CS2313 Computer Programming

LT5 – Array

Outlines

- 1D and 2D **array** in C++.

Outcomes

- Array definition
- Array initialization
- Updating array elements
- Printing the content of arrays

Syntax Summary

- Punctuators-square brackets
  - [...]

Example 1

- Input the marks for `10` students.
- Store the marks in variables.
- Compute the average marks.
- Print the marks of the students and the average.

```
100 30 44 66 50 60 80 75 80 100
The mark of the students are: 100, 30,
44, 66, 50, 60, 80, 75, 80, 100.
Average mark=68.
```

The Example Program

```
/*define variables for storing 10 students' mark*/
int mark1, mark2, mark3, mark4, mark5,
    mark6, mark7, mark8, mark9, mark10, average;

/*input marks of student*/
cin >> mark1 >> mark2 >> mark3 >> mark4 >>     \\
    mark5 >> mark6 >> mark7 >> mark8 >> mark9 >> mark10;

/*print the marks*/
cout << "The mark of the students are: " << mark1 \\
     << mark2 << mark3 << mark4 << mark5 << mark6 \\
     << mark7 << mark8 << mark9 << mark10 << endl;

average = (mark1+mark2+mark3+mark4+mark5
           +mark6+mark7+mark8+mark9+mark10)/10;

cout << "Average mark"<< average << endl;
```

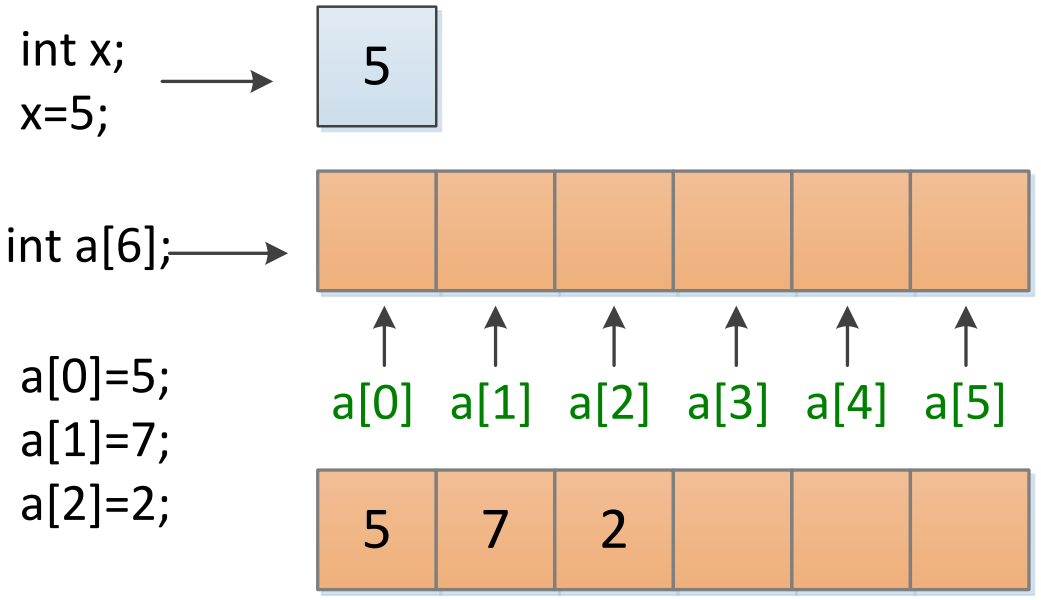
Is it easy to extend the program to handle more students?

