Foreign Student Visualization

variable scope, parallel arrays,
Strings, find the max algorithm

Variable Scope

Where can I access my variable after it's declared?

```
boolean dogsDrawn;

void setup()
{
  dogsDrawn = false;

  color blue = color(0, 0, 200);
  background(blue);
}

void draw()
{
  if (!dogsDrawn)
  {
    drawDog(10, 10); // draw one dog for now
    dogsDrawn = false;
  }
}
```

global variable: accessible anywhere

```
boolean dogsDrawn;

void setup()
{
  dogsDrawn = false;

  color blue = color(0, 0, 200);
  background(blue);
}

void draw()
{
  if (!dogsDrawn)
  {
    drawDog(10, 10); // draw one dog for now
    dogsDrawn = false;
  }
}
```

```
boolean dogsDrawn;

void setup()
{
  dogsDrawn = false;

  color blue = color(0, 0, 200);
  background(blue);
}

void draw()
{
  if (!dogsDrawn)
  {
    drawDog(10, 10); // draw one dog for now
    dogsDrawn = false;
  }
}
```

no problem using it inside setup

local variable: only accessible where it was declared

```
boolean dogsDrawn;

void setup()
{
  dogsDrawn = false;

  color blue = color(0, 0, 200);
  background(blue);
}

void draw()
{
  if (!dogsDrawn)
  {
    drawDog(10, 10); // draw one dog for now
    dogsDrawn = false;
  }
}
```

```
boolean dogsDrawn;

void setup()
{
  dogsDrawn = false;

  color blue = color(0, 0, 200);
  background(blue);
}
```

using `blue` inside `draw()` would be an error

```
void draw()
{
  if (!dogsDrawn)
  {
    drawDog(10, 10); // draw one dog for now
    dogsDrawn = false;
  }
}
```

```
boolean dogsDrawn;

void setup()
{
  dogsDrawn = false;

  color blue = color(0, 0, 200);
  background(blue);
}

void draw()
{
  if (!dogsDrawn)
  {
    drawDog(10, 10); // draw one dog for now
    dogsDrawn = false;
  }
}
```

curly braces create a new ‘block’

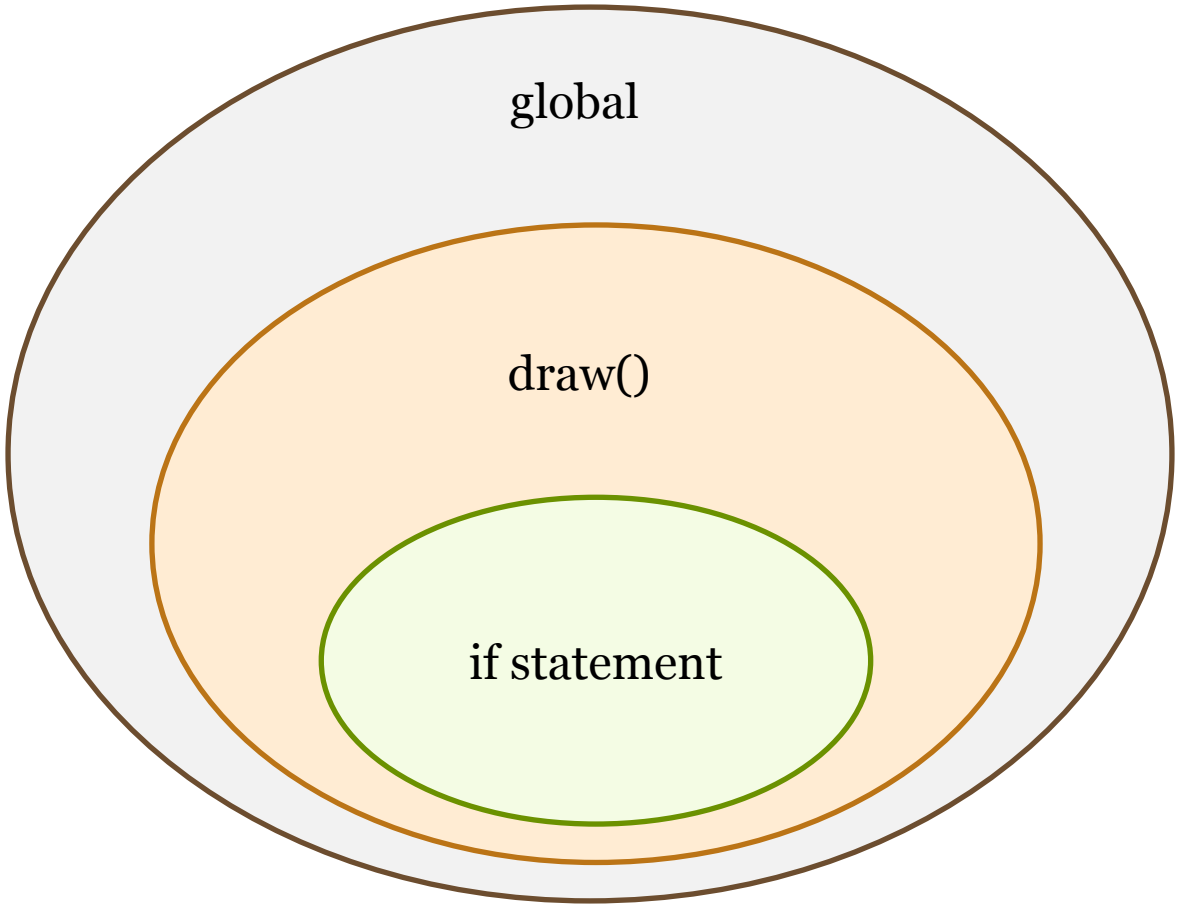
```
boolean dogsDrawn;

void setup()
{
  dogsDrawn = false;

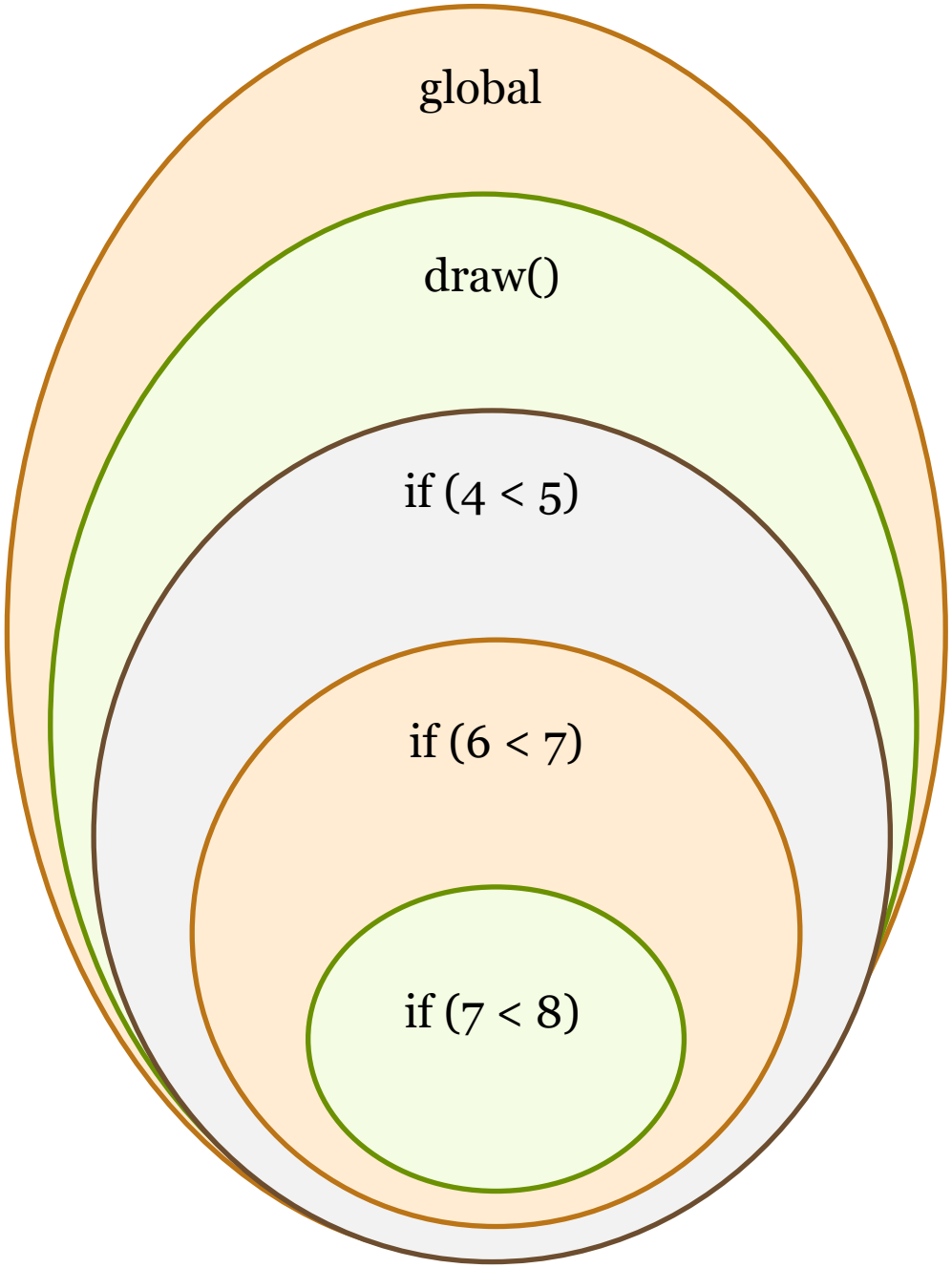
  color blue = color(0, 0, 200);
  background(blue);
}

void draw()
{
  if (!dogsDrawn)
  {
    drawDog(10, 10); // draw one dog for now
    dogsDrawn = false;
  }
}
```

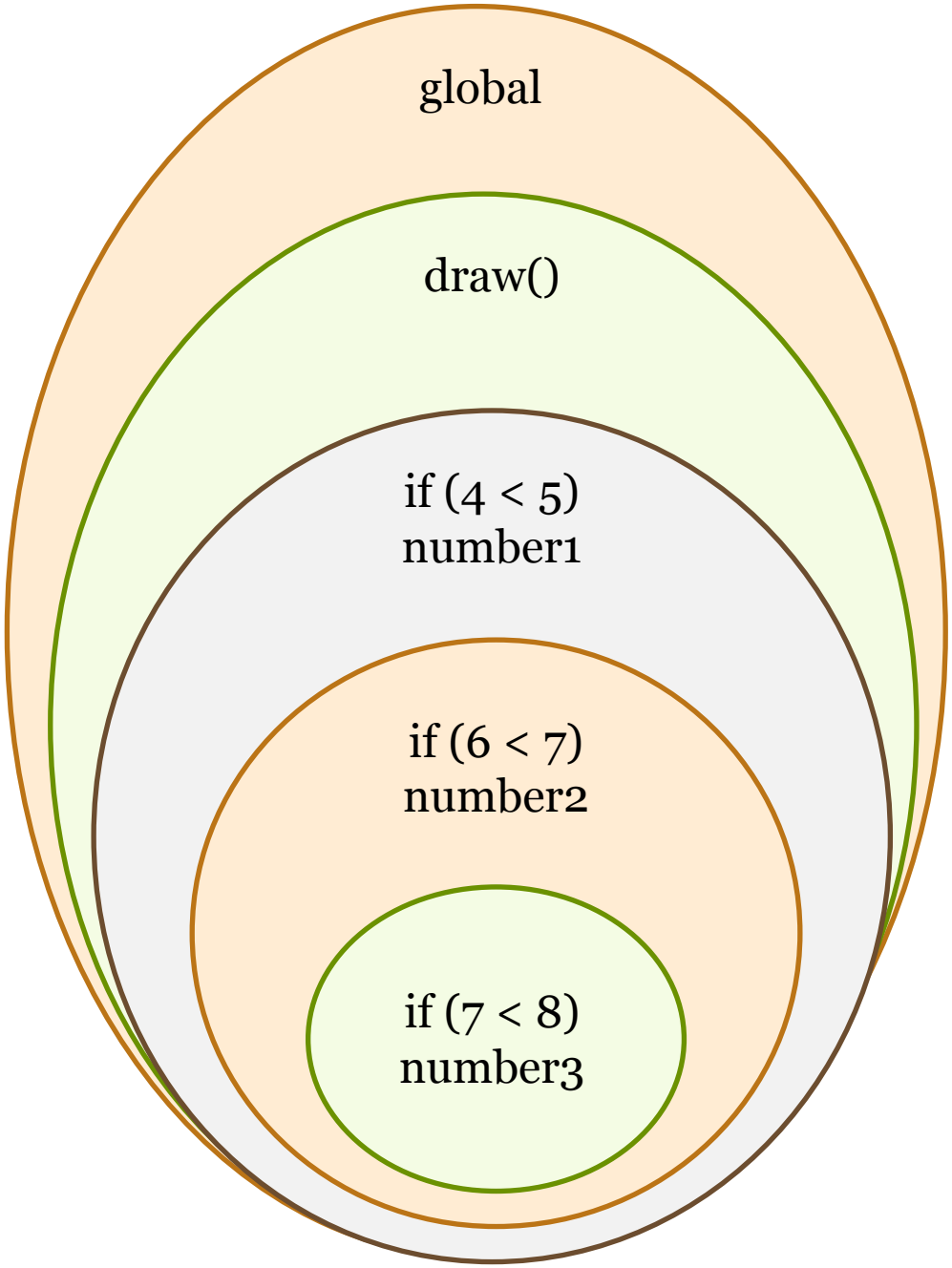
each new block is a new scope


global
draw()
if statement

```
void draw()
{
  if (4 < 5)
  {
    int number1 = 10;
    if (6 < 7)
    {
      int number2 = 20;
      if (7 < 8)
      {
         int number3 = 30;
      }
      number1 += number2;
      number1 += number3;
    }
  }
}
```

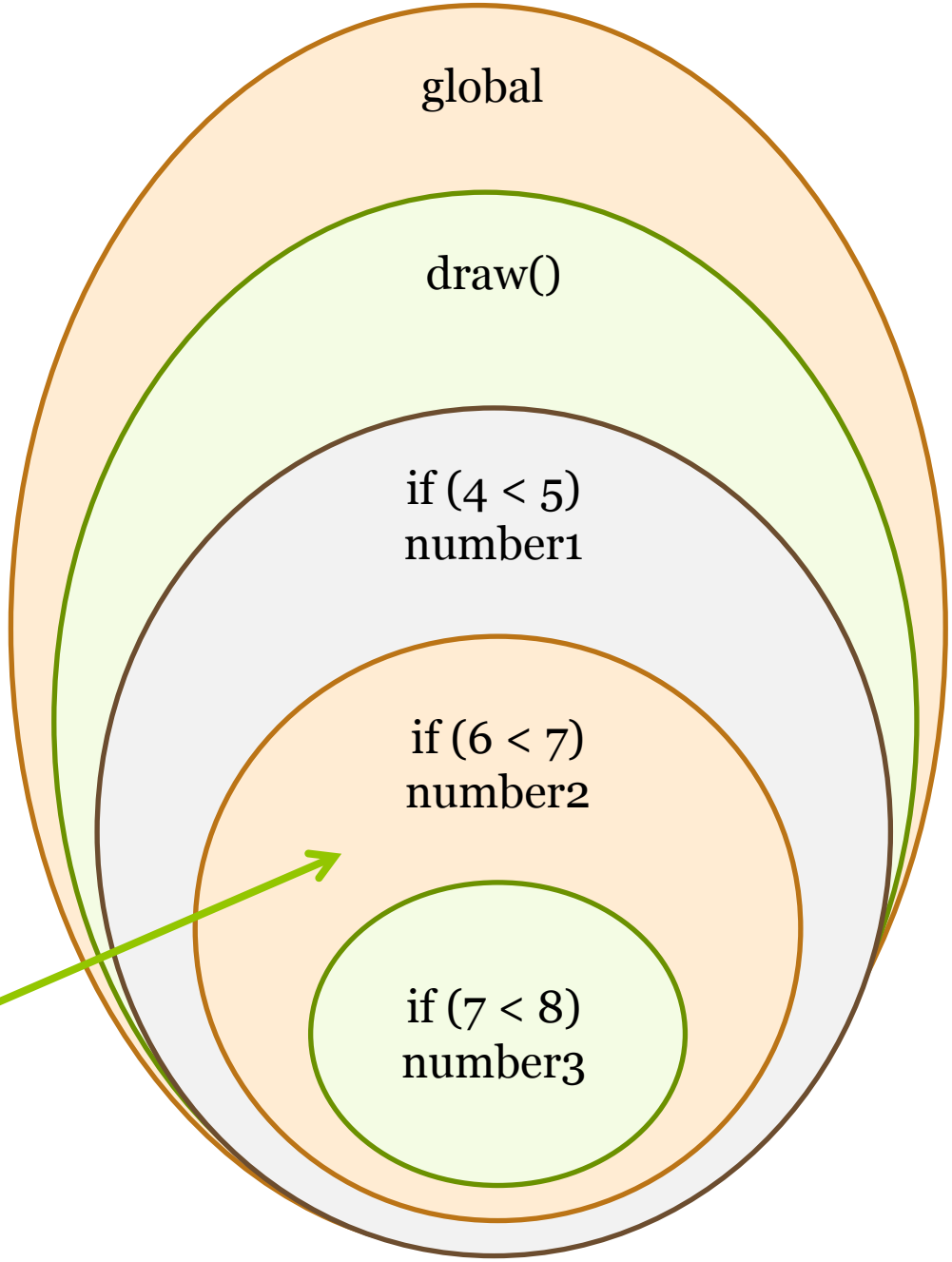


```
void draw()
{
  if (4 < 5)
  {
    int number1 = 10;
    if (6 < 7)
    {
      int number2 = 20;
      if (7 < 8)
      {
         int number3 = 30;
      }
      number1 += number2;
      number1 += number3;
    }
  }
}
```



