

POINTERS

Pointer is a variable, which holds the address of another variable of same type.

Pointer is a memory location, which holds the address of another memory location.

Pointer is a derived data type.

Advantages:

1. Dynamic memory allocation.
2. Program performance is increased due to preventing memory wastage.
3. They are very much used in System programming.
4. They are very much used in dynamic linked list & Stacks [data structures].
5. **It allows to access local variable outside the function i.e. data sharing between functions.**
[**call by address/Reference**].
6. **To handle strings, arrays etc in functions we need pointers.**

7. To handle **data files** we are using pointers.
8. They directly works on variable address. Due to this search time is reduced and execution speed is increased.

Dis-advantage:

They are not secured.

Syntax:

datatype * variable;

- * indicates it is a pointer data type.
- * is called indirection operator.
- * is called dereferencing operator.
- *** is a re-direction operator.**
- * indicates value at that address.
- * indicates pointer value.

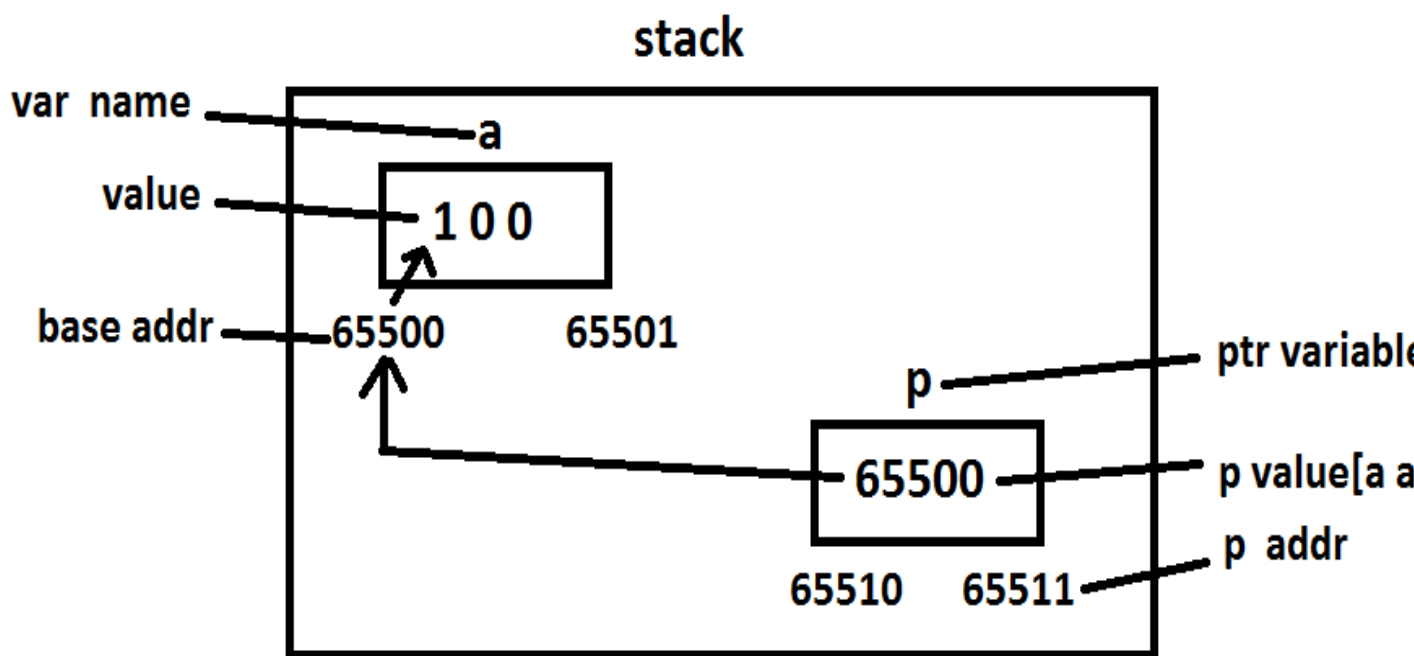
Eg:

```
int a=100, * p;
```

In the above example '**a**' is a general variable.

* indicates '**p**' is a pointer type variable and it is able to store the address of general variable '**a**' as follows.

```
p = &a;
```



In the above example, to pick the value of **a** through pointer variable **p**, we have to use the **printf()** as follows.

```
printf( "%d", *p );
```

→ **100**

Here ***p** means **value of p** or **value at that addr.** i.e. **65500**. But **65500** is the **addr of 'a'**. The **value in a address is 100**.

Or

Here **p** means **65500**. ***p** means **value at 65500**. i.e. **100**.

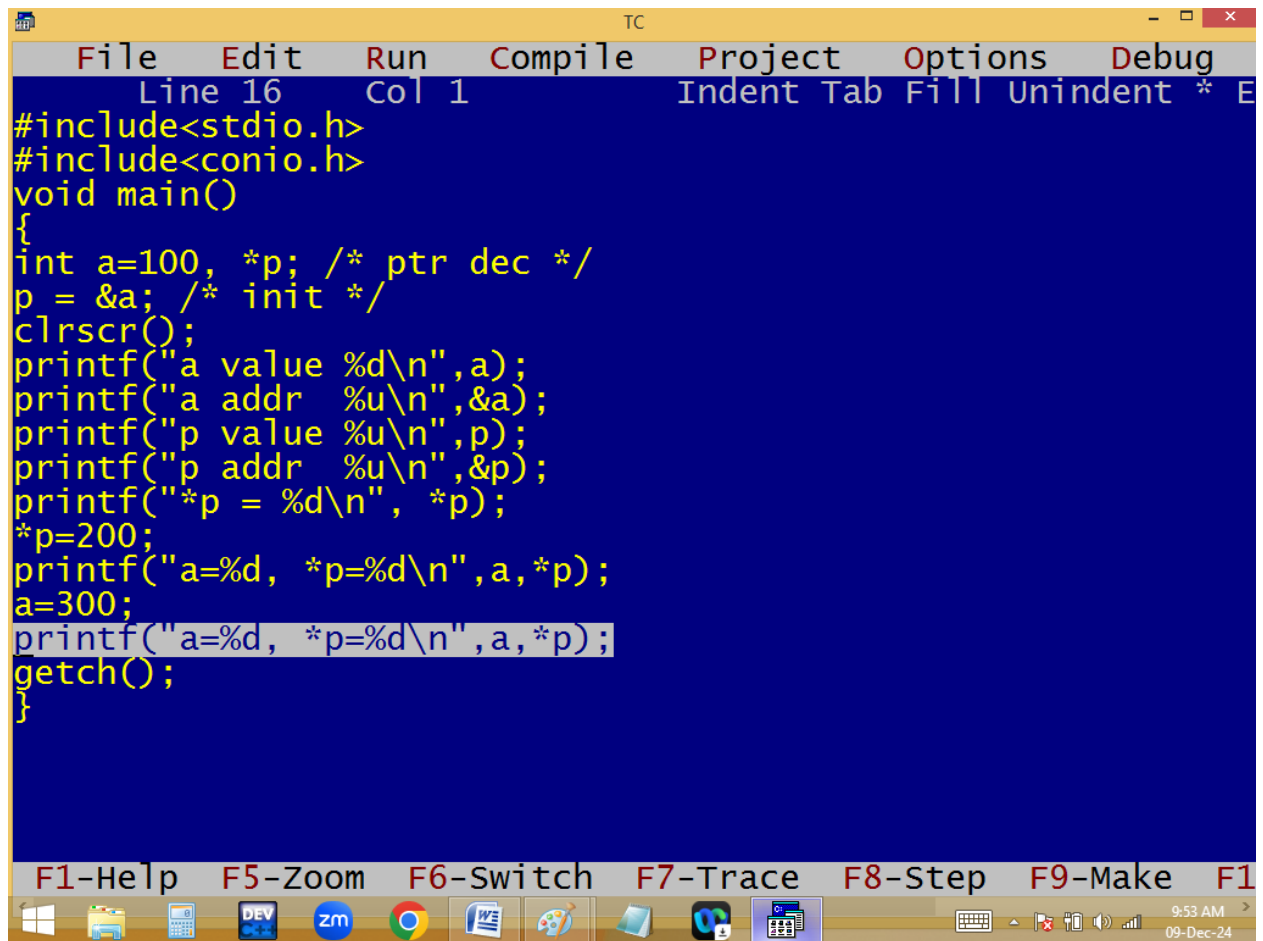
Due to this example any changes conducted in ***p** effects the value of **'a'**. Hence **p** is called **pointer to a**.

Eg: ***p=200;**

Now **a** value becomes **200**.

Eg:

Finding a variable value and address using a pointer:

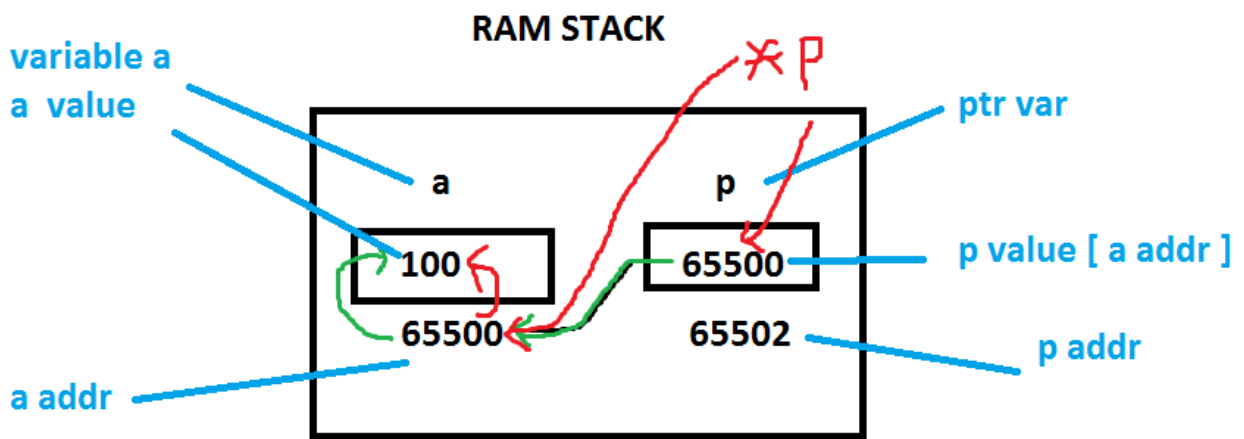


The image shows a screenshot of a Turbo C++ (TC) IDE window. The title bar at the top reads "TC". The menu bar includes "File", "Edit", "Run", "Compile", "Project", "Options", and "Debug". Below the menu bar, the status bar shows "Line 16", "Col 1", and "Indent Tab Fill Unindent * E". The main editing area has a dark blue background with yellow text. The code is as follows:

```
#include<stdio.h>
#include<conio.h>
void main()
{
int a=100, *p; /* ptr dec */
p = &a; /* init */
clrscr();
printf("a value %d\n",a);
printf("a addr %u\n",&a);
printf("p value %u\n",p);
printf("p addr %u\n",&p);
printf("*p = %d\n", *p);
*p=200;
printf("a=%d, *p=%d\n",a,*p);
a=300;
printf("a=%d, *p=%d\n",a,*p);
getch();
}
```

At the bottom of the IDE window, there is a toolbar with function key shortcuts: "F1-Help", "F5-Zoom", "F6-Switch", "F7-Trace", "F8-Step", "F9-Make", and "F10-Run". Below the toolbar is the Windows taskbar, which includes icons for the Start button, File Explorer, Calculator, DEV C++, Zoom, Google Chrome, Word, Paint, and other background applications. The system tray on the right shows the time as "9:53 AM" and the date as "09-Dec-24".

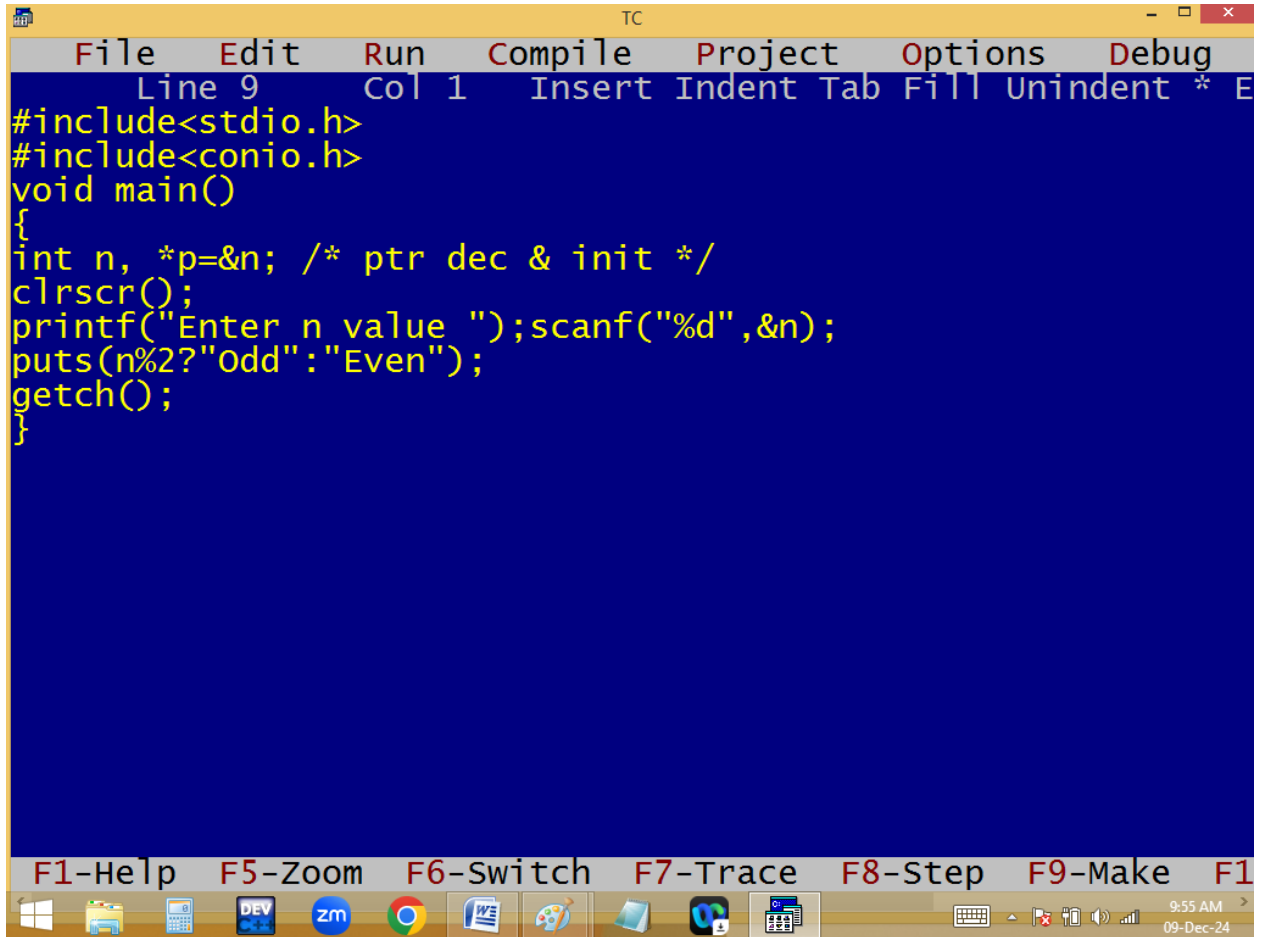
```
TC
a value 100
a addr 65500
p value 65500
p addr 65502
*p = 100
a=200, *p=200
a=300, *p=300
```



```
printf("*p = %d", * p );
```

