Fachhochschule
Nordwestschweiz

Functional Programming

http://www.pngall.com/colored-smoke-png/download/15792

Motivation

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A Tiny Book Library in Java (I)

```
public class Book {
  private String author, title;

  public Book(String author, String title) {
    this.author = author; this.title = title;
  }

  public String getAuthor() { return author; }
  public void setAuthor(String author) { this.author = author; }

  public String getTitle() { return title; }
  public void setTitle(String title) { this.title = title; }

  public String toString() {
    return "Book(" + author +"," + title+ ")";
  }
}
```

A Tiny Book Library in Java (II)

```java
class JavaLibrary {

  public final List<Book> shelf = new LinkedList<>();

  public void addBook(Book book) {
    shelf.add(book);
  }

  public List<Book> booksByAuthor(String author) {
    List<Book> result = new LinkedList<>();
    for (Book b : shelf) {
      if (b.getAuthor().equals(author)) {
        result.add(b);
      }
    }
    return result;
  }
...
```

A Tiny Book Library in Java (III)

```java
  ...

  public static void main(String[] args) {
    JavaLibrary lib = new JavaLibrary();
    lib.addBook(new Book("A", "A1"));
    lib.addBook(new Book("A", "A2"));
    lib.addBook(new Book("B", "B1"));

    List<Book> booksByA = lib.booksByAuthor("A");
    Collections.sort(booksByA, new Comparator<Book>() {
      public int compare(Book b1, Book b2) {
        return b1.getTitle().compareTo(b2.getTitle());
      }
    });
    System.out.print(booksByA);
  }
}
```

A Tiny Book Library in Haskell

```haskell
import Data.List (sortOn)

data Book = Book { author :: String, title :: String } deriving Show

shelf :: [Book]
shelf = [Book "A" "A1", Book "A" "A2", Book "B" "B1"]

booksByAuthor :: String -> [Book] -> [Book]
booksByAuthor name books = filter (\b -> author b == name) books


sortByTitle :: [Book] -> [Book]
sortByTitle books = sortOn title books

main :: IO ()
main = putStrLn (show booksByA)
  where booksByA = sortByTitle (booksByAuthor "A" shelf)
```

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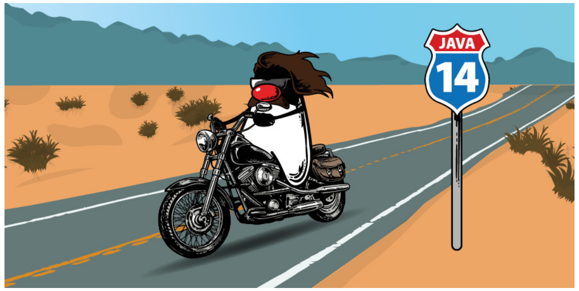


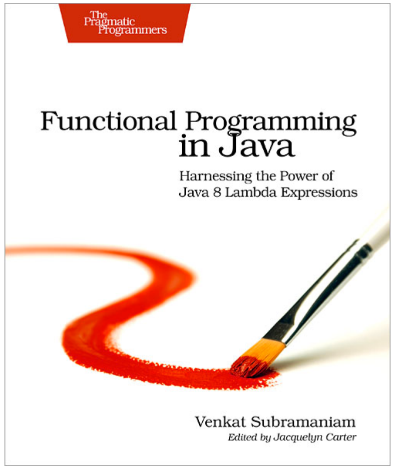
Same in Java 14

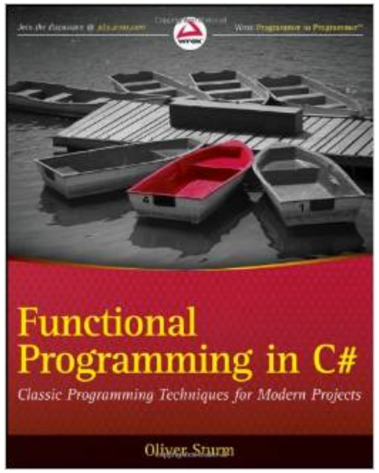
```
public class JavaLibrary {
  record Book(String author, String title){}

  public static final List<Book> shelf =
    Arrays.asList(new Book("A", "A1"), new Book("A", "A2"), new Book("B", "B1"));
  public static List<Book> booksByAuthor(String author) {
    return shelf.stream()
       .filter((b) -> b.author().equals(author))
       .collect(Collectors.toList());
  }
  public static void main(String[] args) {
    List<Book> booksByA = booksByAuthor("A").stream()
      .sorted(Comparator.comparing(book -> book.author()))
      .collect(Collectors.toList());
    System.out.print(booksByA);
  }
}
```

