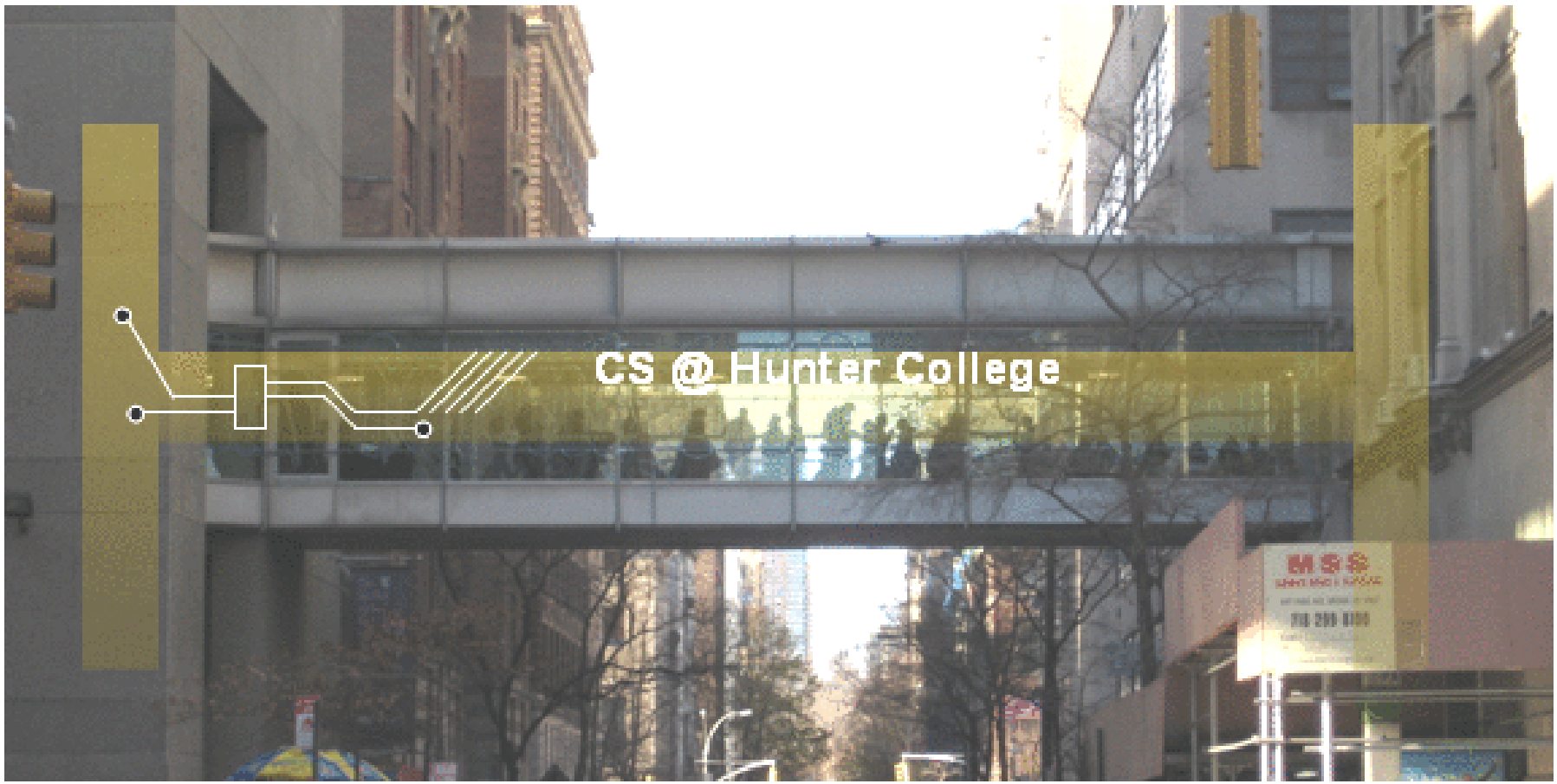
CSci 127: Introduction to Computer Science



hunter.cuny.edu/csci

Frequently Asked Questions

From lecture slips & recitation sections.

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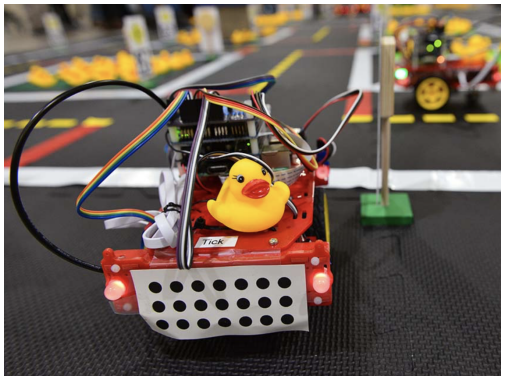
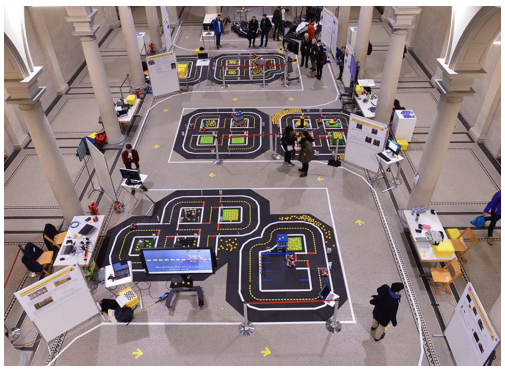
  It's a practice exam that we're holding on 10 December.
  More details at the end of lecture.

Announcements





DuckieTown

(ETH Zurich, 2018)

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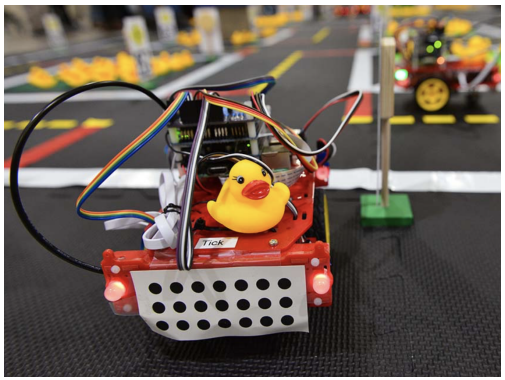

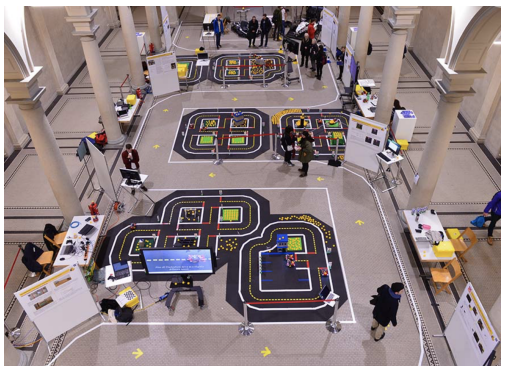

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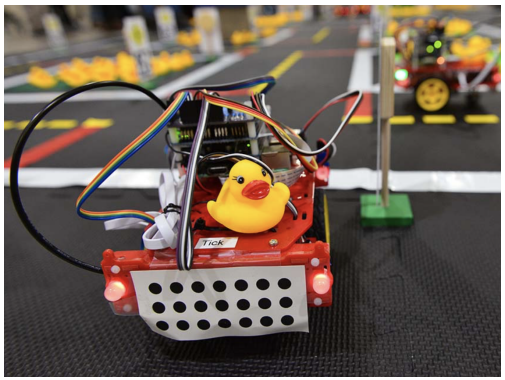

