CS106L Lecture 5: Streams 

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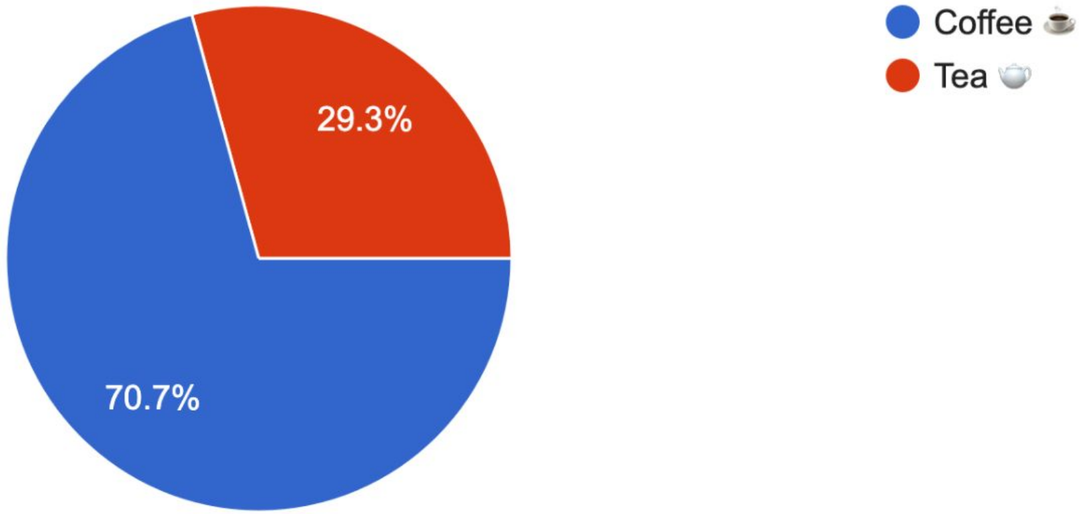
Attendance 🪄

Interesting Stats 🪄

Coffee or Tea? (There is one right answer)

41 responses

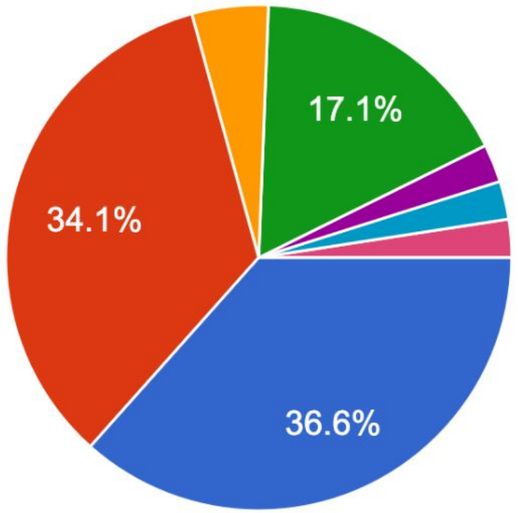


Personally

Interesting Stats 🪄

Which describes your current status?

41 responses



- Present and caffeinated!! ☕
- Here, but I would like caffeine 😪
- My cat is attending on my behalf 🐱
- Physically here, mentally in Hogwarts 🪄
- Here, but would like tea
-
- Physically here, not a fan of coffee OR tea, actually ate lunch beforehand

For the people in Hogwarts (or anyone)

This is a friendly reminder to let us know how to make this class better for you by submitting feedback using our anonymous feedback form here. ***We're interested in why your cat is attending on your behalf, or why you're in Hogwarts!***

I've even make a QR code for your convenience 🤠 (the slides are up on the website):

Plan

1. Quick recap
2. What are streams??!!
3. `stringstreams`
4. `cout` and `cin`
5. Output streams
6. Input streams

A quick recap

1. **Uniform Initialization** 🦄
   a. A *ubiquitous and safe* way of initializing things using {}

A quick recap

1. **Uniform Initialization** 🦄
   a. A *ubiquitous and safe* way of initializing things using {}
2. **References** 🦄
   a. A way of giving variables ***aliases*** and having multiple variables all refer the the **same memory.**

Plan

1. Quick recap
2. **What are streams??!!**
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6. Input streams

Why streams?

"Designing and implementing a general **input/output** facility for a programming language is notoriously difficult"

- *Bjarne Stroustrup*

Streams

"~~Designing and implementing~~ a general **input/output** facility for ~~a programming language is notoriously difficult~~ C++"

- *a stream :)*

Streams

a general **input/output** facility for C++

Streams

~~a general **input/output** facility for C++~~

a general **input/output(IO)** abstraction for C++

Abstractions

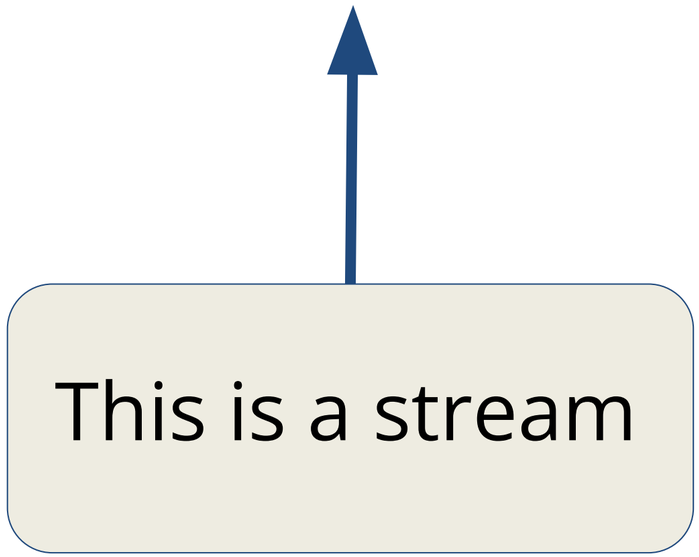
Abstractions provide a consistent ***interface***, and in the case of streams the interface is for reading and writing data!

A familiar stream!

```
std::cout << “Hello, World” << std::endl;
```

A familiar stream!

```
std::cout << “Hello, World” << std::endl;
```



A familiar stream!

```
std::cout << “Hello, World” << std::endl;
```

This is a stream

The **`std::cout`** stream is an instance of **`std::ostream`** which represents the standard output stream!

std::cout

```
std::cout << “Hello, World” << std::endl;
```

```
std::cout
```

“Hello, World”

std::cout

```
std::cout << “Hello, World” << std::endl;
```

```
std::cout
```

“Hello, World”

But how do we go from external source to program?

An Input Stream

How do you read a `double` from your console?

`std::cin` is the console input stream!

The `std::cin` stream is an instance of **`std::istream`** which represents the standard input stream!

```
void verifyPi()
{
  double pi;
  std::cin >> pi;
  /// verify the value of pi!
  std::cout << pi / 2 << '\n';
}
```

std::cin

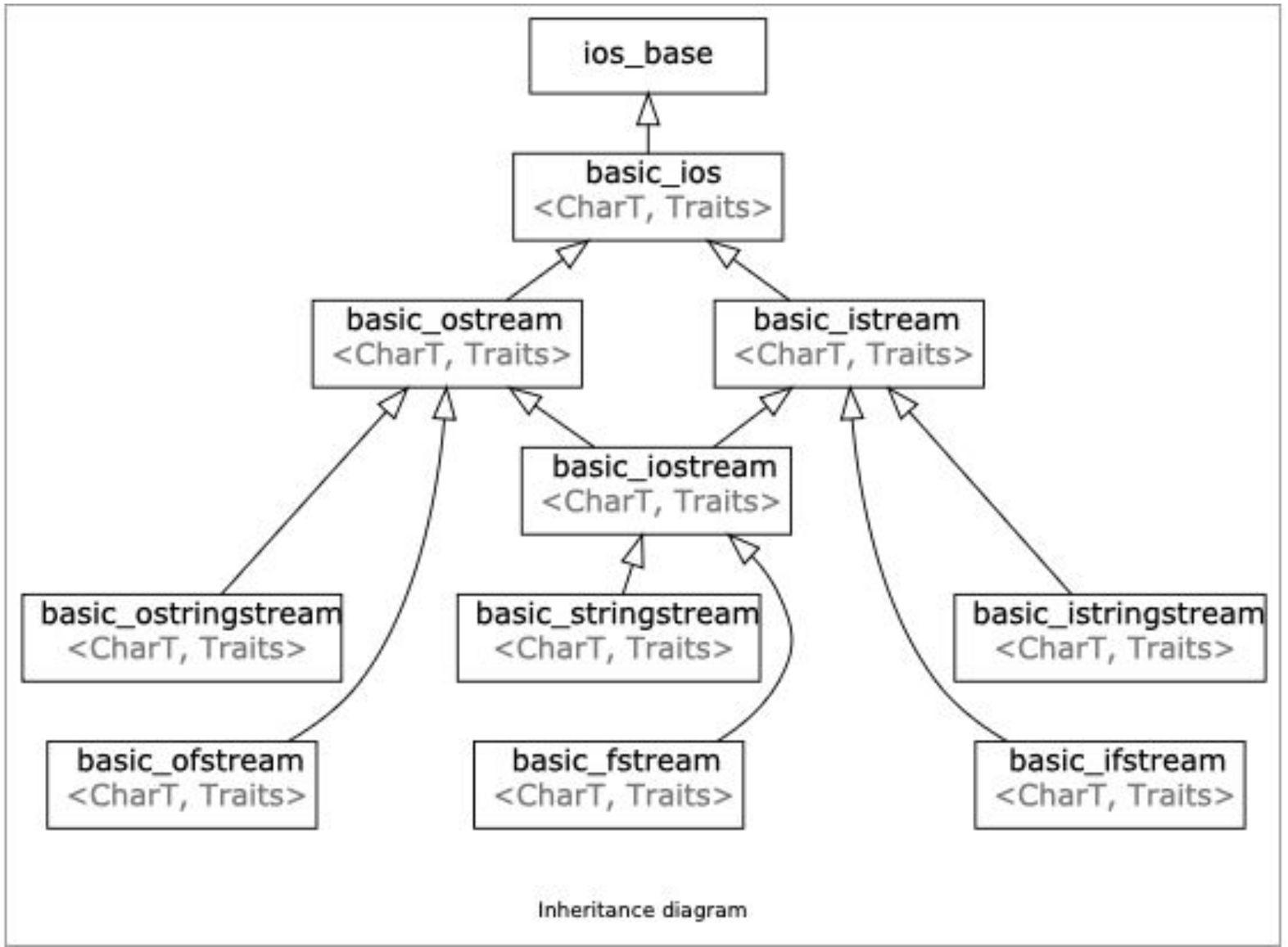
```
int main()
{
  double pi;
  std::cin >> pi;
  /// verify the value of pi!
  std::cout << pi / 2 << '\n';

  return 0;
}
```

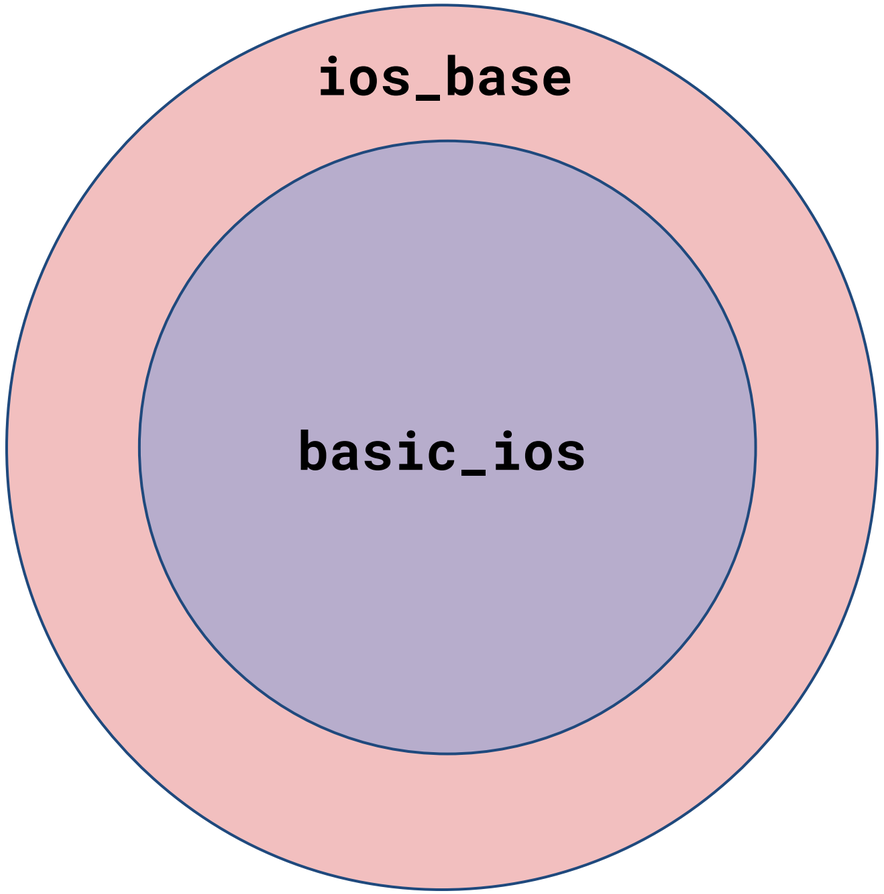
Console

“1.57”

