Compositive structures (part I)

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The **char** variable type

C# treats letters in two distinctly different ways: individual characters of type `char` (usually pronounced *char*) and strings of characters – a type called, cleverly enough, `string`.

The `char` variable is a box capable of holding a single character. A character constant appears as a character surrounded by a pair of **single quotation** marks, as in this example:

```
char c = 'a';
```

Type	Range	Size	.NET Framework type
char	U+0000 to U+ffff	Unicode 16-bit character	**System.Char**

You can store any single character from the Roman, Hebrew, Arabic, Cyrillic, and most other alphabets. You can also store Japanese katakana and hiragana characters, as well as many Japanese and Chinese kanjis.

In addition, `char` **is considered a counting type**. That means **you can use a `char` type to control the looping structures**. Character variables do not suffer from rounding problems.

The character variable includes no font information. So you may store in a `char` variable what you think is a perfectly good kanji (and it may well be) – but when you view the character, it can look like garbage if you're not looking at it through the eyes of the proper font.

UNICODE

Unicode **is a computing industry standard for the consistent encoding, representation and handling of text expressed in most of the world's writing systems**. Developed in conjunction with the **Universal Character Set standard** and published in book form as ***The Unicode Standard***, the latest version of Unicode consists of a repertoire of more than **110,000 characters** covering 100 scripts, a set of code charts for visual reference, an encoding methodology and set of standard character encodings, an enumeration of character properties such as upper and lower case, a set of reference data computer files, and a number of related items, such as character properties, rules for normalization, decomposition, collation, rendering, and bidirectional display order (for the correct display of text containing both right-to-left scripts, such as Arabic and Hebrew, and left-to-right scripts). **As of September 2012, the most recent version is Unicode 6.2**.

Unicode's success at unifying character sets has led to its widespread and predominant use in the internationalization and localization of computer software. The standard has been implemented in many recent technologies, including XML, the Java programming language, the Microsoft .NET Framework, and modern operating systems.

Special **chars**

Some characters within a given font are **not printable**, in the sense that you don't see anything when you look at them on the computer screen or printer. The most obvious example of this is the **space**, which is represented by the character ' ' (***single quote, space, single quote***). Other characters have no letter equivalent – for example, the **tab character**. C# uses the **backslash** to flag these characters, as shown in **Table 1**.

Table 1 Special Characters

Character Constant	Value
'\n'	New line
'\t'	Tab
'\0'	Null character
'\r'	Carriage return
'\\'	Backslash

The **string** type

Another extremely common variable type is the `string`.

The **`string`** type represents a string of Unicode characters. **string** is an alias for **`System.String`** in the .NET Framework.

The following examples show how you declare and initialize `string` variables:

```
// Declare now, initialize later.
string someString1;
someString1 = “this is a string”;

// Or initialize when declared - preferable.
string someString2 = “this is a string”;
```

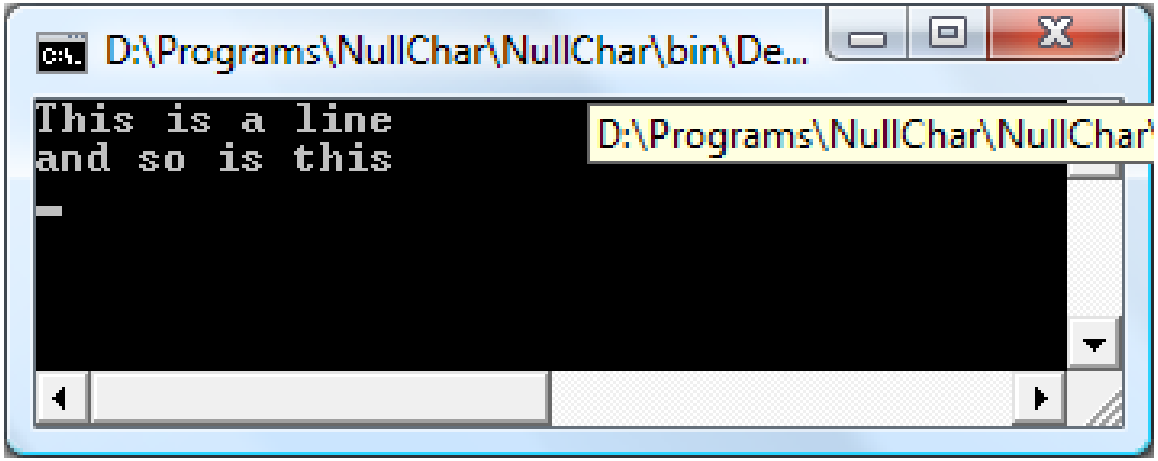
A string constant, often called a string *literal*, **is a set of characters surrounded by double quotes**.