→ p value = 65500
→ value stored at 65500 ==> 100

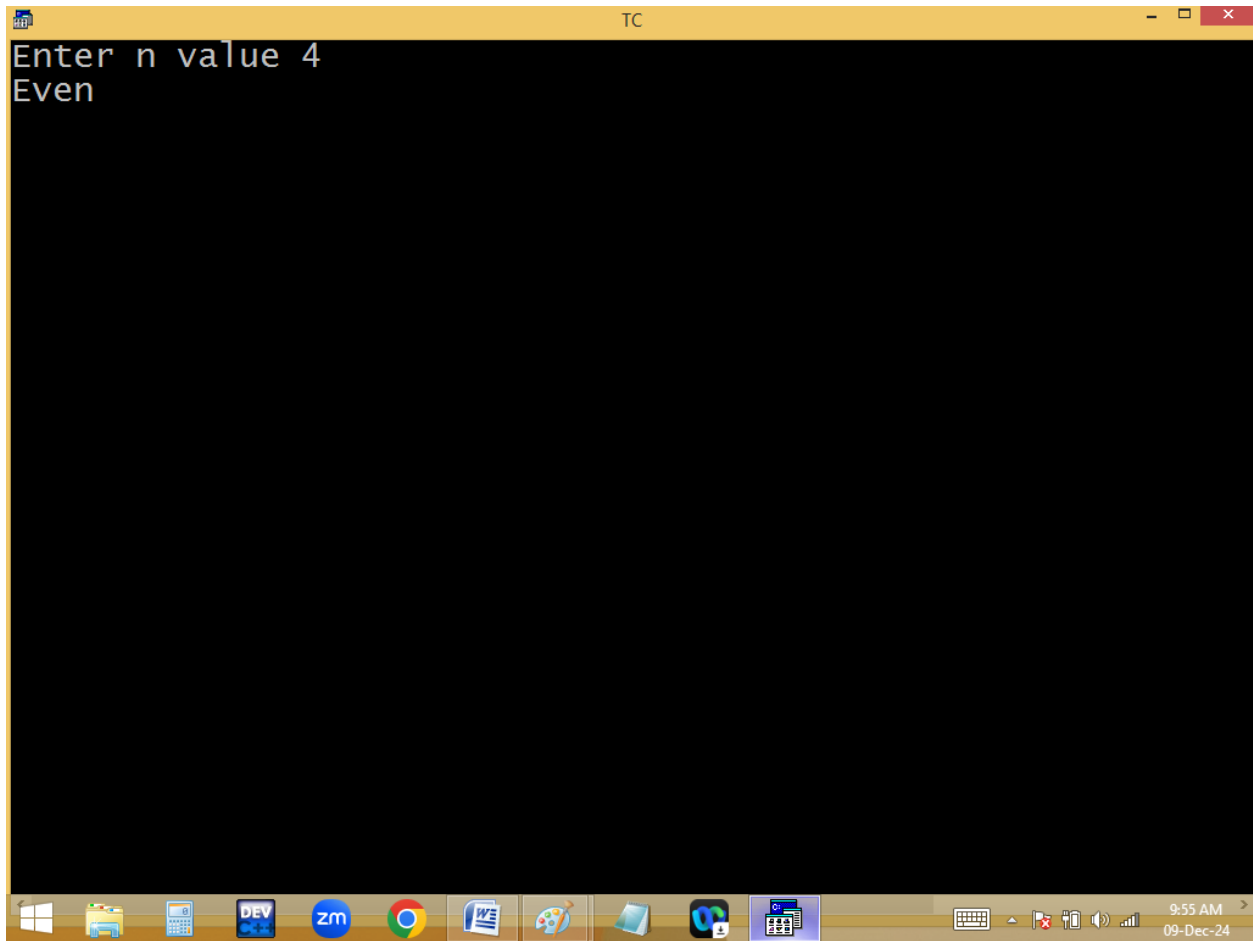
Finding even/odd using pointer:

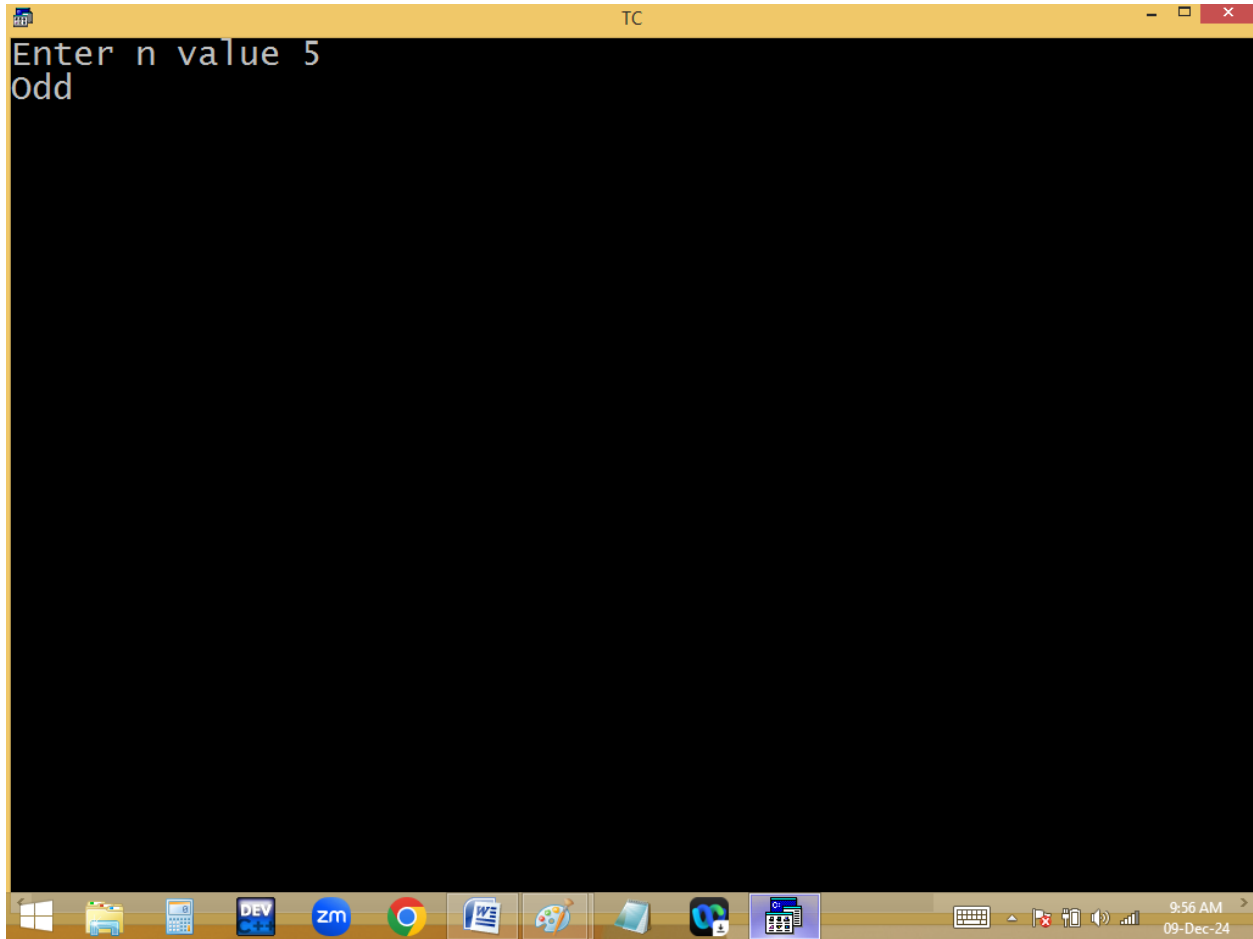


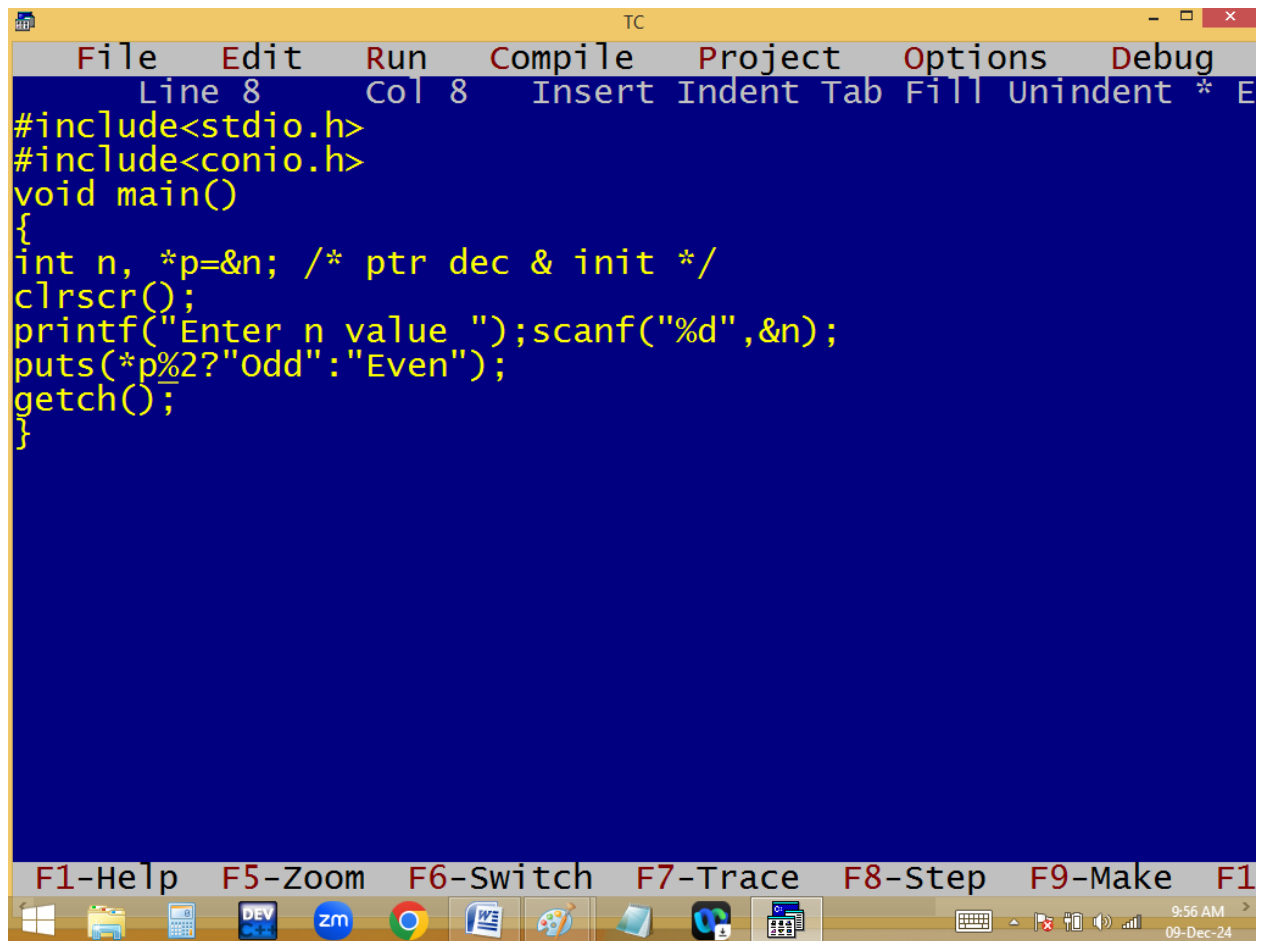
The screenshot shows the Turbo C++ (TC) IDE interface. The menu bar includes File, Edit, Run, Compile, Project, Options, and Debug. The status bar at the top indicates 'Line 9 Col 1'. The code editor contains the following C program:

```
#include<stdio.h>
#include<conio.h>
void main()
{
    int n, *p=&n; /* ptr dec & init */
    clrscr();
    printf("Enter n value ");scanf("%d",&n);
    puts(n%2?"Odd":"Even");
    getch();
}
```

The bottom status bar shows function key shortcuts: F1-Help, F5-Zoom, F6-Switch, F7-Trace, F8-Step, F9-Make, and F10-Run. The Windows taskbar at the bottom includes icons for File Explorer, Calculator, DEV C++, Zoom, Google Chrome, Word, Paint, and other applications. The system clock shows 9:55 AM on 09-Dec-24.