Opening Problem

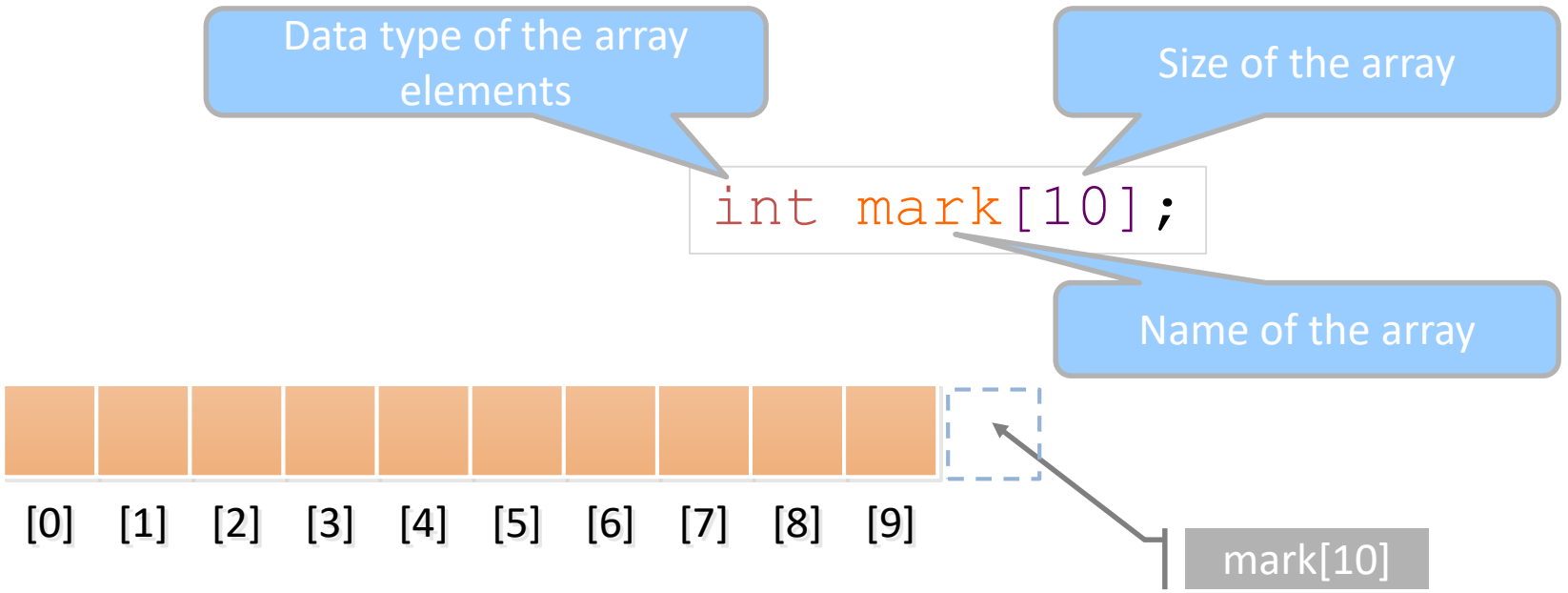
Read one hundred numbers, compute their average, and find out how many numbers are above the average.

What is An Array?

- **Sequence** of data items that are of same type.
  - Stored contiguously.
  - Can be accessed by *index*.



Array Declaration



There are ten elements in this array
`mark[0], mark[1], ……, mark[9].`

The **`i`**th array element is **`mark[i-1]`** .
The range of the subscript `i` ranges from `0` to `sizeOfArray-1`.

The location `mark[10]` is **invalid**.

Array out of bound!

Storing Values to Array

- Suppose the mark for the first student is 30. We can use the notation to store the value to the first element of the array:

```
mark[0] = 30;
```

- Reading the marks of the second student :

```
cin >> mark[1];
```

- Reading the marks for 10 student:

```
for (i=0; i<10; i++)
    cin >> mark[i];
```

Accessing Values of An Array Elements

- Print the mark of the second student:

```
cout << mark[1];
```

- Sum the marks of all the students:

```
int sum = 0;

for (i=0; i<10; i++) {
    cout << mark[i];
    sum = sum + mark[i];
}
```

Summary of Array Declaration and Access

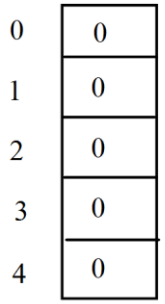
Type	Variable	Array Declaration	Variable Access	Array Access
int	int x;	**int x[20];**	x=1;	**x[0]=1**
float	float x;	**float x[10];**	x=3.4f;	**x[0]=3.4f;** **x[1]=1.2f;**
double	double x;	**double x[20];**	x=0.7;	**x[0]=0.7;** **x[3]=3.4;**
char	char x;	**char x[5];**	x='a';	**x[0]='c';** **X[1]='s';**

Trace Program with Arrays

Declare array variable values, create an array, and assign its reference to values

```
int main()
{
   int values[5]={0,0,0,0,0};
   for (int i = 1; i < 5; i++)
  {
     values[i] = i + values[i-1];
   }
   values[0] = values[1] + values[4];
}
```

After the array is created



Trace Program with Arrays

i becomes 1

```
int main()
{
   int values[5]={0,0,0,0,0};
   for (int i = 1; i < 5; i++)
  {
     values[i] = i + values[i-1];
   }
   values[0] = values[1] + values[4];
}
```

After the array is created

0	0
1	0
2	0
3	0
4	0

Trace Program with Arrays

i (=1) is less than 5

```
int main()
{
   int values[5]={0,0,0,0,0};
   for (int i = 1; i < 5; i++)
  {
     values[i] = i + values[i-1];
   }
   values[0] = values[1] + values[4];
}
```

