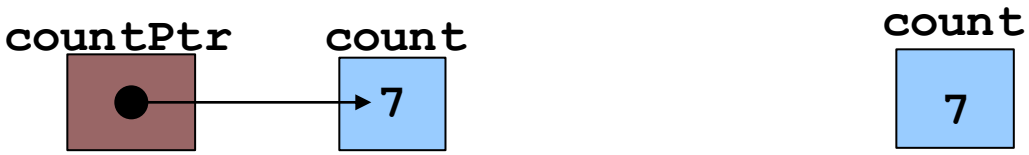
More → Pointers ☺

Week 11

Pointer Variable

- Normal variables
  - Contain a specific value (direct reference)
- Pointer variables
  - Contain memory addresses as their values



Pointer Expressions and Arithmetic

- Arithmetic operations can be performed on pointers
  - Increment/decrement pointer (++ or --)
  - Add an integer to a pointer
    (+ or += , - or -=)
  - Pointers may be subtracted from each other
  - Operations meaningless unless performed on an array

Pointer Expressions and Arithmetic

operation	Description
p++, p--	Increment (decrement) p to point to the next element, it is equivalent to p+=1 (p -=1)
p+i (p-i)	Point to i-th element beyond (in front of) p but value of p is fixed
p[i]	Equivalent to p + i
p + n (integer)	n must be an integer, its meaning is offset
p - q	Offset between pointer p and pointer q
p+q, p*q, p/q, p%q	invalid
Relational operator of two pointers p, q	valid, including p > q, p < q, p == q, p >= q, p <= q, p != q

Pointer Expressions and Arithmetic

- Pointer comparison (<, == , >)
  - See which pointer points to the higher numbered array element (index)
  - Also, see if a pointer points to 0

Long Form	Short Form
if (ptr == NULL)	if (!ptr)
if (ptr != NULL)	if (ptr)

Example – 1 (strcmp with pointers)

```
#include <stdio.h>
 int main()
{       char line[20];
        char *part = "hello";
        do
        {       printf("\nEnter new String: ");
                gets(line);
                if(strcmp(line, part) == 0)
                        printf("The same string %s\n", line);
        } while(strlen(line)!= 0) ;
        return 0;
}
```

Calling Functions by Reference

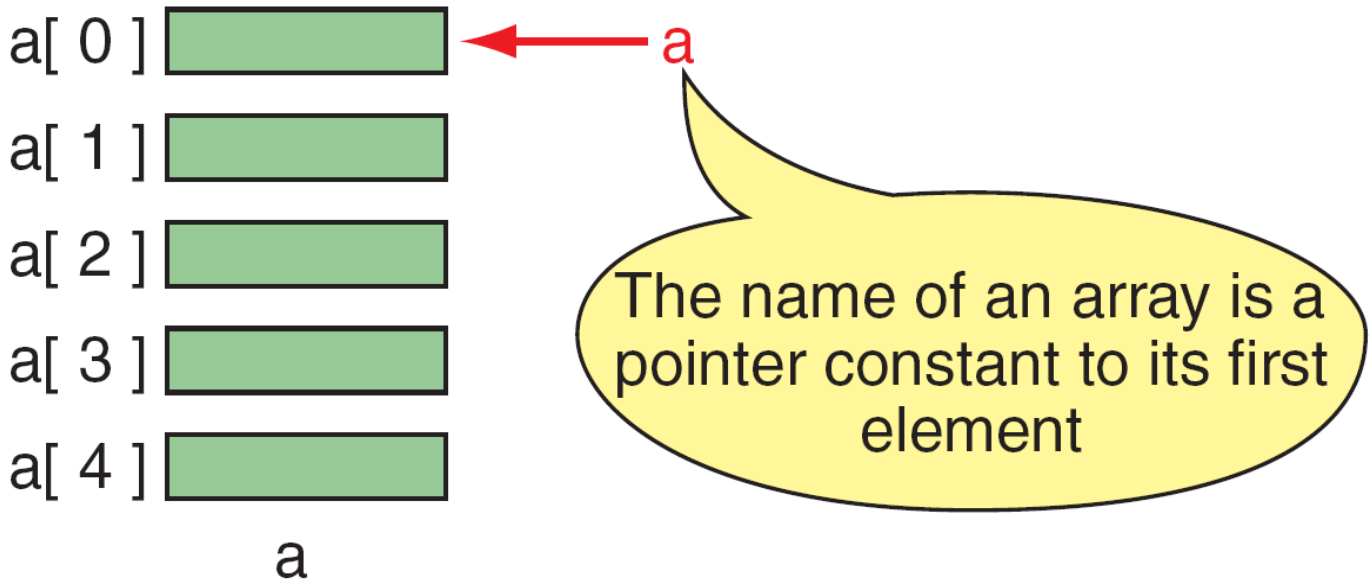
- Call by reference with pointer arguments
  - Pass address of argument using **&** operator
  - Allows you to change actual location in memory
  - Arrays are not passed with **&** because the array name is already a pointer

```
void mydouble( int *number )
 { int x;
   x = *number ;
   *number = 2 * x; }

In main():     mydouble (&y) ;
```