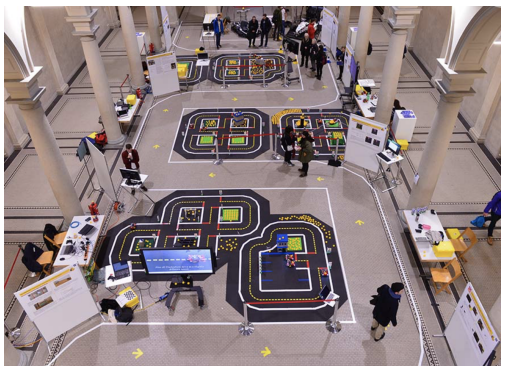

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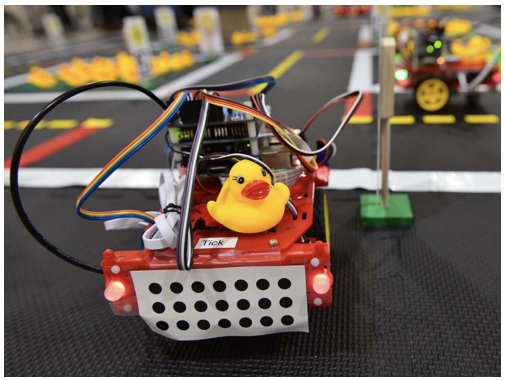

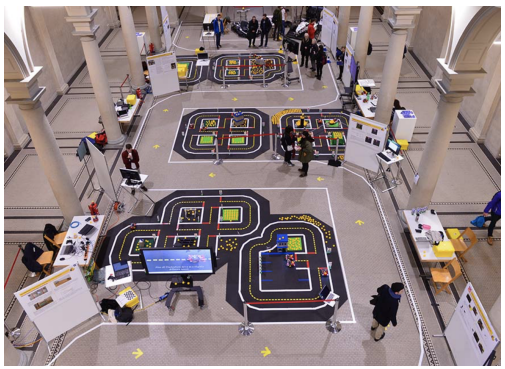

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- 20 days: Final Exam (more at end of lecture).

Today's Topics

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

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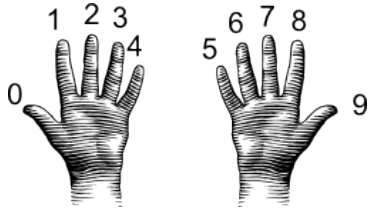
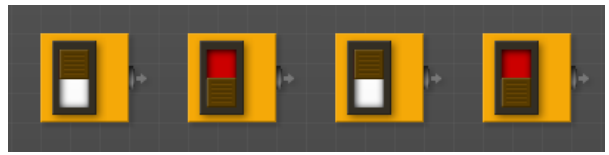
Recap: Design Challenge: Incrementers





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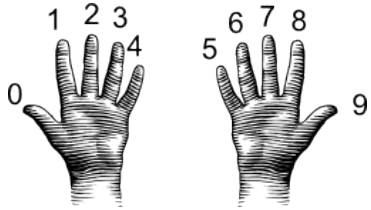

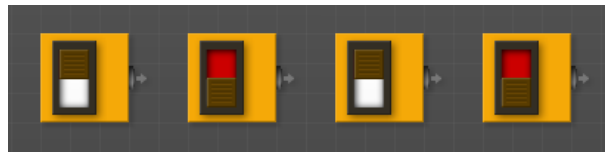

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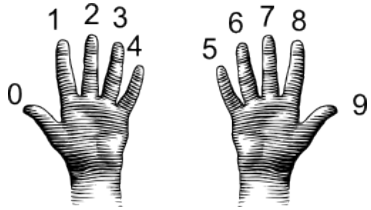

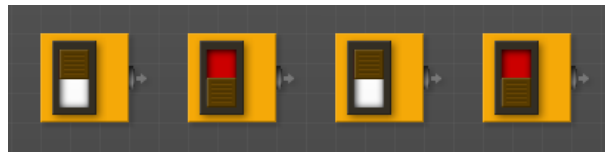

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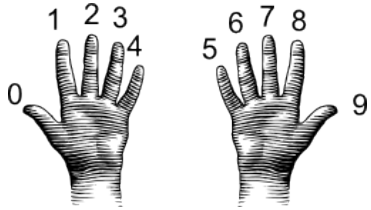

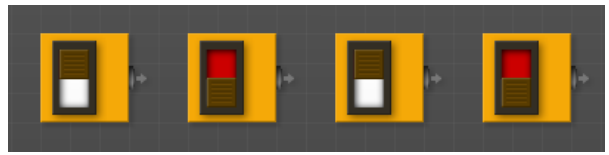

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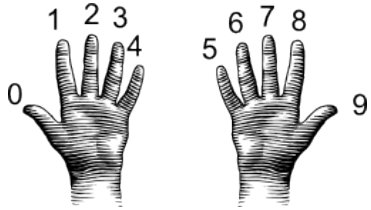

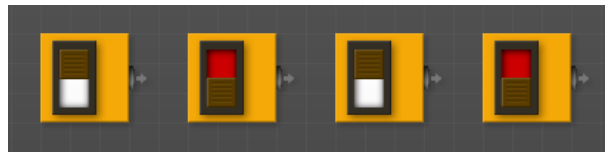

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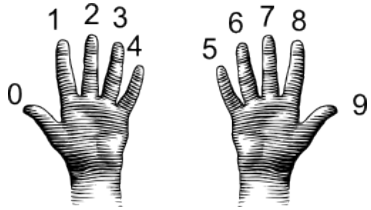

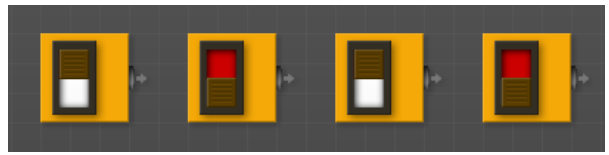

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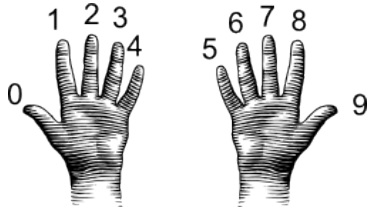

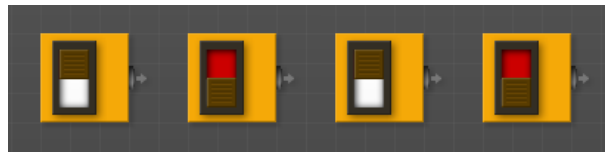

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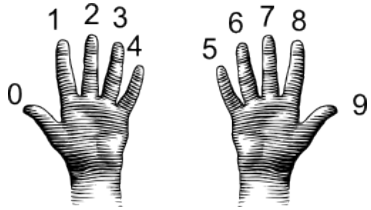

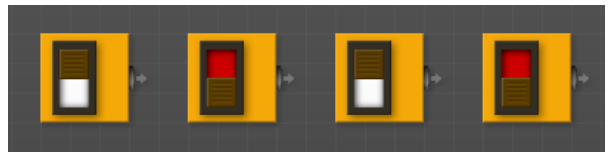

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  Example: `"1001"` → `"1010"`

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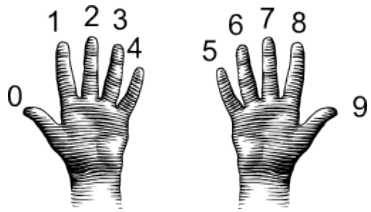

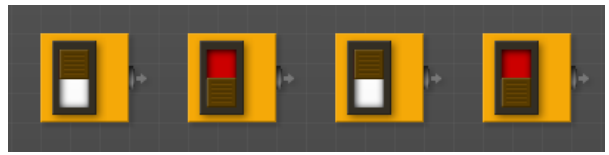

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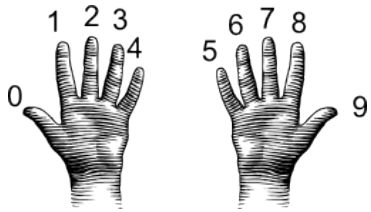

