COMP 1010- Summer 2015 (A01)

Jim (James) Young

young@cs.umanitoba.ca

jimyoung.ca

Hello!

James (Jim) Young
young@cs.umanitoba.ca
jimyoung.ca

office hours T / Th: 17:00 – 18:00
EITC-E2-582
(or by appointment, arrange by email)

ASSIGNMENT 3!!!

No using string functions not covered in class!!!

No indexOf. No substring. Etc.

arrays!

Let’s make a program:

A particle (point) shoots away from the mouse at a random speed in X and Y (== random angle)

If it hits the edge of the screen, start over with a new random speed

Let’s update.. 3 points

Requires copy-paste variables

Repetition of code – can clean up a little with methods, but there is a limit to this

What if I want 50? 1000?

- not feasible

what is an array?

an array is simply an ordered **list of data** of a given type:

you can have an array of 100 **int**s

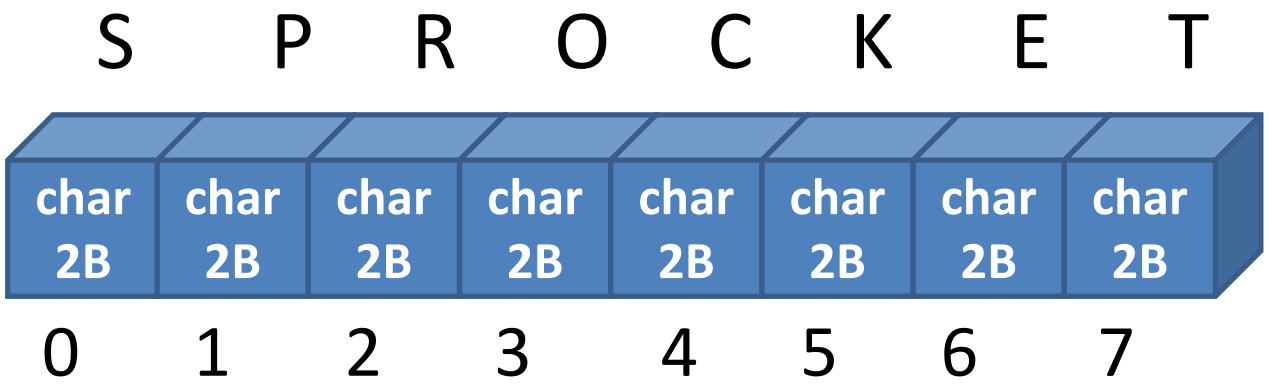
you can have an array of 10,000 **Strings**

you can have an array of 5 chars

Arrays are essential to programming and you will use them often!

we've actually seen the array before…

A Processing String, underneath, is an array of characters:



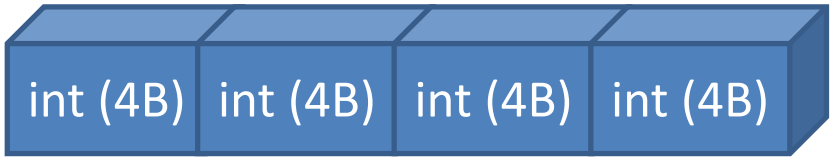
this is an array of characters, of length 8.

note that each box (item) in the array has its own index!! (String.charAt(index))

the Array!

note: an array is a list of data of a given type. You can make an array of any data type!

here is an array of 4 integers:



as with strings, each box has its own unique index:

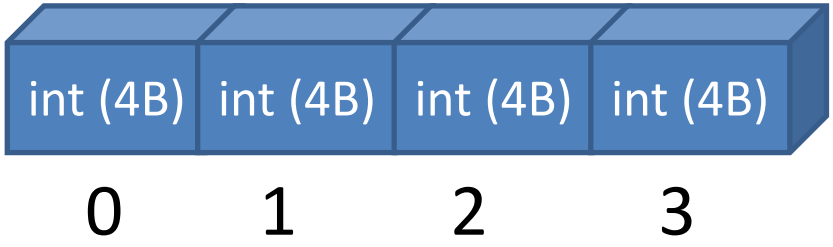
also as with strings, the first index is 0

Arrays have a fixed length

Array length cannot change!

You decide the length when you create an array

You cannot grow or shrink it



What if you need an array to grow or shrink?

