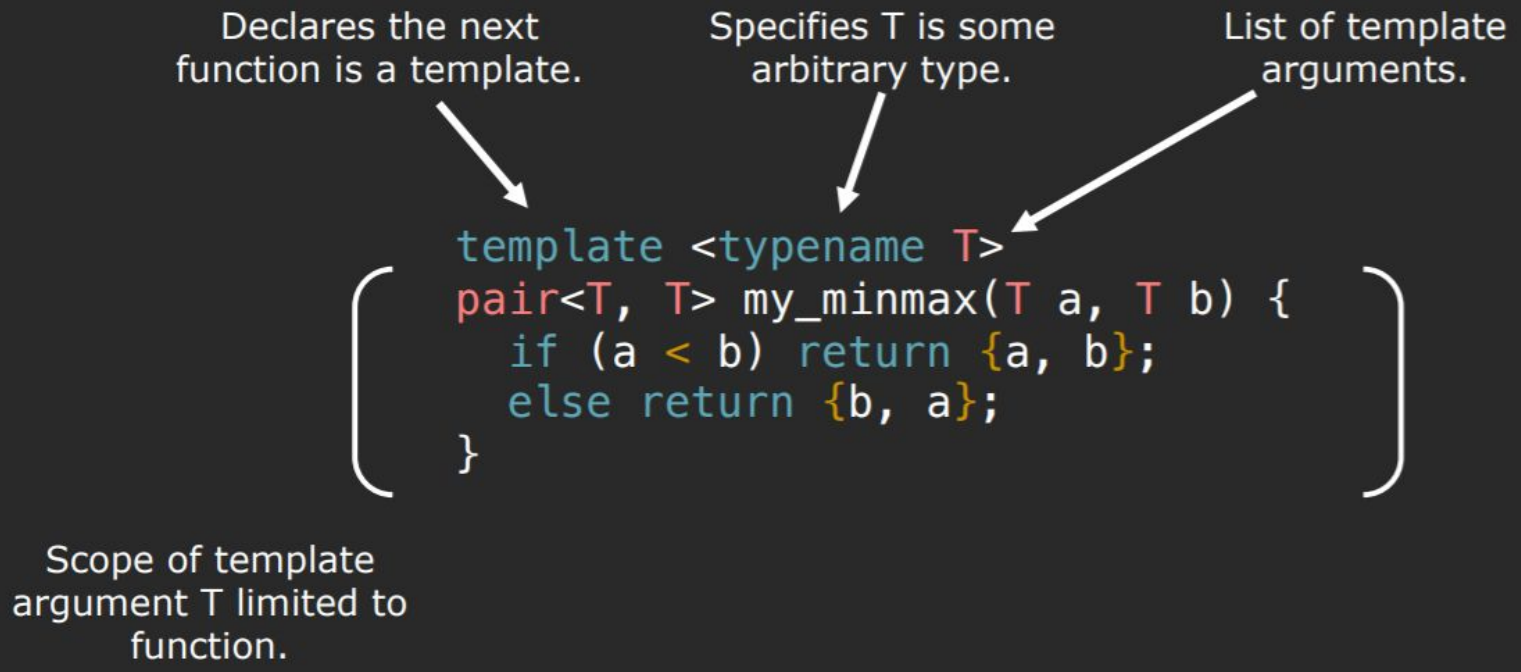
```
int countOccurrences(const string& text,
                     const string& feature)
```