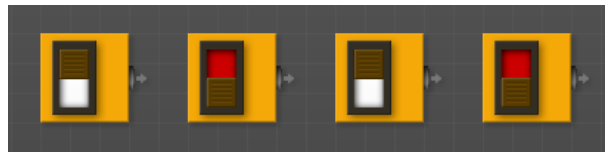

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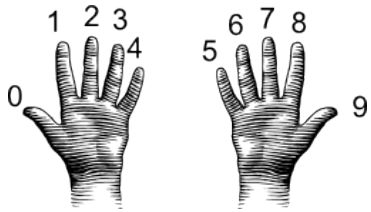

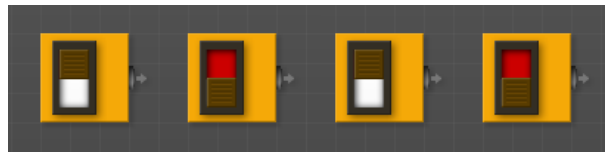

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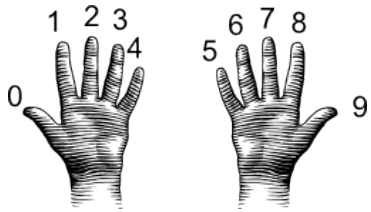

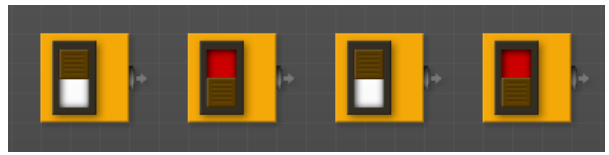

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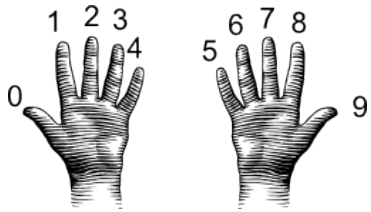

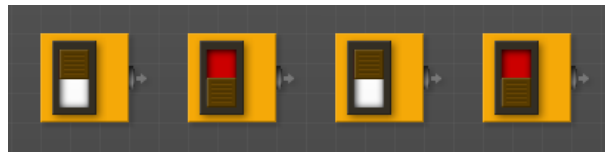

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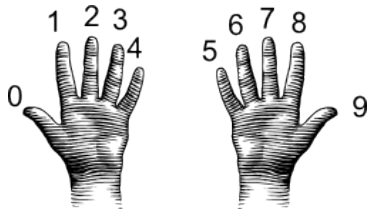
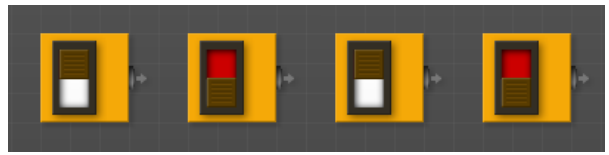
3. Add one (increment) the standard decimal number.

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"`
- *Hint: Convert to numbers, increment, and convert back to strings.*

Pseudocode same for both questions:

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

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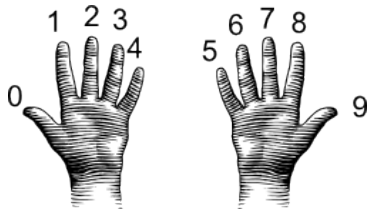

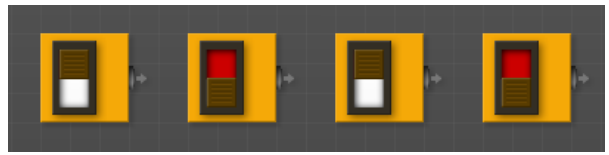

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5. Print the result.

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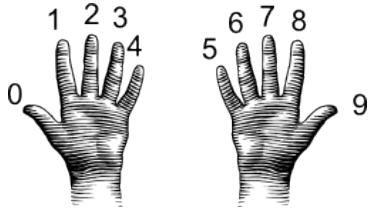

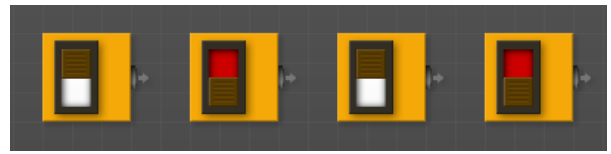

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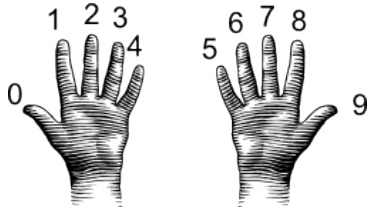

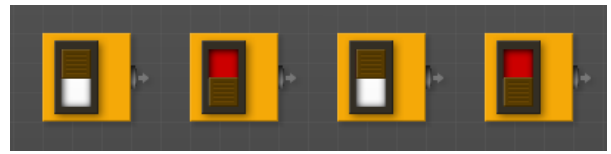

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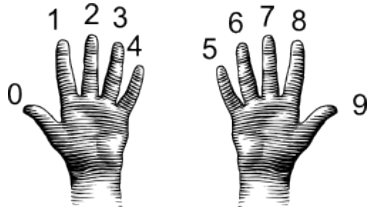
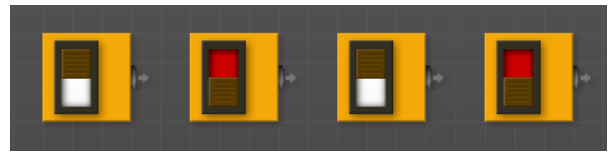
Pseudocode same for both questions:

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

Recap: Incrementer Design Challenge





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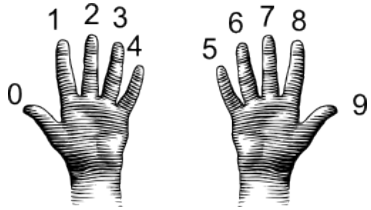
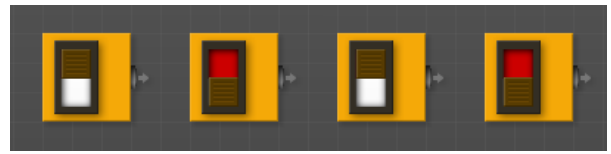
Pseudocode same for both questions:

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

Recap: Incrementer Design Challenge





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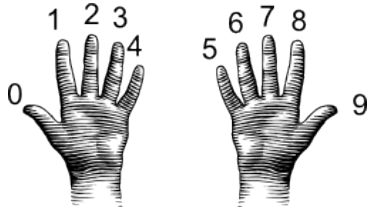
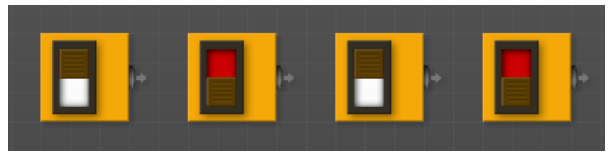
Pseudocode same for both questions:

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

Recap: Incrementer Design Challenge





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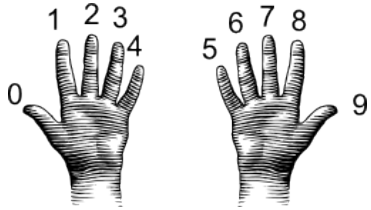

