ARRAYS

CS111 Lab

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I/O WITH MULTIPLE VARIABLES

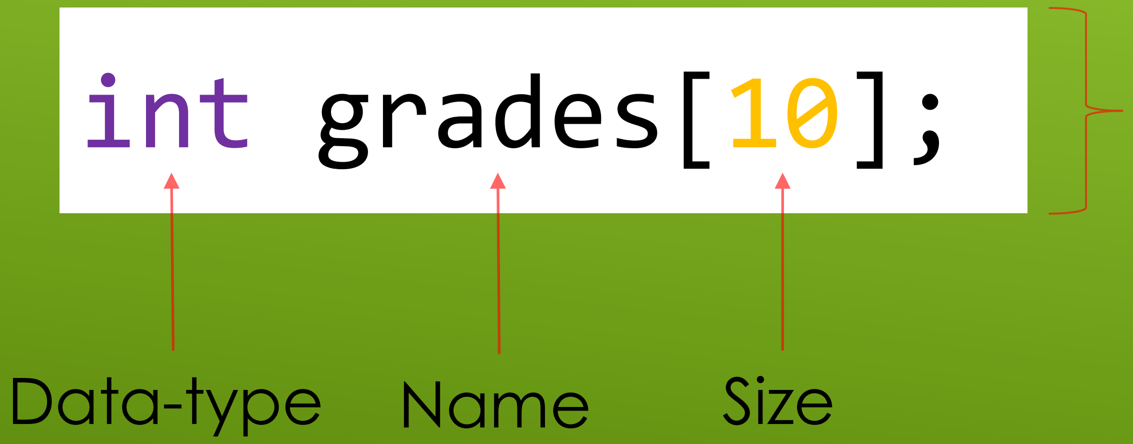
```
//Inputting 5 numbers and averaging them
int main() {
  int x1, x2, x3, x4, x5;
  cout << “Enter 5 numbers: “;
  cin >> x1 >> x2 >> x3 >> x4 >> x5;

  double avg = (x1 + x2 + x3 + x4 + x5) / 5.0;
  cout << “Average: “ << avg << endl;

  return 0;
}
```

Now how about a program to store and calculate the average of 30 exam grades? Should we create 30 variables? Of course not! Luckily, C++ has an easy way to manage many variables.

INTRODUCING **ARRAYS**

Arrays enable us to work with any number of variables! Arrays have the following properties:

- **Data-type** – Can be *int*, *char*, *double*, *string*, *bool*, etc
- **Name** – Arrays have names just like variables do!
- **Size** – How many array “boxes” would you like?

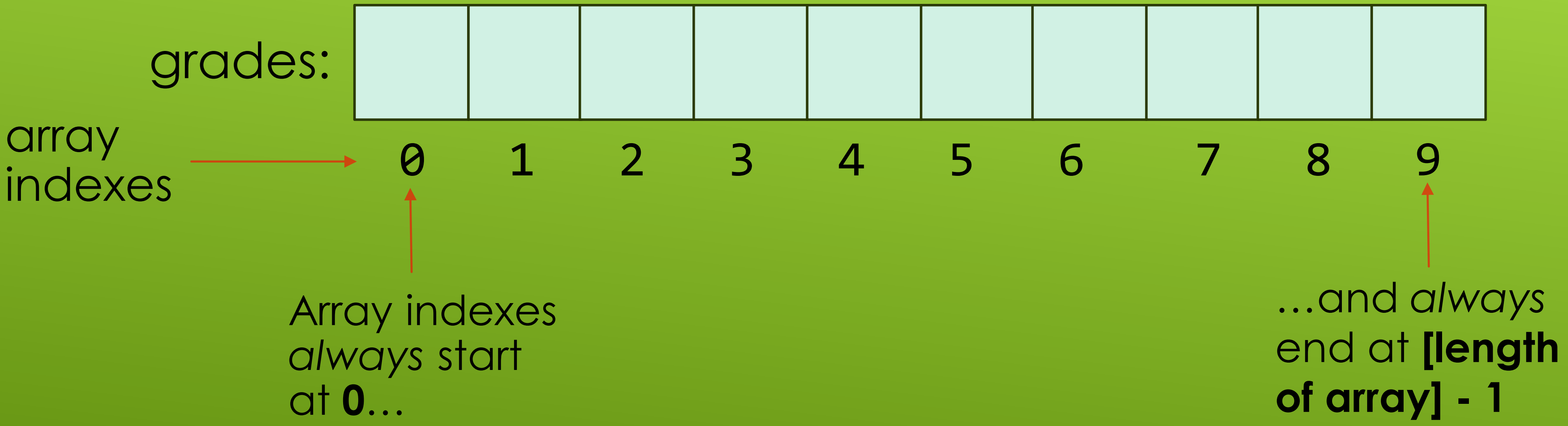


```
int grades[10];
```

This is an *int* array of size 10!
This is as good as making 10 individual integer variables!

