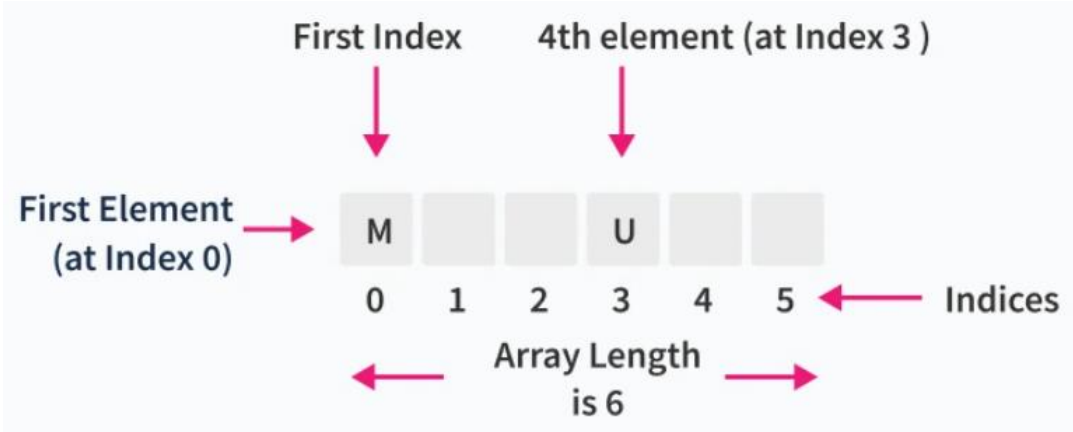
Tutorial 3

C Arrays

UNIVERSITY OF TORONTO

Array basics

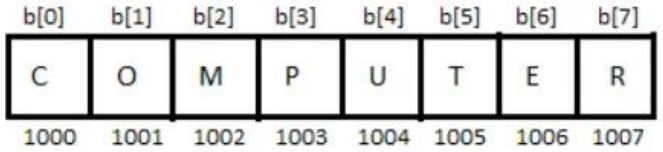


- int sum[5];
  - sum is array name of type integer, and 5 is the size of the array
  - Index from 0 to 4

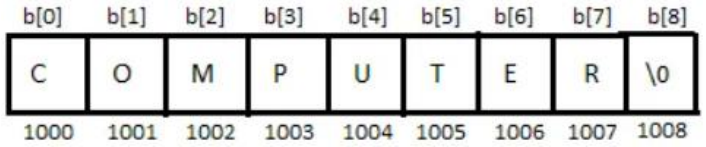
- int nums[5] = {0, 1, 2, 3, 4};

- int <array name>[size] = {0}; (all elements are zero)

- char b[ ]={'C','O','M','P','U','T','E','R'};



char b[ ]="COMPUTER"; // String



Array basics

float x[3][4];

	Column 1	Column 2	Column 3	Column 4
Row 1	x[0][0]	x[0][1]	x[0][2]	x[0][3]
Row 2	x[1][0]	x[1][1]	x[1][2]	x[1][3]
Row 3	x[2][0]	x[2][1]	x[2][2]	x[2][3]

int c[2][3] = {{1, 3, 0}, {-1, 5, 9}};

int c[][3] = {{1, 3, 0}, {-1, 5, 9}};

int c[2][3] = {1, 3, 0, -1, 5, 9};

Numeric Array 1D

Example 1: Array initializing

```
#include <stdio.h>

int main() {
        int nums[5];
        printf("\n Run-Time Initialization Example:\n");
        printf("\n Enter array elements: ");

        for (int i = 0; i < 5; i++) {
                scanf("%d", &nums[i]);
        }

        printf(" Accessing array elements after dynamic Initialization: ");

        for (int i = 0; i < 5; i++) {
                printf("%d ", nums[i]);
        }

   return 0;
}
```

```
Run-Time Initialisation Example:

Enter array elements: 10 20 30 40 50
```

Example 2: Summation

```
#include<stdio.h>
void main()
{
int i,n;
printf("Enter the size of the array: ");
scanf("%d",&n);
float in[n],sum=0;
printf("Enter the array: ");
for(i=0;i<n;++i)
{
scanf("%f",&in[i]);
sum+=in[i];
}
printf("\nSum: %.2f\n",sum);
}
```

```
Enter the size of the array: 5
Enter the array: -2 7 3 9 -8
Sum: 9.00
```

Example 3: Maximum number

```
#include<stdio.h>
void main()
{
int i,n,max;
printf("Enter the size of the array: ");
scanf("%d",&n);
int in[n];
printf("Enter the array: ");
for(i=0;i<n;++i)
scanf("%d",&in[i]);
max=in[0];
for(i=0;i<n;++i)
{
if(in[i]>max)
max=in[i];
}
printf("Maximum number: %d", max);
}
```

```
Enter the size of the array: 5
Enter the array: -2 0 52 -7 83
Maximum number: 83
```

