Equality and Comparisons for Strings

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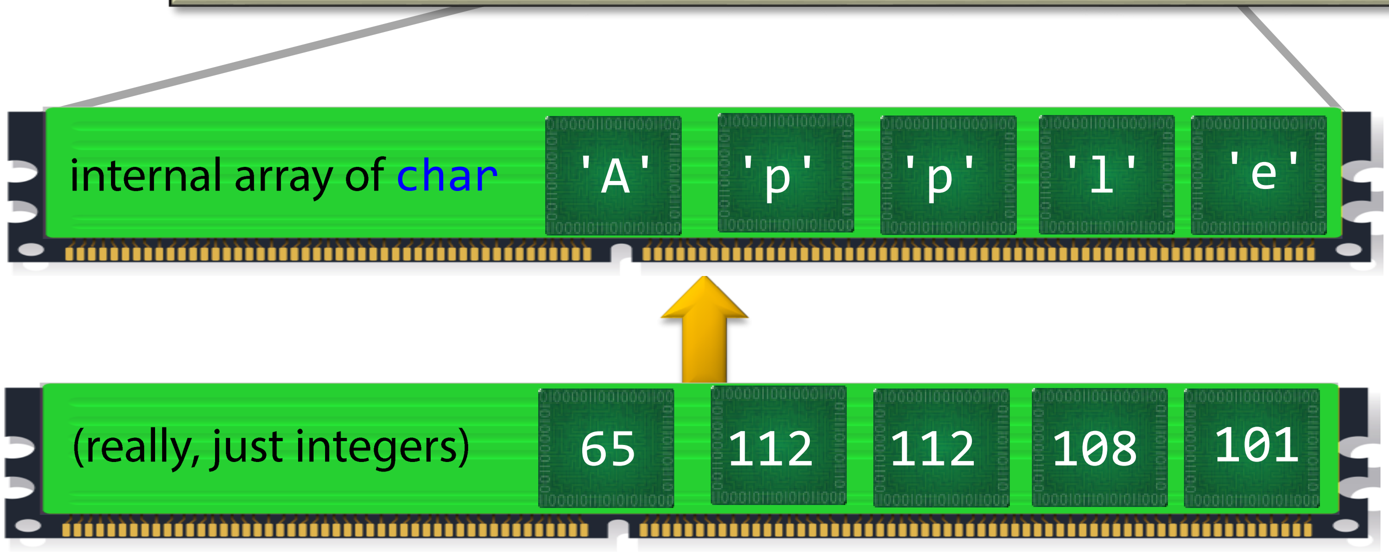
hardcore dev and IT training

- What is in a `char` (not always one character)?
- Issues when comparing strings.
  - Case.
  - Culture.
- Code demos of different types of *string comparisons.*
  - When to use each comparison type.
- What do standard techniques do?
  - `object.Equals()`, `==`, `IComparable<T>`, etc.
- String pooling.

Strings are Composed of Characters

```
string apple = "Apple";
```



16 bit integer, unsigned: Range is 0 to 65535

Mapping Char Values

Many char values represent Unicode characters

Not all!

65

112

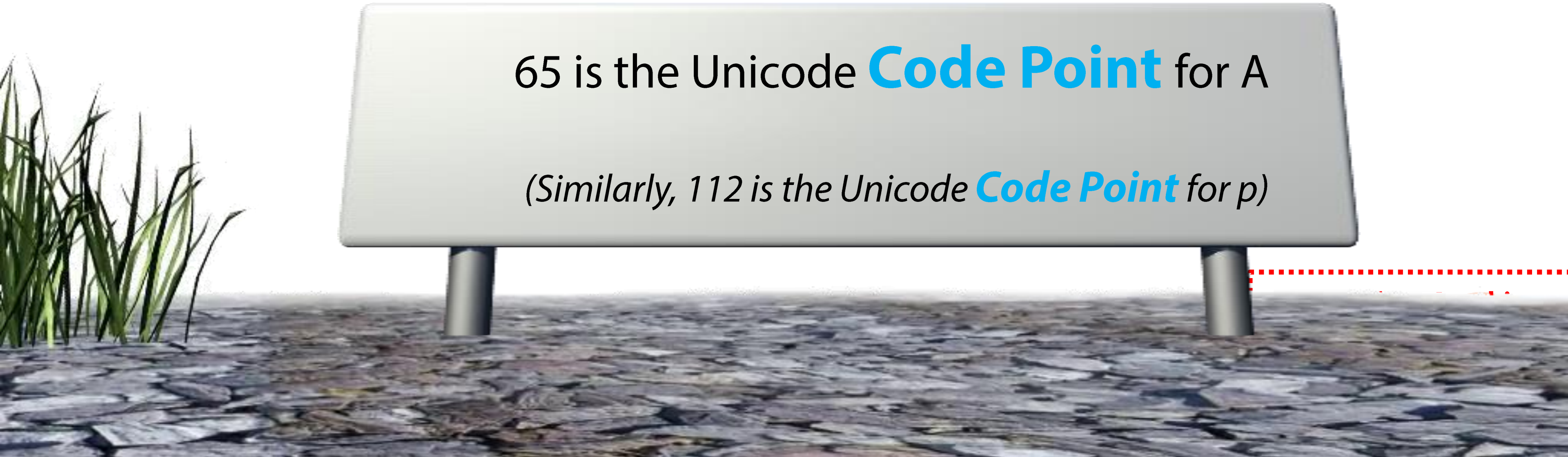
65 is the Unicode **Code Point** for A

*(Similarly, 112 is the Unicode **Code Point** for p)*

Mapping Char Values

(0x41 is hex for 65) U+0041 → A

(0x70 is hex for 112) U+0070 → p


65 is the Unicode **Code Point** for A

(Similarly, 112 is the Unicode ***Code Point*** *for p)*

Useful Code Point Ranges

(65 is U+0041)

65	66	67	68	69
A	B	C	D	E
70	71	72	73	74
F	G	H	I	J
75	76	77	78	79
K	L	M	N	O
80	81	82	83	84
P	Q	R	S	T
85	86	87	88	89
U	V	W	X	Y
90	91	92	93	94
Z	[	\	]	^

(97 is U+0061)

95	96	97	98	99
_	`	a	b	c
100	101	102	103	104
d	e	f	g	h
105	106	107	108	109
i	j	k	l	m
110	111	112	113	114
n	o	p	q	r
115	116	117	118	119
s	t	u	v	w
120	121	122	123	124
x	y	z	{	|

The ß Character

(0xDF is hex for 223)

U+00DF → ß

German eszett (=ss)

Straße = street

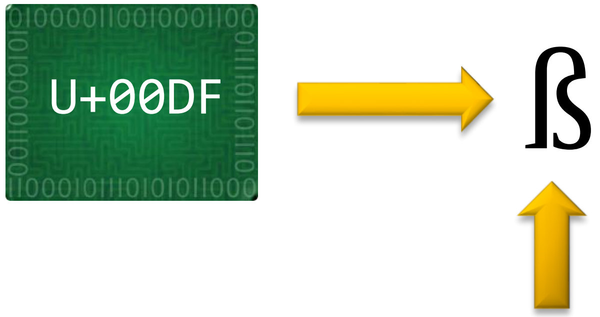
(Strasse)

Fußball = soccer

(Fussball)

The ß Character

(0xDF is hex for 223)



German eszett (=ss)