What streams actually are

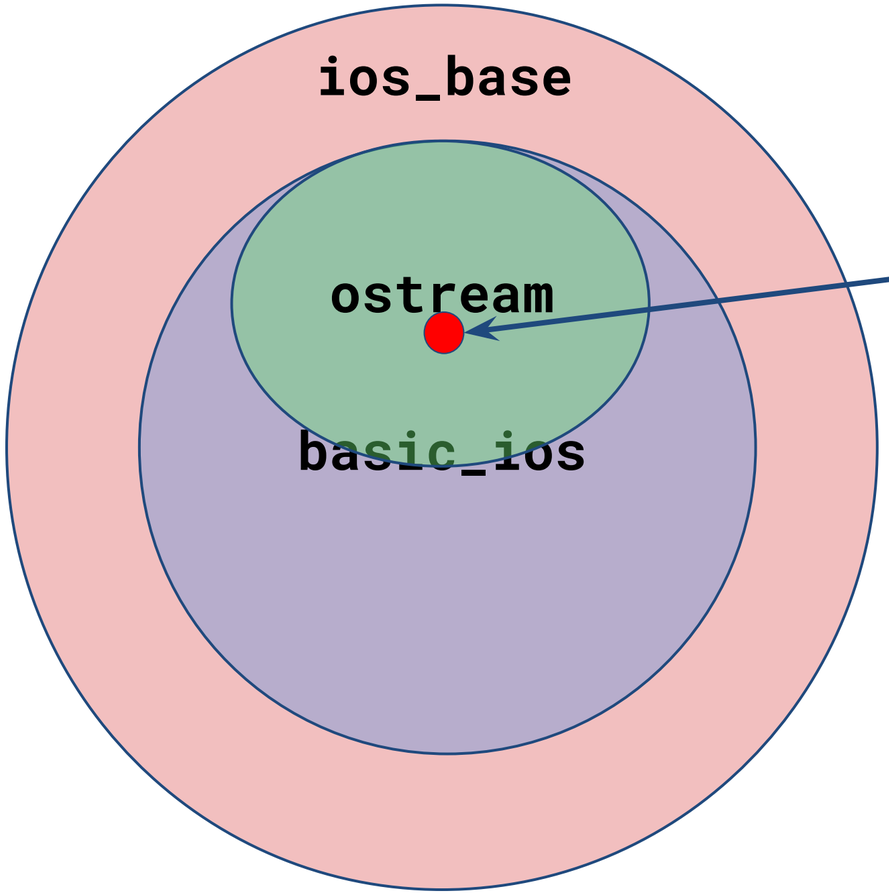


streams and types



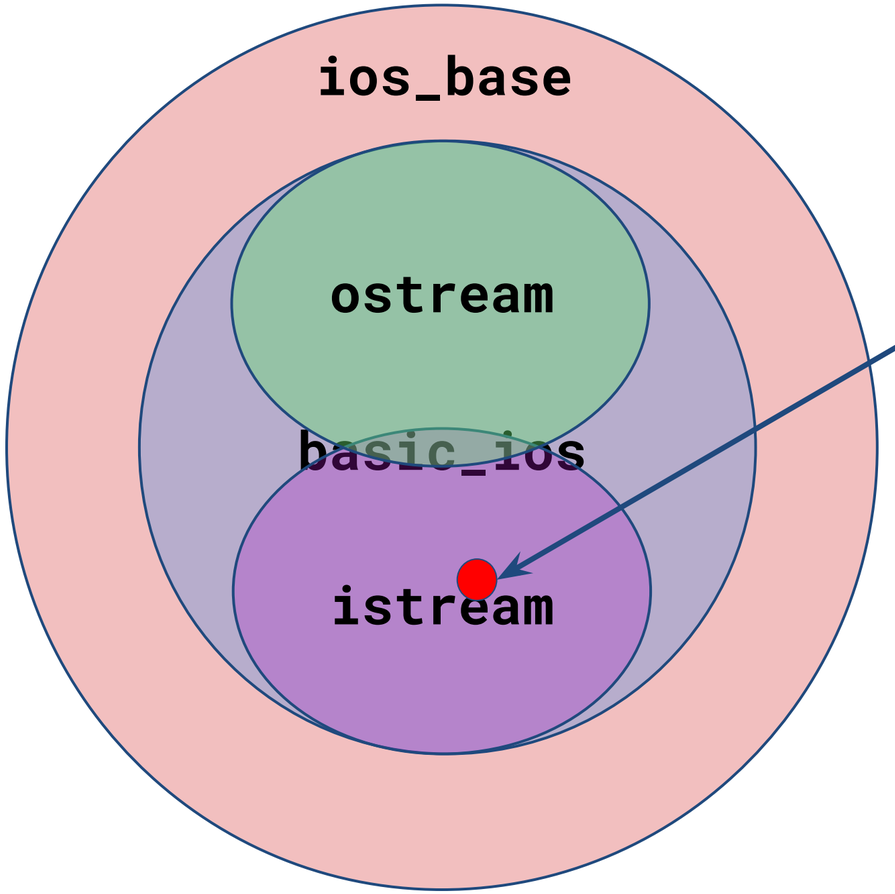
Each of these types are associated with some functionality – more on this later

streams and types



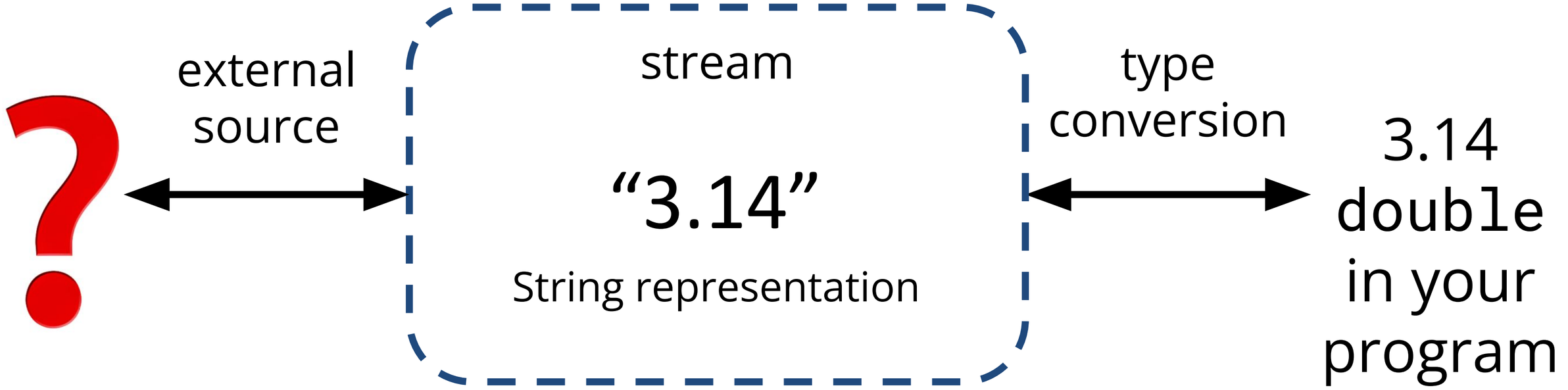
`std::cout` has the property of the **`std::basic_ostream`** type

streams and types

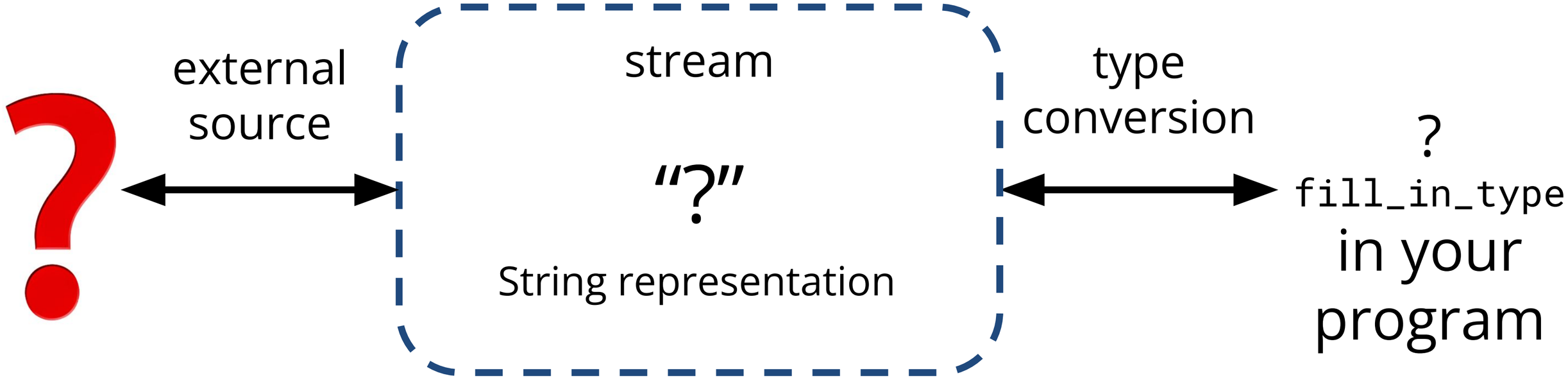


`std::cin` has the property of the **`std::istream`** type

Generalizing the Stream



Implementation vs Abstraction



Why is this even useful?

Streams allow for a **universal** way of **dealing with external data**

What streams actually are

Classifying different types of streams

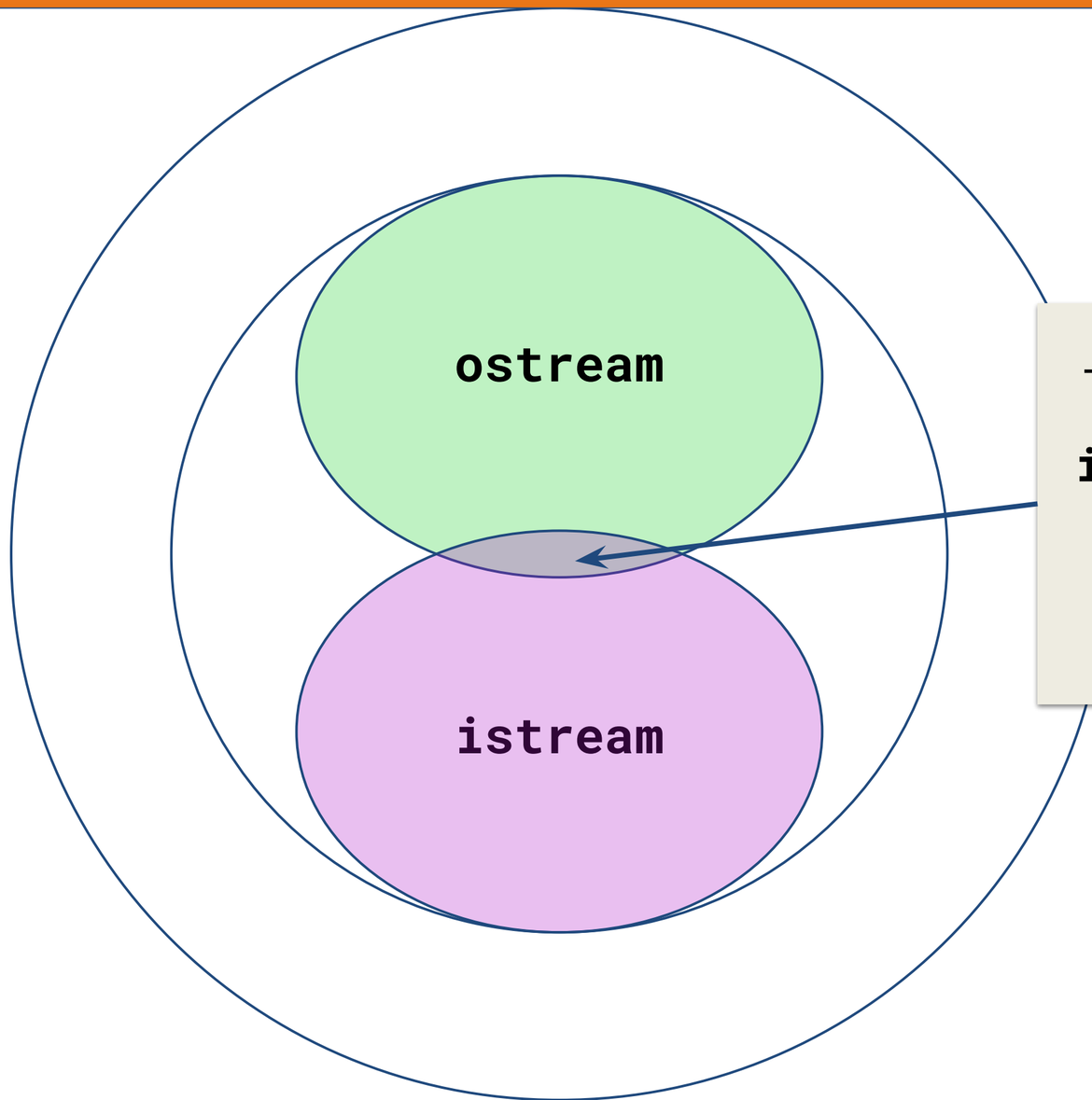
Input streams (I)

- a way to read data from a source
    - Are inherited from **`std::istream`**
    - ex. reading in something from the console (**`std::cin`**)
    - primary operator: **`>>`** (called the extraction operator)

Output streams (O)

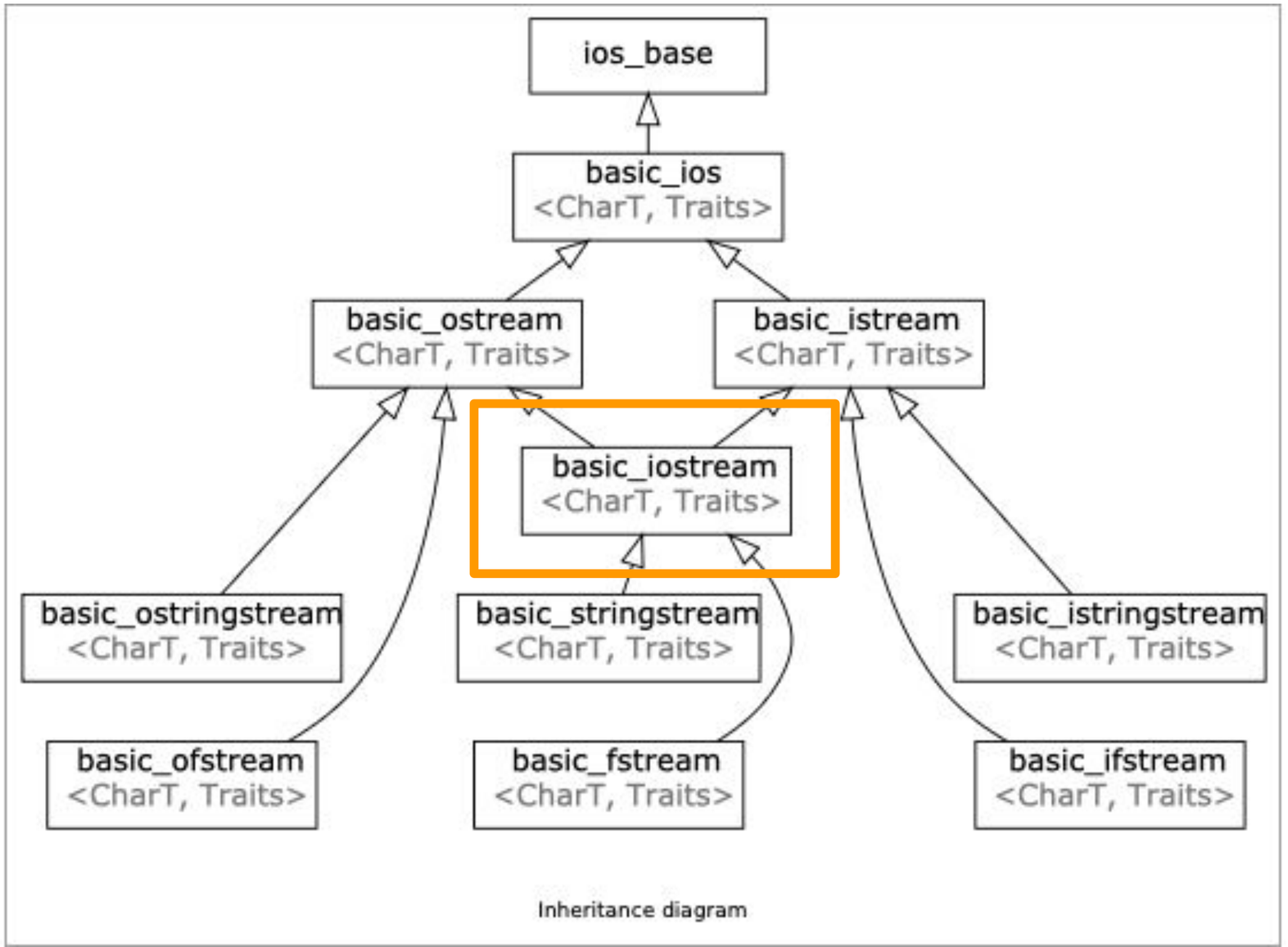
- a way to write data to a destination
    - Are inherited from **`std::ostream`**
    - ex. writing out something to the console (**`std::cout`**)
    - primary operator: **`<<`** (called the insertion operator)

