Functional Code in C#

Version 10 and beyond

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2007 at BASTA Conference: 10 Cool Things You Can Do With C# 3.0

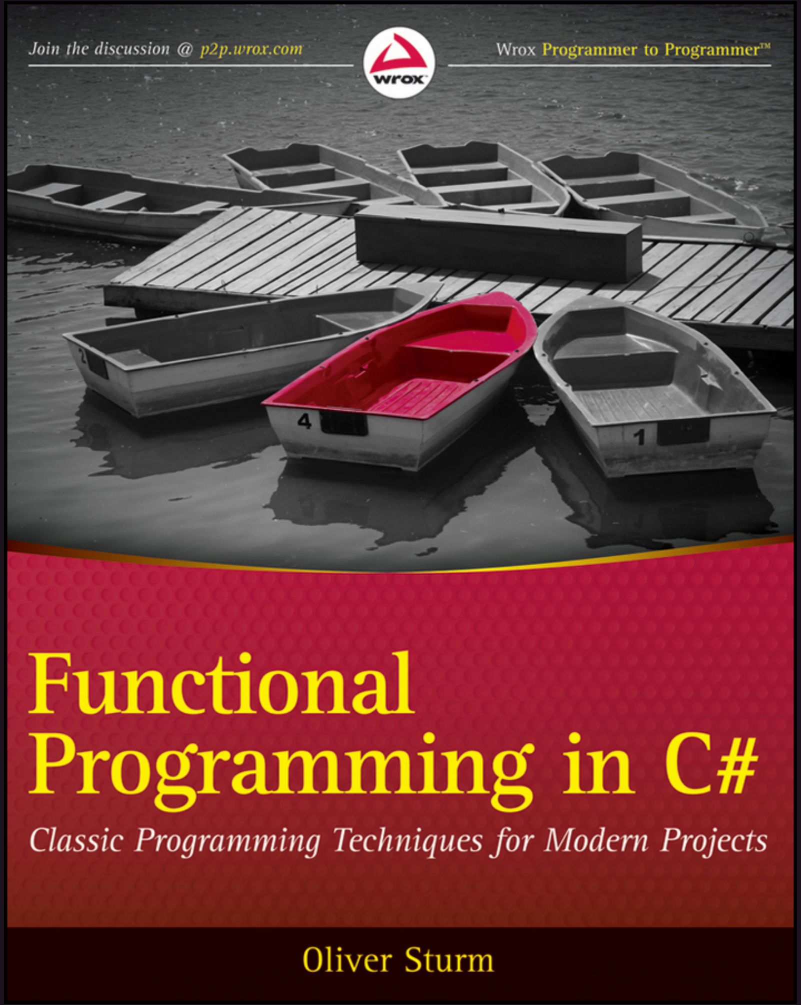
1. Sets
2. Empty anonymous lists
3. Ruby style iterations
4. Control.Invoke
5. Fluent interfaces
6. Dynamic querying
7. Ruby style ranges
9. Specifications
10. Smells like Functional Programming

This simple example demonstrated how to use higher order functions and lambda expressions to do some calculations, instead of imperative techniques.

Since then: many more FP in C# talks

- Basics: Lambdas, closures, standard LINQ features
- Higher order functions known from other languages: Map, Filter, Reduce
- Functional Modularization: Currying, Partial Application, Composition
- Concurrency using FP patterns
- Immutable Data
- 2011 Book: Functional Programming in C#
- Accompanying library: FCSlib
- Monads

Functional Programming in C#, The Book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Functional Programming in C#
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Agenda

- What's FP in C# all about?
- New features in C# relevant to FP
- Immutable objects with `record` (cloning)
- Updating FCSlib
- Basic Pattern Matching (**separate talk right after!**)

What's FP in C# all about?

- Applying the style you like to the language you must use - it's a niche!
- Preference to write functional code
- Use functions as reusable blocks
- Learn from other (pure!) FP languages

Demo

What does FP in C# look like?

Monads - Interlude

In practical terms, a Monad ...

- is a thing that encapsulates a value and adds some extra information
- allows operations executed against the value, returning a new Monad

```
class Monad<T> {
  public Monad<T>(T value);
  public Monad<U> Bind(Func<T, Monad<U>> f);
}
```

- Example: `Option` (or `Maybe`), `Either`

Demo (cont.)

What does FP in C# look like?

New features in C# relevant to FP

- `using static` (6)
- Tuples (7)
- Deconstruction (7)
- Pattern matching (7, mainly 8 and 9, also 10)
- Expression-bodied members (6, 7)
- Throw expressions (7)
- Local functions (7, 8)
- Nullable reference types (8)
- Records (9)

Demo

A look at records and clones

What's the point of `record` / `with` ?

- It's all about isolation - different views on generations of data
- Imperative programming is all about change: state modification
- Something to recognize: change is bad
  - Problems when sharing access to data
  - Locking & Co required when parallelizing
  - Friday afternoon debugging problem
- **Idea: let's not change things**
  - **In the real world, this means establishing "views" to create the illusion of change and preserve isolated states**

Updating FCSlib

In summary, here are important changes I made to the FCSlib code:

- Lots of fixes for nullable reference types. Not sure yet that I've made all the right decisions. E.g. `Option<T>` ?
- Use expression-bodied members where possible
- Implement all tests without the `Functional.` prefix - `using static`
- Considered using records - but no obvious advantage in most FCSlib classes
- Pattern matching. This is important!

Pattern Matching

- C# 7: `value is Type t`, also in `switch`
- C# 8: switch expressions, property, tuple, positional patterns, deconstruction
- C# 9: logical (`and` , `or` , `not`), relational (operators) and structural (parens) enhancements
- C# 10: nested property patterns

Clearly an important feature! Complex expression-based logic implementations would look pretty bad using only ternary expressions!

Again: check out the Pattern Matching talk coming up next!

Demo

Pattern Matching

Sources

- This presentation: https://oliversturm.github.io/functional-cs10
- PDF download: https://oliversturm.github.io/functional-cs10/slides.pdf
- Repository with sample code: https://github.com/oliversturm/functional-cs10-samples
- FCSlib: https://github.com/oliversturm/FCSlib

Thank You

Please feel free to contact me about the content anytime.

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