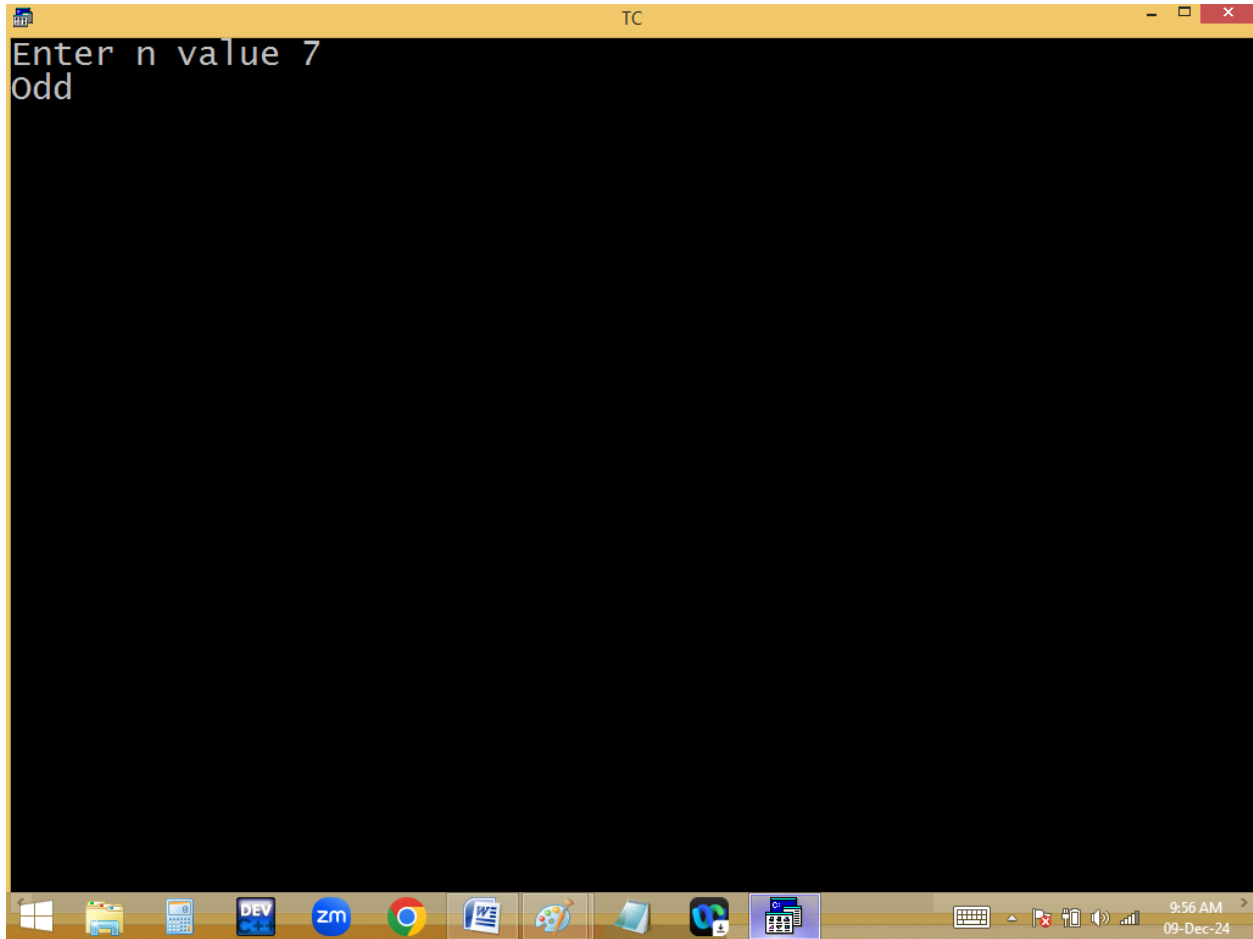




The image shows a screenshot of a Turbo C++ (TC) IDE window. The window has a yellow title bar with the text "TC" and standard window controls. The menu bar includes "File", "Edit", "Run", "Compile", "Project", "Options", and "Debug". Below the menu bar, a status bar shows "Line 8", "Col 8", and various editing options like "Insert", "Indent", "Tab", "Fill", "Unindent", and "E". The main editing area has a dark blue background with yellow text. The code is as follows:

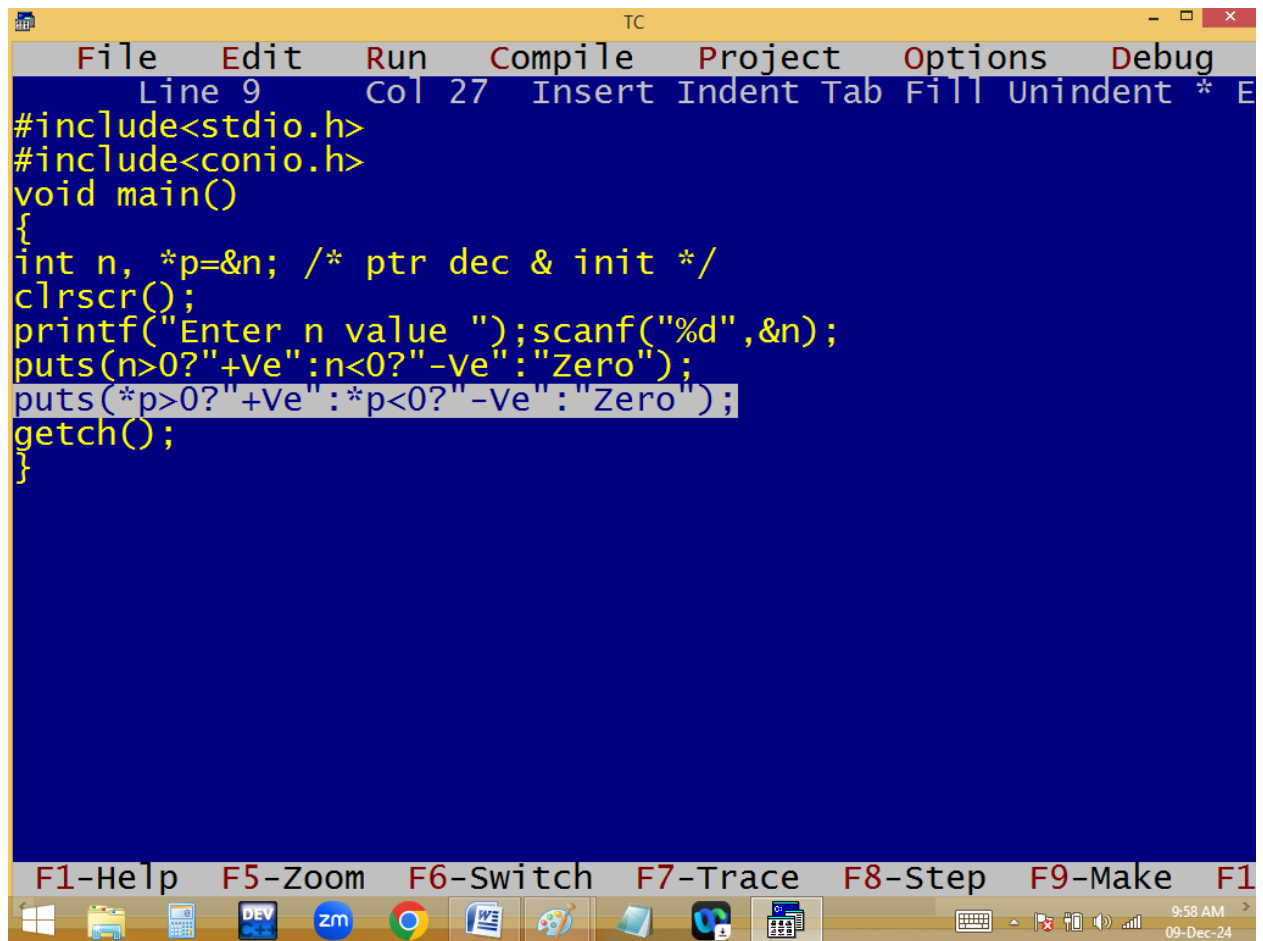
```
#include<stdio.h>
#include<conio.h>
void main()
{
int n, *p=&n; /* ptr dec & init */
clrscr();
printf("Enter n value ");scanf("%d",&n);
puts(*p%2?"Odd":"Even");
getch();
}
```

Below the code editor, there is a toolbar with function key shortcuts: "F1-Help", "F5-Zoom", "F6-Switch", "F7-Trace", "F8-Step", "F9-Make", and "F10-Run". At the very bottom is the Windows taskbar, which includes icons for the Start button, File Explorer, Calculator, DEV C++, Zoom, Google Chrome, Notepad, Paint, and several other applications. The system clock in the bottom right corner shows "9:56 AM" and "09-Dec-24".





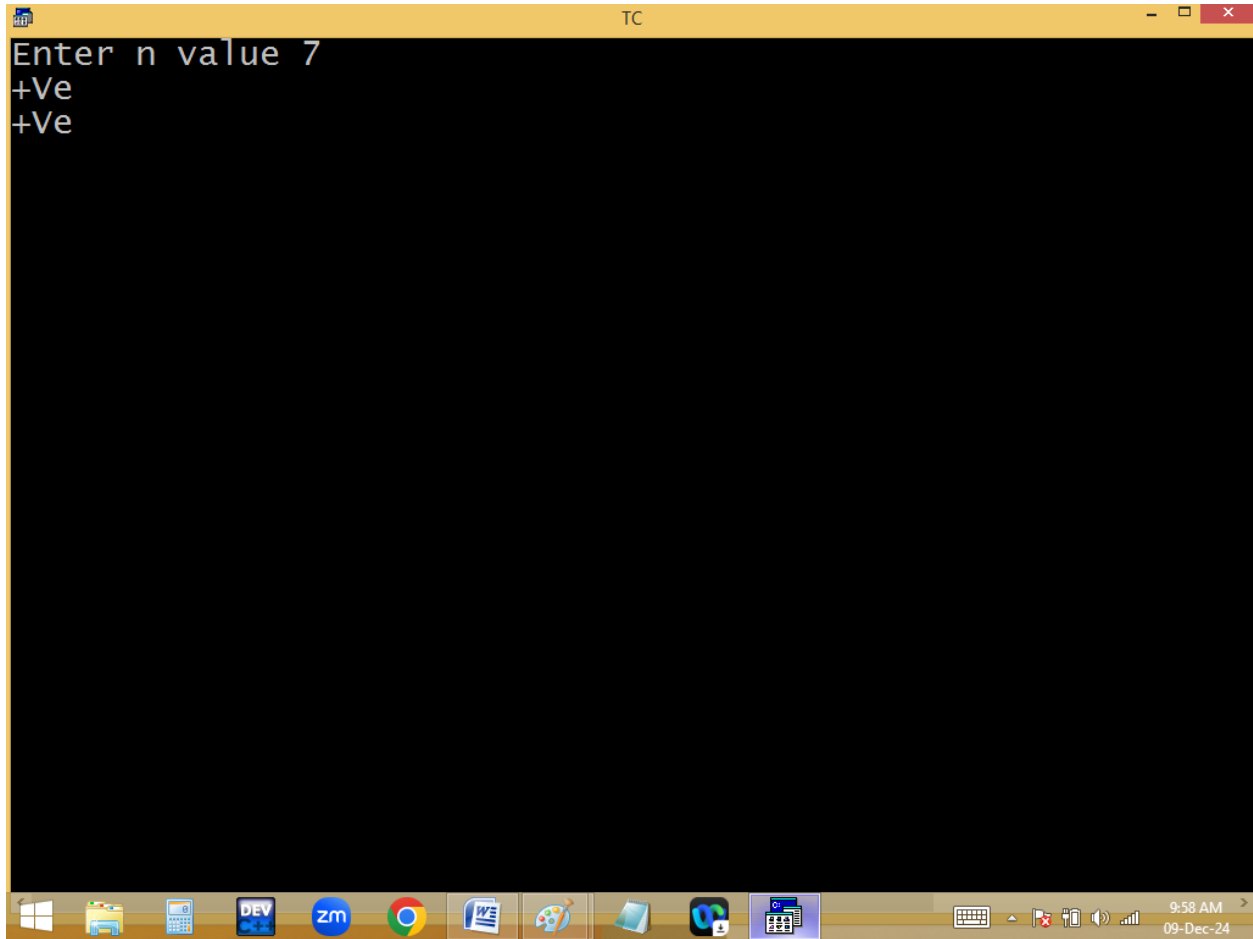
Finding +Ve/-Ve/0 using pointer:

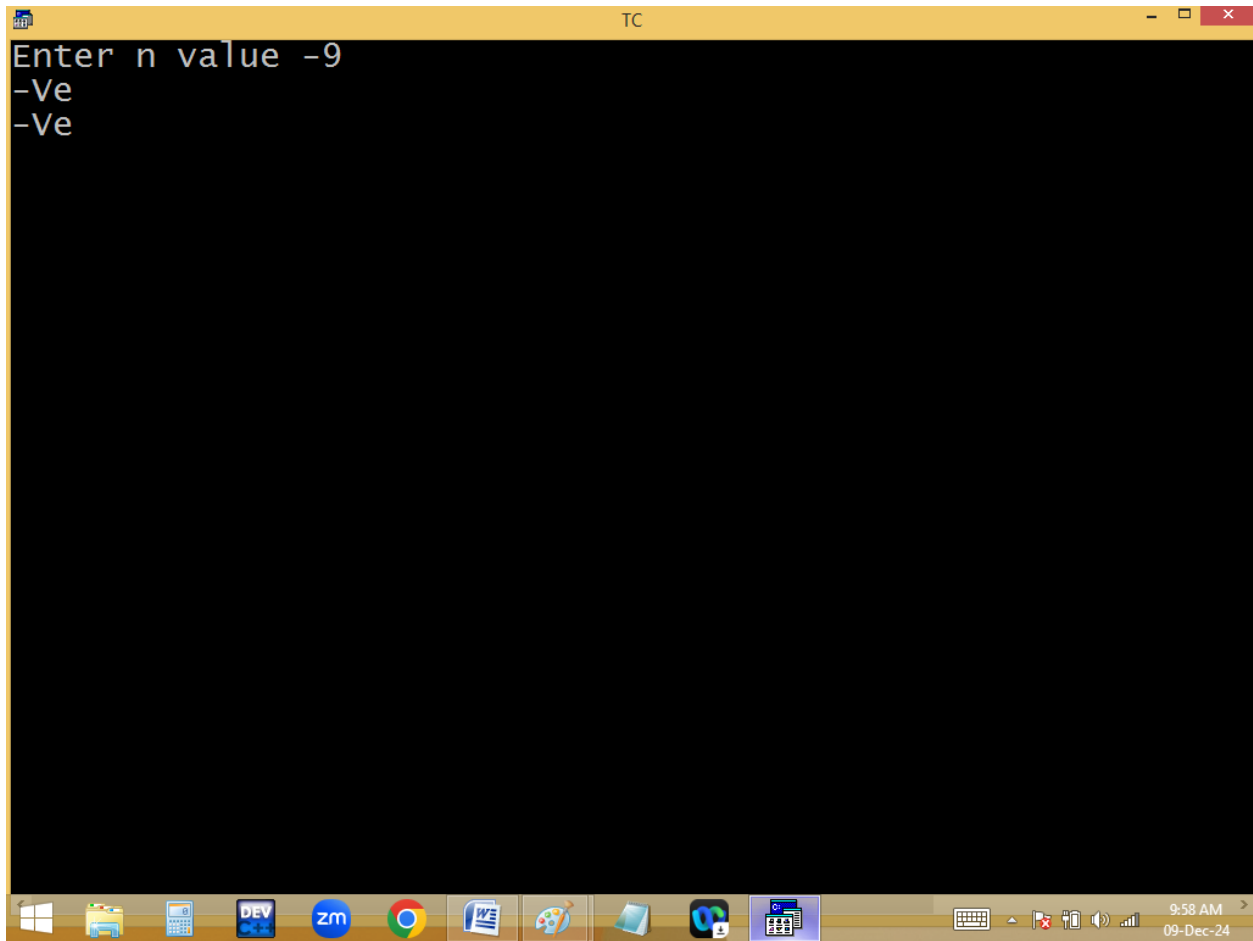


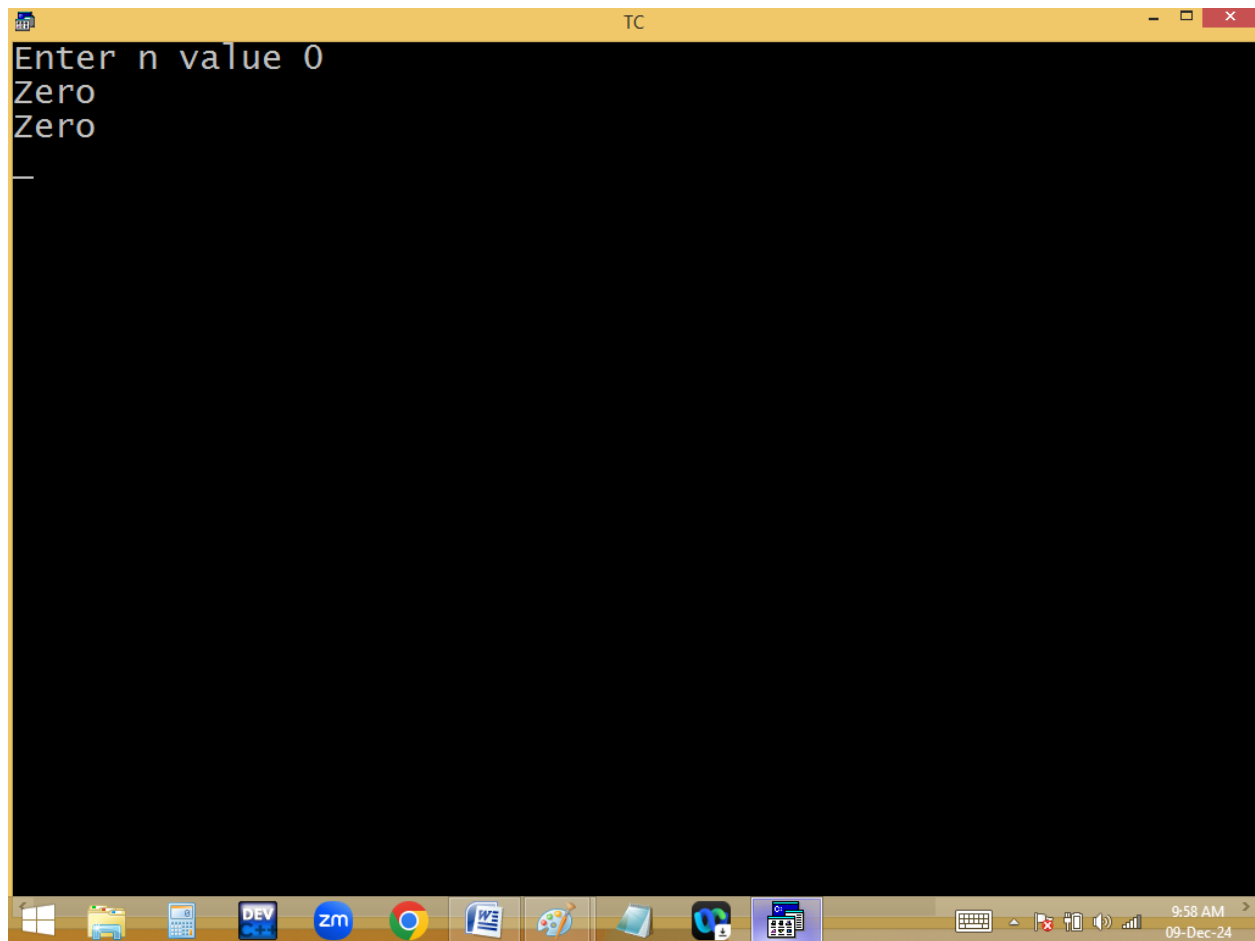
The image shows a screenshot of a Turbo C++ (TC) IDE window. The window has a yellow title bar with the text "TC" and standard window controls. Below the title bar is a menu bar with the following options: File, Edit, Run, Compile, Project, Options, and Debug. Under the "Run" menu, there is a submenu with the following options: Line 9, Col 27, Insert, Indent, Tab, Fill, Unindent, and *. The main editing area has a dark blue background with yellow text. The code is as follows:

```
#include<stdio.h>
#include<conio.h>
void main()
{
int n, *p=&n; /* ptr dec & init */
clrscr();
printf("Enter n value ");scanf("%d",&n);
puts(n>0?" +ve":n<0?" -ve":"Zero");
puts(*p>0?" +ve":*p<0?" -ve":"Zero");
getch();
}
```

At the bottom of the window, there is a status bar with the following text: F1-Help, F5-Zoom, F6-Switch, F7-Trace, F8-Step, F9-Make, and F10-Exit. Below the status bar is a Windows taskbar with various icons, including the Start button, File Explorer, Calculator, DEV C++, Zoom, Google Chrome, Word, Paint, and the Turbo C++ icon. The system clock in the bottom right corner shows the time as 9:58 AM on 09-Dec-24.







The screenshot shows a Windows 10 desktop environment. A terminal window titled "TC" is open, displaying the following text:

```
Enter n value 0  
Zero  
Zero  
_
```

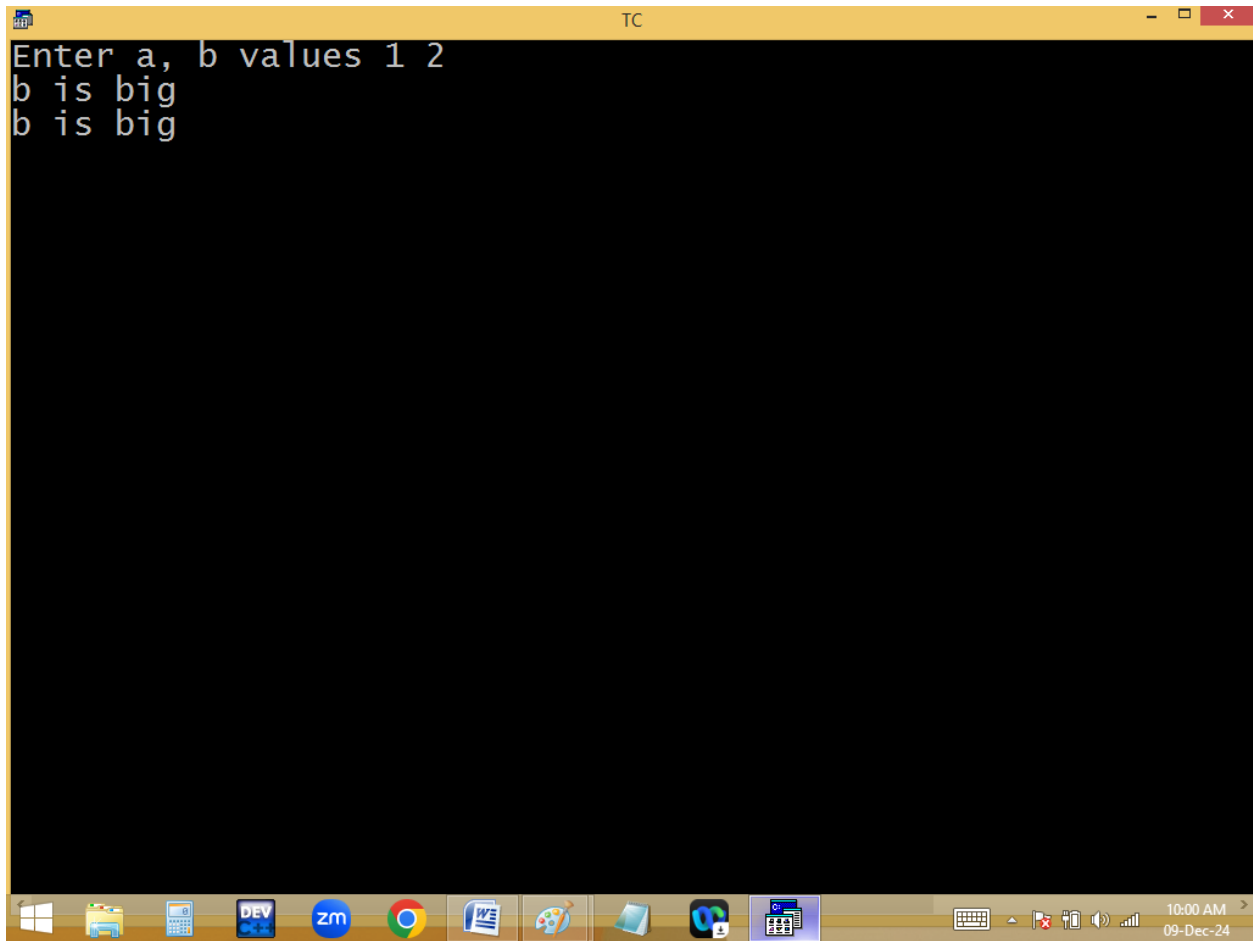
The terminal window has a yellow title bar. The desktop background is black. The taskbar at the bottom is light blue and contains several icons: Windows Start button, File Explorer, Calculator, DEV (a blue icon with white text), ZM (a blue circle with white text), Google Chrome, Microsoft Word, a paint application, a folder icon, a game icon, and a calendar icon. The system tray on the right side of the taskbar shows the time as 9:58 AM and the date as 09-Dec-24.

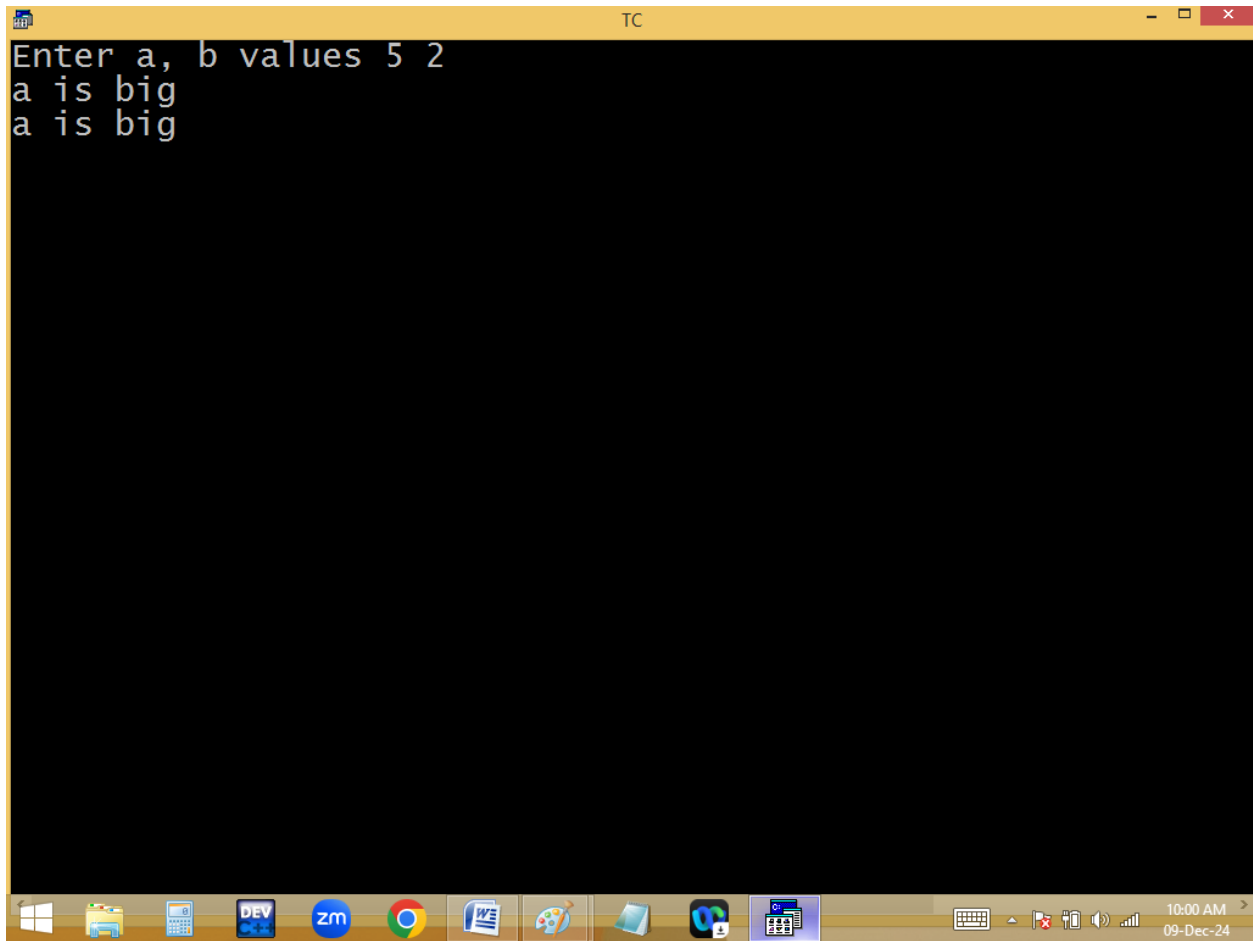
Finding max in 2 no's using pointer:


```
TC
File Edit Run Compile Project Options Debug
Line 10 Col 1 Insert Indent Tab Fill Unindent * E
#include<stdio.h>
#include<conio.h>
void main()
{
int a,b,*p=&a, *q=&b; /* ptr dec & init */
clrscr();
printf("Enter a, b values ");scanf("%d%d",&a,&b);
puts(a>b?"a is big":b>a?"b is big":"Both are equal");
puts(*p>*q?"a is big":*q>*p?"b is big":"Both are equal");
getch();
}
```