Example – 2 (print characters)

```
#include <stdio.h>
void printchars (char *string)
{    int count;
     for(count = 0; count < strlen(string); count ++)
     {       printf (“\n char no: %d is %c” , count , string [count]) ;
             string[count] = ‘a’ + count ;          }
 }
int main() {
     char Arr[]=“This is a test”;
     puts (Arr);
     printchars ( Arr );
     printf (“\n %s” , Arr);
  return 0; }
```

Arrays and Pointers



Arrays and Pointers

Note

same

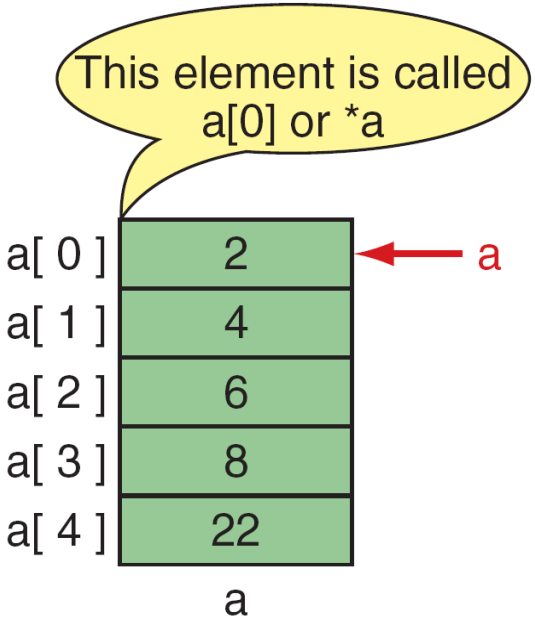
a ⟷ &a[0]

a is a pointer only to the first element—not the whole array.

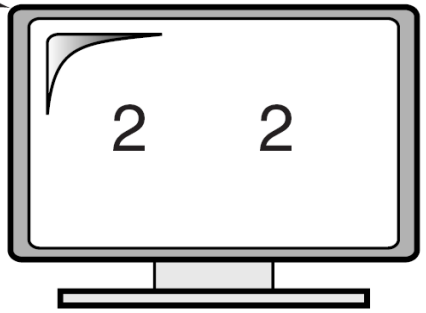
Note

The name of an array is a pointer constant;
it cannot be used as an *lvalue*.

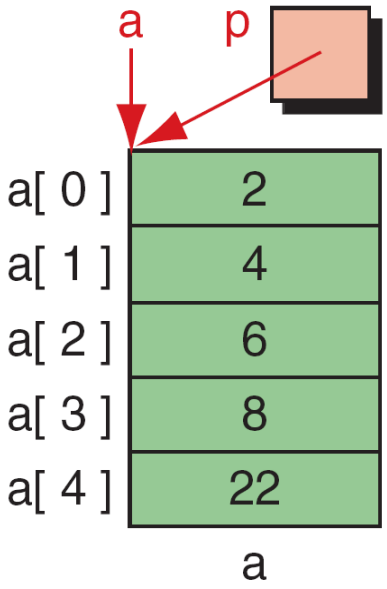
Arrays and Pointers



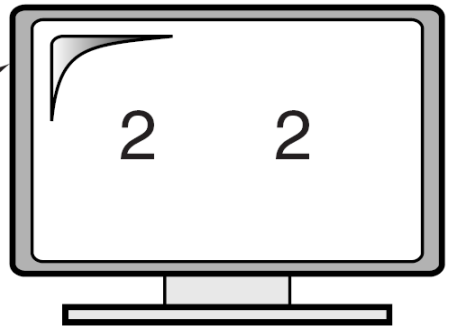

```c
#include <stdio.h>
int main (void)
{
   int a[5] = {2,4,6,8,22};
   printf("%d %d", *a, a[0]);

   return 0;
} // main
```



