Pointers and File Handling

CS10003: PROGRAMMING AND DATA STRUCTURES

Basics of Pointers

Introduction

A pointer is a variable that represents the location (rather than the value) of a data item.

They have a number of useful applications.

- Enables us to access a variable that is defined outside the function.
- Can be used to pass information back and forth between a function and its reference point.

Basic Concept

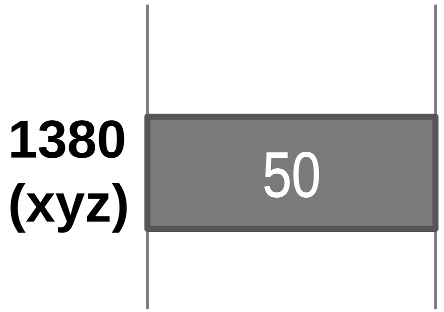
In memory, every stored data item occupies one or more contiguous memory cells.

- The number of memory cells required to store a data item depends on its type (char, int, double, etc.).

Whenever we declare a variable, the system allocates memory location(s) to hold the value of the variable.

- Since every byte in memory has a unique address, this location will also have its own (unique) address.

Example



Consider the statement

```
int  xyz = 50;
```

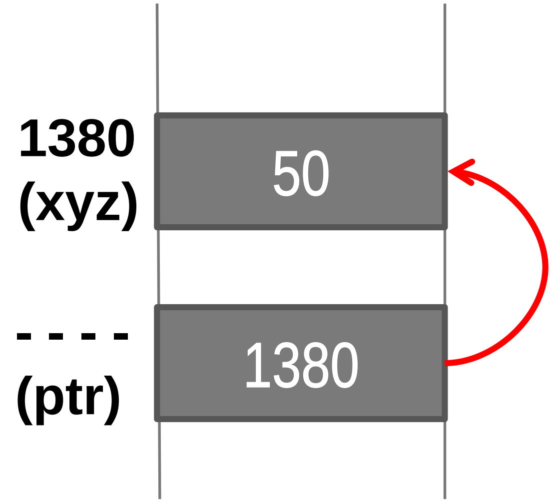
- This statement instructs the compiler to allocate a location for the integer variable xyz, and put the value 50 in that location.

- Suppose that the address location chosen is 1380.
- During execution of the program, the system always associates the name xyz with the address 1380.

- The value 50 can be accessed by using either the name xyz or the address 1380.

Example (Contd.)

```
int xyz = 50;
int *ptr;  // Here ptr is a pointer to an integer
ptr = &xyz;
```



Since memory addresses are simply numbers, they can be assigned to some variables which can be stored in memory.

- Such variables that hold memory addresses are called *pointers*.
- Since a pointer is a variable, its value is also stored in some memory location.

Pointer Declaration

A pointer is just a C variable whose value is the address of another variable!

After declaring a pointer:

```
int *ptr;
```

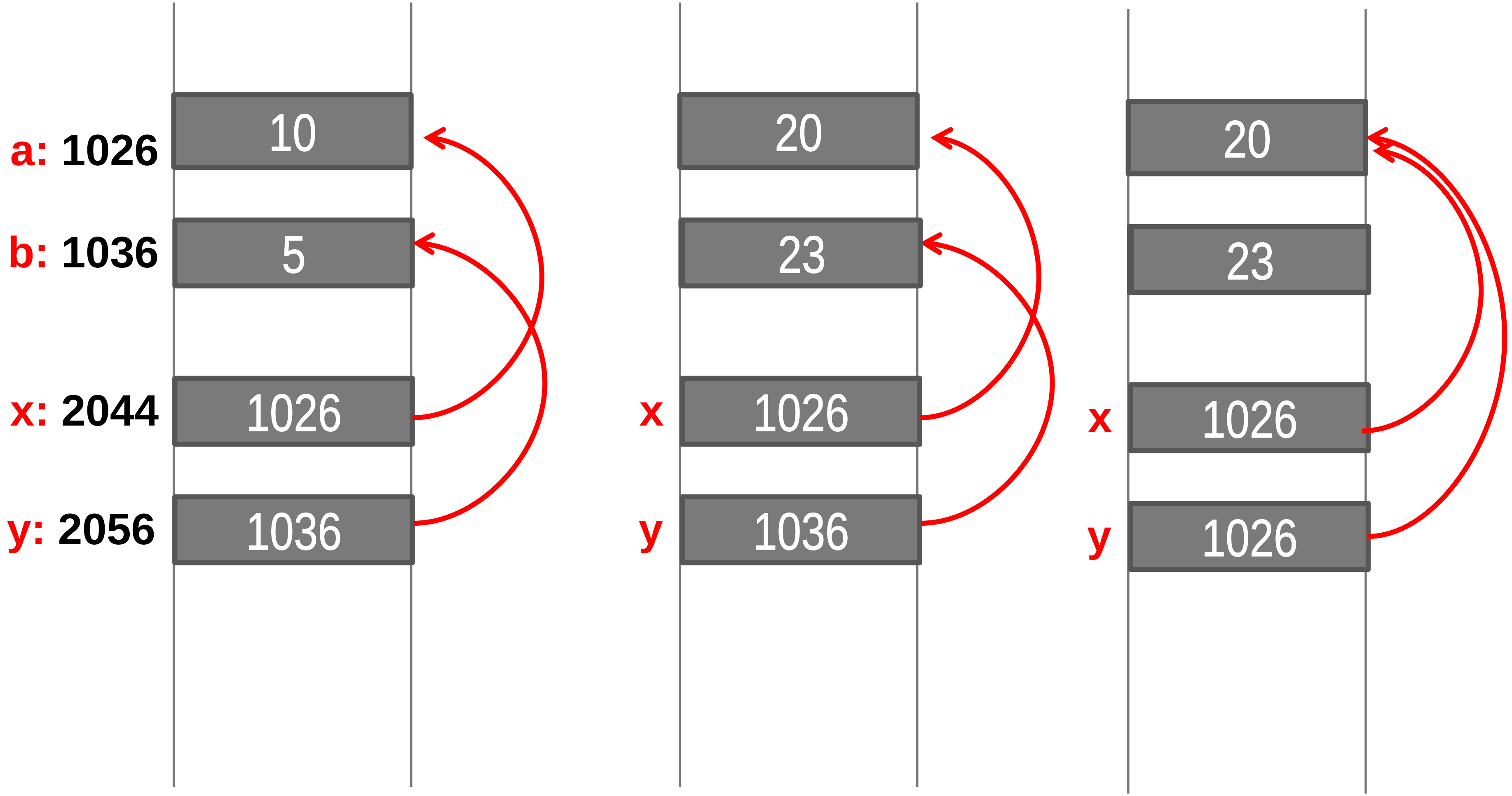
ptr doesn’t actually point to anything yet.