Example 4: Search number

```
#include<stdio.h>
void main()
{
int i,n,find;
printf("Enter array size: ");
scanf("%d",&n);
int a[n];
printf("Enter array: ");
for(i=0;i<n;++i)
scanf("%d",&a[i]);
printf("Search number: ");
scanf("%d",&find);
for(i=0;i<n;++i)
{
if(a[i]==find)
printf("Index position: %d ",i);
}
}
```

```
Enter array size: 7
Enter array: 1 3 -6 5 8 7 4
Search number: 8
```

Example 5: Reverse order

```
#include<stdio.h>
#include<math.h>
void main()
{
int i,n;
printf("Enter array size: ");
scanf("%d",&n);
int a[n],temp;
printf("Enter array: ");
for(i=0;i<n;++i)
scanf("%d",&a[i]);
for(i=0;i<floor(n/2);++i)
{
temp=a[i]; a[i]=a[n-1-i];
a[n-1-i]=temp;
}
printf("Reverse order: ");
for(i=0;i<n;++i)
printf("%d ",a[i]);
}
```

```
Enter array size: 7
Enter array: 5 23 0 -7 8 12 9
Reverse order: 9 12 8 -7 0 23 5
```

Example 6: Find duplicate entries

```
#include<stdio.h>
void main()
{
int i,j,n;
printf("Enter array size: ");
scanf("%d",&n);
int a[n],flag,temp,k;
printf("Enter array: ");
for(i=0;i<n;++i)
scanf("%d",&a[i]);
printf("Duplicate entries: ");
for(i=0;i<n-1;++i)
{
temp=a[i]; flag=0;
for(j=i+1;j<n;++j)
{
if(a[j] == temp)
{
for(k=0;k<i;++k)
{
if(a[k]==temp)
{ flag=1; break; }
}
if(flag==0)
{
printf("%d ",temp);
break;
}
}
}
}
}
```

```
Enter array size: 10
Enter array: 4 5 9 8 3 6 3 4 1 0
Duplicate entries: 4 3
```

Example 7: Find duplicate entries

```
#include<stdio.h>
void main()
{
int i,n1,n2,length;
printf("\n Array 1 size: ");
scanf("%d",&n1);
printf("\n Array 2 size: ");
scanf("%d",&n2);
int a[n1],b[n2];
printf("\n Array 1: ");
for(i=0;i<n1;++i)
scanf("%d",&a[i]);
printf("\n Array 2: ");
for(i=0;i<n2;++i)
scanf("%d",&b[i]);
length=n1+n2-1;
int conv[length],j,k;
for(i=0;i<length;++i)
conv[i]=0;
for(i=0;i<n2;++i)
{
k=0;
for(j=i;j<n1+i;++j)
{
conv[j]+=a[k]*b[i];
++k;
}
}
printf("Convolution:
");
for(i=0;i<length;++i)
printf("%d ",conv[i]);
}
```

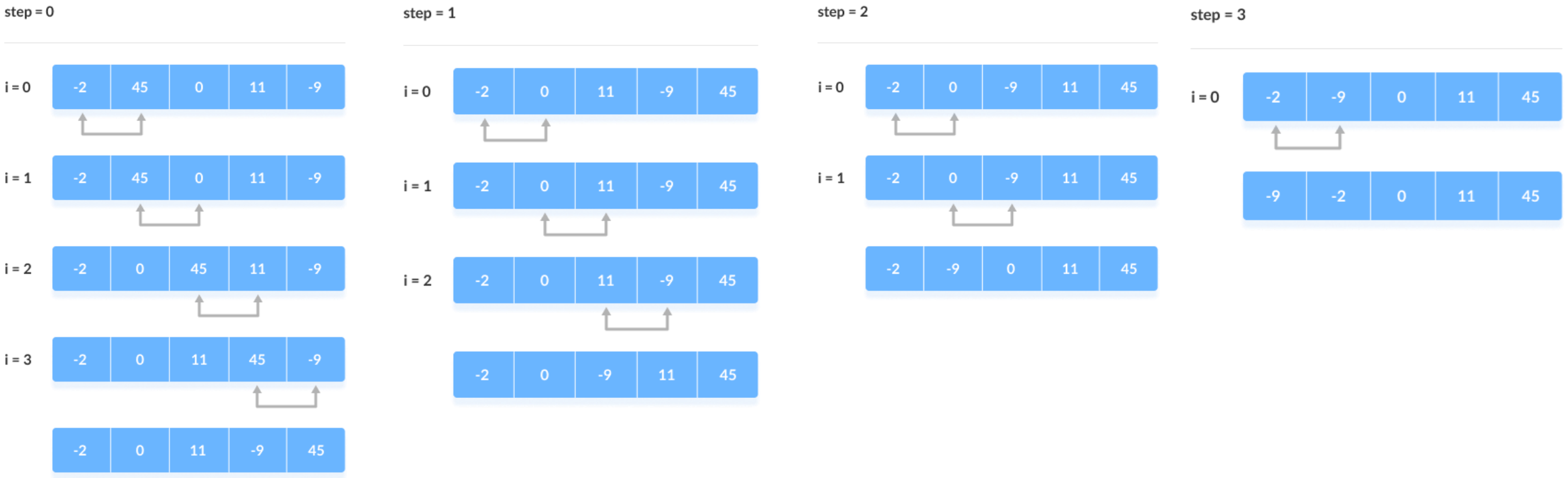
```
Array 1 size: 4
Array 2 size: 3
Array 1: 1 2 3 4
Array 2: 0 1 2
Convolution: 0 1 4 7 10 8
```