Character Expansions

When comparing strings…

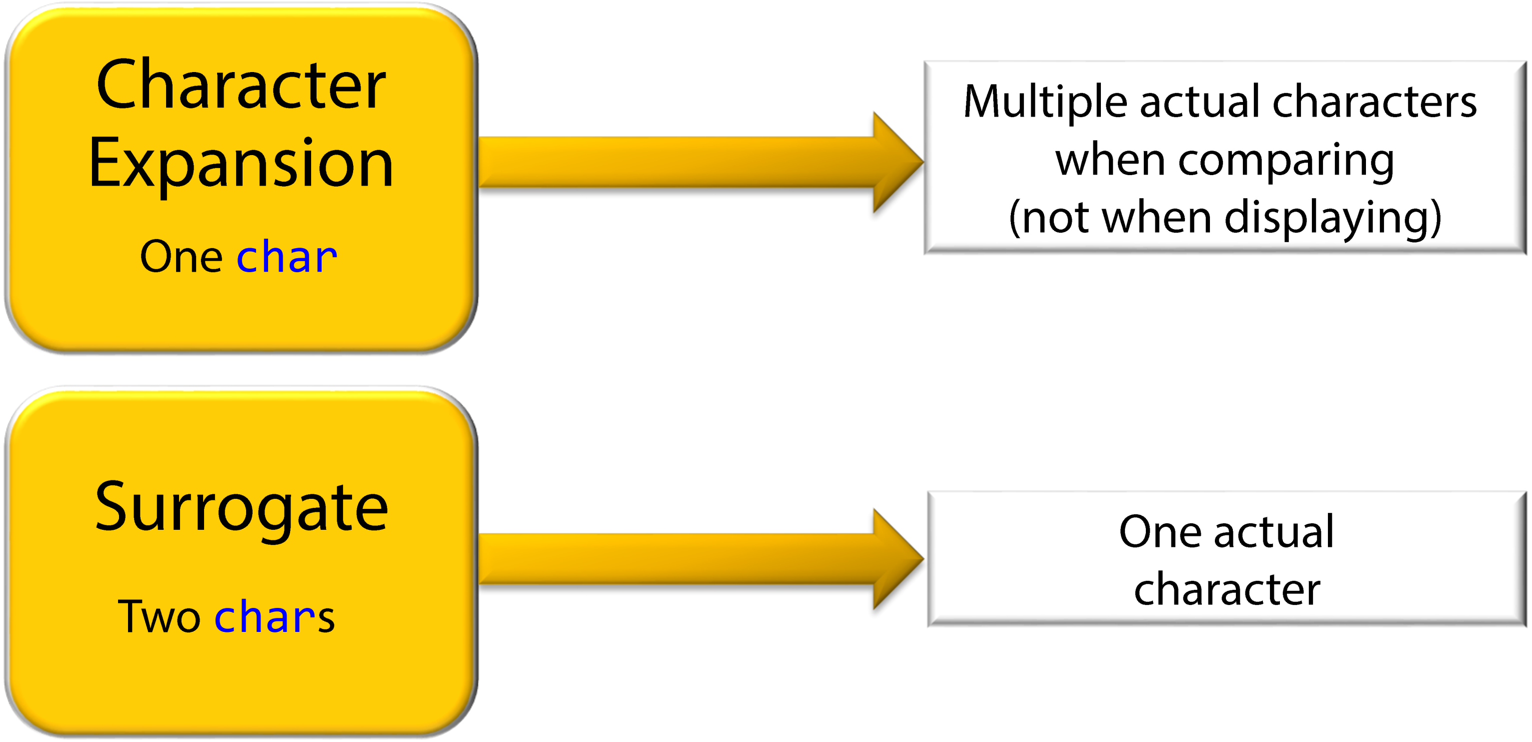
… expand character expansions first!

U+00DF → U+0073 + U+0073

ß → s + s

(Only for comparisons – not when displaying text)

Surrogates vs Expansions



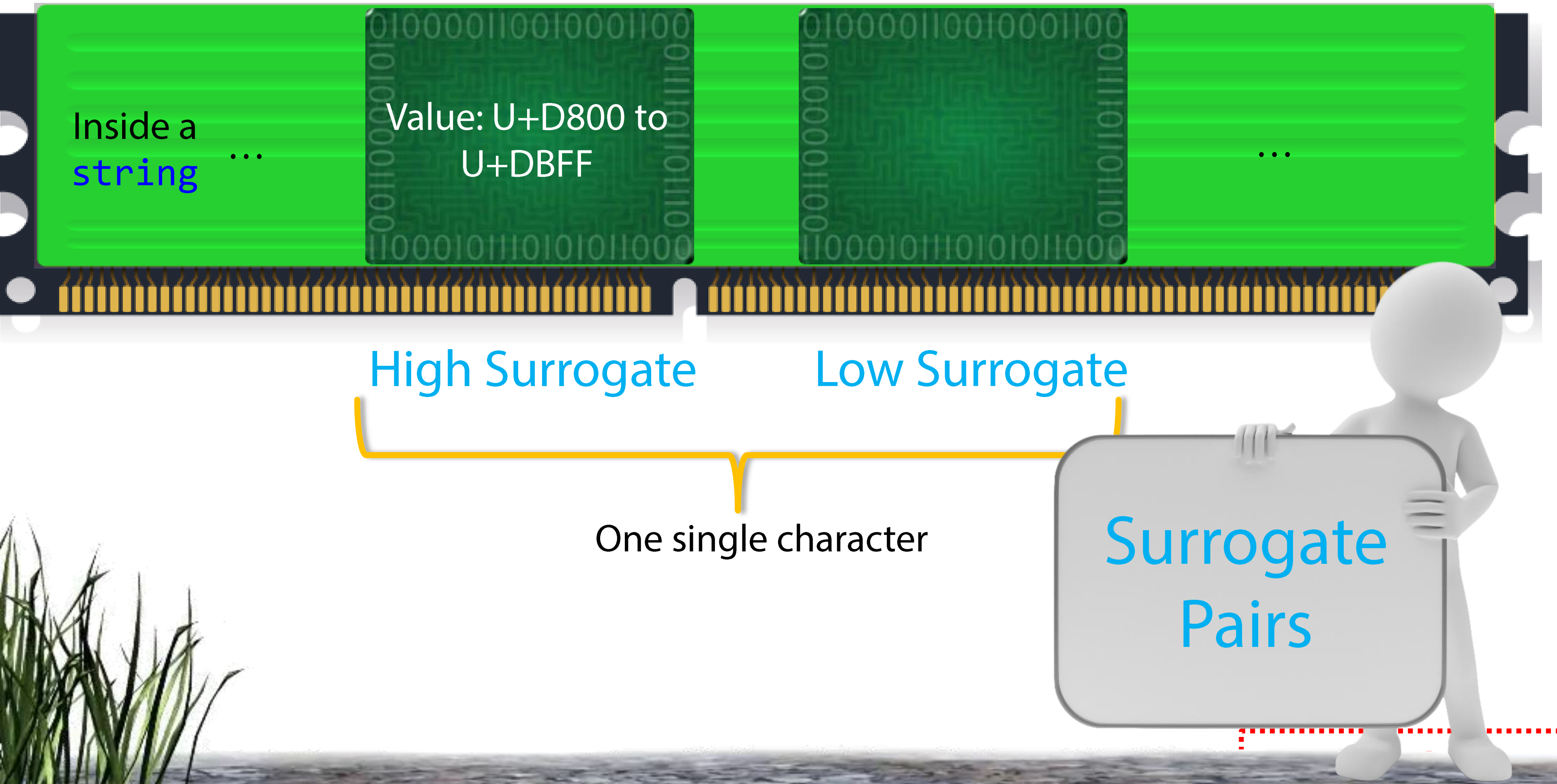
Not Enough Values

char : 16 bits	All Characters	UNICODE Code Points
0 to 65 535 (=0xFFFF)	Perhaps - millions	0 to 1 114 111 (=0x10FFFF)

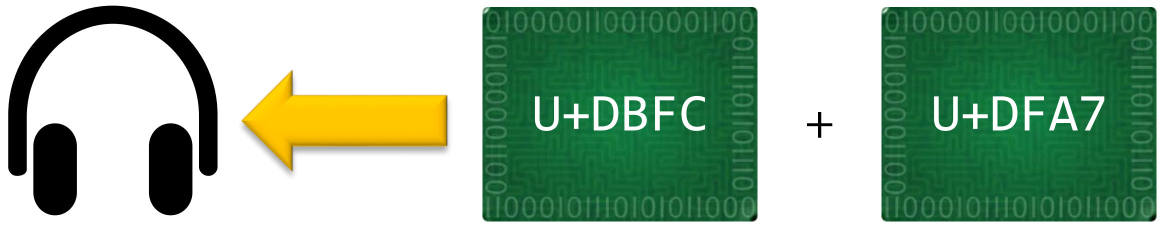
16 bits
don’t have
enough range
for all characters

Surrogates

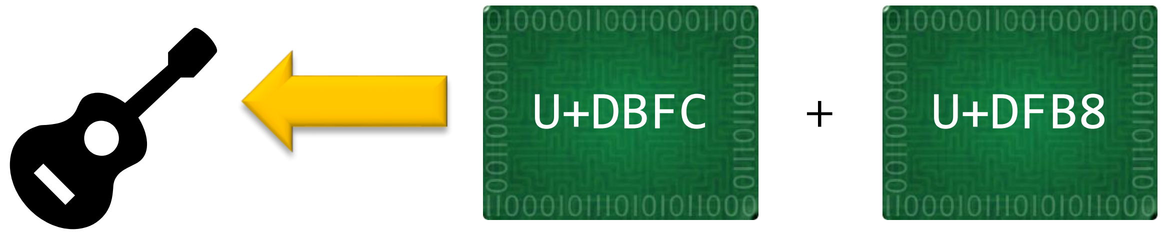
Some characters are represented by two char instances:



Surrogates: Examples



(U+1F3A7)



(U+1F3B8)

