


CS Bridge Module 9 Arrays

1. Motivation

1.1 CS Bridge: Introduction to Static Arrays




CS Bridge: Introduction to Static Arrays


Module 9
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Notes:

1.2 Motivation



Computing the Average (Revisited)



Problem
Write a program that reads grades of students in a class, and prints the average.

Example
Please enter the number of students in the class:
4
Enter the students' grades (separated by a space):
71 86 68 94
The class average is 79.75
[Link to previous module.](#)

1.3 Calculate Average Implementation

```
#include <iostream>
using namespace std;

int main() {
    int numberOfStudents;
    int curr, sum;
    double average;

    cout<<"Please enter the number of students in the class:"<<endl;
    cin>>numberOfStudents;

    cout<<"Enter the students' grades (separated by a space):"<<endl;
    sum = 0;
    for(int i = 0; i<numberOfStudents; i++){
        cin>>curr;
        sum += curr;
    }

    average = (double)sum / (double)numberOfStudents;
    cout<<"The class average is "<<average<<endl;
    return 0;
}
```

1.4 Above the Average

Above The Average

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Problem

Write a program that reads grades of students in a class, prints the average and the grades that are above the average.

Example

Please enter the number of students in the class:

4

Enter the students' grades (separated by a space):

71 86 68 94

The class average is 79.75

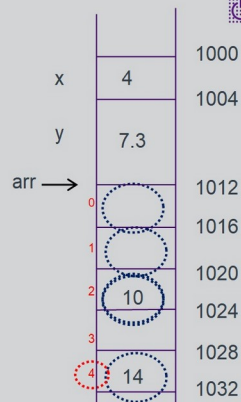
The grades above the average are

86 94

1.5 Implementation

```
int main ( ) {
    int x ;
    double y ;
    int arr [ 5 ] ;

    x = 4 ;
    y = 7.3 ;
    arr [ 2 ] = 10 ;
    arr [ 4 ] = 14 ;
}
```



Notes:

2. Array Basics

2.1 Array Basics

Basic Properties of Arrays

1) The elements are stored continuously in the memory.

2) All of the elements in an array are of the same type.

3) The elements are accessed using a 0-based index system.

Index	Address
0	1000
1	1004
2	1008
3	1012
4	1016
	1020

Notes:

2.2 Basic Array Properties

Basic Properties of Arrays

1) The elements are stored continuously in the memory.

2) All of the elements in an array are of the same type.

3) The elements are accessed using a 0-based index system.

$(\text{address of arr}[2]) = 1000 + 2 \cdot 4 = 1008$

$(\text{address of arr}[i]) = (\text{address of arr}[0]) + i \cdot (\text{size of each element in arr})$

Index	Address	Value
0	1000	4
1	1004	5
2	1008	5
3	1012	
4	1016	
	1020	

2.3 Basic Array Properties Cont'd

Basic Array Properties Cont'd

int arr [6] ;
arr [0] = 4 ;
arr [2] = 5 ;
arr [5] = 7 ;
arr [8] = 10 ;
arr [10] = 20 ;

$(\text{address of arr}[i]) = (\text{address arr begins}) + i \cdot (\text{Size of each element in arr})$
(address of arr [5]) = 1000 + 5 * 4 = 1020

arr →

-2	20	992
...
0	4	1000
1		1004
2	5	1008
3		1012
4		1016
5	7	1020
...
8	10	1040

2.4 Syntactic Notes

Syntactic Notes

Static array syntax:
1. Array's physical size must be a constant, and must be given at declaration.

double y ;

int arr [6] ;
const int X = 7 ;
int arr [X] ;

~~int arr [] ;~~
~~int n = 7 ;~~
~~int arr [n] ;~~

1000

2.5 Knowledge Check

(Multiple Response, 10 points, 6 attempts permitted)

Knowledge Check

Which of the following statements about arrays are false?

