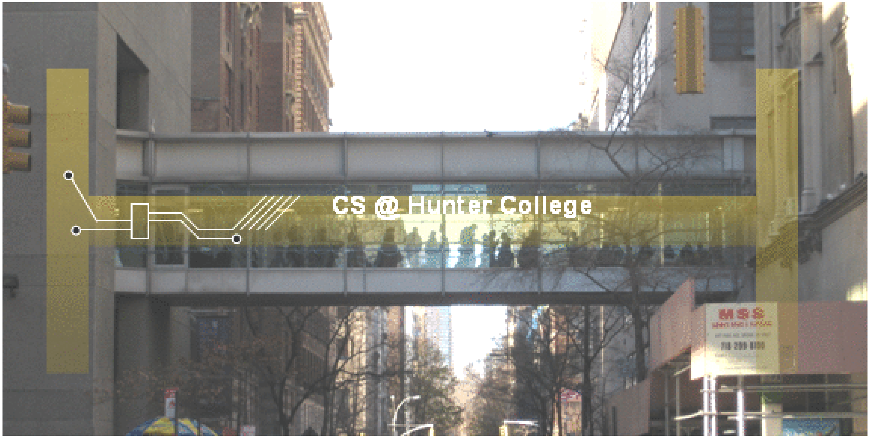
CSci 127: Introduction to Computer Science



hunter.cuny.edu/csci

Frequently Asked Questions

From email and tutoring.

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  Second: it degrades the quality of our students.
  Third: it's a standard question on faculty references.
  Industry & graduate schools hate it: don't want someone who falsifies work.

A few words on Academic Integrity

From our Syllabus.

Hunter College regards acts of academic dishonesty (e.g., plagiarism, cheating on examinations, obtaining unfair advantage, and falsification of records and official documents) as serious offenses against the values of intellectual honesty. The College is committed to enforcing the CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the Hunter College Academic Integrity Procedures. All incidents of cheating will be reported to the Office of Student Conduct in the Vice President for Student Affairs and Dean of Students office.

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- *If the student is found in violation by the Office of Student Conduct, they will receive a 0 on the exam, which also means they will fail the class.*

Today's Topics

- Recap: Incrementer Design Challenge
- C++: Basic Format & Variables
- I/O and Definite Loops in C++
- Conditionals in C++
- Indefinite Loops in C++
- Recap: C++ & Python
- More Info on the Final Exam

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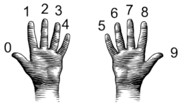
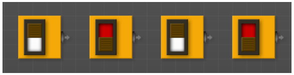
Recap: Design Challenge: Incrementers





- Simplest arithmetic: add one (“increment”) a variable.

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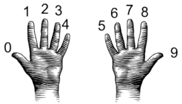

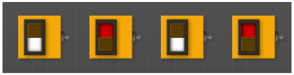

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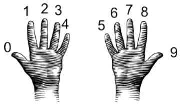

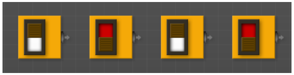

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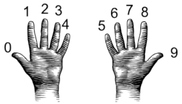

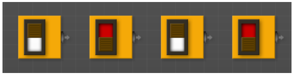

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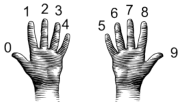

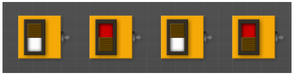

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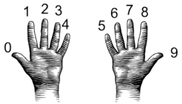

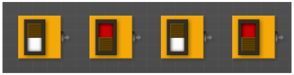

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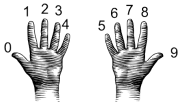

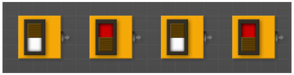

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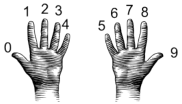

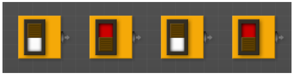

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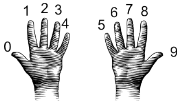

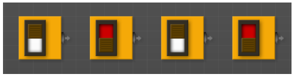

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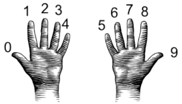

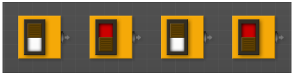

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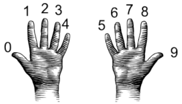

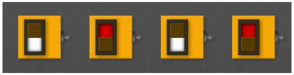

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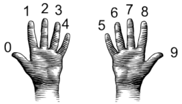

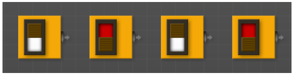

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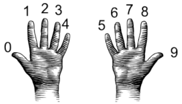

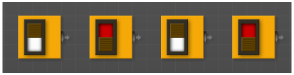

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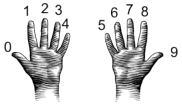

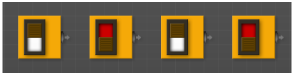

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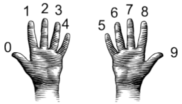

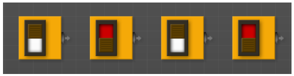

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1. Get user input.
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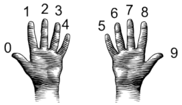
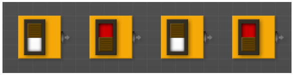
3. Add one (increment) the standard decimal number.
4. Convert back to your format.
5. Print the result.

Recap: Incrementer Design Challenge





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1. Get user input: `"forty one"`

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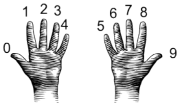

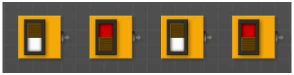

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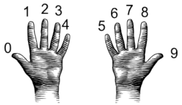
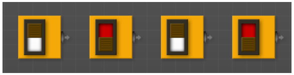
Pseudocode same for both questions:

1. Get user input: `"forty one"`
2. Convert to standard decimal number: `41`

Recap: Incrementer Design Challenge





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Pseudocode same for both questions:

1. Get user input: `"forty one"`
2. Convert to standard decimal number: 41
3. Add one (increment) the standard decimal number: 42

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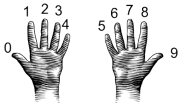

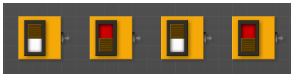

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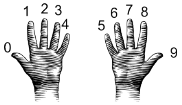
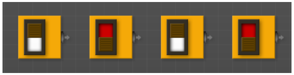
Recap: Incrementer Design Challenge





- Challenge: Write an algorithm for incrementing numbers expressed as words. Example: `"forty one"` $\rightarrow$ `"forty two"`
- Challenge: Write an algorithm for incrementing binary numbers. Example: `"1001"` $\rightarrow$ `"1010"`

Pseudocode same for both questions:

1. Get user input: `"forty one"`
2. Convert to standard decimal number: 41
3. Add one (increment) the standard decimal number: 42
4. Convert back to your format: `"forty two"`
5. Print the result.

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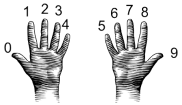
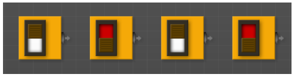


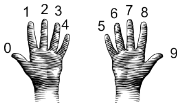


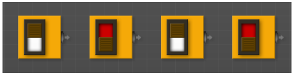
- Challenge: Write an algorithm for incrementing numbers expressed as words. Example: `"forty one"` $\rightarrow$ `"forty two"`
- Challenge: Write an algorithm for incrementing binary numbers. Example: `"1001"` $\rightarrow$ `"1010"`

Pseudocode same for both questions:

1. Get user input: `"1001"`

Recap: Incrementer Design Challenge



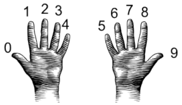


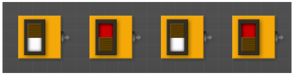
- Challenge: Write an algorithm for incrementing numbers expressed as words. Example: `"forty one"` $\rightarrow$ `"forty two"`
- Challenge: Write an algorithm for incrementing binary numbers. Example: `"1001"` $\rightarrow$ `"1010"`

Pseudocode same for both questions:

1. Get user input: `"1001"`
2. Convert to standard decimal number: 9

Recap: Incrementer Design Challenge



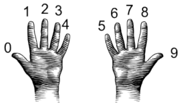


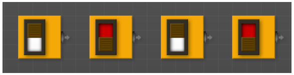
- Challenge: Write an algorithm for incrementing numbers expressed as words. Example: `"forty one"` $\rightarrow$ `"forty two"`
- Challenge: Write an algorithm for incrementing binary numbers. Example: `"1001"` $\rightarrow$ `"1010"`

Pseudocode same for both questions:

```
1 Get user input: "1001"
2 Convert to standard decimal number: 9
3 Add one (increment) the standard decimal number: 10
```

Recap: Incrementer Design Challenge



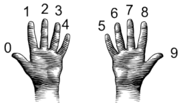


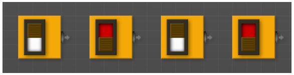
- Challenge: Write an algorithm for incrementing numbers expressed as words. Example: `"forty one"` $\rightarrow$ `"forty two"`
- Challenge: Write an algorithm for incrementing binary numbers. Example: `"1001"` $\rightarrow$ `"1010"`

Pseudocode same for both questions:

1. Get user input: `"1001"`
2. Convert to standard decimal number: 9
3. Add one (increment) the standard decimal number: 10
4. Convert back to your format: `"1010"`

Recap: Incrementer Design Challenge



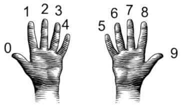


- Challenge: Write an algorithm for incrementing numbers expressed as words. Example: `"forty one"` → `"forty two"`
- Challenge: Write an algorithm for incrementing binary numbers. Example: `"1001"` → `"1010"`

Pseudocode same for both questions:

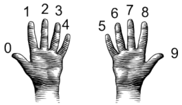
1. Get user input: `"1001"`
2. Convert to standard decimal number: 9
3. Add one (increment) the standard decimal number: 10
4. Convert back to your format: `"1010"`
5. Print the result.