streams and types

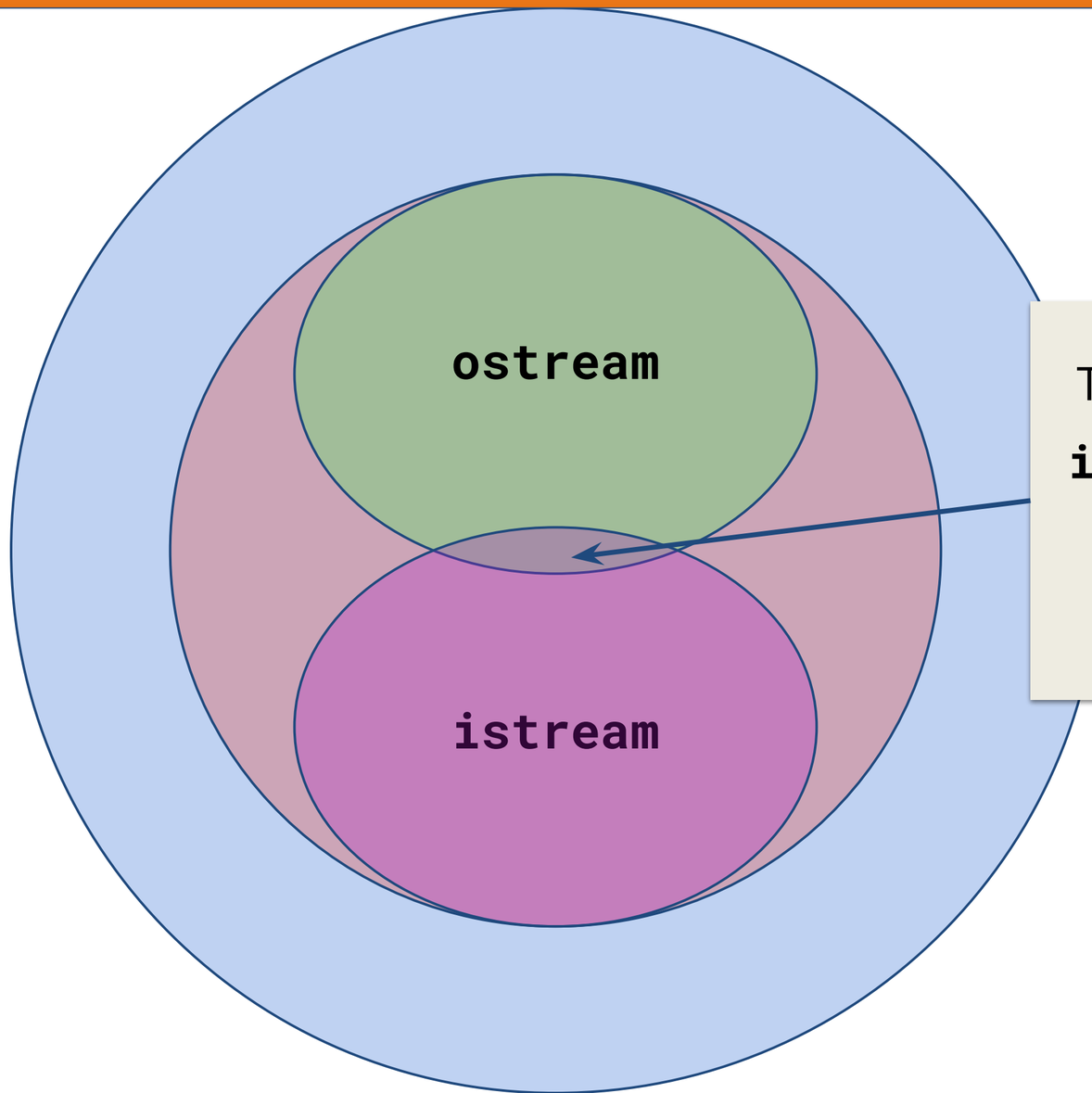


This intersection is known as **`iostream`** which takes has all of the characteristics of **`ostream`** *and* **`istream`**!

What streams actually are

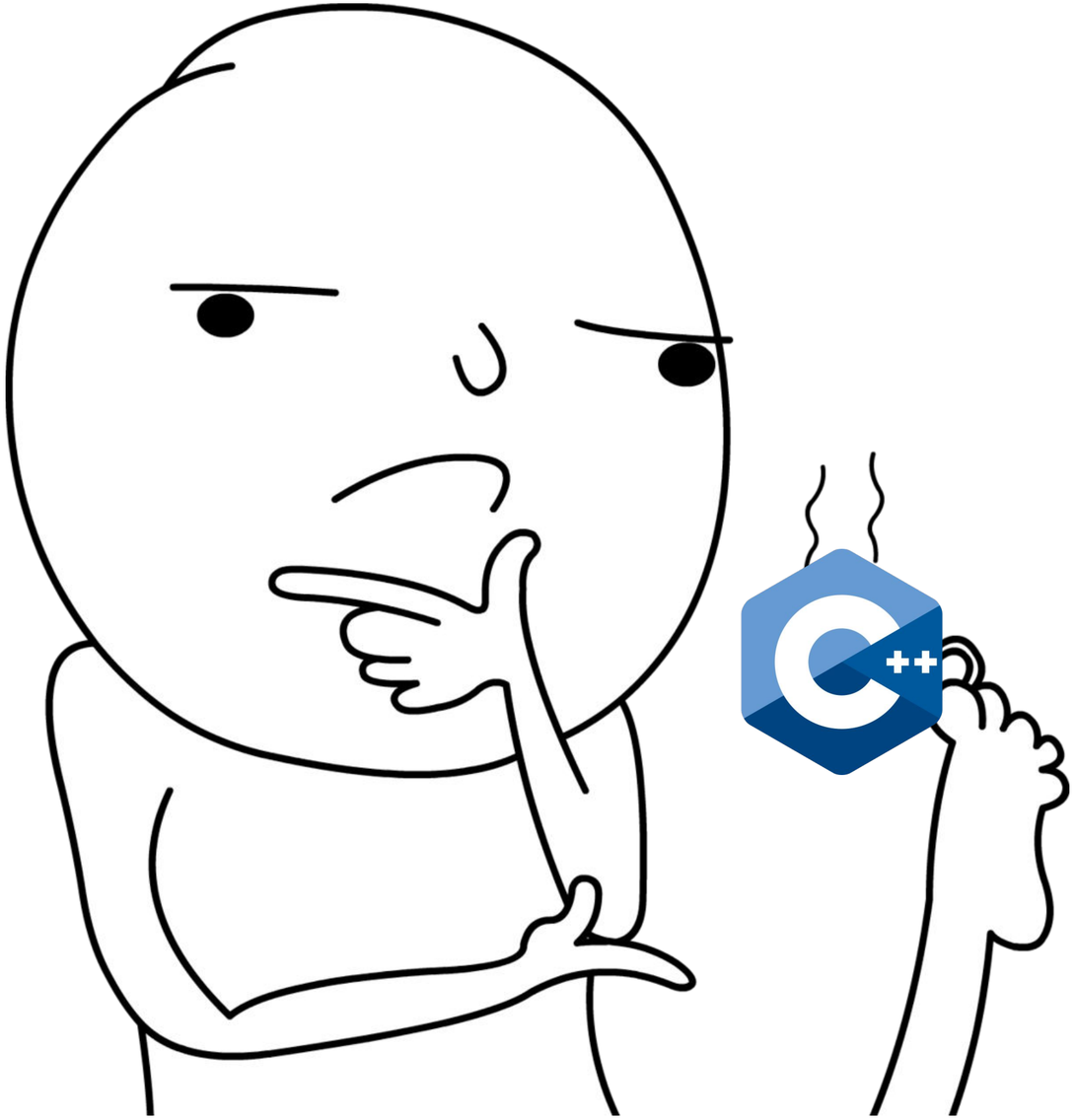


streams and types



This intersection is known as **`iostream`** which takes has all of the characteristics of **`ostream`** *and* **`istream`**!

What questions do we have?



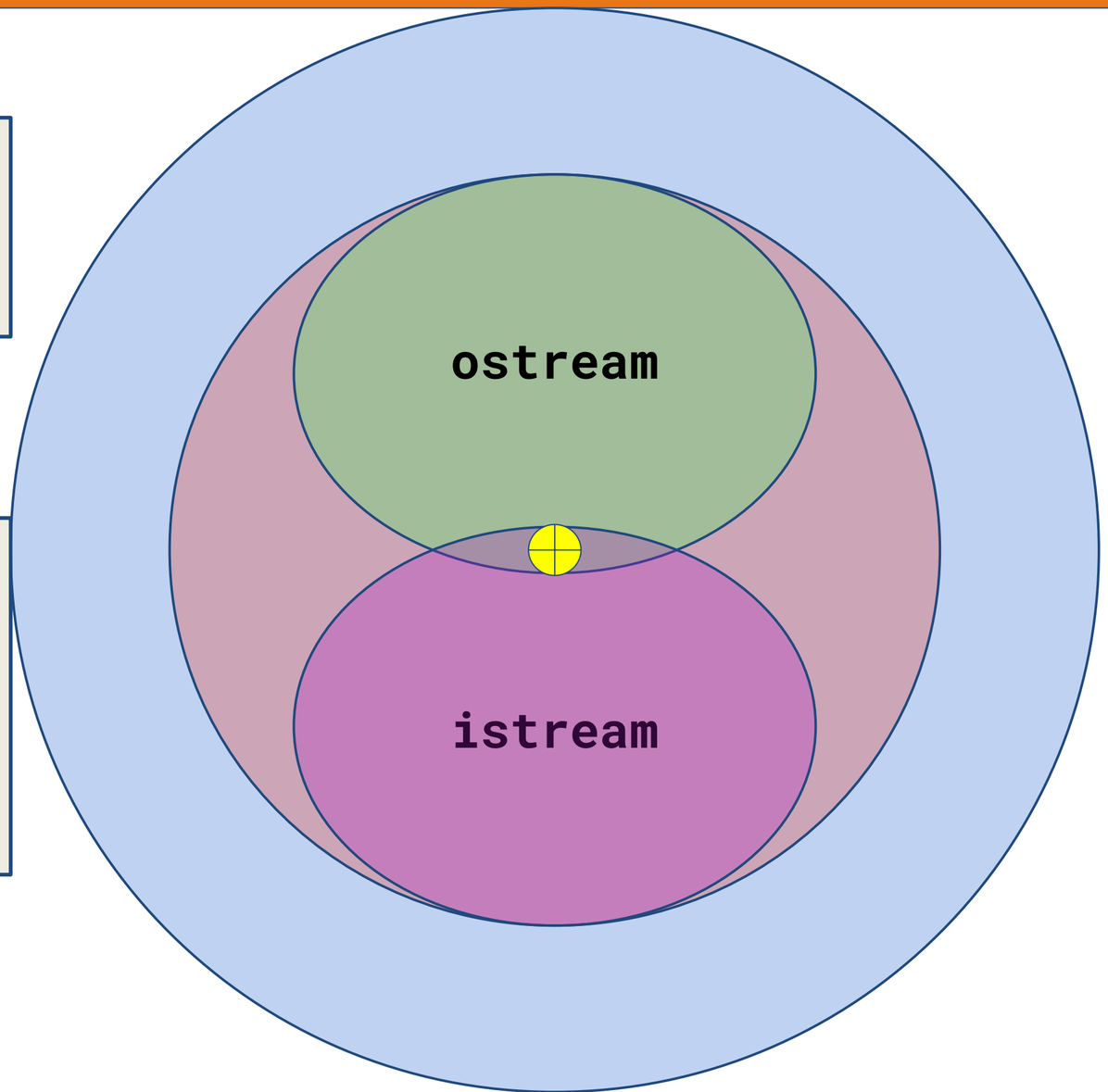
Plan

1. Quick recap
2. What are streams??!!
3. **`stringstreams`**!
4. `cout` and `cin`
5. Output streams
6. Input streams

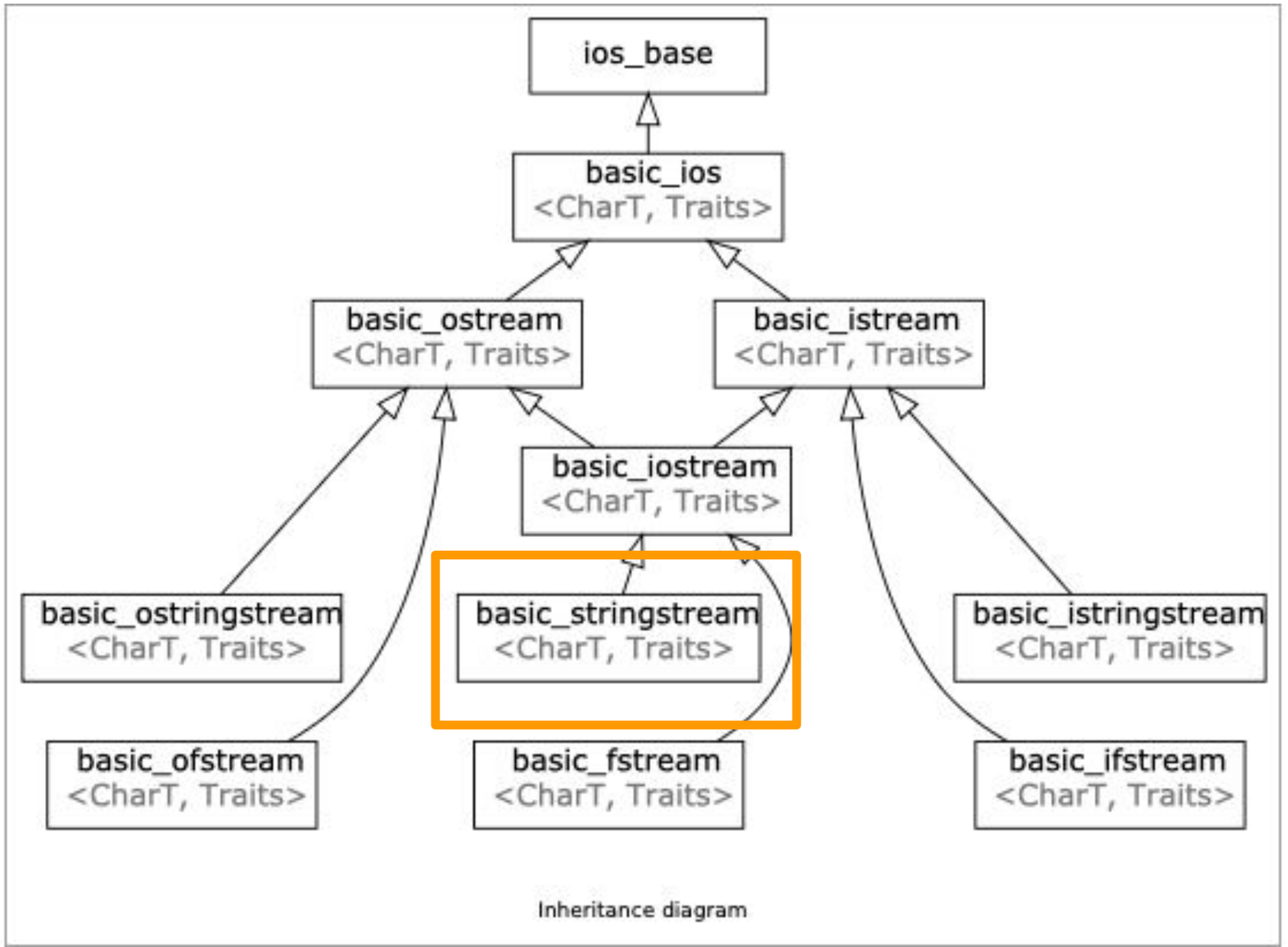
std::stringstream

What?
a way to treat strings as streams

Utility?
`stringstreams` are useful for use-cases that deal with mixing data types