- ☐ The elements are stored in memory continuously
- ☐ The elements are accessed using a 0-based index system
- ☒ The size of the array is the same number as the last index in the array
- ☐ The elements in an array must be of the same type
- ☐ You can have an empty array
- ☐ To access an element, use the [] symbol

Correct	Choice
	The elements are stored in memory continuously
	The elements are accessed using a 0-based index system
X	The size of the array is the same number as the last index in the array
	The elements in an array must be of the same type
	You can have an empty array
	To access an element, use the [] symbol

Feedback when correct:

That's right! You selected the correct response.

Feedback when incorrect:

You did not select the correct response.

Correct (Slide Layer)

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Knowledge Check

Which of the following statements about arrays are false?

Correct

That's right! You selected the correct response.

Continue

☐ The elements in an array must be of the same type
☐ The size of an array is fixed
☒ The size of an array can change
☐ The elements in an array must be of the same type
☐ You can have an empty array
☐ To access an element, use the [] symbol

Incorrect (Slide Layer)

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Knowledge Check

Which of the following statements about arrays are false?

Incorrect

You did not select the correct response.

Continue

☐ The elements in an array must be of the same type
☐ The size of an array is fixed
☒ The size of an array can change
☐ The elements in an array must be of the same type
☐ You can have an empty array
☐ To access an element, use the [] symbol

Try Again (Slide Layer)

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Knowledge Check

Which of the following statements about arrays are false?

Incorrect


That is incorrect. Please try again.

Try Again

☐ The elements in an array must be of the same type
☐ The size of an array is fixed
☒ The size of an array can change
☐ The elements in an array must be of the same type
☐ You can have an empty array
☐ To access an element, use the [] symbol

3. Solve the Above Average Problem

3.1 Above The Average



Above the Average

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Problem
Write a program that reads grades of students in a class, prints the average and the grades that are above the average.

Example
Please enter the number of students in the class:
4
Enter the students' grades (separated by a space):
71 86 68 94
The class average is 79.75
The grades above the average are
86 94

3.2 Above Average 1

```
#include <iostream>
using namespace std;

int main(){
    return 0;
}
```

3.3 Above Average Cont'd

Above Average Cont'd

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```
#include <iostream>
using namespace std;

const int MAX_CLASS_SIZE = 60;

int main() {
    int numOfStudents;
    int gradesList[MAX_CLASS_SIZE];
    int currGrade;
    int ind;

    cout<<"Please enter the numbers of students in the class
(no more than "<<MAX_CLASS_SIZE<<")"
    <<endl;
    cin>>numOfStudents;

    //reading the grades
    for (ind = 0; ind < numOfStudents; ind++) {
        cin>>currGrade;
        gradesList[ind] = currGrade;
    }

    //calculating the average
    // print grades above the average
    return 0;
}
```

numOfStudents	4	1000
gradesList	71	1004
	86	
	68	
	94	
	:	
currGrade	71 86 68 94	
ind	0 1 2 3 4	

3.4 Above Average Cont'd

```
#include <iostream>
using namespace std;

const int MAX_CLASS_SIZE = 60;

int main(){
    int numOfStudents;
    int gradesList[MAX_CLASS_SIZE];
    int currGrade;
    int ind;

    cout<<"Please enter the number of students in the class (no more than "<<MAX_CLASS_SIZE<<")"
    <<endl;
    cin>>numOfStudents;

    //reading the grades
    for (ind = 0; ind < numOfStudents; ind++) {
        cin>>currGrade;
        gradesList[ind] = currGrade;
    }

