

В.В. Подбельский

# Иллюстрации к курсу лекций по дисциплине «Программирование»

## C#\_19 **Generics**

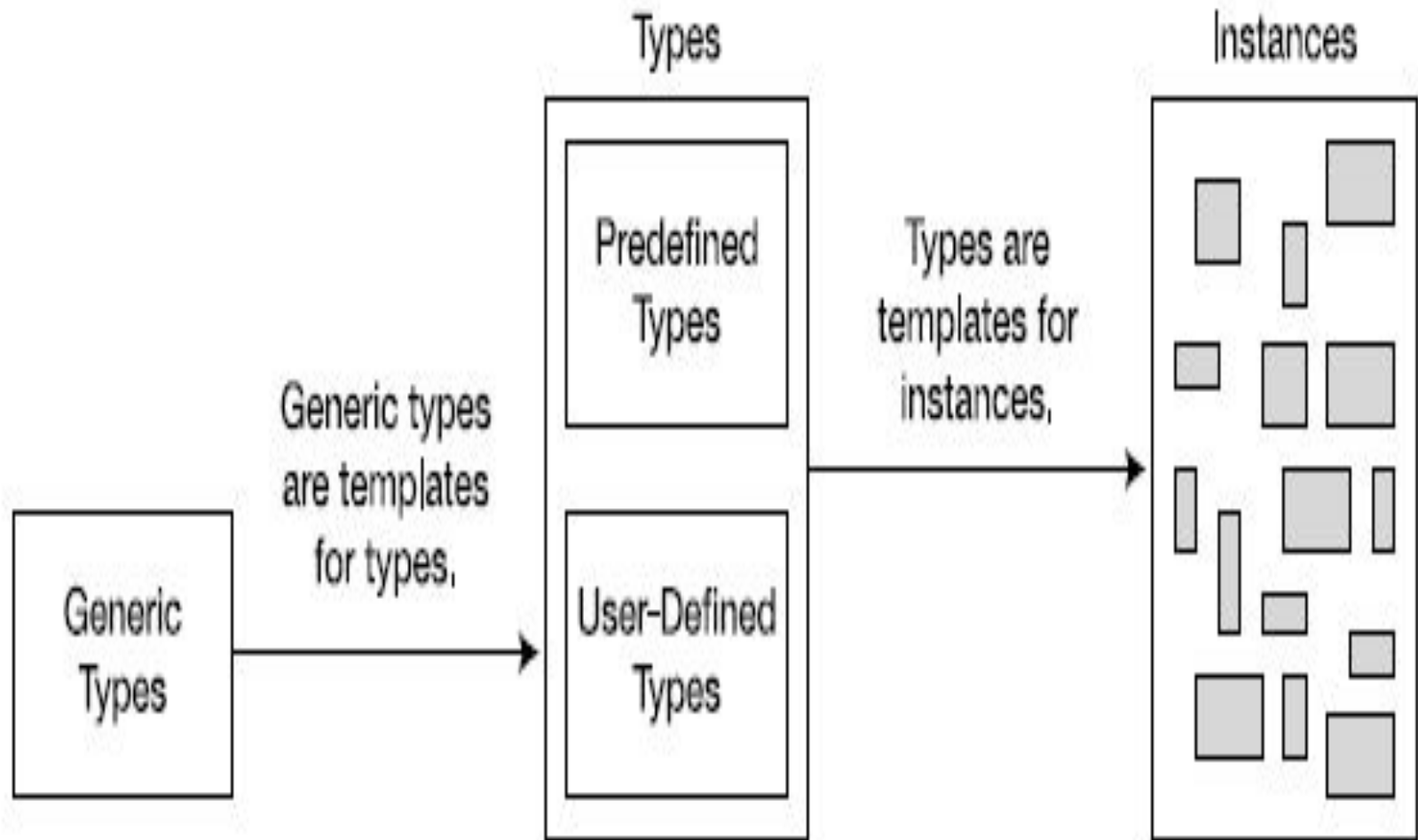
Использованы материалы пособия Daniel Solis, Illustrated C# 2008.