F1-Help F5-Zoom F6-Switch F7-Trace F8-Step F9-Make F10-Run

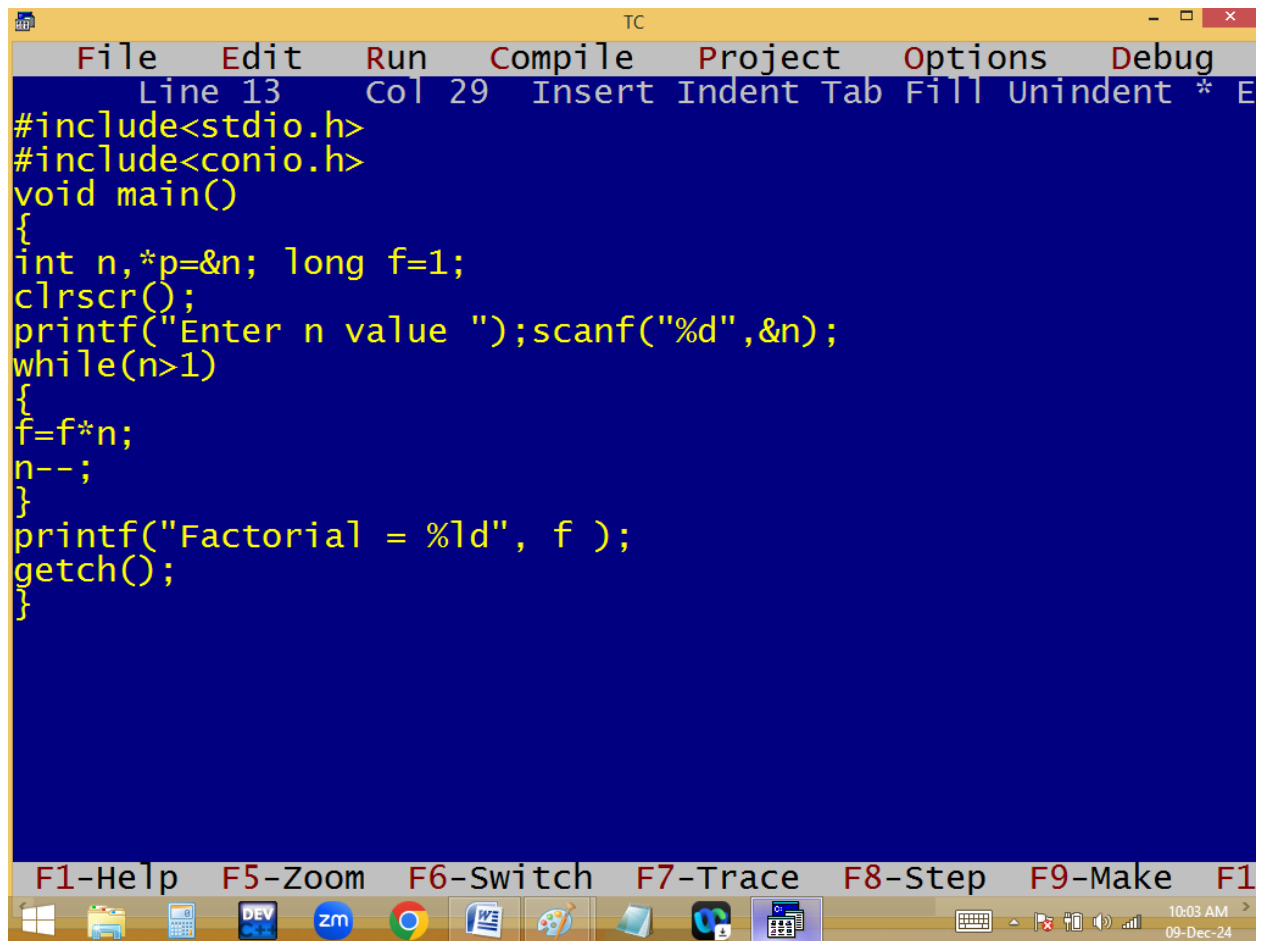
10:00 AM 09-Dec-24





```
TC
Enter a, b values 3 3
Both are equal
Both are equal
```

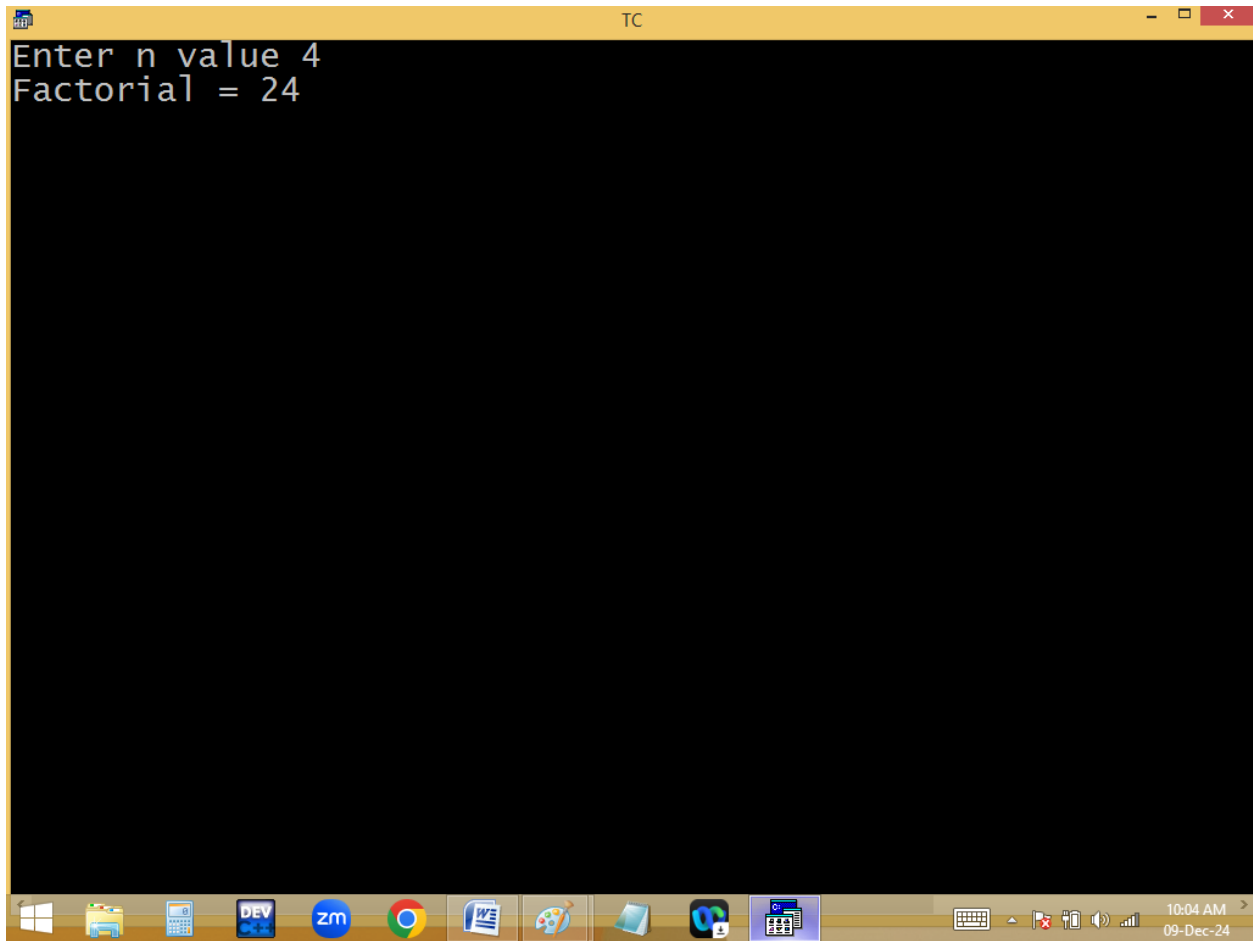
Finding factorial using pointer:



The image shows a screenshot of the Turbo C++ (TC) integrated development environment. The window title is "TC". The menu bar includes "File", "Edit", "Run", "Compile", "Project", "Options", and "Debug". The status bar at the top indicates "Line 13", "Col 29", and lists editing options: "Insert", "Indent", "Tab", "Fill", "Unindent", and "E". The main editing area has a dark blue background with yellow text. The code is a C program to calculate the factorial of a number using a while loop. The code is as follows:

```
#include<stdio.h>
#include<conio.h>
void main()
{
int n,*p=&n; long f=1;
clrscr();
printf("Enter n value ");scanf("%d",&n);
while(n>1)
{
f=f*n;
n--;
}
printf("Factorial = %ld", f );
getch();
}
```

Below the code editor, there is a toolbar with function key shortcuts: "F1-Help", "F5-Zoom", "F6-Switch", "F7-Trace", "F8-Step", "F9-Make", and "F10-Run". The Windows taskbar is visible at the bottom, showing icons for the Start menu, File Explorer, Calculator, DEV C++, Zoom, Google Chrome, Word, Paint, and other applications. The system clock in the bottom right corner shows "10:03 AM" and "09-Dec-24".

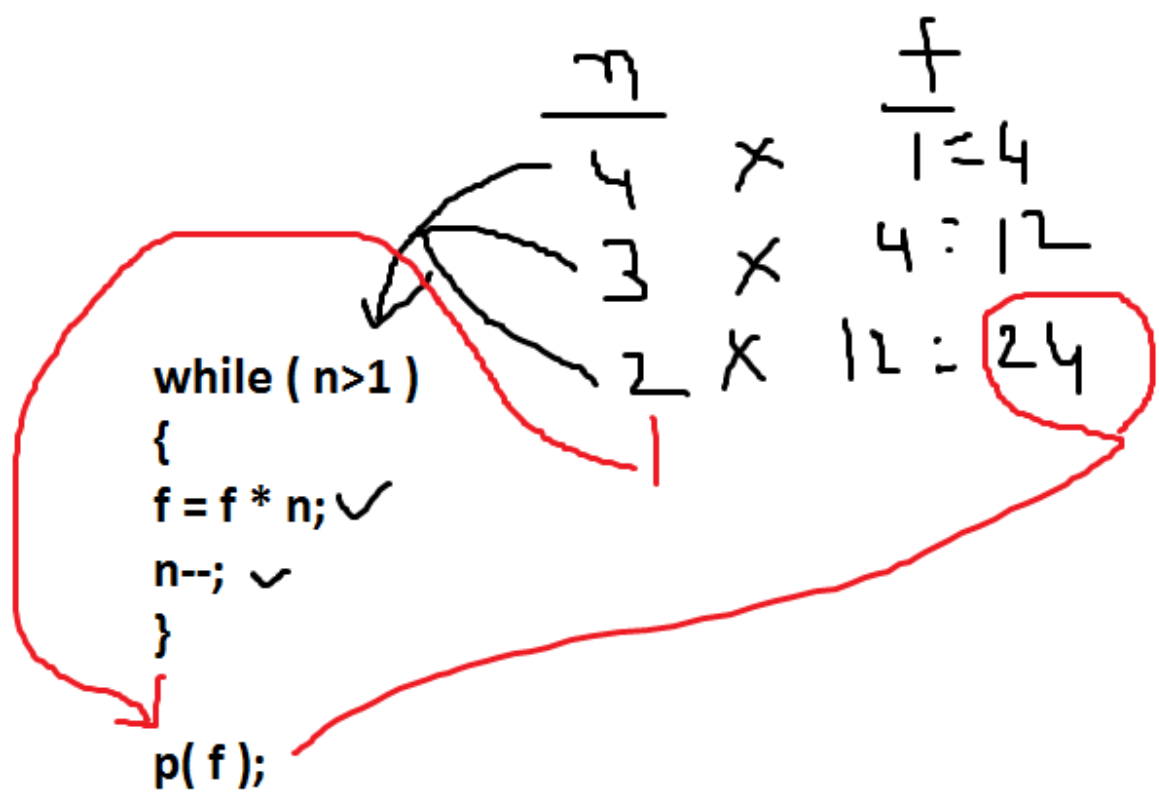


The image shows a screenshot of the Turbo C++ (TC) IDE. The window title is "TC". The menu bar includes "File", "Edit", "Run", "Compile", "Project", "Options", and "Debug". Below the menu bar, the status bar shows "Line 16", "Col 40", and "Insert Indent Tab Fill Unindent * E". The main editing area has a blue background and contains the following C code:

```
#include<stdio.h>
#include<conio.h>
void main()
{
int n,*p=&n; long f=1;
clrscr();
printf("Enter n value ");scanf("%d",&n);
while(*p>1)
{
f=f* *p;
--*p;    /*    (*p)--;    */
}
printf("Factorial = %ld", f );
getch();
}
/* * is having less priority than -- */
```

At the bottom of the IDE, there is a toolbar with function key shortcuts: "F1-Help", "F5-Zoom", "F6-Switch", "F7-Trace", "F8-Step", "F9-Make", and "F10-Run". Below the toolbar is the Windows taskbar, which includes icons for the Start button, File Explorer, Calculator, DEV C++, Zoom, Google Chrome, Word, Paint, and other background applications. The system tray on the right shows the time "10:07 AM" and the date "09-Dec-24".

The image shows a Windows desktop environment. A terminal window titled "TC" is open, displaying the text "Enter n value 4" and "Factorial = 24". The taskbar at the bottom includes icons for the Start menu, File Explorer, Calculator, a folder named "DEV", Zoom, Google Chrome, Microsoft Word, Paint, and a folder named "C++". The system tray on the right shows the time as 10:07 AM on 09-Dec-24, along with icons for keyboard, network, and other system functions.