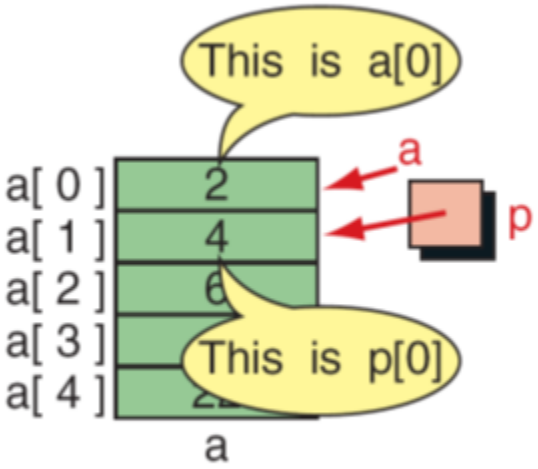
Arrays and Pointers



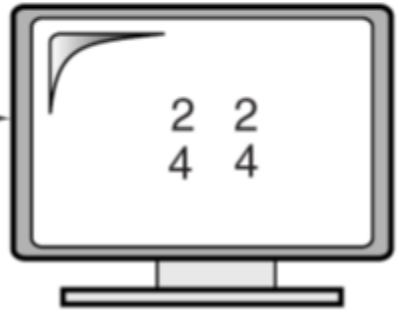

```
#include <stdio.h>
int main (void)
{
int  a[5] = {2, 4, 6, 8, 22};
int* p    =  a;
  …
  printf("%d %d\n", a[0], *p);
  …
  return 0;
} // main
```



Arrays and Pointers




```c
#include <stdio.h>
int main (void)
{
   int  a[5] = {2, 4, 6, 8, 22};
   int* p;
   …
   p = &a[1];

   printf("%d %d", a[0], p[-1]);
   printf("\n");
   printf("%d %d", a[1], p[0]);

   …
} // main
```



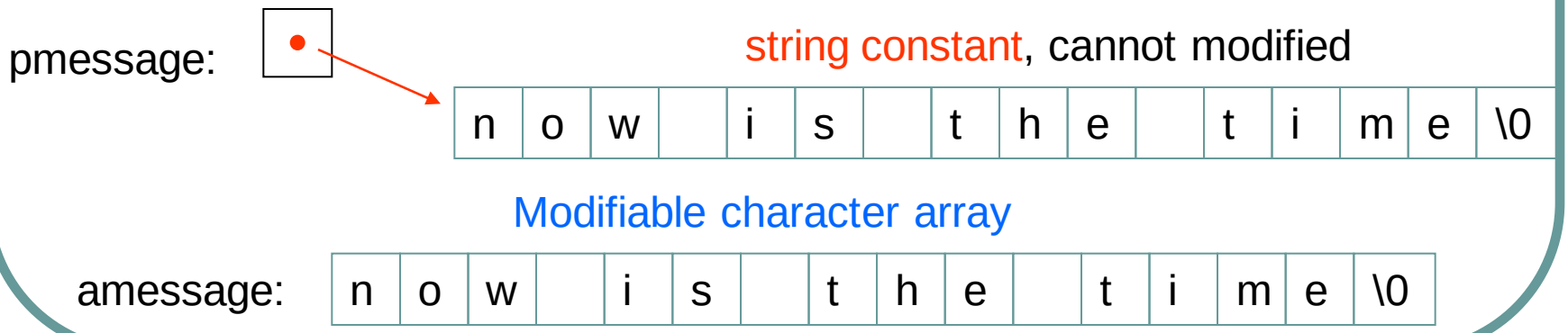
Note

To access an array, any pointer to the first element can be used instead of the name of the array.