The **string** type

The characters in a string can include the special characters shown in Table 1. A string cannot be written across a line in the C# source file, but i**t can contain the new-line character**, as the following examples show (see boldface):

```
// The following is not legal.
string someString = “This is a line
and so is this”;
// However, the following is legal.
string someString = “This is a line\nand so is this”;
```

When written out with `Console.WriteLine`, the last line in this example places the two phrases on separate lines, like this:



The **string** type

A `string` **is not a counting type**. A `string` **is also not a value-type** – no "string" exists that's intrinsic (built in) to the processor. Only one of the common operators works on `string` objects: **The + operator concatenates two strings into one**. For example:

```
string s = "this is a phrase"
+ " and so is this";
```

These lines of code set the `string` variable `s` equal to this character `string`:

```
"this is a phrase and so is this"
```

The `string` with no characters, written "" (two double quotes in a row), **is a valid `string`**, called **an empty `string`** (or sometimes **a null `string`**). A null string ("") is different from a null char (`'\0'`) and from a string containing any amount of space, even one (" ").

You can use the `String.Empty` value **to initialize strings**, which means the same thing as "" and is less prone to misinterpretation:

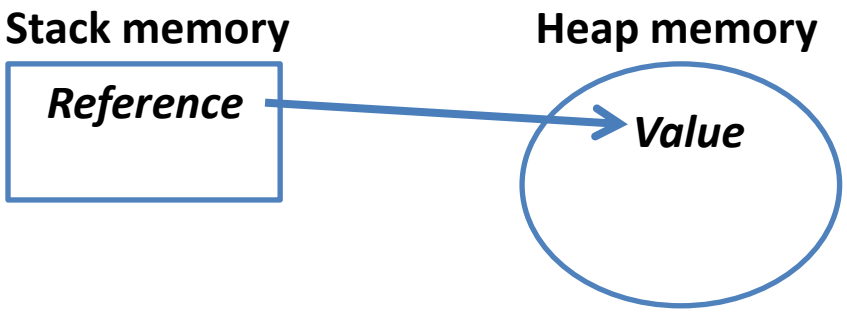
```
string mySecretName = String.Empty;
// A property of the String type
```

What`s a **value** type?

The variable types that we describe are of fixed length – again with the exception of `string`. **A fixed-length variable type always occupies the same amount of memory**. So if you assign `a = b`, C# can transfer the value of `b` into `a` without taking extra measures designed to handle variable length types. This characteristic is why these types of variables are called ***value types***.

The types `int`, `double`, and `bool`, and their close derivatives (like unsigned `int`) are intrinsic variable types built right into the processor. **The intrinsic variable types plus decimal are also known as value types because variables store the actual data**. The `string` type is neither – because the variable actually stores a **sort of "pointer"** to the string's data, called a ***reference***. **The data in the `string` is actually off in another location**.

The programmer-defined types known as ***reference types***, are neither value types nor intrinsic. **The string type is a reference type**, although the C# compiler does accord it some special treatment because strings are so widely used.



Comparing **string** and **char**

Although strings deal with characters, the `string` type is amazingly different from the `char`. Of course, certain trivial differences exist. You enclose a character with single quotes, as in this example:

```
'a'
```

On the other hand, you put double quotes around a `string`:

```
"this is a string"
"a" // So is this -- see the double quotes?
```

The rules concerning strings are not the same as those concerning characters. For one thing, you know that a `char` is a single character, and that's it. For example, the following code makes **no sense**, either as addition or as concatenation:

```
char c1 = 'a';
char c2 = 'b';
char c3 = c1 + c2;
```

⊗	19	Cannot implicitly convert type 'int' to 'char'. An explicit conversion exists (are you missing a cast?) (CS0266)

Comparing **string** and **char**

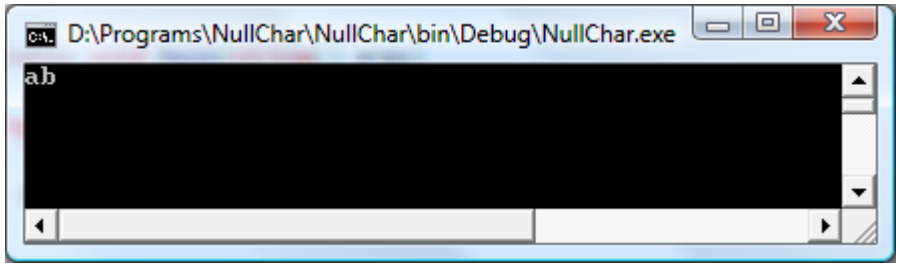
```
char c1 = 'a';
char c2 = 'b';
char c3 = c1 + c2;
```

Actually, this bit of code almost compiles – but with a completely different meaning from what was intended. These statements convert `c1` into an `int` consisting of the numeric value of `c1`. C# also converts `c2` into an `int` and then adds the two integers. The error occurs when trying to store the results back into `c3` – numeric data may be lost storing an `int` into the smaller `char`. In any case, the operation makes no sense.