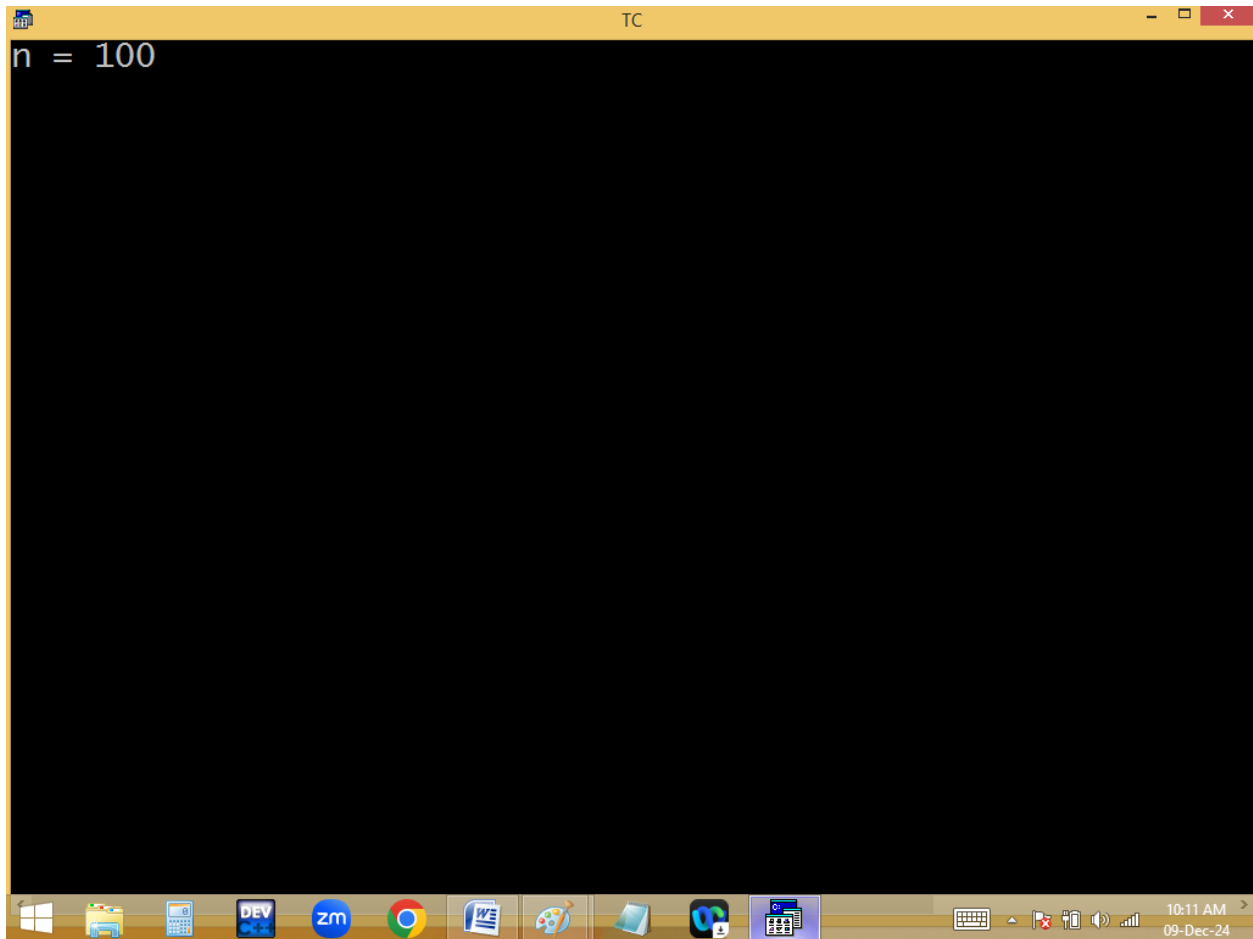


Finding a normal variable value using pointer technique:

```
TC
File Edit Run Compile Project Options Debug
Line 7 Col 21 Insert Indent Tab Fill Unindent * E
#include<stdio.h>
#include<conio.h>
void main()
{
int n=100;
clrscr();
printf("n = %d", *&n);
getch();
}
```

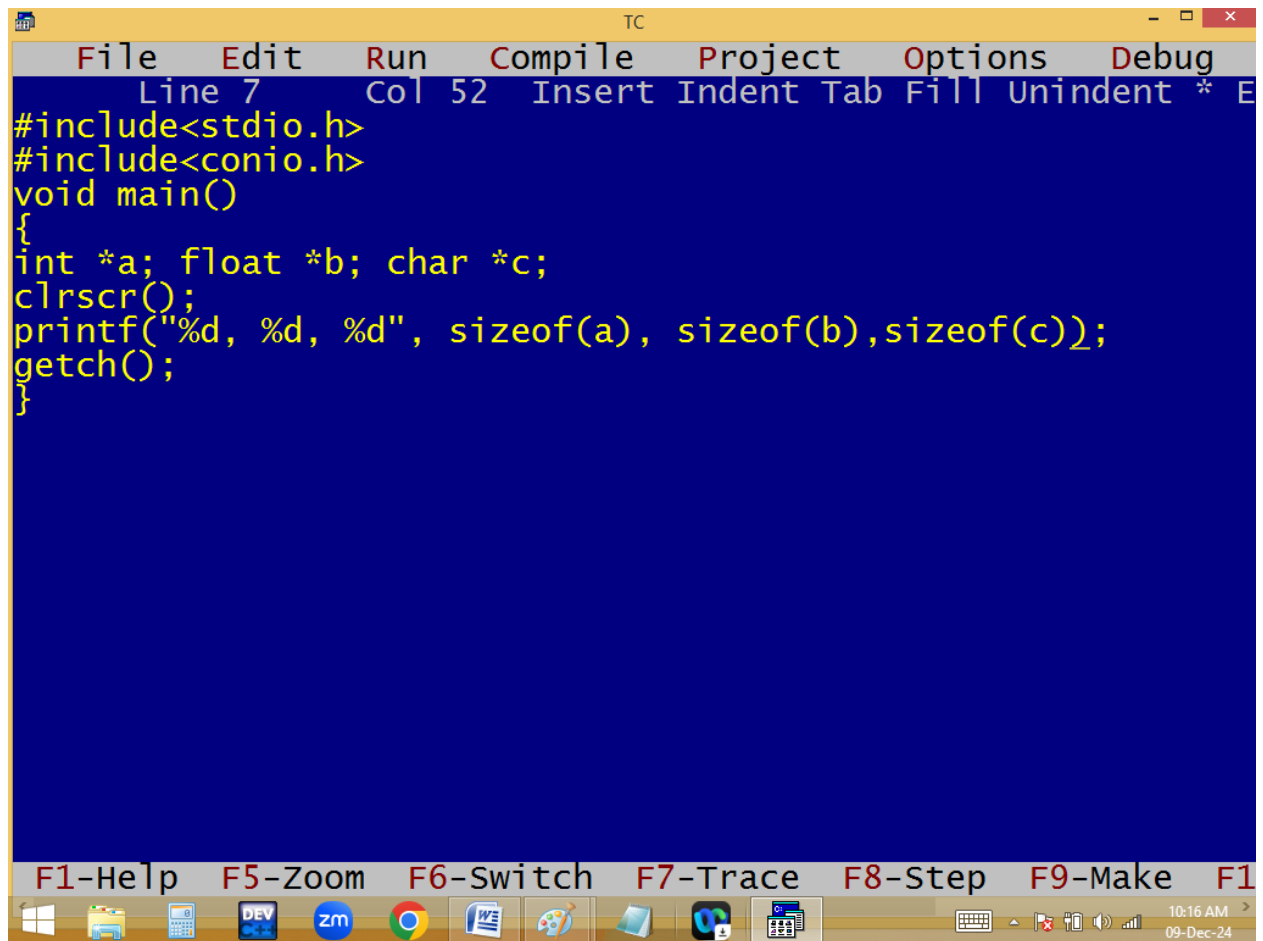
F1-Help F5-Zoom F6-Switch F7-Trace F8-Step F9-Make F10-Exit

10:11 AM
09-Dec-24



Finding pointer size:

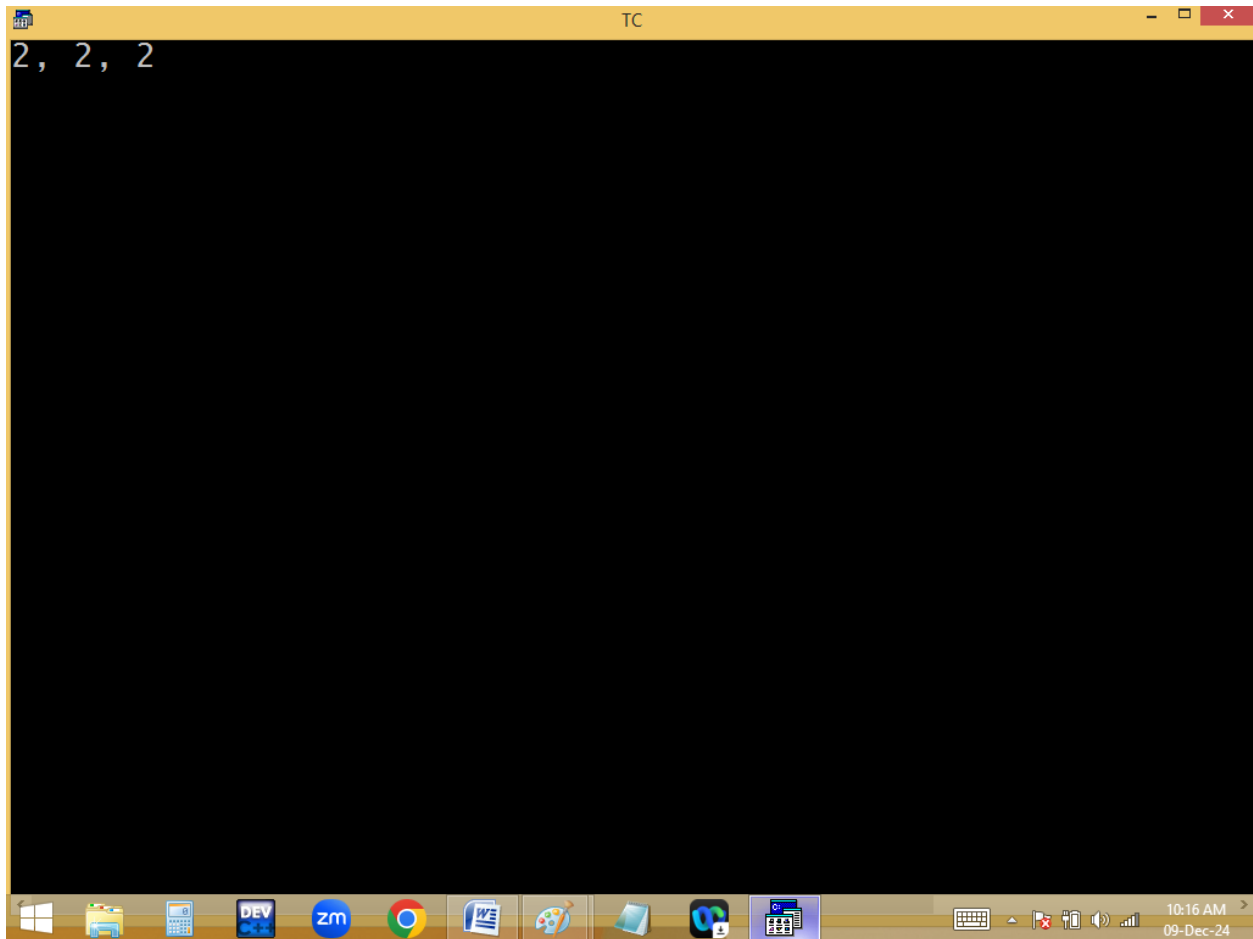
Pointer stores always the variable / memory address and it is an unsigned int. due to this any type of pointer it takes 2 / 4 / 8 bytes in 16 / 32 / 64 bit compilers.



```
TC
File Edit Run Compile Project Options Debug
Line 7 Col 52 Insert Indent Tab Fill Unindent * E
#include<stdio.h>
#include<conio.h>
void main()
{
int *a; float *b; char *c;
clrscr();
printf("%d, %d, %d", sizeof(a), sizeof(b), sizeof(c));
getch();
}
```

F1-Help F5-Zoom F6-Switch F7-Trace F8-Step F9-Make F10-Run

10:16 AM 09-Dec-24



In Dev C++:

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

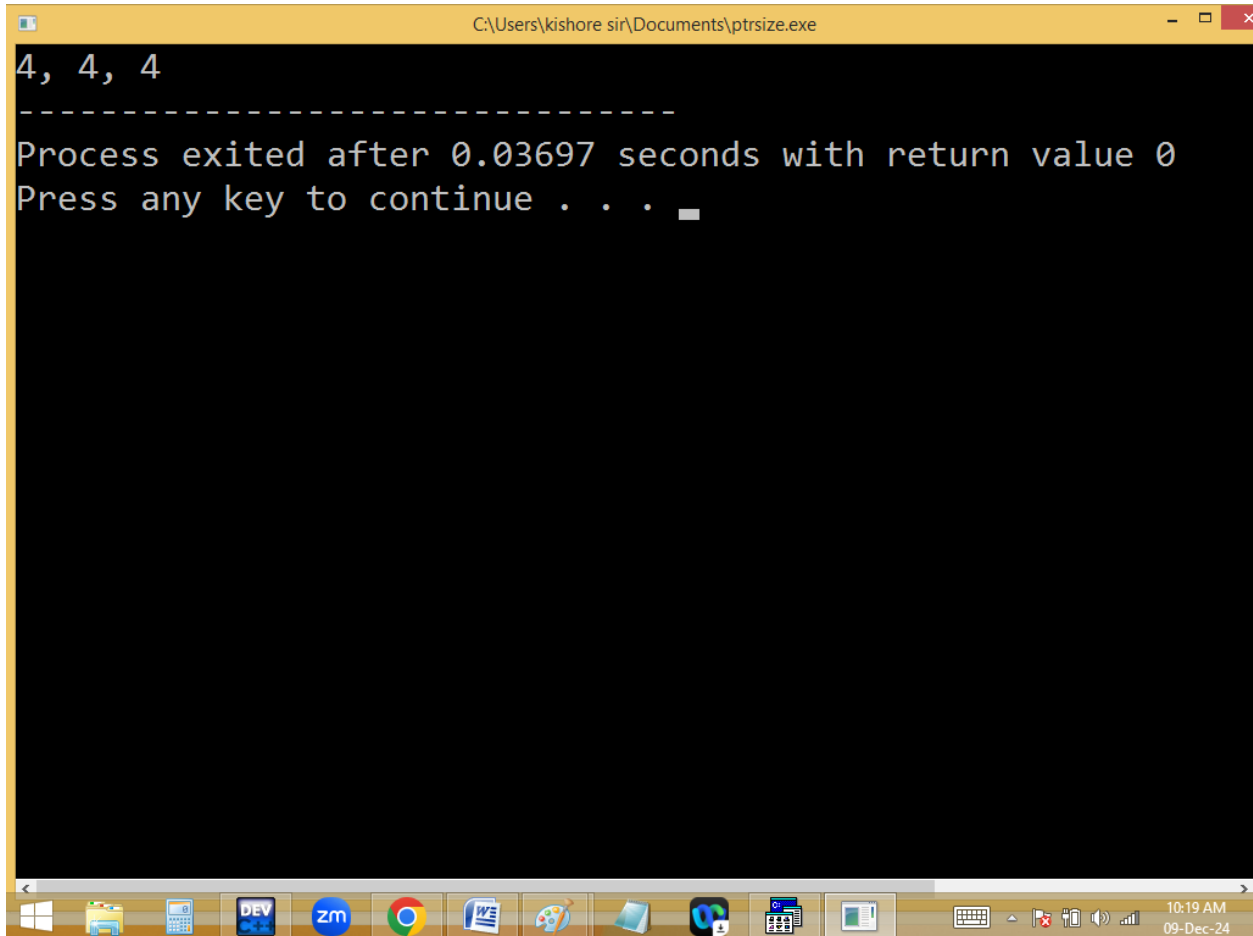
```
int main()
```

```
{
```

```
int *a; float *b; char *c;
```

```
printf("%d, %d, %d",sizeof(a), sizeof(b),sizeof(c));
```