Recap: Incrementer Design Challenge



Focus on: Convert to standard decimal number:

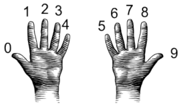
Recap: Incrementer Design Challenge



Focus on: Convert to standard decimal number:

```
def convert2Decimal(numString):
```

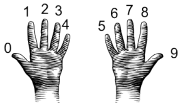
Recap: Incrementer Design Challenge



Focus on: Convert to standard decimal number:

```
def convert2Decimal(numString):
    #Start with one-digit numbers:  zero,one,...,nine
```

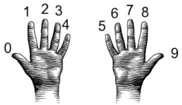
Recap: Incrementer Design Challenge



Focus on: Convert to standard decimal number:

```
def convert2Decimal(numString):
    #Start with one-digit numbers:  zero,one,...,nine
    if numString == "zero":
        return(0)
```

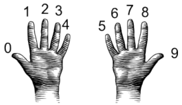
Recap: Incrementer Design Challenge



Focus on: Convert to standard decimal number:

```
def convert2Decimal(numString):
    #Start with one-digit numbers:  zero,one,...,nine
    if numString == "zero":
        return(0)
    elif numString == "one":
        return(1)
```

Recap: Incrementer Design Challenge



Focus on: Convert to standard decimal number:

```
def convert2Decimal(numString):
    #Start with one-digit numbers:  zero,one,...,nine
    if numString == "zero":
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    elif numString == "one":
        return(1)
    elif numString == "two":
        return(2)
```
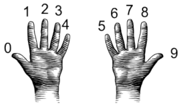

Recap: Incrementer Design Challenge



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def convert2Decimal(numString):
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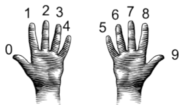
Recap: Incrementer Design Challenge



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    else:
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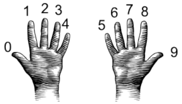
```

Will this work?

Unit Testing: Incrementer Design Challenge



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Will this work? What inputs would find the error(s)?

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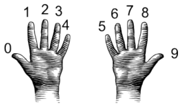

Focus on: Convert to standard decimal number:

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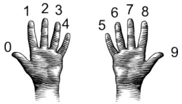
Unit Testing: testing individual units/functions/blocks of code to verify correctness.

Unit Testing: Incrementer Design Challenge



Focus on: Convert to standard decimal number:

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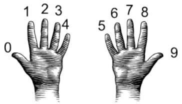
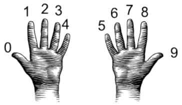
Unit Testing: Incrementer Design Challenge



- Unit Testing: testing individual units/functions/blocks of code to verify correctness. Often automated (e.g. gradescope).
- To test all branches of code, would need to test all inputs: `"zero"`, `"one"`,..., `"nine"`, & some bad inputs.

Unit Testing: Incrementer Design Challenge



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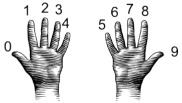
  Also important to test **edge cases**.

Unit Testing: Incrementer Design Challenge



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- To test all branches of code, would need to test all inputs: `"zero"`, `"one"`,..., `"nine"`, & some bad inputs.
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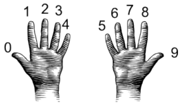
- If large, design automated tests that will “cover” as many branches as possible and use randomly generated inputs:

Unit Testing: Incrementer Design Challenge



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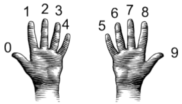
```
names = ["zero","one",...,"nine"]
```

Unit Testing: Incrementer Design Challenge



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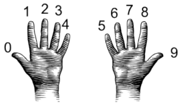
```
names = ["zero","one",...,"nine"]
x = random.randrange(10)
```

Unit Testing: Incrementer Design Challenge



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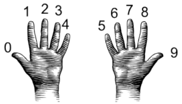
- If large, design automated tests that will "cover" as many branches as possible and use randomly generated inputs:

```
names = ["zero","one",...,"nine"]
x = random.randrange(10)
if x == convert2Decimal(names[x]):
```

Unit Testing: Incrementer Design Challenge



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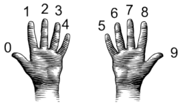
```
names = ["zero","one",...,"nine"]
x = random.randrange(10)
if x == convert2Decimal(names[x]):
    #PASS
```

Unit Testing: Incrementer Design Challenge



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```
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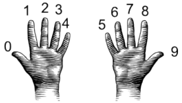
Unit Testing: Incrementer Design Challenge



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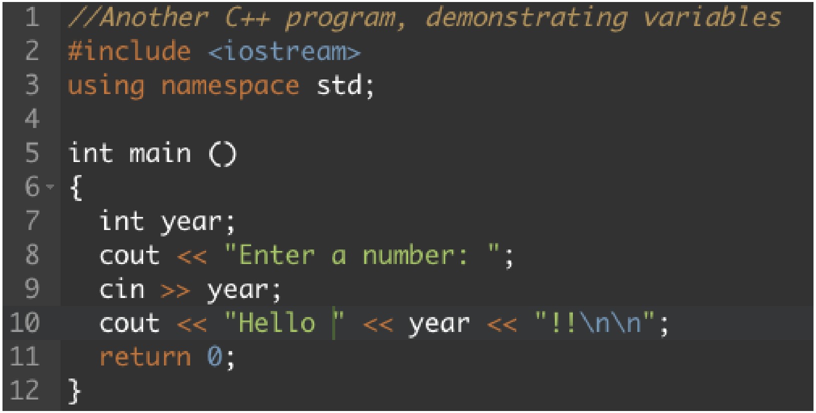
```
names = ["zero","one",...,"nine"]
x = random.randrange(10)
if x == convert2Decimal(names[x]):
    #PASS
else:
    #FAIL
```

Today's Topics

- Recap: Incrementer Design Challenge
- **C++: Basic Format & Variables**
- I/O and Definite Loops in C++
- Conditionals in C++
- Indefinite Loops in C++
- Recap: C++ & Python
- More Info on the Final Exam

Challenge:

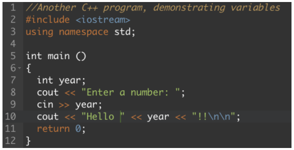
- *Using what you know from Python, predict what the C++ code will do:*



```
//Another C++ program, demonstrating variables
#include <iostream>
using namespace std;

int main ()
{
  int year;
  cout << "Enter a number: ";
  cin >> year;
  cout << "Hello " << year << "!!\n\n";
  return 0;
}
```

onlinegdb demo



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}
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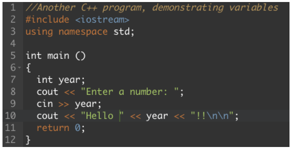
(Demo with `onlinegdb`)

Introduction to C++



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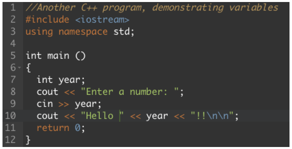
  return 0;
}
```

- C++ is a popular programming language that extends C.

Introduction to C++



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}
```
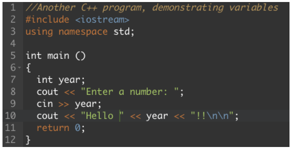

- C++ is a popular programming language that extends C.
- Fast, efficient, and powerful.

Introduction to C++



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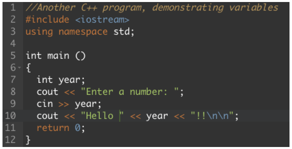
- C++ is a popular programming language that extends C.
- Fast, efficient, and powerful.
- Used for systems programming (and future courses!).

Introduction to C++



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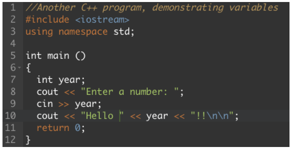
  return 0;
}
```

- C++ is a popular programming language that extends C.
- Fast, efficient, and powerful.
- Used for systems programming (and future courses!).
- Today, we'll introduce the basic structure and simple input/output (I/O) in C/C++.