Example 8: Sort

6 5 3 1 8 7 2 4

(Click to open the gif)

Example



Sort: Descending

```
#include<stdio.h>

void bubbleSort(int array[], int size) {
  for (int step = 0; step < size; step++) {
    for (int i = 0; i < size - step; i++) {
      if (array[i] > array[i + 1]) {
        int temp = array[i];
        array[i] = array[i + 1];
        array[i + 1] = temp;
      }
    }
  }
}

void printArray(int array[], int size) {
  for (int i = 0; i < size; ++i) {
    printf("%d  ", array[i]);
  }
  printf("\n");
}
```

```
int main() {

  int size, i;
  printf("Enter the Array size: ");
  scanf("%d", &size);
  int data[size];
  printf("Enter the Array: ");
  for (int i = 0; i < size; i++) {
    scanf("%d", &data[i]);
  }

  bubbleSort(data, size);

  printArray(data, size);
}
```

```
Enter the Array size: 5
Enter the Array: 9 5 -1 3 2
-1  2  3  5  9
```

Numeric Array 2D

Example 1: Array summation

```
#include<stdio.h>
void main()
{
int i,j,r,c;
printf("Enter row number:
");
scanf("%d",&r);
printf("Enter column
number: ");
scanf("%d",&c);
int a[r][c],b[r][c],out[r][c];
printf("Enter array 1:\n");
for(i=0;i<r;++i)
{ for(j=0;j<c;++j)
scanf("%d",&a[i][j]); }
printf("Enter array 2:\n");
for(i=0;i<r;++i)
{ for(j=0;j<c;++j)
scanf("%d",&b[i][j]); }
printf("Output
array:\n");
for(i=0;i<r;++i)
{
for(j=0;j<c;++j)
{
out[i][j]=a[i][j]+b[i][j];
printf("%d ",out[i][j]);
}
printf("\n");
}
}
```

```
Enter row number: 2
Enter column number: 2
Enter array 1:
1 2
3 4
Enter array 2:
5 0
1 2
Output array:
6 2
4 6
```

Example 2: Transpose of a matrix

```
#include<stdio.h>
void main()
{
int i,j,r,c;
printf("Enter row: ");
scanf("%d",&r);
printf("Enter column: ");
scanf("%d",&c);
int org[r][c],transpose[c][r];
printf("Enter array:\n");
for(i=0;i<r;++i)
{ for(j=0;j<c;++j)
scanf("%d",&org[i][j]); }
printf("Transpose:\n");
for(i=0;i<r;++i)
{
for(j=0;j<c;++j)
{
transpose[i][j]=org[j][i];
printf("%d ", transpose[i][j]);
}
printf("\n");
}
}
```

```
Enter row: 3
Enter column: 3
Enter array:
1 2 3
4 5 6
7 8 9
Transpose:
1 4 7
2 5 8
3 6 9
```

Example 3: Matrix multiplication

```
#include<stdio.h>
void main()
{
int i,j,k,r,c;
printf("Enter row: ");
scanf("%d",&r);
printf("Enter column: ");
scanf("%d",&c);
int a[r][c],b[r][c],out[r][c];
printf("Matrix 1:\n");
for(i=0;i<r;++i)
{ for(j=0;j<c;++j)
scanf("%d",&a[i][j]); }
printf("Matrix 2:\n");
for(i=0;i<r;++i)
{ for(j=0;j<c;++j)
scanf("%d",&b[i][j]); }
for(i=0;i<r;++i)
{ for(j=0;j<c;++j)
out[i][j]=0; }
printf("Output:\n");
for(i=0;i<r;++i)
{
for(j=0;j<c;++j)
{ for(k=0;k<c;++k)
{ out[i][j]+=a[i][k]*b[k][j]; }
printf("%d ",out[i][j]);
}
printf("\n");
}
}
```

```
Enter row: 2
Enter column: 2
Matrix 1:
1 2
3 4
Matrix 2:
5 6
7 8
Output:
19 22
43 50
```