Combining Characters

Some code points modify the previous character…

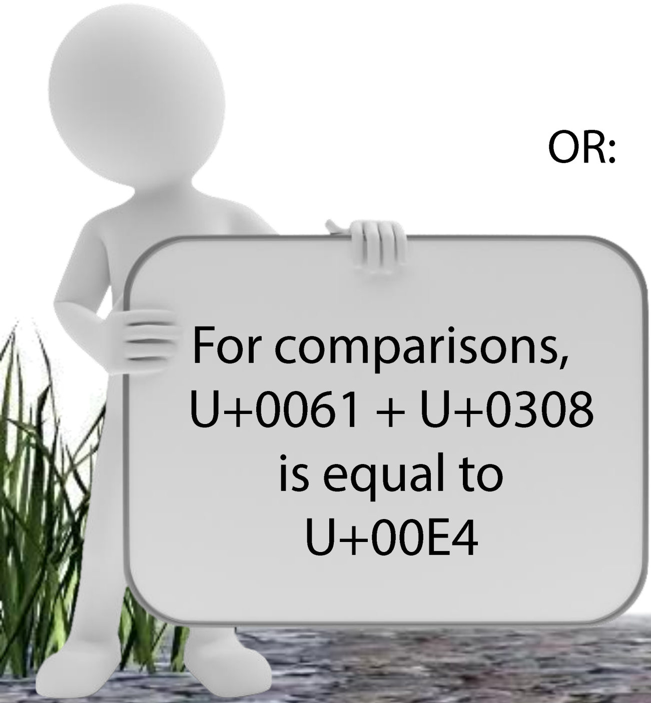
Example - the umlaut: ¨

U+00E4 = ä

OR: U+0061 + U+0308

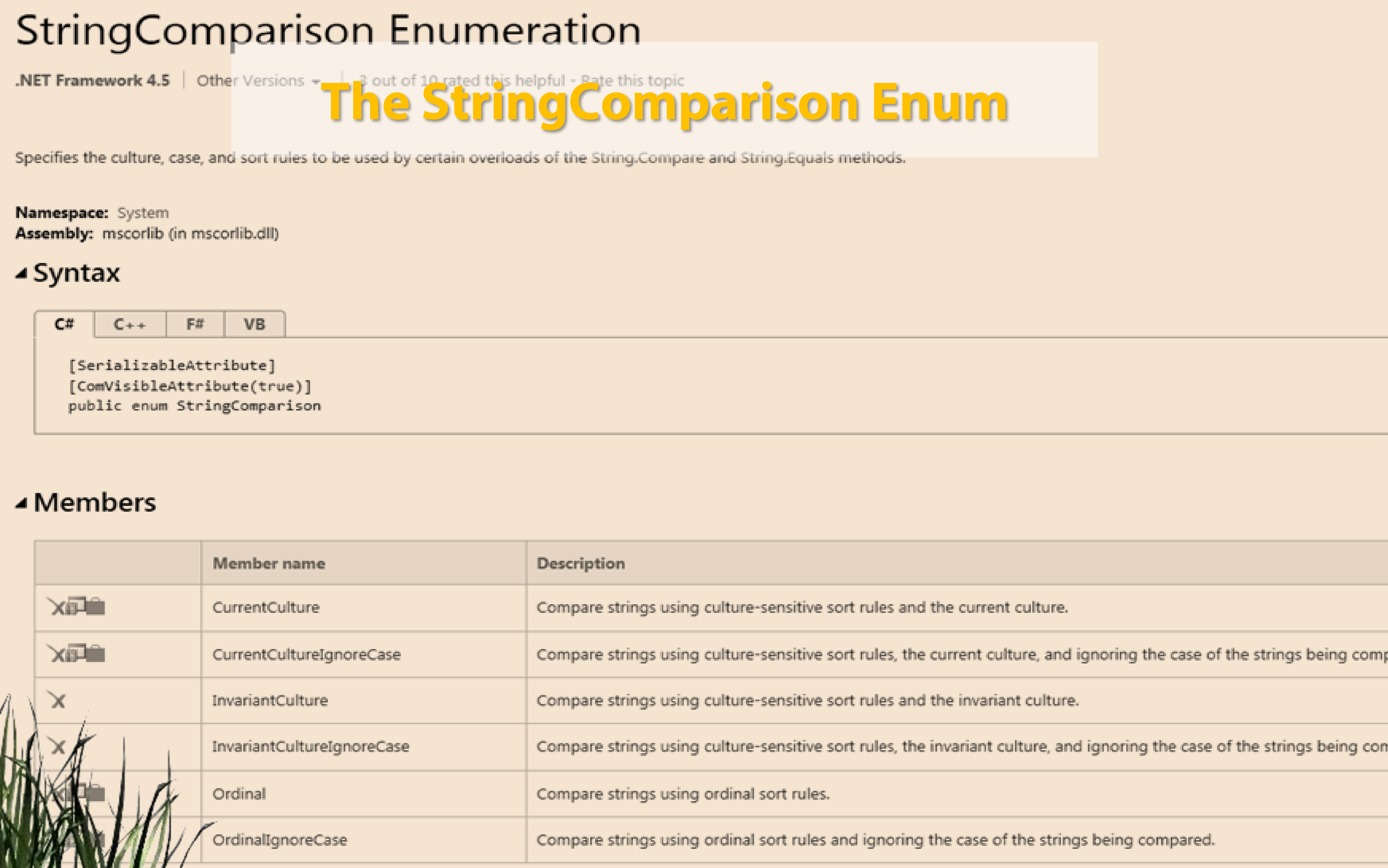
a ¨

Combining diaeresis
(an example of a
combining character)



For comparisons,
U+0061 + U+0308
is equal to
U+00E4

The StringComparison Enum



StringComparison Enumeration

.NET Framework 4.5 | Other Versions | 3 out of 10 rated this helpful - Rate this topic

Specifies the culture, case, and sort rules to be used by certain overloads of the String.Compare and String.Equals methods.

Namespace: System
Assembly: mscorlib (in mscorlib.dll)

Syntax

C# | C++ | F# | VB

```
[SerializableAttribute]
[ComVisibleAttribute(true)]
public enum StringComparison
```

Members

	Member name	Description
	CurrentCulture	Compare strings using culture-sensitive sort rules and the current culture.
	CurrentCultureIgnoreCase	Compare strings using culture-sensitive sort rules, the current culture, and ignoring the case of the strings being comp
	InvariantCulture	Compare strings using culture-sensitive sort rules and the invariant culture.
	InvariantCultureIgnoreCase	Compare strings using culture-sensitive sort rules, the invariant culture, and ignoring the case of the strings being com
	Ordinal	Compare strings using ordinal sort rules.
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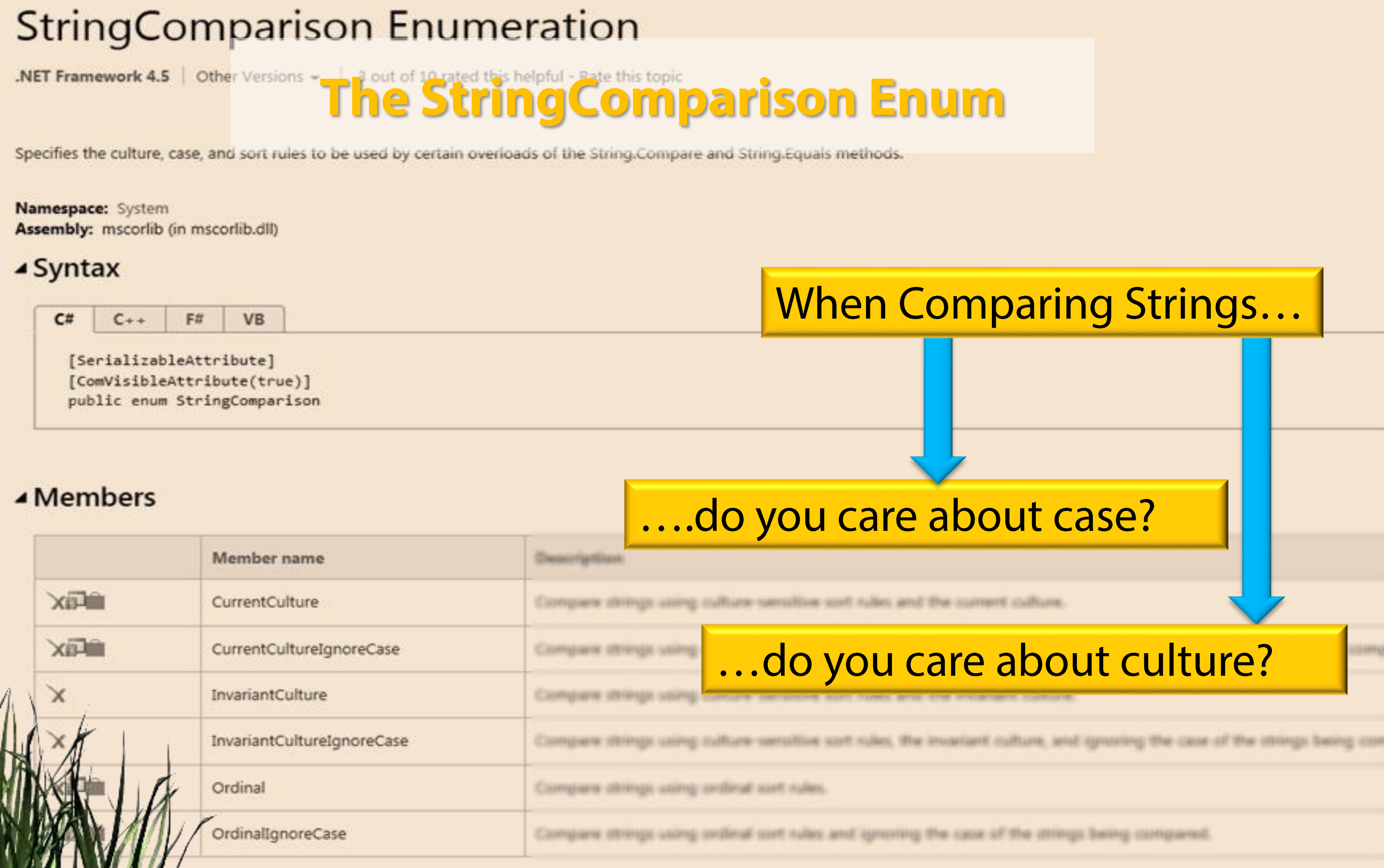
(From MSDN docs)