We can either:

- make it point to some existing variable (which is in the stack), or
- dynamically allocate memory (in the heap) and make it point to it

Making it point

```
int a=10, b=5;
int *x, *y;
x= &a; y=&b;
*x= 20;
*y= *x + 3;
y= x;
```



Accessing the Address of a Variable

The address of a variable can be determined using the ‘&’ operator.

- The operator ‘&’ immediately preceding a variable returns the *address* of the variable.

Example:

```
p = &xyz;
```

- The *address* of xyz (1380) is assigned to p.

The ‘&’ operator can be used only with a *simple variable* or an *array element*.

```
&distance
&x[0]
&x[i-2]
```

Illegal usages

Following usages are illegal:

```
&235
```

- Pointing at constant.

```
int   arr[20];
   :
&arr;
```

- Pointing at array name.

```
&(a+b)
```

- Pointing at expression.

Pointer Declarations and Types

Pointer variables must be declared before we use them.

General form:

data_type *pointer_name;

Three things are specified in the above declaration:

- The asterisk (*) tells that the variable pointer_name is a pointer variable.
- pointer_name needs a memory location.
- pointer_name points to a variable of type data_type.

Pointers have types

Example:

```
int    *count;
float *speed;
```

Once a pointer variable has been declared, it can be made to point to a variable using an assignment statement like:

```
int *p, xyz;
 :
 p = &xyz;
```

- This is called *pointer initialization*.

Things to remember

Pointer variables must always point to a data item of the *same type*.

```
 float   x;
int    *p;
p = &x;               // This is an erroneous assignment
```

Assigning an absolute address to a pointer variable is prohibited.

```
int   *count;
count = 1268;
```

Pointer Expressions

Like other variables, pointer variables can be used in expressions.

If p1 and p2 are two pointers, the following statements are valid:

```
sum = (*p1) + (*p2);
prod = (*p1) * (*p2);
*p1 = *p1 + 2;
x = *p1 / *p2 + 5;
```

More on pointer expressions

What are allowed in C?

- Add an integer to a pointer.
- Subtract an integer from a pointer.
- Subtract one pointer from another
    - If p1 and p2 are both pointers to the same array, then p2–p1 gives the number of elements between p1 and p2.

More on pointer expressions

What are not allowed?

- Add two pointers.

```
p1 = p1 + p2;
```

- Multiply / divide a pointer in an expression.

```
p1 = p2 / 5;
p1 = p1 – p2 * 10;
```

Scale Factor

We have seen that an integer value can be added to or subtracted from a pointer variable.

```
int x[ 5 ] = { 10, 20, 30, 40, 50 };
int *p;

p = &x[1];
printf( “%d”, *p);          // This will print 20

p++;                        // This increases p by the number of bytes for an integer
printf( “%d”, *p);          // This will print 30

p = p + 2;                  // This increases p by twice the sizeof(int)
printf( “%d”, *p);          // This will print 50
```

More on Scale Factor

```
struct  complex {
    float real;
    float imag;
};
struct complex x[10];

struct complex *p;

p = &x[0];                // The pointer p now points to the first element of the array

p = p + 1;                // Now p points to the second structure in the array
```

The increment of *p* is not by one byte, but by the size of the data type to which *p* points.

This is why we have many data types for pointers, not just a single “address” data type

Pointer types and scale factor

Data Type	Scale Factor
char	1
int	4
float	4
double	8

- If p1 is an integer pointer, then

  p1++

  will increment the value of p1 by 4.

Scale factor may be machine dependent

- The exact scale factor may vary from one machine to another.
- Can be found out using the **`sizeof`** function.

```
#include  <stdio.h>
main( )
{
  printf (“No. of bytes occupied by int is %d \n”,  sizeof(int));
  printf (“No. of bytes occupied by float is %d \n”,  sizeof(float));
  printf (“No. of bytes occupied by double is %d \n”, sizeof(double));
  printf (“No. of bytes occupied by char is %d \n”,   sizeof(char));
}
```

<u>Output:</u>

```
Number of bytes occupied by int is  4
Number of bytes occupied by float is  4
Number of bytes occupied by double is  8
Number of bytes occupied by char is  1
```

Passing Pointers to a Function

Pointers are often passed to a function as arguments.

- Allows data items within the calling program to be accessed by the function, altered, and then returned to the calling program in altered form.
- Called *call-by-reference* (or by *address* or by *location*).

Normally, arguments are passed to a function *by value*.

- The data items are copied to the function.
- Changes are not reflected in the calling program.

Passing arguments by value or reference

```
#include  <stdio.h>
main( )
{
    int  a, b;
    a = 5;  b = 20;
    swap (a, b);
    printf (“\n a=%d, b=%d”, a, b);
}

void  swap (int x, int y)
{
    int  t;
    t = x;  x = y;  y = t;
}
```

Output

a=5, b=20

```
#include  <stdio.h>
main( )
{
    int  a, b;
    a = 5;  b = 20;
    swap (&a, &b);
    printf (“\n a=%d, b=%d”, a, b);
}

void swap (int *x, int *y)
{
   int  t;
   t = *x;   *x = *y;   *y = t;
}
```

Output

a=20, b=5

Pointers and Arrays

When an array is declared:

- The compiler allocates a *base address* and sufficient amount of storage to contain all the elements of the array in contiguous memory locations.
- The *base address* is the location of the first element (*index 0*) of the array.
- The compiler also defines the array name as a *constant pointer* to the first element.

Example

Consider the declaration:

```
int x[5] = {1, 2, 3, 4, 5};
```

- Suppose that the base address of x is 2500, and each integer requires 4 bytes.

Element	Value	Address
x[0]	1	2500
x[1]	2	2504
x[2]	3	2508
x[3]	4	2512
x[4]	5	2516

Example (contd)

Both x and &x[0] have the value 2500.

p = x; and p = &x[0]; are equivalent

- We can access successive values of x by using p++ or p-- to move from one element to another.