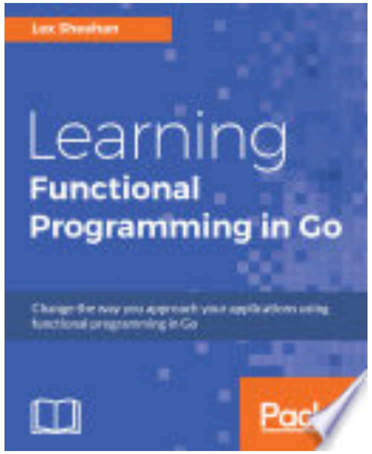
Why Functional Programming

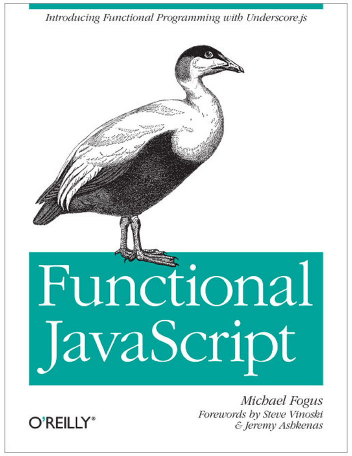
FP (Haskell)	OOP (Java)
Declarative (what to do) Combining expressions	**Imperative** (how to do it) Step-by-step statements
Data Functions	Classes Interfaces Inheritance Hierarchies Methods Objects (this, super) Dynamic Dispatch
Evaluating expressions	Changing state
Reduce movable parts (things do no change)	Encapsulate movable parts (you can’t see what changes)
Simple: Big advantage when building complex systems.	Complex: Seldom the right choice to build a system.

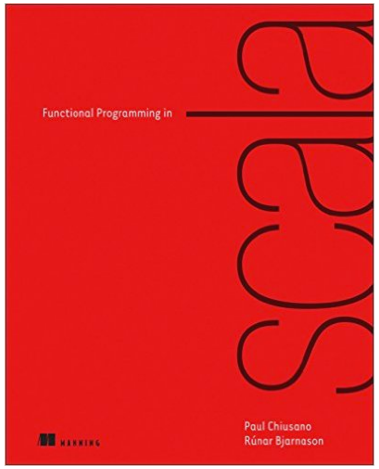
Many Languages Adopt Functional Ideas

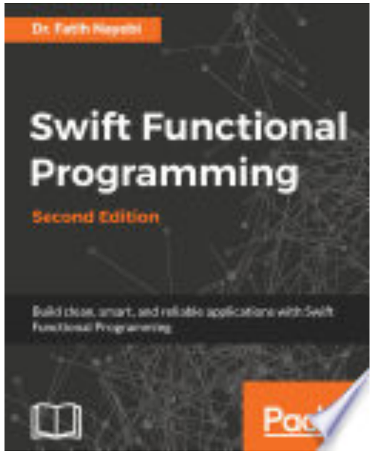

The Pragmatic Programmers
Functional Programming in Java
Harnessing the Power of Java 8 Lambda Expressions
Venkat Subramaniam
Edited by Jacquelyn Carter

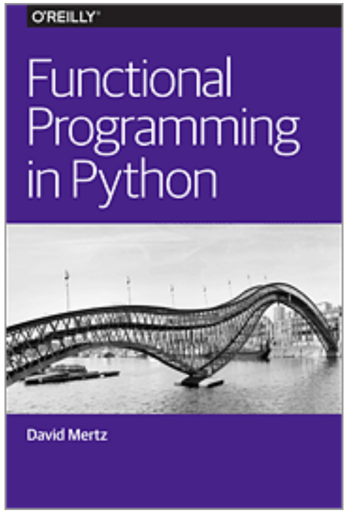

Functional Programming in C#
Classic Programming Techniques for Modern Projects
Oliver Sturm


Lex Sheehan
Learning Functional Programming in Go
Change the way you approach your applications using functional programming in Go


Introducing Functional Programming with Underscore.js
Functional JavaScript
O'REILLY
Michael Fogus
Forewords by Steve Vinoski & Jeremy Ashkenas




Dr. Fatih Nayebi
Swift Functional Programming
Second Edition
Build clean, smart, and reliable applications with Swift Functional Programming



Why Haskell?

- Because Haskell is
  - Designed from the ground up to be a purely functional language
    - No compromise / no cheating allowed
  - Statically typed (the compiler is your friend)
  - Currently one of the coolest languages!