The StringComparison Enum



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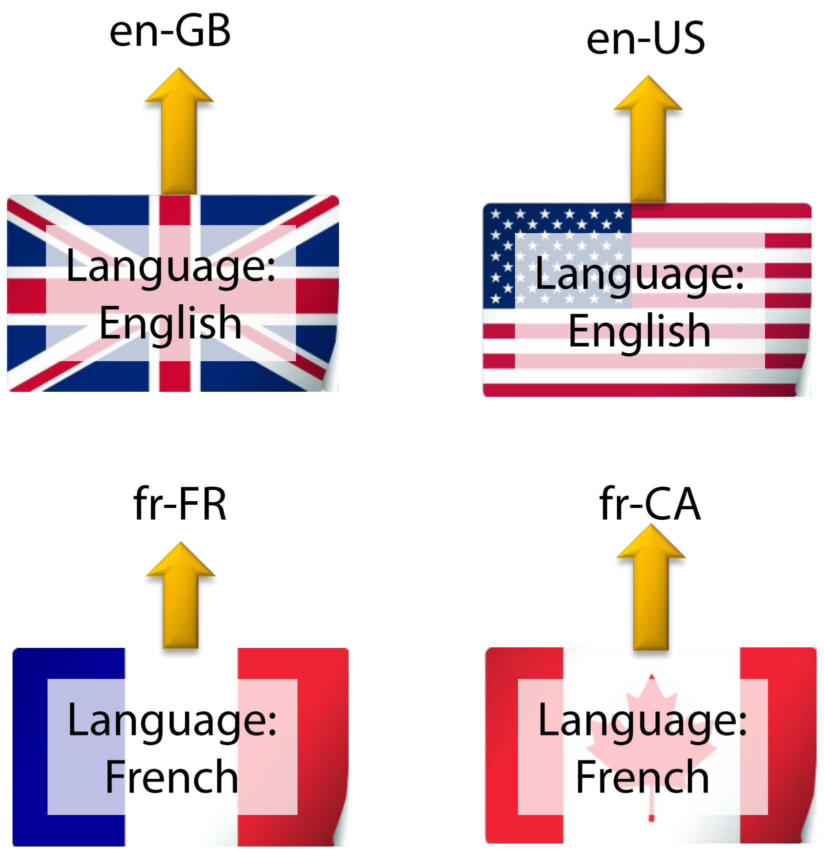
When Comparing Strings…

….do you care about case?

…do you care about culture?

(From MSDN docs)

What is Culture?

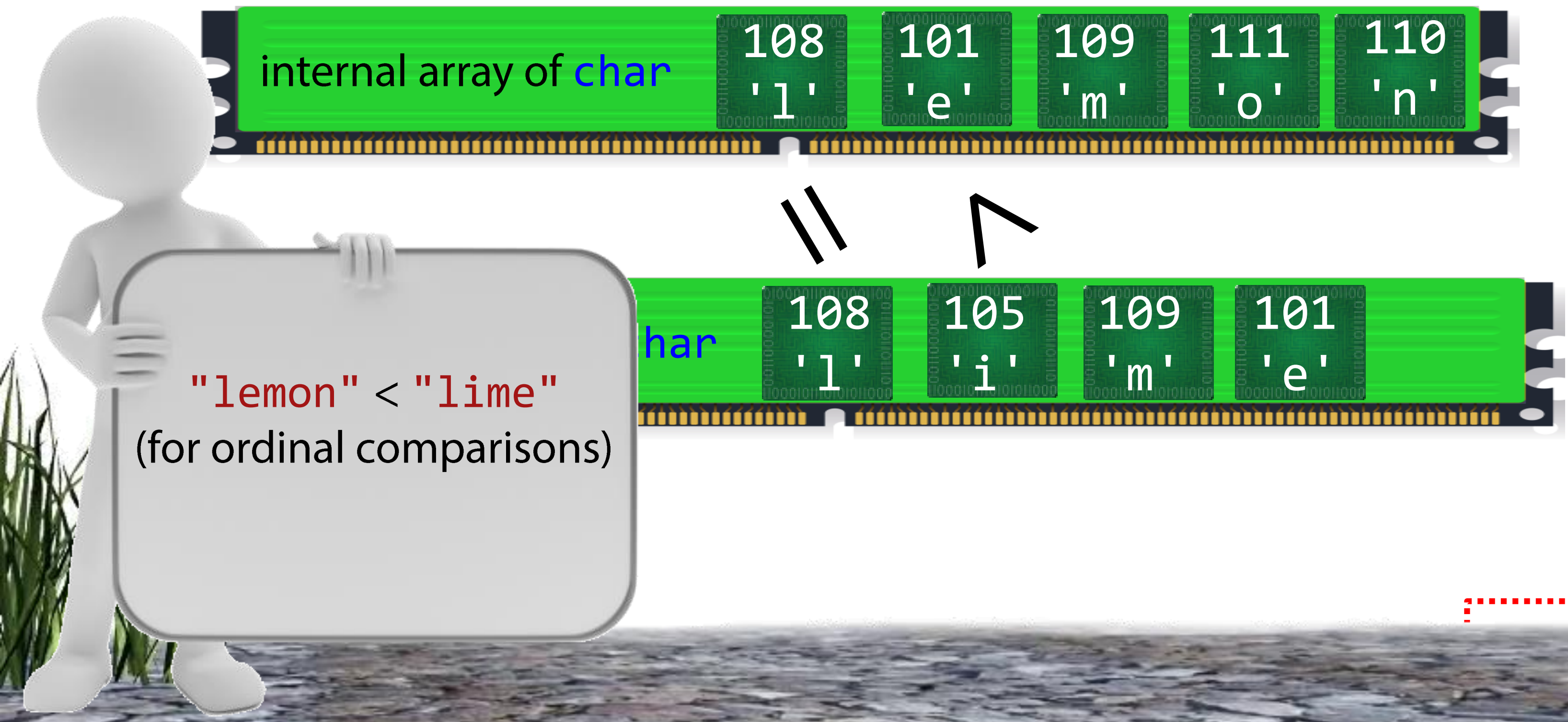


Ordinal Comparisons

Ordinal:

- Ignore the culture and Unicode issues
- Compare **numeric** values of chars only

```
string.Compare("lemon", "lime", StringComparison.Ordinal)
```