## **Обобщения**

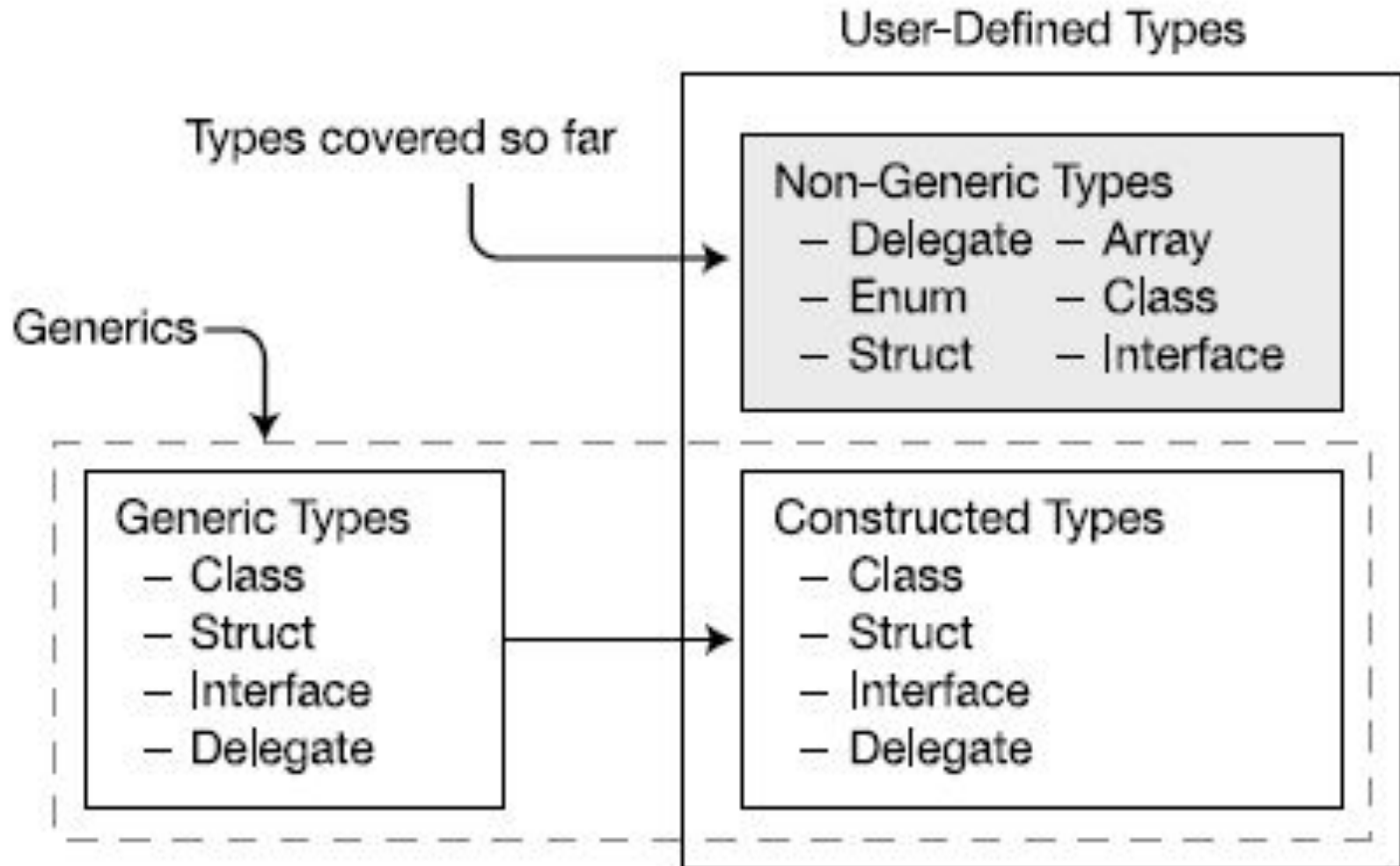
## 19.1. Стек для чисел

```
class MyFloatStack    // Stack for floats
{
    int StackPointer = 0;
    float [] StackArray;    // Array of float
    ↑      float
    float      ↓
    public void Push( float x ) // Input type: float
    { ... }
    float
    ↓
    public float Pop()    // Return type: float
    { ... }
    ...
}
```