Relationship between p and x:

```
p    =  &x[0]  =  2500
p+1  =  &x[1]  =  2504
p+2  =  &x[2]  =  2508
p+3  =  &x[3]  =  2512
p+4  =  &x[4]  =  2516
```

***(p+i) gives the value of x[i]**

Arrays and pointers

- An array name is an address, or a pointer value.
- Pointers as well as arrays can be subscripted.
- A pointer variable can take different addresses as values.
- An array name is an address, or pointer, that is fixed.
  - It is a CONSTANT pointer to the first element.

Arrays

Consequences:

- `ar` is a pointer
- `ar[0]` is the same as `*ar`
- `ar[2]` is the same as `*(ar+2)`
- We can use pointer arithmetic to access arrays more conveniently.

Declared arrays are only allocated while the scope is valid

```
char *foo( ) {
  char string[32];
  return string;
}
```

This is incorrect

```
char *foo( ) {
  char *string;
  string = malloc(32);  // Dynamic memory allocation
  return string;
}
```

This is okay

Arrays In Functions

An array parameter can be declared as an array or a pointer; an array argument can be passed as a pointer

```
int strlen(char s[])
{


}
```

```
int strlen(char *s)
{


}
```

Arrays and pointers

int a[20], i, *p;

The expression a[i] is equivalent to *(a+i)

p[i] is equivalent to *(p+i)

When an array is declared the compiler allocates a sufficient amount of contiguous space in memory. The base address of the array is the address of a[0].

Suppose the system assigns 300 as the base address of a. a[0], a[1], ...,a[19] are allocated 300, 304, ..., 376.

Arrays and pointers

```
#define N 20
```

```
int a[2N], i, *p, sum;
```

`p = a;` is equivalent to `p = &a[0];`

`p` is assigned 300.

Pointer arithmetic provides an alternative to array indexing.

`p=a+1;` is equivalent to `p=&a[1];` (p is assigned 304)

```
for (p=a; p<&a[N]; ++p)  sum += *p ;
```

```
p=a;
for (i=0; i<N; ++i)  sum += p[i] ;
```

```
for (i=0; i<N; ++i) sum += *(a+i) ;
```

Arrays and pointers

int a[N];

a is a constant pointer.

a=p; ++a; a+=2; illegal

Pointer arithmetic and element size

```
double * p, *q ;
```

The expression p+1 yields the correct machine address for the next variable of that type.

Other valid pointer expressions:

- p+i
- ++p
- p+=i
- p-q /* No of array elements between p and q */

Pointer Arithmetic

Since a pointer is just a mem address, we can add to it to traverse an array.

`p+1` returns a ptr to the next array element.

`(*p)+1` vs `*p++` vs `*(p+1)` vs `(*p)++` ?

- `x = *p++` ⇒ `x = *p ; p =  p + 1;`
- `x = (*p)++` ⇒ `x = *p ; *p = *p + 1;`

What if we have an array of large structs (objects)?

- C takes care of it: In reality, **`p+1`** doesn't add **`1`** to the memory address, it adds the size of the array element.

Pointer Arithmetic

We can use pointer arithmetic to “walk” through memory:

```
void copy(int *from, int *to, int n) {
    int i;
    for (i=0; i<n; i++)  *to++ = *from++;
}
```

- C automatically adjusts the pointer by the right amount each time (i.e., 1 byte for a char, 4 bytes for an int, etc.)

Arrays of Structures

We can define an array of structure records as

```
struct stud class[100];
```

The structure elements of the individual records can be accessed as:

```
class[i].roll
class[20].dept_code
class[k++].cgpa
```

Pointers and Structures

Once **ptr** points to a structure variable, the members can be accessed as:

```
ptr -> roll;
ptr -> dept_code;
ptr -> cgpa;
```

- The symbol "**->**" is called the *arrow* operator.

A Warning

When using structure pointers, we should take care of operator precedence.

- Member operator “.” has higher precedence than “*”.

  ptr –> roll   and   (*ptr).roll   mean the same thing.

  *ptr.roll   will lead to error.

- The operator “**–>**” enjoys the highest priority among operators.

  ++ptr –> roll   will increment roll, not ptr.

  (++ptr) –> roll   will do the intended thing.

Use of pointers to structures

```
#include <stdio.h>
struct complex  {
                float  real;
                float  imag;
};

main( )
{
   struct  complex  a, b, c;
   scanf ( “%f %f”, &a.real, &a.imag );
   scanf ( “%f %f”, &b.real, &b.imag );
   add( &a, &b, &c ) ;
   printf ( “\n %f %f”, c,real, c.imag );
}
```

```
void add (x, y, t)
struct complex  *x, *y, *t;
{
   t->re = x->real + y->real;
   t->im = x->imag + y->imag;
}
```

Dynamic Memory Allocation

Basic Idea

Sometimes we face situations where data is dynamic in nature.

- Amount of data cannot be predicted beforehand.
- Number of data items keeps changing during program execution.

Such situations can be handled more easily and effectively using dynamic memory management techniques.