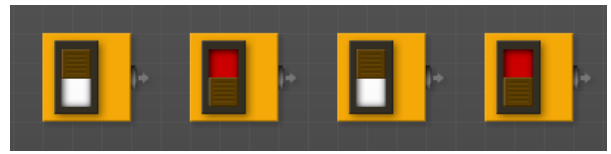

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1. Get user input: `"1001"`

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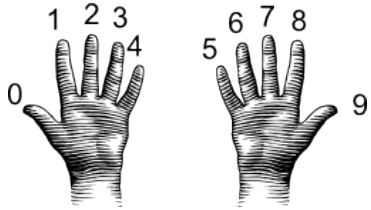

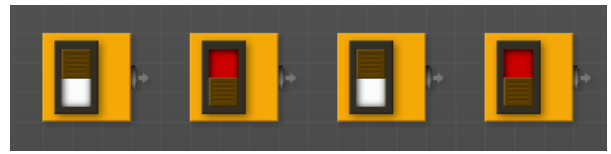

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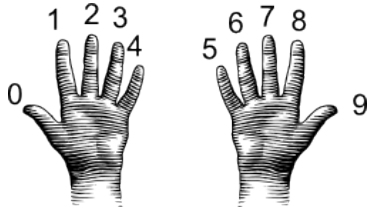
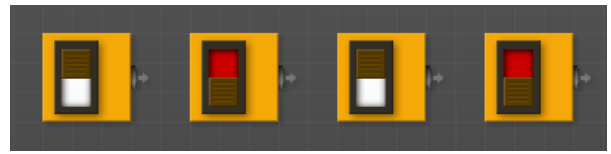
Pseudocode same for both questions:

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

Recap: Incrementer Design Challenge





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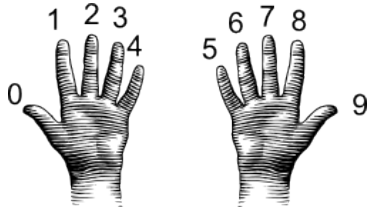
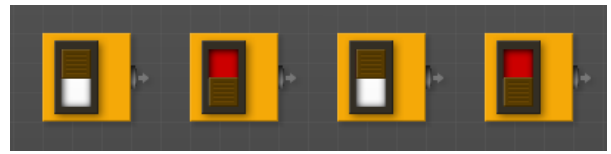
Pseudocode same for both questions:

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





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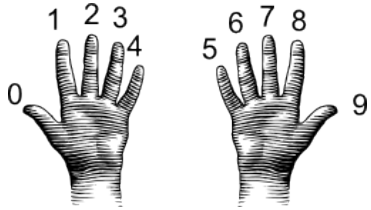

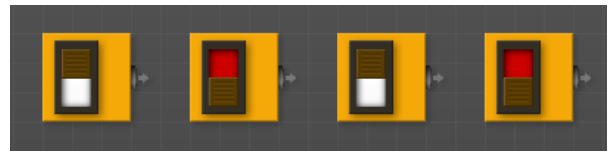

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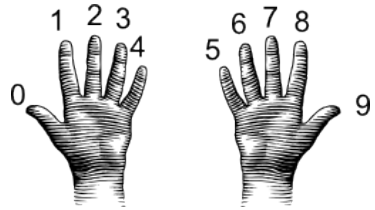

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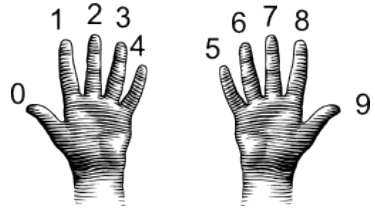

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```
def convert2Decimal(numString):
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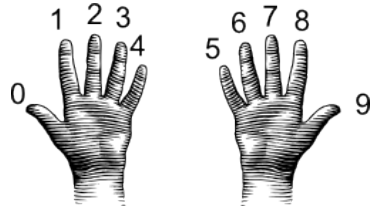

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def convert2Decimal(numString):
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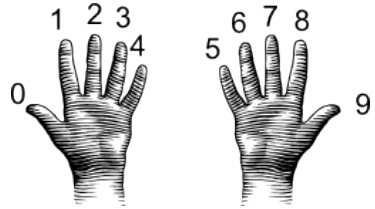

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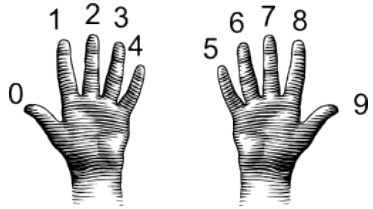

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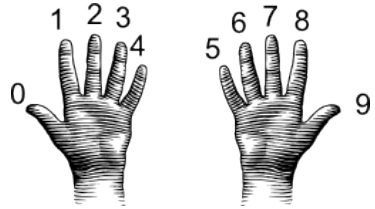

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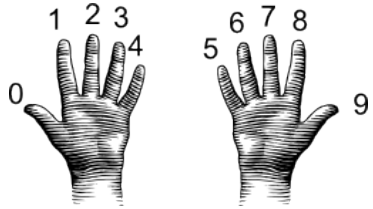

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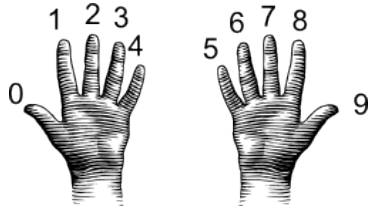

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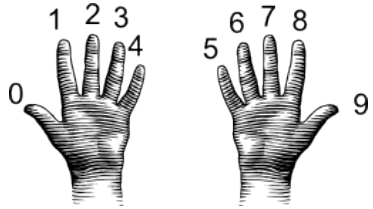

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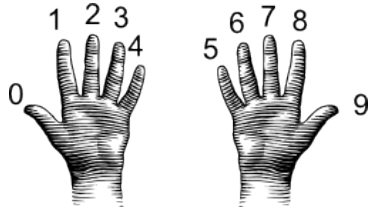
Unit Testing: Incrementer Design Challenge



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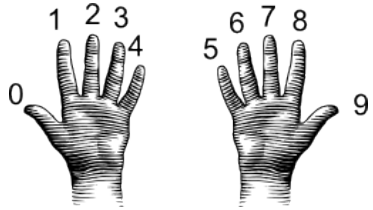
Will this work? What inputs would find the error(s)?

Unit Testing: Incrementer Design Challenge



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

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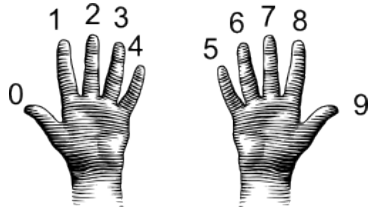

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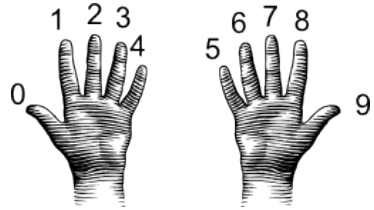

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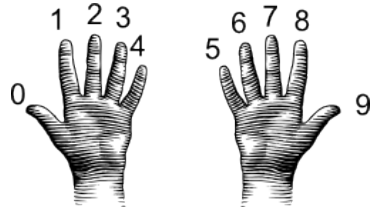

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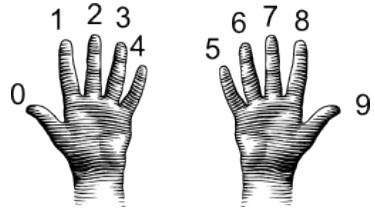

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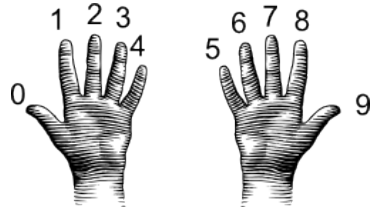
```
names = ["zero","one",...,"nine"]
```