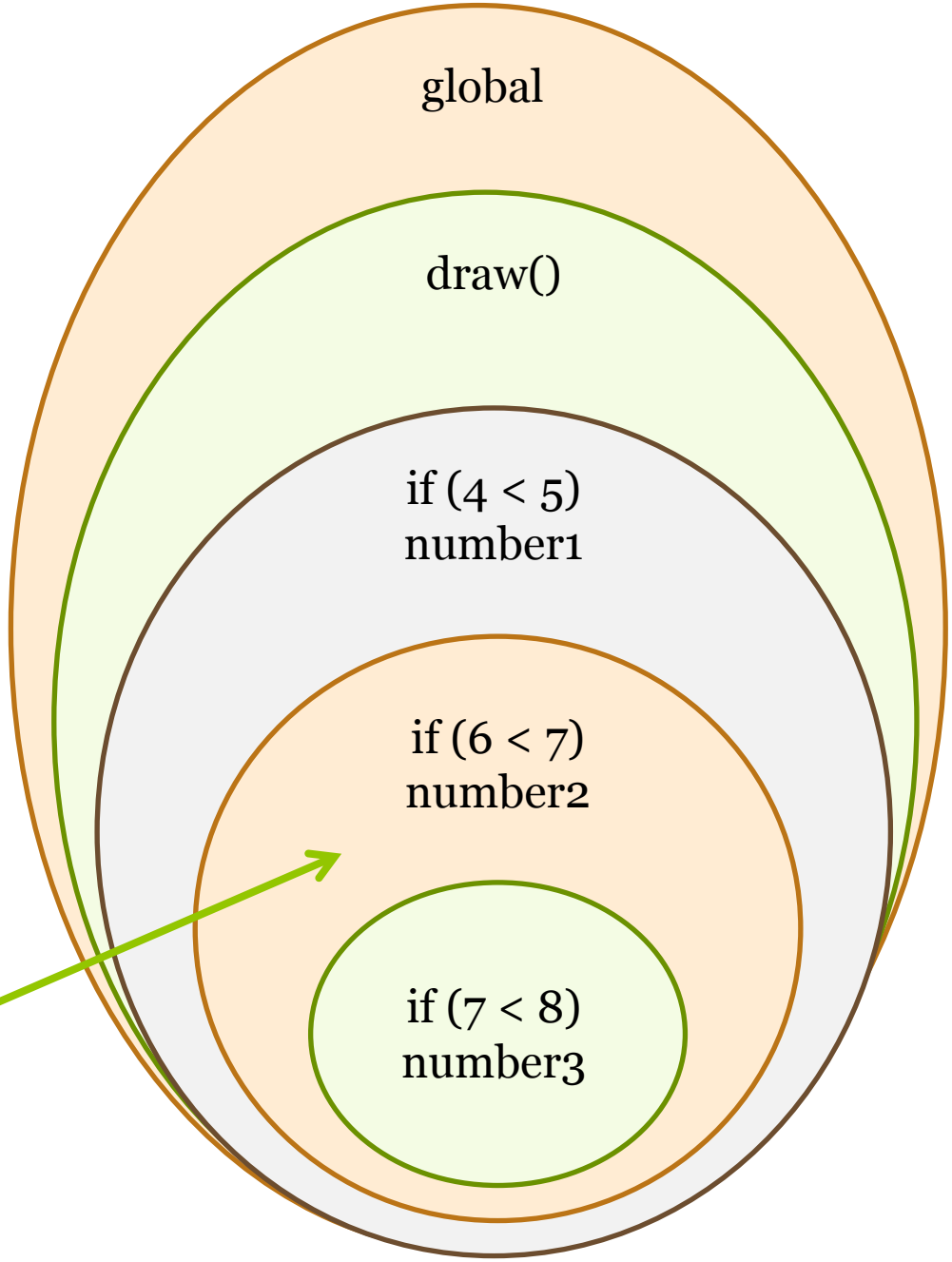
```
void draw()
{
  if (4 < 5)
  {
    int number1 = 10;
    if (6 < 7)
    {
      int number2 = 20;
      if (7 < 8)
      {
        int number3 = 30;
      }
      number1 += number2;
      number1 += number3;
    }
  }
}
```

start in this scope



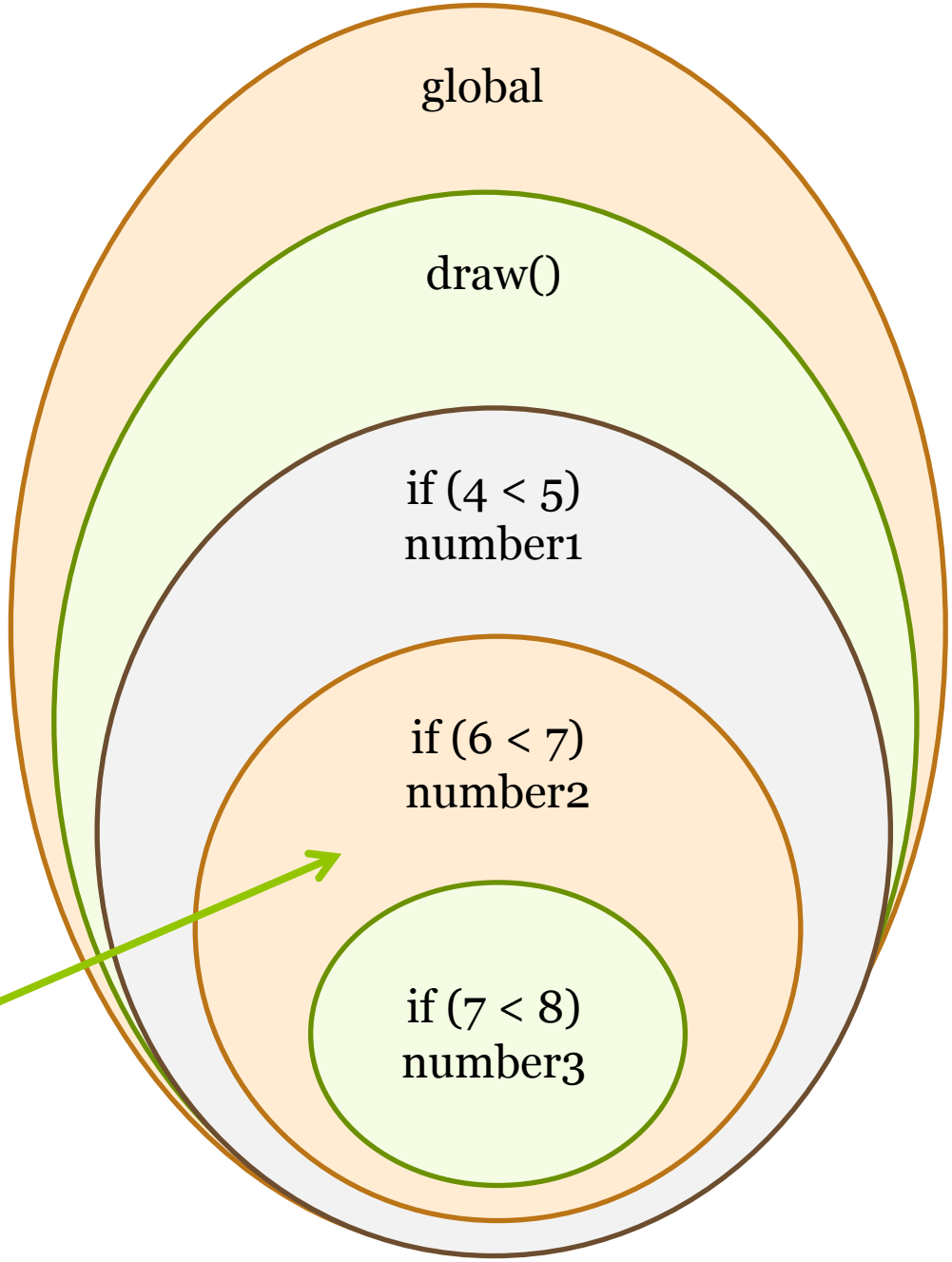
```
void draw()
{
  if (4 < 5)
  {
    int number1 = 10;
    if (6 < 7)
    {
      int number2 = 20;
      if (7 < 8)
      {
        int number3 = 30;
      }
      number1 += number2;
      number1 += number3;
    }
  }
}
```

number2
found here



```
void draw()
{
  if (4 < 5)
  {
    int number1 = 10;
    if (6 < 7)
    {
      int number2 = 20;
      if (7 < 8)
      {
        int number3 = 30;
      }
      number1 += number2;
      number1 += number3;
    }
  }
}
```

`number1` is not here



```
void draw()
{
  if (4 < 5)
  {
    int number1 = 10;
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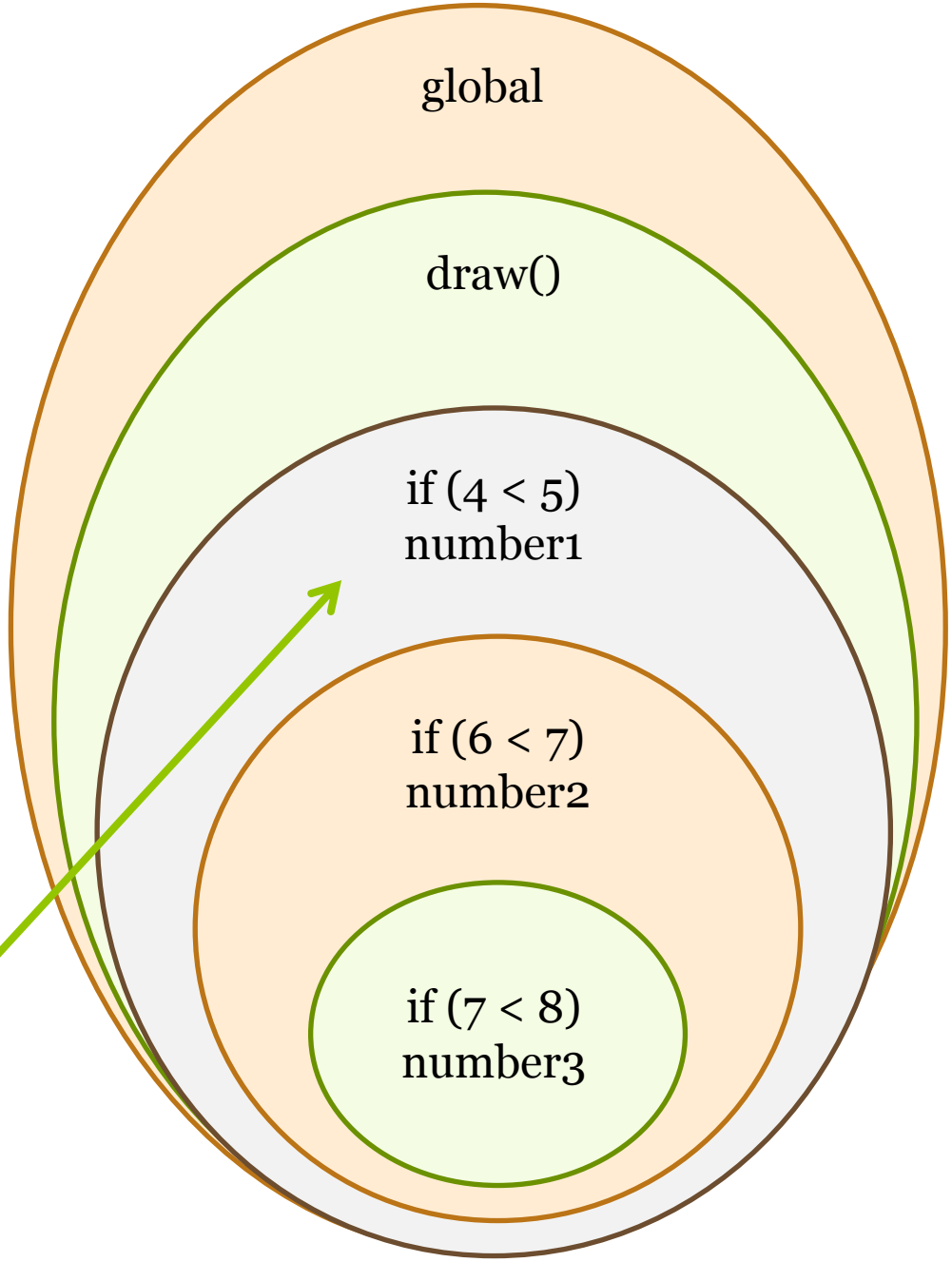
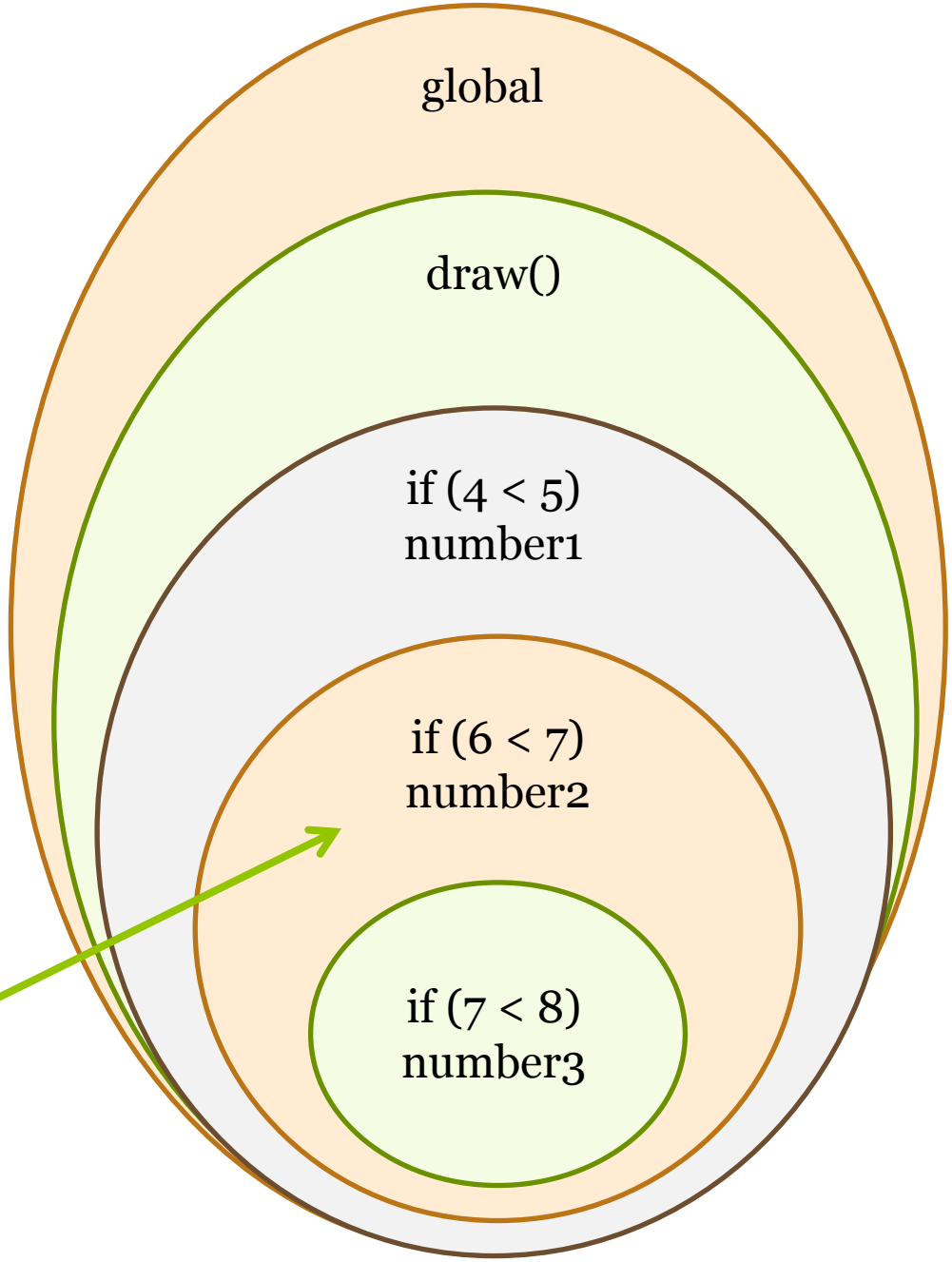
    {
      int number2 = 20;
      if (7 < 8)
      {
        int number3 = 30;
      }
      number1 += number2;
      number1 += number3;
    }
  }
}
```

