The Principles of Functional Programming

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https://github.com/panicz/writings/tree/master/talks/datamass

datamass.io summit, 29.09.2017

The goals of the talk

- explain what Functional Programming is
- expose some common confusion
- debunk some widespread myths
- show the value and applicability of FP
- and fallacies that arise when **not using FP**

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What is functional programming?

Myth #1: Functional programming isn't well defined.

> ***functional programming*** *– programming paradigm that treats computation as the evaluation of mathematical functions and avoids changing-state and mutable data*

`https://en.wikipedia.org/wiki/Functional_programming`

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Function vs. procedure

procedure *– a sequence of instructions that show how to achieve some result, such as to prepare or make something*

https://en.wikipedia.org/wiki/Procedure

```
int main(void) {
  printf("Hello world!\n");
  return 0;
}
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Function vs. procedure

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Procedure – real life example

Function (in mathematical sense)

function *– a relation that associates an input to a single output according to some rule*

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```
int square(int x) {
  return x * x;
}
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(a procedure can implement a function)

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Functions and procedures in standard C library

functions

```
tolower
isdigit
strlen
strcmp
sqrt
+ - * / < == >
```

procedures

```
printf
scanf
memcpy
clock
rand
++ -- = += *=
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Lambdas

Myth #2: functional programming is about using *lambdas* or *closures* or *higher-order functions/procedures*

Lambda, Λ, λ *– is the 11th letter of the Greek alphabet*

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function make_counter() {
  var counter = 0;
  return function() {
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Parts of speech

Myth #3: objects are like nouns and functions are like verbs

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insertions::  a -> [a] -> [[a]]
insertions x []     = [[x]]
insertions x (h:t) = [(x:h:t)] ++ entwined
  where entwined = (map (h:) (insertions x t))

e.g. insertions 0 [1,2,3] ===>
  [[0,1,2,3],[1,0,2,3],[1,2,0,3],[1,2,3,0]]
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other examples: `powerset`, `permutations`, `sorted`

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Imperative functional programming

Myth #4: (pure) functions cannot be implemented in non-functional (imperative) way

```
int factorial(int n) {
  int result = 1;
  while (n > 0)
    result *= n--;
  return result;
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```
int factorial(int n) {
  if (n < 1) return 1;
  else return
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Myth #5: you need to understand Category Theory to use functional programming

Imperative programs explain how to **do** things (perform *actions*), while functional programs **mean** things (refer to *objects*).

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Sum of squares of initial 7 prime numbers (procedural)

```
counter := 7
number := 0
sum := 0
while(counter > 0):
    if is_prime(number):
        sum := sum + number^2
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```

After its execution, the `sum` variable contains the desired value

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Sum of squares of initial 7 prime numbers (definitions)

```
(define (numbers-from first)
  `(,first . ,(numbers-from (+ first 1))))

(define numbers (numbers-from 0))

(define (only qualifying? elements)
  (match elements
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    (`(,first . ,rest)
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The substitution model of computation

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Binding vs. assignment

Myth #6: binding and assignment are the same thing

- **definition** – creates a new binding in the current scope

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(define variable value)
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- **assignment** – changes the value bound by a variable in the current scope

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(set! variable new-value)
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- **binding** – creates a new scope, possibly shadowing some existing binding

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Myth #6: binding and assignment are the same thing

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(define variable value)
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- **assignment** – changes the value bound by a variable in the current scope

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(set! variable new-value)
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- **binding** – creates a new scope, possibly shadowing some existing binding

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- by explaining the new meaning to everyone
- by modifying the structure of the brains of all the people

What about the previous usages of that word?

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- code is easier to read and refactor and less prone to errors
- no control flow means more flexible interpretation
- better multicore optimization
- we don't care what the computer do will

Disadvantages:

- may cause performance penalties
- difficult to reason about resource usage
- often leads smug programmers to awkward abstractions
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