## 19-2. Generic types are templates for types



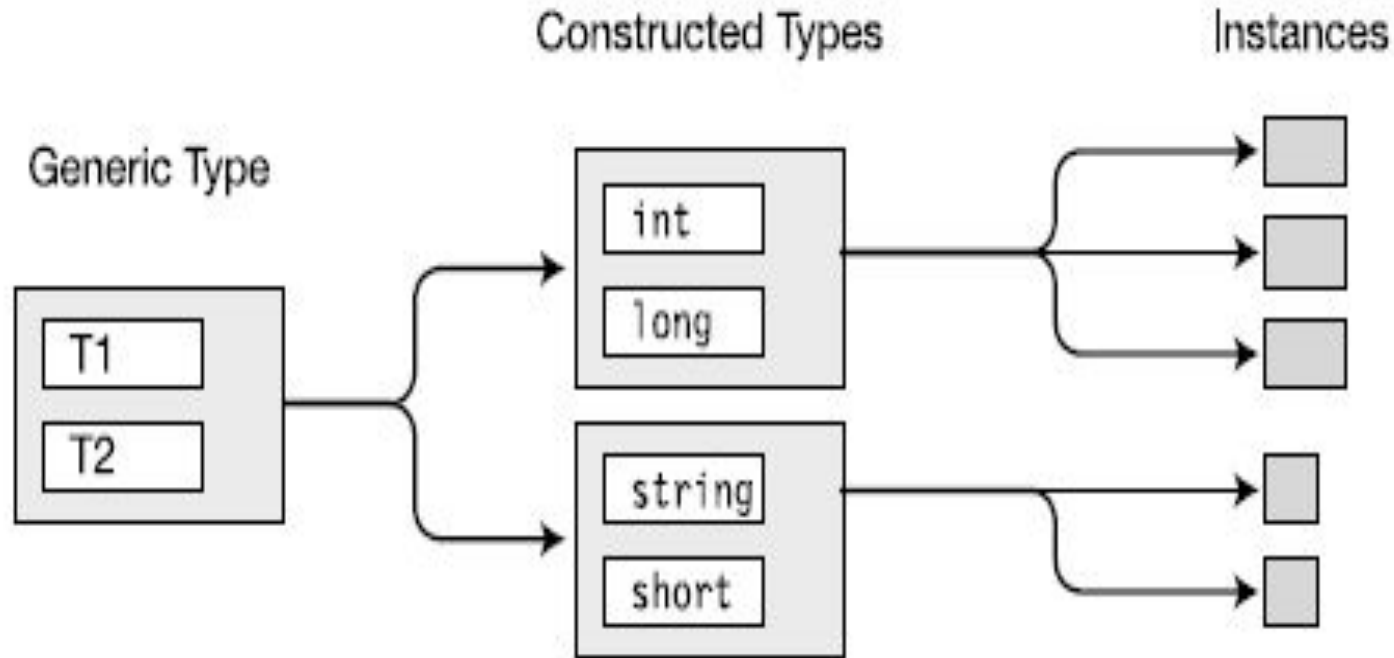
## 19-3. Generics and user-defined types



## 19-4. Continuing with the Stack Example

```
class MyStack <T>
{
    int StackPointer = 0;
    T [] StackArray;
    public void Push(T x ) {...}
    public T Pop() {...}
    ...
}
```

# 19-5. Creating instances from a generic type



① Declare generic type.

② Create constructed types by supplying actual types.

③ Create instances from the constructed types.

## 19-6. Declaring a Generic Class

Type parameters



```
class SomeClass < T1, T2 >
```

{ Normally, types would be used in these positions.



```
public T1 SomeVar = new T1();
```