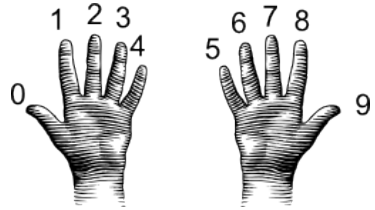
Unit Testing: Incrementer Design Challenge



- 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. Often do, if important or small.
- 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)
```

Unit Testing: Incrementer Design Challenge



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

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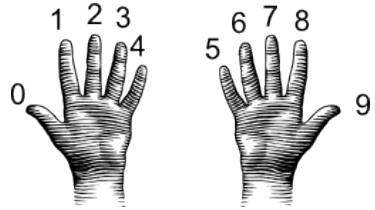

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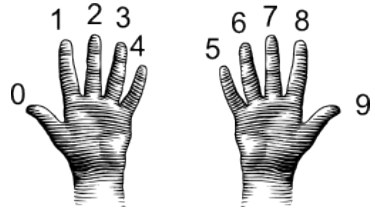
```
names = ["zero","one",...,"nine"]
x = random.randrange(10)
if x == convert2Decimal(names[x]):
    #PASS
```

Unit Testing: Incrementer Design Challenge



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if x == convert2Decimal(names[x]):
    #PASS
else:
```
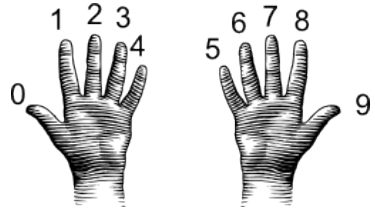

Unit Testing: Incrementer Design Challenge



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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++
- More Info on the Final Exam

In Pairs or Triples:

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

```
1  //Another C++ program, demonstrating variables
2  #include <iostream>
3  using namespace std;
4
5  int main ()
6  {
7    int year;
8    cout << "Enter a number: ";
9    cin >> year;
10   cout << "Hello " << year << "!!\n\n";
11   return 0;
12 }
```

onlinegdb demo

```cpp
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  return 0;
}
```

(Demo with `onlinegdb`)

Introduction to C++

```cpp
//Another C++ program, demonstrating variables
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- 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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- Used for systems programming (and future courses!).

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- 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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5  int main ()
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Example:

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Introduction to C++

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Example:

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

Introduction to C++

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In Pairs or Triples:

Predict what the following pieces of code will do:

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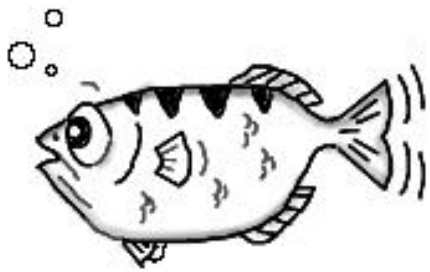
#include <iostream>
using namespace std;

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

Side Note: gdb



gdb.org

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

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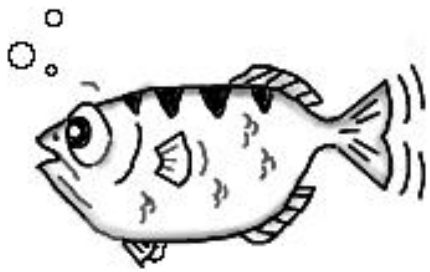

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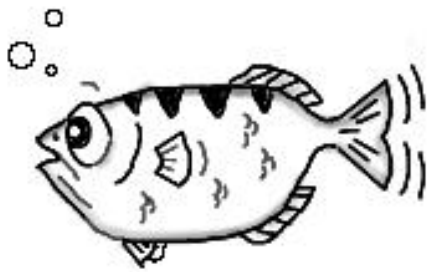

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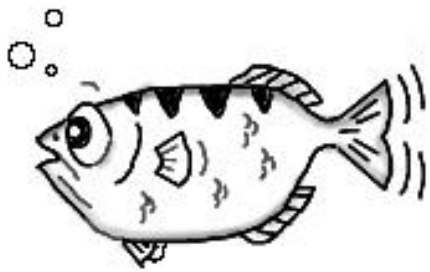

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- Written in 1986, `gdb` is the GNU debugger and based on `dbx` from the Berkeley Distribution of Unix.
- Lightweight, widely-available program that allows you to "step through" your code line-by-line.
- Available on the lab machines (via command-line and the IDE `spyder`) and on-line (`onlinegdb.com`).

C++ Demo

```cpp
//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;
}
```

(Demo with `onlinegdb`)

In Pairs or Triples...

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

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}
```

Python Tutor

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  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++**
- More Info on the Final Exam

In Pairs or Triples:

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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int main ()
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```

(Demo with `onlinegdb`)

Definite loops

```
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int main ()
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  {
      cout << j << " ";
  }
  cout << "Blast off!!" << endl;

  return 0;
}
```

General format:

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

command1;
command2;
command3;
...

}

In Pairs or Triples:

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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int main ()
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  cin >> size;
  for (i = 0; i < size; i++)
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    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;
}
```

(Demo with `onlinegdb`)

In Pairs or Triples:

Predict what the following pieces of code will do:

```
//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;
}
```

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#include <iostream>
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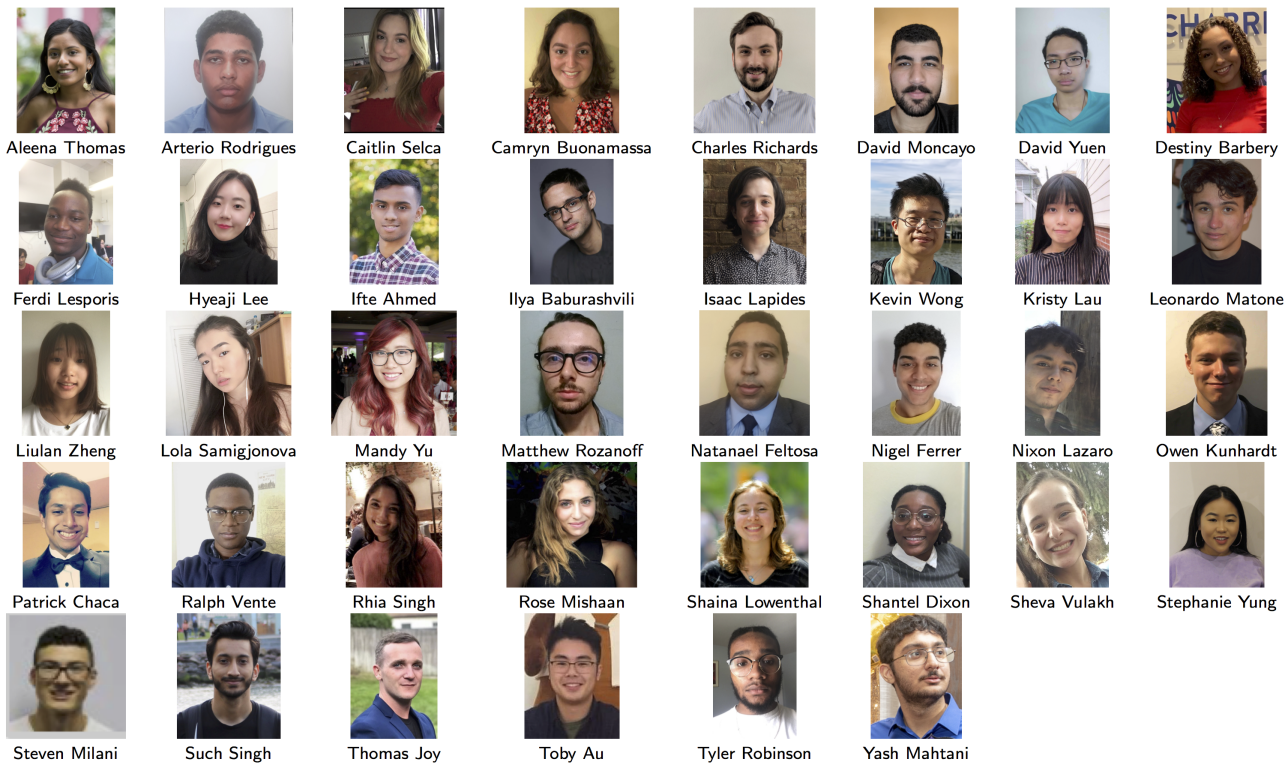
Lecture Slips

Which UTA have you spoken with most? Why?

Introductions: Undergraduate Teaching Assistants



Lecture Slips

In pairs or triples: **translate** the C++ program into Python:

```cpp
//Growth example
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int main ()
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  for (int year = 0; year < 100; year= year+5)
  {
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      population = population * 2;

  }
  return 0;
}
```

Lecture Slips

Translate line-by-line:

```
//Growth example
#include <iostream>
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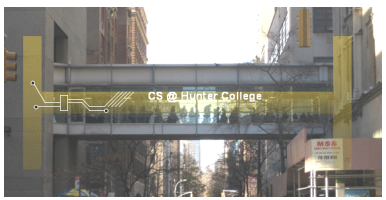
int main ()
{
  int population = 100;
  cout << "Year\tPopulation\n";
  for (int year = 0; year < 100; year= year+5)
  {
      cout << year << "\t" << population << "\n";
      population = population * 2;

  }
  return 0;
}
```

Recap: C++

- On lecture slip, write down a topic you wish we had spent more time (and why).



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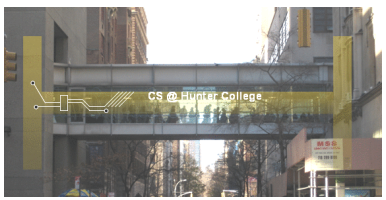

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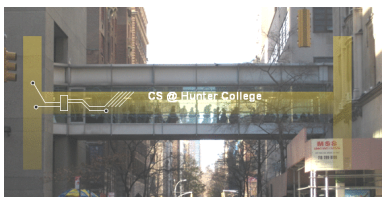

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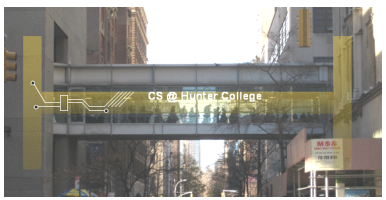

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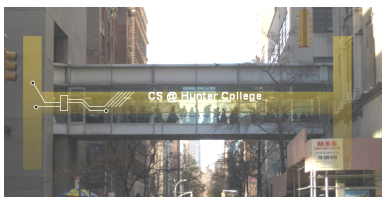

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- Pass your lecture slip to the aisles for UTA's to collect.

Today's Topics

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

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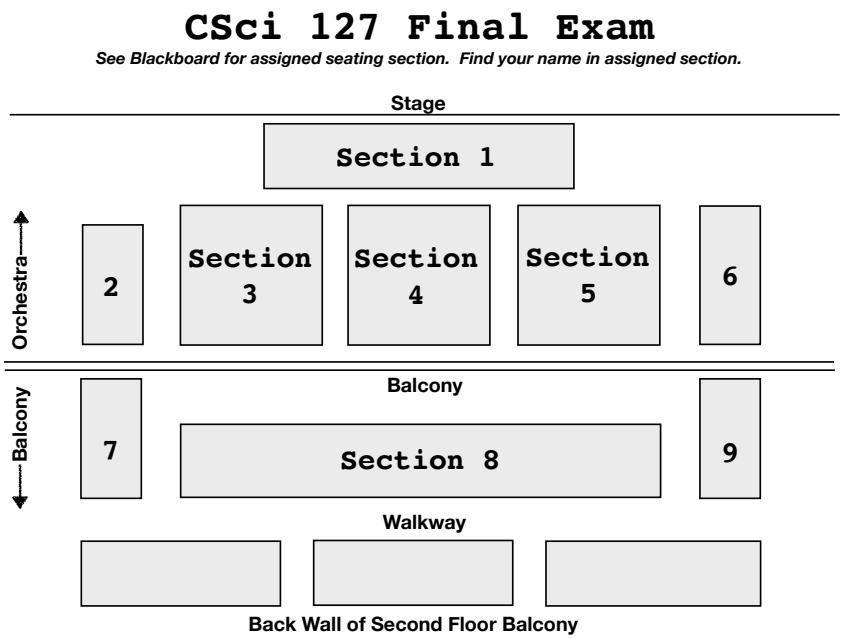

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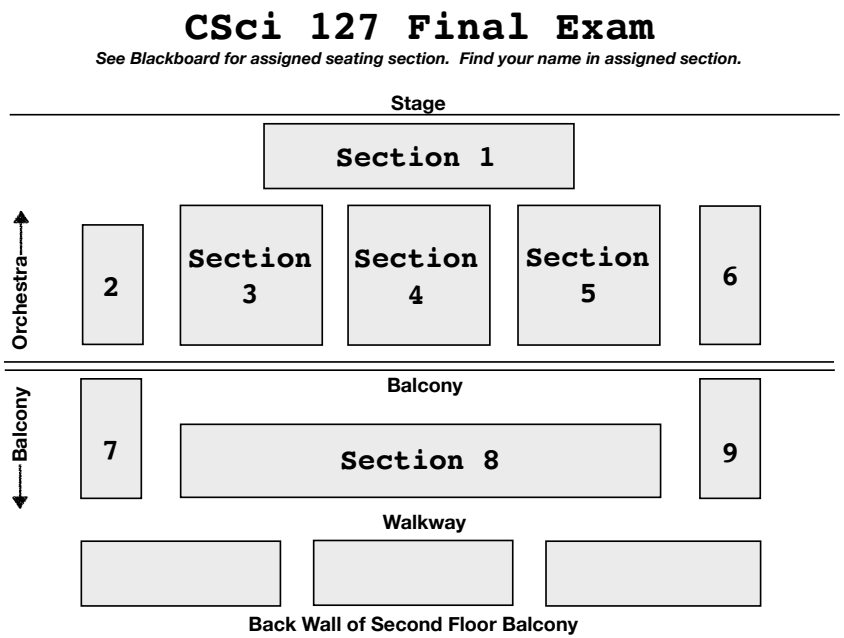

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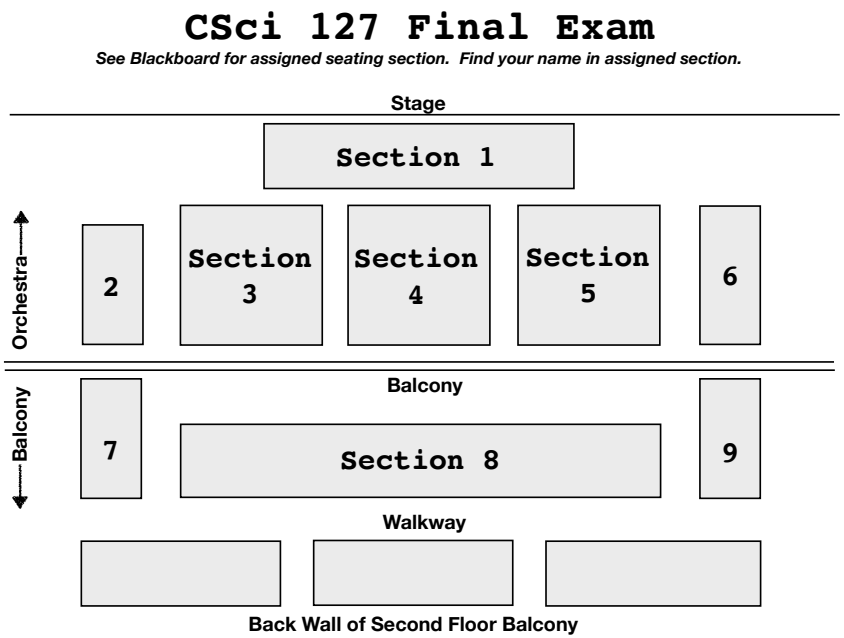

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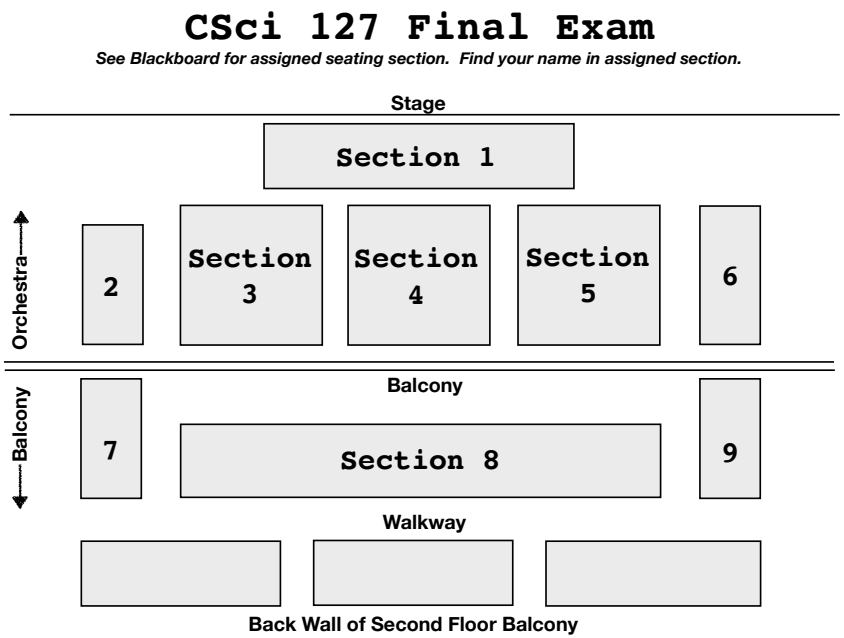

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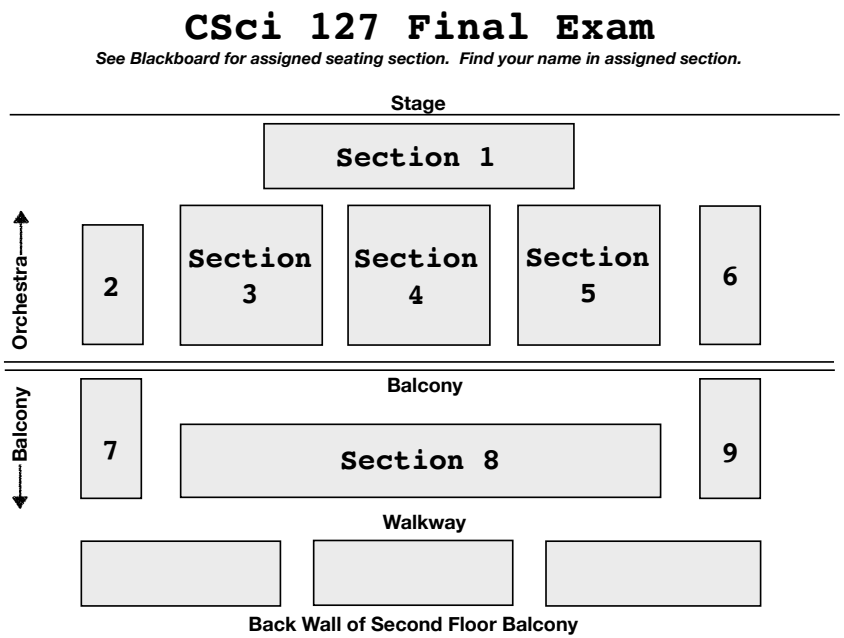

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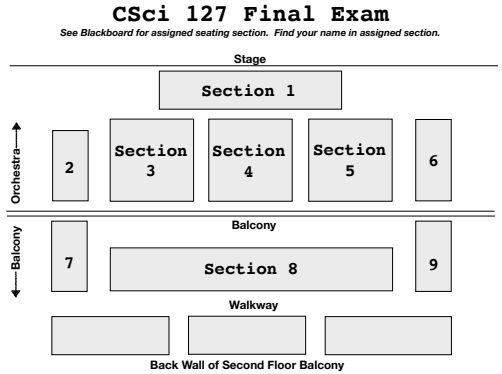