Introduction to C++

- Programs are organized in functions.



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  return 0;
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```

Introduction to C++

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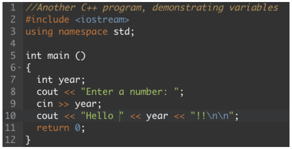
  Example:



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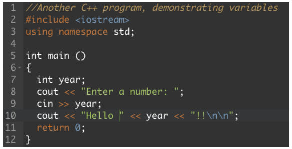
Introduction to C++



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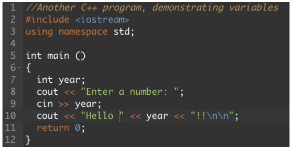
```

- Programs are organized in functions.

  Example:

  `int main()`

Introduction to C++



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  ```
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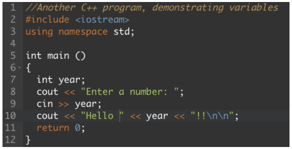
Introduction to C++



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  return 0;
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```

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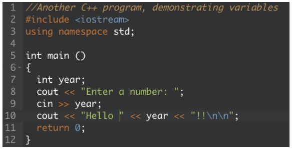
  Example:

```
int main()
{
    cout << "Hello world!";
    return(0);
}
```

Introduction to C++



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Introduction to C++

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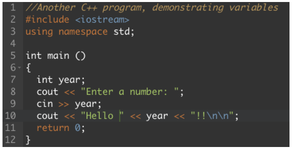

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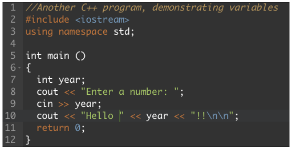

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Introduction to C++

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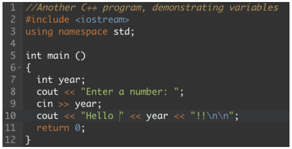

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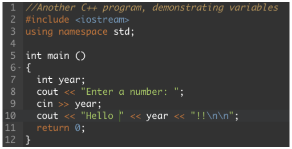
Introduction to C++



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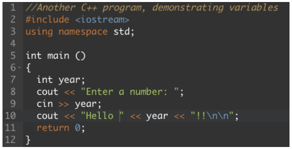
Introduction to C++



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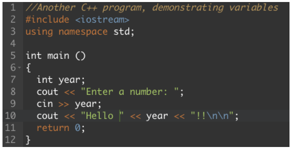
Introduction to C++



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{
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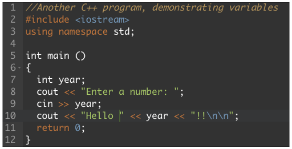
Introduction to C++



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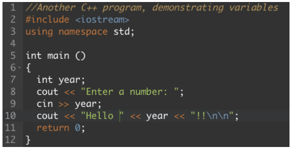
Introduction to C++



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- To print, we'll use cout <<:
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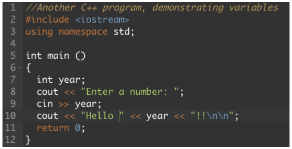
- To get input, we'll use cin >>:

Introduction to C++



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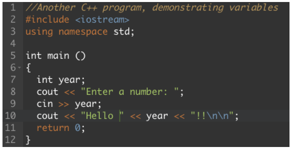
Introduction to C++



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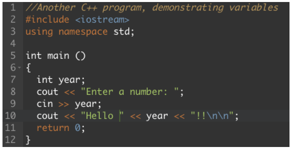
Introduction to C++



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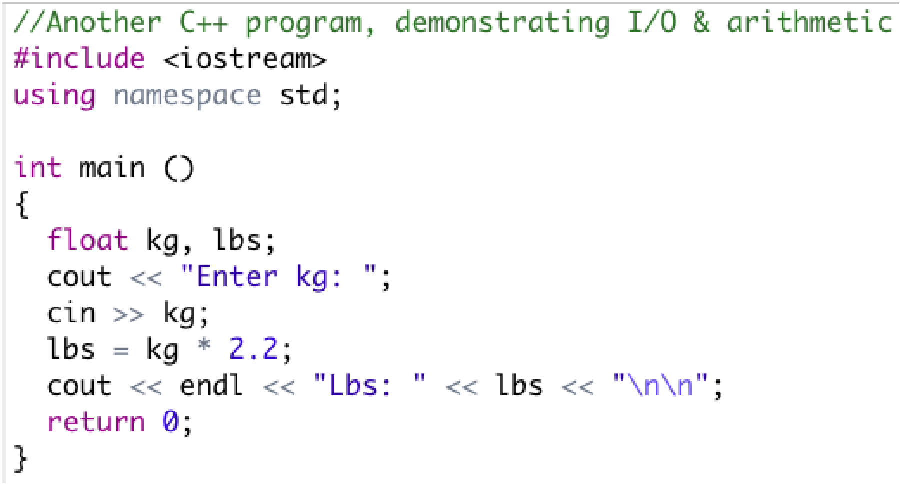
Challenge:

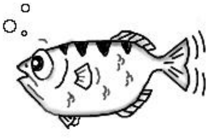
Predict what the following pieces of code will do:



```
//Another C++ program, demonstrating I/O & arithmetic
#include <iostream>
using namespace std;

int main ()
{
  float kg, lbs;
  cout << "Enter kg: ";
  cin >> kg;
  lbs = kg * 2.2;
  cout << endl << "Lbs: " << lbs << "\n\n";
  return 0;
}
```

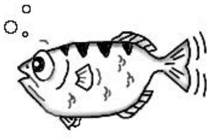
Side Note: gdb



gdb.org

- Part of Richard Stallman's "GNU is Not Unix" (GNU) project.

Side Note: gdb


gdb.org

- Part of Richard Stallman's "GNU is Not Unix" (GNU) project.
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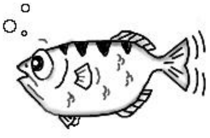
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- Part of Richard Stallman's "GNU is Not Unix" (GNU) project.
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- Lightweight, widely-available program that allows you to "step through" your code line-by-line.

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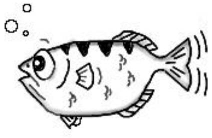

gdb.org

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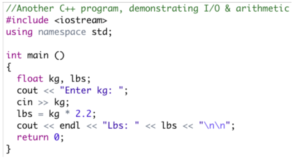
- Written in 1986, gdb is the GNU debugger and based on dbx from the Berkeley Distribution of Unix.
- Lightweight, widely-available program that allows you to "step through" your code line-by-line.
- Available on-line (onlinegdb.com) or follow installation instructions in Lab 12.

C++ Demo



```
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#include <iostream>
using namespace std;

int main ()
{
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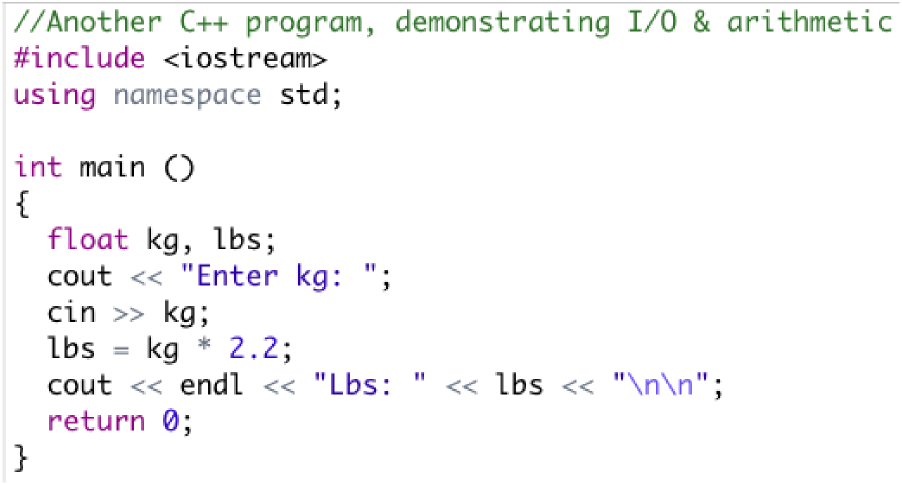
  lbs = kg * 2.2;
  cout << endl << "Lbs: " << lbs << "\n\n";
  return 0;
}
```

(Demo with `onlinegdb`)

Challenge:...

Convert the C++ code to a **Python program***:*



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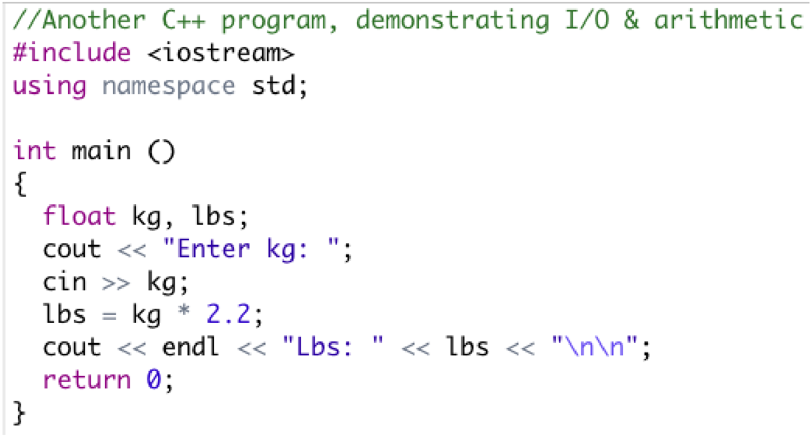
Python Tutor

Convert the C++ code to a **Python program***:*



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  lbs = kg * 2.2;
  cout << endl << "Lbs: " << lbs << "\n\n";
  return 0;
}
```

