Generics in C#

In c#, **generic** is a type used to define a [class](https://www.tutlane.com/tutorial/csharp/csharp-classes-and-objects-with-examples), [structure](https://www.tutlane.com/tutorial/csharp/csharp-structures-structs), [interface](https://www.tutlane.com/tutorial/csharp/csharp-interface), or [method](https://www.tutlane.com/tutorial/csharp/csharp-methods-functions-with-examples) with **placeholders** (type parameters) to indicate that they can store or use one or more of the types. In c#, the compiler will replace placeholders with the specified type at compile time.

In c#, we will mostly use generics with [collections](https://www.tutlane.com/tutorial/csharp/csharp-collections) and the [methods](https://www.tutlane.com/tutorial/csharp/csharp-methods-functions-with-examples) that operate on them to specify a type of objects to be stored in a [collection](https://www.tutlane.com/tutorial/csharp/csharp-collections). The generics are introduced in .NET Framework 2.0 with a new [namespace](https://www.tutlane.com/tutorial/csharp/csharp-namespaces-with-examples) called **System.Collections.Generic**.

In c#, generics are useful for improving code reusability, type safety, and performance compared with [non-generic types](https://www.tutlane.com/tutorial/csharp/csharp-collections) such as [arraylist](https://www.tutlane.com/tutorial/csharp/csharp-arraylist).

Type safety in .NET has been introduced to prevent the objects of one type from peeking into the memory assigned for the other object. Writing safe code also means to prevent data loss during conversion of one type to another.

C# Generics Declaration

To define a [class](https://www.tutlane.com/tutorial/csharp/csharp-classes-and-objects-with-examples) or [method](https://www.tutlane.com/tutorial/csharp/csharp-methods-functions-with-examples) as generic, we need to use a type parameter as a placeholder with angle (**<>**) brackets.

Following is the example of defining a generic class with type parameter (**T**) as a placeholder with an angle (**<>**) brackets.

public class GenericClass<T>  
{  
    public T msg;  
    public void genericMethod(T name, T location)  
    {  
       Console.WriteLine("{0}", msg);  
       Console.WriteLine("Name: {0}", name);  
       Console.WriteLine("Location: {0}", location);  
    }  
}

If you observe the above class, we created a class (**GenericClass**) with one parameter (**msg**) and method (genericMethod) using type parameter (**T**) as a placeholder with an angle (**<>**) brackets.

Here, the angle (**<>**) brackets will indicate a **GenericClass** is generic, and type parameter (**T**) is used to accept a requested type. The type parameter name can be anything like **X** or **U**, etc., based on our requirements.

Generally, while creating an instance of the class, we need to specify an actual type, then the compiler will replace all the type parameters such as **T** or **U** or **X**, etc., with specified actual type. In c#, the following is the example of creating an instance of a generic class.

// Instantiate Generic Class, string is the type argument  
GenericClass<string> gclass = new GenericClass<string>();  
gclass.msg = "Welcome to Tutlane";  
gclass.genericMethod("Suresh Dasari", "Hyderabad");

If you observe the above code, we are sending a type as “**string**” so the compiler will substitute all the type parameters (**T**) with defined type “**string**” and our class (**GenericClass**) will be like as shown below.

public class GenericClass  
{  
    public string msg;  
    public void genericMethod(string name, string location)  
    {  
       Console.WriteLine("{0}", msg);  
       Console.WriteLine("Name: {0}", name);  
       Console.WriteLine("Location: {0}", location);  
    }  
}

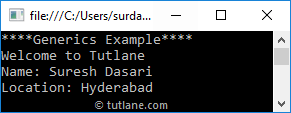
In c#, we can also create our own custom generic types and methods to provide our own generalized solutions that are type-safe and efficient.

C# Generic Class Example

Following is the example of creating a generic class using type parameter (**T**) with angle (**<>**) brackets in c# programming language.

using System;  
  
namespace Tutlane  
{  
    public class GenericClass<T>  
    {  
        public T msg;  
        public void genericMethod(T name, T location)  
        {  
            Console.WriteLine("{0}", msg);  
            Console.WriteLine("Name: {0}", name);  
            Console.WriteLine("Location: {0}", location);  
        }  
    }  
    class Program  
    {  
        static void Main(string[] args)  
        {  
            Console.WriteLine("\*\*\*\*Generics Example\*\*\*\*");  
            // Instantiate Generic Class, string is the type argument  
            GenericClass<string> gclass = new GenericClass<string>();  
            gclass.msg = "Welcome to Tutlane";  
            gclass.genericMethod("Suresh Dasari", "Hyderabad");  
            Console.ReadLine();  
        }  
    }  
}

When you execute the above c# program, you will get the result as shown below.



This is how we can use generics in c# to create generic classes or methods based on our requirements.

C# Generic Class as Base / Derived Class

In c#, you can use the generic class as a [base](https://www.tutlane.com/tutorial/csharp/csharp-base-keyword) class, but we need to provide a type instead of type parameter for the [base](https://www.tutlane.com/tutorial/csharp/csharp-base-keyword) class because there is no way to send a required type argument to instantiate a base class at run time.

Following is the example of using a generic class as a [base](https://www.tutlane.com/tutorial/csharp/csharp-base-keyword) class in the c# programming language.

// No Error  
class DClass1 : GenericClass<string> {  
// implementation  
}  
// Compile Time Error  
//class DClass2 : GenericClass<T> {  
// implementation  
//}

If derived class is generic, then we don’t need to specify a type for the generic base class instead, we can use the type parameter (**T**).