number1
found here



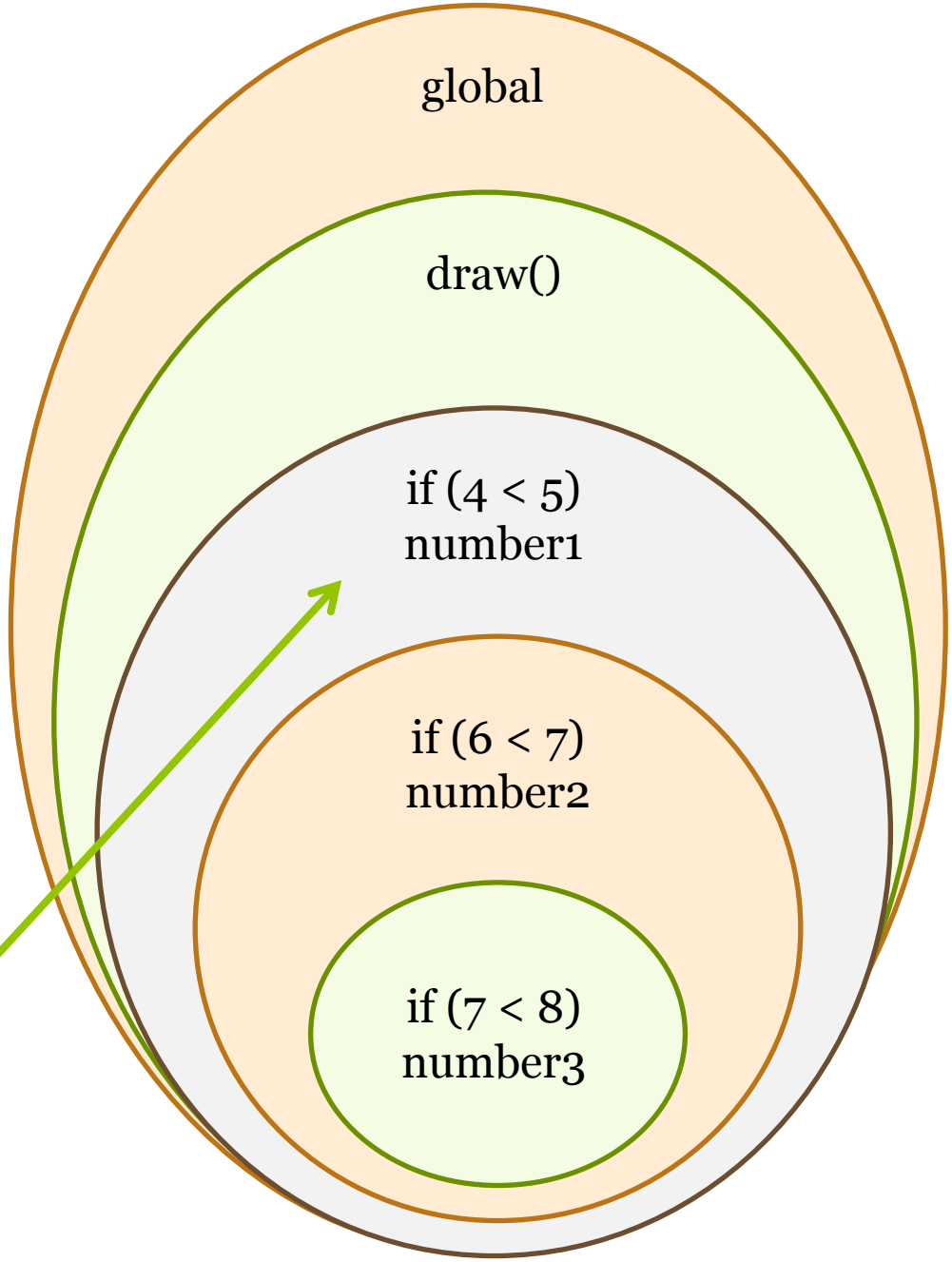
```
void draw()
{
  if (4 < 5)
  {
    int number1 = 10;
    if (6 < 7)
    {
      int number2 = 20;
      if (7 < 8)
      {
        int number3 = 30;
      }
      number1 += number2;
      number1 += number3;
    }
  }
}
```

`number3` is not here



```
void draw()
{
  if (4 < 5)
  {
    int number1 = 10;
    if (6 < 7)
    {
      int number2 = 20;
      if (7 < 8)
      {
        int number3 = 30;
      }
      number1 += number2;
      number1 += number3;
    }
  }
}
```

`number3` is not here



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  if (4 < 5)
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      if (7 < 8)
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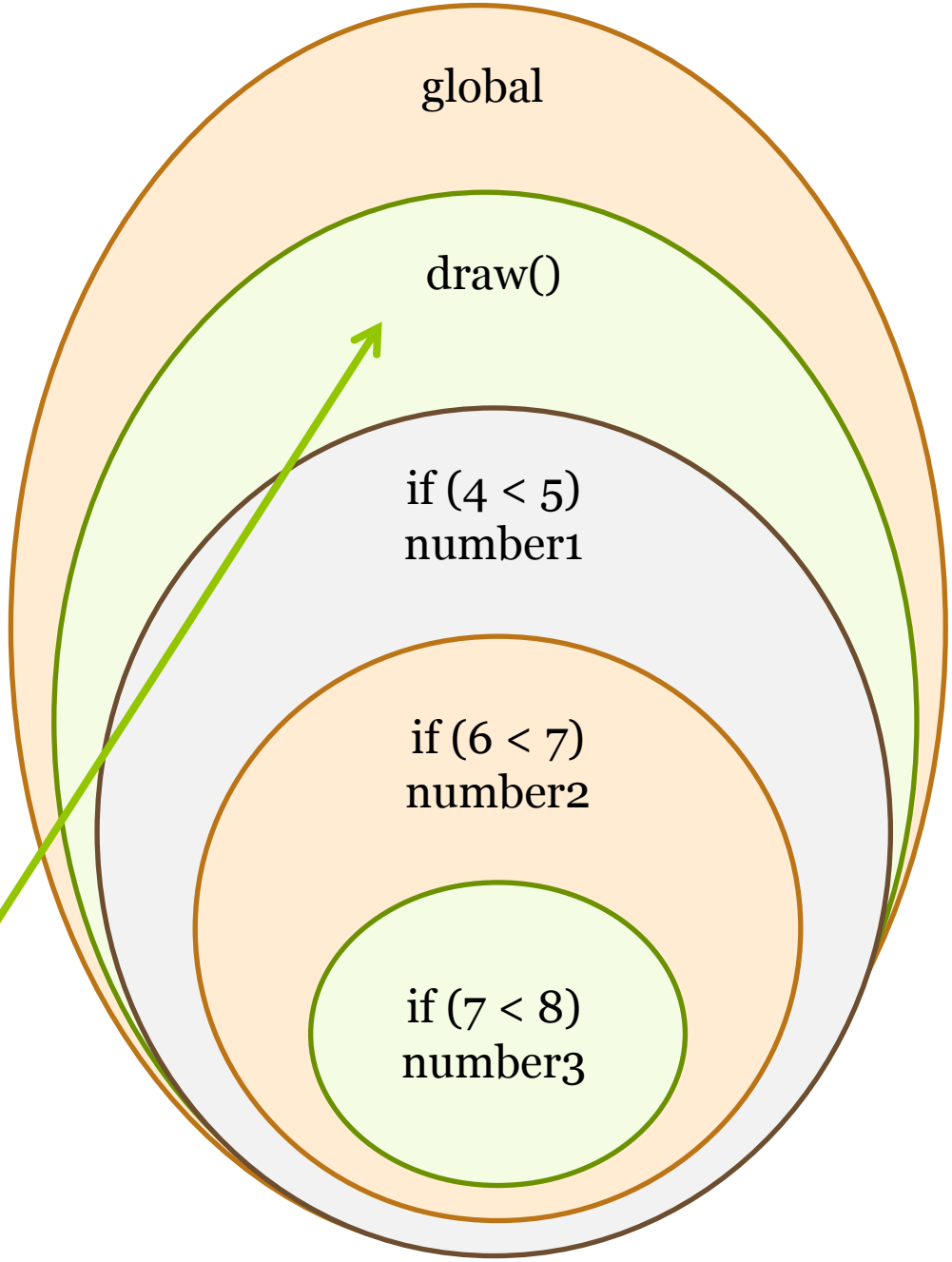
      }
      number1 += number2;
      number1 += number3;
    }
  }
}
```

`number3` is not here



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  if (4 < 5)
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    {
      int number2 = 20;
      if (7 < 8)
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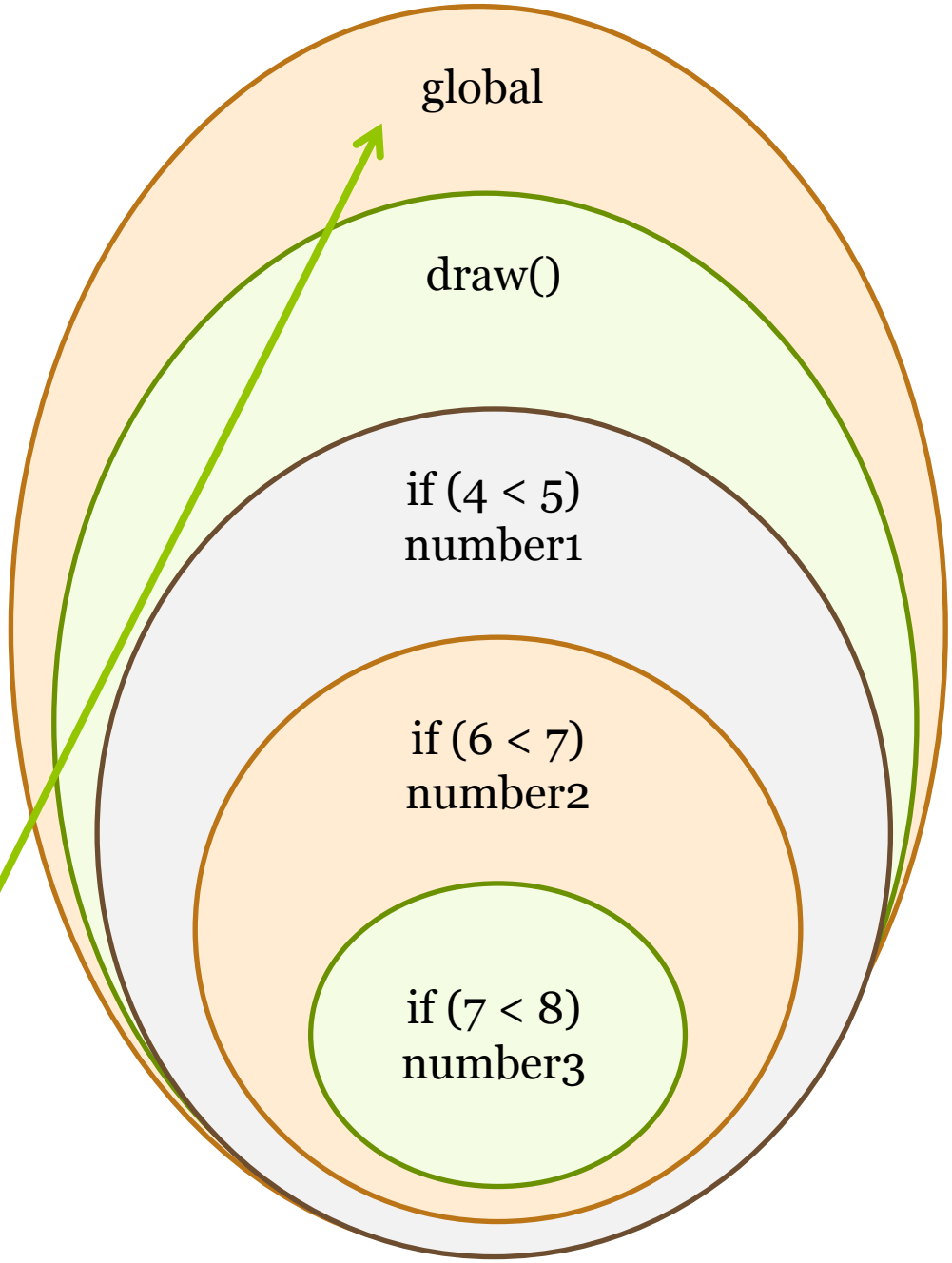
        int number3 = 30;
      }
      number1 += number2;
      number1 += number3;
    }
  }
}
```

`number3` is not here



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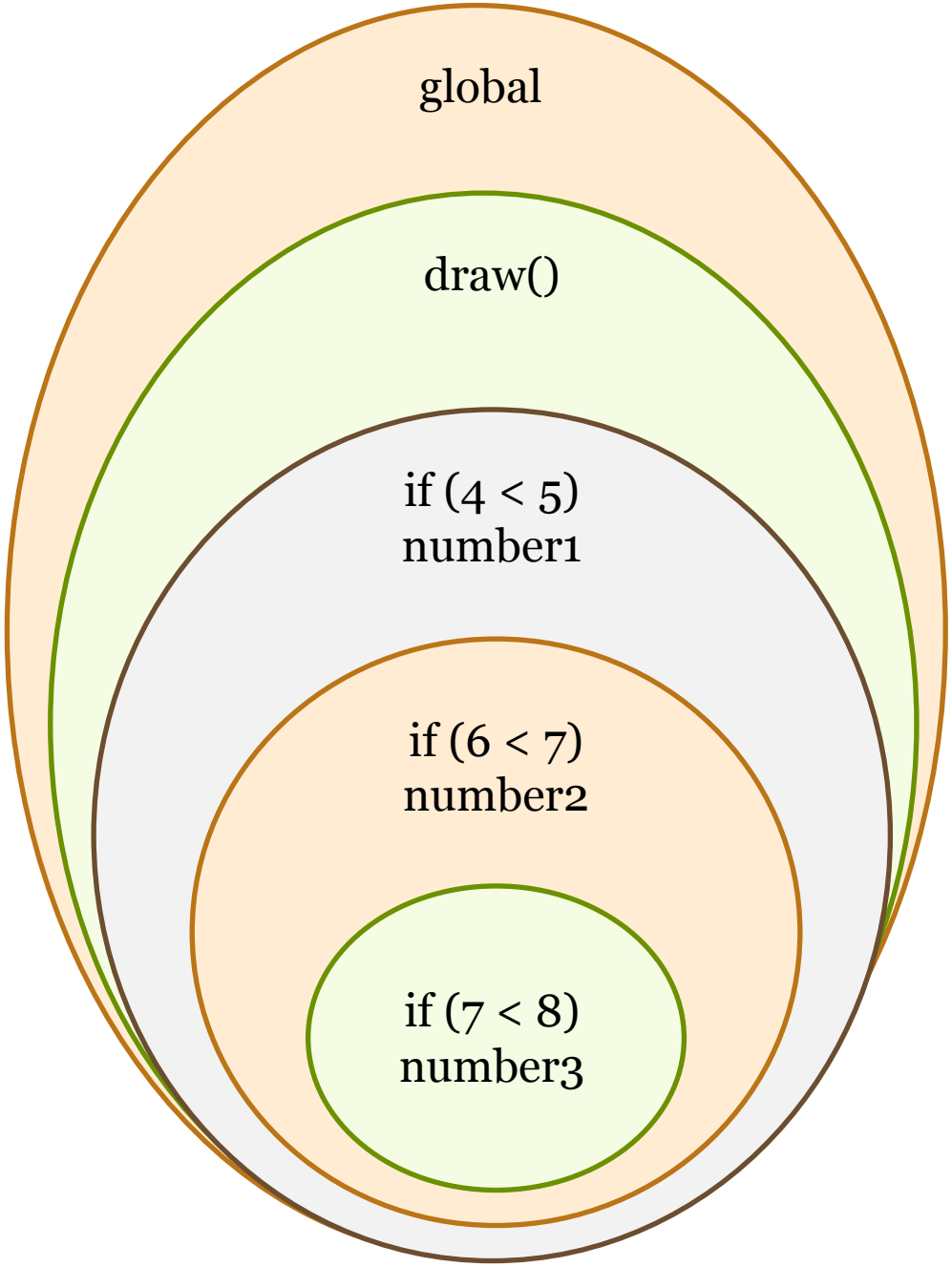
    {
      int number2 = 20;
      if (7 < 8)
      {
        int number3 = 30;
      }
      number1 += number2;
      number1 += number3;
    }
  }
}
```

error!



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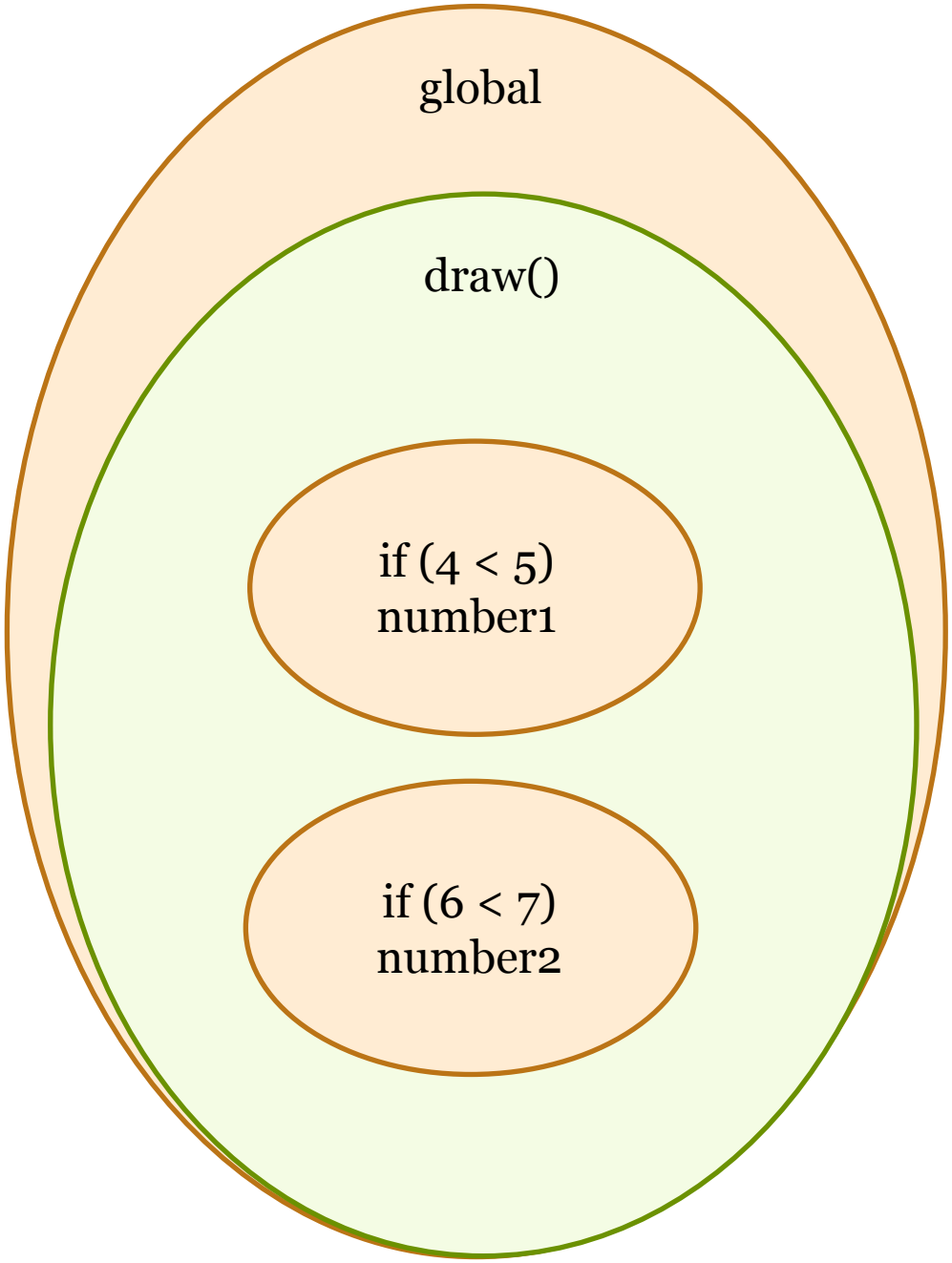
  number1 += number2;
}
```