A `string`, on the other hand, **can be any length**. So concatenating two strings, as shown here, ***does* make sense**:

```
string s1 = "a";
string s2 = "b";
string s3 = s1 + s2; // Result is "ab"
```

As part of its library, C# defines an entire suite of string operations.



Naming conventions

Programming is hard enough without programmers making it harder. To make your C# source code easier to wade through, adopt a **naming convention** and stick to it. As much as possible, your naming convention should follow that adopted by other C# programmers:

☑ **The names of things other than variables start with a capital letter, and variables start with a lowercase letter.** Make these names as descriptive as possible – which often means that a name consists of multiple words. These words should be capitalized but butted up against each other with no underscore between them – for example, `ThisIsALongName`. Names that start with a capital are *Pascal-cased*, from the way a 1970s-era language called Pascal named things.

☑ **The names of variables start with a lowercase letter.** A typical variable name looks like this: `thisIsALongVariable-Name`. This variable naming style is called *camel-casing* because it has humps in the middle.

Naming conventions

Prior to the .NET era, it was common among Windows programmers to use a convention in which the first letter of the variable name indicated the type of the variable. Most of these letters were straightforward: `f` for `float`, `d` for `double`, `s` for `string`, and so on. The only one that was even the slightest bit different was `n` for `int`. One exception to this rule existed: For reasons that stretch way back into the Fortran programming language of the 1960s, the single letters `i`, `j`, and `k` were also used as common names for an `int`, and they still are in C#. This style of naming variables was called ***Hungarian notation***, after a famous Microsoftie Charles Simonyi.

Hungarian notation has fallen out of favor, at least in .NET programming circles. With recent Visual Studio versions, you can simply rest the cursor on a variable in the debugger to have its data type revealed in a tooltip box. That makes the Hungarian prefix a bit less useful, although a few folks still hold out for Hungarian.

Representation of textual data

C# textual data is represented by the intrinsic `string` and `char` keywords, which are simple shorthand notations for `System.String` and `System.Char`, both of which are Unicode under the hood. A `string` represents a contiguous set of characters (e.g., `"Hello"`), while the `char` can represent a single slot in a string type (e.g., `'H'`).

```
static void CharFunctionality()
{
 Console.WriteLine("=> char type Functionality:");

 char myChar = 'a';
 Console.WriteLine("char.IsDigit('a'): {0}", char.IsDigit(myChar));
 Console.WriteLine("char.IsLetter('a'): {0}", char.IsLetter(myChar));
 Console.WriteLine("char.IsWhiteSpace('Hello There', 5): {0}",  char.IsWhiteSpace("Hello There", 5));
 Console.WriteLine("char.IsWhiteSpace('Hello There', 6): {0}",  char.IsWhiteSpace("Hello There", 6));
 Console.WriteLine("char.IsPunctuation('?'): {0}", char.IsPunctuation('?'));
 Console.WriteLine();
}
```

The `System.Char` type provides you with a great deal of functionality beyond the ability to hold a single point of character data. Using the static methods of `System.Char`, you are able to determine whether a given character is numerical, alphabetical, a point of punctuation, or whatnot.

Parsing Values from String Data

The .NET data types provide the ability **to generate a variable of their underlying type given a textual equivalent** (e.g., **parsing**). This technique can be extremely helpful when you wish to convert a bit of user input data (such as a selection from a GUI-based drop-down list box) into a numerical value.

```
static void ParseFromStrings()
{
 Console.WriteLine("=> Data type parsing:");
 bool b = bool.Parse("True");
 Console.WriteLine("Value of b: {0}", b);
 double d = double.Parse("99.884");
 Console.WriteLine("Value of d: {0}", d);
 int i = int.Parse("8");
 Console.WriteLine("Value of i: {0}", i);
 char c = Char.Parse("w");
 Console.WriteLine("Value of c: {0}", c);
 Console.WriteLine();
}
```