- But what you learn in this class is applicable to:
  - JavaScript, ECMA Script
  - Java, C# (and other languages which adopt functional concepts)
  - F# (Microsoft’s functional language)
  - Erlang (Drives WhatsApp with 1.5B users)
  - Scala (FP-OO Hybrid on JVM, used heavily by Twitter)
  - Clojure (Lisp on the JVM)

Goals

- **The Students**

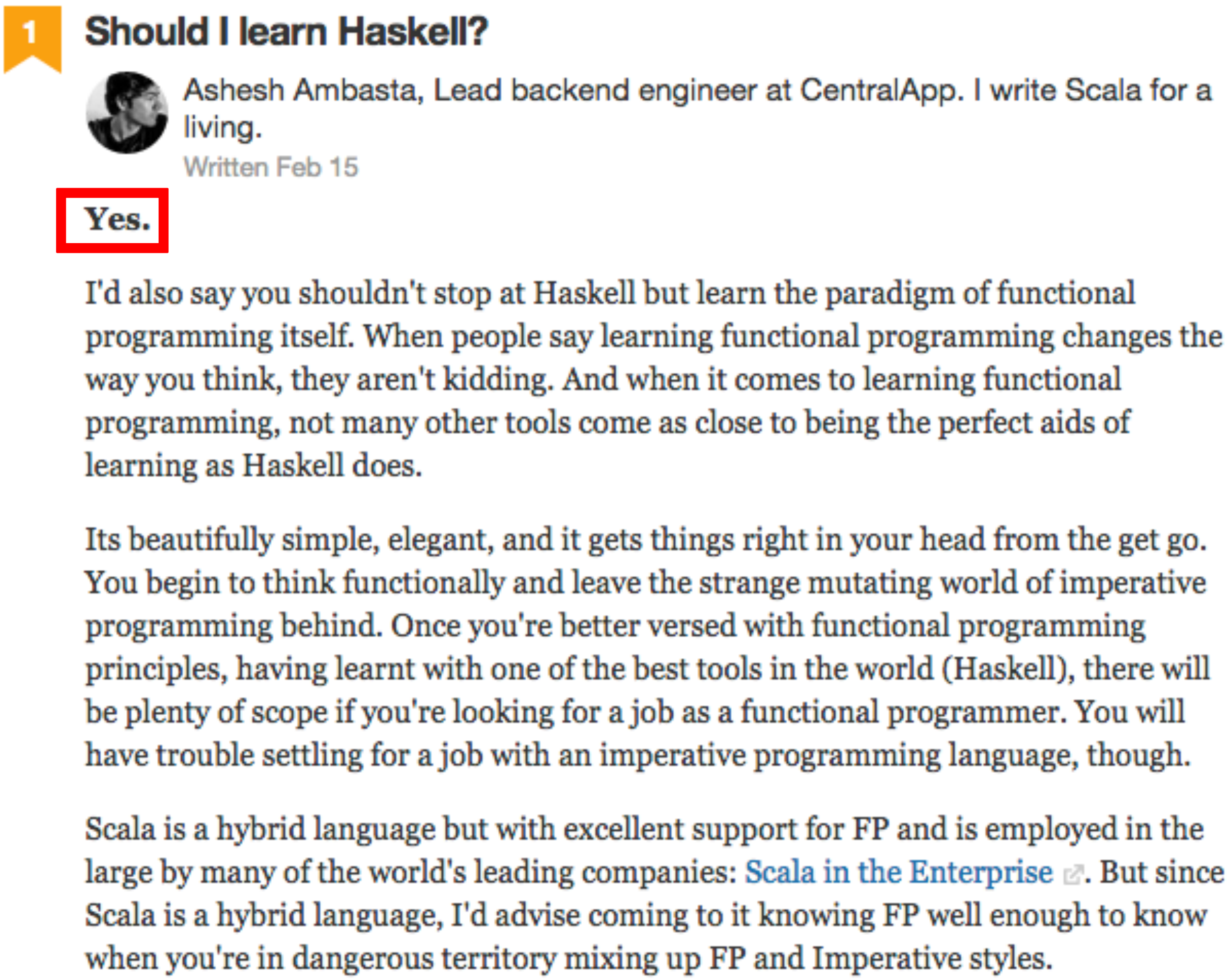
  ... learn a new way of thinking about programing

  ... appreciate the clear and concise style of functional programs

  ... can write functional programs in Haskell

  ... can apply functional concepts to other programming languages such as Java or C#

Quora #1 Haskell Question [1]



1

Should I learn Haskell?

Ashesh Ambasta, Lead backend engineer at CentralApp. I write Scala for a living.

Written Feb 15

Yes.