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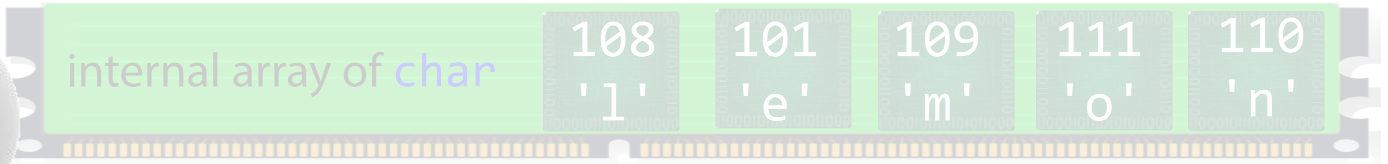
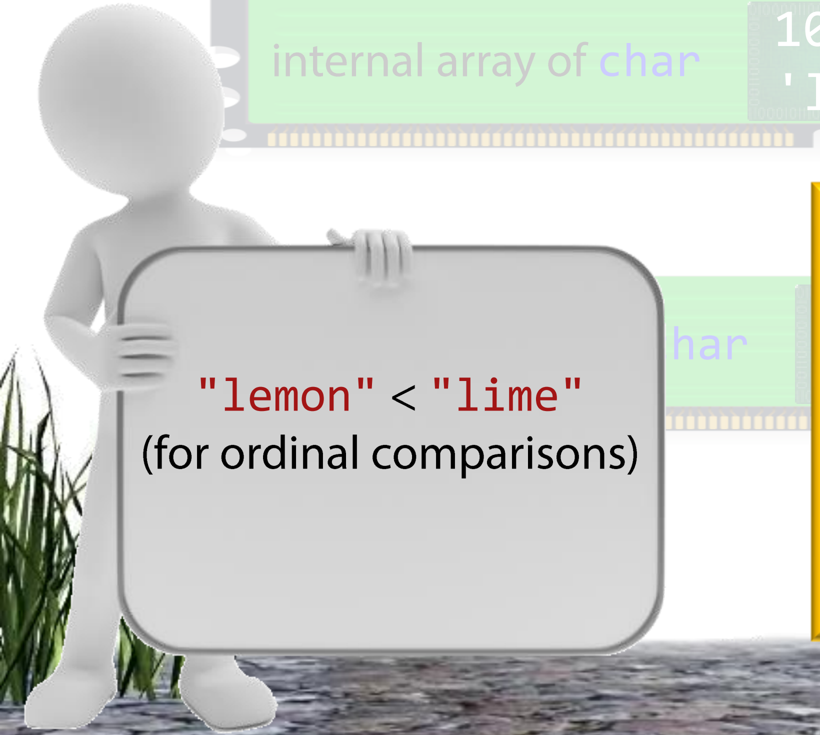




"lemon" < "lime"
(for ordinal comparisons)

```
string.Compare(x,y) …
      =0  if  x=y
      <0  if  x<y
      >0  if  x>y
```

Code Demo

Ignoring Case Often Takes Longer

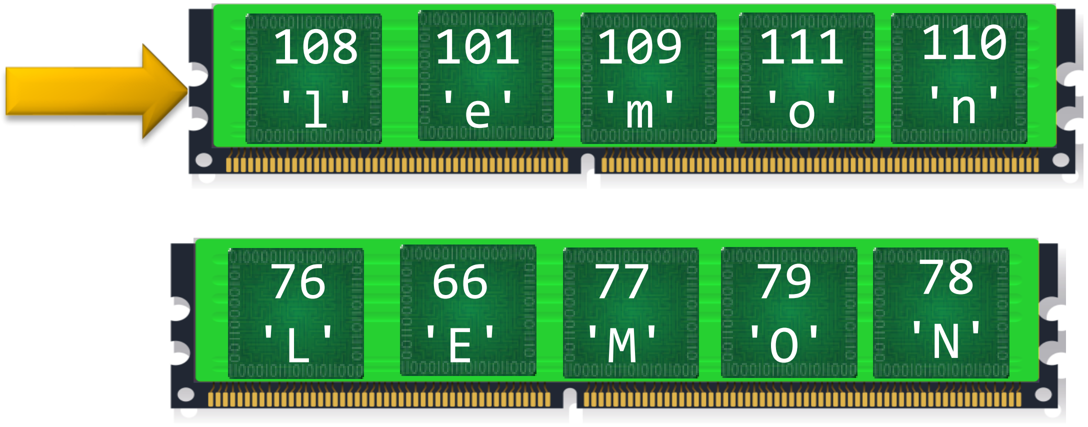
Additional work:

Try to match letters $'L' \overset{?}{==} 'l'$?

May need to examine more characters

OrdinalIgnoreCase:
No letters are different

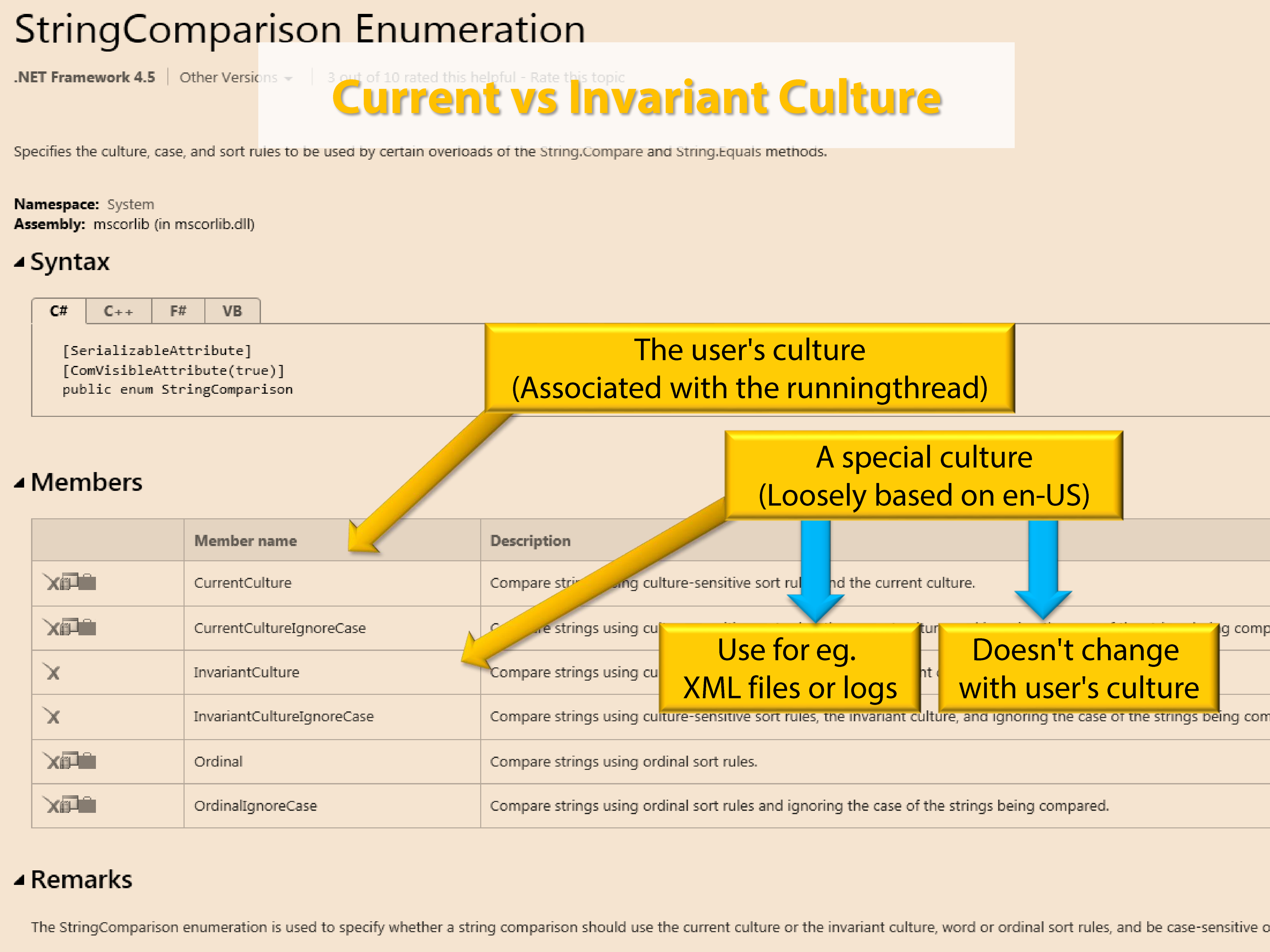
Ordinal:
First different letter
is here



Ordinal vs Culture-Sensitive

For each char…	Ordinal	Culture-Sensitive
	Consider numeric value only	Consider 'meaning' of numeric value
		eg. ß $\longrightarrow$ ss
		Consider any ordering rules for the culture
		Eg. Rules for accented chars

Current vs Invariant Culture



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Remarks

The StringComparison enumeration is used to specify whether a string comparison should use the current culture or the invariant culture, word or ordinal sort rules, and be case-sensitive o

The user's culture
(Associated with the runningthread)

A special culture
(Loosely based on en-US)