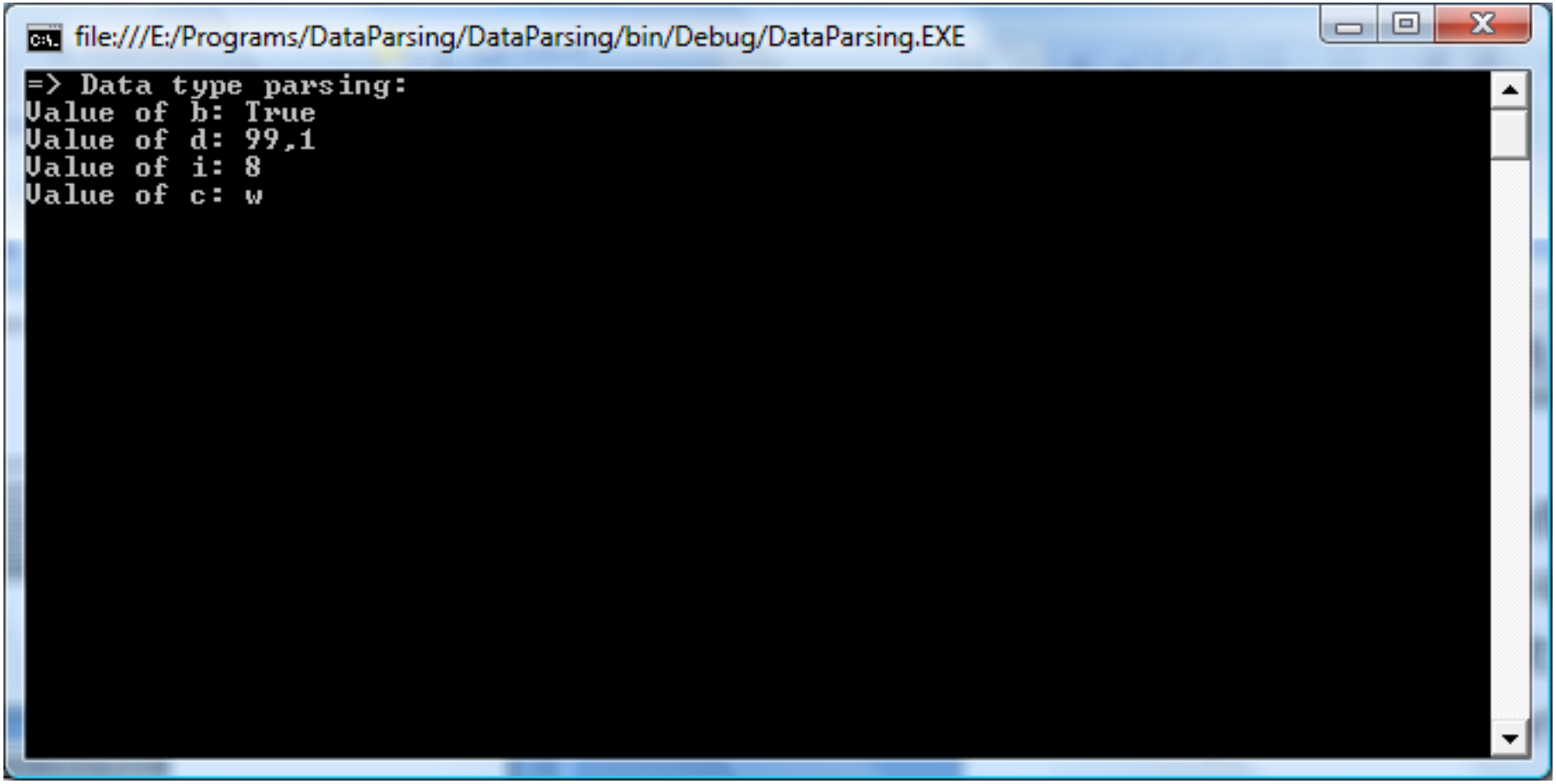
Culture-dependent method

```
namespace DataParsing
{
 class Program
 {
  static void ParseFromStrings()
  {
   Console.WriteLine("=> Data type parsing:");

   bool b = bool.Parse("True");
   Console.WriteLine("Value of b: {0}", b);
   double d = double.Parse("99,1");
   Console.WriteLine("Value of d: {0}", d);
   int i = int.Parse("8");
   Console.WriteLine("Value of i: {0}", i);
   char c = Char.Parse("w");
   Console.WriteLine("Value of c: {0}", c);
   Console.WriteLine();
  }

  static void Main(string[] args)
  {
```

Watch 1

Name	Value	Type
b	true	bool
d	99.1	double
i	8	int
c	119 'w'	char

Parsing Values from String Data



Parsing Values from String Data

Parsing refers to the action by software of breaking an artifact into its constituent elements and capturing the relationship between those elements.
All numeric types have **two static parsing methods**, **`Parse`** and **`TryParse`**, that you can use ***to convert the string representation of a number into a numeric type***.