Pointers and Arrays

```c
#include <stdio.h>

int main( )
{
    char amessage[] = "now is the time" ; // an array
    char *pmessage  = "now is the time" ; // a pointer

    printf("amessage(  %p) = %s \n", amessage, amessage ) ;
    printf("pmessage(  %p) = %s \n", pmessage, pmessage ) ;

    return 0 ;
}
```

Compiler determine length of string and then size of amessage



Example – 3 (Array and pointers)

```
#include <stdio.h>
int my_array[] = {1,23,17,4,-5,100};
int *ptr;
 int main(void)
 {    int i;
      ptr = &my_array[0]; /* point our pointer to the first element of the array */
      printf("\n\n");
      for (i = 0; i < 6; i++)
            {          printf("my_array[%d] = %d ", i , my_array[i] );
                       printf("\t ptr + %d = %d\n", i , *(ptr + i) );        }
      return 0;
 }
```

Example – 4 (count a character)

```
#include <stdio.h>
int countnchar (char *string, char ch)
{    char *p;
     int count = 0;
     for(p = string; *p != '\0'; p++)
     {       if(*p == ch)         count++;          }
     return count; }
int main() {
  char f = ‘A’; int x ;
  char Arr[]=“This is A test for letter A”;
  x = countnchar ( Arr , f );
  printf (“Letter A exist : %d times”, x );
  return 0; }
```

Example – 5 (swap with array index)

```
#include <stdio.h>
# define N 5
void swap (int *a, int *b){
  int temp = *a;
  *a = *b;
  *b = temp;                    }
int main() {
  int i, j;
  int Arr[N]={1,2,3,4,5};
  for (i=0; i < N/2 ; i++)
      swap ( & Arr [ i ] , & Arr [ (N-1) – i ] );
  return 0; }
```

Example – 6 (swap with pointers)

```
#include <stdio.h>
# define N 5
void swap (int *a, int *b){
  int temp = *a;
  *a = *b;
  *b = temp;                    }
int main() {
  int i, j;
  int Arr[N]={1,2,3,4,5};
  for (i=0; i < N/2 ; i++)
      swap ( Arr + i , Arr + (N-1) – i );
  return 0; }
```

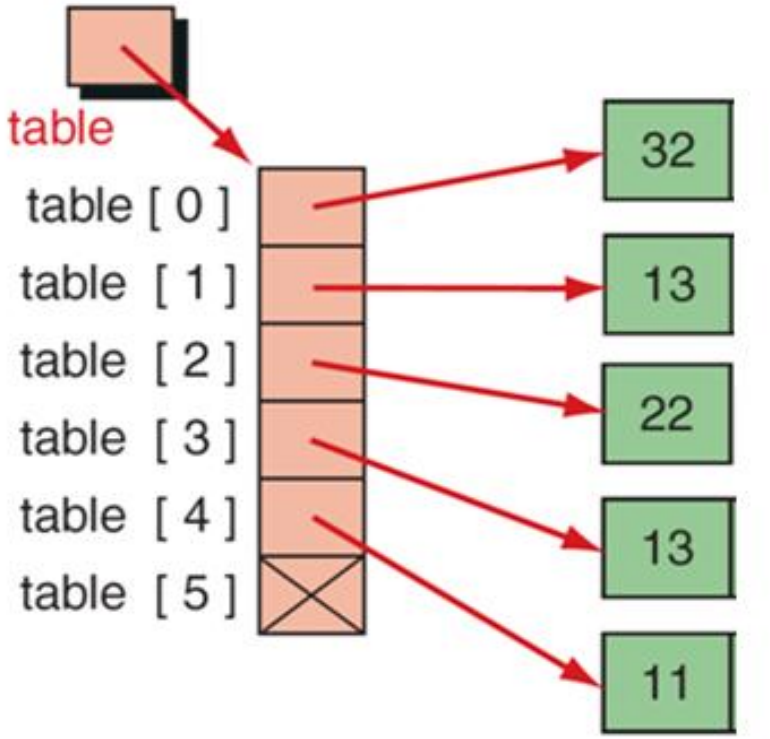
Example – 7 (reverse with pointers)

```
#include <stdio.h>
void reverse(char *mysrt)
{   char * lp = mysrt;                          /* left pointer */
    char *rp = &mysrt[strlen(mysrt)-1];       /* right pointer */
    char tmp;
    while(lp < rp)    {
          tmp = *lp;
          *lp = *rp;
          *rp = tmp;
          lp++;
          rp--;          }
}
```

```
int main()
{  char Arr[]="This is a test";
    puts(Arr);
    reverse (Arr);
     printf("\n");
     puts(Arr);
     return 0;
}
```

Arrays of Pointers

- Arrays can contain pointers to …..