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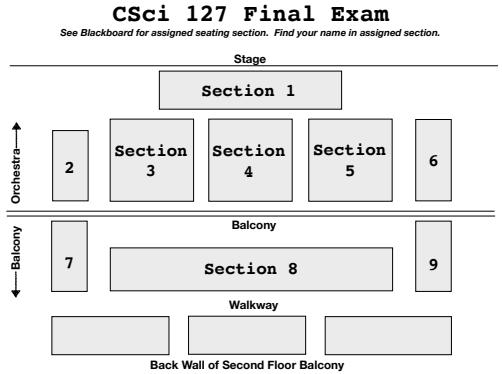

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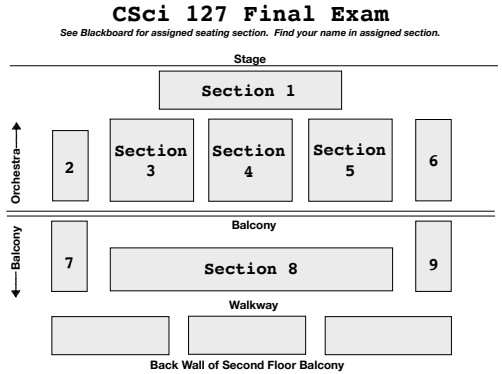

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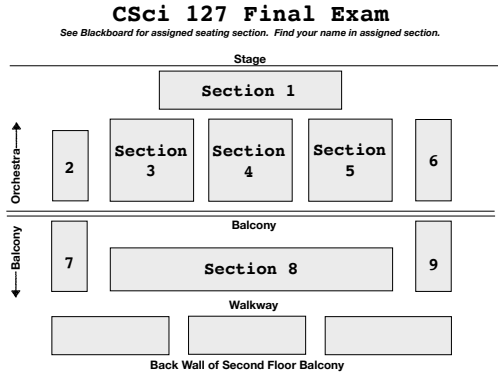

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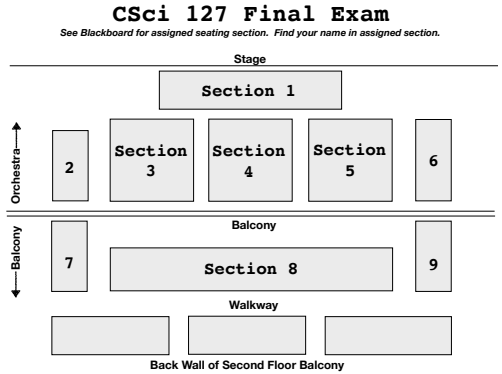

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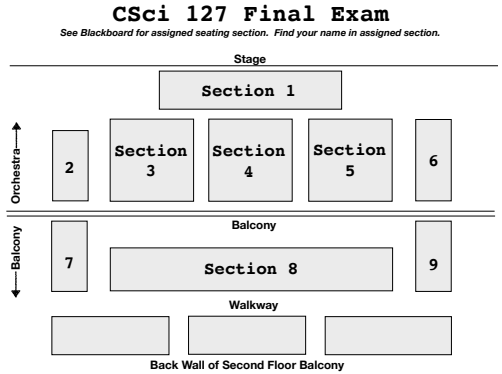

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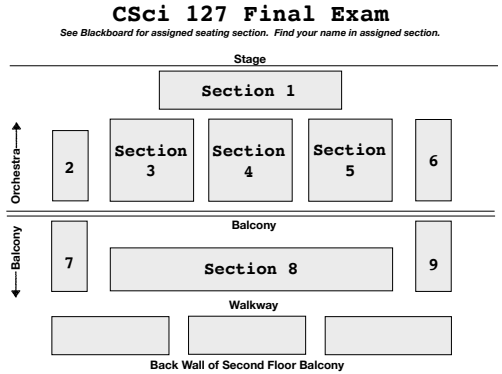

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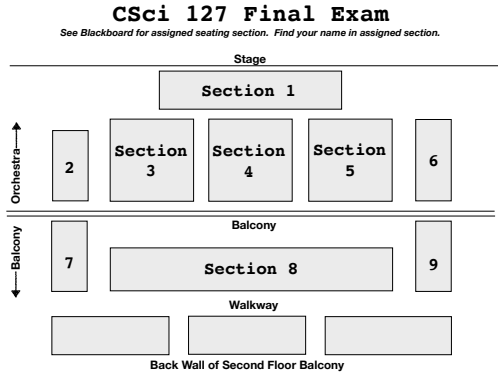

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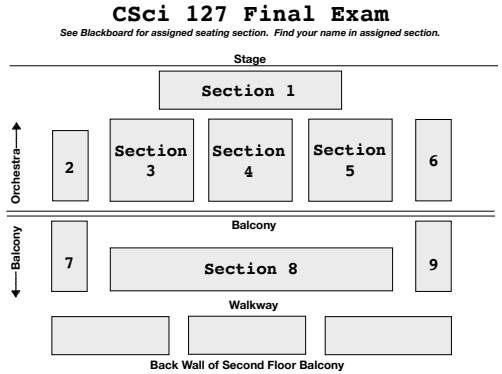

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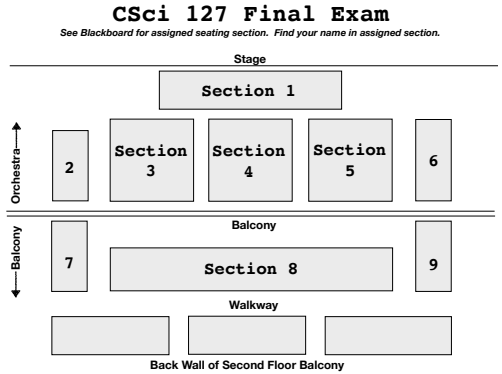

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- Aim to complete 7 to 10 past exams (one a day in the week leading up to the final).

Final Overview: Top-Down Design & APIs

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

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- Write a function that takes a weight in kilograms and returns the weight in pounds.
- Write a function that takes a string and returns its length.
- Write a function that, given a DataFrame, returns the minimal value in the first column.
- Write a function that takes a whole number and returns the corresponding binary number as a string.
- Write a function that computes the total monthly payment when given the initial loan amount, annual interest rate, number of years of the loan.

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(Hint: highlight key words, make list of inputs, list of outputs, then put together.)

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```
def kg2lbs(kg):
    ...
    return(lbs)
```