- **`Int32.Parse(String)`** Converts the string representation of a number to its 32-bit signed integer equivalent.
- **`Boolean.Parse(String)`** Converts the specified string representation of a logical value to its Boolean equivalent.
- **`Char.Parse(String)`** Converts the value of the specified string to its equivalent Unicode character.

Convert Class Converts a base data type to another base data type.

- **`Convert.ToInt32` Method** Converts a specified value to a 32-bit signed integer.
- **`Convert.ToDouble` Method** Converts a specified value to a double-precision floating point number.
- **`Convert.ToString` Method** Converts the specified value to its equivalent String representation.

http://msdn.microsoft.com/en-us/library/system.convert(v=VS.71).aspx

System.String Type

http://msdn.microsoft.com/en-us/library/system.string.aspx

`System.String` provides a number of **methods** you would expect from such a utility class, including methods that return the length of the character data, find substrings within the current string, convert to and from uppercase/lowercase, and so forth.

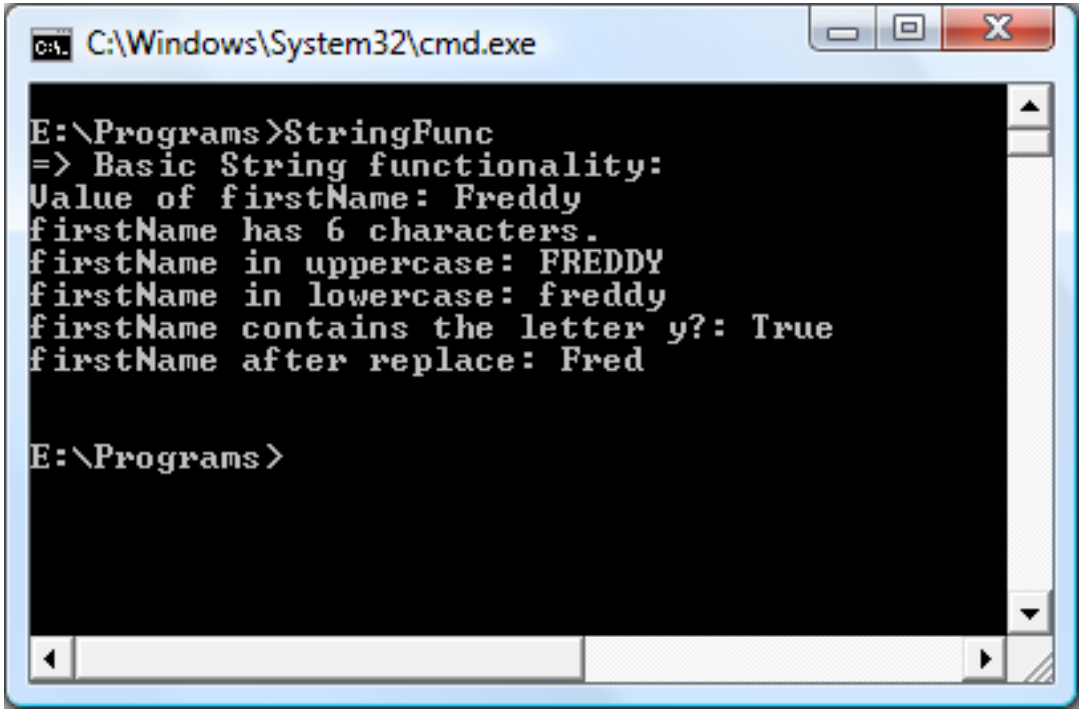
String member	Meaning in life
Length	This property returns the length of the current string.
Compare()	This method compares two strings.
Contains()	This method determines whether a string contains a specific substring.
Equals()	This method tests whether two string objects contain identical character data.
Format()	This method formats a string using other primitives (e.g., numerical data, other strings) and the {0} notation.
Insert()	This method inserts a string within a given string.
PadLeft()	These methods are used to pad a string with some characters.
PadRight()	
Remove()	Use these methods to receive a copy of a string, with modifications (characters removed or replaced).
Replace()	
Split()	This method returns a String array containing the substrings in this instance that are delimited by elements of a specified Char or String array.
Trim()	This method removes all occurrences of a set of specified characters from the beginning and end of the current string.
ToUpper()	These methods create a copy of the current string in uppercase or lowercase format, respectively.
ToLower()	

