Arrays

Chapter 8

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Arrays (8.1)

- One variable that can store a *group of values of the same type*

- Storing a number of related values
  - all grades for one student
  - all temperatures for one month
  - hours worked for each day
Arrays

```c
int age = 42;

int ages[3];

// datatype variable_name [ size ];

const int CLASSSIZE = 24;
string names[CLASSSIZE];
```

The size of the array must be a *literal* or a `const int`.
Using arrays (8.2)

- The first element in the array is the 0\textsuperscript{th} element!
- The \textit{index} is an \texttt{int}

```c
int y, x = 3;
int years[10];

years[0] = 2;
years[x] = 4;
y = years[0] + 9;
```
Practice

• Declare an array to hold the height, in inches, of six trees.

• Set the height of the trees as:
  - 32 inches
  - 45 inches
  - 99 inches
  - 120 inches
  - 500 inches
  - 600 inches
Practice (8.3)

- Write a snippet of code to print to the screen every value in this array:

```c
const int ARRAYSIZE = 4;
int vals[ARRAYSIZE];
```

- Print the sum and average
Practice

• Read 20 exam scores from a file and print them in reverse order

• Ask the user for an exam number (0-19) and print that exam score to the screen

• Ask the user for an exam number and add 2 bonus points to that exam score.

• Find the max score in the array
Out of bounds (p 479)

- C++ does *not* check to make sure the *index* falls within the array
  - no *bounds checking*
  - this will cause unpredictable results!
Initialization (8.4)

• What is the equivalent of:

```java
int value = 2; // initialize the variable
int tests[2] =
string names[3] =
```

• Initialize just a few values:

```java
int value[4] =
```
Implicit array sizing (p 486)

- Set the size of the array by initializing it
- You *must* either specify a size or initialize the array

```c
string names[] =
char letters[] =
```
void printArray(string arr[], int arraySize);

int main()
{
    const int MAXPEOPLE = 100;
    string names[MAXPEOPLE];

    // read data from user
    printArray(ages, MAXPEOPLE);
Practice

• Write a function that will accept an integer array and a size for that array, and return the sum of all the elements in the array

```c
int sumArray(int array[], int size);
```
Arrays as Parameters

- Arrays are *always* passed by reference

```c
void initializeArray(int array[], int size, int value);

doubleEachValueInTheArray();
```
Practice – parallel arrays

• Write a function to read the file below into two arrays. There are at most 100 students listed.

• Write a function to print the PUNetIDs of students who have a score between min and max (values supplied by the user).

Grades.txt

<table>
<thead>
<tr>
<th>PUNetID</th>
<th>FinalAverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAAA1234</td>
<td>90.2</td>
</tr>
<tr>
<td>will4614</td>
<td>85.4</td>
</tr>
</tbody>
</table>

Write a function call to print the PUNetIDs of students with scores between 88-100
72-100
• Write a function to add X bonus points to Y's score.
  ○ write a function call to add 10 bonus points to AAAA1234
  ○ write a function call to add 7 bonus points to will4614

• Write a function to find the overall class average.
  ○ use this function to print the average to the screen
Two dimensional arrays (8.9)

- A grid of data!

```c
int testScores[2][3];

testScores[0][0] = 99;
testScores[0][1] = 80;
testScores[0][2] = 88;
testScores[1][0] = 89;
testScores[1][1] = 77;
testScores[1][2] = 85;
```
Why use 2D arrays?

- Hold the scores for each student in one array.

```cpp
const int BOB = 0;
const int ALICE = 1;
const int MIDTERM1 = 0;
const int MIDTERM2 = 1;
const int FINAL = 2;
int testScores[2][3] = { {0, 0, 0},
                         {0, 0, 0} };

testScores[BOB][MIDTERM1] = 99;
testScores[ALICE][FINAL] = 85;
```

- Which values are we setting above?
- How do we set Alice’s Midterm2 score?
- What is stored in `testScores[0][1]`?
Practice

- Use a two dimensional array to store the scores of 8 Pacific Volleyball games. Store the opponent names in a separate one dimensional array. Read these values from PV.txt. Pacific’s score is listed first.

Concordia 3 2
Schreiner 3 0
Wartburg 3 2
Iowa 3 2
LaVerne 3 2
UCSC 2 3
CalLutheran 0 3
Pomona 2 3

- Print the name of the first team that Pacific beat.
- Print the name of the last team that Pacific beat.
- Print the name of the first team that beat Pacific.
Practice

• Using the array below, calculate:
  ○ the average score on each assignment
  ○ the average score for each student
  ○ assume the array already contains data

```c
const int NUMOFSTUDENTS = 24;
const int NUMOFASSIGNMENTS = 6;

int testScores[NUMOFSTUDENTS][NUMOFASSIGNMENTS];
```
N-Dimensional Arrays (8.10)

// cost of seats in a theatre

// 4 sections, each section has
// 20 rows with 30 seats each.

double seats[4][20][30];

seats[0][0][0] = 100.00;
seats[2][0][0] = seats[1][0][0] / 2;
seats[3][19][25] = 10.00;

// we can have as many dimensions as
// necessary in an array