Templates Recap

Templates Recap



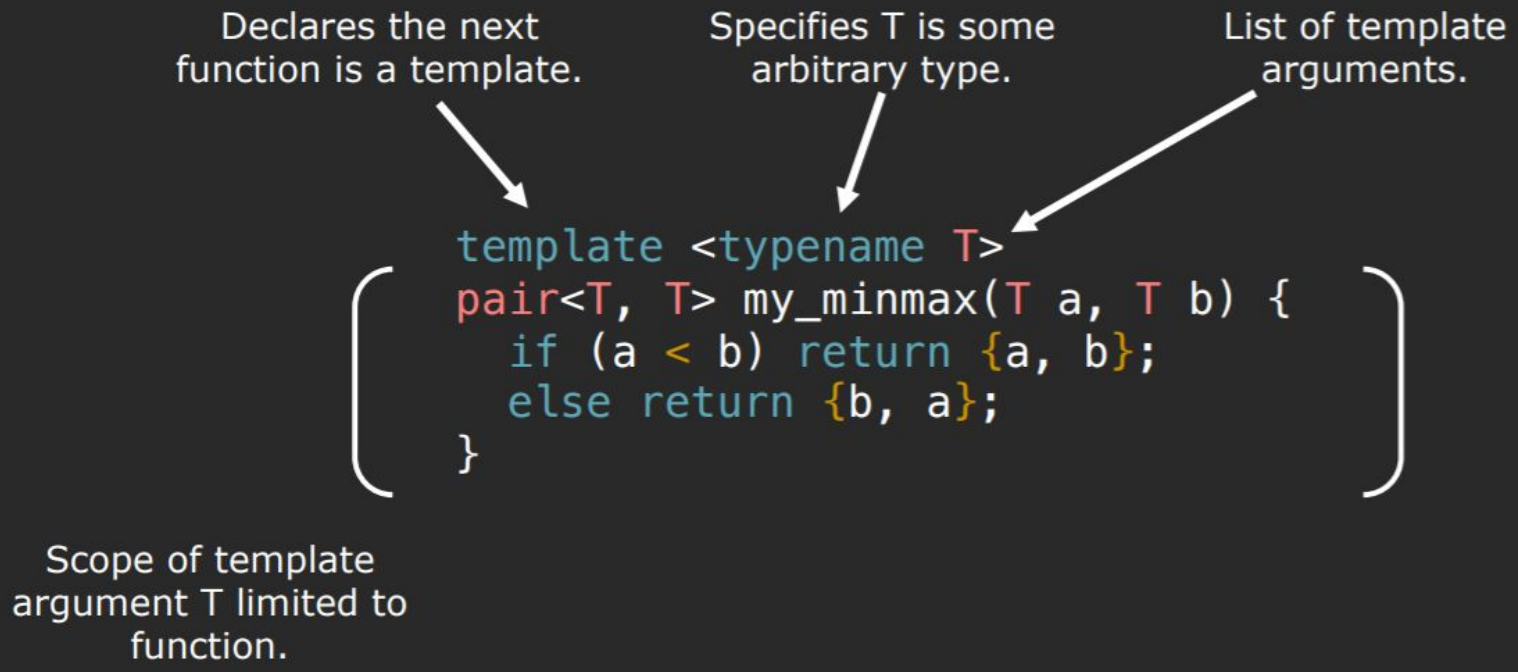
Templates Recap



Explicit instantiation:

- my_minmax<string>(“Avery”, “Anna”);

Templates Recap



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- my_minmax<string>(“Avery”, “Anna”);

Implicit instantiation:
- my_minmax(3, 6);
- my_minmax(“Avery”, “Anna”); won’t do as you expect! Will deduce C-strings