System.String Type

http://msdn.microsoft.com/en-us/library/system.console(v=vs.71).aspx

```
static void BasicStringFunctionality()
{
 Console.WriteLine("=> Basic String functionality:");
 string firstName = "Freddy";
 Console.WriteLine("Value of firstName: {0}", firstName);
 Console.WriteLine("firstName has {0} characters.", firstName.Length();
 Console.WriteLine("firstName in uppercase: {0}", firstName.ToUpper());
 Console.WriteLine("firstName in lowercase: {0}", firstName.ToLower());
 Console.WriteLine("firstName contains the letter y?: {0}",
firstName.Contains("y"));
 Console.WriteLine("firstName after replace: {0}", firstName.Replace("dy",
""));
 Console.WriteLine();
}
```

The dot operator (.) is used for member access. The dot operator specifies a member of a type or namespace. ***For example, the dot operator is used to access specific methods within the .NET Framework class libraries***.

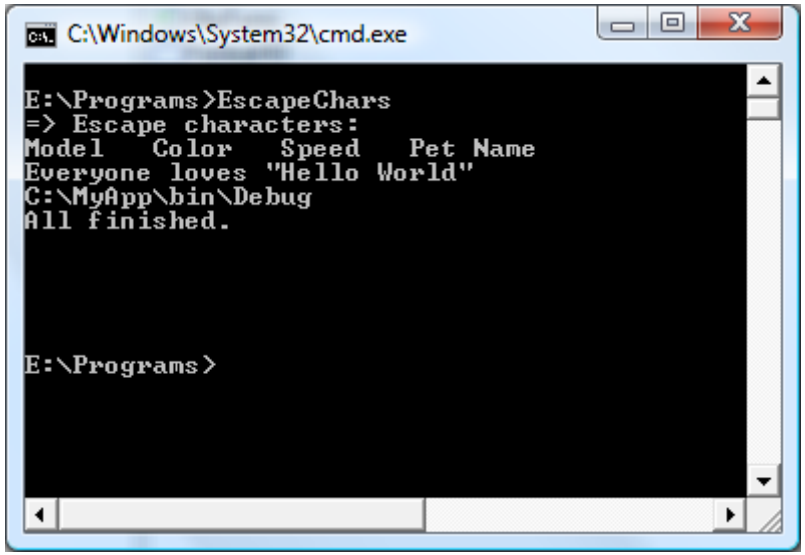


Special (escape) characters

Like in other C-based languages, C# string literals may contain various escape characters, which qualify how the character data should be printed to the output stream. Each escape character begins with a backslash, followed by a specific token.

Character	Meaning in life
\'	Inserts a single quote into a string literal.
\"	Inserts a double quote into a string literal.
\\	Inserts a backslash into a string literal. This can be quite helpful when defining file paths.
\a	Triggers a system alert (beep). For console programs, this can be an audio clue to the user.
\n	Inserts a new line.
\r	Inserts a carriage return.
\t	Inserts a horizontal tab into the string literal.

```
static void EscapeChars()
{
 Console.WriteLine("=> Escape characters:\a");
 string strWithTabs = "Model\tColor\tSpeed\tPet
Name\a ";
 Console.WriteLine(strWithTabs);
 Console.WriteLine("Everyone loves \"Hello World\"\a
");
 Console.WriteLine("C:\\MyApp\\bin\\Debug\a ");
 // Adds a total of 4 blank lines (then beep
again!).
 Console.WriteLine("All finished.\n\n\n\a ");
 Console.WriteLine();
}
```



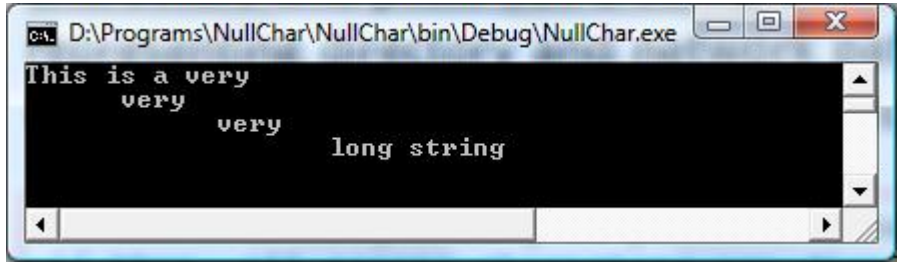
Defining Verbatim Strings

When you prefix a string literal with the @ symbol, you have created what is termed a **verbatim string**. Using verbatim strings, you **disable the processing of a literal's escape characters and print out a string as is**. This can be most useful when working with strings representing directory and network paths. Therefore, rather than making use of \\ escape characters, you can simply write the following:

```
// The following string is printed verbatim
// thus, all escape characters are displayed.
Console.WriteLine(@"E:\Programs");
```