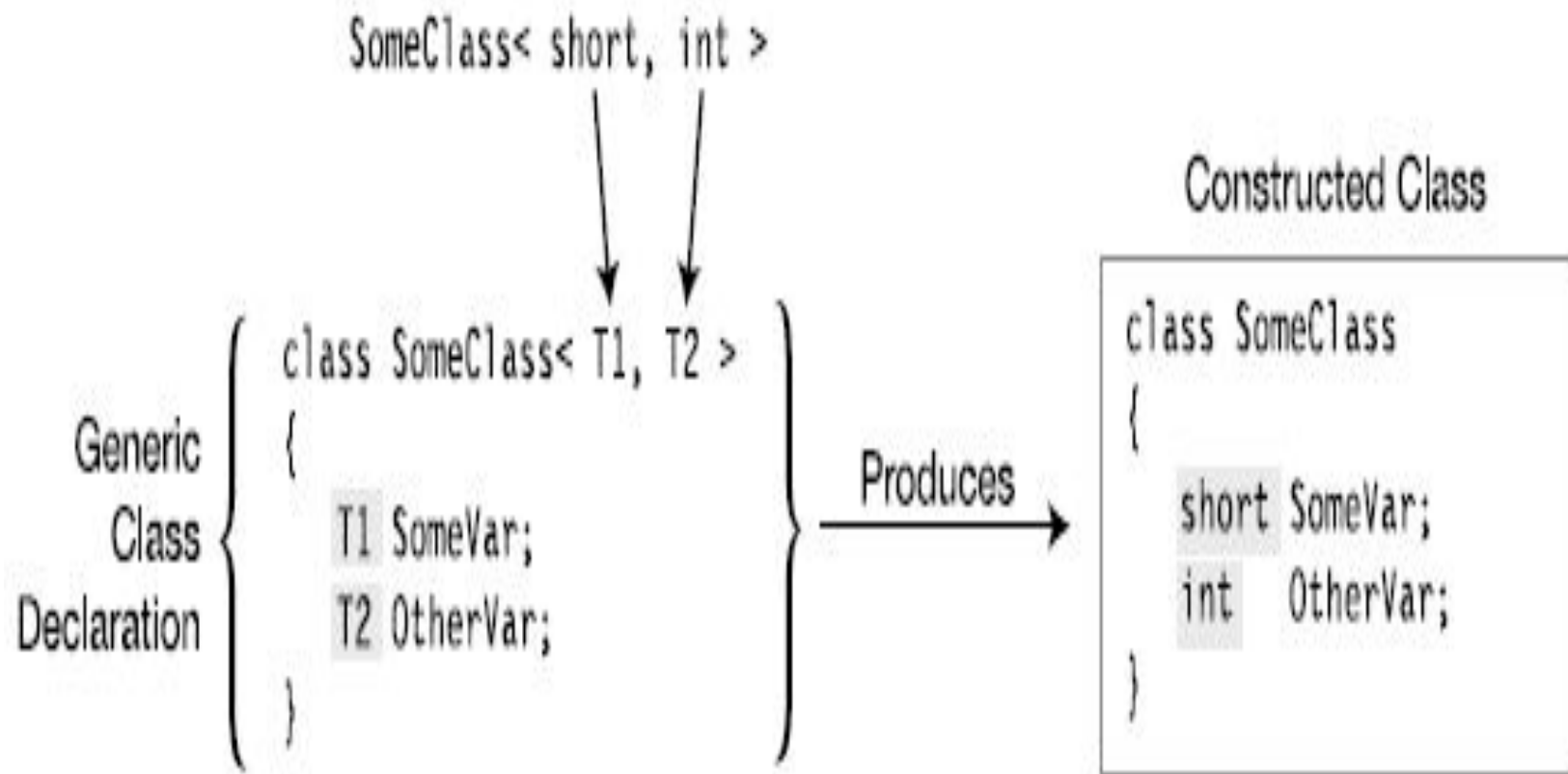
```
public T2 OtherVar = new T2();
```

```
}
```



Normally, types would be used in these positions.