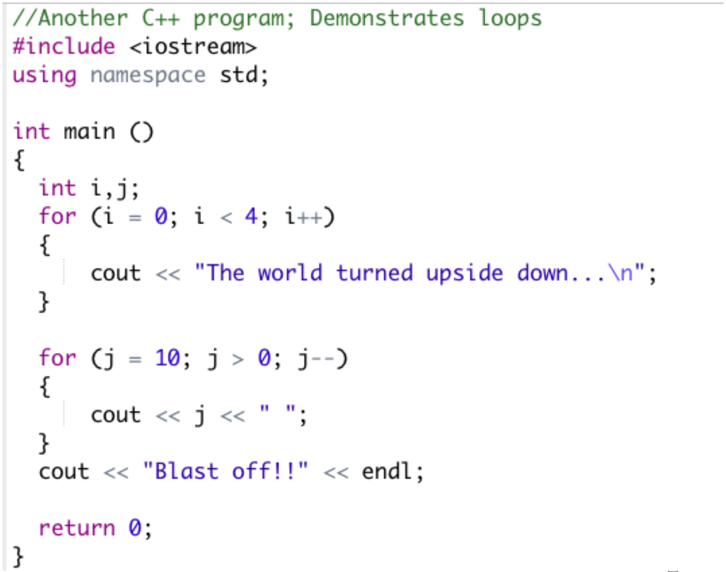
(Write from scratch in `pythonTutor`.)

Today's Topics

- Recap: Incrementer Design Challenge
- C++: Basic Format & Variables
- **I/O and Definite Loops in C++**
- Conditionals in C++
- Indefinite Loops in C++
- Recap: C++ & Python
- More Info on the Final Exam

Challenge:

Predict what the following pieces of code will do:



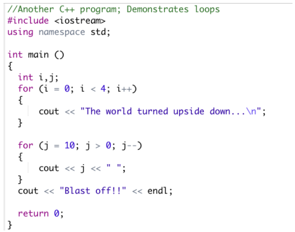
```
//Another C++ program; Demonstrates loops
#include <iostream>
using namespace std;

int main ()
{
  int i,j;
  for (i = 0; i < 4; i++)
  {
    cout << "The world turned upside down...\n";
  }

  for (j = 10; j > 0; j--)
  {
    cout << j << " ";
  }
  cout << "Blast off!!" << endl;

  return 0;
}
```

C++ Demo



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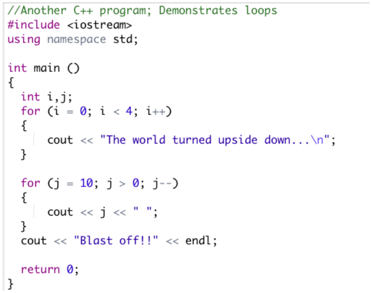
(Demo with `onlinegdb`)

Definite loops



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  }
  cout << "Blast off!!" << endl;

  return 0;
}
```

General format:

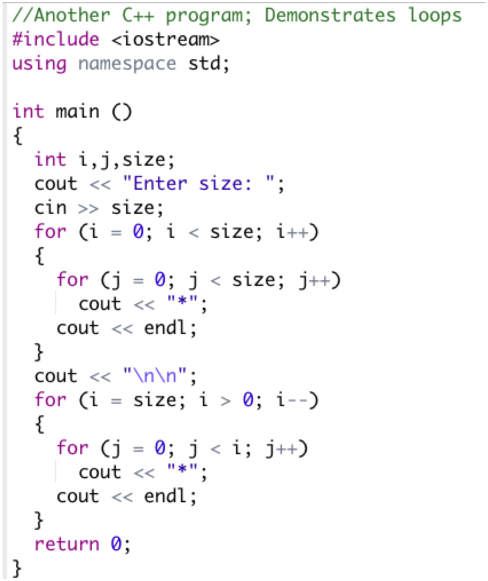
`for` (*initialization* ; *test* ; *updateAction*)
{

command1;
command2;
command3;
...

}

Challenge:

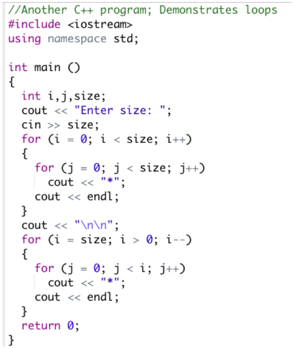
Predict what the following pieces of code will do:



```
//Another C++ program; Demonstrates loops
#include <iostream>
using namespace std;

int main ()
{
  int i,j,size;
  cout << "Enter size: ";
  cin >> size;
  for (i = 0; i < size; i++)
  {
    for (j = 0; j < size; j++)
      cout << "*";
    cout << endl;
  }
  cout << "\n\n";
  for (i = size; i > 0; i--)
  {
    for (j = 0; j < i; j++)
      cout << "*";
    cout << endl;
  }
  return 0;
}
```

C++ Demo



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    cout << endl;
  }
  cout << "\n\n";
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}
```

(Demo with `onlinegdb`)

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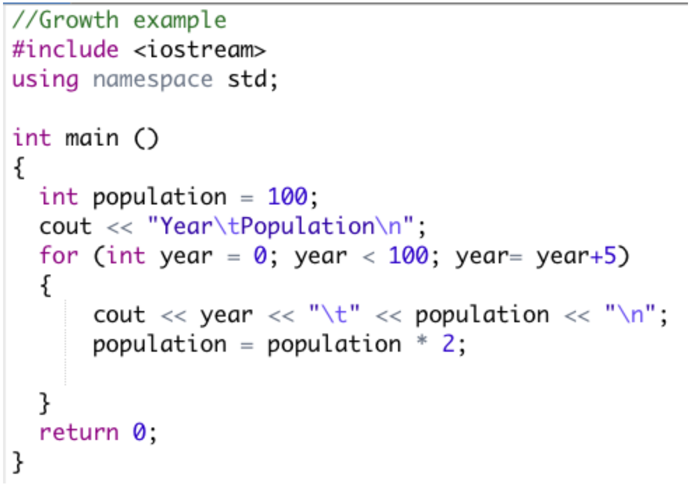


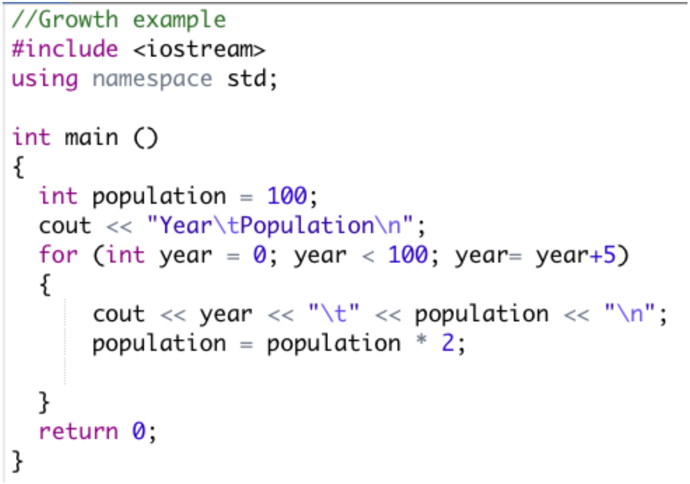
```
//Growth example
#include <iostream>
using namespace std;

int main ()
{
  int population = 100;
  cout << "Year\tPopulation\n";
  for (int year = 0; year < 100; year= year+5)
  {
      cout << year << "\t" << population << "\n";
      population = population * 2;

  }
  return 0;
}
```

Challenge:

Translate the C++ program into Python:



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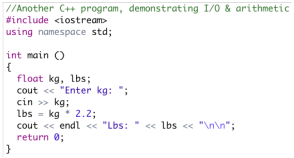
  }
  return 0;
}
```

Recap: Basic Form & I/O in C++

- Efficient for systems programming.



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#include <iostream>
using namespace std;

int main ()
{
  float kg, lbs;
  cout << "Enter kg: ";
  cin >> kg;
  lbs = kg * 2.2;
  cout << endl << "Lbs: " << lbs << "\n\n";
  return 0;
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```
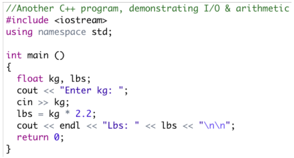

Recap: Basic Form & I/O in C++

- Efficient for systems programming.
- Programs are organized in functions.



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Recap: Basic Form & I/O in C++

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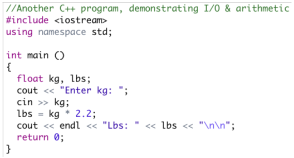

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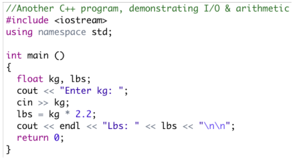

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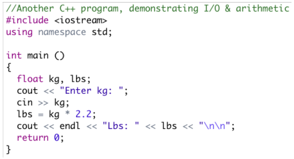

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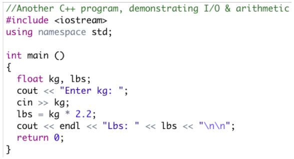

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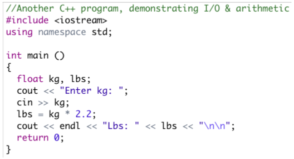

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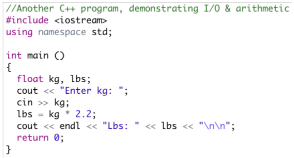

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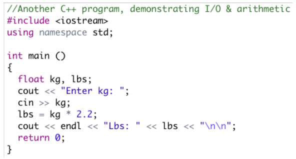

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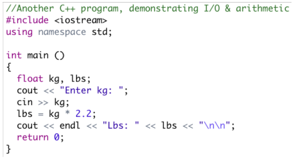

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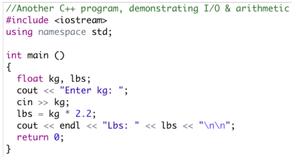

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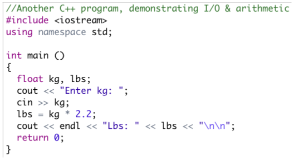

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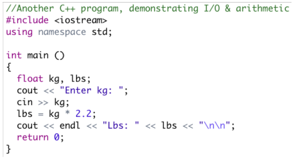

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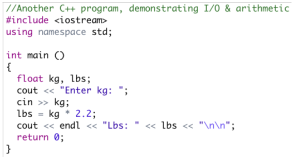

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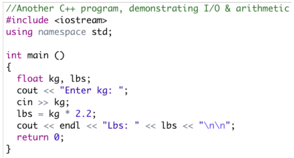

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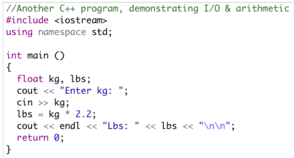

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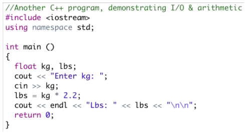
- Blocks of code uses '{' and '}'.
- Commands generally end in ';'.

Today's Topics



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- Recap: Incrementer Design Challenge
- C++: Basic Format & Variables
- I/O and Definite Loops in C++
- **Conditionals in C++**
- Indefinite Loops in C++
- Recap: C++ & Python
- More Info on the Final Exam

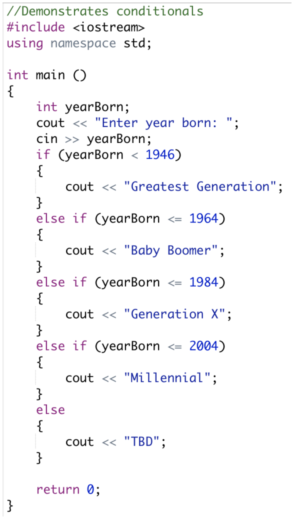
Challenge:

Predict what the following pieces of code will do:

```cpp
//Demonstrates conditionals
#include <iostream>
using namespace std;

int main ()
{
    int yearBorn;
    cout << "Enter year born: ";
    cin >> yearBorn;
    if (yearBorn < 1946)
    {
        cout << "Greatest Generation";
    }
    else if (yearBorn <= 1964)
    {
        cout << "Baby Boomer";
    }
    else if (yearBorn <= 1984)
    {
        cout << "Generation X";
    }
    else if (yearBorn <= 2004)
    {
        cout << "Millennial";
    }
    else
    {
        cout << "TBD";
    }

    return 0;
```

```cpp
using namespace std;

int main ()
{
    string conditions = "blowing snow";
    int winds = 100;
    float visibility = 0.2;

    if ( ( (winds > 35) && (visibility < 0.25) ) ||
         ( (conditions == "blowing snow") ||
           (conditions == "heavy snow") ) )
        cout << "Blizzard!\n";

    string origin = "South Pacific";

    if (winds > 74)
        cout << "Major storm, called a ";
    if ((origin == "Indian Ocean")
        ||(origin == "South Pacific"))
        cout << "cyclone.\n";
    else if (origin == "North Pacific")
        cout << "typhoon.\n";
    else
        cout << "hurricane.\n";
```

C++ Demo



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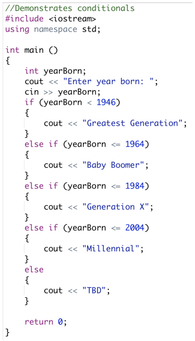
    return 0;
}
```

(Demo with `onlinegdb`)

Conditionals



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    }
    else
    {
        cout << "TBD";
    }

    return 0;
}
```

General format:

```
if ( logical expression )
{
      command1;
      ...
}
else if ( logical expression )
{
      command1;
      ...
}
else
{
      command1;
      ...
}
```

Logical Operators in C++

Very similar, just different names: `&&`, `||`, and `!`:

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and (`&&`)

in1		in2	*returns:*
False	&&	False	False
False	&&	True	False
True	&&	False	False
True	&&	True	True

Logical Operators in C++

Very similar, just different names: `&&`, `||`, and `!`:

and (`&&`)

in1		in2	*returns:*
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or (`||`)

in1		in2	*returns:*
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Logical Operators in C++

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or (`||`)

in1		in2	*returns:*
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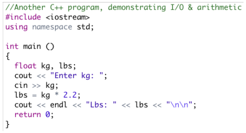
not (`!`)

	in1	*returns:*
!	False	True
!	True	False

Today's Topics



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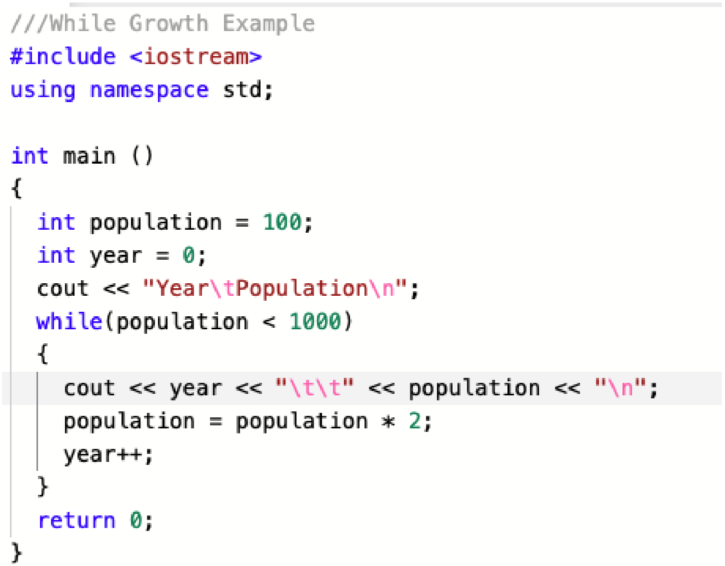
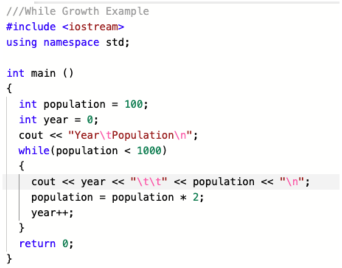


```cpp
///While Growth Example
#include <iostream>
using namespace std;

int main ()
{
  int population = 100;
  int year = 0;
  cout << "Year\tPopulation\n";
  while(population < 1000)
  {
    cout << year << "\t\t" << population << "\n";
    population = population * 2;
    year++;
  }
  return 0;
}
```

C++ Demo



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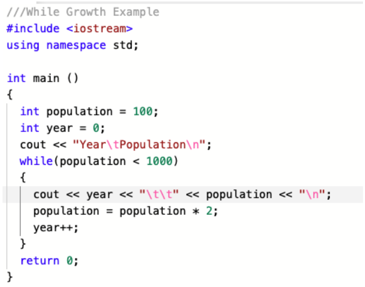
```