What streams actually are



std::stringstream example

```
void foo() {
  /// partial Bjarne Quote
  std::string initial_quote = “Bjarne Stroustrup C makes it easy to shoot
  yourself in the foot”;

  /// create a stringstream
  std::stringstream ss(initial_quote);

  /// data destinations
  std::string first;
  std::string last;
  std::string language, extracted_quote;

  ss >> first >> last >> language >> extracted_quote;
  std::cout << first << “ ” << last << “ said this: ”<< language << “ “ <<
  extracted_quote << std::endl;
}
```

initialize `stringstream` with string constructor

std::stringstream example

```
void foo() {
  /// partial Bjarne Quote
  std::string initial_quote = “Bjarne Stroustrup C makes it easy to shoot
  yourself in the foot”;

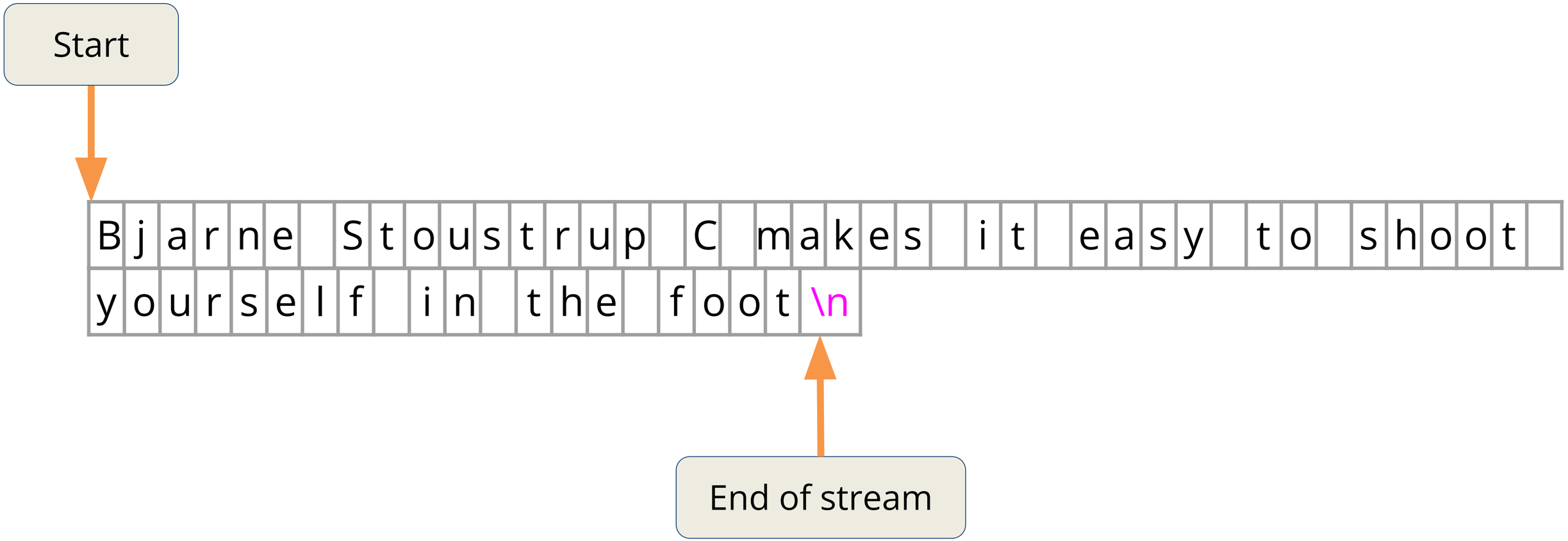
  /// create a stringstream
  std::stringstream ss;
  ss << initial_quote;

  /// data destinations
  std::string first;
  std::string last;
  std::string language, extracted_quote;

  ss >> first >> last >> language >> extracted_quote;
  std::cout << first << “ ” << last << “ said this: ”<< language << “ “ <<
  extracted_quote << std::endl;
}
```

since this is a stream we can also **insert** the `initial_quote` like this!

what the stream looks like!



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  ss >> first >> last >> language;
  std::cout << first << “ ” << last << “ said this: ”<< language << “ “ <<
  extracted_quote << std::endl;
}
```

Remember! Streams move data from one place to another

std::stringstream example

```
void foo() {
  /// partial Bjarne Quote
  std::string initial_quote = “Bjarne Stroustrup C makes it easy to shoot
  yourself in the foot”;

  /// create a stringstream
  std::stringstream ss(initial_quote);

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  std::string first;
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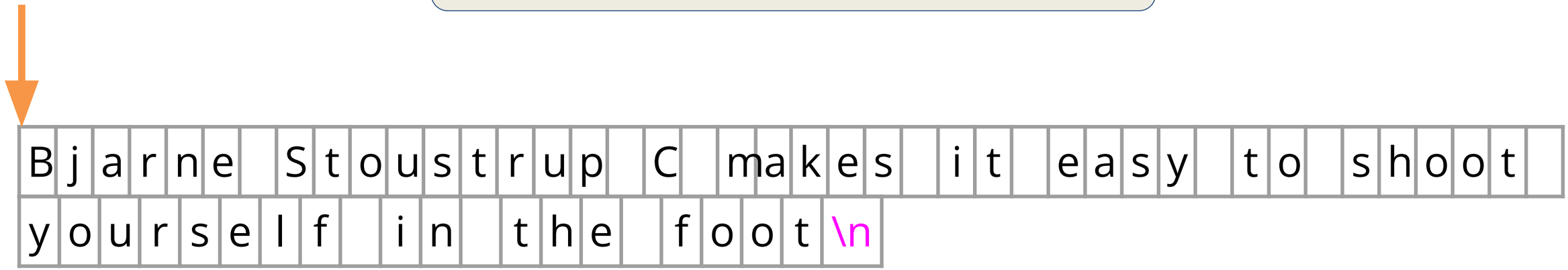
  ss >> first >> last >> language;
  std::cout << first << “ ” << last << “ said this: ”<< language << “ “ <<
  extracted_quote << std::endl;
}
```

We’re making use of the insertion operator

what the stream looks like!

```
ss >> first >> last >> language;
```



First

Last

Language

what the stream looks like!

```
ss >> first >> last >> language;
```

extracts from the stream!

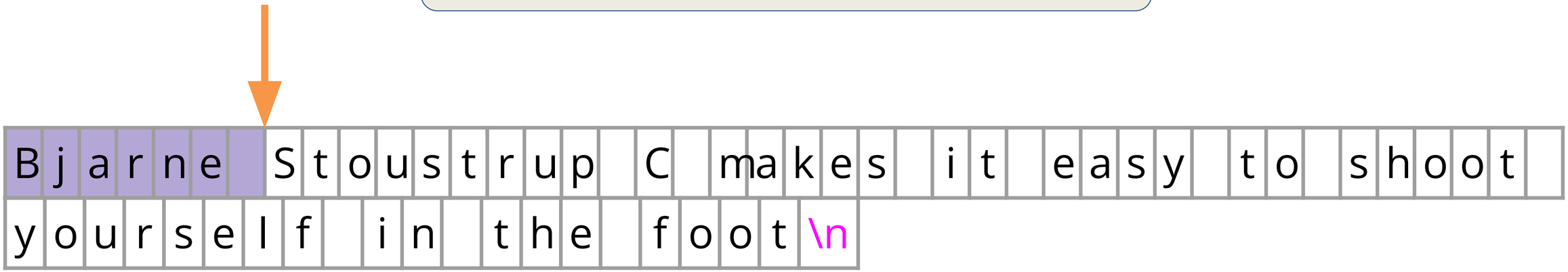
First

Last

Language

what the stream looks like!

```
ss >> first >> last >> language;
```



Bjarne

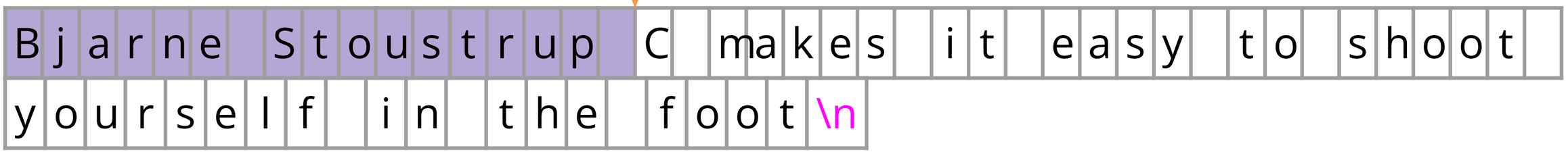
First

Last

Language

what the stream looks like!

```
ss >> first >> last >> language;
```



Bjarne

Stroustrup

First

Last

Language

what the stream looks like!

```
ss >> first >> last >> language;
```

Bjarne

Stroustrup

C

First

Last

Language

std::stringstream example

```
void foo() {
  /// partial Bjarne Quote
  std::string initial_quote = “Bjarne Stroustrup C makes it easy to shoot
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  /// create a stringstream
  std::stringstream ss(initial_quote);

  /// data destinations
  std::string first;
  std::string last;
  std::string language, extracted_quote;

  ss >> first >> last >> language;
  std::cout << first << “ ” << last << “ said this: ” << language << “ “ <<
  extracted_quote << std::endl;
}
```

We want to extract the quote!

what the stream looks like!

```
ss >> first >> last >> language >> extracted_quote;
```

Bjarne

Stroustrup

C

First

Last

Language

what the stream looks like!

Problem:
?

```
ss >> first >> last >> language >> extracted_quote;
```

Bjarne

Stroustrup

C

First

Last

Language

what the stream looks like!

Problem:
The **>>** operator only reads until the next whitespace!

```
ss >> first >> last >> language >> extracted_quote;
```

Bjarne

First

Stroustrup

Last

C

Language

what the stream looks like!

Problem:
The **>>** operator only reads until the next whitespace!

```
ss >> first >> last >> language >> extracted_quote;
```

Bjarne

First

Stroustrup

Last

C

Language

Use `getline()`!

```
istream& getline(istream& is, string& str, char delim)
```

- **`getline()`** reads an input stream, **`is`**, up until the **`delim`** char and stores it in some buffer, **`str`**.

Use `getline()`!

```
istream& getline(istream& is, string& str, char delim)
```

- **`getline()`** reads an input stream, **`is`**, up until the **`delim`** char and stores it in some buffer, **`str`**.

- The `delim` char is by default ‘`\n`’.

Use `getline()`!

```
istream& getline(istream& is, string& str, char delim)
```

- **`getline()`** reads an input stream, **`is`**, up until the **`delim`** char and stores it in some buffer, **`str`**.
- The `delim` char is by default ‘`\n`’.
- **`getline()`** ***consumes*** the `delim` character!
  - PAY ATTENTION TO THIS :)

use std::getline()!

```
ss >> first >> last >> language >> extracted_quote;
```

Bjarne

First

Stroustrup

Last

C

Language

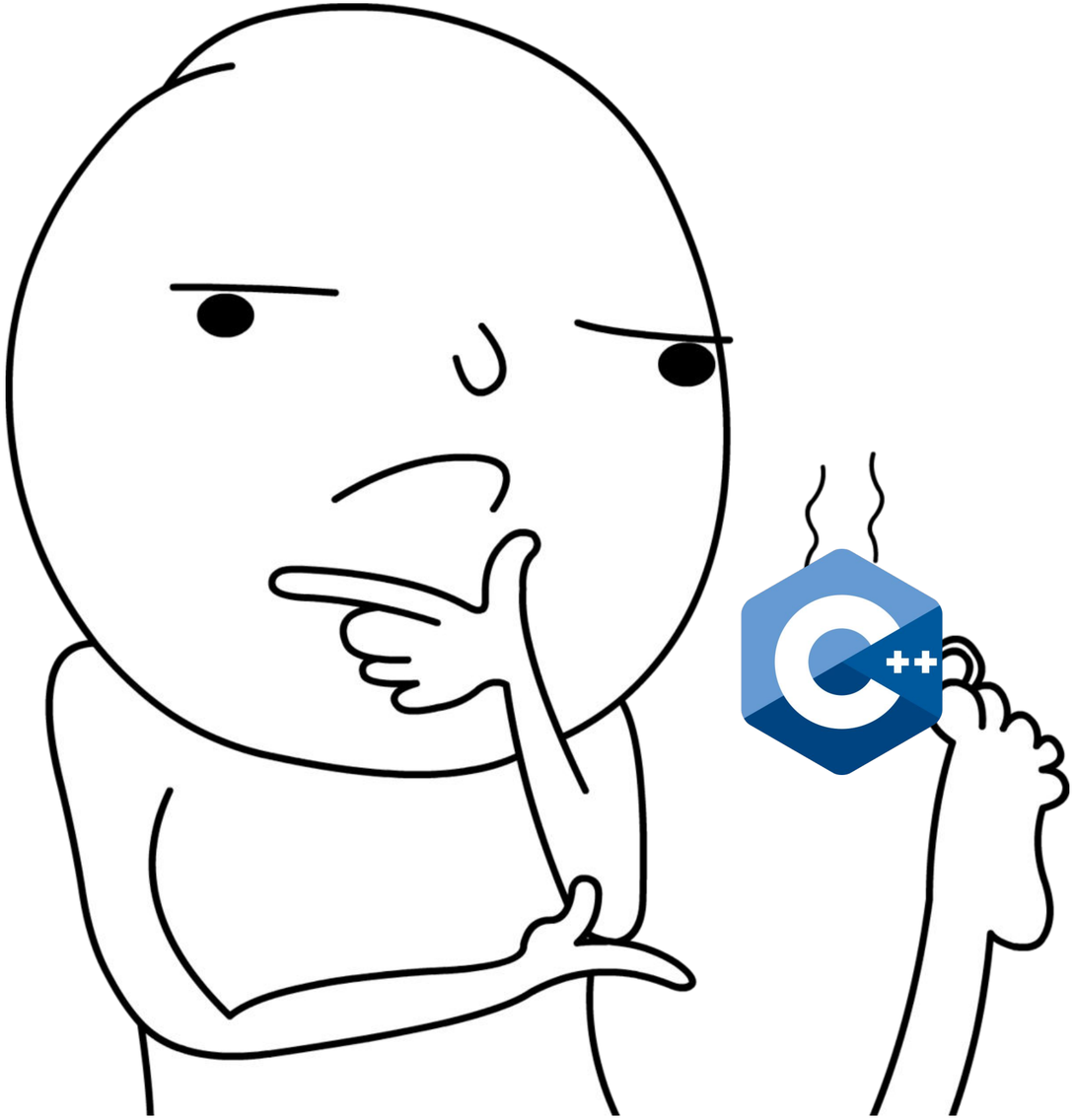
std::stringstream example

```
void foo() {
  /// partial Bjarne Quote
  std::string initial_quote = “Bjarne Stroustrup C makes it easy to shoot
  yourself in the foot”;

  /// create a stringstream
  std::stringstream ss(initial_quote);