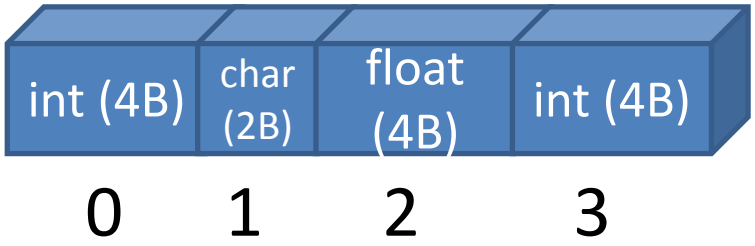
(classic final exam question)

Make a new one of the right size and copy your data

Arrays are homogenous

note: an array only has a single type, types cannot be mixed:

you cannot create an array like this:



choose your array type carefully because you are stuck with it!!

Syntax!

creating an array has two steps:

1. declare the variable container for the array
2. create the array (allocate memory) and assign it to the container.

1:

```
type [] variableName; // type is any Processing type.
double [] studentScores;
String [] studentNames;
```

note: square brackets: []. this marks an array

note: you do not tell how large (how many boxes..) your array is at this point!!

once variable is declared, have to make the array…

2. create the array (allocate memory) and assign it to the container

```
variableName = new type [arraySize];
double[] studentScores;
studentScores = new double[30];
```

combined **declaration** and **creation** is very common:

```
int[] studentAges = new int[30];
```

note: once an array is created it CANNOT be resized. choose your size wisely!!

examples of **declaration** and **instantiation**

declaration	**instantiation**
`double [] gameScores`	`= new double[5000];`
`String [] blogComments`	`= new String[200];`
`long [] bigNumbers`	`= new long[100];`

note: must both **declare** the variable and **instantiate** the array.

using the array

int[] numbers = new int[10]; // array of 10 ints

you can access any bin in the array just by putting it in square brackets:

numbers[0] ← first int in the array

numbers[5] ← sixth int in the array

numbers[9] ← last…

numbers[10] ← ???

this will raise an error: index out of bounds

accessing array bins

store values:

variableName[**bin**] = value;

studentScores[15] = 20;

studentScores[0] = 15;

retrieve values

int i = studentScores[15];

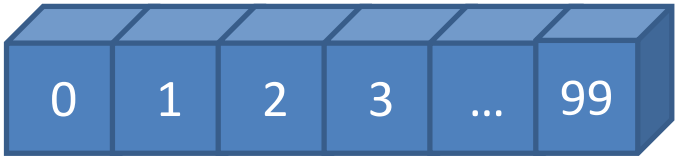
if (studentScores[i] > 90) message = “woohoo”;

can be used anywhere a normal value can be used!

studentScores[15] = studentScores[14]*2;

array bins:

double[] values = new values[100]; // 100 bins
values[3] to access 4th bin (bin 3).

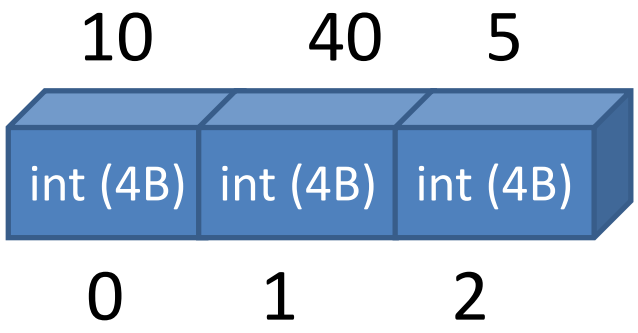


you can use a literal (e.g, 3, 4) or a variable as the bin index:
int i = 5;
values[i] to access bin i

the index MUST BE AN INTEGER TYPE
values[5.5] ← doesn't make sense
values["yo!"] ← doesn't make sense
values[false] ← doesn't make sense

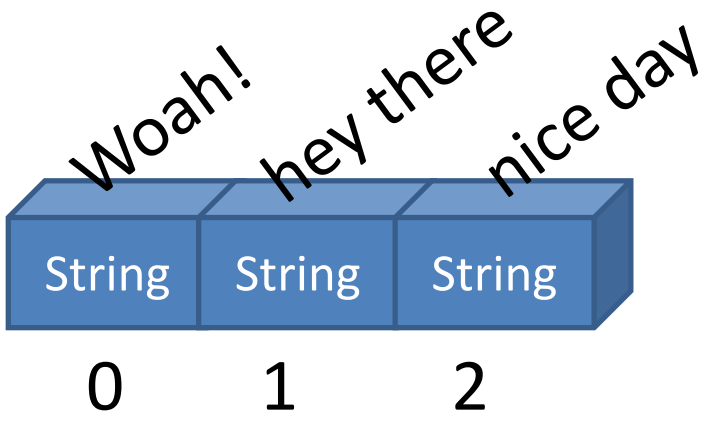
example:

make an array of integers of size three, and put three numbers into it: 10, 40, 5



Example cont…

make an array of Strings of size three, and put three messages into it: “woah!” “hey there” “nice day”



Example cont…

Use the arrays to print out the three messages at different locations

Good progress-

Only made one variable, not three

But still copy pasted code.. Any ideas?

