

About C#

- Two languages that are central to .NET framework are C# and Visual Basic.
- It is fundamentally a simple and object oriented language.
- It was developed by Microsoft development team.
- Lot of syntax for C# is obtained C language. C# also shares many similarity with popular Java language, thereby making learning of C# even more simpler.
- Several version of C# have come up starting from 2002. The latest version is C# 10.0. Visual Studio 2022 supports this.

Comments

Single line comment

```
//
```

```
// This is a single line comment
```

Multiline comments

```
/* */
```

```
/* This is a multi  
    line comment */
```

Variables

- Variables are storage locations that are associated with a value.
- The value that a variable stores are of certain data type.
- **Syntax: Datatype var_name;**
- There are different types of variables that can be defined in C# depending on the scope : static variables, instance variables, array elements, and local variables.
- The variables created inside Method are local. They are available only inside the method where they are declared.
- The local variable must always be initialized before using.

Keywords

<code>abstract</code>	<code>event</code>	<code>new</code>	<code>struct</code>	<code>decimal</code>
<code>as</code>	<code>explicit</code>	<code>null</code>	<code>switch</code>	<code>default</code>
<code>base</code>	<code>extern</code>	<code>object</code>	<code>this</code>	<code>int</code>
<code>bool</code>	<code>false</code>	<code>operator</code>	<code>throw</code>	<code>double</code>
<code>break</code>	<code>finally</code>	<code>out</code>	<code>true</code>	<code>else</code>
<code>byte</code>	<code>fixed</code>	<code>override</code>	<code>try</code>	<code>enum</code>
<code>case</code>	<code>float</code>	<code>params</code>	<code>typeof</code>	<code>lock</code>
<code>catch</code>	<code>for</code>	<code>private</code>	<code>uint</code>	<code>long</code>
<code>char</code>	<code>foreach</code>	<code>protected</code>	<code>ulong</code>	<code>namespace</code>
<code>checked</code>	<code>goto</code>	<code>public</code>	<code>unchecked</code>	<code>stackalloc</code>
<code>class</code>	<code>if</code>	<code>readonly</code>	<code>unsafe</code>	<code>static</code>
<code>const</code>	<code>implicit</code>	<code>ref</code>	<code>ushort</code>	<code>string</code>
<code>continue</code>	<code>in</code>	<code>return</code>	<code>using</code>	<code>internal</code>
<code>delegate</code>	<code>interface</code>	<code>sbyte</code>	<code>virtual</code>	<code>is</code>
<code>do</code>	<code>short</code>	<code>sealed</code>	<code>volatile</code>	<code>void</code>
<code>sizeof</code>	<code>while</code>			

C# Data types

- C# like C and C++ is a strongly typed language and so every variable must have a data type.
- Data types in C# are of 2 types
 - Value types
 - Reference types.

C# Data types

- Value types
 - Built in Data types like int, char, float ,double and user defined types like struct or enum
 - For every value type there is a type(Class or Struct) in BCL
 - They are allocated in stack
 - Value types can not contain the value null.

C# Data types

- Reference
 - User defined type created using class or interfaces
 - Reference types are allocated in heap at runtime.
 - Reference types can contain the value null

C# Value Types

Built in Types

- Boolean type
 - `bool`
- Integer types
 - `byte int long sbyte short uint ulong ushort`
- Character type
 - `char`
- Floating point types
 - `decimal double float`

User Defined Types

- `enum`
- `struct`

Integer types

C# type	CLS compliant	System Type	Range
sbyte	No	System.Sbyte	-128 to 127 (signed 8-bit)
byte	Yes	System.Byte	0 to 255 (unsigned 8 bit)
short	Yes	System.Int16	-32768 to 32767 (signed 16 bit)
ushort	No	System.UInt16	0 to 65535 (unsigned 16 bit)
int	Yes	System.Int32	-2147783648(-2^{31}) to 2147483647($2^{31}-1$) (signed 32 bit)
uint	No	System.UInt32	0 to $2^{32}-1$ (unsigned 32 bits)
long	Yes	System.Int64	-2^{63} to $2^{63}-1$ (signed 64 bit number)
ulong	No	System.UInt64	0 to $2^{64}-1$ (unsigned 64 bit number)