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

```
def kg2lbs(kg)
    lbs = kg * 2.2
    return(lbs)
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```
def sLength(str):
    ...
    return(length)
```

Final Overview

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 string and returns its length.

```
def sLength(str):
    length = len(str)
    return(length)
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def getMin(df):
    ...
    return(min)
```

Final Overview

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

- 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):
    ...
    return(bin)
```

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- Write a function that takes a whole number and returns the corresponding binary number as a string.

```
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)
```

Final Overview

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

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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):
    ....
    return(payment)
```

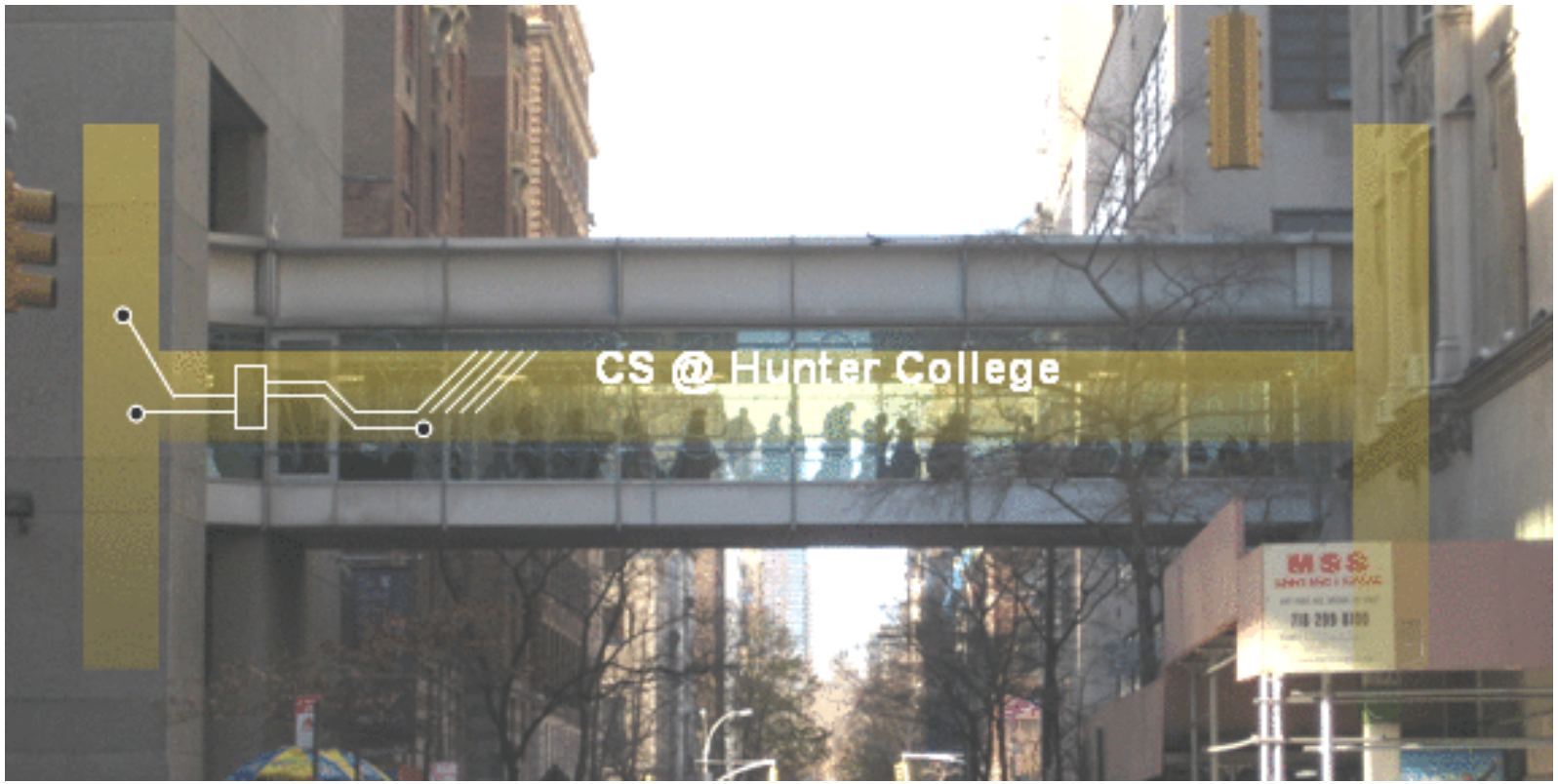
Final Overview

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

- 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)
```

Writing Boards



- Return writing boards as you leave...