After the array is created

0	0
1	0
2	0
3	0
4	0

Trace Program with Arrays

After this line is executed, value[1] is 1

```
int main()
{
   int values[5]={0,0,0,0,0};
   for (int i = 1; i < 5; i++)
  {
    values[i] = i + values[i-1];
   }
   values[0] = values[1] + values[4];
}
```

After the first iteration

0	0
1	1
2	0
3	0
4	0

Trace Program with Arrays

After i++, i becomes 2

```
int main()
{
   int values[5] ={0,0,0,0,0};
   for (int i = 1; i < 5; i++)
  {
     values[i] = i + values[i-1];
   }
   values[0] = values[1] + values[4];
}
```

After the first iteration

0	0
1	1
2	0
3	0
4	0

Trace Program with Arrays

```
int main()
{
   int values[5] ={0,0,0,0,0};
   for (int i = 1; i < 5; i++)
  {
     values[i] = i + values[i-1];
   }
   values[0] = values[1] + values[4];
}
```

i (= 2) is less than 5

After the first iteration

0	0
1	1
2	0
3	0
4	0

Trace Program with Arrays

After this line is executed,
values[2] is 3 (2 + 1)

```
int main()
{
   int values[5] ={0,0,0,0,0};
   for (int i = 1; i < 5; i++)
  {
    values[i] = i + values[i-1];
   }
   values[0] = values[1] + values[4];
}
```

After the second iteration

0	0
1	1
2	3
3	0
4	0

Trace Program with Arrays

After this, i becomes 3.

```
int main()
{
   int values[5] ={0,0,0,0,0};
   for (int i = 1; i < 5; i++)
  {
     values[i] = i + values[i-1];
   }
   values[0] = values[1] + values[4];
}
```

After the second iteration

0	0
1	1
2	3
3	0
4	0

Trace Program with Arrays

i (=3) is still less than 5.

```
int main()
{
   int values[5] ={0,0,0,0,0};
   for (int i = 1; i < 5; i++)
  {
     values[i] = i + values[i-1];
   }
   values[0] = values[1] + values[4];
}
```

After the second iteration

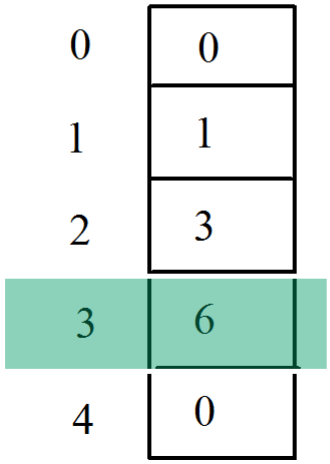
0	0
1	1
2	3
3	0
4	0

Trace Program with Arrays

After this line, values[3] becomes 6 (3 + 3)

```
int main()
{
   int values[5]={0,0,0,0,0};
   for (int i = 1; i < 5; i++)
  {
     values[i] = i + values[i-1];
   }
   values[0] = values[1] + values[4];
}
```

After the third iteration



Trace Program with Arrays

After this, i becomes 4

```
int main()
{
   int values[5]={0,0,0,0,0};
   for (int i = 1; i < 5; i++)
  {
     values[i] = i + values[i-1];
   }
   values[0] = values[1] + values[4];
}
```

After the third iteration

0	0
1	1
2	3
3	6
4	0

Trace Program with Arrays

i (=4) is still less than 5

```
int main()
{
   int values[5]={0,0,0,0,0};
   for (int i = 1; i < 5; i++)
  {
     values[i] = i + values[i-1];
   }
   values[0] = values[1] + values[4];
}
```

After the third iteration

0	0
1	1
2	3
3	6
4	0

Trace Program with Arrays

After this, values[4] becomes 10 (4 + 6)

```
int main()
{
   int values[5]={0,0,0,0,0}
   for (int i = 1; i < 5; i++)
  {
     values[i] = i + values[i-1];
   }
   values[0] = values[1] + values[4];
}
```

After the fourth iteration

0	0
1	1
2	3
3	6
4	10

Trace Program with Arrays

After i++, i becomes 5

```
int main()
{
   int values[5]={0,0,0,0,0};
   for (int i = 1; i < 5; i++)
  {
     values[i] = i + values[i-1];
   }
   values[0] = values[1] + values[4];
}
```

After the fourth iteration

0	0
1	1
2	3
3	6
4	10

Trace Program with Arrays

i (=5) < 5 is false. Exit the loop

```
int main()
{
   int values[5]={0,0,0,0,0};
   for (int i = 1; i < 5; i++)
  {
     values[i] = i + values[i-1];
   }
   values[0] = values[1] + values[4];
}
```

After the fourth iteration

0	0
1	1
2	3
3	6
4	10

Trace Program with Arrays