  /// data destinations
  std::string first;
  std::string last;
  std::string language, extracted_quote;
  ss >> first >> last >> language;
  std::getline(ss, extracted_quote);
  std::cout << first << “ ” << last << “ said this: ‘” << language << “ “ <<
  extracted_quote + “‘“ << std::endl;
}
```

What questions do we have?



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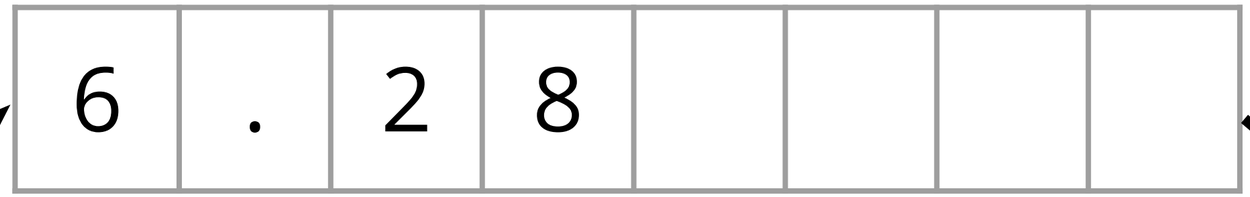
Output Streams

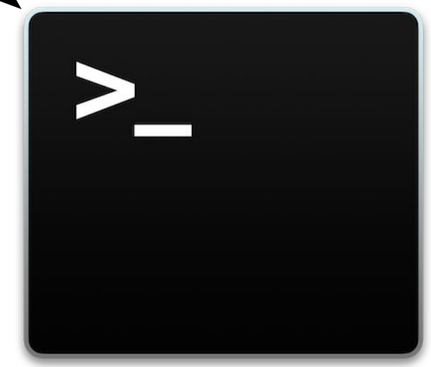
- a way to write data to a destination/external source
  - ex. writing out something to the console (`std::cout`)
  - use the << operator to ***send*** to the output stream

Zooming in on Output Streams!

Character in output streams are stored in an intermediary buffer before being flushed to the destination

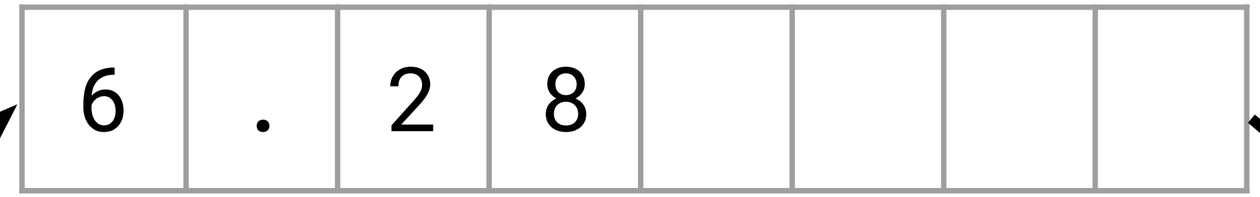


Flush

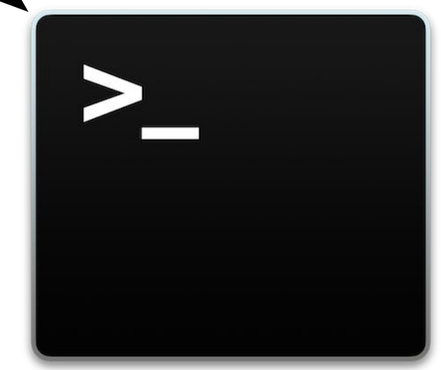



```
double tao = 6.28;
std::cout << tao;
```

Zooming in on Output Streams!



Flush

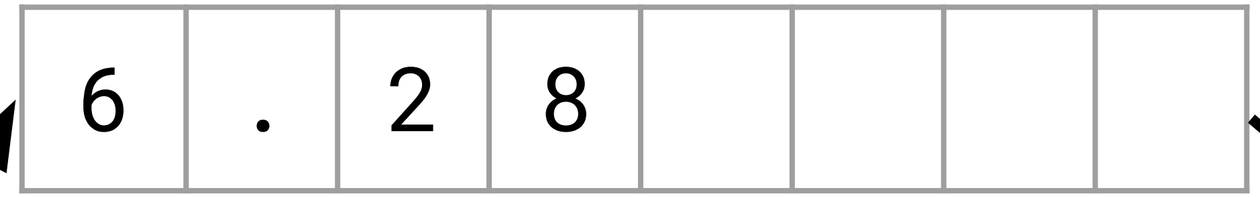



```
double tao = 6.28;
std::cout << tao;
```

`std::cout` stream is **line-buffered**

contents in buffer not shown on external source until an explicit flush occurs!

Zooming in on Output Streams!

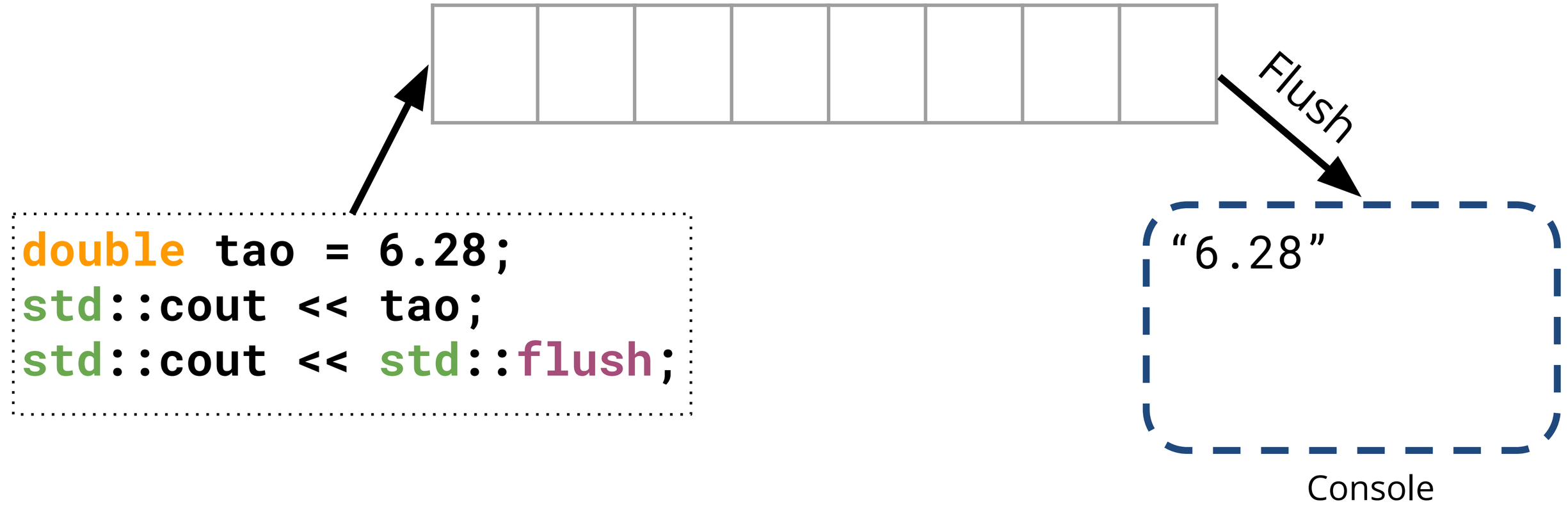


Flush

```
double tao = 6.28;
std::cout << tao;
std::cout << std::flush;
```

Console

Zooming in on Output Streams!



Zooming in on Output Streams!

Flush

```
double tao = 6.28;
std::cout << tao;
/// Also flushes!
std::cout << std::endl;
```

“6.28”

Console

std::endl

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << std::endl;
  }
  return 0;
}
```

Output:

"1"
"2"
"3"
"4"
"5"

`std::endl` tells the `cout` stream to end the line!

Here's without `std::endl`

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i;
  }
  return 0;
}
```

Output:

"12345"

std::endl

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << std::endl;
  }
  return 0;
}
```

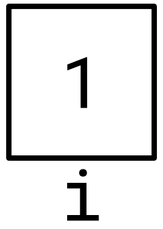
Output:

"1"
"2"
"3"
"4"
"5"

`std::endl` ***also*** tells the stream to **flush**

std::endl

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << std::endl;
  }
  return 0;
}
```

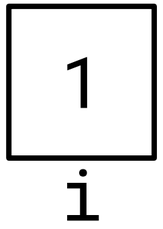


Output:

`std::endl` ***also*** tells the stream to **flush**

std::endl

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << std::endl;
  }
  return 0;
}
```



intermediate buffer

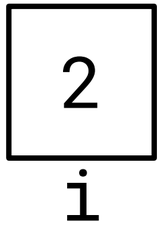
endl also flushes! So it is immediately sent to destination

Output:

`std::endl` ***also*** tells the stream to **flush**

std::endl

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << std::endl;
  }
  return 0;
}
```



intermediate buffer

When a stream is flushed the **intermediate buffer is cleared!**

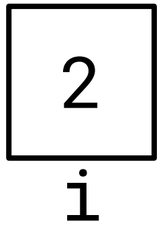
Output:

"1"

`std::endl` ***also*** tells the stream to **flush**

std::endl

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << std::endl;
  }
  return 0;
}
```



intermediate buffer

Next integer is put into the stream and immediately flushed!

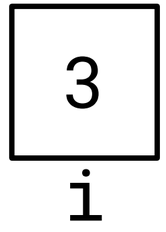
Output:

“1”

`std::endl` ***also*** tells the stream to **flush**

std::endl

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << std::endl;
  }
  return 0;
}
```



intermediate buffer

Next integer is put into the stream and immediately flushed!

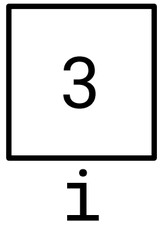
Output:

"1"
"2"

`std::endl` ***also*** tells the stream to **flush**

std::endl

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << std::endl;
  }
  return 0;
}
```



intermediate buffer

Next integer is put into the stream and immediately flushed!

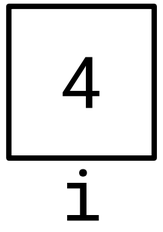
Output:

“1”
“2”

`std::endl` ***also*** tells the stream to **flush**

std::endl

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << std::endl;
  }
  return 0;
}
```



intermediate buffer

Next integer is put into the stream and immediately flushed!

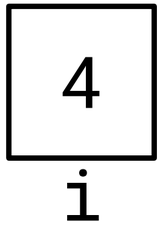
Output:

"1"
"2"
"3"

`std::endl` ***also*** tells the stream to **flush**

std::endl

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << std::endl;
  }
  return 0;
}
```



intermediate buffer

Next integer is put into the stream and immediately flushed!

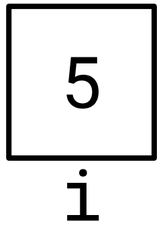
Output:

“1”
“2”
“3”

`std::endl` ***also*** tells the stream to **flush**

std::endl

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << std::endl;
  }
  return 0;
}
```



intermediate buffer

Next integer is put into the stream and immediately flushed!

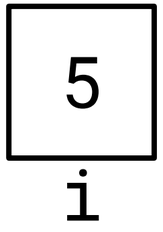
Output:

"1"
"2"
"3"
"4"

`std::endl` ***also*** tells the stream to **flush**

std::endl

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << std::endl;
  }
  return 0;
}
```



intermediate buffer

Next integer is put into the stream and immediately flushed!

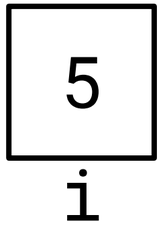
Output:

“1”
“2”
“3”
“4”

`std::endl` ***also*** tells the stream to **flush**

std::endl

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << std::endl;
  }
  return 0;
}
```



intermediate buffer

Next integer is put into the stream and immediately flushed!

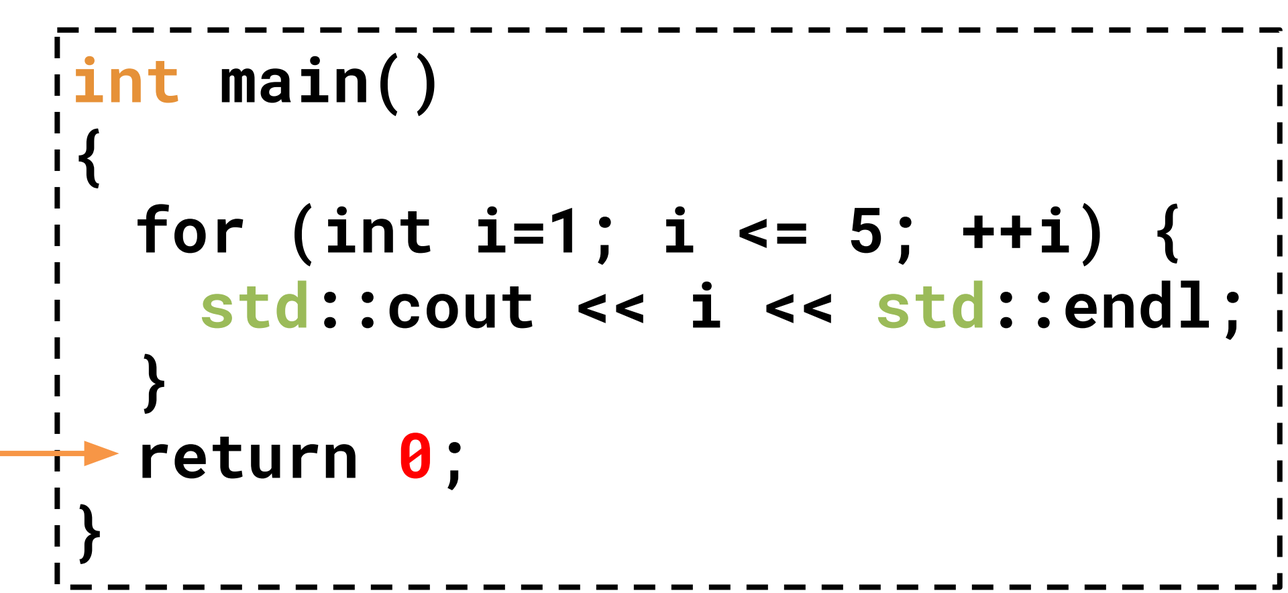
Output:

"1"
"2"
"3"
"4"
"5"

`std::endl` ***also*** tells the stream to **flush**

std::endl

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << std::endl;
  }
  return 0;
}
```



intermediate buffer

flushing is an expensive operation!