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{
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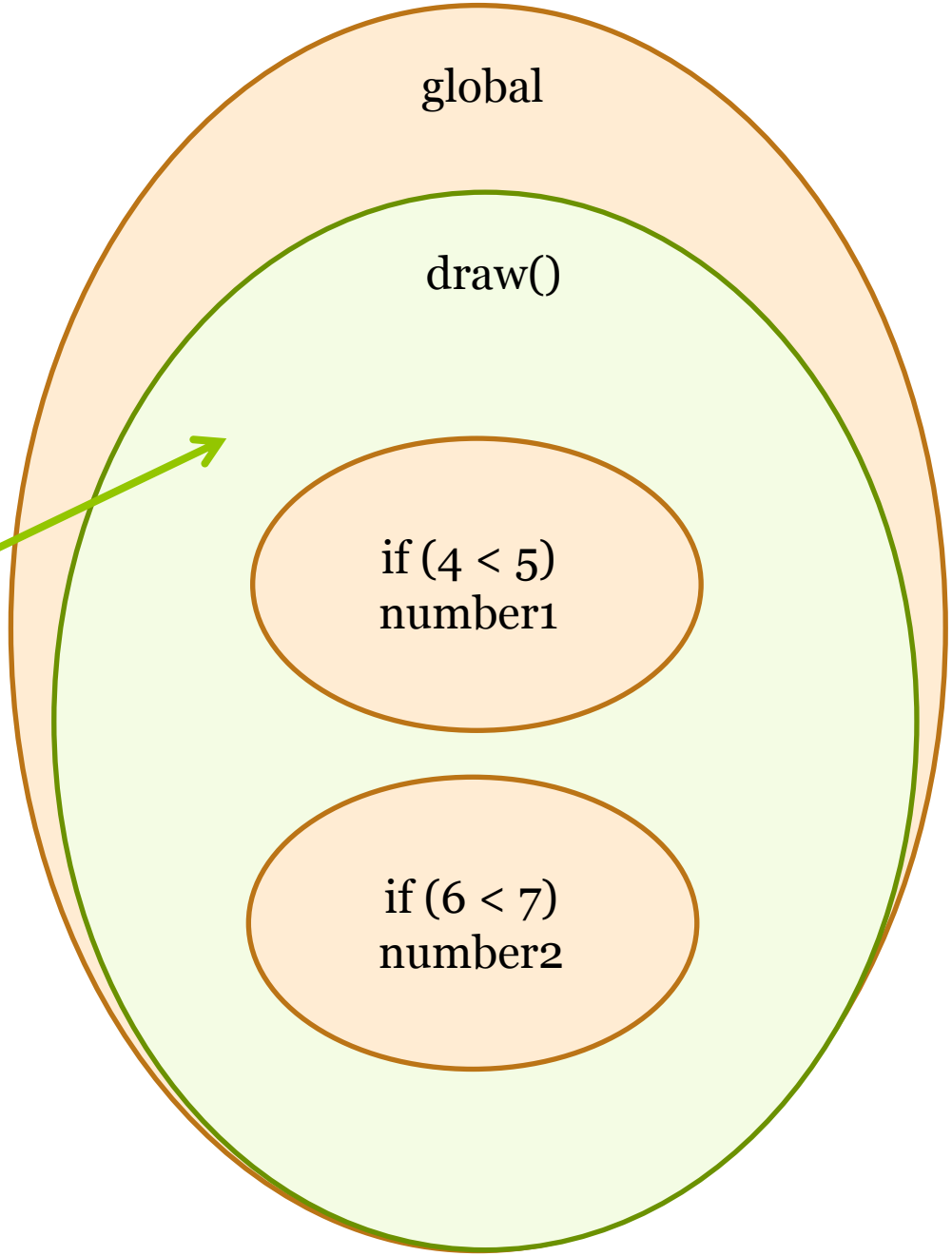
}
```



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void draw()
{
  if (4 < 5)
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    int number2 = 20;
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  number1 += number2;
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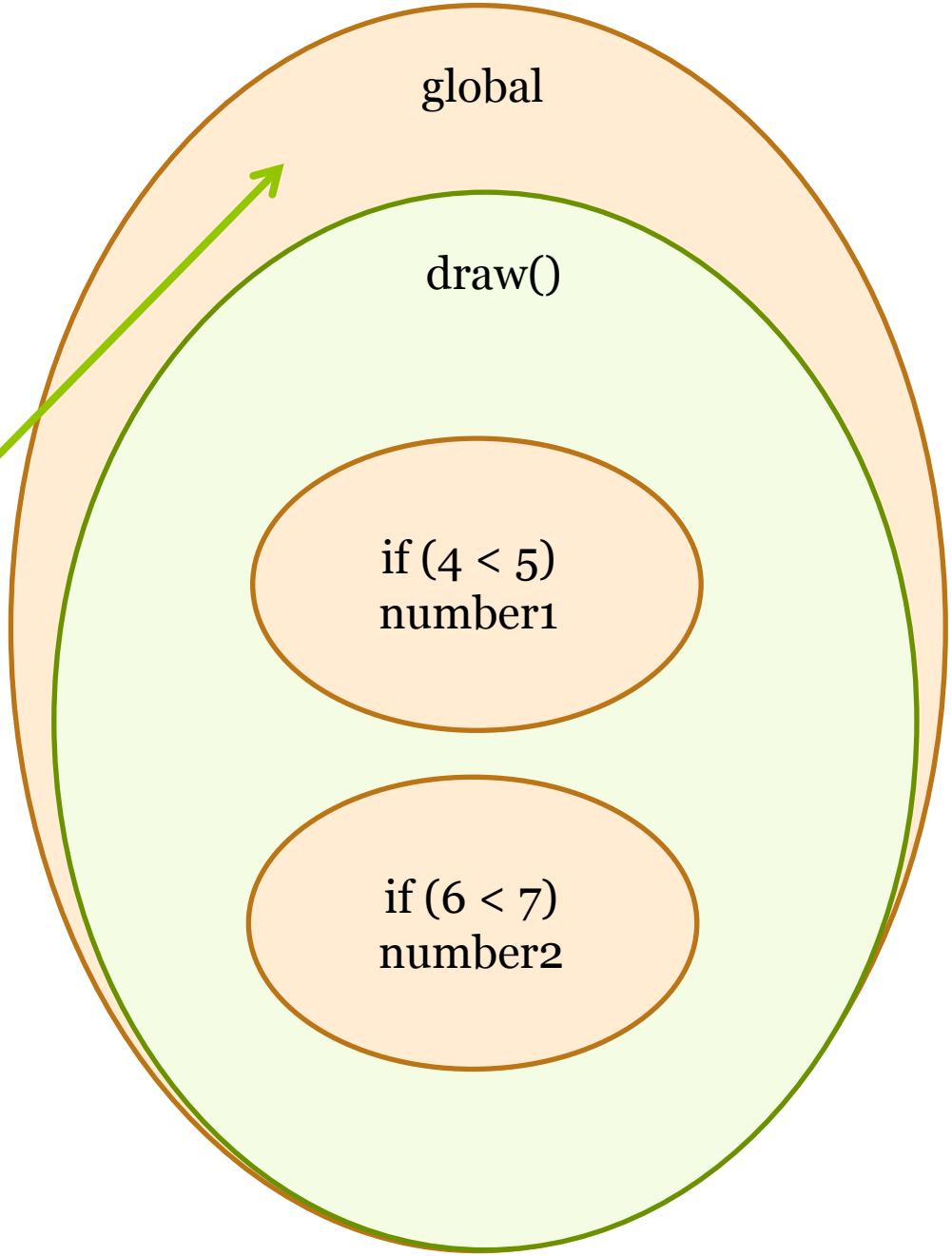
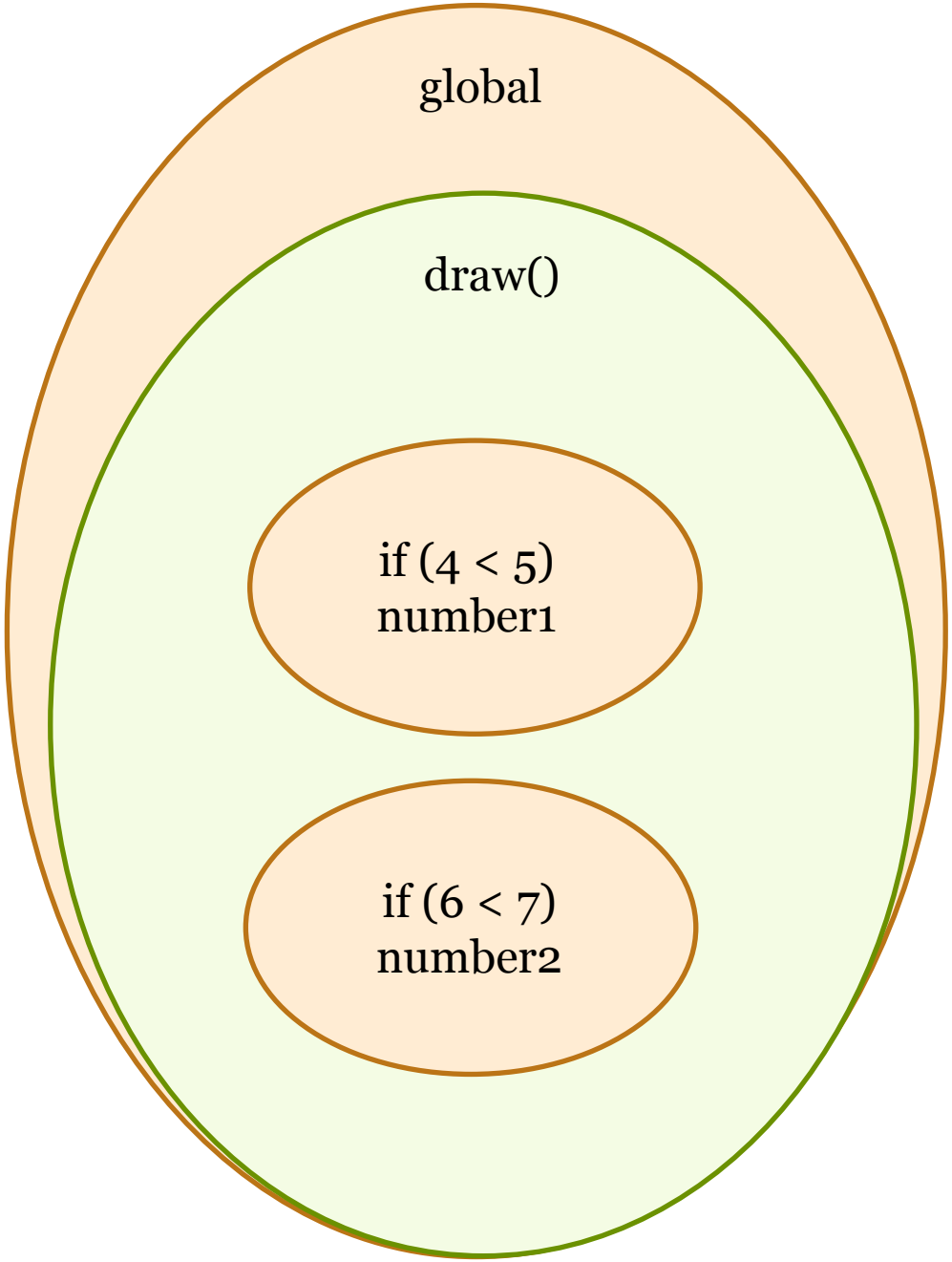