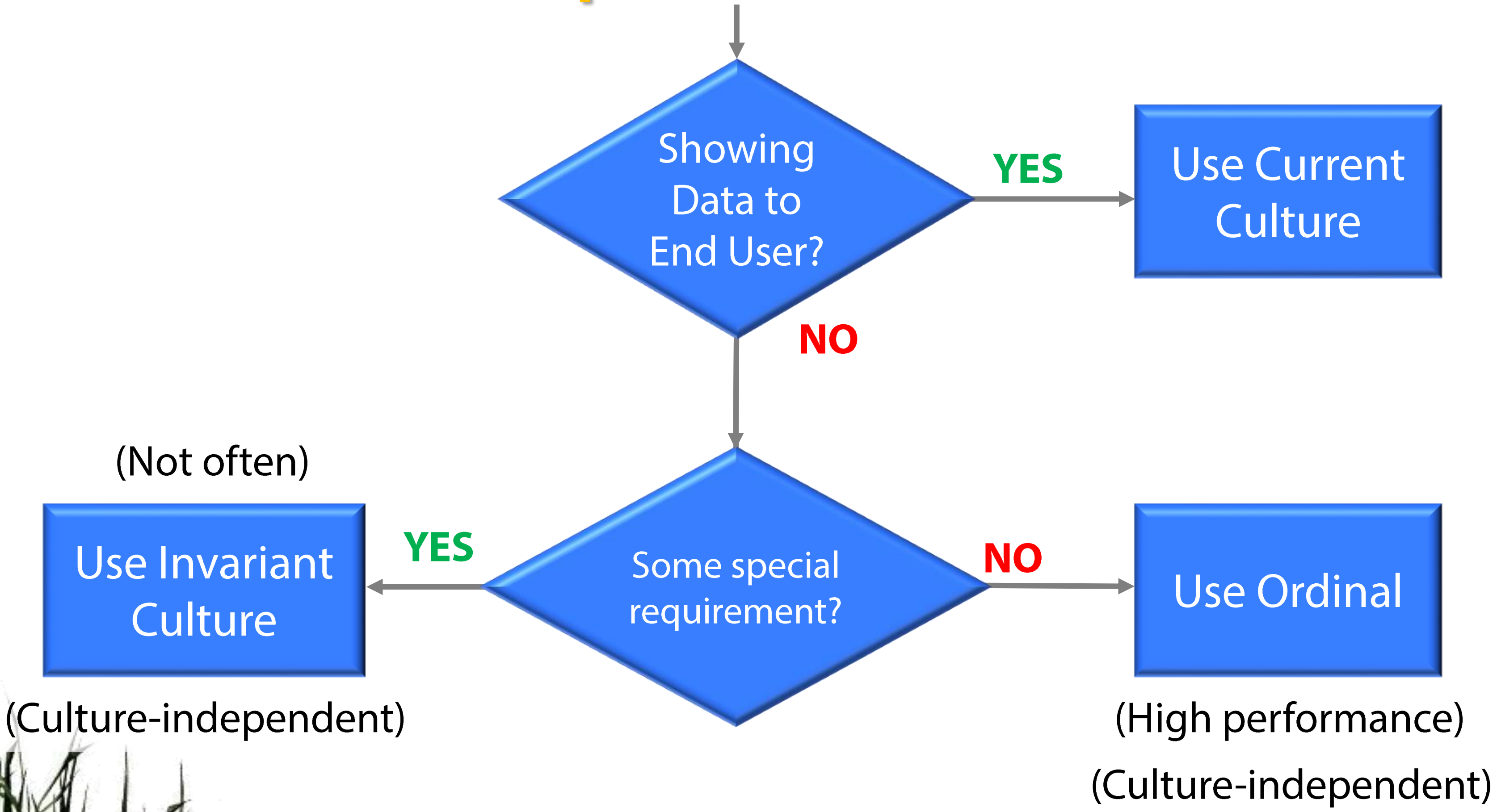
Use for eg.
XML files or logs

Doesn't change
with user's culture

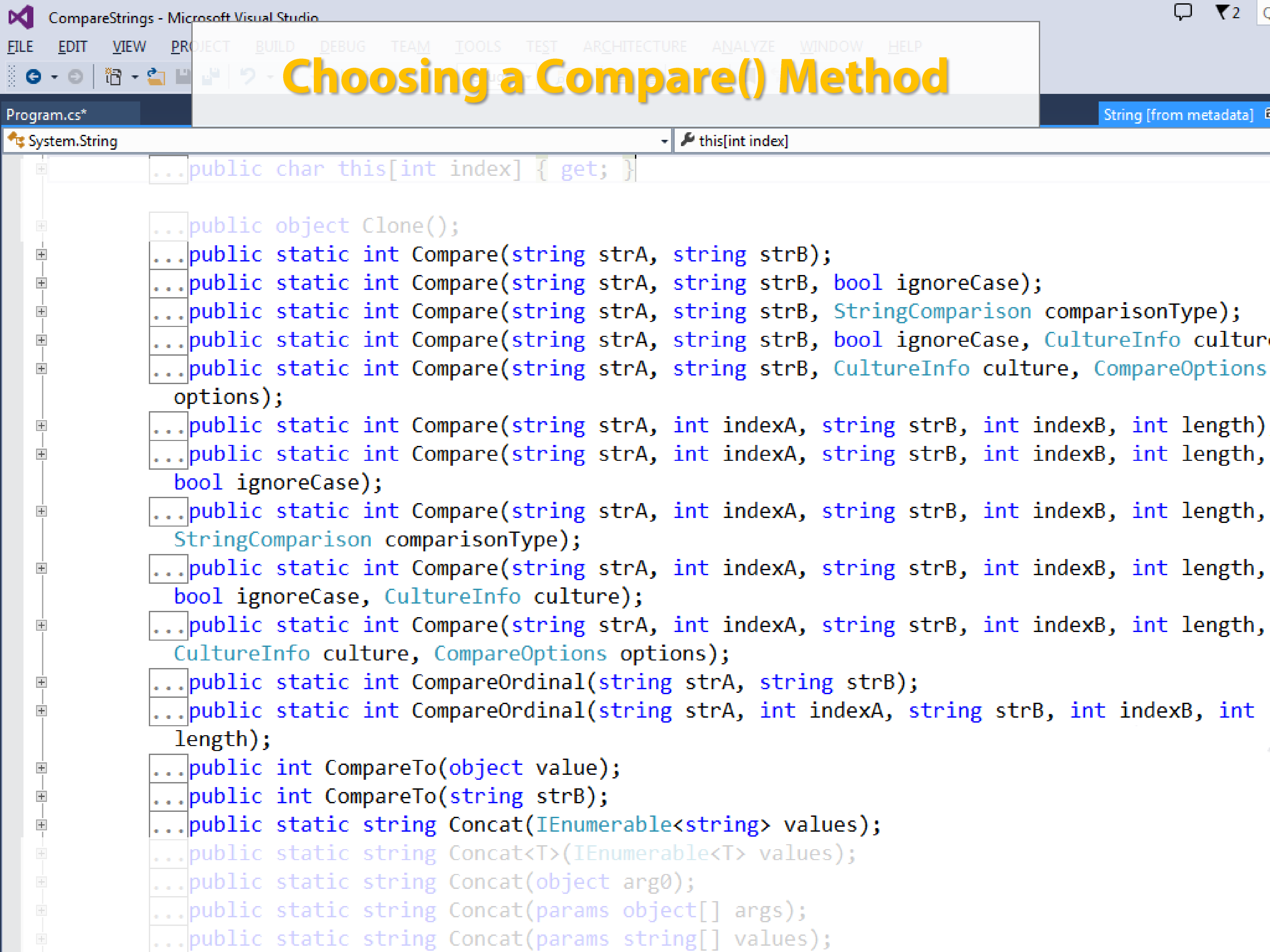
Letter Orders

Cultural	a < A < b < B < c < C < …. < z < Z
Ordinal	A < B < … < Z < a < b < … z
Cultural/Ignore-Case Ordinal/Ignore-Case	(a = A) < (b = B) < (c = C) < …. < (z = Z)

Which Comparison Should You Choose?