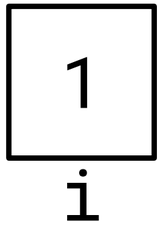
Output:

"1"
"2"
"3"
"4"
"5"

`std::endl` ***also*** tells the stream to **flush**

‘\n’ 

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << '\n';
  }
  return 0;
}
```



intermediate buffer

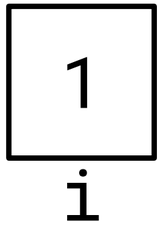
C++ is (kinda) smart! It knows when to auto flush

Output:

Let’s try just adding the **‘\n’** character

‘\n’ 

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << ‘\n’;
  }
  return 0;
}
```



intermediate buffer

C++ is (kinda) smart! It knows when to auto flush

Output:

Let’s try just adding the ‘\n’ character

‘\n’ 

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << ‘\n’;
  }
  return 0;
}
```

intermediate buffer

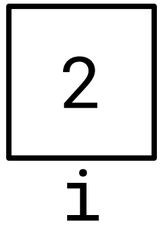
C++ is (kinda) smart! It knows when to auto flush

Output:

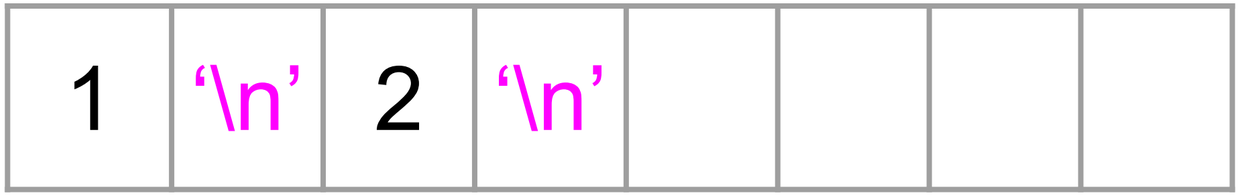
Let’s try just adding the ‘\n’ character

‘\n’ 

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << '\n';
  }
  return 0;
}
```



intermediate buffer



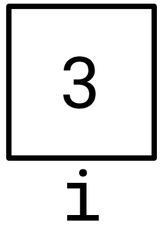
C++ is (kinda) smart! It knows when to auto flush

Output:

Let’s try just adding the ‘\n’ character

‘\n’ 

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << ‘\n’;
  }
  return 0;
}
```



intermediate buffer

1	‘\n’	2	‘\n’				

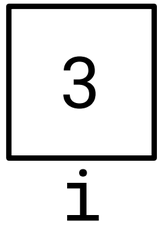
C++ is (kinda) smart! It knows when to auto flush

Output:

Let’s try just adding the ‘\n’ character

‘\n’ 

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << '\n';
  }
  return 0;
}
```



intermediate buffer

1	‘\n’	2	‘\n’	3	‘\n’		

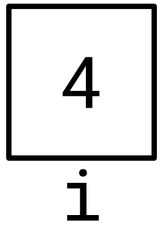
C++ is (kinda) smart! It knows when to auto flush

Output:

Let’s try just adding the ‘\n’ character

‘\n’ 

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << ‘\n’;
  }
  return 0;
}
```



intermediate buffer

1	‘\n’	2	‘\n’	3	‘\n’		

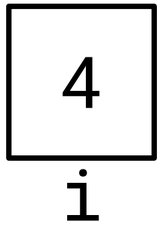
C++ is (kinda) smart! It knows when to auto flush

Output:

Let’s try just adding the ‘\n’ character

‘\n’ 

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << '\n';
  }
  return 0;
}
```



intermediate buffer

1	‘\n’	2	‘\n’	3	‘\n’	4	‘\n’

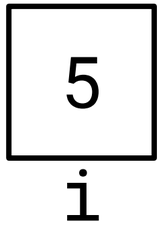
C++ is (kinda) smart! It knows when to auto flush

Output:

Let’s try just adding the ‘\n’ character

‘\n’ 

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << ‘\n’;
  }
  return 0;
}
```



intermediate buffer

1	‘\n’	2	‘\n’	3	‘\n’	4	‘\n’

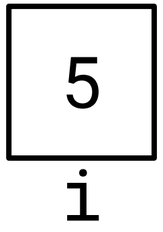
C++ is (kinda) smart! It knows when to auto flush

Output:

Let’s try just adding the ‘\n’ character

‘\n’ 🤠

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << '\n';
  }
  return 0;
}
```



intermediate buffer

1	‘\n’	2	‘\n’	3	‘\n’	4	‘\n’

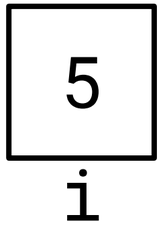
😱🤯 Our intermediate buffer is full!

Output:

Let’s try just adding the ‘\n’ character

‘\n’ 🤠

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << ‘\n’;
  }
  return 0;
}
```



intermediate buffer

C++: FLUSH

Output:

“1”
“2”
“3”
“4”

Let’s try just adding the ‘\n’ character

‘\n’ 🤠

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << ‘\n’;
  }
  return 0;
}
```

intermediate buffer

5	‘\n’						

Yay!

Output:

“1”
“2”
“3”
“4”

Let’s try just adding the ‘\n’ character

‘\n’ 🤠

```
int main()
{
  for (int i=1; i <= 5; ++i) {
    std::cout << i << ‘\n’;
  }
  return 0;
}
```

intermediate buffer

Yay!

Output:

“1”
“2”
“3”
“4”
“5”

Let’s try just adding the ‘\n’ character

Recall

- **`cerr` and `clog`**

  `cerr`: used to output errors (unbuffered)

  `clog`: used for non-critical event logging (buffered)

read more here: GeeksForGeeks

A shoutout and clarification

So there’s a small caveat to this

A shoutout and clarification

However, upon testing these examples, I observed that '\n' seems to flush the buffer in a manner similar to std::cout. Further research led me to the CPP Reference std::endl, which states, "In many implementations, standard output is line-buffered, and writing '\n' causes a flush anyway, unless std::ios::sync_with_stdio(false) was executed." This suggests that in many standard outputs, '\n' behaves the same as std::cout. Additionally, when I appended | cat to my program, I noticed that in file output, '\n' does not immediately flush the buffer.

In case you're looking at these slides Aolin, thank you for pointing this out!

A shoutout and clarification

However, upon testing these examples, I observed that '\n' seems to flush the buffer in a manner similar to std::cout. Further research led me to the CPP Reference std::endl, which states, "In many implementations, standard output is line-buffered, and writing '\n' causes a flush anyway, unless `std::ios::sync_with_stdio(false)` was executed." This suggests that in many standard outputs, '\n' behaves the same as std::cout. Additionally, when I appended | cat to my program, I noticed that in file output, '\n' does not immediately flush the buffer.

In case you're looking at these slides Aolin, thank you for pointing this out!

A shoutout and clarification

```cpp
int main()
{
  std::ios::sync_with_stdio(false)
  for (int i=1; i <= 5; ++i) {
    std::cout << i << '\n';
  }
  return 0;
}
```

You ***may*** get a massive performance boost from this. Read more about this here

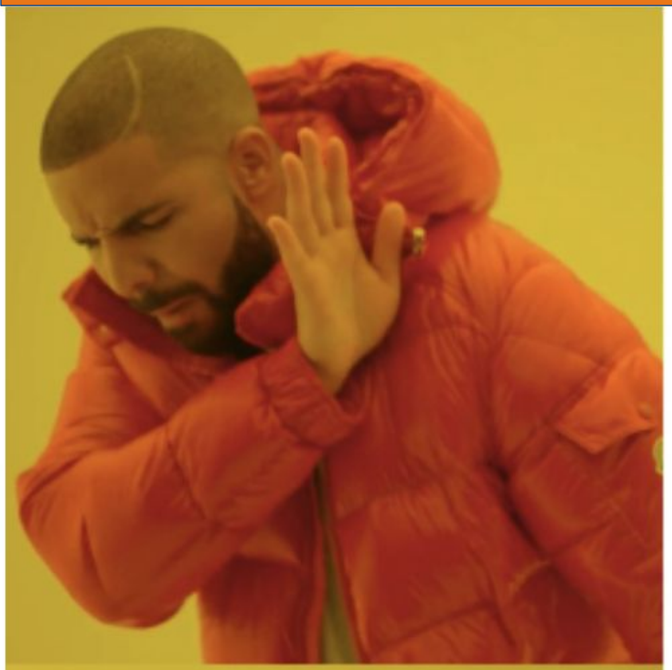
In case you're looking at these slides Aolin, thank you for pointing this out!


Jewel-Osco


YOU WASTED ENOUGH OF MY TIME
CAN I PLEASE HAVE MY LIFE BACK?
memeshappen.com

ASIDE: If you’re interested in how computers are able to do multiple things at the same time take CS149!

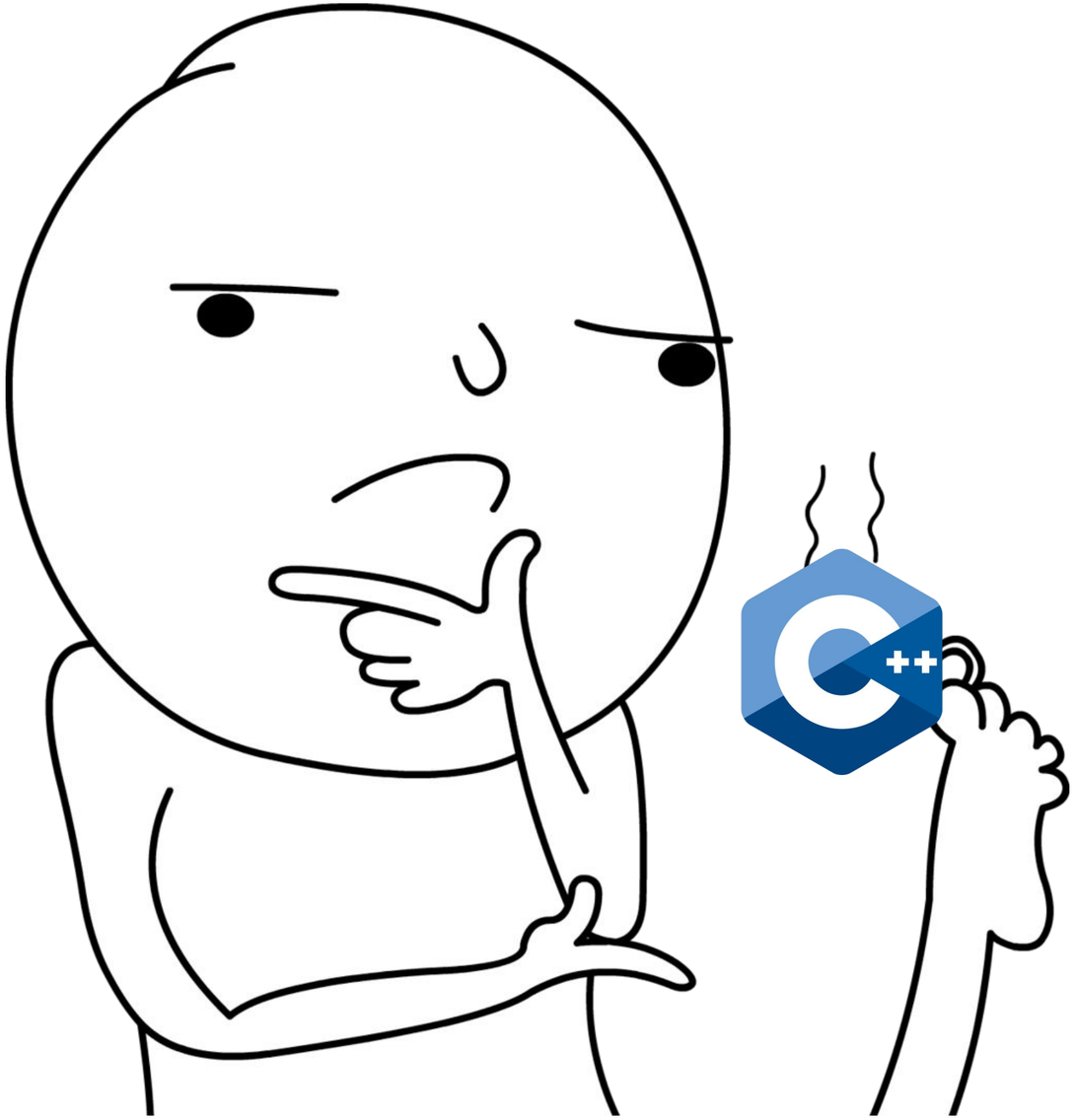
Use ‘\n’!



```
std::cout << “Draaaakkkkeeeeeeeeeee” << std::endl;
```

```
std::cout << “Draaaakkkkeeeeeeeeeee” << ‘\n’;
```

What questions do we have?



Output File Streams

- Output file streams have a type: `std::ofstream`
- a way to write data to a file!
  - use the << insertion operator to ***send*** to the file
  - There are some methods for `std::ofstream` check them out
  - Here are some you should know:
    - `is_open()`
    - `open()`
    - `close()`
    - `fail()`

Output File Streams

```
int main() {
  /// associating file on construction
  std::ofstream ofs("hello.txt");
  if (ofs.is_open()) {
    ofs << "Hello CS106L!" << '\n';
  }
  ofs.close();
  ofs << "this will not get written";

  ofs.open("hello.txt");
  ofs << "this will though! It's open
again";
  return 0;
}
```

Output File Streams

```
int main() {
  /// associating file on construction
  std::ofstream ofs("hello.txt");
  if (ofs.is_open()) {
    ofs << "Hello CS106L!" << '\n';
  }
  ofs.close();
  ofs << "this will not get written";

  ofs.open("hello.txt");
  ofs << "this will though! It's open
again";
  return 0;
}
```

Creates an output file stream to the file "hello.txt"

Output File Streams

```
int main() {
  /// associating file on construction
  std::ofstream ofs("hello.txt");
  if (ofs.is_open()) {
    ofs << "Hello CS106L!" << '\n';
  }
  ofs.close();
  ofs << "this will not get written";

  ofs.open("hello.txt");
  ofs << "this will though! It's open
again";
  return 0;
}
```

Checks if the file is open and if it is, then tries to write to it!

Output File Streams

```
int main() {
  /// associating file on construction
  std::ofstream ofs("hello.txt");
  if (ofs.is_open()) {
    ofs << "Hello CS106L!" << '\n';
  }
  ofs.close();
  ofs << "this will not get written";

  ofs.open("hello.txt");
  ofs << "this will though! It's open
again";
  return 0;
}
```

This closes the output file stream to "hello.txt"

Output File Streams

```
int main() {
  /// associating file on construction
  std::ofstream ofs("hello.txt");
  if (ofs.is_open()) {
    ofs << "Hello CS106L!" << '\n';
  }
  ofs.close();
  ofs << "this will not get written";

  ofs.open("hello.txt");
  ofs << "this will though! It's open
again";
  return 0;
}
```

Will silently fail

Output File Streams

```
int main() {
  /// associating file on construction
  std::ofstream ofs("hello.txt");
  if (ofs.is_open()) {
    ofs << "Hello CS106L!" << '\n';
  }
  ofs.close();
  ofs << "this will not get written";

  ofs.open("hello.txt");
  ofs << "this will though! It's open
again";
  return 0;
}
```

Reopens the stream

Output File Streams

```
int main() {
  /// associating file on construction
  std::ofstream ofs("hello.txt");
  if (ofs.is_open()) {
    ofs << "Hello CS106L!" << '\n';
  }
  ofs.close();
  ofs << "this will not get written";

  ofs.open("hello.txt");
  ofs << "this will though! It's open
again";
  return 0;
}
```

Successfully writes to stream

Let's checkout some code!

My cue to see code :)

Output File Streams

```
int main() {
  /// associating file on construction
  std::ofstream ofs("hello.txt")
  if (ofs.is_open()) {
    ofs << "Hello CS106L!" << '\n';
  }
  ofs.close();
  ofs << "this will not get written";

  ofs.open("hello.txt", std::ios::app);
  ofs << "this will though! It's open
again";
  return 0;
}
```

Flag specifies you want to append, not truncate!