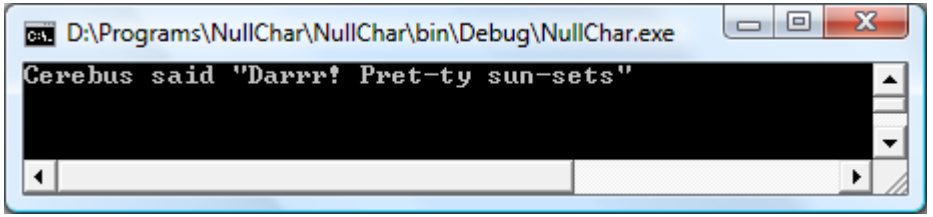
Also note that verbatim strings can be used to preserve white space for strings that flow over multiple lines:

```
// White space is preserved with verbatim strings.
string myLongString = @"This is a very
      very
            very
                  long string";
Console.WriteLine(myLongString);
```



Using verbatim strings, you can also directly insert a double quote into a literal string by doubling the " token, for example:

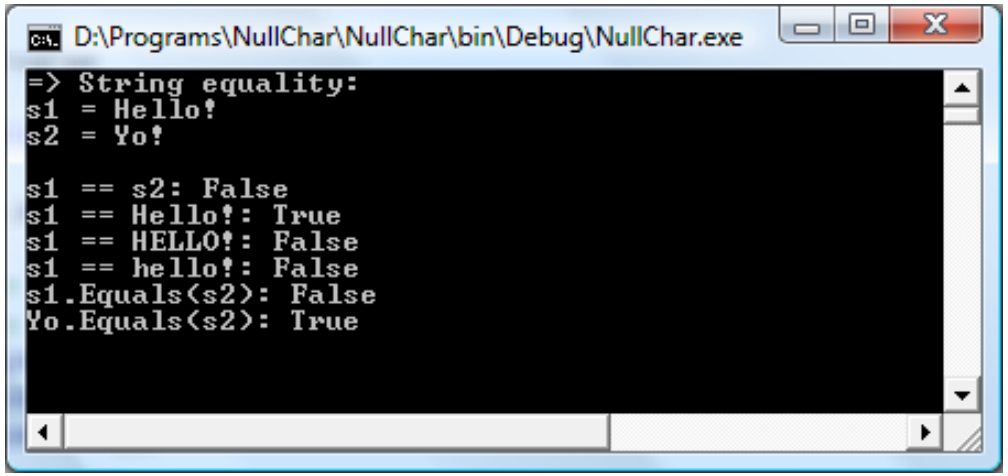
```
Console.WriteLine(@"Cerebus said ""Darrr! Pret-ty sun-sets""");
```



Strings and Equality

A **reference type** is an object allocated on the garbage-collected managed heap. When you perform a **test for equality** on reference types (via the C# **==** and **!=** operators), you will be returned `true` if the references are pointing to the same object in memory.

However, even though the `string` data type is indeed a reference type, the equality operators have been redefined to compare the values of string objects, not the object in memory to which they refer:




```
static void StringEquality()
{
 Console.WriteLine("=> String equality:");

 string s1 = "Hello!";
 string s2 = "Yo!";
 Console.WriteLine("s1 = {0}", s1);
 Console.WriteLine("s2 = {0}", s2);
 Console.WriteLine();

 // Test these strings for equality.
 Console.WriteLine("s1 == s2: {0}", s1 == s2);
 Console.WriteLine("s1 == Hello!: {0}", s1 == "Hello!");
 Console.WriteLine("s1 == HELLO!: {0}", s1 == "HELLO!");
 Console.WriteLine("s1 == hello!: {0}", s1 == "hello!");
 Console.WriteLine("s1.Equals(s2): {0}", s1.Equals(s2));
 Console.WriteLine("Yo.Equals(s2): {0}", "Yo!".Equals(s2));
 Console.WriteLine();
}
```