ARRAYS IN MEMORY

```
int grades[10];
```


grades:
array indexes
0
1
2
3
4
5
6
7
8
9
Array indexes *always* start at **0**…
…and *always* end at **[length of array] - 1**

Each "box" of any array is a variable with the data-type of the array! In the example above, each box of the array is an integer variable! You can access an array box/element as follows: **`array_name[array_index]`**

ARRAY ACCESS WITH FOR-LOOPS

We usually use *for-loops* to traverse (travel across) arrays! Again, remember that array indexes start from **0** and end at **array_size-1**:

Our "usual" loop

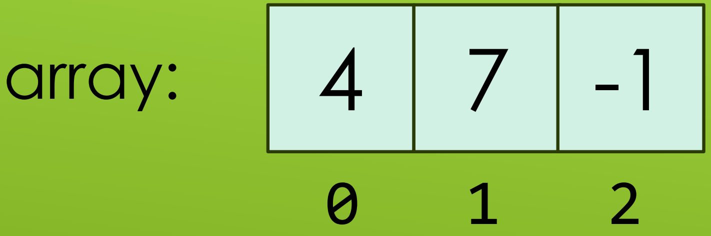
```
for (int i = 0; i < n; ++i) { //"n" is the size of the array
  …do something with array element at index i…
}
```

You may also do the following, though the loop above is preferred:

```
for (int i = 0; i <= n-1; ++i) {
  …do something with array element at index i…
}
```

ARRAYS INITIALIZATION AND ACCESS

```
int array[3] = {4, 7, -1}; //initialization
```



```
//print individually
cout << array[0]; //4
cout << array[1]; //7
cout << array[2]; //-1
```

```
//assign individually
array[0] = 5; //5
array[1] = array[0]; //5
array[2] = array[1] + 2; //7
```

```
//print with loop
for (int i = 0; i < 3; ++i)
  cout << array[i] << endl;
```

```
//assign with loop
for (int i = 0; i < 3; ++i)
  array[i] = i;
```

PROGRAM EXAMPLE

```
//Inputting 30 grades and averaging them
int main() {
  int grades[30]; //making room in memory for 30 integers

  for (int i = 0; i < 30; ++i) {
    cout << “Enter grade #” << i+1 << “: “;
    cin >> grades[i]; //yes, this is possible!
  } //remember that each element of grades is an int variable!

  double avg = 0;
  for (int i = 0; i < 30; ++i)
    avg += grades[i];

  cout << “Class average: “ << avg/30 << endl;
  return 0;
}
```

DON'T DO THIS

```
int n;
cout << “Enter a size: “;
cin >> n;

int array[n]; //BIG NO-NO!!!
```

Chances are your compiler may allow this, but what you see above is **illegal** by C++ standards! Don't do it. In this course, we'll stick with arrays with “set” sizes (i.e. sizes known while writing the program):

```
int array[1000];
for (int i = 0; i < 100; ++i) {
  cin >> array[i];
} //you need not use every element of the array you declared!
```

ARRAYS AND FUNCTIONS

Typical array print function:

```
void print(int array[], int size) {
  for (int i = 0; i < size; ++i) {
    cout << array[i] << " ";
  }
  cout << endl;
}
```

Optional: Put array size in parameter

```
void print(int array[4], int size) {
  for (int i = 0; i < size; ++i) {
    cout << array[i] << " ";
  }
  cout << endl;
}
```

In *main()*:

```
int main() {
  int a[4] = {1, 4, 0, 8};

  //pass the NAME of the array
  //to the function!
  print(a, 4);

  return 0;
}
```

<u>Output</u>

```
1 4 0 8
```

ARRAYS AND FUNCTIONS

Arrays are always "passed by reference".

```
void add5(int array[], int size) {
  for (int i = 0; i < size; ++i)
    array[i] += 5;
}

void print(int array[], int size) {
  for (int i = 0; i < size; ++i) {
    cout << array[i] << " ";
  }
  cout << endl;
}
```

In *main()*:

```
int main() {
  int a[4] = {1, 4, 0, 8};

  cout << "Now: ";
  print(a, 4);

  add5(a, 4);

  cout << "Later: ";
  print(a, 4);

  return 0;
}
```

Output

```
Now: 1 4 0 8
Later: 6 9 5 13
```