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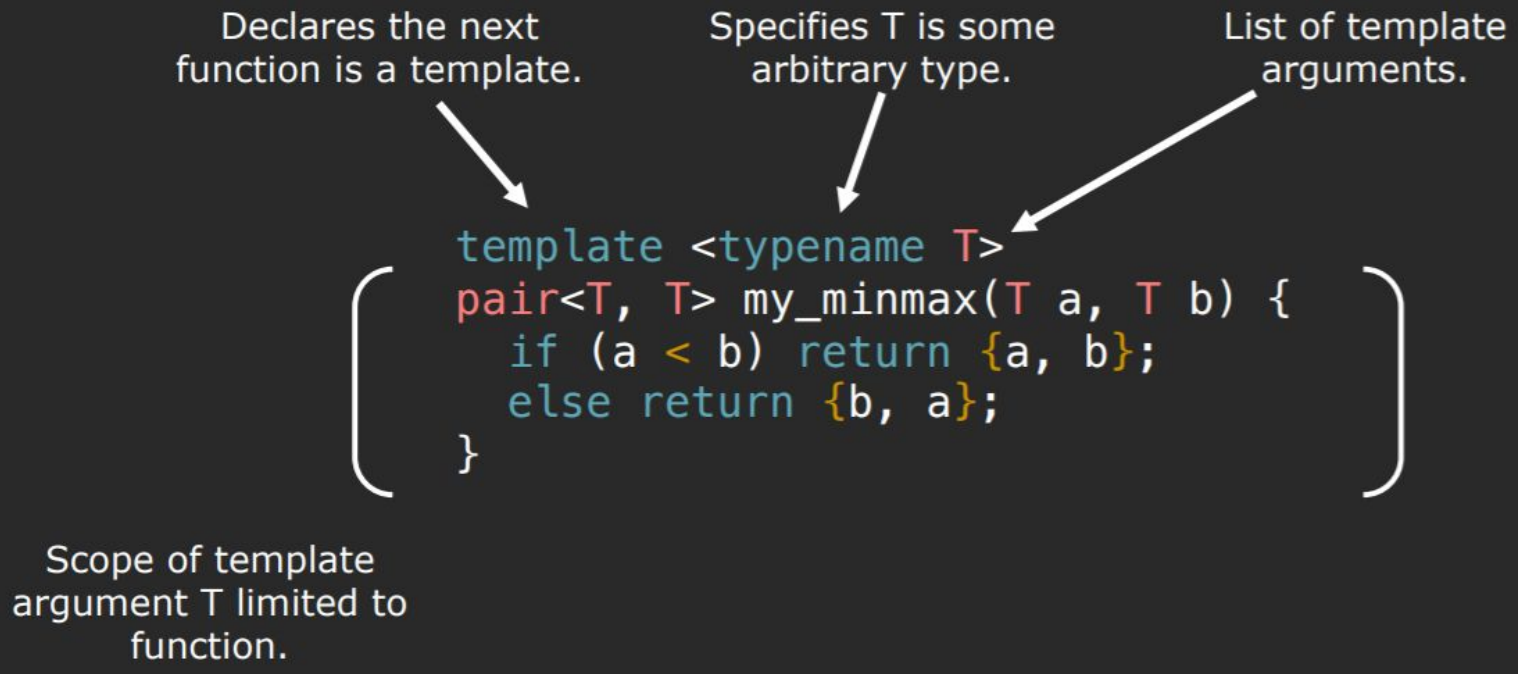

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Implicit instantiation:
- my_minmax(3, 6);
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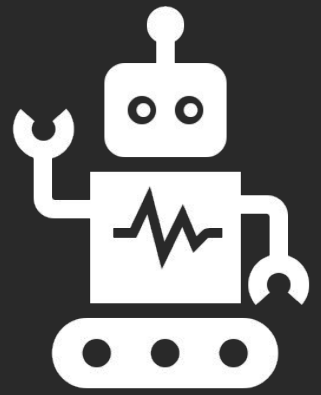
Concept (C++20) = turns the implicit assumptions that your code is making, into explicit requirements