Input File Streams

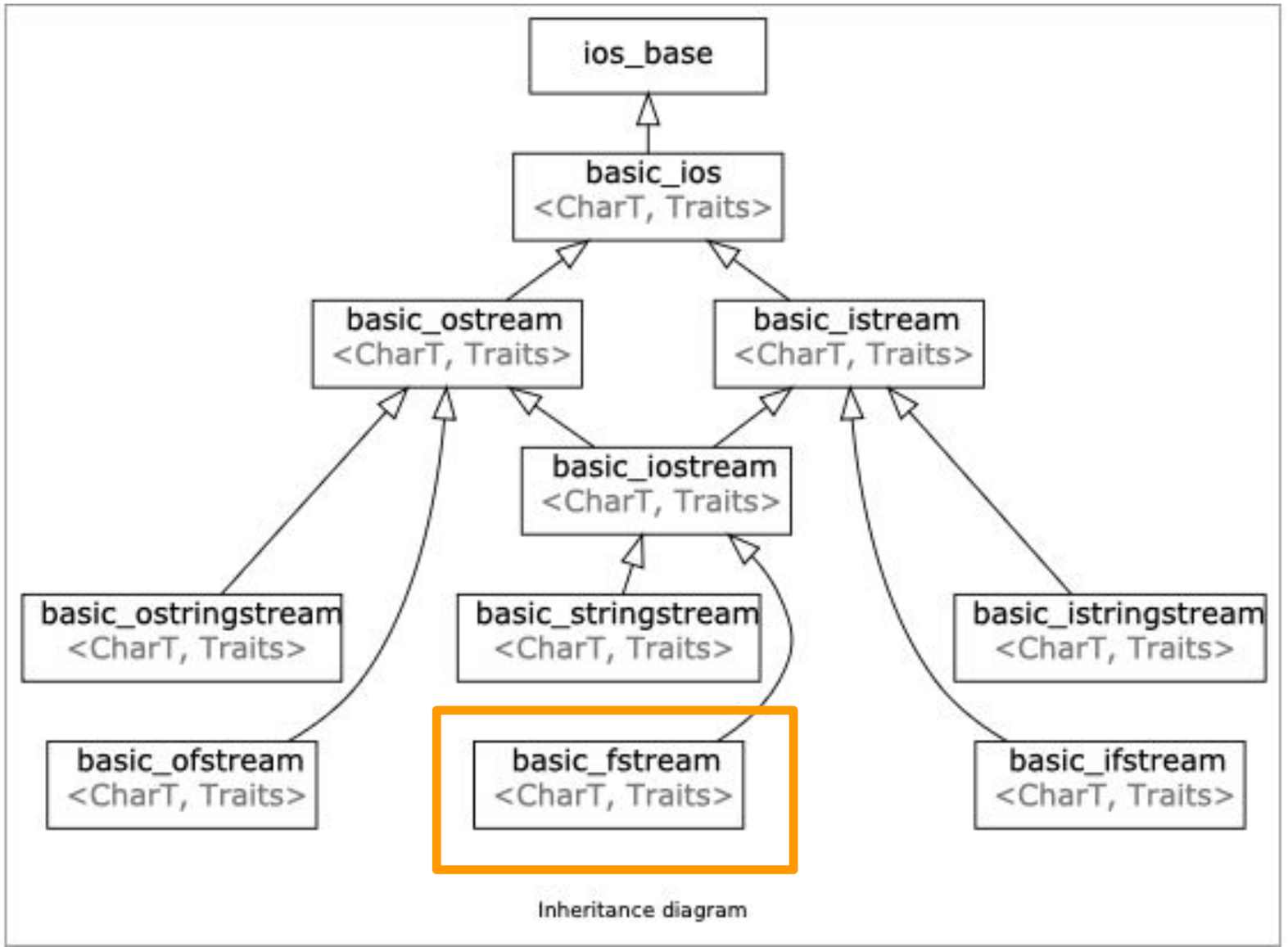
```
int inputFileStreamExample() {
  std::ifstream ifs("input.txt");
  if (ifs.is_open()) {
      std::string line;
      std::getline(ifs, line);
      std::cout << "Read from the file: " << line << '\n';
  }
  if (ifs.is_open()) {
      std::string lineTwo;
      std::getline(ifs, lineTwo);
      std::cout << "Read from the file: " << lineTwo << '\n';
  }
  return 0;
}
```

Input File Streams

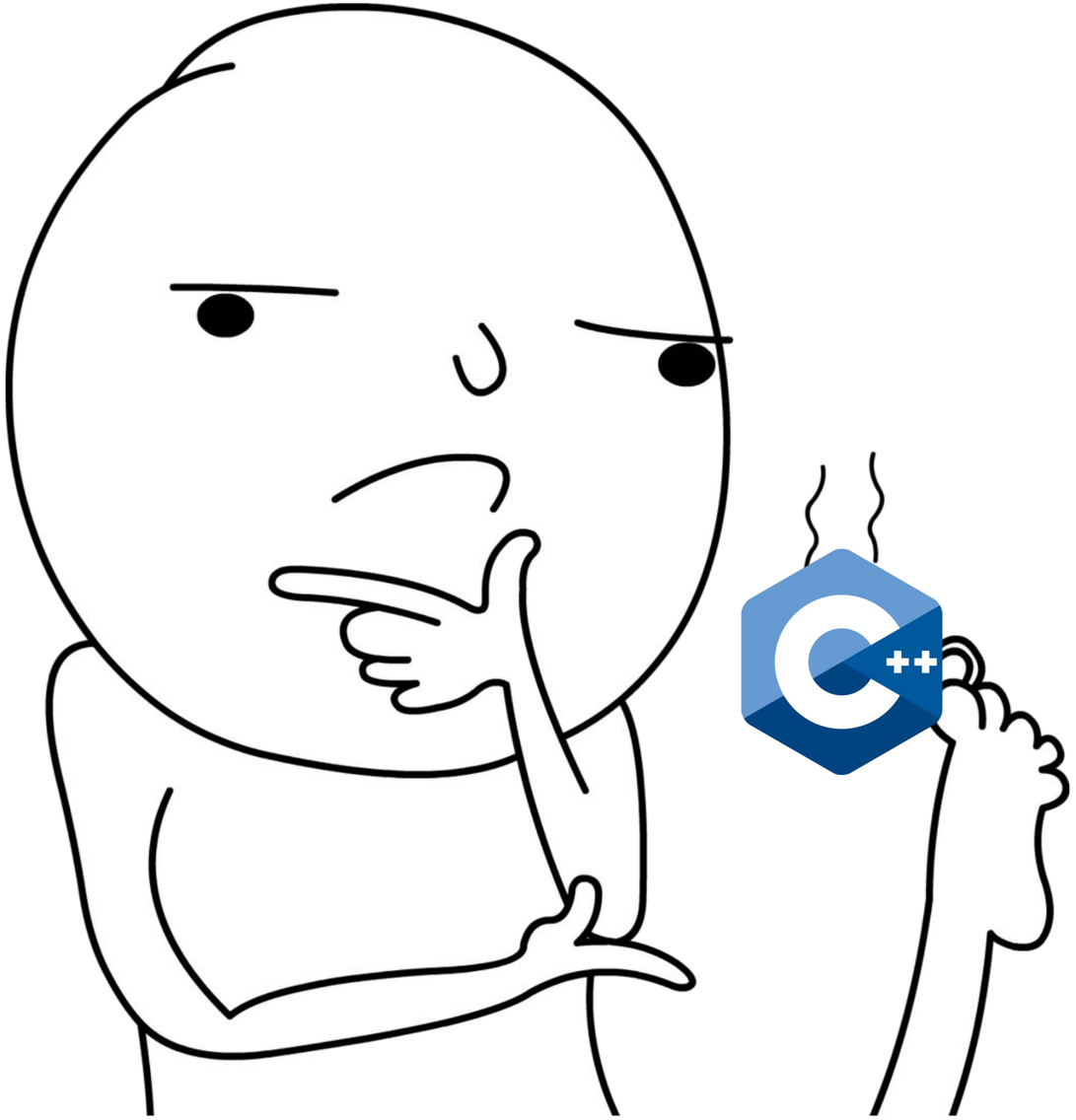
```
int inputFileStreamExample() {
  std::ifstream ifs("input.txt");
  if (ifs.is_open()) {
      std::string line;
      std::getline(ifs, line);
      std::cout << "Read from the file: " << line << '\n';
  }
  if (ifs.is_open()) {
      std::string lineTwo;
      std::getline(ifs, lineTwo);
      std::cout << "Read from the file: " << lineTwo << '\n';
  }
  return 0;
}
```

Input and output streams on the same source/destination type are complimentary!

IO File Streams



What questions do we have?



Plan

1. Quick recap
2. What are streams??!!
3. `stringstreams`!
4. `cout` and `cin`
5. Output streams
6. **Input streams**

Input Streams

- Input streams have the type `std::istream`
- a way to read data from an destination/external source
  - use the `>>` extractor operator to ***read*** from the input stream
  - Remember the `std::cin` is the console input stream

`std::cin`

- `std::cin` is buffered
- Think of it as a place where a user can store some data and then read from it
- `std::cin` buffer stops at a whitespace

std::cin

- `std::cin` is buffered
- Think of it as a place where a user can store some data and then read from it
- `std::cin` buffer stops at a whitespace
- Whitespace in C++ includes:
  - “ ” – a literal space
  - `\n` character
  - `\t` character

std::cin


```
int main()
{
  double pi;
  std::cin; /// what does this do?
  std::cin >> pi;
  std::cout << “pi is: “ << pi << ‘\n’;
  return 0;
}
```

cin buffer is empty so prompts for input!

std::cin


```
int main()
{
  double pi;
  std::cin; /// what does this do?
  std::cin >> pi;
  std::cout << “pi is: “ << pi << ‘\n’;
  return 0;
}
```

3.14

std::cin


```
int main()
{
  double pi;
  std::cin; /// what does this do?
  std::cin >> pi;
  std::cout << “pi is: “ << pi << ‘\n’;
  return 0;
}
```

cin not empty so it reads up to white space and saves it to **double pi**

3.14

std::cin


```
int main()
{
  double pi;
  std::cin; /// what does this do?
  std::cin >> pi;
  std::cout << “pi is: “ << pi << ‘\n’;
  return 0;
}
```

cout

“3.14”
“pi is: 3.14”

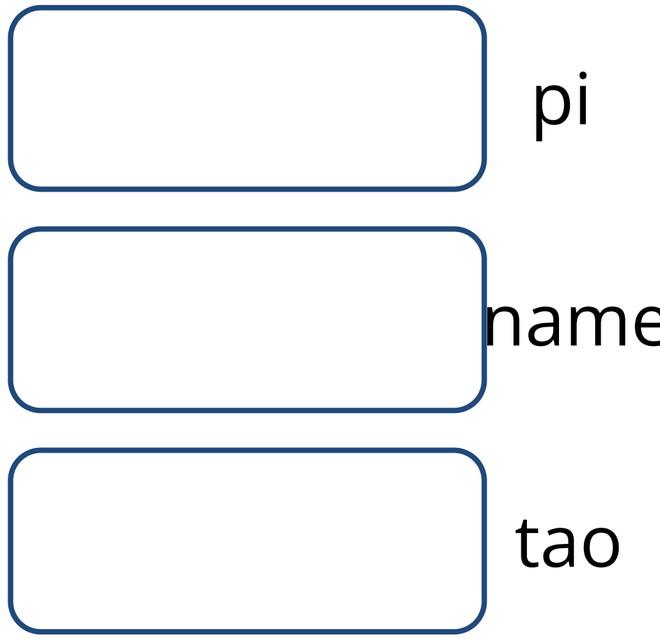
Alternatively


```
int main()
{
  double pi;
  std::cin >> pi; /// input directly!
  std::cout << “pi is: “ << pi << ‘\n’;
  return 0;
}
```

“3.14”
“pi is: 3.14”

When std::cin fails!

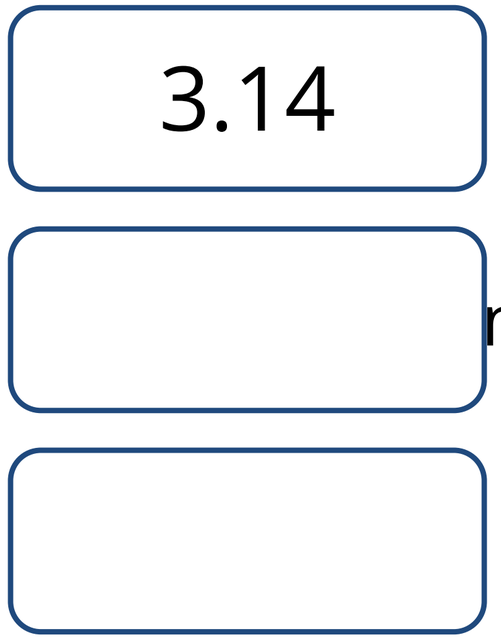

```
int main()
{
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::cin >> name;
  std::cin >> tao;
  std::cout << “my name is: “ << name <<
  “ tao is: “ << tao << “ pi is: “ << pi << ‘\n’;
  return 0;
}
```



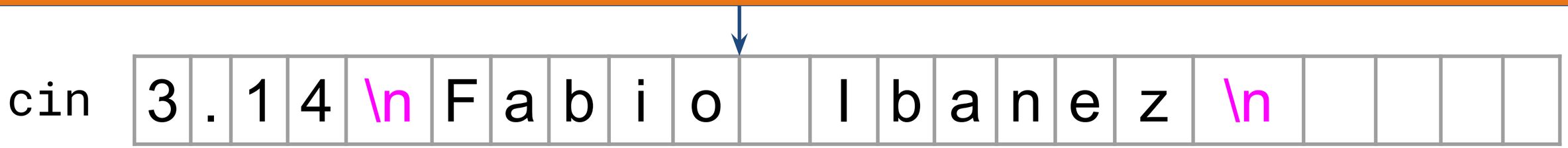
When std::cin fails!


```
int main()
{
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::cin >> name;
  std::cin >> tao;
  std::cout << “my name is: “ << name <<
  “ tao is: “ << tao << “ pi is: “ << pi << ‘\n’;
  return 0;
}
```

cin prompts user to enter a value saved in **pi**

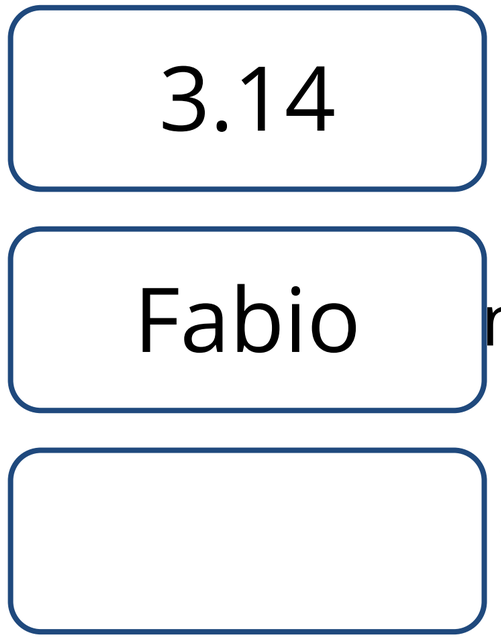


When std::cin fails!