Floating point types

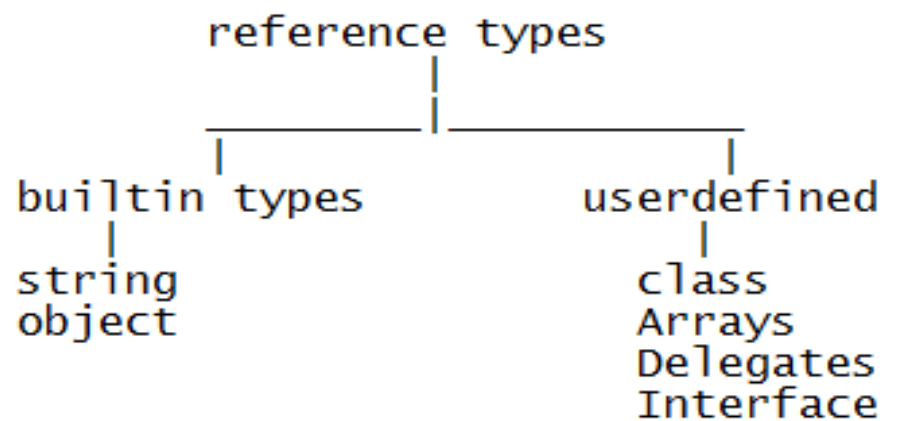
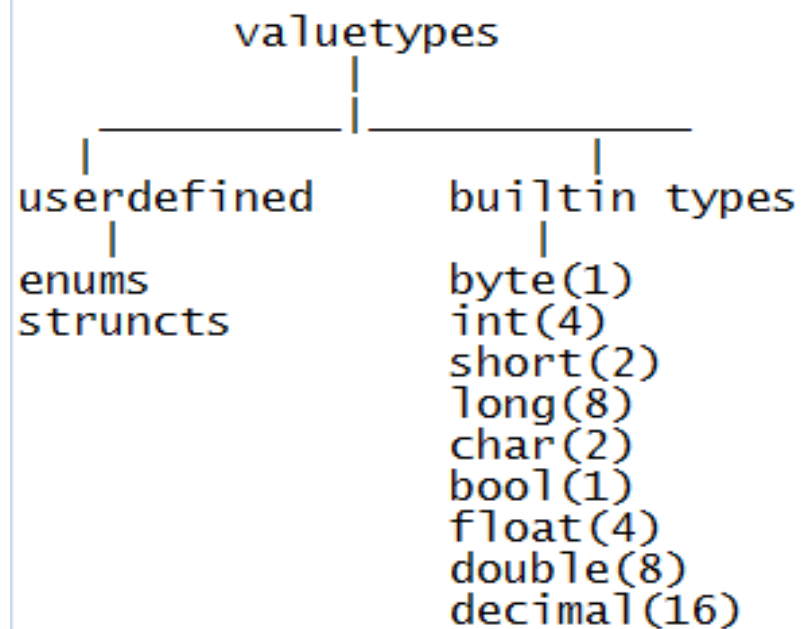
C# type	CLS compliant	System Type	Range
<code>float</code>	Yes	<code>System.Single</code>	1.5×10^{-45} to 3.4×10^{38} (32 bit floating point number)
<code>double</code>	Yes	<code>System.Double</code>	5.0×10^{-324} to 1.7×10^{308} (64 bit floating point number)
<code>decimal</code>	Yes	<code>System.Decimal</code>	$\pm 1.0 \times 10^{-28}$ to $\pm 7.9 \times 10^{28}$ (28-29 significant digits)

Floating-point literals

- Floating-point literals can be written in two ways
 - Fixed notation: 3.14
 - Scientific notation: 0.314E1, 314e-2
- Floating-point literal types
 - Literal with no suffix → is **double**
 - Literal with F or f as suffix (Example 3.14f, 3.14F) → is **float**
 - Literal with D or d as suffix (Example 3.14D, 3.14D) → is **double**
 - Literal with M or m as suffix (Example 3.14m, 3.14M) → is **decimal**
- `decimal d = 3.45; //error`
- `decimal d = 3.45m; //ok`
- `float f = 3.4; // error`
- `float f = 3.4f; // ok`