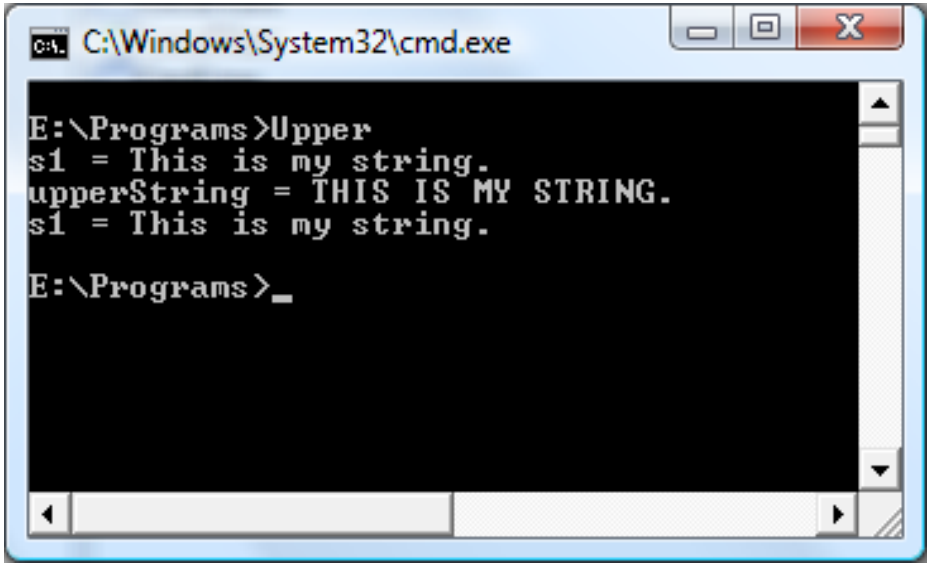
Notice that the C# equality operators perform a case-sensitive, character-by-character equality test. Therefore, "Hello!" is not equal to "HELLO!", which is different from "hello!".

Strings Are Immutable

One of the interesting aspects of `System.String` is that once you assign a string object with its initial value, the character data cannot be changed. At first glance, this might seem like a flat-out lie, given that we are always reassigning strings to new values and due to the fact that the System.

String type defines a number of methods that appear to modify the character data in one way or another (uppercasing, lowercasing, etc.). However, if you look more closely at what is happening behind the scenes, you will notice the methods of the string type are in fact returning you a brand-new string object in a modified format:

```
static void StringAreImmutable()
{
 // Set initial string value.
 string s1 = "This is my string.";
 Console.WriteLine("s1 = {0}", s1);

 // Uppercase s1?
 string upperString = s1.ToUpper();
 Console.WriteLine("upperString = {0}",
upperString);

 // Nope! s1 is in the same format!
 Console.WriteLine("s1 = {0}", s1);
}
```



Letting the C# compiler infer data types

Earlier when you declared a variable, you ***always*** specified its exact data type, like this:

```
int i = 5;
string s = "Hello C#";
double d = 1.0;
```

You're allowed to offload some of that work onto the C# compiler, using the `var` keyword:

```
var i = 5;
var s = "Hello C# 4.0";
var d = 1.0;
```

Now the compiler ***infers*** the data type for you — it looks at the stuff on the right side of the assignment to see what type the left side is.

Letting the C# compiler infer data types

Suppose, for example, you have an initializing expression like this:

```
var x = 3.0 + 2 - 1.5;
```

The compiler can figure out that `x` is a `double` value. It looks at `3.0` and `1.5` and sees that they're of type `double`. Then it notices that `2` is an `int`, which the compiler can convert ***implicitly*** to a `double` for the calculation. All of the addition terms in `x`'s initialization expression end up as `double`s. So the ***inferred*** *type* of `x` is `double`.

You can simply use the word `var` and supply an initialization expression, and the compiler does the rest:

```
var aVariable = <initialization expression here>;
```

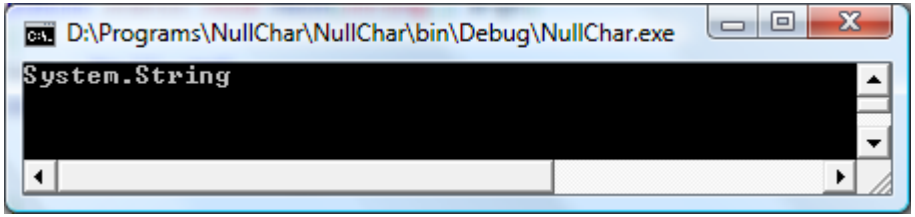
Letting the C# compiler infer data types

Take a look at this:

```
var aString = "Hello C#";
Console.WriteLine(aString.GetType().ToString());
```

The `WriteLine` statement calls the `String.GetType()` method on `aString` to get its C# type. Then it calls the resulting object's `ToString()` method to display the object's type. Here's what you see in the console window:

```
System.String
```



It proves that the compiler correctly inferred the type of aString.

Being explicit about the type of a variable is clearer to anyone reading your code than using `var`.

A new type in C# 4.0 is even more flexible than `var`: The `dynamic` type takes `var` a step further.

The `var` type causes the compiler to infer the type of the variable based on expected input. The `dynamic` keyword does this at runtime, using a totally new set of tools called the Dynamic Language Runtime.

Thanks for attention