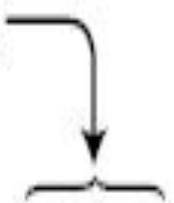
# 19-7. Creating a Constructed Type





# 19-8. Type parameters versus type arguments

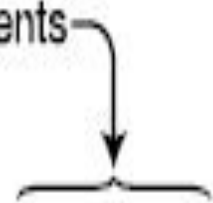
Type Parameters



```
class SomeClass< T1, T2 >  
{  
    ...  
}
```

Generic Class Declaration

Type Arguments



```
SomeClass< short, int >
```

Constructed Type

## 19-9. Creating Variables and Instances

```
MyNonGenClass myNGC = new MyNonGenClass ();
```

Constructed class

Constructed class



```
SomeClass<short, int> mySc1 = new SomeClass<short, int>();  
var mySc2 = new SomeClass<short, int>();
```

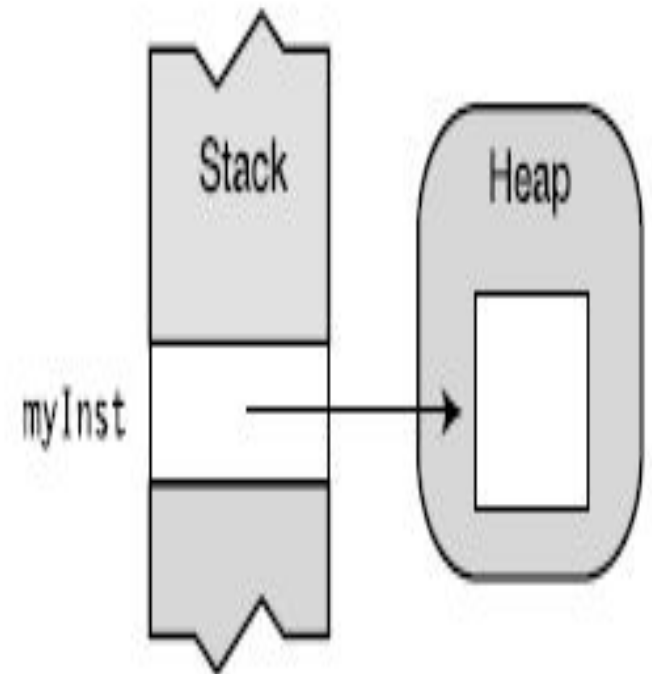
# 19-10.

```
class SomeClass< T1, T2 >
{
    public T1 SomeVar;
    public T2 OtherVar;
}
...
SomeClass< short, int > myInst;
myInst = new SomeClass< short, int >( );
```

Generic Class Declaration

Allocate class variable

Allocate instance



## 19-11. *Two constructed classes created from a generic class*

```
class SomeClass< T1, T2 >  
{  
    T1 SomeVar;  
    T2 OtherVar;  
}
```

```
...  
var first = new SomeClass<short, int> ( );
```

```
var second = new SomeClass<int, long> ( );
```

```
...
```

```
class SomeClass <short,int>  
{  
    short SomeVar;  
    int OtherVar;  
}
```

```
class SomeClass <int,long>  
{  
    int SomeVar;  
    long OtherVar;  
}
```

## 19-12. Constraints on Type Parameters

```
class Simple<T>
{
    static public bool LessThan(T i1, T i2)
    {
        return i1 < i2; // Error
    }
    ...
}
```

## 19-13. Where Clauses

Type parameter

Constraint list

↓ ↓  
where *TypeParam* : *constraint, constraint, ...*

↑  
Colon

nbounded

With constraints

↓ ↓ No separators

class MyClass < T1, T2, T3 > ↓  
where T2: Customer // Constraint for T2  
where T3: Comparable // Constraint for T3  
{  
...  
}

↑  
No separators

# 19-14. Constraint Types and Order

Constraint Type	Description
<i>ClassName</i>	Only classes of this type, or classes derived from it, can be used as the type argument.
class	Any reference type, including classes, arrays, delegates, and interfaces, can be used as the type argument.
struct	Any value type can be used as the type argument.
<i>Interface Name</i>	Only this interface, or types that implement this interface, can be used as the type argument.
new()	Any type with a parameterless public constructor can be used as the type argument. This is called the <i>constructor constraint</i> .