Dynamic Memory Allocation

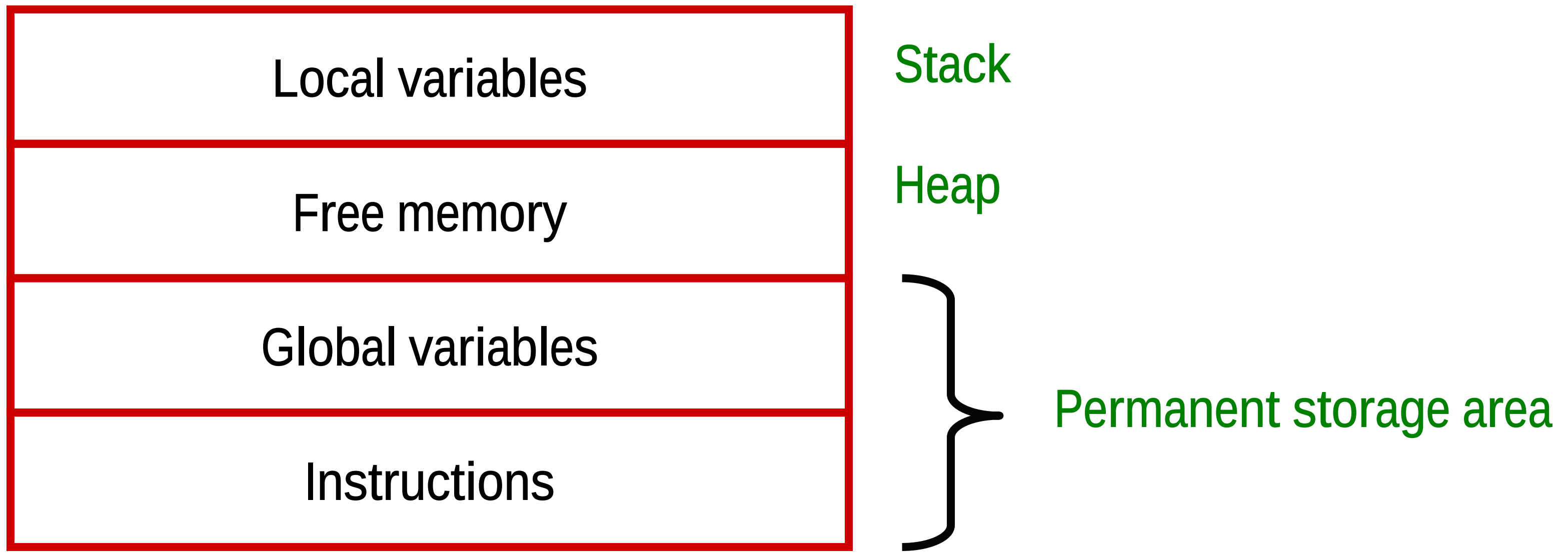
Normally the number of elements in an array is specified in the program

- Often leads to wastage or memory space or program failure.

Dynamic Memory Allocation

- Memory space required can be specified at the time of execution.
- C supports allocating and freeing memory dynamically using library routines.

Memory Allocation Process in C



Memory Allocation Process

The program instructions and the global variables are stored in a region known as *permanent storage area*.

The local variables are stored in another area called *stack*.

The memory space between these two areas is available for dynamic allocation during execution of the program.

- This free region is called the *heap*.
- The size of the heap keeps changing.

Memory Allocation Functions

`malloc`

- Allocates requested number of bytes and returns a pointer to the first byte of the allocated space.

`calloc`

- Allocates space for an array of elements, initializes them to zero and then returns a pointer to the memory.

`free`

- Frees previously allocated space.

`realloc`

- Modifies the size of previously allocated space.

Allocating a Block of Memory

A block of memory can be allocated using the function malloc.

- Reserves a block of memory of specified size and returns a pointer of type void.
- The return pointer can be type-casted to any pointer type.

General format:

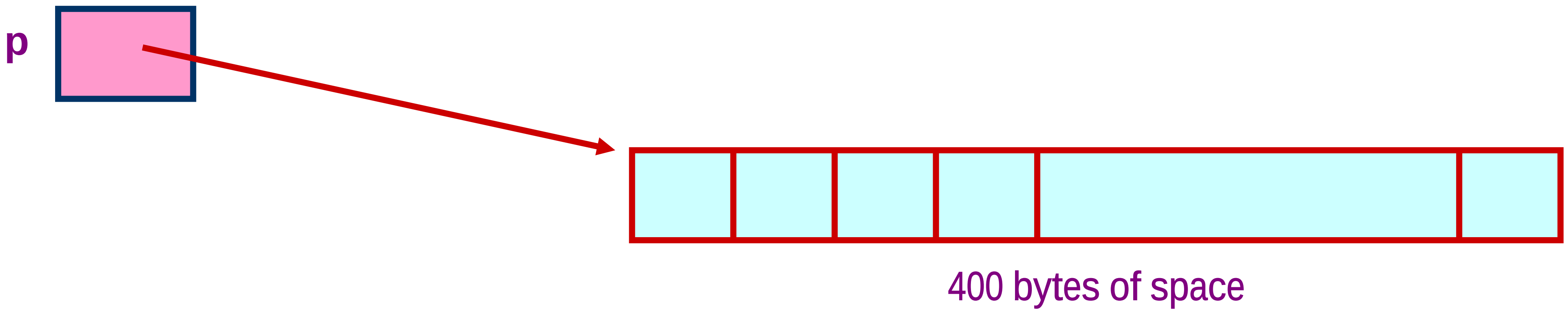
```
ptr =  (type *) malloc (byte_size);
```

Continued

Examples

```
p = (int *) malloc(100 * sizeof(int));
```

- A memory space equivalent to *100 times the size of an int* bytes is reserved.
- The address of the first byte of the allocated memory is assigned to the pointer **`p`** of type **`int`**.



Contd.

```
cptr = (char *) malloc (20);
```

- Allocates 20 bytes of space for the pointer cptr of type char.

```
sptr = (struct stud *) malloc (10 * sizeof (struct stud));
```

- Allocates space for a structure array of 10 elements. sptr points to a structure element of type “struct stud”.

Points to Note

`malloc` always allocates a block of contiguous bytes.

- The allocation can fail if sufficient contiguous memory space is not available.
- If it fails, `malloc` returns NULL.

```
if  ((p = (int *) malloc(100 * sizeof(int))) == NULL)
{
        printf (“\n Memory cannot be allocated”);
        exit( ) ;
}
```

Releasing the Used Space

When we no longer need the data stored in a block of memory, we may release the block for future use.

How?

- By using the **`free`** function.

General syntax:

```
free (ptr);
```

where **`ptr`** is a pointer to a memory block which has been previously created using **`malloc`**.

Altering the Size of a Block

Sometimes we need to alter the size of some previously allocated memory block.

- More memory needed.
- Memory allocated is larger than necessary.

How?

- By using the `realloc` function.

If the original allocation is done as:

```
ptr = malloc (size);
```

then reallocation of space may be done as:

```
ptr = realloc (ptr, newsize);
```

Contd.

- The new memory block may or may not begin at the same place as the old one.
    - If it does not find space, it will create it in an entirely different region and move the contents of the old block into the new block.
- The function guarantees that the old data remains intact.
- If it is unable to allocate, it returns **`NULL`** and frees the original block.