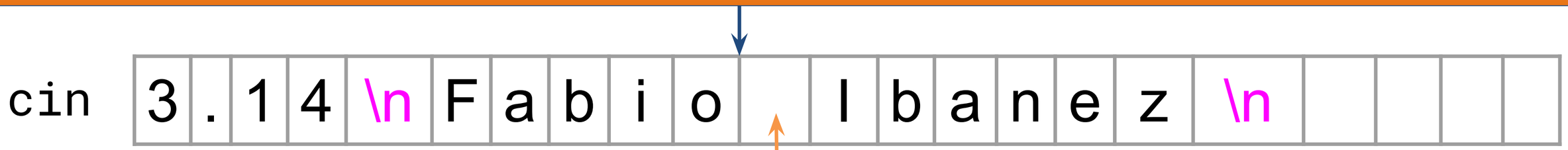



```
int main()
{
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::cin >> name;
  std::cin >> tao;
  std::cout << “my name is: “ << name <<
  “ tao is: “ << tao << “ pi is: “ << pi << ‘\n’;
  return 0;
}
```

cin prompts user to enter a value saved in **name**



When std::cin fails!




```
int main()
{
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::cin >> name;
  std::cin >> tao;
  std::cout << “my name is: “ << name <<
  “ tao is: “ << tao << “ pi is: “ << pi << ‘\n’;
  return 0;
}
```

Notice that cin ***only*** reads until the next whitespace

cin prompts user to enter a value saved in **name**

3.14	pi
Fabio	name
	tao

When std::cin fails!


```
int main()
{
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::cin >> name;
  std::cin >> tao;
  std::cout << “my name is: “
  “ tao is: “ << tao << “ pi is: “ << pi << ‘\n’;
  return 0;
}
```

cin buffer is not empty, so it reads until the next whitespace

3.14	pi
Fabio	name
?	tao

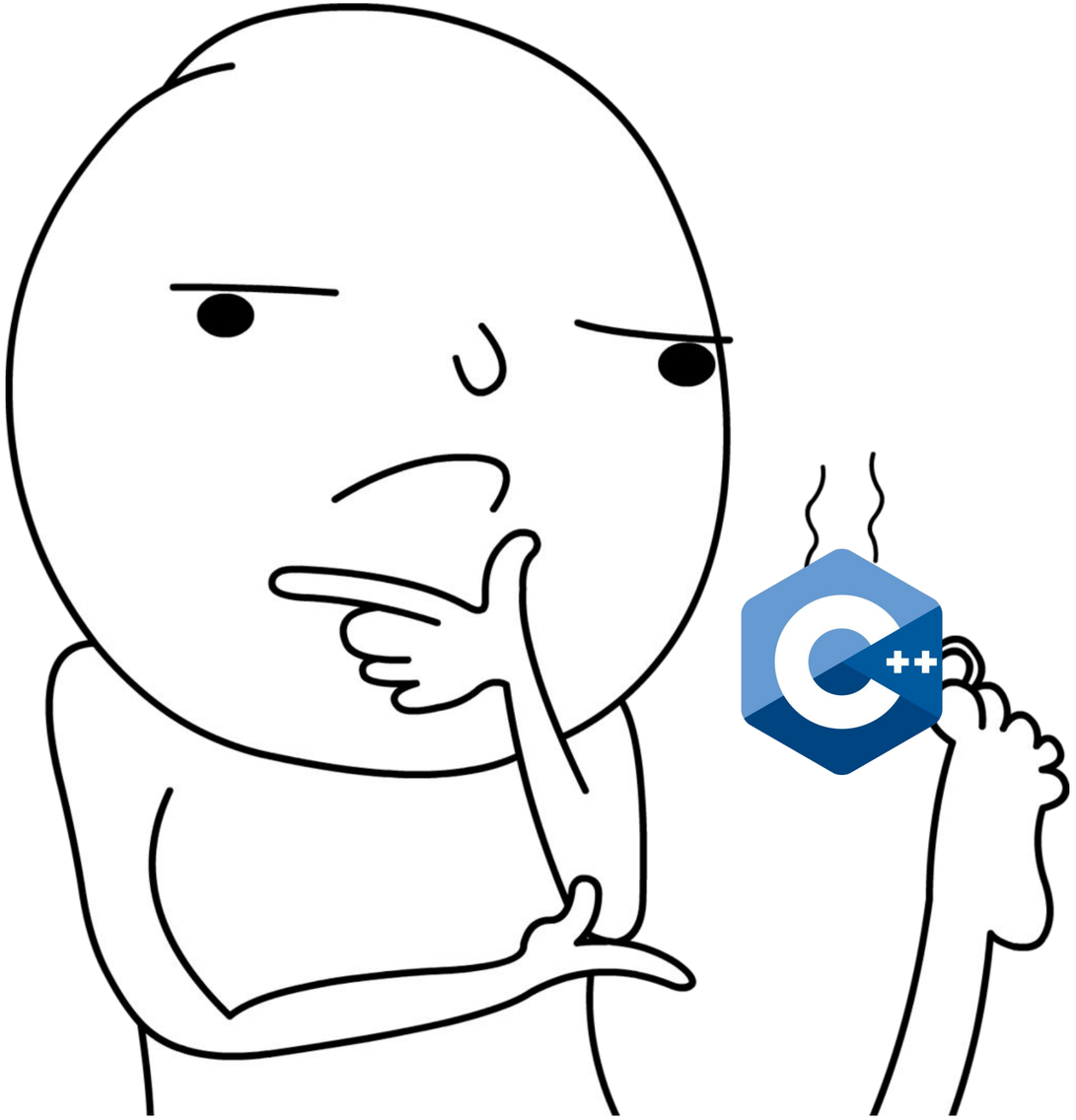
When std::cin fails!


```
void cinFailure() // replit name
{
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::cin >> name;
  std::cin >> tao;
  std::cout << “my name is: “
  “ tao is: “ << tao << “ pi is: “ << pi << ‘\n’;
}
```

cin buffer is not empty, so it reads until the next whitespace

3.14	pi
Fabio	name
0	tao

What questions do we have?



How do we fix this?

Anyone want to take a guess?

Fix?


```
void cinGetlineBug() {
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::getline(std::cin, name);
  std::cin >> tao;
  std::cout << "my name is : " << name << " tao is :
" << tao
            << " pi is : " << pi << '\n';
}
```

3.14	pi
Fabio	name
0	tao

Fix?


```
void cinGetlineBug() {
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::getline(std::cin, name);
  std::cin >> tao;
  std::cout << "my name is : " << name << " tao is :
" << tao
            << " pi is : " << pi << '\n';
}
```

3.14 pi

Fabio name

0 tao

Fix?


```
void cinGetlineBug() {
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::getline(std::cin, name);
  std::cin >> tao;
  std::cout << "my name is : " << name << " tao is :
" << tao
            << " pi is : " << pi << '\n';
}
```

Any guesses for what happens here?

3.14	pi
Fabio	name
0	tao

Fix?


```
void cinGetlineBug() {
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::getline(std::cin, name);
  std::cin >> tao;
  std::cout << "my name is : " << name << " tao is :
" << tao
            << " pi is : " << pi << '\n';
}
```

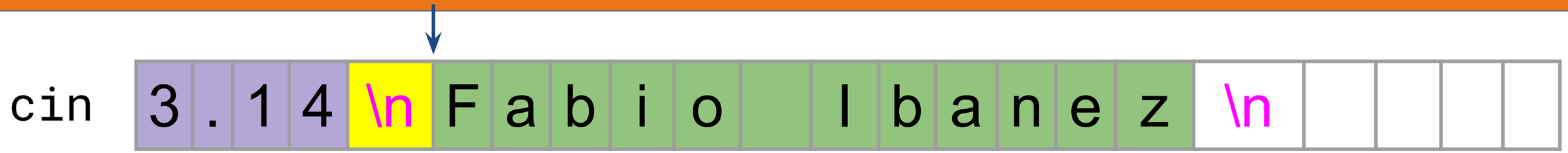
getline consumes the newline character

Fix?


```
void cinGetlineBug() {
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::getline(std::cin, name);
  std::cin >> tao;
  std::cout << "my name is : " << na
" << tao
            << " pi is : " << pi << '\n';
}
```

tao is going to be garbage because the buffer is not empty

Fix?




```
void cinGetlineBug() {
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::getline(std::cin, name);
  std::cin >> tao;
  std::cout << "my name is : " << na
" << tao
            << " pi is : " << pi << '\n';
}
```

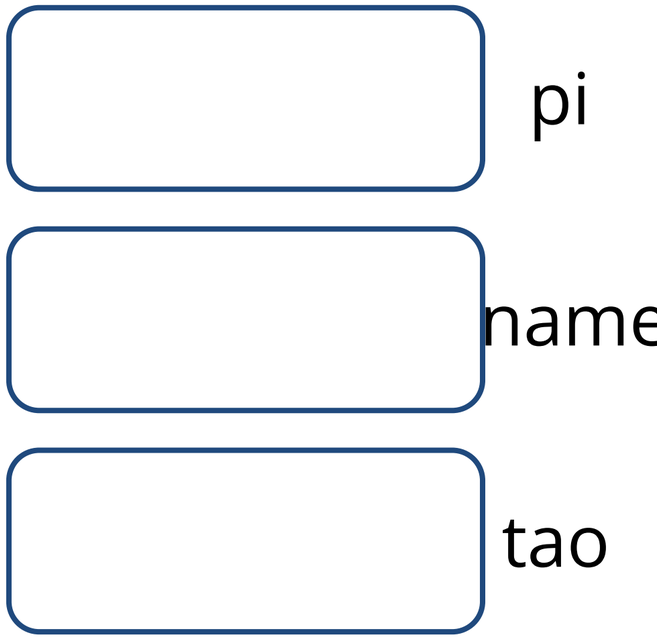
It's going to try to read the green stuff (name). But tao is a **double**!

How do we fix this?

Anyone want to take another guess?

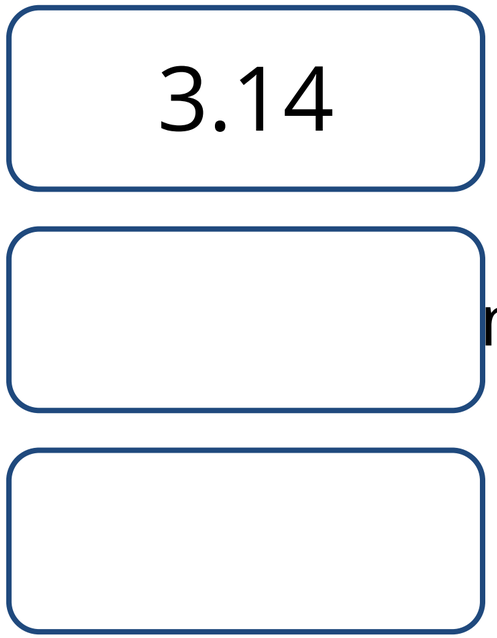
Fix?


```
void cinGetline() {
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::getline(std::cin, name);
  std::getline(std::cin, name);
  std::cin >> tao;
  std::cout << "my name is : " << name << " tao is :
" << tao << " pi is : " << pi << '\n';
}
```



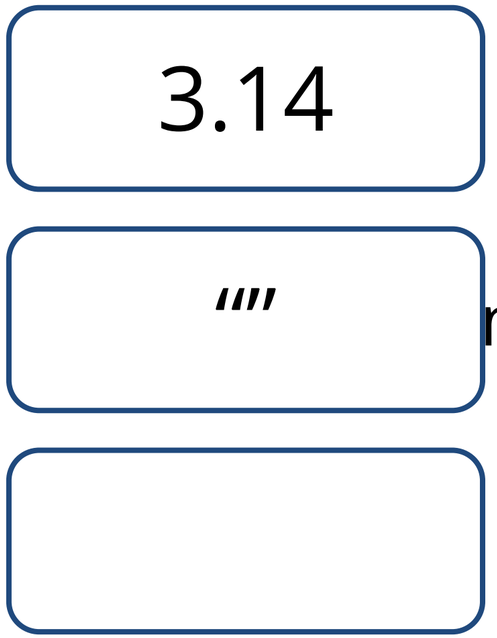
Fix?


```
void cinGetline() {
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::getline(std::cin, name);
  std::getline(std::cin, name);
  std::cin >> tao;
  std::cout << "my name is : " << name << " tao is :
" << tao << " pi is : " << pi << '\n';
}
```



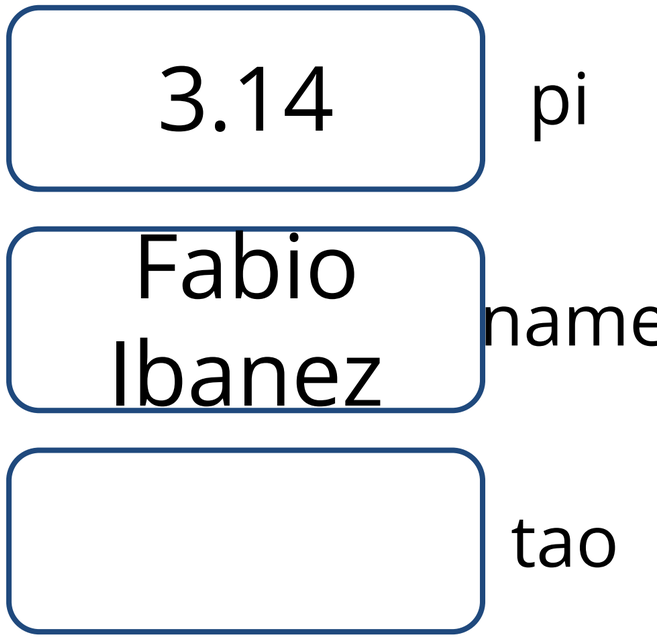
Fix ✅


```
void cinGetline() {
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::getline(std::cin, name);
  std::getline(std::cin, name);
  std::cin >> tao;
  std::cout << "my name is : " << name << " tao is :
" << tao << " pi is : " << pi << '\n';
}
```

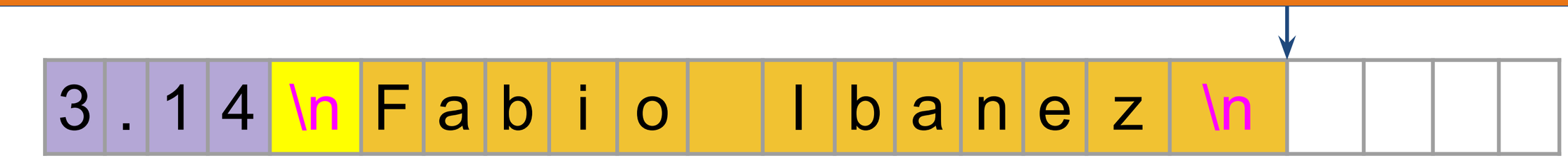


Fix ✅


```
void cinGetline() {
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::getline(std::cin, name);
  std::getline(std::cin, name);
  std::cin >> tao;
  std::cout << "my name is : " << name << " tao is :
" << tao << " pi is : " << pi << '\n';
}
```

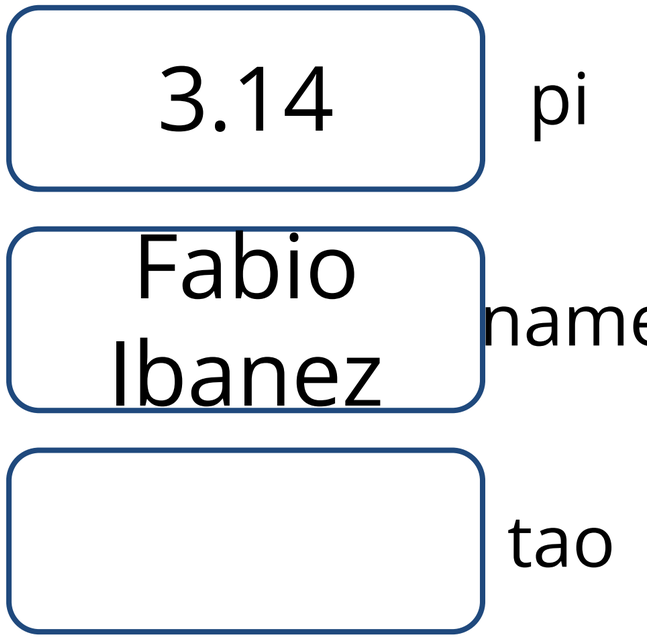


Fix ✅




```
void cinGetline() {
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::getline(std::cin, name);
  std::getline(std::cin, name);
  std::cin >> tao;
  std::cout << "my name is : " << name << " tao is :
" << tao << " pi is : " << pi << '\n';
}
```

The stream is empty! So it is going to prompt a user for input



Fix ✅


```
void cinGetline() {
  double pi;
  double tao;
  std::string name;
  std::cin >> pi;
  std::getline(std::cin, name);
  std::getline(std::cin, name);
  std::cin >> tao;
  std::cout << "my name is : " << name << " tao is :
" << tao << " pi is : " << pi << '\n';
}
```

3.14 pi

Fabio Ibanez name

6.28 tao

That being said

You shouldn’t use **`getline()`** and **`std::cin()`** together because of the difference in how they parse data.

`std::cin()` - leaves the newline in the buffer
`getline()` - gets rid of the newline

Whew that was a lot!

To conclude (Main takeaways):

1. Streams are a general interface to read and write data in programs
2. Input and output streams on the same source/destination type compliment each other!
3. Don't use **`getline()`** and **`std::cin()`** together, unless you *really really* have to!

Acknowledgements

Credit to **Avery Wang's** streams lecture which I took a lot of inspiration from, particularly for formatting and flow.