Use a for loop to go through the array bins 0,1,2

Change sizes[0] to sizes[i]

Add two more lines

Two things:

- make the arrays bigger
- store the new data

And everything else still works.

Example:

Make arrays of size 8, one for x, one for y

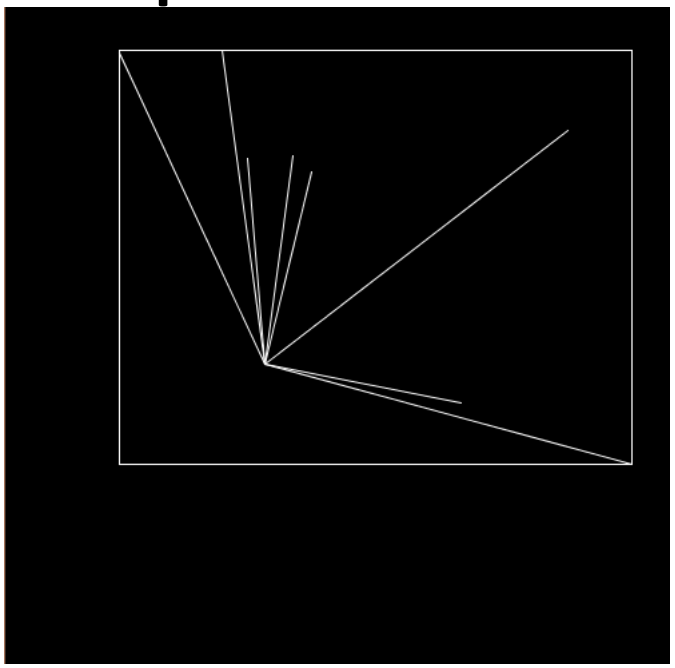
- fill it with 8 random points at program start
- draw lines from the mouse to those points
- if the mouse is pressed, make new random points

Scale up to 1000;

Update: draw a bounding box, a box that fits the points as best as possible

Find the smallest X and Y of all the points. This is the top left

Find the largest X and Y of all the points. This is the bottom right



Algorithm – smallest in array

Make a variable for smallest

Assume first element is smallest

Go through array – check if that new number is smaller – if so, save it. (use existing for loop)

Do the same for largest.

Draw order issue!!!

At home - fix

Example: mouse explosion!

```
final int CANVAS_SIZE = 500;
final float MAX_SPEED = 5;
float ballX = -1;
float ballY = -1;
float ballSpeedX = 0;
float ballSpeedY = 0;


void setup()
{
  size(CANVAS_SIZE, CANVAS_SIZE);
}

void draw()
{
  background(0);
  if (ballY < 0 || ballY > height ||
    ballX < 0 || ballX > width)
  {
    // move the ball to the mouse
    ballX = mouseX;
    ballY = mouseY;

    ballSpeedX = random(MAX_SPEED*2)-MAX_SPEED;
    ballSpeedY = random(MAX_SPEED*2)-MAX_SPEED;
  }

  ballX += ballSpeedX;
  ballY += ballSpeedY;

  stroke(255);
  point(ballX, ballY);
}
```

Update this to use arrays

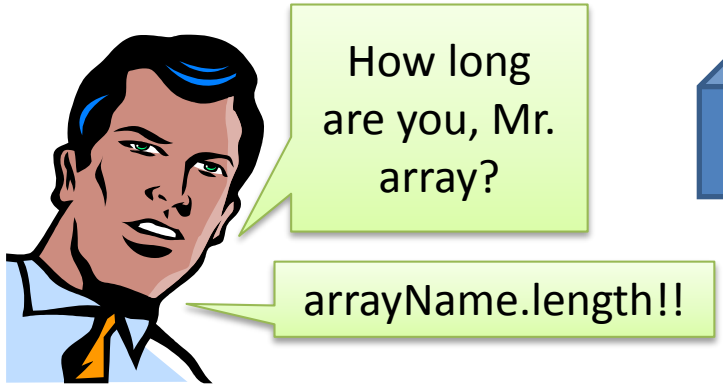
First, make a new global to decide how many balls