Character type and Character Literal

- **char** keyword is alias for **System.Char**
- It is CLS compliant.
- **char c='a' ; //ok**
- **char c=1; //error**



Identifiers Naming Rules

- Identifiers are variables, methods , class or any other named constructs in C#
- Rules
 - Should not be a keyword
 - Must start with a letter or underscore or @
 - Subsequent characters can be a letter, number or underscore

Operators

Operators-Arithmetic

+	-	/	*	++	--	%
---	---	---	---	----	----	---

- Most of the operators work the same way as it does in C.
- Applicable to integer and floating point types
- ```
int i = 10;
int j = i + 255;
byte k = i + 255; //error
```
- ```
const double PI = 3.14;  
double f = PI + 12;
```
- When 2 of any integral types (other than long) are involved in arithmetic operation, the result is an int.

```
byte i = 10;  
byte j = 20;  
j=j+i; //error
```


Operators-Relational

==

!=

<

>

>=

<=

- Relational operator return bool value – true or false.

```
int i=10;
```

```
int j=20;
```

```
Console.WriteLine( i>j ); // output is False
```

```
Console.WriteLine(i == 10); // output is True
```

Operators-Logical

&& || !

- These are both boolean operators. These work only on bool values.
- **&&** checks if the first condition is false. If it is so then it doesn't evaluate the second condition.
- **||** checks if the first condition is true. If it is so then it doesn't evaluate the second condition.

```
int i=0;  
int j=2;  
bool b= (i>j) && (j++>i);  
Console.WriteLine(j);
```

What does the code print?

Assignment Operators

= += -= *= /= %=

```
int a = 10;
int b=2;
a+=b; // 12 same as a=a+b;
Console.WriteLine(a);

double d=45.3;
d/=1.2;
Console.WriteLine(d); // 37.75 same as d=d/1.2

float d1=2.4f;
d1 %= 1.2f;
Console.WriteLine(d1); // 0
```

Other Operators

Operator	Name	Example
? :	Ternary operator	10 % 2 > 0 ? 1 : 10
[]	Array subscript	a[1]
()	Cast	
.	dot operator	n.Length
is	Type Conversion	
as		
typeof	In refaction	
new		
checked		
unchecked		
=>	Lambda	

Conversion

Conversions

- Type conversion is a process of converting values from one data type to another data types
- Conversion types:
 - Implicit Conversion
 - Casting
 - Boxing
 - Un Boxing

Implicit Conversions

Implicit numerical conversions

- `byte` → `short`, `int`, `long`, `float`, `double`, `decimal`
- `char` → `int`, `long`, `float`, `double`, `decimal`
- `short` → `int`, `long`, `float`, `double`, `decimal`
- `int` → `long`, `float`, `double`, `decimal`
- `long` → `float`, `double`, `decimal`
- `float` → `double`

Example

- using System;
- class Convert{
- public static void Main(){
- char c='A';
- int i=c; vice versa is not allowed implicitly
- Console.WriteLine(i);
- long l=23456789100;
- float f=l;
- Console.WriteLine(f);
- }}

```
65
2.345679E+10
Press any key to continue . . .
```


Casting

- Any conversion that happens in the opposite direction of implicit numerical conversions requires explicit request from the compiler through casting.
- Casting
 - Number casting example

```
long l2 = 12500;
```

```
int i2 = (int)l2;
```

- ```
int i = 256;
```

```
byte b1 = (byte)i;
```

# Casting

- floating point cast to int example

```
float f=12.f;
```

```
int i2 = (int)f;
```

Example 1:

```
float b1 = 1f; int b2 = 2;
```

```
float b3 = b1 + b2;
```

Example 2:

```
long b1 = 1; double b2 = 2;
```

```
double b3 = b1 + b2;
```

Example 3:

```
double b2 = 2;
```

```
int a3 = (int)b2;
```

# Convert

- Note that conversions of numeric value to string and vice versa, bool to string and vice versa etc. is not possible either implicitly or explicitly.
- This can be done through the methods below:

Example:

```
/* Boolean values */
ii= Convert.ToBoolean("true");
 Console.WriteLine(ii); //True
ii = Convert.ToBoolean("gg");
 Console.WriteLine(ii); // Runtime error call
 //FormatException
```