Challenge #4: Templates



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Lambdas Recap

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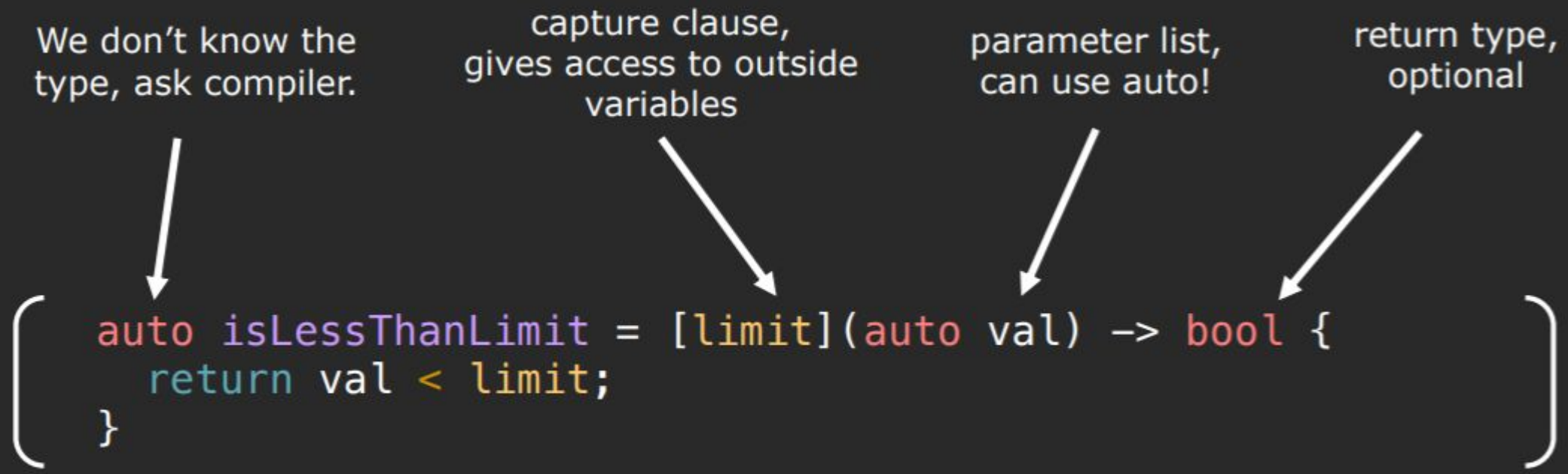
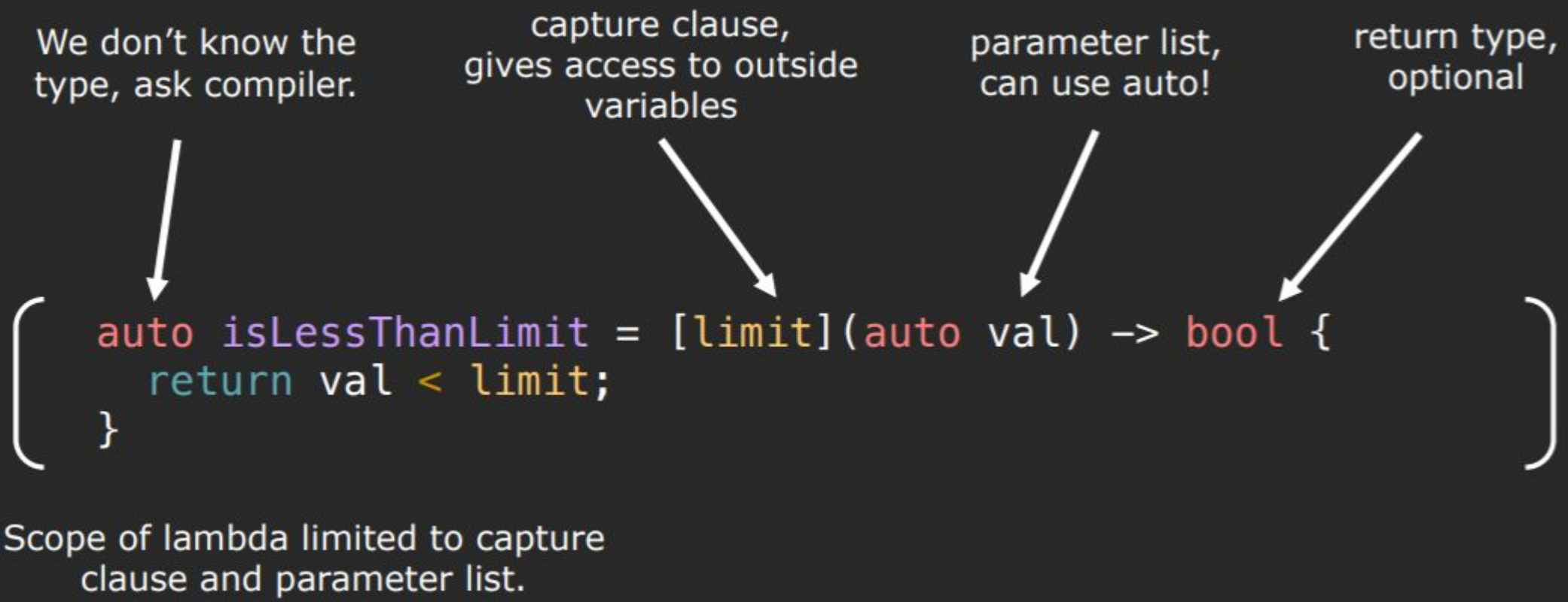


Scope of lambda limited to capture clause and parameter list.