Arrays of Pointers

Static array of pointers

```
#define  N   20
#define  M  10
int main()
{
    char word[N], *w[M];
    int i, n;
    scanf("%d",&n);
    for (i=0; i<n; ++i) {
        scanf("%s", word);
        w[i] = (char *) malloc ((strlen(word)+1)*sizeof(char));
        strcpy (w[i], word) ;
    }
    for (i=0; i<n; i++) printf("w[%d] = %s \n",i,w[i]);
    return 0;
}
```

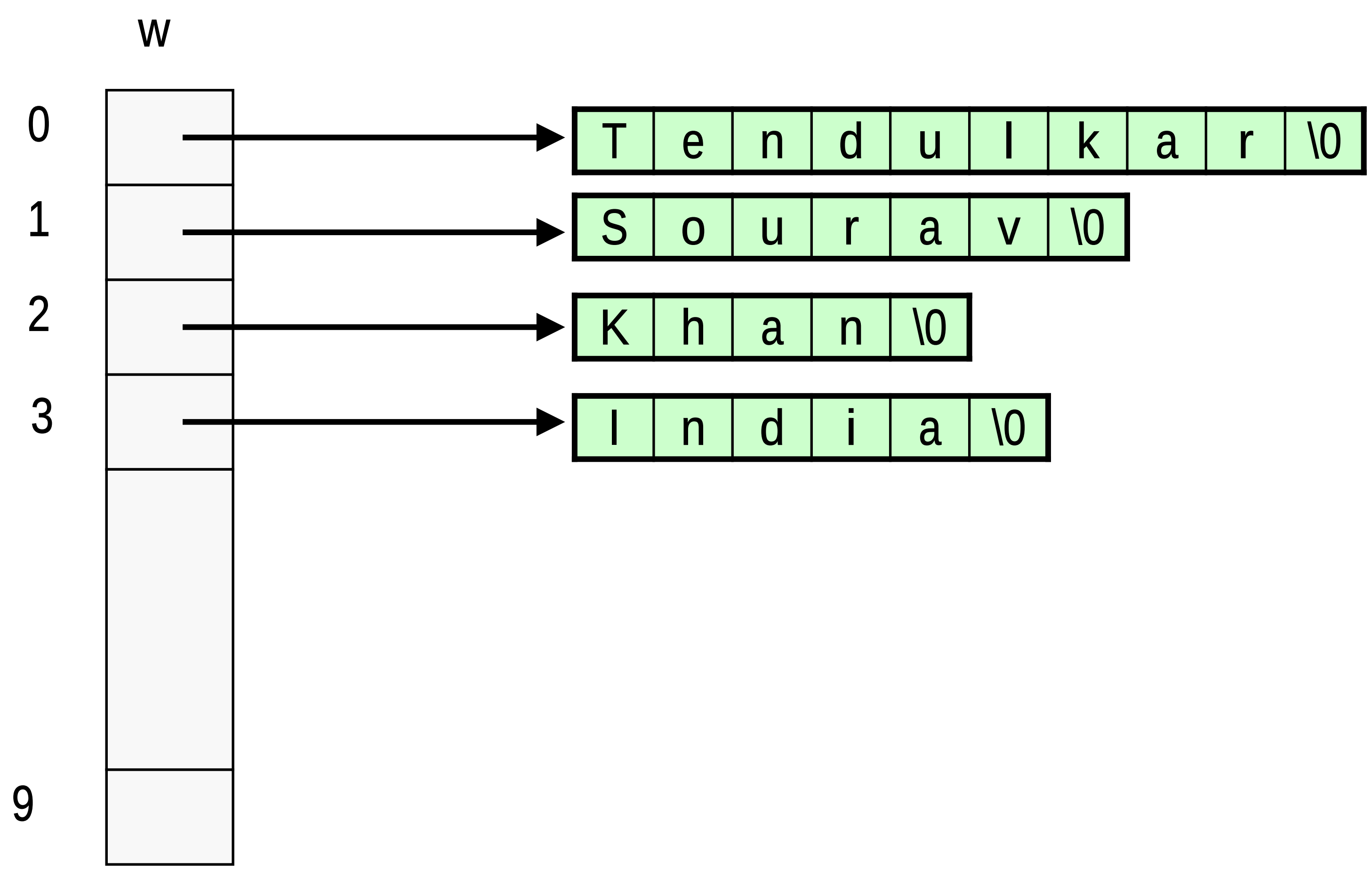
Static array of pointers

```
#define  N   20
#define  M  10
int main()
{
    char word[N], *w[M];
    int i, n;
    scanf("%d",&n);
    for (i=0; i<n; ++i) {
        scanf("%s", word);
        w[i] = (char *) malloc ((strlen(word)+1)*sizeof(char));
        strcpy (w[i], word) ;
    }
    for (i=0; i<n; i++) printf("w[%d] = %s \n",i,w[i]);
    return 0;
}
```

Input / Output

```
4
Tendulkar
Sourav
Khan
India
w[0] = Tendulkar
w[1] = Sourav
w[2] = Khan
w[3] = India
```

How it will look like



Pointers to pointers

- Pointers are also variables (storing addresses), so they have a memory location, so they also have an address
- Pointer to pointer – stores the address of a pointer variable

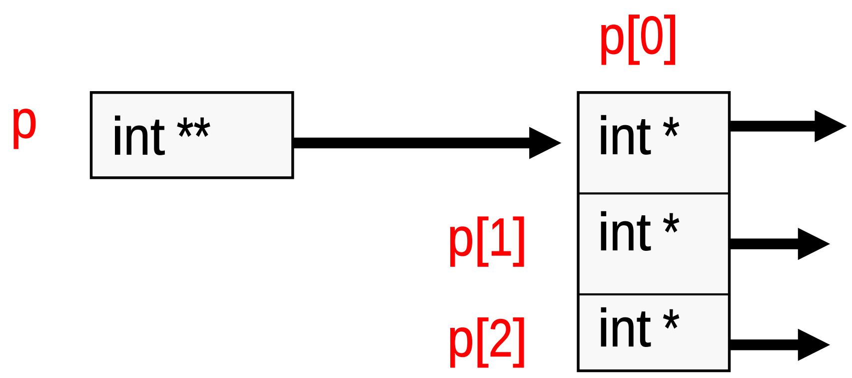
```
int x = 10, *p, **q;
p = &x;
q = &p;
printf("%d  %d  %d", x, *p, *(*q));

will print 10  10  10 (since *q = p)
```