**19-15. *If a type parameter has multiple constraints, they must be in this order.***

Primary  
(0 or 1)

$\left\{ \begin{array}{l} \text{ClassName} \\ \text{class} \\ \text{struct} \end{array} \right\}$

Secondary  
(0 or more)

$\left\{ \text{InterfaceName} \right\}$

Constructor  
(0 or 1)

$\left\{ \text{new}() \right\}$



## 19-16. Правила задания ограничений

```
class SortedList<S>  
    where S: IComparable<S> { ... }  
class LinkedList<M,N>  
    where M : IComparable<M>  
    where N : ICloneable { ... }  
class MyDictionary<KeyType, ValueType>  
    where KeyType : IEnumerable,  
        new() { ... }
```

## 19-17. Generic Structs

```
struct PieceOfData<T> // Generic struct
{
    public PieceOfData(T value) { _Data = value; }
    private T _Data;
    public T Data
    {
        get { return _Data; }
        set { _Data = value; }
    }
}
```

## 19-18. Generic Structs

```
class Program {  
    static void Main()    Constructed type  
    {  
        ↓  
        var intData = new PieceOfData<int>(10);  
        var stringData = new PieceOfData<string>("Hi there.");  
        ↑  
        Constructed type  
        Console.WriteLine("intData = {0}", intData.Data);  
        Console.WriteLine("stringData = {0}", stringData.Data);  
    }  
}
```

# 19-19. Generic Interfaces

Type parameter



```
interface IMylfc<T>           // Generic interface
{ T ReturnIt(T inValue); }
```

Type parameter    Generic interface



```
class Simple<S> : IMylfc<S>   // Generic class
{
public S ReturnIt(S inValue)   // Implement interface
{ return inValue; }
}
```

## 19-20. Generic Interfaces

```
class Program{  
    static void Main(){  
        var trivInt = new Simple<int>();  
        var trivString = new Simple<string>();  
        Console.WriteLine("{0}", trivInt.ReturnIt(5));  
        Console.WriteLine("{0}", trivString.ReturnIt("Hi there."));  
    }  
}
```

This code produces the following output:

5

Hi there.

# 19-21. Using Generic Interfaces

```
interface IMylfc<T>                // Generic interface
{  T ReturnIt(T inValue);  }
```

Two different interfaces from the same generic interface



```
class Simple : IMylfc<int>, IMylfc<string> // Non-generic class
{
  public int ReturnIt(int inValue) /      / Implement int interface
  { return inValue; }
  public string ReturnIt(string inValue) // Implement string interface
  { return inValue; }
}
```

## 19-22. Using Generic Interfaces

```
class Program {  
    static void Main() {  
        Simple trivInt = new Simple();  
        Simple trivString = new Simple();  
        Console.WriteLine("{0}", trivInt.ReturnIt(5));  
        Console.WriteLine("{0}", trivString.ReturnIt("Hi there."));  
    }  
}
```

This code produces the following output:

5

Hi there.

## 19-23. Duplicate interface

```
interface IMylfc<T> {    T ReturnIt(T inValue); }
```

```
class Simple<S> : IMylfc<int>, IMylfc<S>    {// Error!
public int ReturnIt(int inValue)           // Implement first interface.
    {return inValue; }
public S ReturnIt(S inValue)   // Implement second interface,
    {return inValue; }      // but if it's int, it would be
                           // the same as the one above.
}
```



# 19-24. Generic Delegates

Type parameters



```
delegate R MyDelegate<T, R>( T value );
```



Return type



Delegate formal parameter

## 19-25. Generic delegate and matched delegate methods

```
delegate void MyDelegate<T>(T value); // Generic delegate
```

```
class Simple {  
    static public void PrintString(string s)  
    { Console.WriteLine(s);}  
    static public void PrintUpperString(string s)  
    { Console.WriteLine("{0}", s.ToUpper()); }  
}
```

## 19-26. Generic Delegate

```
class Program {  
    static void Main( ) {  
        var myDel =                // Create inst of delegate  
            new MyDelegate<string>(Simple.PrintString);  
        myDel += Simple.PrintUpperString;    // Add a method.  
        myDel("Hi There."); // Call delegate  
    }  
}
```

This code produces the following output:

Hi There.