(Demo with `onlinegdb`)

Indefinite Loops: `while`



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int main ()
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  int population = 100;
  int year = 0;
  cout << "Year\tPopulation\n";
  while(population < 1000)
  {
    cout << year << "\t\t" << population << "\n";
    population = population * 2;
    year++;
  }
  return 0;
}
```

General format:

`while` (*logical expression*)
{

command1;
command2;
command3;
...

}

Challenge:

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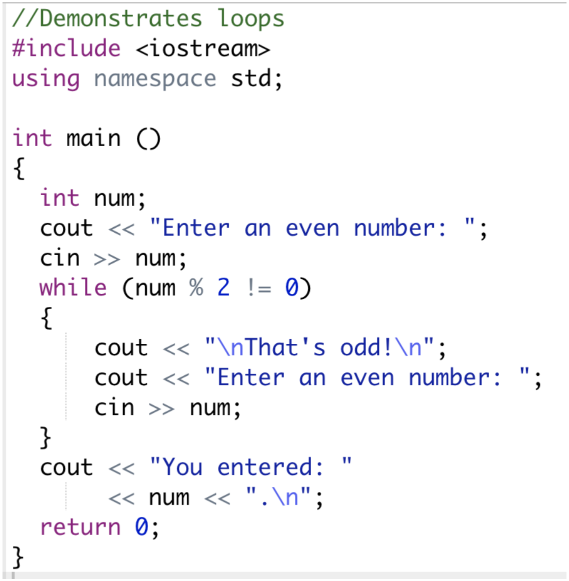
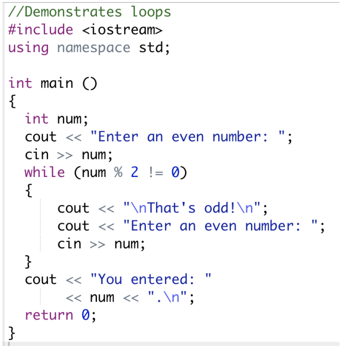


```
//Demonstrates loops
#include <iostream>
using namespace std;

int main ()
{
  int num;
  cout << "Enter an even number: ";
  cin >> num;
  while (num % 2 != 0)
  {
      cout << "\nThat's odd!\n";
      cout << "Enter an even number: ";
      cin >> num;
  }
  cout << "You entered: "
       << num << ".\n";
  return 0;
}
```

C++ Demo



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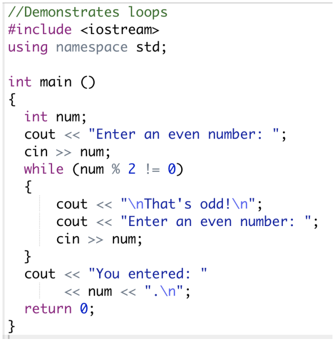

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  return 0;
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```

General format:

`while` (*logical expression*)
{

command1;
command2;
command3;
...

}

Challenge:

Predict what the following pieces of code will do:

```
//Demonstrates do-while loops
#include <iostream>
using namespace std;

int main ()
{
  int num;
  do
  {
      cout << "Enter an even number: ";
      cin >> num;
  } while (num % 2 != 0);

  cout << "You entered: "
       << num << ".\n";
  return 0;
}
```

C++ Demo

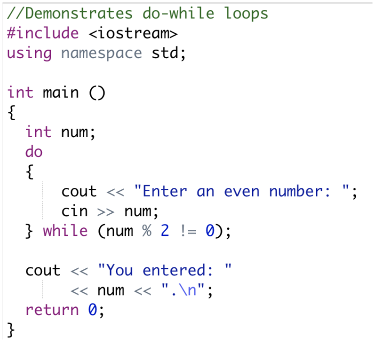
```
//Demonstrates do-while loops
#include <iostream>
using namespace std;

int main ()
{
  int num;
  do
  {
      cout << "Enter an even number: ";
      cin >> num;
  } while (num % 2 != 0);

  cout << "You entered: "
       << num << ".\n";
  return 0;
}
```

(Demo with `onlinegdb`)

Indefinite Loops: `do-while`



```
//Demonstrates do-while loops
#include <iostream>
using namespace std;

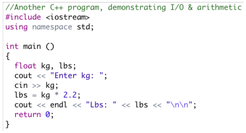
int main ()
{
  int num;
  do
  {
      cout << "Enter an even number: ";
      cin >> num;
  } while (num % 2 != 0);

  cout << "You entered: "
       << num << ".\n";
  return 0;
}
```

General format:

do
{
    command1;
    command2;
    command3;
    ...
} `while` (*logical expression*);

Today's Topics



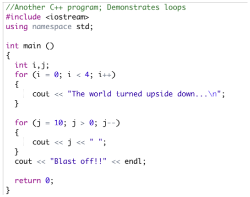
```
//Another C++ program, demonstrating I/O & arithmetic
#include <iostream>
using namespace std;

int main ()
{
  float kg, lbs;
  cout << "Enter kg: ";
  cin >> kg;
  lbs = kg * 2.2;
  cout << endl << "Lbs: " << lbs << "\n\n";
  return 0;
}
```

- Recap: Incrementer Design Challenge
- C++: Basic Format & Variables
- I/O and Definite Loops in C++
- Conditionals in C++
- Indefinite Loops in C++
- **Recap: C++ & Python**
- More Info on the Final Exam

Recap: C++ Control Structures

- I/O:



```
//Another C++ program; Demonstrates loops
#include <iostream>
using namespace std;

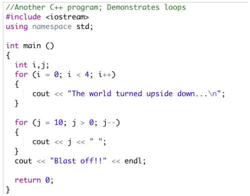
int main ()
{
  int i,j;
  for (i = 0; i < 4; i++)
  {
      cout << "The world turned upside down...\n";
  }

  for (j = 10; j > 0; j--)
  {
      cout << j << " ";
  }
  cout << "Blast off!!" << endl;

  return 0;
}
```

Recap: C++ Control Structures

- I/O: `cin >> ...;`



```
//Another C++ program; Demonstrates loops
#include <iostream>
using namespace std;

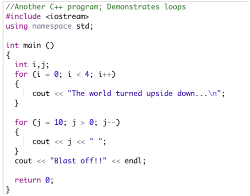
int main ()
{
  int i,j;
  for (i = 0; i < 4; i++)
  {
      cout << "The world turned upside down...\n";
  }

  for (j = 10; j > 0; j--)
  {
      cout << j << " ";
  }
  cout << "Blast off!!" << endl;

  return 0;
}
```

Recap: C++ Control Structures

- I/O: `cin >> ...;` & `cout << ...;`



```
//Another C++ program; Demonstrates loops
#include <iostream>
using namespace std;

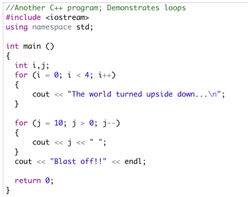
int main ()
{
  int i,j;
  for (i = 0; i < 4; i++)
  {
      cout << "The world turned upside down...\n";
  }

  for (j = 10; j > 0; j--)
  {
      cout << j << " ";
  }
  cout << "Blast off!!" << endl;

  return 0;
}
```

Recap: C++ Control Structures

- I/O: `cin >> ...;` & `cout << ...;`
- Definite loops:



```
//Another C++ program; Demonstrates loops
#include <iostream>
using namespace std;

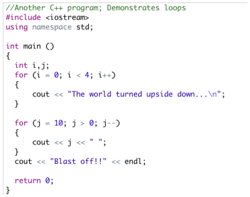
int main ()
{
  int i,j;
  for (i = 0; i < 4; i++)
  {
      cout << "The world turned upside down...\n";
  }

  for (j = 10; j > 0; j--)
  {
      cout << j << " ";
  }
  cout << "Blast off!!" << endl;

  return 0;
}
```

Recap: C++ Control Structures

- I/O: `cin >> ...;` & `cout << ...;`
- Definite loops:
```
for (i = 0; i < 10; i++)
{
      ...
}
```



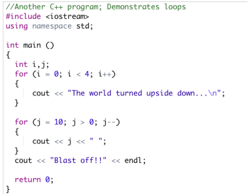
```
//Another C++ program; Demonstrates loops
#include <iostream>
using namespace std;

int main ()
{
  int i,j;
  for (i = 0; i < 4; i++)
  {
      cout << "The world turned upside down...\n";
  }

  for (j = 10; j > 0; j--)
  {
      cout << j << " ";
  }
  cout << "Blast off!!" << endl;

  return 0;
}
```

Recap: C++ Control Structures



```
//Another C++ program; Demonstrates loops
#include <iostream>
using namespace std;