Allocating pointer to pointer

```
int **p;

p = (int **) malloc(3 * sizeof(int *));
```



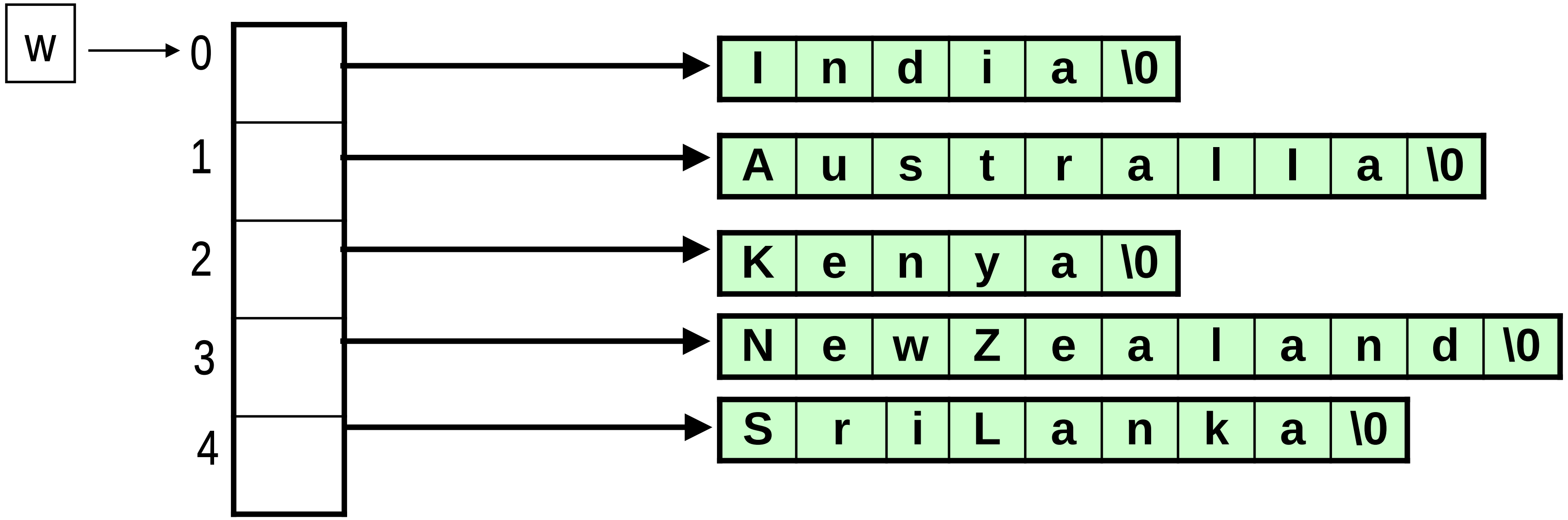
Dynamic arrays of pointers

```
int main()
{
        char word[20], **w;  /*  "**w" is a pointer to a pointer array */
        int i, n;
        scanf("%d",&n);
        w = (char **) malloc (n * sizeof(char *));
        for (i=0; i<n; ++i) {
                scanf("%s", word);
                w[i] = (char *) malloc ((strlen(word)+1)*sizeof(char));
                strcpy (w[i], word) ;
        }
        for (i=0; i<n; i++) printf("w[%d] = %s \n",i, w[i]);
        return 0;
}
```

Output

```
5
India
Australia
Kenya
NewZealand
SriLanka
w[0] = India
w[1] = Australia
w[2] = Kenya
w[3] = NewZealand
w[4] = SriLanka
```

How this will look like



Data Type of 2-D Array

```
#include <stdio.h>
int main( )
{
    int matrix[4][3] = { {1, 2, 3},
                         {4, 5, 6},
                         {7, 8, 9},
                         {10, 11, 12}};
    int** pmat = (int **)matrix;

    printf("&matrix[0][0] = %u\n", &matrix[0][0]);
    printf("&pmat[0][0] = %u\n", &pmat[0][0]);
    return 0;
}
```

```
OUTPUT
=======
&matrix[0][0] = 1245016
&pmat[0][0] = 1
```

Why are they different?

2D Arrays and Pointers

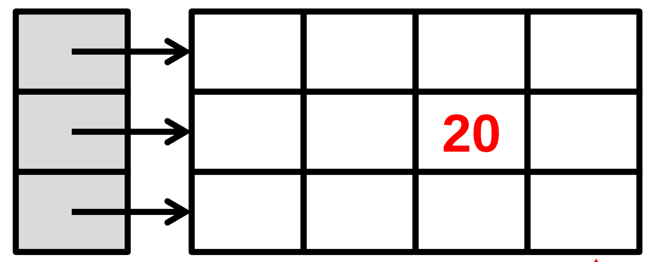
```
#define COL 5
int y[5][COL];
int x = *(y + 2*COL + 2);
```

This is not correct !!

```
#define COL 5
int y[5][COL];
int x = *((int *)y + 2*COL + 2);
```

This is correct!!

Dynamic Allocation of 2D array

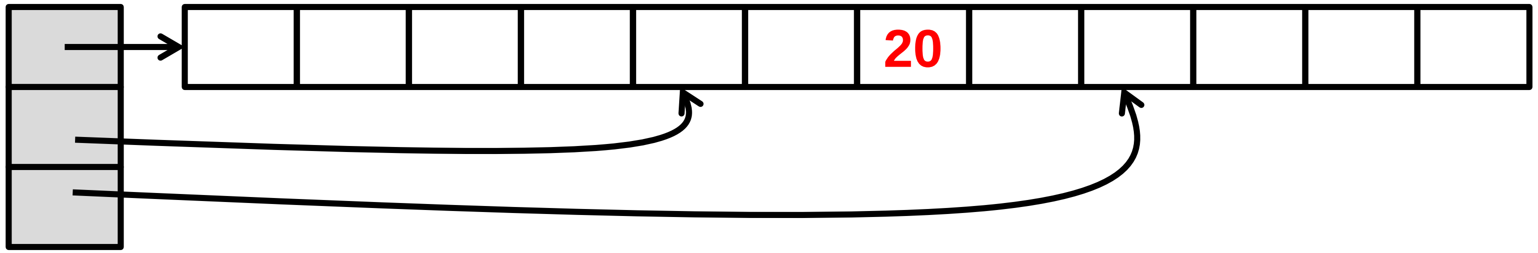



```
#include <stdio.h>
#include <stdlib.h>
#define ROW 3
#define COL 4
int main()
{
    int  count;
    int **arr = (int **) malloc(ROW * sizeof(int *));
    for (i=0; i<ROW; i++) arr[i] = (int *)malloc(COLUMN * sizeof(int));
    arr[2][3] = 20;  // Note that the style of accessing is the same
}
```