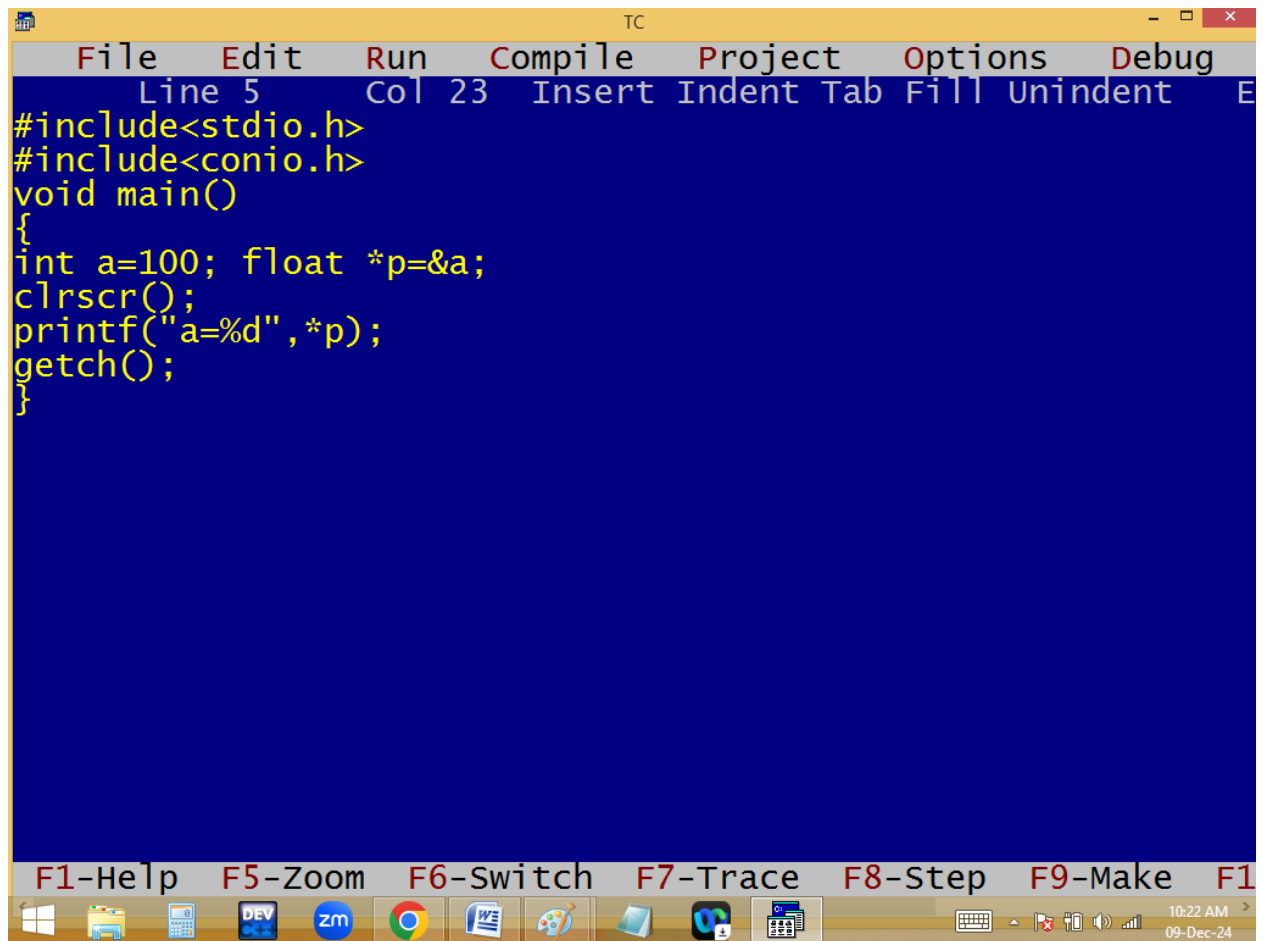
}



```
4, 4, 4
-----
Process exited after 0.03697 seconds with return value 0
Press any key to continue . . .
```

Online compiler:

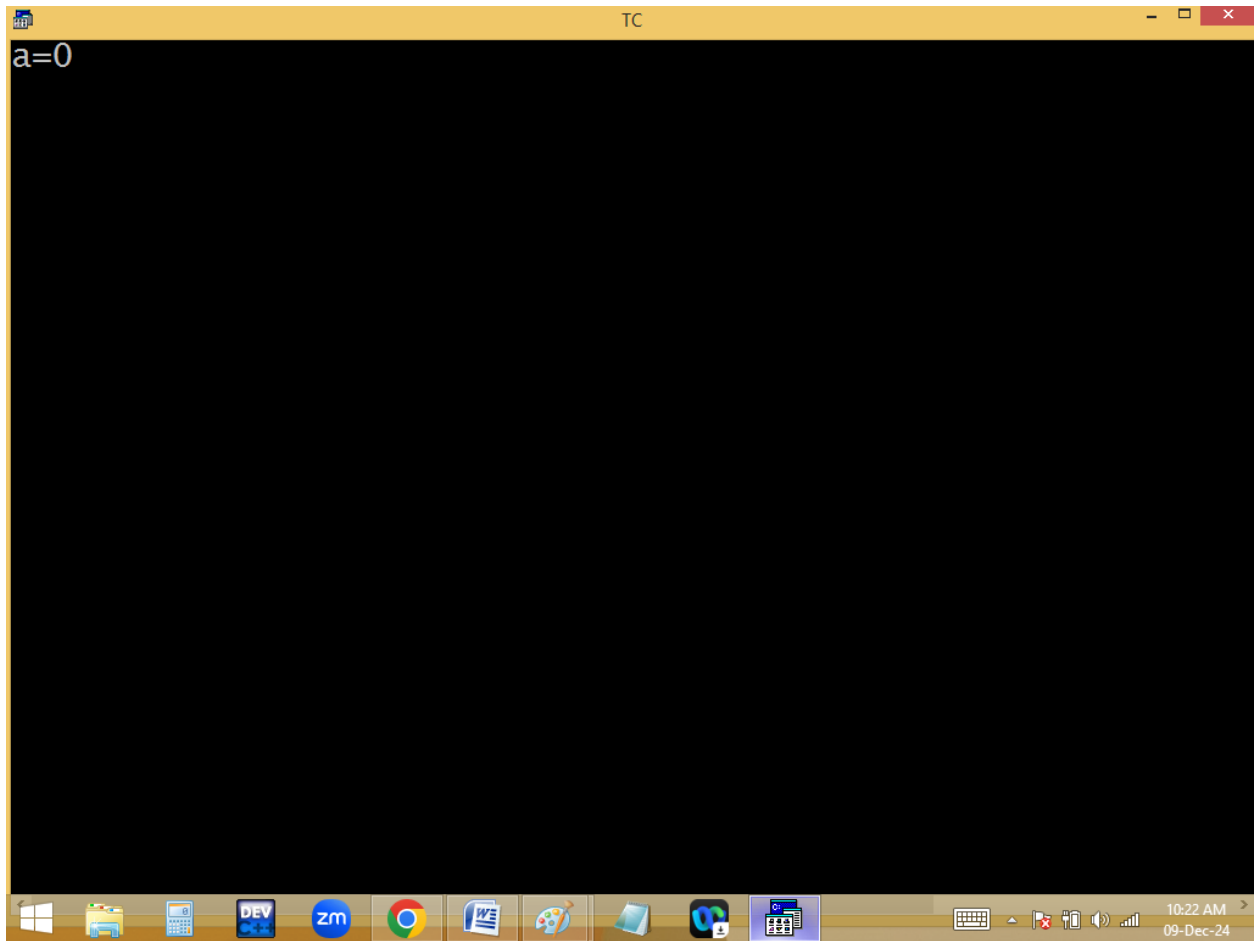
Pointer compatibility: Pointer can store only the same type of variable address. When we are providing different type address, it gives either garbage or runtime error.

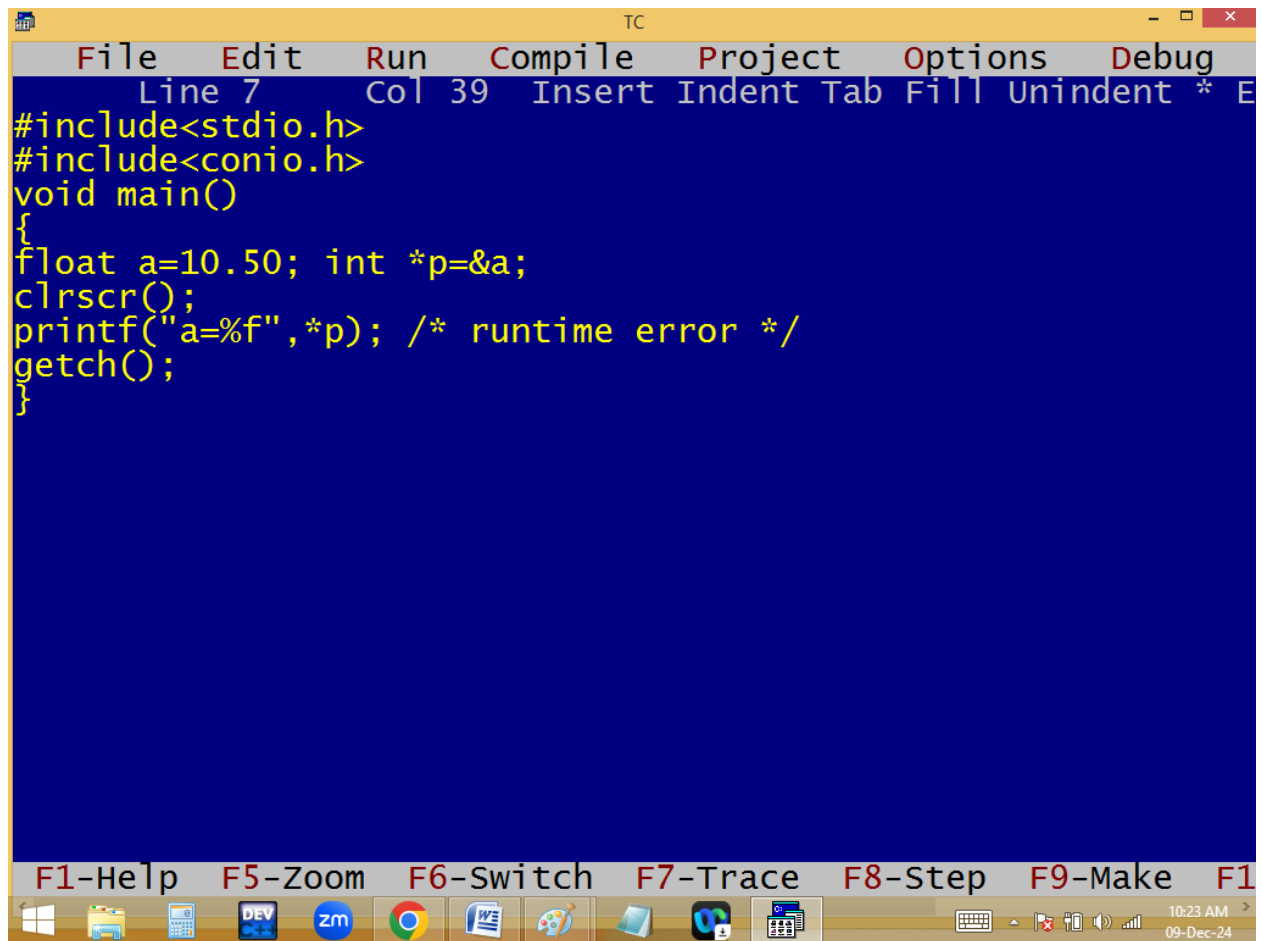


The image shows a screenshot of the Turbo C++ (TC) IDE. The window title is "TC". The menu bar includes File, Edit, Run, Compile, Project, Options, and Debug. The status bar at the top indicates "Line 5 Col 23" and lists editing options: Insert, Indent, Tab, Fill, Unindent, and End. The code in the editor is as follows:

```
#include<stdio.h>
#include<conio.h>
void main()
{
int a=100; float *p=&a;
clrscr();
printf("a=%d",*p);
getch();
}
```

The bottom of the window features a toolbar with function key shortcuts: F1-Help, F5-Zoom, F6-Switch, F7-Trace, F8-Step, F9-Make, and F10-Run. The Windows taskbar at the very bottom shows the Start button, taskbar buttons for File Explorer, Calculator, DEV C++, Zoom, Google Chrome, Word, Paint, and VS Code, followed by system tray icons for keyboard, network, volume, and battery. The system clock shows 10:22 AM on 09-Dec-24.