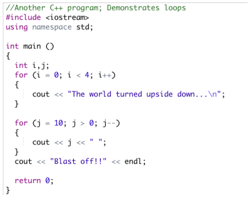
int main ()
{
  int i,j;
  for (i = 0; i < 4; i++)
  {
      cout << "The world turned upside down...\n";
  }

  for (j = 10; j > 0; j--)
  {
      cout << j << " ";
  }
  cout << "Blast off!!" << endl;

  return 0;
}
```

- I/O: `cin >> ...;` & `cout << ...;`
- Definite loops:
  ```
  for (i = 0; i < 10; i++)
  {
        ...
  }
  ```
- Conditionals:

Recap: C++ Control Structures



```
//Another C++ program; Demonstrates loops
#include <iostream>
using namespace std;

int main ()
{
  int i,j;
  for (i = 0; i < 4; i++)
  {
      cout << "The world turned upside down...\n";
  }

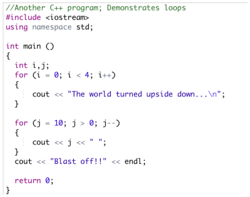
  for (j = 10; j > 0; j--)
  {
      cout << j << " ";
  }
  cout << "Blast off!!" << endl;

  return 0;
}
```

- I/O: `cin >> ...;` & `cout << ...;`
- Definite loops:
  ```
  for (i = 0; i < 10; i++)
  {
        ...
  }
  ```
- Conditionals:

  `if` (*logical expression*)
  ```
  {
        ...
  }
  else
  {
        ...
  }
  ```

Recap: C++ Control Structures

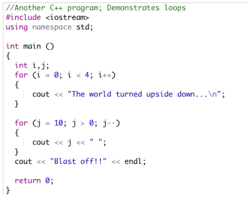


```cpp
//Another C++ program; Demonstrates loops
#include <iostream>
using namespace std;

int main ()
{
  int i,j;
  for (i = 0; i < 4; i++)
  {
      cout << "The world turned upside down...\n";
  }

  for (j = 10; j > 0; j--)
  {
      cout << j << " ";
  }
  cout << "Blast off!!" << endl;

  return 0;
}
```

- I/O: `cin >> ...;` & `cout << ...;`
- Definite loops:
  ```
  for (i = 0; i < 10; i++)
  {
        ...
  }
  ```
- Conditionals:

  `if` (*logical expression*)
  ```
  {
        ...
  }
  else
  {
        ...
  }
  ```
- Indefinite loops:

Recap: C++ Control Structures



```
//Another C++ program; Demonstrates loops
#include <iostream>
using namespace std;

int main ()
{
  int i,j;
  for (i = 0; i < 4; i++)
  {
      cout << "The world turned upside down...\n";
  }

  for (j = 10; j > 0; j--)
  {
      cout << j << " ";
  }
  cout << "Blast off!!" << endl;

  return 0;
}
```

- I/O: `cin >> ...;` & `cout << ...;`
- Definite loops:
  ```
  for (i = 0; i < 10; i++)
  {
        ...
  }
  ```
- Conditionals:
  `if` (*logical expression*)
  ```
  {
        ...
  }
  else
  {
        ...
  }
  ```
- Indefinite loops:
  `while` (*logical expression*)
  ```
  {
        ...
  }
  ```

Challenge: Definite Loops in Python & C++

- *Rewrite this program in C++:*

```
for i in range(2017, 2000, -2):
    print("Year is", i)
```

- *Rewrite this program in Python:*

```
#include <iostream>
using namespace std;
int main()
{
  for (int i = 1; i < 50; i++)
  {
    cout << i << endl;
  }
  return 0;
}
```

Challenge: Definite Loops in Python & C++

- *Rewrite this program in C++:*

```
for i in range(2017, 2000, -2):
    print("Year is", i)
```

Challenge: Definite Loops in Python & C++

- *Rewrite this program in C++:*

```
for i in range(2017, 2000, -2):
    print("Year is", i)
```

```
#include <iostream>
using namespace std;
```

Challenge: Definite Loops in Python & C++

- *Rewrite this program in C++:*

```
for i in range(2017, 2000, -2):
    print("Year is", i)
```

```
#include <iostream>
using namespace std;
int main()
```

Challenge: Definite Loops in Python & C++

- *Rewrite this program in C++:*

```
for i in range(2017, 2000, -2):
    print("Year is", i)
```

```
#include <iostream>
using namespace std;
int main()
{
```

Challenge: Definite Loops in Python & C++

- *Rewrite this program in C++:*

```
for i in range(2017, 2000, -2):
    print("Year is", i)
```

```
#include <iostream>
using namespace std;
int main()
{
  for (int i = 2017; i > 2000; i=i-2)
```

Challenge: Definite Loops in Python & C++

- *Rewrite this program in C++:*

```
for i in range(2017, 2000, -2):
    print("Year is", i)
```

```
#include <iostream>
using namespace std;
int main()
{
  for (int i = 2017; i > 2000; i=i-2)
  {
    cout << "Year is " << i << endl;
```

Challenge: Definite Loops in Python & C++

- *Rewrite this program in C++:*

```
for i in range(2017, 2000, -2):
    print("Year is", i)
```

```
#include <iostream>
using namespace std;
int main()
{
  for (int i = 2017; i > 2000; i=i-2)
  {
    cout << "Year is " << i << endl;
  }
  return 0;
}
```

Challenge: Definite Loops in Python & C++

- *Rewrite this program in Python:*

```
#include <iostream>
using namespace std;
int main()
{
  for (int i = 1; i < 50; i++)
  {
    cout << i << endl;
  }
  return 0;
}
```

Challenge: Definite Loops in Python & C++

- *Rewrite this program in Python:*

```
#include <iostream>
using namespace std;
int main()
{
  for (int i = 1; i < 50; i++)
  {
    cout << i << endl;
  }
  return 0;
}
```

```
for i in range(1, 50):
```

Challenge: Definite Loops in Python & C++

- *Rewrite this program in Python:*

```
#include <iostream>
using namespace std;
int main()
{
  for (int i = 1; i < 50; i++)
  {
    cout << i << endl;
  }
  return 0;
}
```

```
for i in range(1, 50):
    print(i)
```

Challenge: Conditionals in Python & C++

- *Python: what is the output?*

```
year = 2016
if year % 4 == 0 and \
    (not (year % 100 == 0) or (year % 400 == 0)):
     print("Leap!!")
print("Year")
```

- *Write a C++ program that asks the user the number of times they plan to ride transit this week. Your program should then print if it is cheaper to buy single ride metro cards or 7-day unlimited card.*
  (The 7-day card is $33.00, and the cost of single ride, with bonus, is $2.75).

Challenge: Conditionals in Python & C++

- *Python: what is the output?*

```
year = 2016
if year % 4 == 0 and \
    (not (year % 100 == 0) or (year % 400 == 0)):
     print("Leap!!")
print("Year")
```

Challenge: Conditionals in Python & C++

- *Python: what is the output?*

```
year = 2016
if year % 4 == 0 and \
    (not (year % 100 == 0) or (year % 400 == 0)):
     print("Leap!!")
print("Year")  year = 2016



if TRUE and \
    (not (year % 100 == 0) or (year % 400 == 0)):
     print("Leap!!")
print("Year")
```

Challenge: Conditionals in Python & C++

- *Python: what is the output?*

```
year = 2016
if year % 4 == 0 and \
    (not (year % 100 == 0) or (year % 400 == 0)):
     print("Leap!!")
print("Year")
```

Challenge: Conditionals in Python & C++

- *Python: what is the output?*

```
year = 2016
if year % 4 == 0 and \
    (not (year % 100 == 0) or (year % 400 == 0)):
     print("Leap!!")
print("Year")
```

```
year = 2016
if TRUE and \
    (not FALSE or (year % 400 == 0)):
     print("Leap!!")
print("Year")
```

Challenge: Conditionals in Python & C++

- *Python: what is the output?*

```
year = 2016
if year % 4 == 0 and \
    (not (year % 100 == 0) or (year % 400 == 0)):
     print("Leap!!")
print("Year")
```

Challenge: Conditionals in Python & C++

- *Python: what is the output?*

```
year = 2016
if year % 4 == 0 and \
    (not (year % 100 == 0) or (year % 400 == 0)):
     print("Leap!!")
print("Year")
```

```
year = 2016
if TRUE and \
    (TRUE or (year % 400 == 0)):
     print("Leap!!")
print("Year")
```

Challenge: Conditionals in Python & C++

- *Python: what is the output?*

```
year = 2016
if year % 4 == 0 and \
    (not (year % 100 == 0) or (year % 400 == 0)):
     print("Leap!!")
print("Year")
```

Challenge: Conditionals in Python & C++

- *Python: what is the output?*