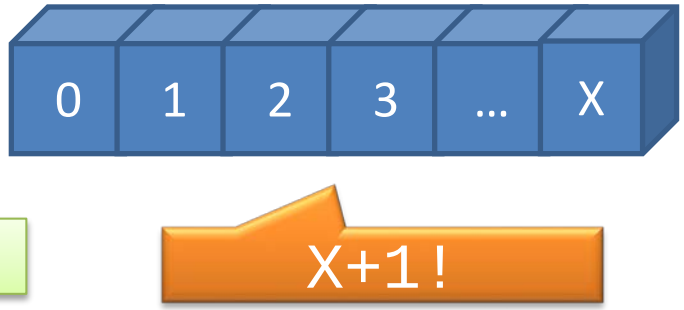
Then, *upgrade* the variables to arrays

Every time we use that variable, we now need to use arrays

- instead of doing something just once, we need to do it per array bin.
- use a for loop

length of the array?





Processing provides a mechanism for giving us the length of an array:

variableName.length

```
int numbers[] = new int[100];
println(numbers.length); // result?
```

notice!! no () why is this?

.length is not a **method**, it is a **property**

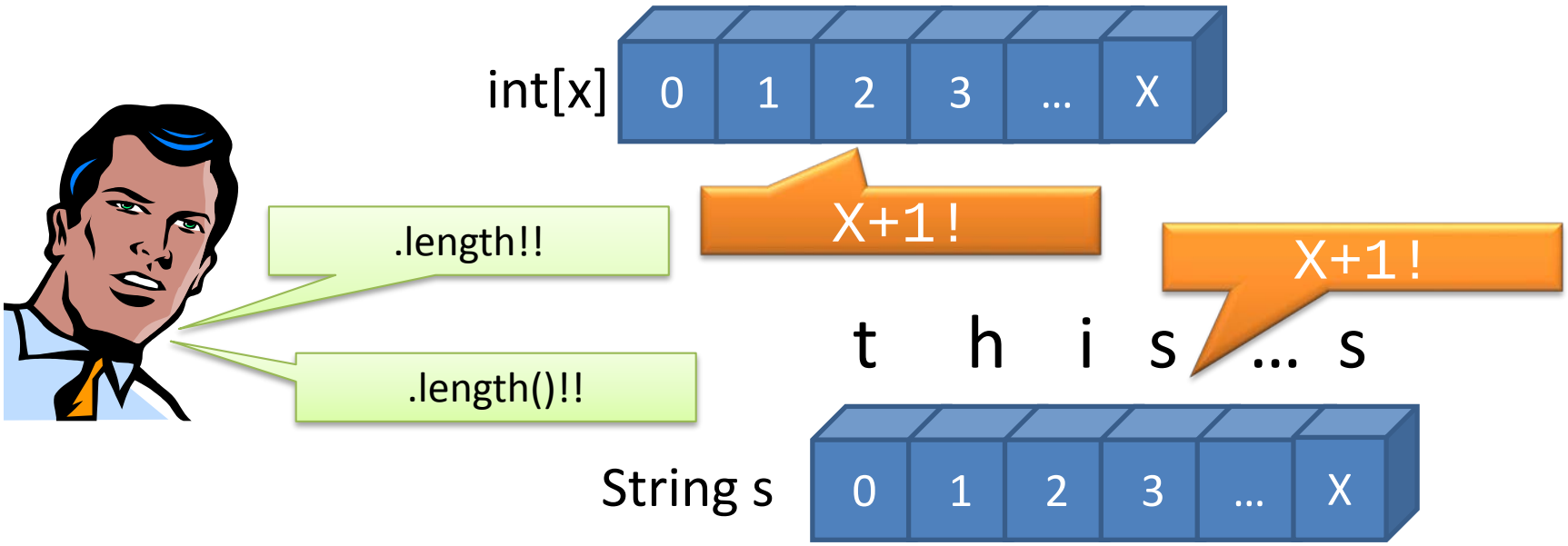
you will learn more about this later, but for now, remember that array length has no ().

array length vs string length

to get the length of a string:

```
stringVariable.length(); // method call
arrayVariable.length;  // property
```

note: this is VERY annoying. have to memorize ☹



safety

using arrayVariable.length is SAFER because you cannot make a mistake about the length of the array

- you don’t need to remember the length, just ask for it.