```
void draw()
{
  if (4 < 5)
  {
    int number1 = 10;
  }
  if (6 < 7)
  {
    int number2 = 20;
  }
  number1 += number2;
}
```

error!



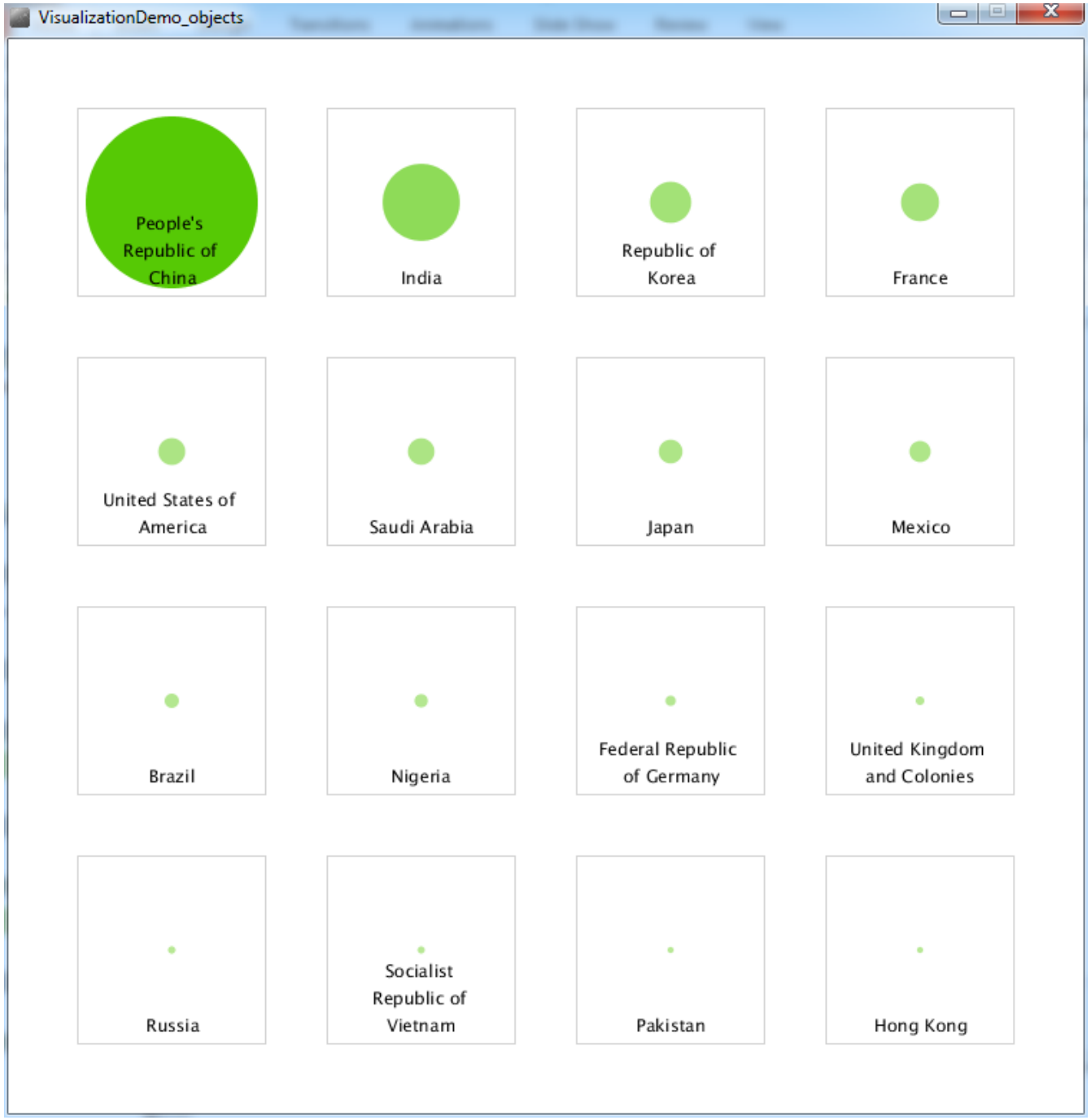
Foreign Student Data Visualization

What countries are international students in Canada coming from?

When the program starts:

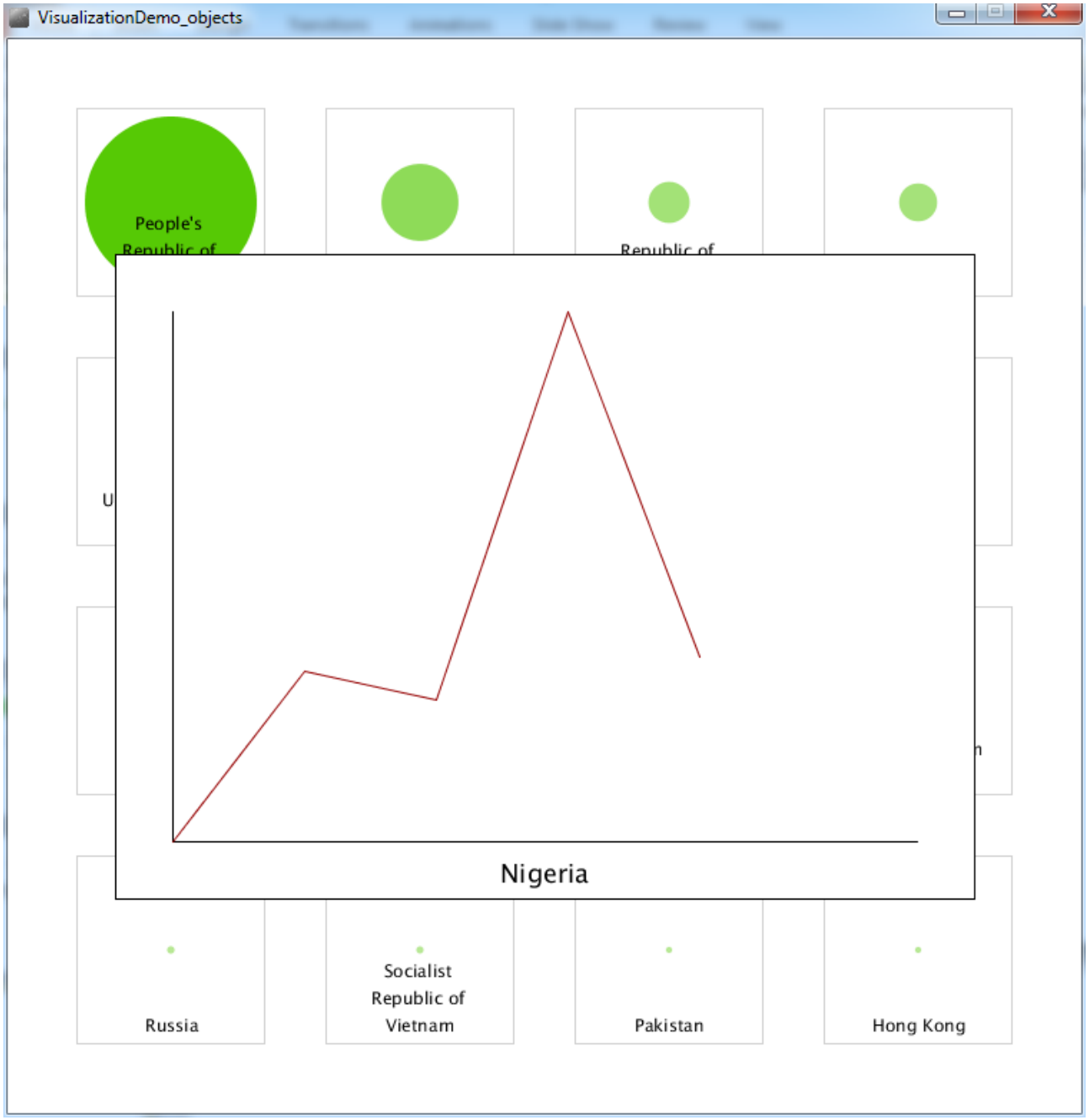
Read in comma separated value file about foreign students, obtained from data.gc.ca.

Display circles whose sizes and colours are proportional to how many students came from each country.


VisualizationDemo_objects
People's Republic of China
India
Republic of Korea
France
United States of America
Saudi Arabia
Japan
Mexico
Brazil
Nigeria
Federal Republic of Germany
United Kingdom and Colonies
Russia
Socialist Republic of Vietnam
Pakistan
Hong Kong

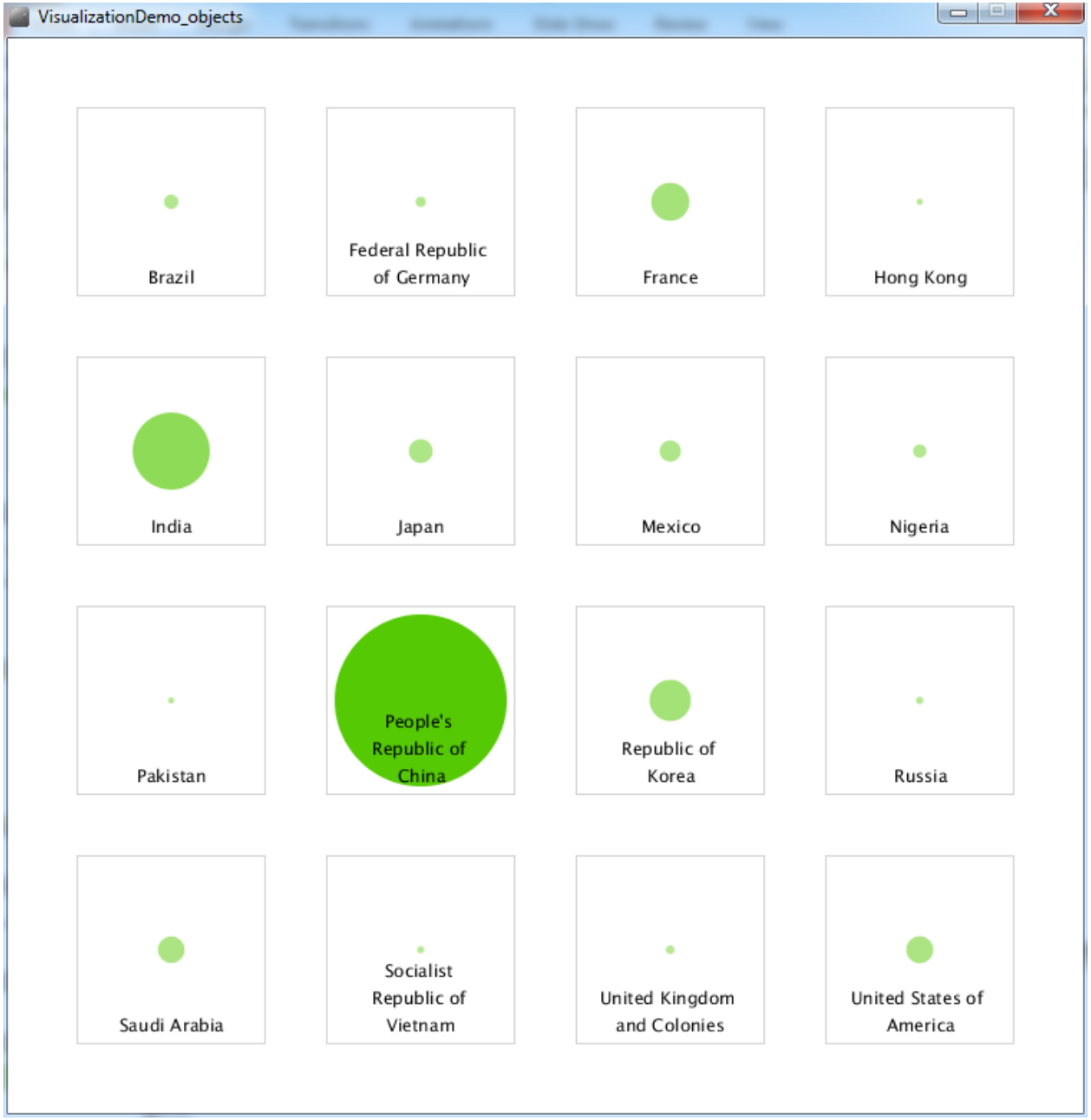
When a circle is clicked:

Display a line graph that shows how many students came in each quarter of 2013.


VisualizationDemo_objects
People's
Republic of
Republic of
Nigeria
Russia
Socialist
Republic of
Vietnam
Pakistan
Hong Kong

When the 's' key is pressed:

Toggle the sorting order between alphabetical and the total number of students from the countries.


VisualizationDemo_objects
Brazil
Federal Republic of Germany
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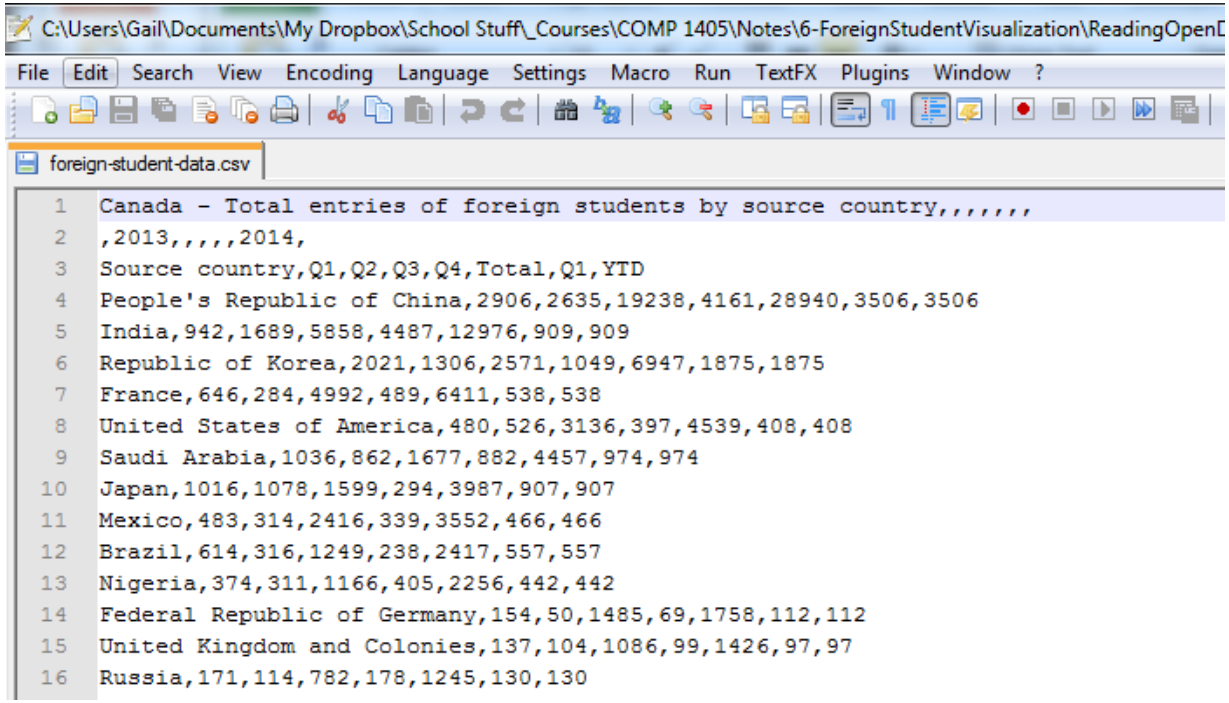
India
Japan
Mexico
Nigeria
Pakistan
People's Republic of China
Republic of Korea
Russia
Saudi Arabia
Socialist Republic of Vietnam
United Kingdom and Colonies
United States of America

Making a plan:

1. Create arrays to store data from the CSV file.
2. Read the data from the file and store it in the arrays.
3. Display the data flexibly so any number of countries can be shown.
4. Find what country (if any) was clicked on when the mouse is pressed.
5. Display a line graph when a country was clicked.
6. Change the sorting order when the s key is pressed.

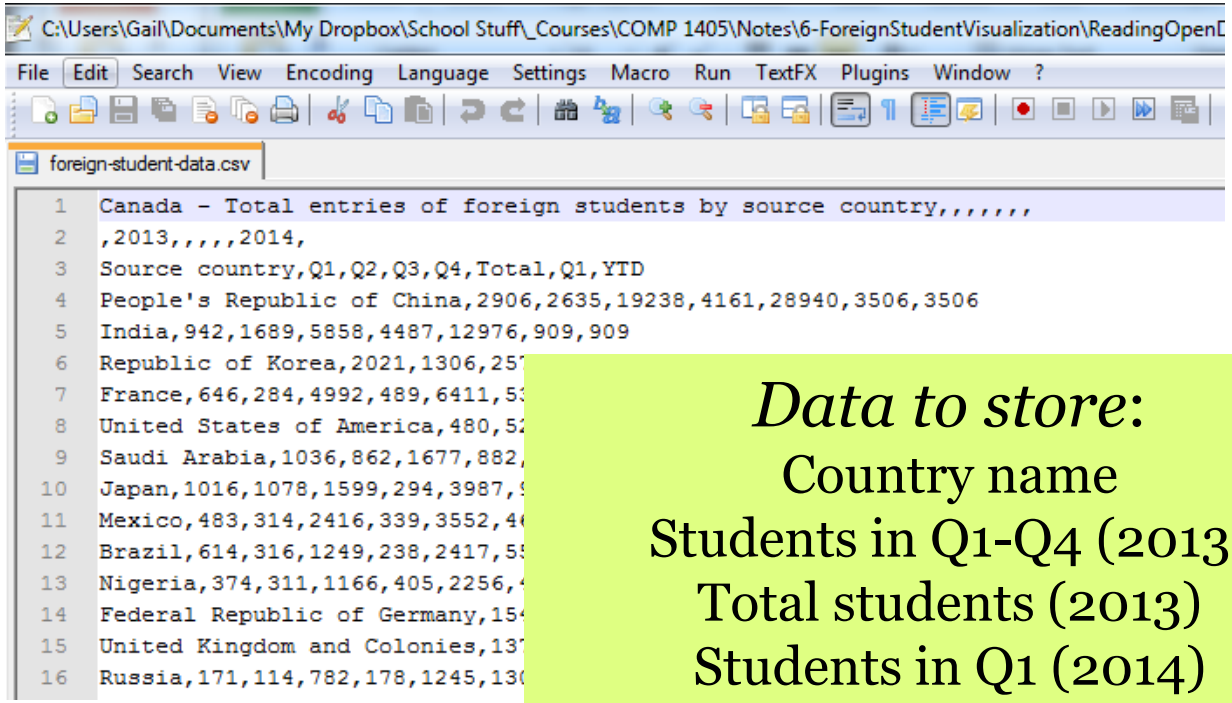
Step 1

Create arrays to store data from the CSV file.



Step 1

Create arrays to store data from the CSV file.



Data to store:

Country name

Students in Q1-Q4 (2013)

Total students (2013)

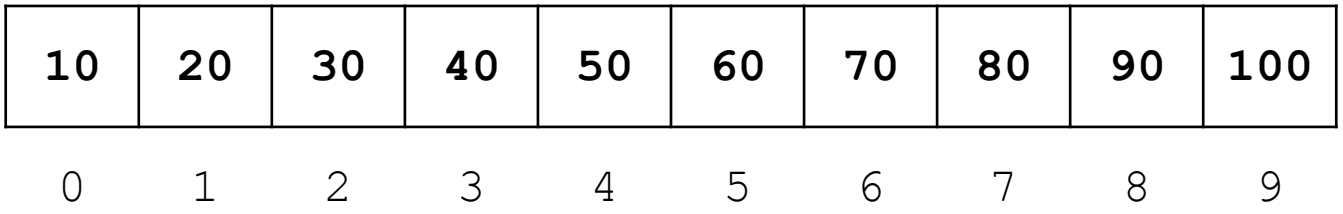
Students in Q1 (2014)

Total students YTD (2014)

Step 2

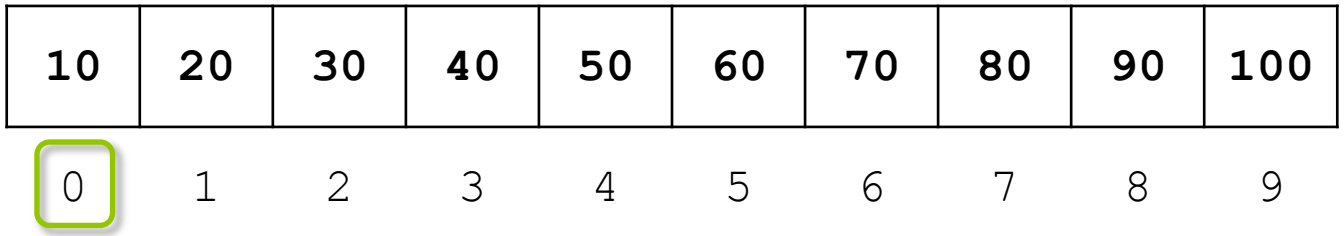
Read the data from the file and store it in the arrays.

Arrays



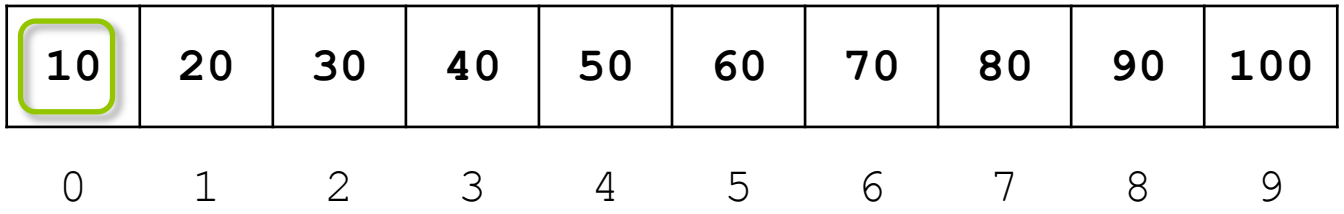