```
year = 2016
if year % 4 == 0 and \
    (not (year % 100 == 0) or (year % 400 == 0)):
     print("Leap!!")
print("Year")
```

```
year = 2016
if TRUE and \
    (TRUE or FALSE):
     print("Leap!!")
print("Year")
```

Challenge: Conditionals in Python & C++

- *Python: what is the output?*

```
year = 2016
if year % 4 == 0 and \
    (not (year % 100 == 0) or (year % 400 == 0)):
     print("Leap!!")
print("Year")
```

```
year = 2016
if TRUE and \
    (TRUE or FALSE):
     print("Leap!!")
print("Year")
```

Challenge: Conditionals in Python & C++

- *Python: what is the output?*

```
year = 2016
if year % 4 == 0 and \
    (not (year % 100 == 0) or (year % 400 == 0)):
     print("Leap!!")
print("Year")
```

```
year = 2016
if TRUE and \
    (TRUE):
     print("Leap!!")
print("Year")
```

Challenge: Conditionals in Python & C++

- *Python: what is the output?*

```
year = 2016
if year % 4 == 0 and \
    (not (year % 100 == 0) or (year % 400 == 0)):
     print("Leap!!")
print("Year")
```

```
year = 2016
if TRUE:
     print("Leap!!")
print("Year")
```

Challenge: Conditionals in Python & C++

- *Python: what is the output?*

```
year = 2016
if year % 4 == 0 and \
    (not (year % 100 == 0) or (year % 400 == 0)):
     print("Leap!!")
print("Year")
```

```
year = 2016
if TRUE:
     print("Leap!!")
print("Year")
```

Prints: `Leap!`
`Year`

Challenge: Conditionals in Python & C++

- *Your program should then print if it is cheaper to buy single ride metro cards ($2.75 per ride) or 7-day unlimited card ($33.00).*

```
#include <iostream>
using namespace std;
```

Challenge: Conditionals in Python & C++

- *Your program should then print if it is cheaper to buy single ride metro cards ($2.75 per ride) or 7-day unlimited card ($33.00).*

```
#include <iostream>
using namespace std;
int main()
```

Challenge: Conditionals in Python & C++

- *Your program should then print if it is cheaper to buy single ride metro cards ($2.75 per ride) or 7-day unlimited card ($33.00).*

```
#include <iostream>
using namespace std;
int main()
{
  int rides;
```

Challenge: Conditionals in Python & C++

- *Your program should then print if it is cheaper to buy single ride metro cards ($2.75 per ride) or 7-day unlimited card ($33.00).*

```
#include <iostream>
using namespace std;
int main()
{
  int rides;
  cout << "Enter number of rides:";
```

Challenge: Conditionals in Python & C++

- *Your program should then print if it is cheaper to buy single ride metro cards ($2.75 per ride) or 7-day unlimited card ($33.00).*

```
#include <iostream>
using namespace std;
int main()
{
  int rides;
  cout << "Enter number of rides:";
  cin >> rides;
```

Challenge: Conditionals in Python & C++

- *Your program should then print if it is cheaper to buy single ride metro cards ($2.75 per ride) or 7-day unlimited card ($33.00).*

```
#include <iostream>
using namespace std;
int main()
{
  int rides;
  cout << "Enter number of rides:";
  cin >> rides;
  if (2.75 * rides < 33.00)
```

Challenge: Conditionals in Python & C++

- *Your program should then print if it is cheaper to buy single ride metro cards ($2.75 per ride) or 7-day unlimited card ($33.00).*

```
#include <iostream>
using namespace std;
int main()
{
  int rides;
  cout << "Enter number of rides:";
  cin >> rides;
  if (2.75 * rides < 33.00)
  {
    cout << "Cheaper to buy single ride metro cards.\n";
  }
```

Challenge: Conditionals in Python & C++

- *Your program should then print if it is cheaper to buy single ride metro cards ($2.75 per ride) or 7-day unlimited card ($33.00).*

```
#include <iostream>
using namespace std;
int main()
{
  int rides;
  cout << "Enter number of rides:";
  cin >> rides;
  if (2.75 * rides < 33.00)
  {
    cout << "Cheaper to buy single ride metro cards.\n";
  }
  else
```

Challenge: Conditionals in Python & C++

- *Your program should then print if it is cheaper to buy single ride metro cards ($2.75 per ride) or 7-day unlimited card ($33.00).*

```
#include <iostream>
using namespace std;
int main()
{
  int rides;
  cout << "Enter number of rides:";
  cin >> rides;
  if (2.75 * rides < 33.00)
  {
    cout << "Cheaper to buy single ride metro cards.\n";
  }
  else
  {
    cout << "Cheaper to buy 7-day unlimited card.\n";
  }
```

Challenge: Conditionals in Python & C++

- *Your program should then print if it is cheaper to buy single ride metro cards ($2.75 per ride) or 7-day unlimited card ($33.00).*

```
#include <iostream>
using namespace std;
int main()
{
  int rides;
  cout << "Enter number of rides:";
  cin >> rides;
  if (2.75 * rides < 33.00)
  {
    cout << "Cheaper to buy single ride metro cards.\n";
  }
  else
  {
    cout << "Cheaper to buy 7-day unlimited card.\n";
  }
  return 0;
}
```

Challenge: Indefinite Loops in Python & C++

- Write Python code that repeatedly prompts for a non-empty string.

- Write C++ code that repeatedly prompts until an odd number is entered.

Challenge: Indefinite Loops in Python & C++

- Write Python code that repeatedly prompts for a non-empty string.

Challenge: Indefinite Loops in Python & C++

- Write Python code that repeatedly prompts for a non-empty string.

```
s = ""
```

Challenge: Indefinite Loops in Python & C++

- Write Python code that repeatedly prompts for a non-empty string.

```
s = ""
while s == "":
```

Challenge: Indefinite Loops in Python & C++

- Write Python code that repeatedly prompts for a non-empty string.

```
s = ""
while s == "":
  s = input("Enter a non-empty string:  ")
```

Challenge: Indefinite Loops in Python & C++

- Write Python code that repeatedly prompts for a non-empty string.

```
s = ""
while s == "":
  s = input("Enter a non-empty string:  ")
print("You entered:  ", s)
```

Challenge: Indefinite Loops in Python & C++

- Write Python code that repeatedly prompts for a non-empty string.

```
s = ""
while s == "":
  s = input("Enter a non-empty string:  ")
print("You entered:  ", s)
```

- Write C++ code that repeatedly prompts until an odd number is entered.

Challenge: Indefinite Loops in Python & C++

- Write Python code that repeatedly prompts for a non-empty string.

```
s = ""
while s == "":
  s = input("Enter a non-empty string:  ")
print("You entered:  ", s)
```

- Write C++ code that repeatedly prompts until an odd number is entered.

```
#include <iostream>
using namespace std;
```

Challenge: Indefinite Loops in Python & C++

- Write Python code that repeatedly prompts for a non-empty string.

```
s = ""
while s == "":
  s = input("Enter a non-empty string:  ")
print("You entered:  ", s)
```

- Write C++ code that repeatedly prompts until an odd number is entered.

```
#include <iostream>
using namespace std;
int main()
```

Challenge: Indefinite Loops in Python & C++

- Write Python code that repeatedly prompts for a non-empty string.

```
s = ""
while s == "":
  s = input("Enter a non-empty string:  ")
print("You entered:  ", s)
```

- Write C++ code that repeatedly prompts until an odd number is entered.

```
#include <iostream>
using namespace std;
int main()
{
  int num = 0;
```

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  return 0;
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Today's Topics

- Recap: Incrementer Design Challenge
- C++: Basic Format & Variables
- I/O and Definite Loops in C++
- Conditionals in C++
- Indefinite Loops in C++
- Recap: C++ & Python
- **More Info on the Final Exam**

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All acts of academic dishonesty will be reported to the Office of Academic and Student Affairs and will result in a 0 grade on the exam.

Final Exam Practice Rounds:

For each question, write the function header (name & inputs) and return values (often called the Application Programming Interface (API)):

- **Write a function that takes a weight in kilograms and returns the weight in pounds.**

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def kg2lbs(kg)
    lbs = kg * 2.2
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def sLength(str):
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- **Write a function that, given a DataFrame, returns the minimal value in the "Manhattan" column.**

```
def getMin(df):
    min = df['Manhattan'].min()
    return(min)
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def num2bin(num):
    binStr = ""
    while (num > 0):
        #Divide by 2, and add the remainder to the string
        r = num %2
        binString = str(r) + binStr
        num = num / 2
    return(binStr)
```

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- **Write a function that computes the total monthly payment when given the initial loan amount, annual interest rate, number of years of the loan.**

```
def computePayment(loan,rate,year):
    (Some formula for payment)
    return(payment)
```