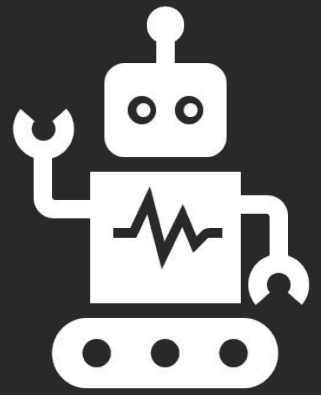
Lambdas Recap



Capture clause:

- [=, &obj] ➔ captures everything by value, except obj by reference
- [&, limit] ➔ captures everything by reference, except limit by value

Challenge #5: Lambdas



```
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```

Algorithms Recap

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Algorithms we've seen:

- std::sort
- std::find
- std::count
- std::nth_element
- std::stable_partition
- std::copy
- std::copy_if
- std::remove_if
- and more!

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- and more!

Special iterators:

- back_inserter
  - e.g., std::copy(vec.begin(), vec.end(), std::back_inserter(newVec));
- stream_iterator
  - e.g., std::copy(vec.begin(), vec.end(), std::ostream_iterator<int>(cout, ", "));

Algorithms Recap

Algorithms we've seen:

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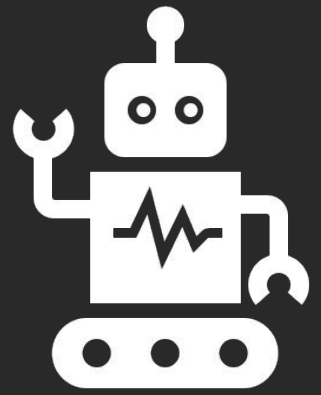
Erase-remove idiom using algorithms*:

```
std::erase(
    std::remove(v.begin(), v.end()), v.end()
);
```

*many containers will define their own erase function which does this for you - this only applies if you use the STL erase/remove algorithms

Challenge #6: Algorithms



```
int dotProduct(const vector<int>& v1,
               const vector<int>& v2)
```

STL Wrap-Up:
Let's put it all together!

THE

FEDERALIST:

A COLLECTION OF

ESSAYS,

WRITTEN IN FAVOUR OF THE

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AS AGREED UPON BY THE

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SEPTEMBER 17, 1787.

IN TWO VOLUMES.
VOL. I.

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No money required till delivery.

To render this work more complete, will be added, without any additional expence,

PHILO-PUBLIUS,

AND THE

Articles of the Convention,

As agreed upon at Philadelphia, September 17th, 1787.

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The FŒDERALIST, No. 10.

To the People of the State of New-York.

AMONG the numerous advantages promiſed by a well conſtructed Union, none deſerves to be more accurately developed than its tendency to break and control the violence of faction. The friend of popular governments, never finds himſelf ſo much alarmed for their character and fate, as when he contemplates their propenſity to this dangerous vice. He will not fail therefore to ſet a due value on any plan which, without violating the principles to which he is attached, provides a proper cure for it. The inſtability, injuſtice and confuſion introduced into the public councils, have in truth been the mortal diſeaſes under which popular governments have every where periſhed; as they continue to be the favorite and fruitful topics from which the adverſaries to liberty derive their moſt ſpecious declamations. The valuable improvements made by the American Conſtitutions on the popular models, both ancient and modern, cannot certainly

The influence of factious leaders may kindle a flame within their particular States, but will be unable to ſpread a general conflagration through the other States: A religious ſect, may degenerate into a political faction in a part of the confederacy; but the variety of ſects diſperſed over the entire face of it, muſt ſecure the national Councils againſt any danger from that ſource: A rage for paper money, for an abolition of debts, for an equal diviſion of property, or for any other improper or wicked project, will be leſs apt to pervade the whole body of the Union, than a particular member of it; in the ſame proportion as ſuch a malady is more likely to taint a particular county or diſtrict, than an entire State.

In the extent and proper ſtructure of the Union, therefore, we behold a republican remedy for the diſeaſes moſt incident to republican Government. And according to the degree of pleaſure and pride, we feel in being Republicans, ought to be our zeal in cheriſhing the ſpirit and ſupporting the character of Fœderaliſts.

PUBLIUS.

Can we discover an author’s identity from their writing?

Can we discover an author’s identity from their writing?

stylometry noun

sty·lom·e·try | \ stī ˈlämə·trē, -tri\

plural -es

Definition of *stylometry*

: the study of the chronology and development of an author's work based especially on the recurrence of particular turns of expression or trends of thought

The Idea

Authors have an underlying writing style.

Subconsciously writers tend to write in a consistent manner.

...

The Idea

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Subconsciously writers tend to write in a consistent manner.

...

Could we use these tendencies as a literary fingerprint?

The Idea

We need a writer invariant.

The Idea

We need a writer invariant.

Function words:

- Syntactic glue of a language
- E.g. *the, I, he, she, do, from, because...*

The Idea

Let’s imagine our language only has 3 function words:

```
[I, the, there]
```

Deep into that darkness peering, long I stood there, wondering, fearing, doubting, dreaming dreams no mortal ever dared to dream before.

- Edgar Allan Poe

I first met Dean not long after my wife and I split up. I had just gotten over a serious illness that I won’t bother to talk about, except that it had something to do with the miserably weary split-up and my feeling that everything there was dead.

- Jack Kerouac

The Idea

We can create a fingerprint vector for the two texts.

```
[I, the, there]
```

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```
[I, the, there]

[ 0 ,  0 ,  0 ]
```

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```
[I, the, there]

[ 1 ,  0 ,  0 ]
```

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Deep into that darkness peering, long I stood **there**, wondering, fearing, doubting, dreaming dreams no mortal ever dared to dream before.

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I first met Dean not long after my wife and I split up. I had just gotten over a serious illness that I won't bother to talk about, except that it had something to do with the miserably weary split-up and my feeling that everything there was dead.

- Jack Kerouac

The Idea

```
[I, the, there]

[ 1 ,  0 ,  1 ]
```

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- Jack Kerouac

The Idea

[I, the, there]

[1 , 0 , 1]

[0 , 0 , 0]

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The Idea

[I, the, there]

[1 , 0 , 1]

[0 , 0 , 0]

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The Idea

[I, the, there]

[1 , 0 , 1]

[0 , 0 , 0]

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- Jack Kerouac

The Idea

[I, the, there]

[1 , 0 , 1]

[4 , 0 , 0]

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- Jack Kerouac

The Idea

[I, **the**, there]

[1 , 0 , 1]

[4 , 0 , 0]

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- Jack Kerouac

The Idea

[I, **the**, there]

[1 , 0 , 1]

[4 , **0** , 0]

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- Jack Kerouac

The Idea

[I, **the**, there]

[4 , 1 , 0]

[1 , 0 , 1]

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The Idea

[I, the, **there**]

[1 , 0 , 1]

[4 , 1 , 0]

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The Idea

[I, the, **there**]

[1 , 0 , 1]

[4 , 1 , **0**]

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The Idea

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[1 , 0 , 1]

[4 , 1 , 1]

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The Idea

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[I, the, there]
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- Edgar Allan Poe

```
[ 4 ,  1 ,  1 ]
```

I first met Dean not long after my wife and I split up. I had just gotten over a serious illness that I won't bother to talk about, except that it had something to do with the miserably weary split-up and my feeling that everything there was dead.

- Jack Kerouac

The Idea