```
int[] arrayOfInts = new int[10];
```

Arrays



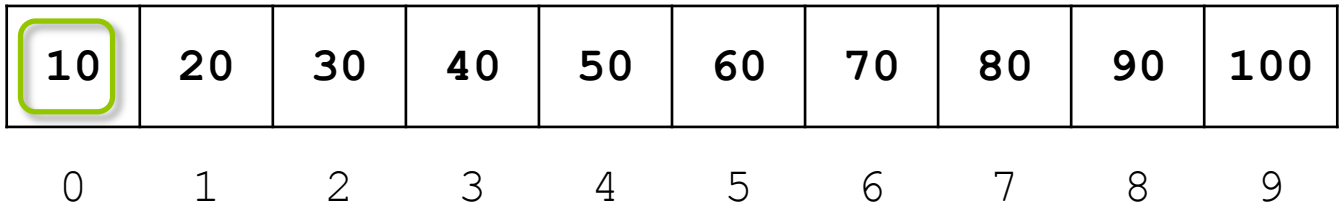
index 0: the 0th slot in the array

Arrays



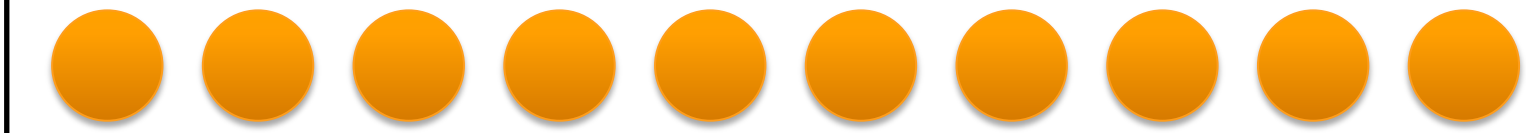
integer 10: the 0th value in the array

Arrays



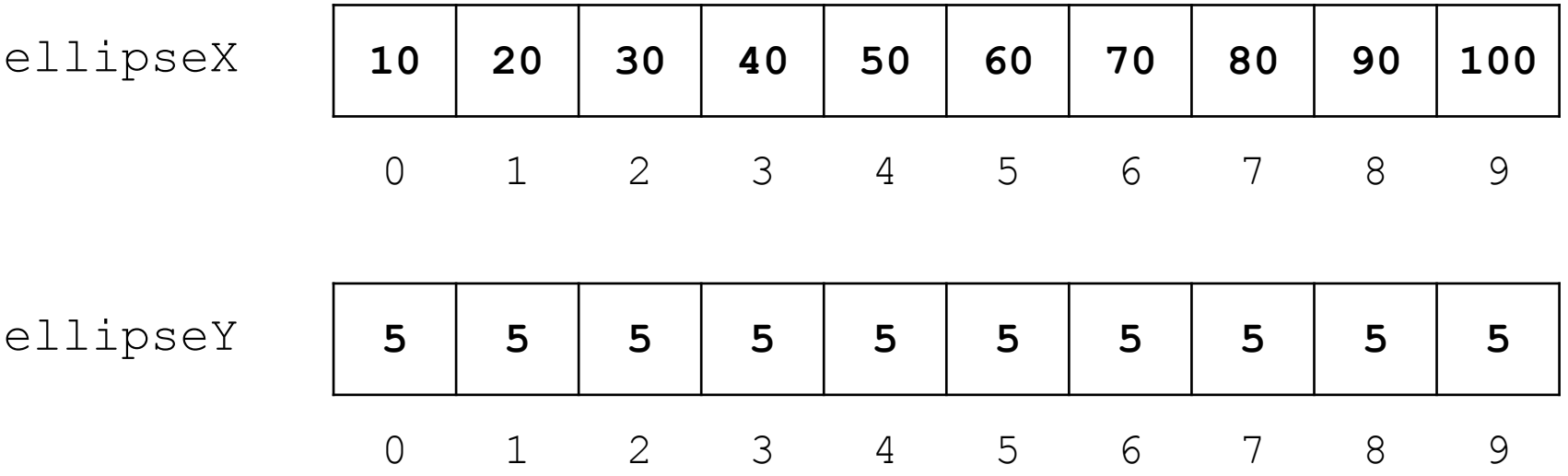
`arrayOfInts[0]`

Parallel Arrays



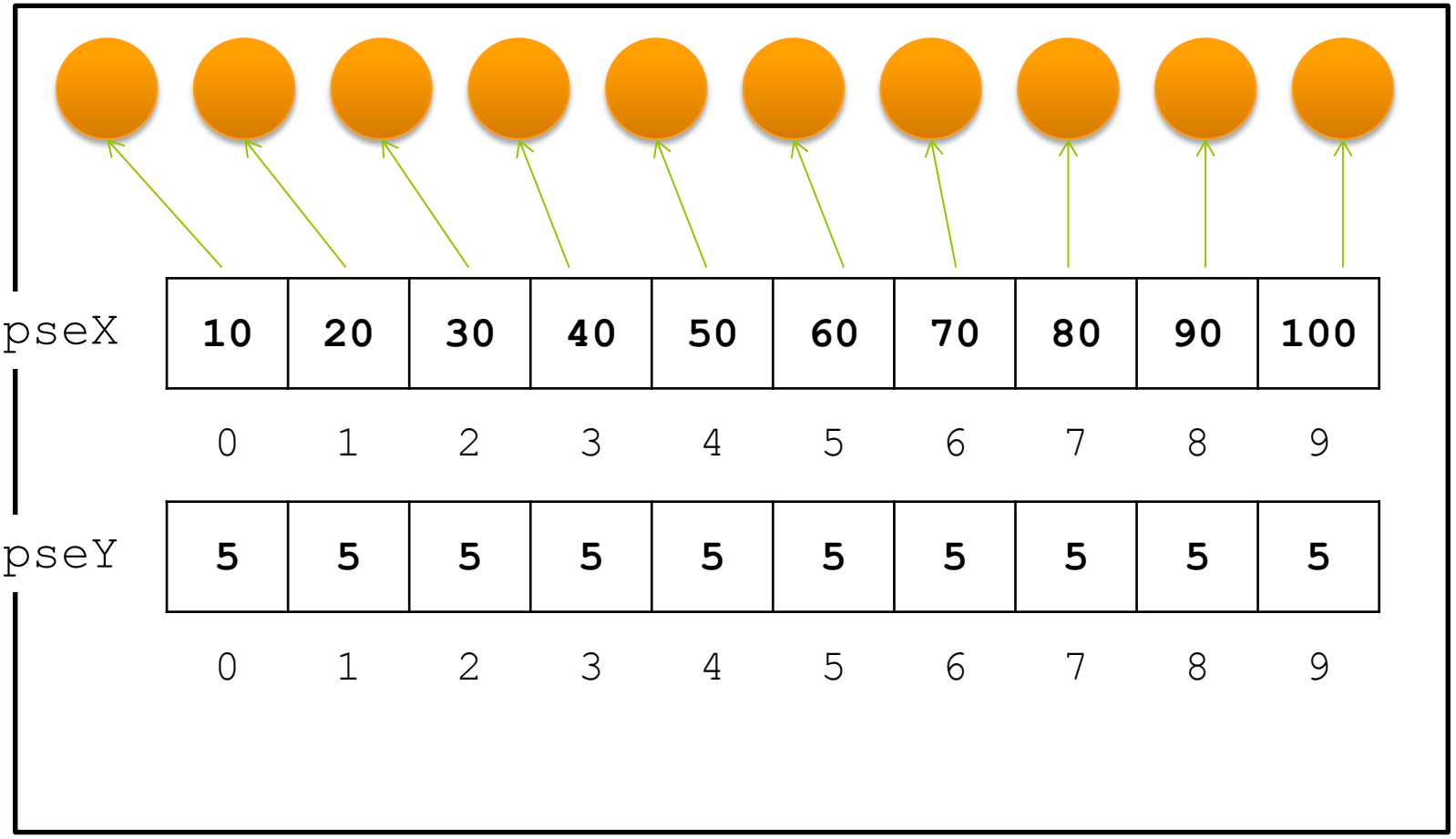
How do we track positions for an arbitrary number of balls?

Parallel Arrays




```
int[] ellipseX = new int[10];
int[] ellipseY = new int[10];
```

Parallel Arrays



Step 2

Read the data from the file and store it in the arrays.

Data in file is stored as text

Strings

```
char letterGrade = 'A';
String magicWord = "abacadabra";
```

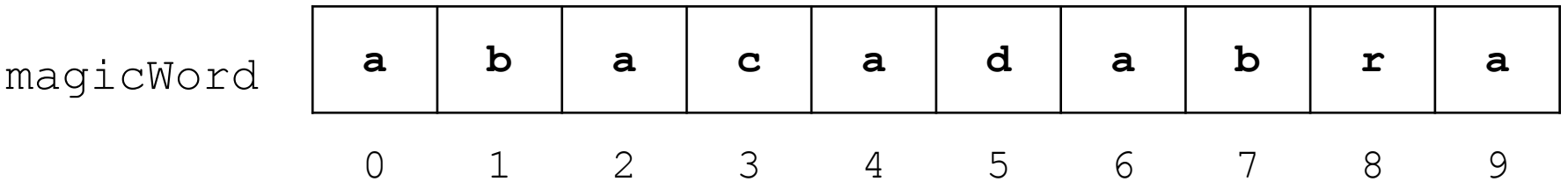
A character (`char`) is a single letter or symbol.

A `String` is a data type that holds a 'string' of characters.

Strings

```
char letterGrade = 'A';
String magicWord = "abacadabra";
```

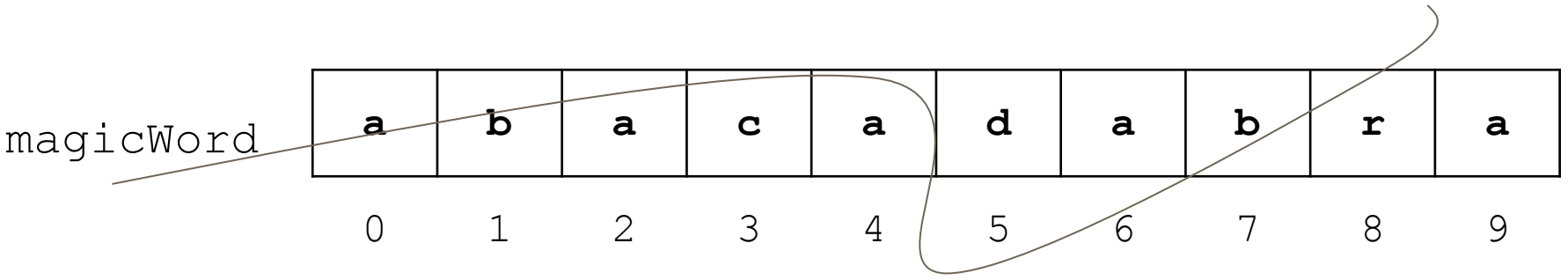
A String is an array of `char` types behind the scenes.



Strings

```
char letterGrade = 'A';
String magicWord = "abacadabra";
```

But this fact is abstracted away – we can forget about the details when using String.



Strings

```
String magicWord = "abacadabra";
String otherMagicWord = "abacadabra";

// this expression is NOT true
if (magicWord == otherMagicWord)
{
}
```

The usual equality operator does not work the way you expect for Strings.

Strings

```
String magicWord = "abacadabra";
String otherMagicWord = "abacadabra";

// this expression IS true
if (magicWord == magicWord)
{
}
```

The usual equality operator does not work the way you expect for Strings.

Strings

```
String magicWord = "abacadabra";
String otherMagicWord = "abacadabra";

// this expression IS true
if (magicWord.equals(otherMagicWord))
{
}
```

Use `aString.equals(otherString)` instead.

Strings

```
String magicWord = "abacadabra";
String otherMagicWord = "kazam";

println(magicWord + otherMagicWord);
```

Concatenate Strings with the + operator.

Prints: `abacadabrakazam`

Strings

```
String[] lines = loadStrings(filename);
```

Loads the file line by line, storing each line as a String in the lines array.

Strings

```
String[] splitLine = lines[lineIndex].split(",");
```

Breaks a `String` apart into pieces that are separated by the String provided as an argument (a comma in this case).

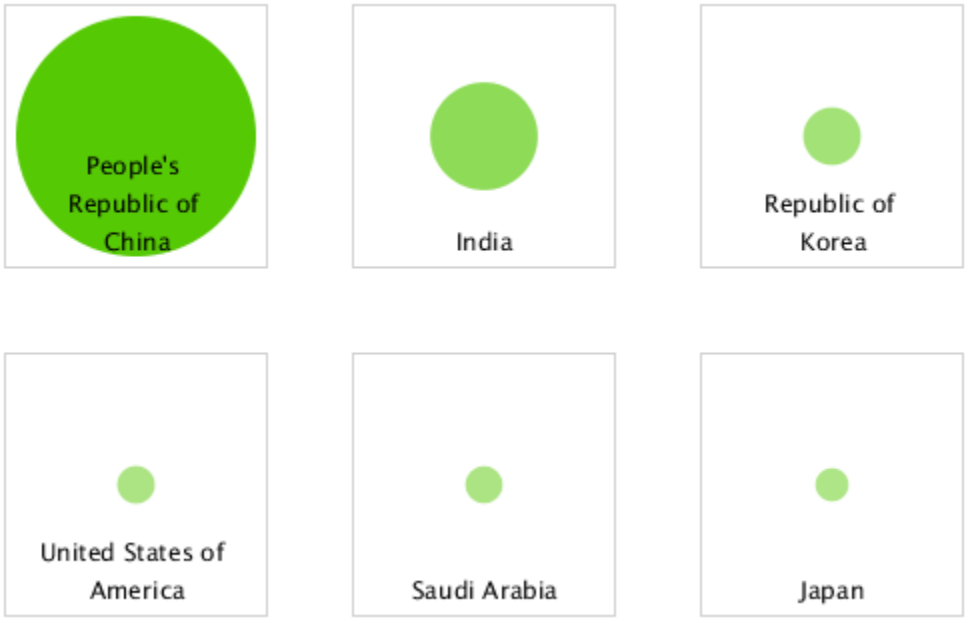
Strings