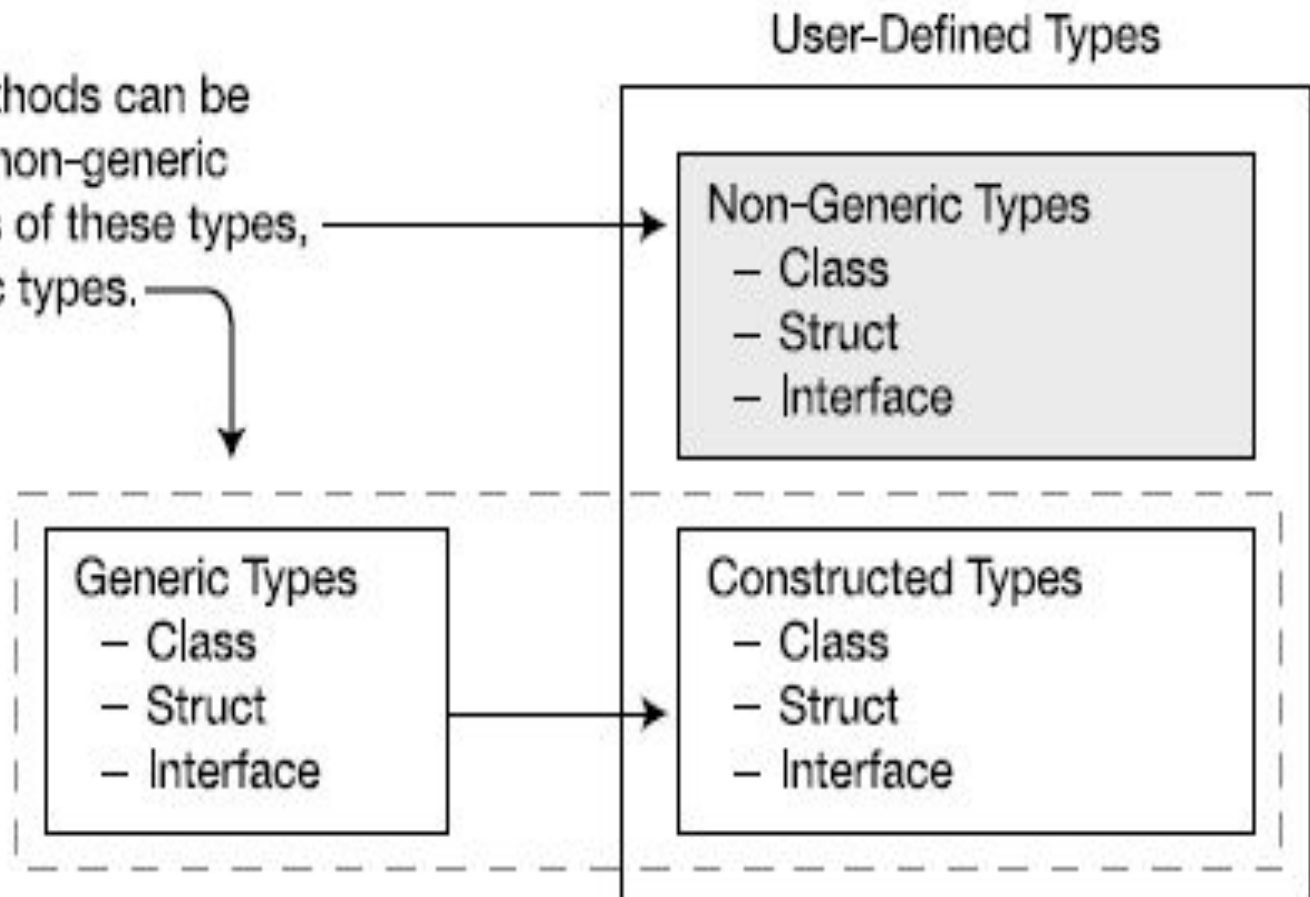
HI THERE.

## 19-27. Generic Delegate

```
public delegate TR Func<T1, T2, TR>(T1 p1, T2 p2);  
class Simple {  
    static public string PrintString(int p1, int p2)  
    {int total = p1 + p2;    return total.ToString(); }  
}  
class Program {  
    static void Main() {  
        var myDel = new Func<int, int, string>(Simple.PrintString);  
        Console.WriteLine("Total: {0}", myDel(15, 13));  
    }  
}
```

# 19-28. Generic Methods

Generic methods can be included in non-generic declarations of these types, or in generic types.