Choosing a Compare() Method



```
...public char this[int index] { get; }

...public object Clone();
...public static int Compare(string strA, string strB);
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...public static int Compare(string strA, string strB, StringComparison comparisonType);
...public static int Compare(string strA, string strB, bool ignoreCase, CultureInfo cultur
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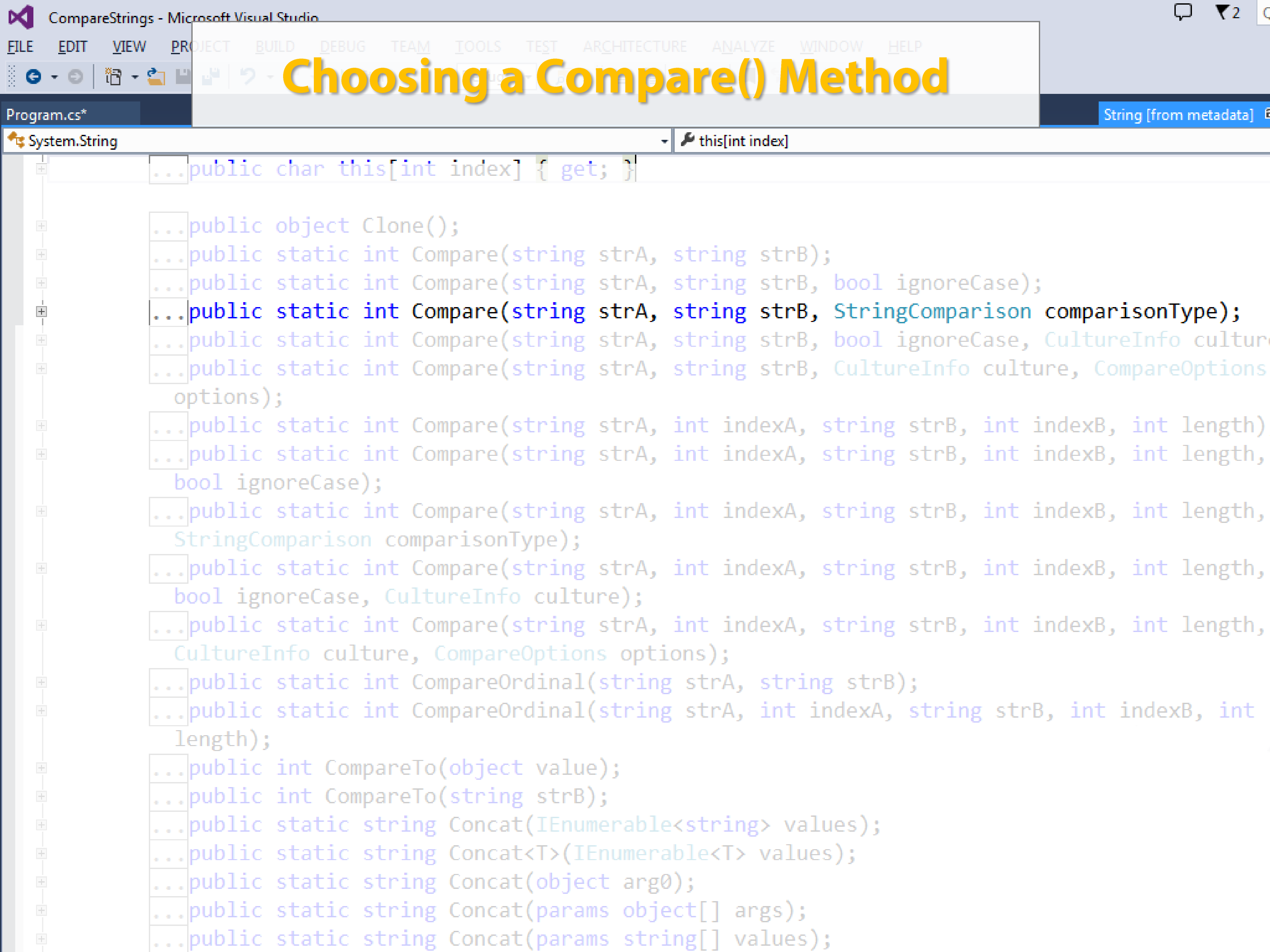
Choosing a Compare() Method



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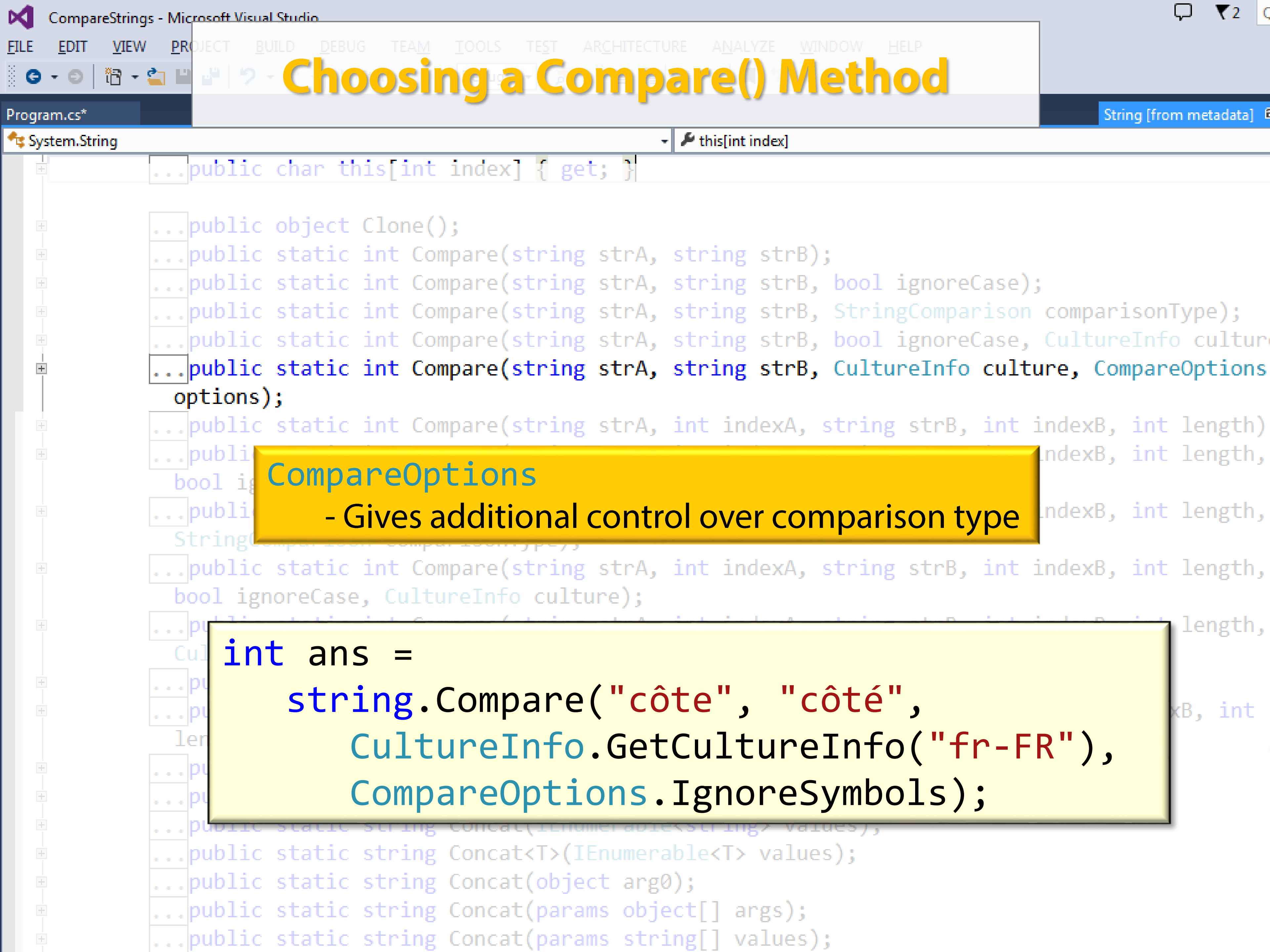

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```
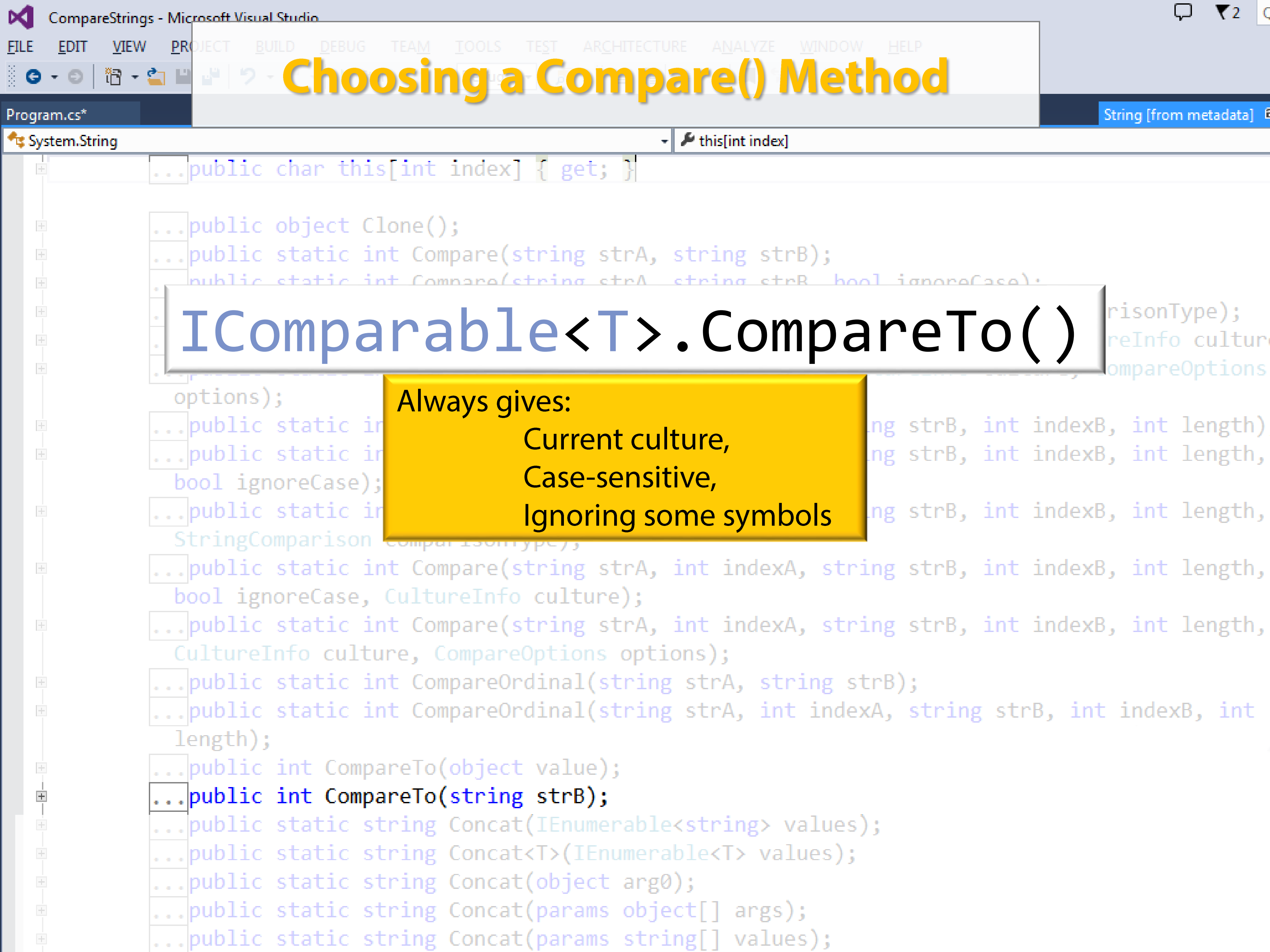

CompareOptions

- Gives additional control over comparison type