```
Integer.parseInt(splitLine[1]);
```

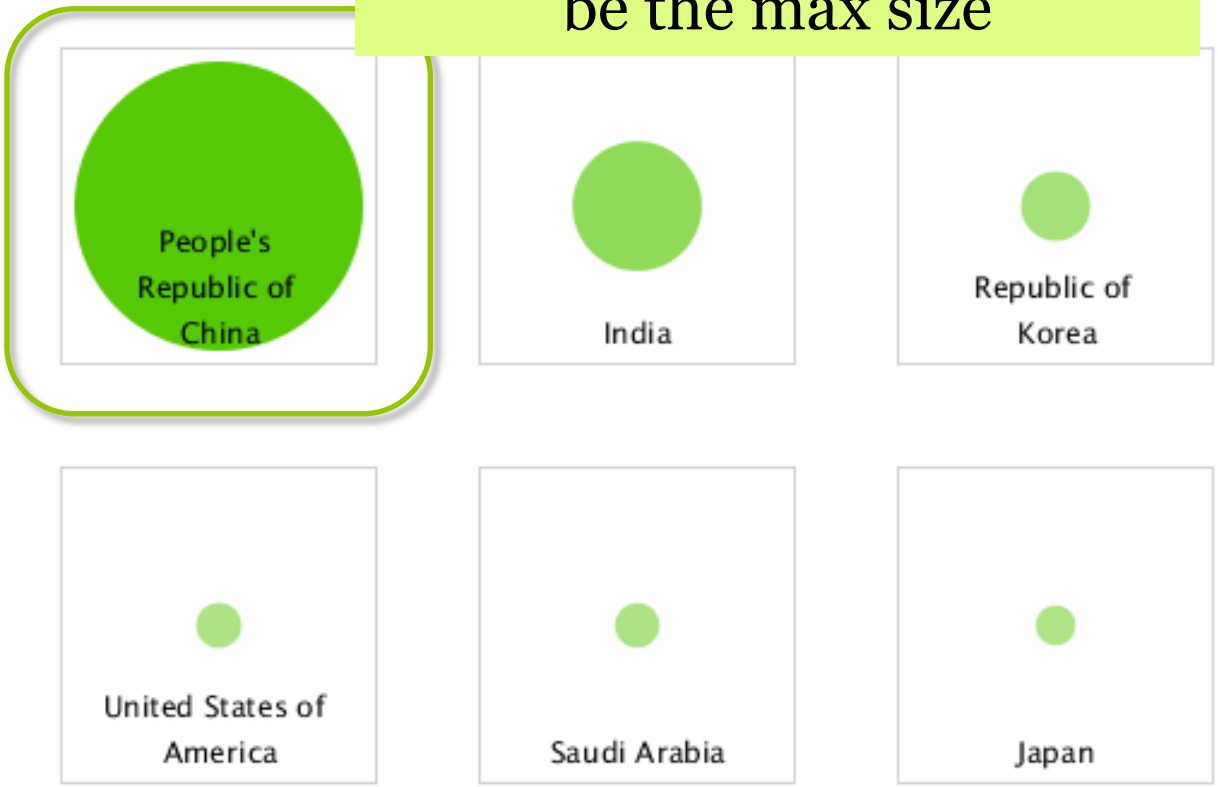
Turns a `String` into the integer value it represents. If the `String` is not a valid integer, you will get an error.

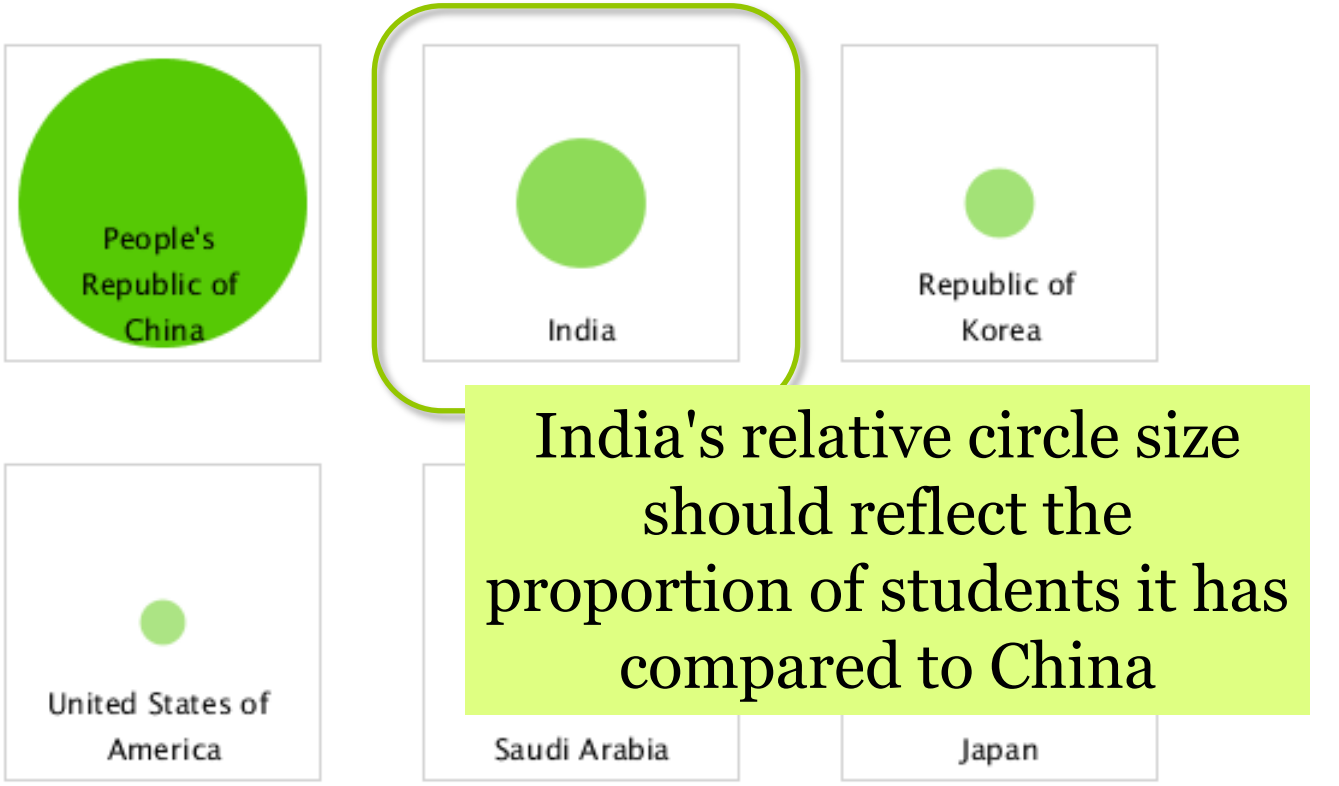
Step 3

Display the data flexibly so any number of countries can be shown.

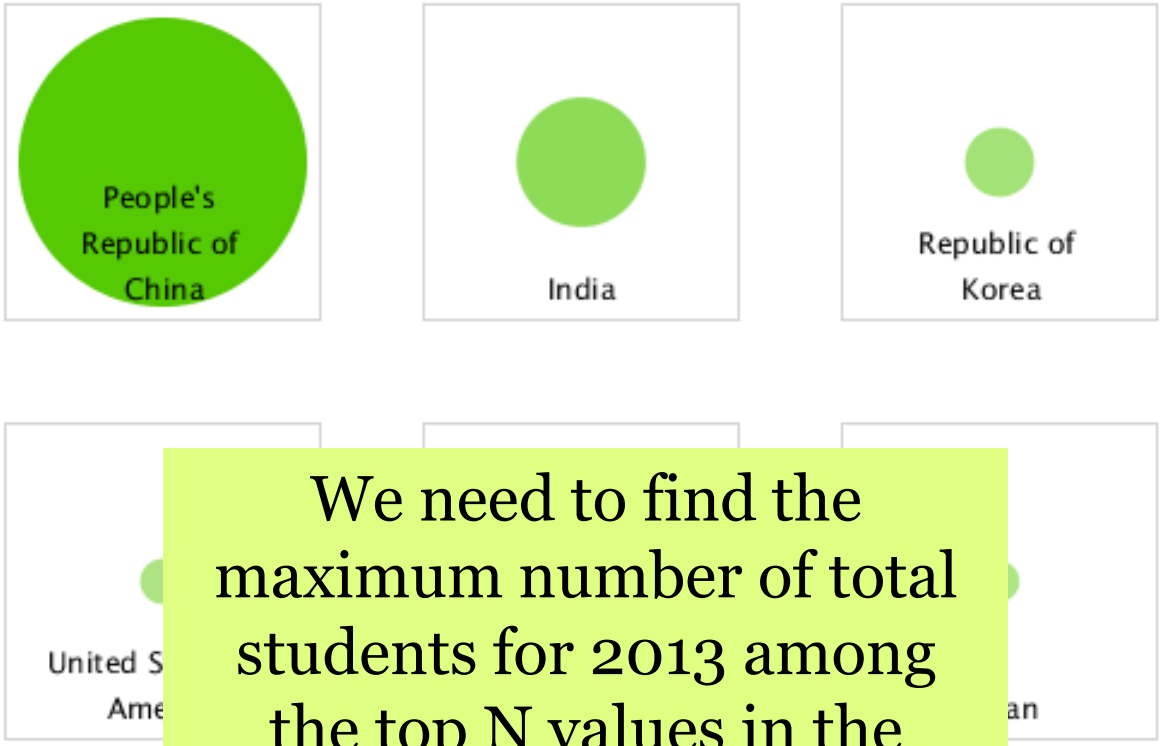


China has the most students, so its circle should be the max size





India's relative circle size should reflect the proportion of students it has compared to China



We need to find the maximum number of total students for 2013 among the top N values in the array…

Algorithms

A series of steps
to solve a problem
in a general way

Find the Maximum Algorithm

```
input: an array of unsorted data to search
output: index of the maximum value

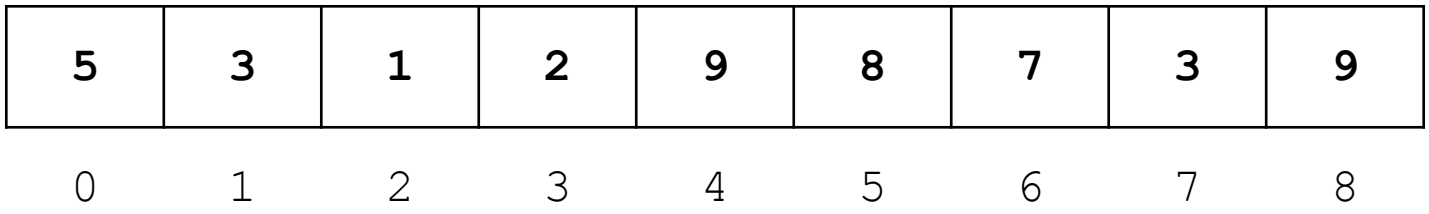
set maxValue to -1
set currentIndex to 0

while (currentIndex < size of array ):
    if (value at currentIndex > maxValue):
        set maxValue to value at currentIndex