# 19-29. Declaring a Generic Method

Type parameter list

Constraint clauses



```
public void PrintData<S, T> ( S p ) where S: Person  
{  
    ....  
}
```



Method parameter list

# 19-30. Invoking a Generic Method

Объявление обобщенного метода:

```
void MyMethod<T1, T2>() {  
    T1 someVar;  
    T2 otherVar;  
    ...  
}
```

**Type arguments**



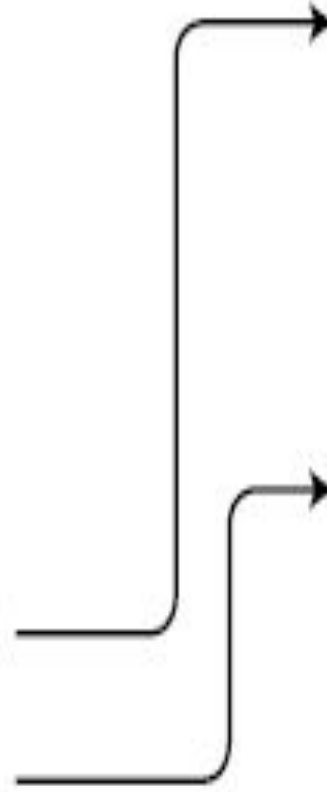
```
MyMethod<short, int>();  
MyMethod<int, long >();
```

## 19-31. A generic method with two instantiations

```
void DoStuff< T1, T2 >( )  
{  
    T1 SomeVar;  
    T2 OtherVar;  
    ...  
}
```

```
...  
DoStuff< short, int > ( );
```

```
DoStuff< int, long > ( );
```



```
void DoStuff <short,int >( ) {  
    short SomeVar;  
    int OtherVar;  
    ...  
}
```

```
void DoStuff <int,long >( ) {  
    int SomeVar;  
    long OtherVar;  
    ...  
}
```



## 19-32. Inferring Types

```
public void MyMethod <T> (T myVal) { ... }
```



**Both are of type T**

```
int MyInt = 5;
```

```
MyMethod <int> (MyInt);
```



**Both are ints**

```
MyMethod(MyInt);
```

## 19-33. Example of a Generic Method

```
class Simple {    // Non-generic class
static public void ReverseAndPrint<T>(T[] arr) // Generic method
{
    Array.Reverse(arr);
    foreach (T item in arr) // Use type argument T.
        Console.Write("{0}, ", item.ToString());
    Console.WriteLine("");
}
}
```

## 19-34. Example of a Generic Method

```
class Program {  
    static void Main() {  
        var intArray = new int[] { 3, 5, 7, 9, 11 };  
        var stringArray = new string[] { "first", "second", "third" };  
        var doubleArray = new double[] { 3.567, 7.891, 2.345 };  
        Simple.ReverseAndPrint<int>(intArray); // Invoke method  
        Simple.ReverseAndPrint(intArray); // Infer type and invoke  
        Simple.ReverseAndPrint<string>(stringArray);  
        Simple.ReverseAndPrint(stringArray);  
        Simple.ReverseAndPrint<double>(doubleArray);  
        Simple.ReverseAndPrint(doubleArray);  
    }  
}
```

# 19-35. Extension Methods with Generic Classes

```
static class ExtendHolder {  
    public static void Print<T>(this Holder<T> h)    {  
        T[] vals = h.GetValues();  
        Console.WriteLine("{0},\t{1},\t{2}", vals[0], vals[1], vals[2]);    }  
    }  
  
    class Holder<T> {  
        T[] Vals = new T[3];  
        public Holder(T v0, T v1, T v2)  
        { Vals[0] = v0; Vals[1] = v1; Vals[2] = v2; }  
        public T[] GetValues() { return Vals; }  
    }
```

## 19-36. Example

```
class Program {  
    static void Main(string[] args) {  
        var intHolder = new Holder<int>(3, 5, 7);  
        var stringHolder = new Holder<string>("a1", "b2", "c3");  
        intHolder.Print();  
        stringHolder.Print();  
    }  
}
```

This code produces the following output:

3, 5, 7

a1, b2, c3

**19-37.**