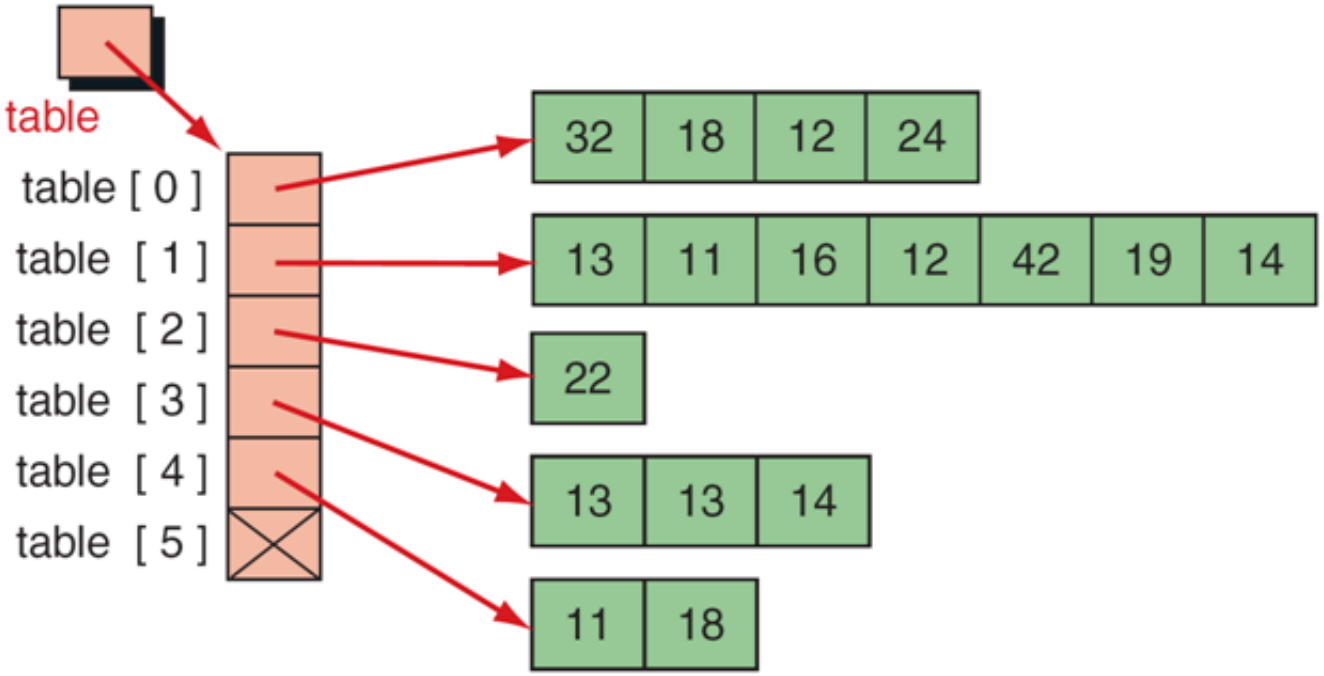


Array of Pointers

```
int  x = 4;
int *y = &x;
int *z[4] = {NULL, NULL, NULL, NULL};
int  a[4] = {1, 2, 3, 4};

z[0] = a;       // same as &a[0];
z[1] = a + 1;   // same as &a[1];
z[2] = a + 2;   // same as &a[2];
z[3] = a + 3;   // same as &a[3];

for (x=0;x<4;x++)
 printf("\n %d --- %d ",a[x],*z[x]);
```

Arrays of Pointers

- Arrays can contain pointers to (**array**)