```
int ans =
    string.Compare("côte", "côté",
        CultureInfo.GetCultureInfo("fr-FR"),
        CompareOptions.IgnoreSymbols);
```

Choosing a Compare() Method


CompareStrings - Microsoft Visual Studio
FILE EDIT VIEW PROJECT BUILD DEBUG TEAM TOOLS TEST ARCHITECTURE ANALYZE WINDOW HELP
Program.cs*
String [from metadata]
System.String
this[int index]

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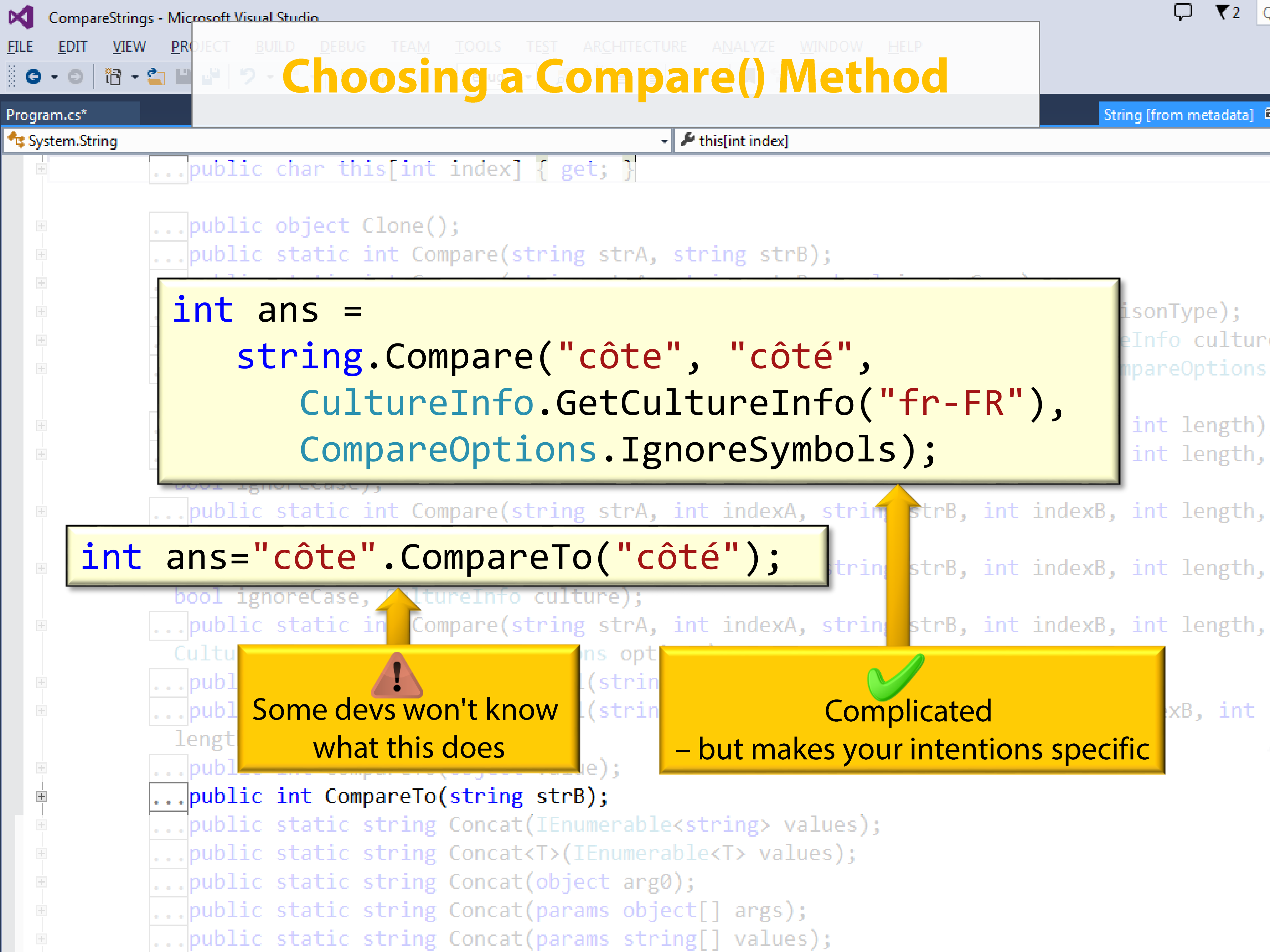
IComparable<T>.CompareTo()

Always gives:

- Current culture,
- Case-sensitive,
- Ignoring some symbols

Choosing a Compare() Method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```
int ans="côte".CompareTo("côté");
```

Some devs won't know what this does

Complicated – but makes your intentions specific

String Pooling

```
string apple1 = "Apple";
string apple2 = "Ap" + "ple";
```

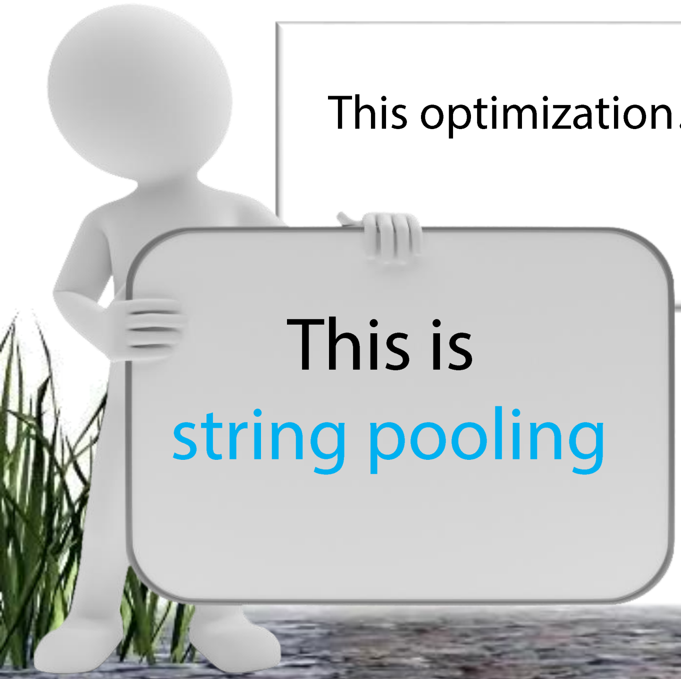
Hardcoded strings *might* compile to a single instance…

`ReferenceEquals()` *might* return `true`

This optimization…

✓ Saves memory

✓ Can speed string comparisons



Code Demo

Summary

- Ordinal comparison: Just check numerical value of each `char`.
- Culture-sensitive comparisons:
  - Perform character expansions etc.
  - Take account of specified culture.
  - Slower.
- `string` offers overloads of `Compare()` and `Equals()`.
- == gives an ordinal, case-sensitive equality comparison.
  - But `IComparable<T>.CompareTo()` is culture-sensitive.
- The compiler might do string pooling.