# Convert

```
/* String values */
 string s= Convert.ToString(true);
 Console.WriteLine(s); //True
 s = Convert.ToString(1.23);
 Console.WriteLine(s); //1.23
 s = Convert.ToString('A');
 Console.WriteLine(s); //A
 Console.WriteLine(Convert.ToString(null));
// prints nothing
/* Numeric Values */
 int i = Convert.ToInt32("1009");
 short j = Convert.ToInt16("100");
 long k = Convert.ToInt64("9292929");
 byte b=Convert.ToByte("20");
 No ToFloat method!
 double d=Convert.ToDouble("sss"); // runtime
```

error

# Parse() Method

- Another way to convert strings to basic type is by using System Type
- Every System Type has Parse() method that can be used to convert a string into the respective System Type.
- <Type>. Parse(string s)

Where <Type> could be any System Type/ C# type that we looked at earlier.

- using System;
- class ParseTest{
- static void Main(string[] args) {
- sbyte i1= sbyte.Parse("123");
- float f1= float.Parse("123.3");
- decimal d1= decimal.Parse("123.45");
- bool b= bool.Parse("true");
- Console.WriteLine("{0}, {1}, {2}, {3}, {4}, {5}, {6}", i1, f1, d1, b);
- }}

# Boxing And Unboxing

- Boxing and unboxing allows a value-type to be converted to and from type object.
- Converting a value type to reference type is called Boxing. Boxing is implicit conversion.

```
int i = 1;
object o = (object)i; // boxing
```

Or simply `object o=i;`

- And reverse is unboxing

```
o = 1;
i = (int)o; // unboxing
```

- Unboxing is explicit conversion.
- When value-type are boxed they are stored in heap.
- Boxing and unboxing are computationally expensive processes.

# Conditional Statement & Loops

# Decision constructs: if statement

- `if` statement

```
if (Condition) ← Condition must evaluate to bool value
{
 statements;
}
```



# Decision constructs: if-else statement

- **if/else statement**

```
if(Condition) ← Condition must evaluate to bool value
{
 statements;
}
[
else{
 statements;
}
]
```

- **Example:** `if (c > 0) c++; else c--;`

# Decision constructs: switch statement

- switch statement

```
switch (var)
{
 case val1:
 statements;
 break;
 case val2:
 statements;
 break;

 default: statements;
 break; }
```

Any numeric value or string

constants

# Example

```
char c;
c = char.Parse(Console.ReadLine());
switch(c) {
 case 'r': Console.WriteLine("RED");
 break;
 case 'g': Console.WriteLine("GREEN");
 break;
 case 'b': Console.WriteLine("BLUE");
 break;
}
```

- C# compiler enforces that every case statement must have a `break` statement. In other words control cannot fall through from one case label to another.

# Multiple Cases

```
char c;
 c = char.Parse(Console.ReadLine());
switch(c) {
 case 'r':
 case 'R': Console.WriteLine("RED");
 break;

 case 'g':
 case 'G': Console.WriteLine("GREEN");
 break;

 case 'b':
 case 'B': Console.WriteLine("BLUE");
 break;}
}
```

# Looping Statements- for statement

There are two forms of `for` statement

## 1. for loop

```
for(intialization; condition; increment/decrement) {
 //statements
}
```

Ex: `for(int i=0;i<10;i++)`

## 2. foreach loop:

```
foreach(object variable in itemlist){
 //statements
}
```

Ex: `int[] arr={1,2,3,4,5};`

```
 foreach(int s in arr)
 Console.WriteLine(s);
```

# while and do while

// while loop

```
while(Condition) {
 statements
}
```

Ex: int i=0;

```
while(i<10) {
 Console.WriteLine(i);
 i++;
}
```

Condition must evaluate to bool value



do-while loop

```
do{
 statements
}while(Condition);
```

Ex: int i=0;

```
do {
 Console.WriteLine(i);
 i++;
} while(i<10);
```

# break and continue

- Used with loop statements
- `break` is used to break out of the loop. Is used with switch statement also.
- `continue` is used to exit out of current iteration and continue with the next iteration.

```
int j = 100;
while (true)
{
 if (j % 13 == 0) break;
 else
 j++;

 Console.WriteLine(j); //104
```