Array of Pointers

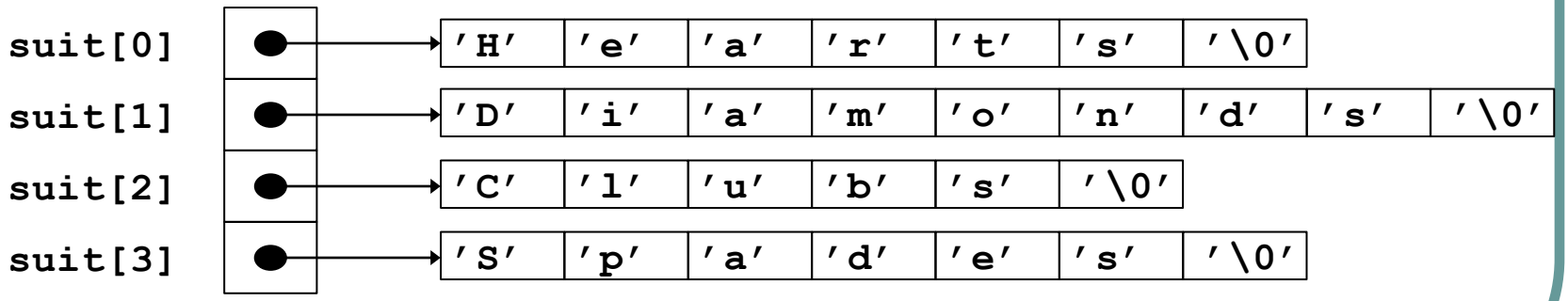
- For example: an array of strings

```
char *suit[ 4 ] = {     "Hearts",
                        "Diamonds",
                        "Clubs",
                        "Spades" };
```

  - Strings are pointers to the first character
  - **E**ach element of **`suit`** is a pointer to a **`char`**
  - The strings are not actually stored in the array **`suit`**, only pointers to the strings are stored
  - **`suit`** array has a fixed size, but strings can be of any size

Arrays of Pointers

- **`char *`** – each element of **`suit`** is a pointer to a **`char`**
- The strings are not actually stored in the array **`suit`**, only pointers to the strings are stored
- **`suit`** array has a fixed size, but strings can be of any size



Example – 8 (Array of strings)

```
char *suit[ 4 ] = { "Hearts",
                    "Diamonds",
                    "Clubs",
                    "Spades" };
int main()
{ int  x ;
  for (x = 0; x < 4 ; x++)
    printf("\n %s    ---    %d ",
           suit[x],strlen(suit[x]));
return 0; }
```

Pointer to Structure

- We can use pointer to struct:
  - `struct MyPoint {int x, int y};`
  - `MyPoint point, *ptr;`
  - `point.x = 0;`
  - `point.y = 10;`
  - `ptr = &point;`
  - **`ptr->x = 12;`** same as **`(*ptr).x`**
  - **`ptr->y = 40;`** same as **`(*ptr).y`**

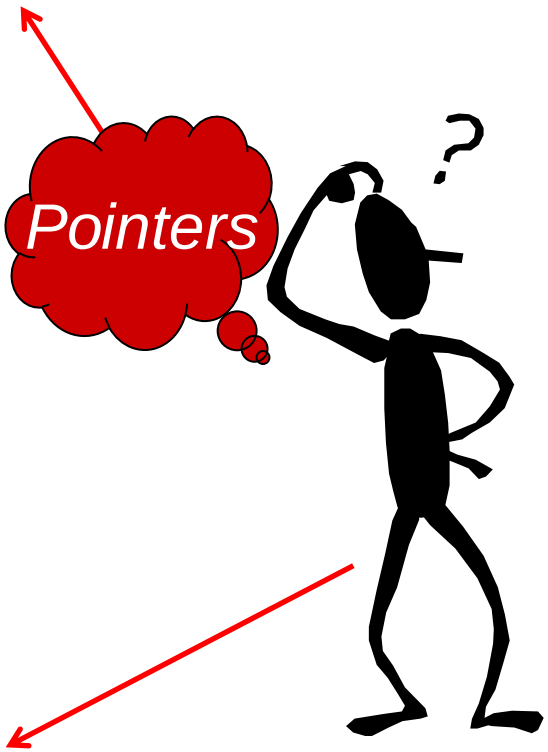
Example – 9 (pointer to struct)

```
#include <stdio.h>
struct inven
{       char  code;
        float cost;
        int   pices ; } ;
int main()
{ struct inven part;
  read (&part);
  write (part);
  return 0;       }
```

Example – 9 (pointer to struct) -cont

```
void read (struct inven *in)
{   printf ("\n Enter Product Data. \n") ;
    printf (" Enter part code: ");     scanf  ("%c",&in->code);
    printf (" Enter part cost: ");     scanf  ("%f",&in->cost);
    printf (" Enter no of pices: "); scanf  ("%d",&in->pices);
}
void write (struct inven out)
{         printf (" part code: %c   \n", out.code);
          printf (" part cost: %f   \n", out.cost);
          printf (" no of pices: %d \n", out.pices);            }
```

Questions?



Pointers can

point to

everywhere ,

anywhere , .

in **MEMORY**!