```
[ 1 ,  0 ,  1 ]          [ 4 ,  1 ,  1 ]
```

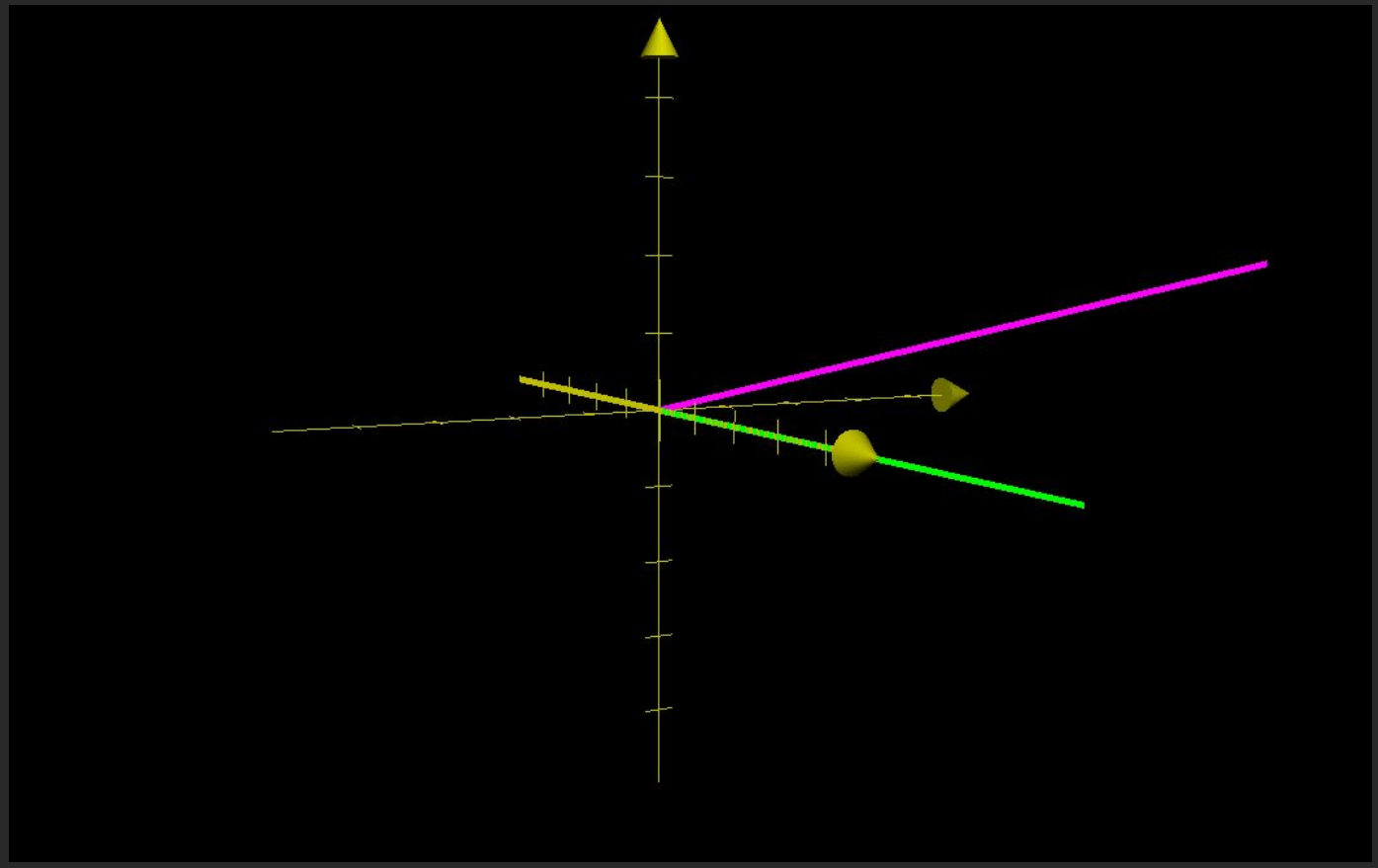
The Idea