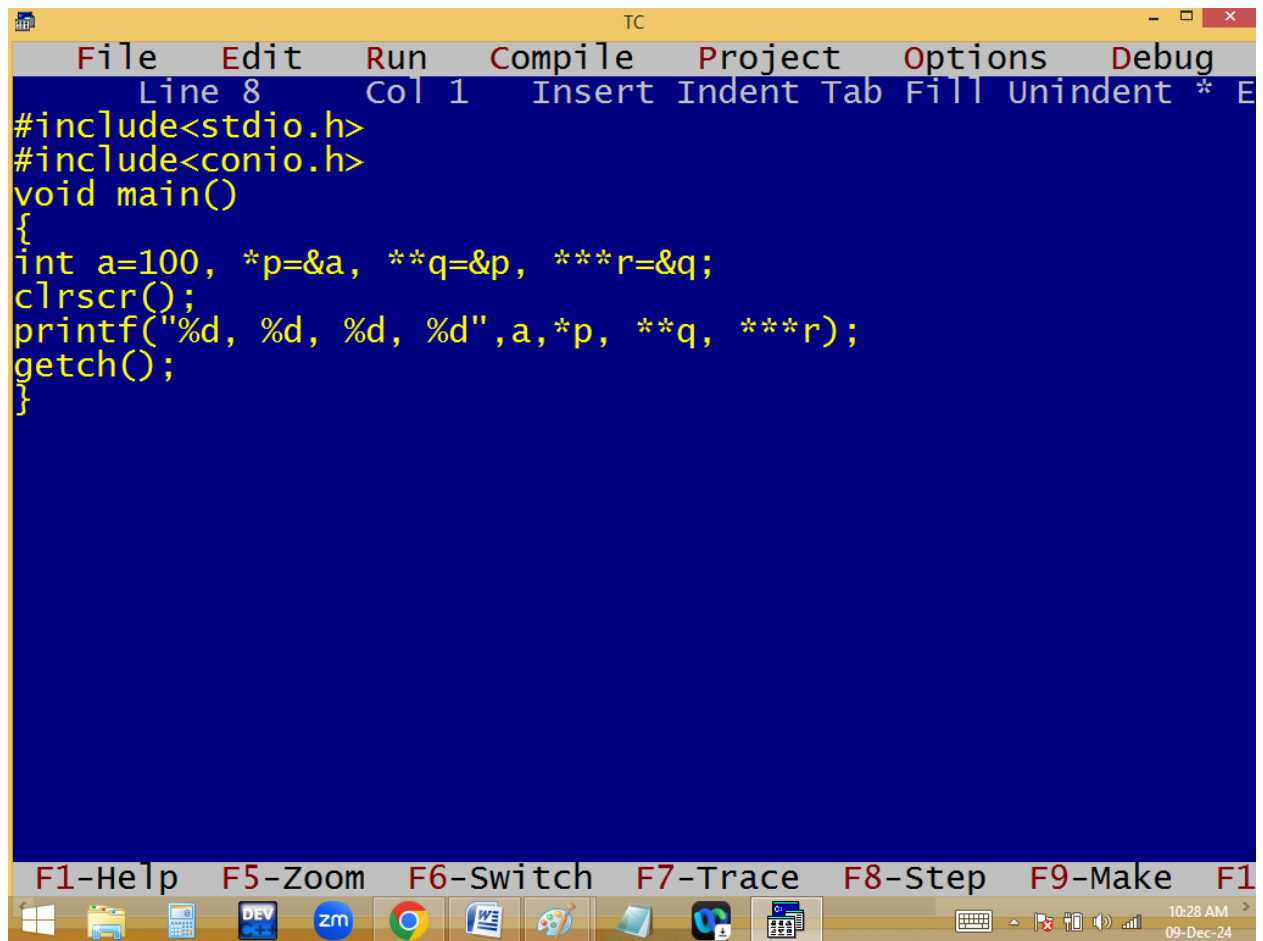


The image shows a screenshot of the Turbo C++ (TC) IDE. The window title is "TC". The menu bar includes File, Edit, Run, Compile, Project, Options, and Debug. The status bar at the top indicates "Line 7 Col 39 Insert Indent Tab Fill Unindent * E". The code in the editor is as follows:

```
#include<stdio.h>
#include<conio.h>
void main()
{
float a=10.50; int *p=&a;
clrscr();
printf("a=%f",*p); /* runtime error */
getch();
}
```

The bottom status bar shows function key shortcuts: F1-Help, F5-Zoom, F6-Switch, F7-Trace, F8-Step, F9-Make, and F10-Run. The Windows taskbar at the bottom displays various application icons and the system clock showing 10:23 AM on 09-Dec-24.

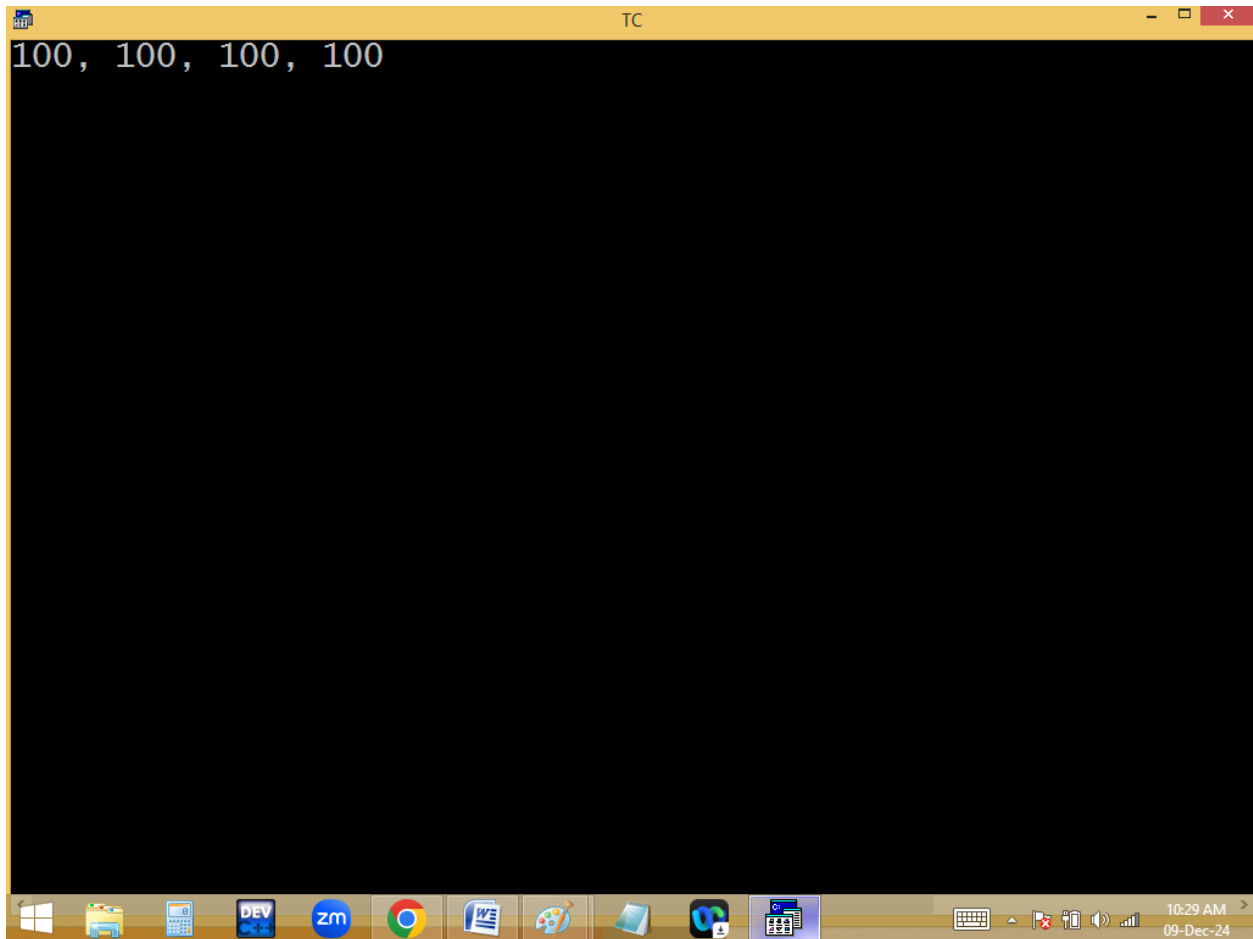
Double pointer / pointer to pointer: the pointer which stores the address of another pointer is called double pointer. It is used to handle dynamic multi dimensional arrays.



The image shows a screenshot of the Turbo C++ (TC) IDE. The window title is "TC". The menu bar includes "File", "Edit", "Run", "Compile", "Project", "Options", and "Debug". The status bar at the top indicates "Line 8", "Col 1", and "Insert Indent Tab Fill Unindent * E". The code is written in yellow text on a dark blue background. It includes headers for `stdio.h` and `conio.h`, and defines a `main` function. Inside `main`, it declares an integer `a` with the value 100, and three pointers: `*p` pointing to `a`, `**q` pointing to `p`, and `***r` pointing to `q`. It then calls `clrscr()` to clear the screen, prints the values of `a`, `*p`, `**q`, and `***r` using `printf`, and finally calls `getch()` to wait for a key press before exiting the function.

```
#include<stdio.h>
#include<conio.h>
void main()
{
int a=100, *p=&a, **q=&p, ***r=&q;
clrscr();
printf("%d, %d, %d, %d",a,*p, **q, ***r);
getch();
}
```

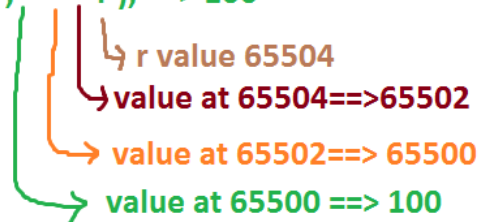
The bottom of the window features a toolbar with function key shortcuts: "F1-Help", "F5-Zoom", "F6-Switch", "F7-Trace", "F8-Step", "F9-Make", and "F10-Run". The Windows taskbar at the very bottom shows the Start button, several application icons (including File Explorer, Calculator, DEV C++, Zoom, Chrome, Word, and Paint), and the system tray with the date and time "10:28 AM 09-Dec-24".



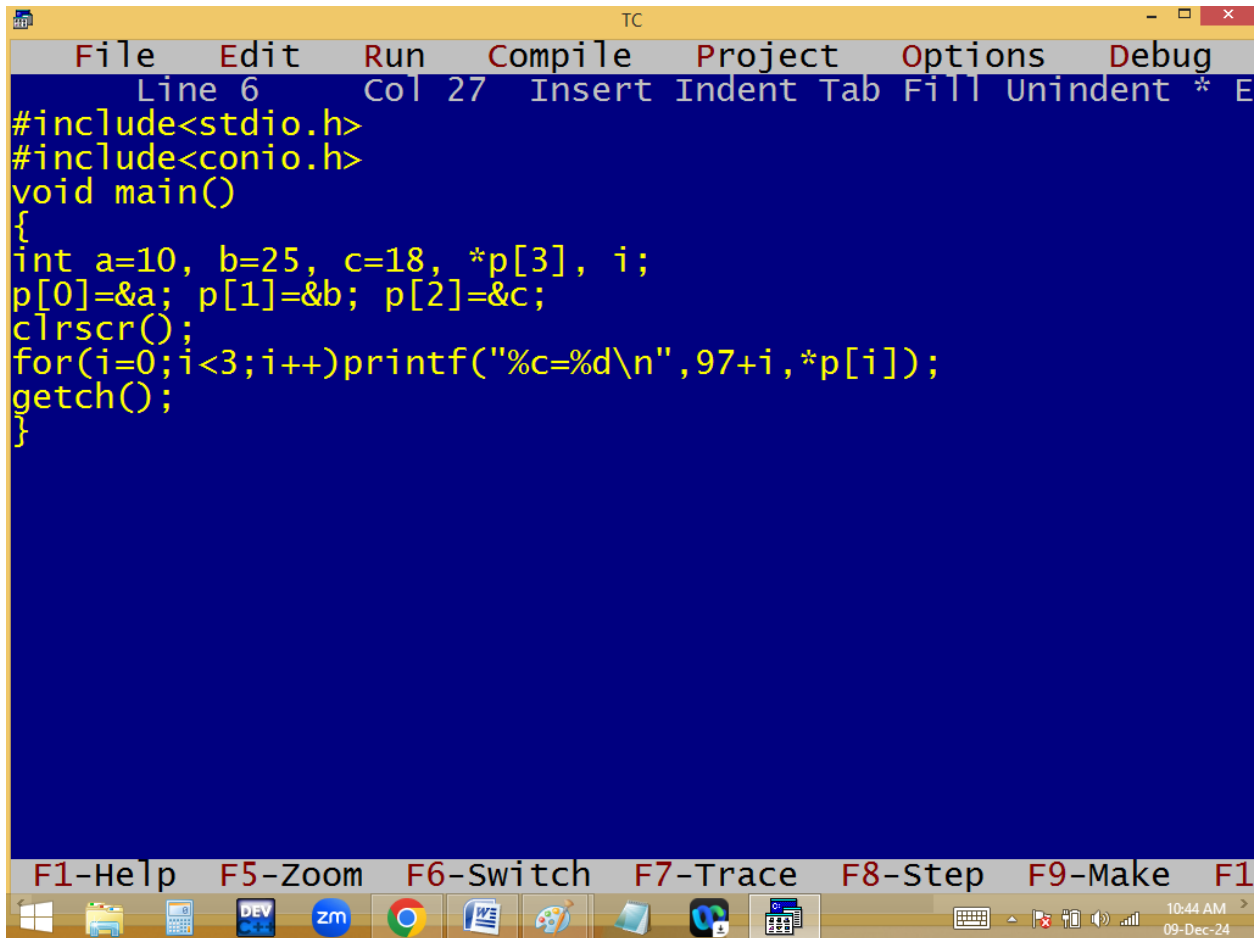
stack

variable	value	addr
r	65504	65506
q	65502	65504
p	65500	65502
a	100	65500

printf(" %d ", * * * r); ==> 100



Array of pointer: Like general variables, we can also declare pointer using array. Due to this we can store multiple variable address in a single pointer. It is used to handle dynamic multi dimensional arrays.



```
TC
File Edit Run Compile Project Options Debug
Line 6 Col 27 Insert Indent Tab Fill Unindent * E
#include<stdio.h>
#include<conio.h>
void main()
{
int a=10, b=25, c=18, *p[3], i;
p[0]=&a; p[1]=&b; p[2]=&c;
clrscr();
for(i=0;i<3;i++)printf("%c=%d\n",97+i,*p[i]);
getch();
}
```

F1-Help F5-Zoom F6-Switch F7-Trace F8-Step F9-Make F10-Run

10:44 AM
09-Dec-24

```
a=10
b=25
c=18
```