This creates a list of pointers

This creates each row

We could use one malloc( ) call for all the rows




```
#include<stdio.h>
#include<stdlib.h>
#define ROW 3
#define COL 4
int main( )
{
    int **arr;
    int i, j;

    arr  = (int **)malloc(sizeof(int *) * ROW);
    arr[0] = (int *)malloc(sizeof(int) * COL * ROW);

    for(i = 0; i < ROW; i++) arr[i] = (*arr + COL * i);
    arr[2][3] = 20;
}
```

Dynamic allocation of 2-D Arrays

```
int **allocate (int h, int w)
{
    int **p;
    int i, j;

    p = (int **) malloc(h*sizeof (int *) );
    for (i=0;i<h;i++)
      p[i] = (int *) malloc(w * sizeof (int));
    return(p);
}
```

Allocate array of pointers

Allocate array of integers for each row

```
void read_data (int **p, int h, int w)
{
    int i, j;
    for (i=0;i<h;i++)
      for (j=0;j<w;j++)
        scanf ("%d", &p[i][j]);
}
```

Elements accessed like 2-D array elements.

Dynamic allocation of 2-D Arrays

```
void print_data (int **p, int h, int w)
 {
    int i, j;
     for (i=0;i<h;i++)
     {
     for (j=0;j<w;j++)
       printf ("%5d ", p[i][j]);
      printf ("\n");
     }
}
```

```
int main()
{
  int **p;
  int M, N;
  printf ("Give M and N \n");
  scanf ("%d%d", &M, &N);
  p = allocate (M, N);
  read_data (p, M, N);
  printf ("\nThe array read as \n");
  print_data (p, M, N);
  return 0;
}
```

```
Give M and N
3 3
1 2 3
4 5 6
7 8 9
The array read as
    1    2    3
    4    5    6
    7    8    9
```

Memory layout in dynamic allocation

```
int main()
{
    int **p;
    int M, N;
    printf ("Give M and N \n");
    scanf ("%d%d", &M, &N);
    p = allocate (M, N);
    for (i=0;i<M;i++) {
        for (j=0;j<N;j++)
            printf ("%10d", &p[i][j]);
            printf("\n");
    }
    return 0;
}
```

```
int **allocate (int h, int w)
{
    int **p;
    int i, j;

    p = (int **)malloc(h*sizeof (int *));
    for (i=0; i<h; i++) printf("%10d", &p[i]);
    printf("\n\n");
    for (i=0;i<h;i++)
            p[i] = (int *)malloc(w*sizeof(int));
    return(p);
}
```

Output

```
3 3
31535120  31535128  31535136


31535152  31535156  31535160
31535184  31535188  31535192
31535216  31535220  31535224
```

Starting address of each row, contiguous (pointers are 8 bytes long)

Elements in each row are contiguous

File Handling

What is a file?

A named collection of data, stored in secondary storage (typically).

Typical operations on files:

- Open
- Read
- Write
- Close

How is a file stored?

- Stored as sequence of bytes, logically contiguous (may not be physically contiguous on disk).

File Types

- The last byte of a file contains the end-of-file character (**EOF**), with ASCII code 1A (hex).
- While reading a text file, the EOF character can be checked to know the end.

Two kinds of files:

- Text :: contains ASCII codes only
- Binary :: can contain non-ASCII characters
    - Image, audio, video, executable, etc.
    - To check the end of file here, the *file size* value (also stored on disk) needs to be checked.

File handling in C

In C we use **FILE *** to represent a pointer to a file.

fopen is used to open a file. It returns the special value **NULL** to indicate that it is unable to open the file.

```
FILE *fptr;
char filename[ ]= "file2.dat";

fptr = fopen (filename,"w");

if (fptr == NULL) {
  printf (“ERROR IN FILE CREATION”);
     /* DO SOMETHING */
}
```

Modes for opening files

The second argument of `fopen` is the *mode* in which we open the file. There are three modes.

"r" opens a file for reading.

"w" creates a file for writing, and writes over all previous contents (deletes the file so be careful!).

"a" opens a file for appending – writing on the end of the file.

Binary Files

We can add a “b” character to indicate that the file is a *binary* file.

- “rb”, “wb” or “ab”

```
fptr = fopen (“xyz.jpg”, “rb”);
```

The exit( ) function

Sometimes error checking means we want an "*emergency exit*" from a program.

In `main()` we can use `return` to stop.

In functions we can use `exit()` to do this.

Exit is part of the stdlib.h library.

```
exit(0);
```

exits the program

Usage of exit( )

```
FILE *fptr;
char filename[ ]= "file2.dat";
fptr = fopen (filename,"w");

if (fptr == NULL) {
  printf (“ERROR IN FILE CREATION”);
  exit(0);
}
```

Writing to a file using fprintf( )

`fprintf()` works just like **`printf()`** and **`sprintf()`**

except that its first argument is a file pointer.

```
int a=10, b=5;
FILE *fptr;
fptr = fopen ( "file.dat", "w“ );

fprintf (fptr, "Hello World!\n");
fprintf (fptr, “%d %d”, a, b);
```

Reading Data Using fscanf( )

```
int x, y;
FILE *fptr;
fptr = fopen (“input.dat”, “r”);

fscanf (fptr, “%d%d”, &x, &y);
```

The file pointer moves forward with each read operation

Reading lines from a file using fgets( )

We can read a string using **fgets().**

```
FILE *fptr;
char line [1000];
……                                   /* Open file and check it is open */
while (fgets(line, 1000, fptr) != NULL)
{
   printf (“We have read the line: %s\n", line);
}
```

fgets( ) takes 3 arguments – a string, maximum number of characters to read, and a file pointer.
It returns NULL if there is an error (such as EOF).