```
[ 1 ,  0 ,  1 ]          [ 4 ,  1 ,  1 ]
```

The Idea

```
[ 1 ,  0 ,  1 ]
```

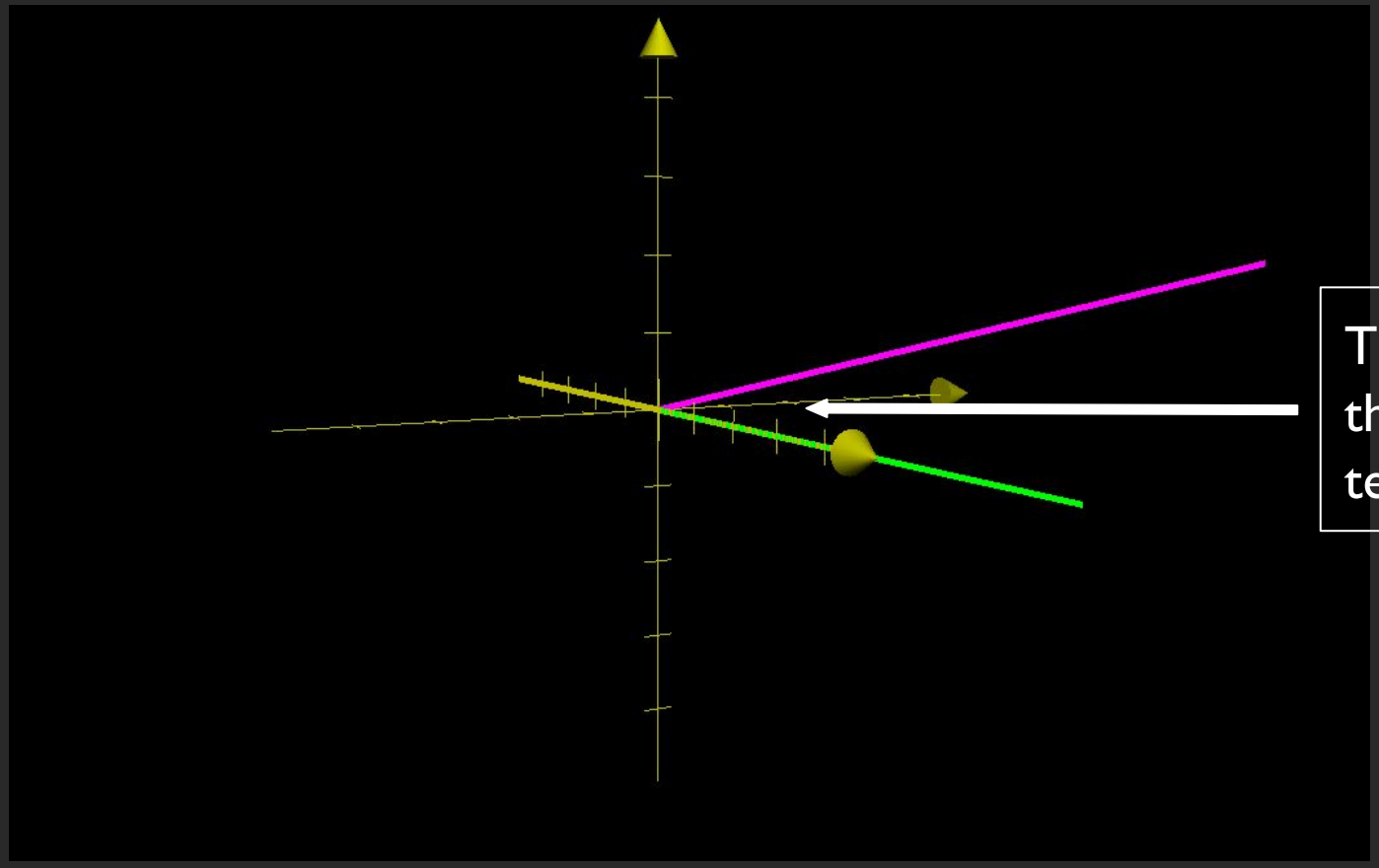
```
[ 4 ,  1 ,  1 ]
```



The Idea

```
[ 1 ,  0 ,  1 ]
```

```
[ 4 ,  1 ,  1 ]
```

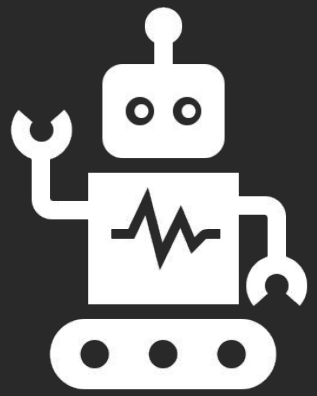


The closer this angle, the more similar the texts

The Idea

$$\cos\theta = \frac{\vec{u} \cdot \vec{v}}{\|\vec{u}\|\|\vec{v}\|}$$

Let’s get coding!



Example

Stylometry

Closing Notes

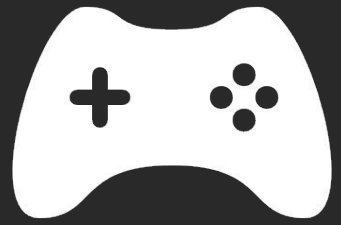
Closing Notes

The code for getting the word count (i.e. countOccurrences) will be really useful for the first part of assignment 2.

Congratulations!

"As mathematicians learned to lift theorems into their most general setting, so I wanted to lift algorithms and data structures."

— *Alex Stepanov, inventor of the STL*



Next time

Class Design with Iterators

Starting a new unit: Object-Oriented Programming (in Modern C++)!