Example 4: Matrix inverse

```
#include<stdio.h>
void main()
{
int i,j;
float a[3][3],cofactor[3][3],transcof[3][3],inverse[3][3],det=0;
printf("Enter 3x3 matrix:\n");
for(i=0;i<3;++i)
{ for(j=0;j<3;++j)
scanf("%f",&a[i][j]); }
for(i=0;i<3;++i)
{ for(j=0;j<3;++j)
{ cofactor[i][j]=a[(i+1)%3][(j+1)%3]*a[(i+2)%3][(j+2)%3]-
a[(i+2)%3][(j+1)%3]*a[(i+1)%3][(j+2)%3]; } }
for(i=0;i<3;++i)
{ for(j=0;j<3;++j)
transcof[i][j]=cofactor[j][i]; }
for(i=0;i<3;++i)
det+=a[0][i]*(a[1][(i+1)%3]*a[2][(i+2)%3]-
a[1][(i+2)%3]*a[2][(i+1)%3]);
printf("Matrix inverse:\n");
for(i=0;i<3;++i)
{ for(j=0;j<3;++j)
{
inverse[i][j]=transcof[i][j]/det;
printf("%0.2f ",inverse[i][j]);
}
printf("\n");
}
}
```

```
Enter 3x3 matrix:
1 2 1
3 2 1
7 8 9
Matrix inverse:
-0.50 0.50 -0.00
1.00 -0.10 -0.10
-0.50 -0.30 0.20
```

String Array

Example 1: Length of a string

```
#include<stdio.h>
void main()
{
int i=0;char str[100];
printf("Enter the string: ");
gets(str);
printf("Length: ");
while(str[i]!='\0')
++i;
printf("%d",i);
}
```

```
Enter the string: CSCA48 - Introduction to Computer Science II
Length: 44
```

Example 2: Count words

```
#include<stdio.h>
void main()
{
int i=0,c=0;char str[100];
printf("Enter the string: ");
gets(str);
while(str[i]!='\0')
{
if(str[i]==' ')
++c;
++i;
}
printf("Words: %d",c+1);
}
```

```
Enter the string: Introduction to Computer Science
Words: 4
```

Example 3: Count vowels

```
#include<stdio.h>
void main()
{
int i=0,vowel=0; char str[100];
printf("Enter string: ");
gets(str);
while(str[i]!='\0')
{
switch(str[i])
{
case 'a': case 'e': case 'i': case 'o': case 'u':
case 'A': case 'E': case 'I': case 'O': case 'U':
++vowel;
break;
default:
break;
}
++i;
}
printf("Vowels: %d",vowel);
}
```

```
Enter string: Introduction to Computer Science
Vowels: 12
```

Example 4: Lower case to Upper case

```
#include<stdio.h>
void main()
{
char str[50];
int i=0;
printf("Enter a string: ");
gets(str);
while(str[i]!='\0')
{
if(str[i]>=97&&str[i]<=122)
str[i]=str[i]-32;
++i;
}
printf("\nUC: %s",str);
}
```

```
Enter a string: Introduction to Computer Science
UC: INTRODUCTION TO COMPUTER SCIENCE
```

Example 5: Palindrome

```
#include<stdio.h>
#include<string.h>
void main()
{
char str[100];
int i,flag=0;
printf("Enter string: ");
scanf("%s",str);
for(i=0;i<strlen(str);++i)
{
if(str[i]!=str[strlen(str)-i-1])
flag=1;
}
if(flag==1)
printf("The string is not a palindrome");
else
printf("The string is a palindrome");
}
```

```
Enter string: HANNAH
The string is a palindrome
```

```
Enter string: CSCA48
The string is not a palindrome
```

Example 6: Concatenation

```
#include<stdio.h>
#include<strings.h>
void main()
{
int i=0,j=0; char str1[100],str2[100];
printf("String 1: ");
gets(str1);
printf("String 2: ");
gets(str2);
i=strlen(str1);
while(str2[j]!='\0')
str1[i++]=str2[j++];
str1[i]='\0';
printf("Output: ");
puts(str1);
}
```

```
String 1: CSCA48
String 2: Introduction to Computer Science II
Output: CSCA48 Introduction to Computer Science II
```

Minesweeper Game

Click link to download the C code