Following is the example of defining a generic derived class in the c# programming language.

// No Error  
class DClass1 : GenericClass<string> {  
// implementation  
}  
// No Error  
class DClass2<T> : GenericClass<T> {  
// implementation  
}

C# Generic Methods

In c#, if we define a [method](https://www.tutlane.com/tutorial/csharp/csharp-methods-functions-with-examples) with a type parameter, then it is called a **generic method**. Following is the example of defining a generic method with a type parameter using angle (**<>**) brackets.

public void genericMethod<T>(T a, T b)  
{  
// Implementation  
}

This generic method can be called either by specifying the type of argument or without an argument like as shown below.

genericMethod<int>(1, 2);  
  
//or  
  
genericMethod(1, 2);

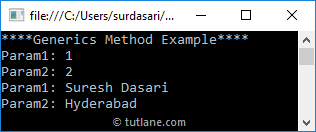
C# Generic Method Example

In c#, you can call a generic method by passing any type of argument. Following is the example of defining a generic method in the c# programming language.

using System;  
  
namespace Tutlane  
{  
     public class SampleClass  
     {  
         public void GMethod<T>(T a, T b)  
         {  
            Console.WriteLine("Param1: {0}", a);  
            Console.WriteLine("Param2: {0}", b);  
         }  
     }  
     class Program  
     {  
        static void Main(string[] args)  
        {  
            Console.WriteLine("\*\*\*\*Generics Method Example\*\*\*\*");  
            SampleClass s = new SampleClass();  
            s.GMethod<int>(1, 2);  
            s.GMethod("Suresh Dasari", "Hyderabad");  
            Console.ReadLine();  
        }  
     }  
}

If you observe the above code, we call our generic method (**GMethod**) with or without type parameters and send different types of arguments based on our requirements.

When you execute the above c# program, you will get the result as shown below.



This is how you can define generic methods in the c# programming language based on our requirements.

C# Generic Delegates

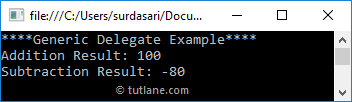
In c#, a generic [delegate](https://www.tutlane.com/tutorial/csharp/csharp-delegates) will be same as a normal [delegate](https://www.tutlane.com/tutorial/csharp/csharp-delegates), but the only difference is a generic [delegate](https://www.tutlane.com/tutorial/csharp/csharp-delegates) will have a generic type with angle (<>) brackets.

Following is the example of defining a generic delegate in the c# programming language.

using System;  
  
namespace Tutlane  
{  
    // Declare Generic Delegate  
    public delegate T SampleDelegate<T>(T a, T b);  
    class MathOperations  
    {  
       public int Add(int a, int b)  
       {  
          return a + b;  
       }  
       public int Subtract(int x, int y)  
       {  
          return x - y;  
       }  
    }  
    class Program  
    {  
       static void Main(string[] args)  
       {  
          Console.WriteLine("\*\*\*\*Generic Delegate Example\*\*\*\*");  
          MathOperations m = new MathOperations();  
          // Instantiate delegate with add method  
          SampleDelegate<int> dlgt = new SampleDelegate<int>(m.Add);  
          Console.WriteLine("Addition Result: " + dlgt(10, 90));  
          // Instantiate delegate with subtract method  
          dlgt = m.Subtract;  
          Console.WriteLine("Subtraction Result: " + dlgt(10, 90));  
          Console.ReadLine();  
       }  
    }  
}

If you observe the above code, we defined a delegate (**SampleDelegate**) with generic type parameter (**T**) using angle (**<>**) brackets and accessing it by creating an instance of [delegate](https://www.tutlane.com/tutorial/csharp/csharp-delegates) with a required argument (**int**).

When you execute the above c# program, you will get a result, as shown below.



This is how we can use generics with [delegates](https://www.tutlane.com/tutorial/csharp/csharp-delegates) based on our requirements in the c# programming language.

C# Generics Overview

The following are the important properties of generics in the c# programming language.

* In c#, generics are represented by using angle bracket **<>**.
* To define a [class](https://www.tutlane.com/tutorial/csharp/csharp-classes-and-objects-with-examples) or [method](https://www.tutlane.com/tutorial/csharp/csharp-methods-functions-with-examples) as generic, we need to use a type parameter as a placeholder with angle (**<>**) brackets.
* The compiler will replace all the placeholders with the specified type at compile time.
* In c#, generics are useful for improving the code reusability, type safety, and performance compared with non-generic types such as [arraylist](https://www.tutlane.com/tutorial/csharp/csharp-arraylist" \o "C# ArrayList with Examples" \t "_blank).
* In c#, you can use generics with [interfaces](https://www.tutlane.com/tutorial/csharp/csharp-interface), [classes](https://www.tutlane.com/tutorial/csharp/csharp-classes-and-objects-with-examples), [methods](https://www.tutlane.com/tutorial/csharp/csharp-methods-functions-with-examples), [properties](https://www.tutlane.com/tutorial/csharp/csharp-properties-get-set), [delegates](https://www.tutlane.com/tutorial/csharp/csharp-delegates), [events](https://www.tutlane.com/tutorial/csharp/csharp-events), and [operators](https://www.tutlane.com/tutorial/csharp/csharp-operators-arithmetic-relational-logical-assignment-precedence).