Closing a file

We can close a file simply using **fclose()** and the file pointer.

```
FILE *fptr;
char filename[ ]= "myfile.dat";

fptr = fopen (filename,"w");

if (fptr == NULL) {
    printf ("Cannot open file to write!\n");
    exit(0);
}

fprintf (fptr,"Hello World of filing!\n");
fclose (fptr);
```

Three special streams

Three special file streams are defined in the `<stdio.h>` header

- stdin reads input from the keyboard
- stdout send output to the screen
- stderr prints errors to an error device (usually also the screen)

What might this do?

```
fprintf (stdout,"Hello World!\n");
```

An example program

```
#include <stdio.h>
main( )
{
     int i;

    fprintf(stdout,"Give value of i \n");
    fscanf(stdin,"%d",&i);
    fprintf(stdout,"Value of i=%d \n",i);
    fprintf(stderr,"No error: But an example to  show error message.\n");
 }
```

Output:

```
Give value of i
15
Value of i=15
No error: But an example to show error message.
```

Input File & Output File redirection

One may redirect the standard input and standard output to other files (other than **stdin** and **stdout**).

Usage: Suppose the executable file is **a.out**:

```
$ ./a.out <in.dat  >out.dat
```

scanf() will read data inputs from the file “in.dat”, and printf() will output results on the file “out.dat”.

A Variation

```
$ ./a.out <in.dat  >>out.dat
```

scanf() will read data inputs from the file “in.dat”, and printf() will append results at the end of the file “out.dat”.

Reading and Writing a character

A character reading/writing is equivalent to reading/writing a byte.

```
int getchar( );
int putchar(int  c);
```

} stdin, stdout

```
int fgetc(FILE *fp);
int fputc(int c, FILE *fp);
```

} file

Example:

```
char c;
c = getchar();
putchar(c);
```

Command Line Arguments

What are they?

A program can be executed by directly typing a command at the operating system prompt.

```
$ cc –o test test.c
$ ./a.out in.dat out.dat
$ prog_name param_1 param_2 param_3 ..
```

- The individual items specified are separated from one another by spaces.
  - First item is the program name.
- Variables *argc* and *argv* keep track of the items specified in the command line.

How to access them?

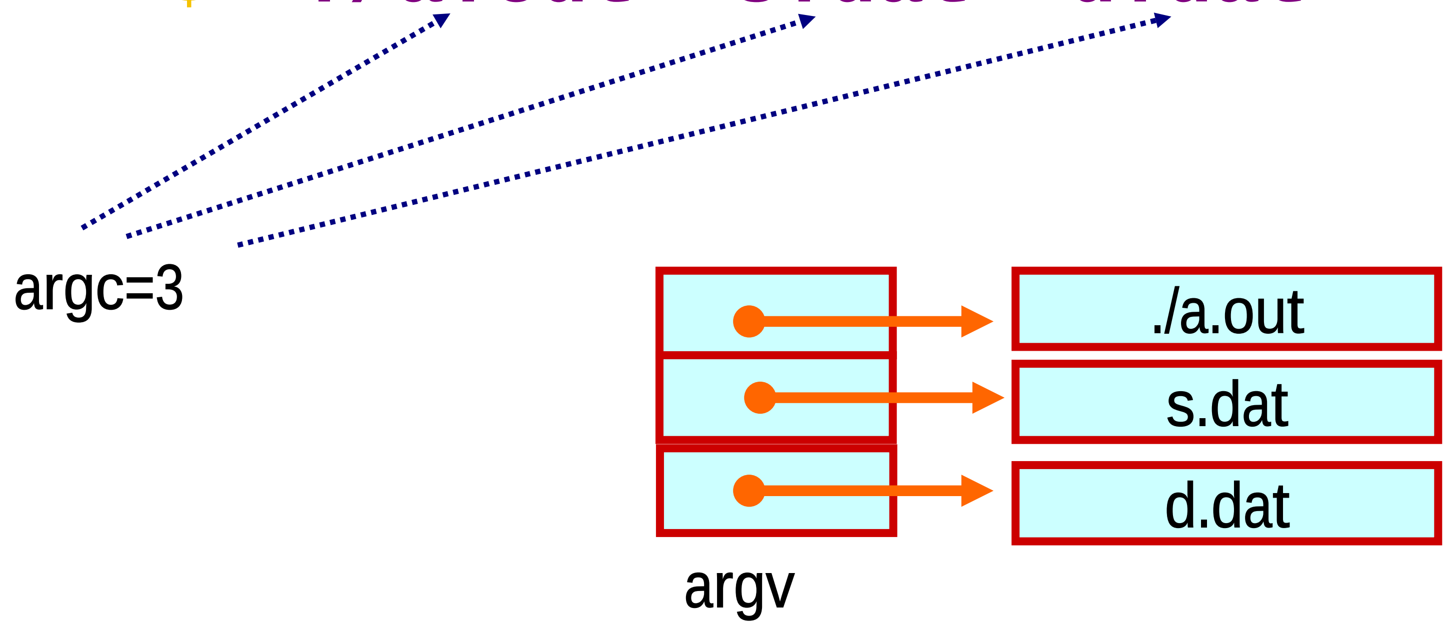
Command line arguments may be passed by specifying them under **`main().`**

```
int main (int argc, char *argv[]);
```

Argument Count

Array of strings as command line arguments including the command itself.

```
$ ./a.out s.dat d.dat
```



argv[0] = “./a.out” argv[1] = “s.dat” argv[2] = “d.dat”

Example: Program for Copying a File

```
#include <stdio.h>
#include <string.h>

int main( int argc, char *argv[ ] )
{
      FILE *ifp, *ofp;
      int i, c;
      char src_file[100], dst_file[100];

      if (argc!=3) {
                        printf ("Usage: ./a.out <src_file> <dst_file> \n");  exit(0);
      }
     else {
                              strcpy (src_file, argv[1]);   strcpy (dst_file, argv[2]);
}
```

Example: contd.

```
if ((ifp = fopen(src_file,"r")) == NULL)  {
     printf (“Input File does not exist.\n");   exit(0);
  }

  if ((ofp = fopen(dst_file,"w")) == NULL)  {
     printf (“Output File not created.\n");   exit(0);
  }

  while ((c = fgetc(ifp)) != EOF)  fputc (c,ofp);    // This is where the copying is done

  fclose(ifp);  fclose(ofp);
}
```

Practice problems

- Take any of the problems you have done so far using 1-d arrays or 2-d arrays. Now do them by allocating the arrays dynamically first instead of declaring then statically