    //calculating the average
    //print grades above the average
    return 0;
}
```

3.5 Above Average Cont'd

Above Average Implementation

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```
#include <iostream>
using namespace std;
const int MAX_CLASS_SIZE = 60;
int main() {
    int numOfStudents;
    int gradesList[MAX_CLASS_SIZE];
    int currGrade;
    int ind;

    cout<<"Please enter the numbers of students in the class
(no more than "<<MAX_CLASS_SIZE<<")"
    <<endl;
    cin>>numOfStudents;

    //reading the grades
    for (ind = 0; ind < numOfStudents; ind++) {
        cin>>currGrade;
        gradesList[ind] = currGrade;
    }

    //calculating the average
    sum = 0;
    for (ind = 0; ind < numOfStudents; ind++) {
        sum += gradesList[ind];
    }
    average = (double)sum / (double)numOfStudents;
    cout<<"The class average is " <<average<<endl;
    // print grades above the average
    return 0;
}
```

numOfStudents	4	1000
gradesList	71	1004
	86	
	68	
	94	
	:	
currGrade	71 86 68 94	
ind	0 1 2 3 4	
sum	0 71 157 225 319	
average	79.75	

3.6 Above Average Cont'd

```
#include <iostream>
using namespace std;

const int MAX_CLASS_SIZE = 60;

int main(){
    int numOfStudents;
    int gradesList[MAX_CLASS_SIZE];
    int currGrade;
    int ind, sum;
    double average;

    cout<<"Please enter the number of students in the class (no more than "<<MAX_CLASS_SIZE<<")"
    <<endl;
    cin>>numOfStudents;

    //reading the grades
    for (ind = 0; ind < numOfStudents; ind++) {
        cin>>currGrade;
        gradesList[ind] = currGrade;
    }

    //calculating the average
    sum = 0;
    for (ind = 0; ind < numOfStudents; ind++) {
        sum += gradesList[ind];
    }
    average = (double)sum / (double)numOfStudents;
    cout<<"The class average is "<<average<<endl;

    //print grades above the average
}
```

Notes:

4. Additional Syntactic Notes for Static Arrays

4.1 Syntactic Notes

Syntactic Notes

Basic properties of array (at declaration)

1. The element size must be a constant and memory must be given at declaration.
2. All of the elements in an array are of the same type.
3. The elements are accessed using a 0-based index system.
2. Array's name is a legal C++ expression.

address of arr[i] = (address of arr begins) + i * (Size of each element in arr).

It's value is the address in the memory where the array starts.

5	arr →	1000
7	0	1004
6	1	1008
8	2	1012
0	3	1016
0	4	1020

4.2 Knowledge Check

(Multiple Choice, 10 points, unlimited attempts permitted)

Knowledge Check

In the following code, what is the value of fib[7]?

```
const int size = 20;
int main(){
int fib[size];
fib[0];
fib[1]=1;
for (int i=2; i<21; i++)
    fib[i]=fib[i-1]+fib[i-2]
return 0;
}
```

- ☐ 8
☒ 13
☐ 21
☐ 5

Correct	Choice	Feedback
	8	Incorrect, this is the value of fib[6]
X	13	Correct!
	21	Incorrect, this is the value of fib[8]
	5	Incorrect, this is the value of fib[5]

8 (Slide Layer)

Knowledge Check

In the following code, what is the value of fib[7]?

```
const int
int main()
int fib[si
fib[0];
fib[1]=1;
for (int i
    fib[i]
return 0;
}
```

Incorrect

Incorrect, this is the value of fib[6]

Continue

13 (Slide Layer)

Knowledge Check

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In the following code, what is the value of fib[7]?

```
const int  
int main()  
int fib[si  
fib[0];  
fib[1]=1;  
for (int i  
    fib[i]  
return 0;  
}
```

Correct
Correct!
Continue

21 (Slide Layer)

Knowledge Check

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In the following code, what is the value of fib[7]?

```
const int  
int main()  
int fib[si  
fib[0];  
fib[1]=1;  
for (int i  
    fib[i]  
return 0;  
}
```

Incorrect
Incorrect, this is the value of fib[8]
Continue

5 (Slide Layer)

Knowledge Check

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In the following code, what is the value of fib[7]?

```
const int  
int main()  
int fib[si  
fib[0];  
fib[1]=1;  
for (int i  
    fib[i]  
return 0;  
}
```

Incorrect
Incorrect, this is the value of fib[5]
Continue

4.3 End of Module