    increase currentIndex by 1

return maxValue
```

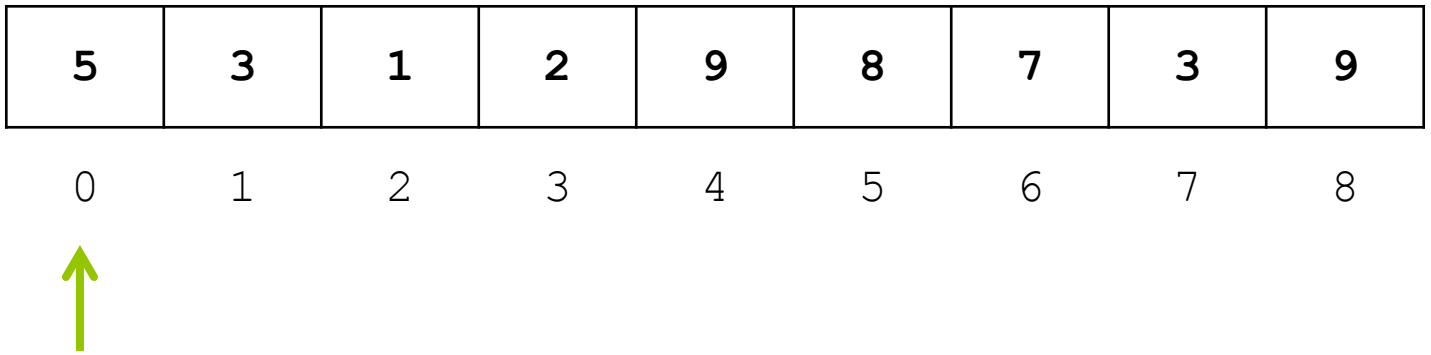
Find the Maximum Algorithm



start with -1 as maximum

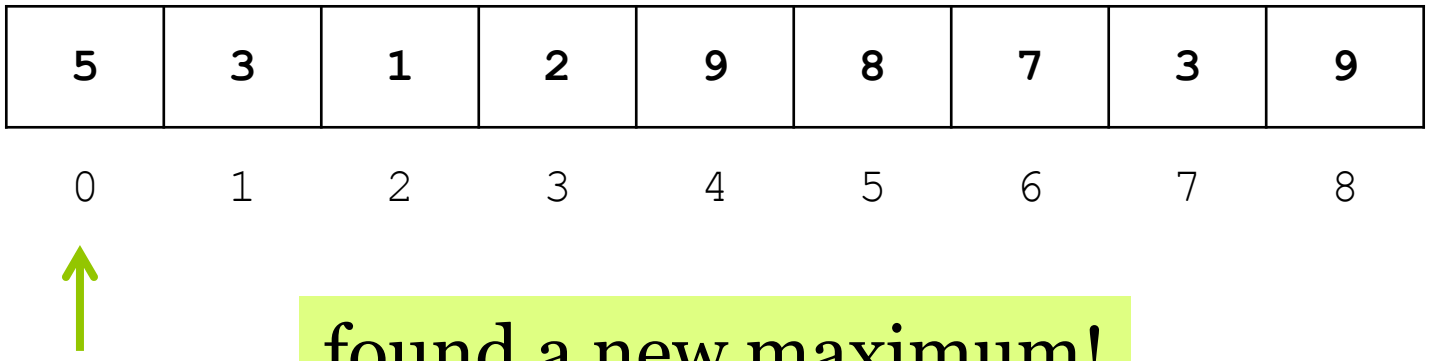
currentIndex: 0
maxValue: -1

Find the Maximum Algorithm



currentIndex: 0
maxValue: -1

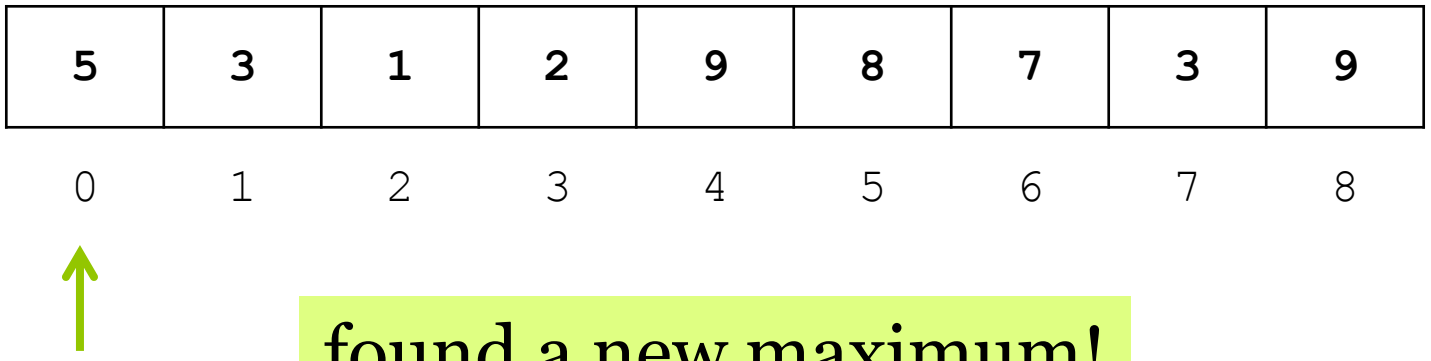
Find the Maximum Algorithm



found a new maximum!

currentIndex: 0
maxValue: -1

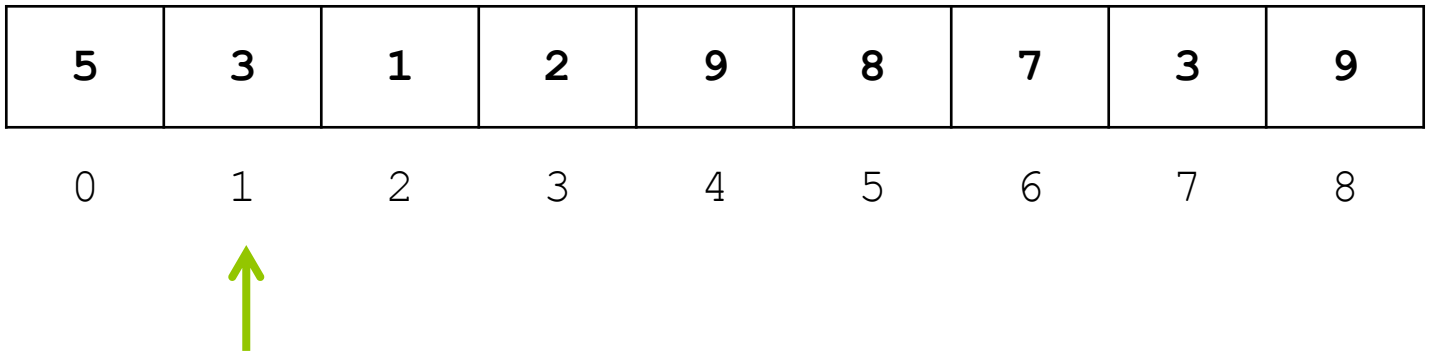
Find the Maximum Algorithm



found a new maximum!

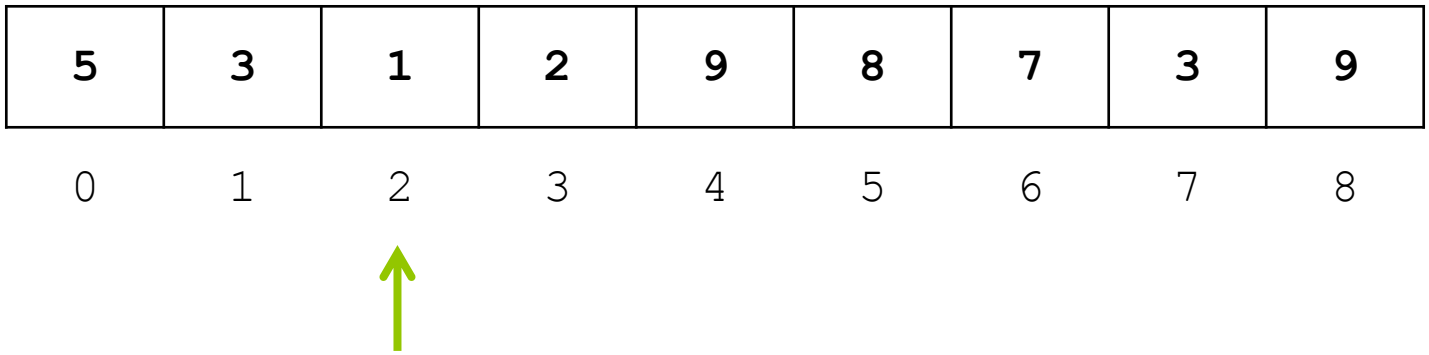
currentIndex: 0
maxValue: 5

Find the Maximum Algorithm



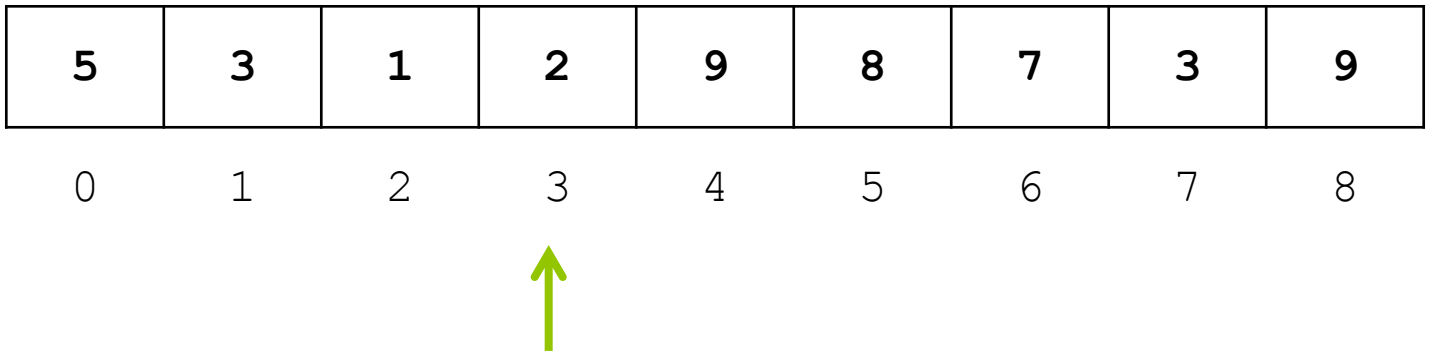
currentIndex: 1
maxValue: 5

Find the Maximum Algorithm



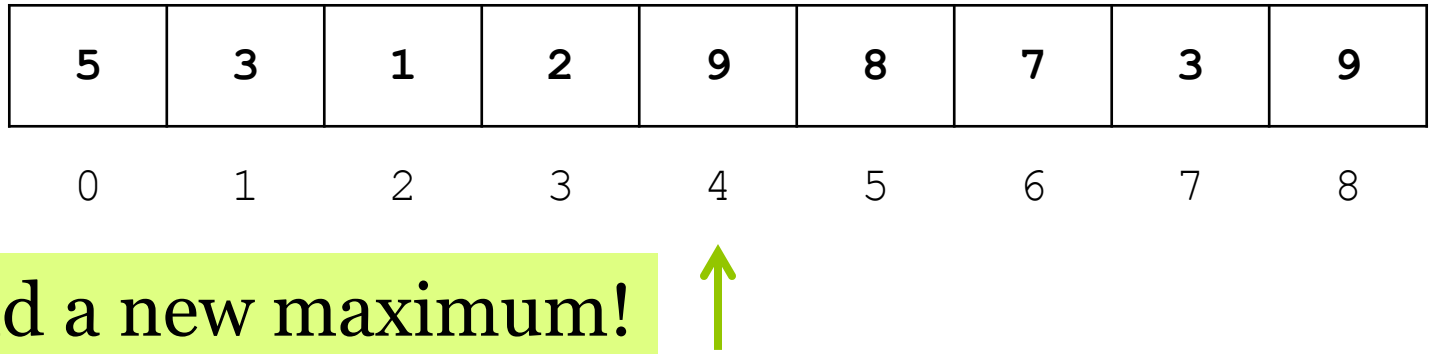
currentIndex: 2
maxValue: 5

Find the Maximum Algorithm



currentIndex: 3
maxValue: 5

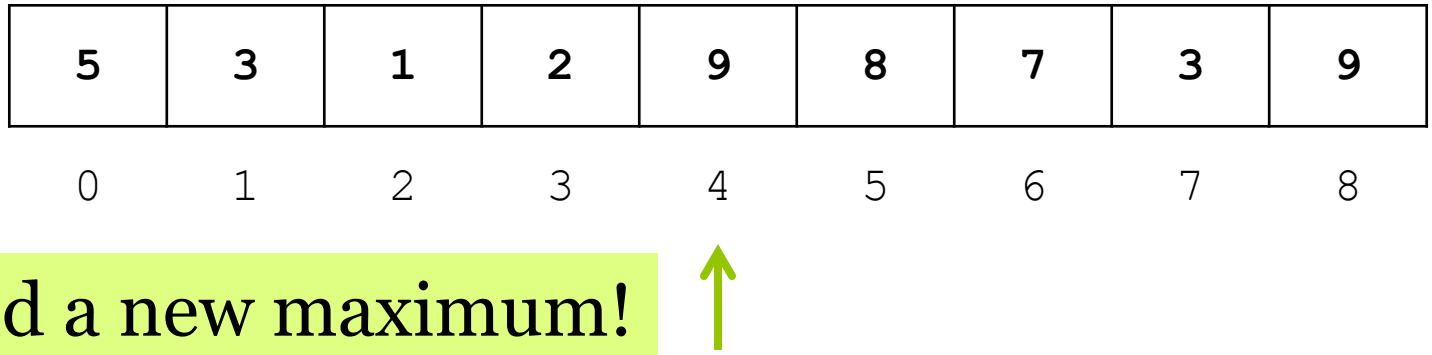
Find the Maximum Algorithm



found a new maximum!

currentIndex: 4
maxValue: 5

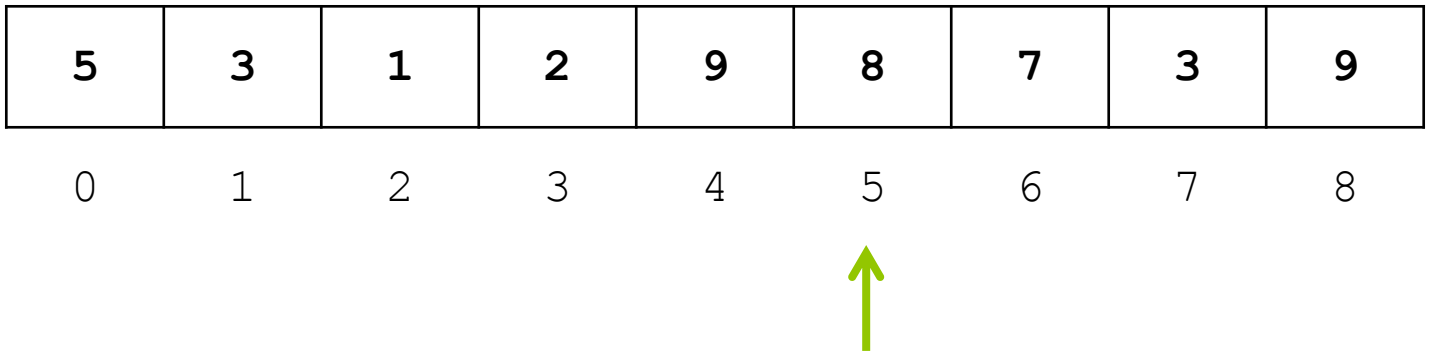
Find the Maximum Algorithm



found a new maximum!

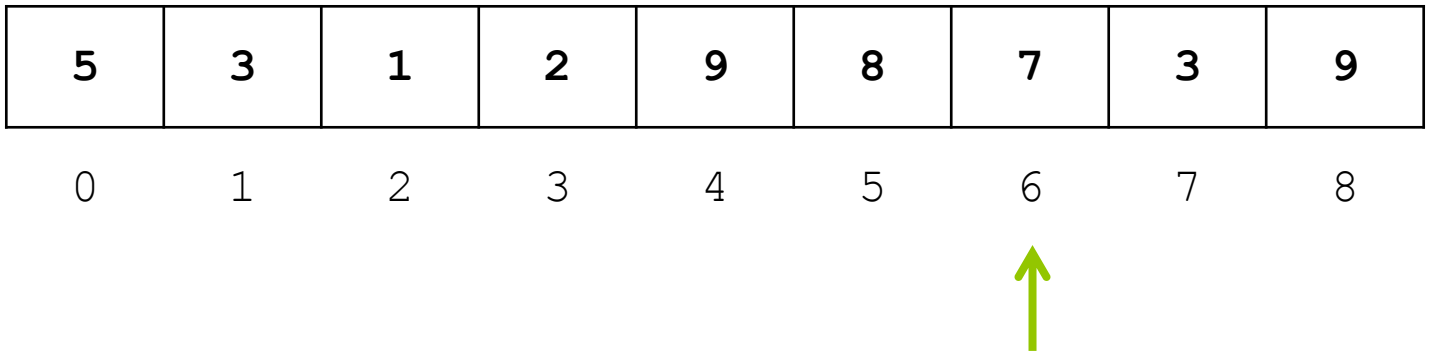
currentIndex: 4
maxValue: 9

Find the Maximum Algorithm



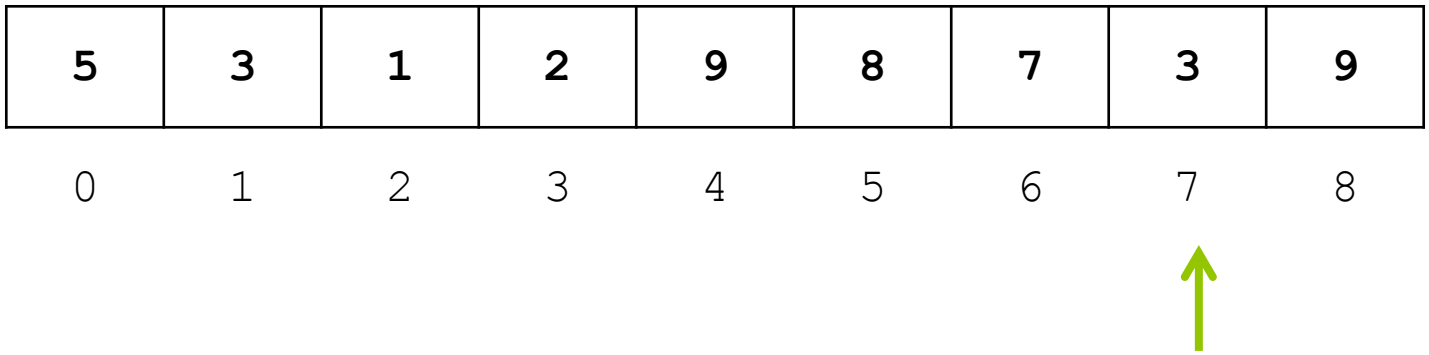
currentIndex: 5
maxValue: 9

Find the Maximum Algorithm



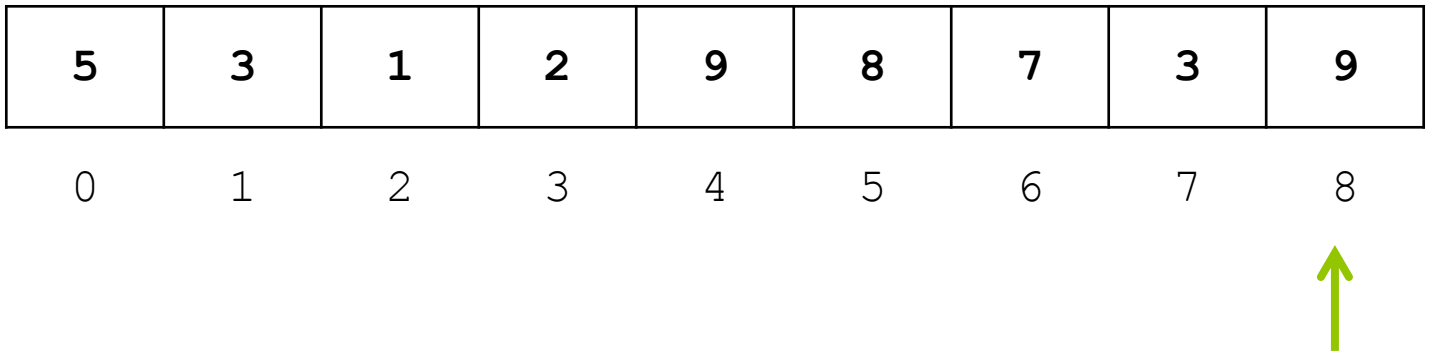
currentIndex: 6
maxValue: 9

Find the Maximum Algorithm



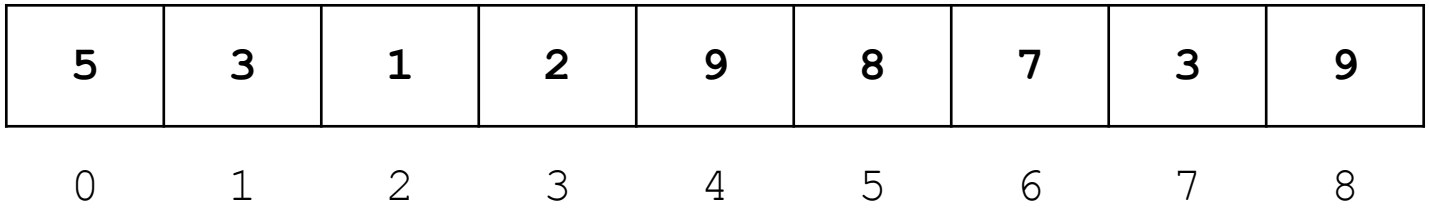
currentIndex: 7
maxValue: 9

Find the Maximum Algorithm



currentIndex: 8
maxValue: 9

Find the Maximum Algorithm

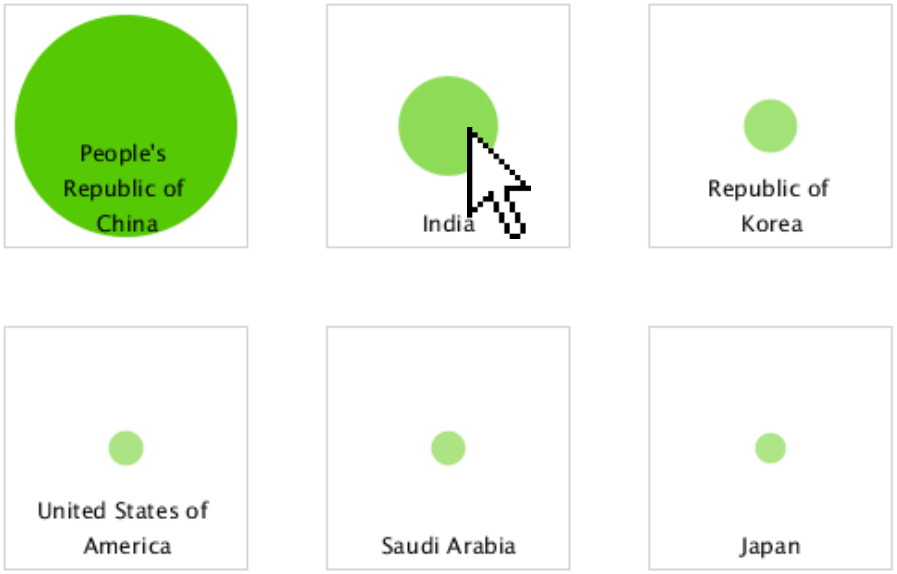


Finished: output is 9

currentIndex: 8
maxValue: 9

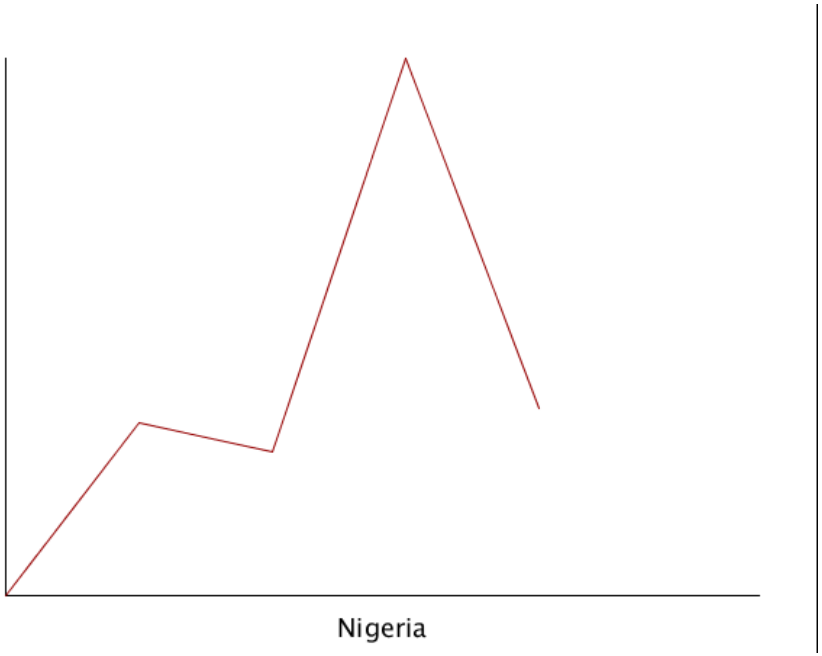
Step 4

Find what country (if any) was clicked on when the mouse is pressed.



Step 5

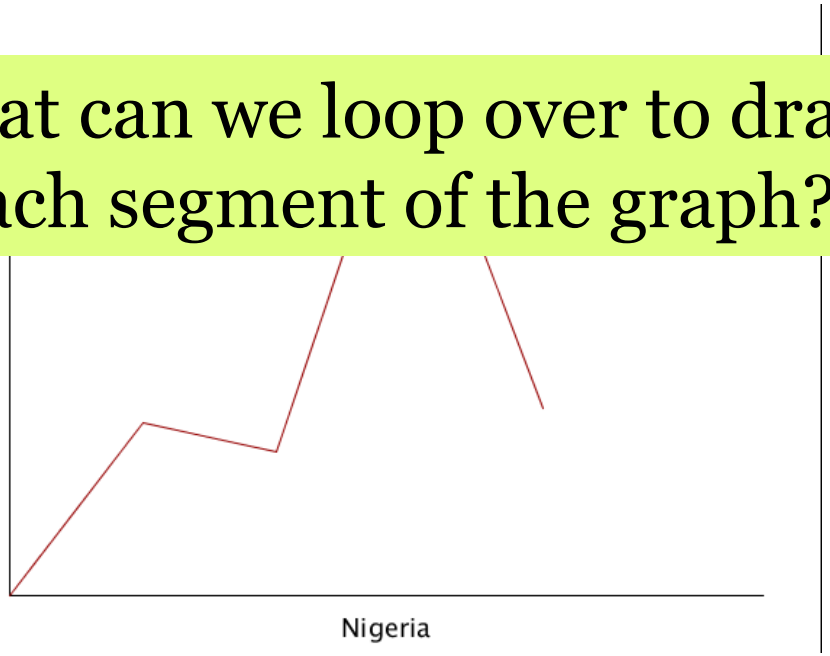
Display a line graph when a country was clicked.



Step 5

Display a line graph when a country was clicked.

What can we loop over to draw each segment of the graph?



Step 5

Display a line graph when a country was clicked.

What can we loop over to draw each segment of the graph?

Can't do it with parallel arrays...