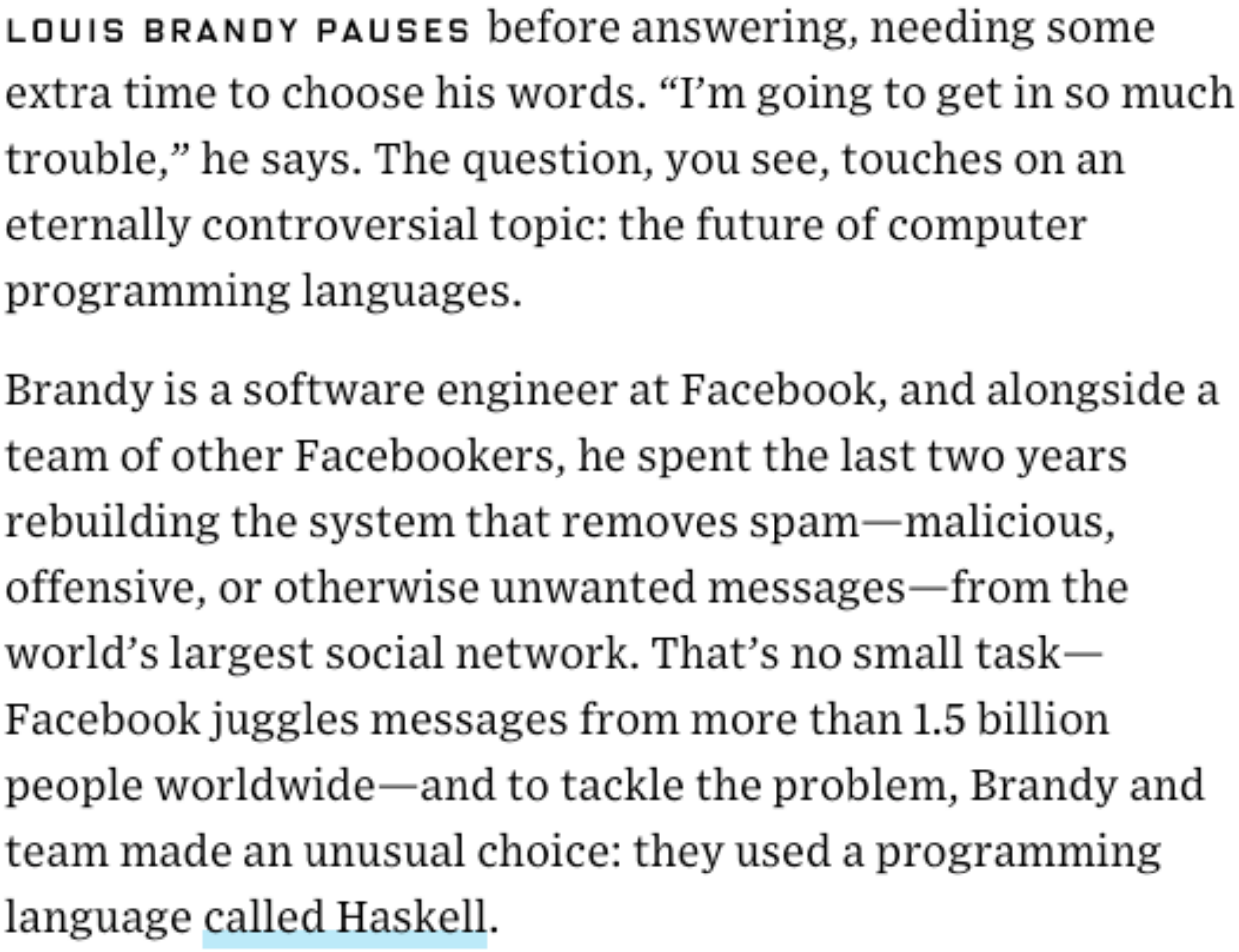
I'd also say you shouldn't stop at Haskell but learn the paradigm of functional programming itself. When people say learning functional programming changes the way you think, they aren't kidding. And when it comes to learning functional programming, not many other tools come as close to being the perfect aids of learning as Haskell does.

Its beautifully simple, elegant, and it gets things right in your head from the get go. You begin to think functionally and leave the strange mutating world of imperative programming behind. Once you're better versed with functional programming principles, having learnt with one of the best tools in the world (Haskell), there will be plenty of scope if you're looking for a job as a functional programmer. You will have trouble settling for a job with an imperative programming language, though.

Scala is a hybrid language but with excellent support for FP and is employed in the large by many of the world's leading companies: Scala in the Enterprise. But since Scala is a hybrid language, I'd advise coming to it knowing FP well enough to know when you're in dangerous territory mixing up FP and Imperative styles.

[1] https://www.quora.com/topic/Haskell-programming-language

Facebook’s New Spam-Killer Hints at the Future of Coding

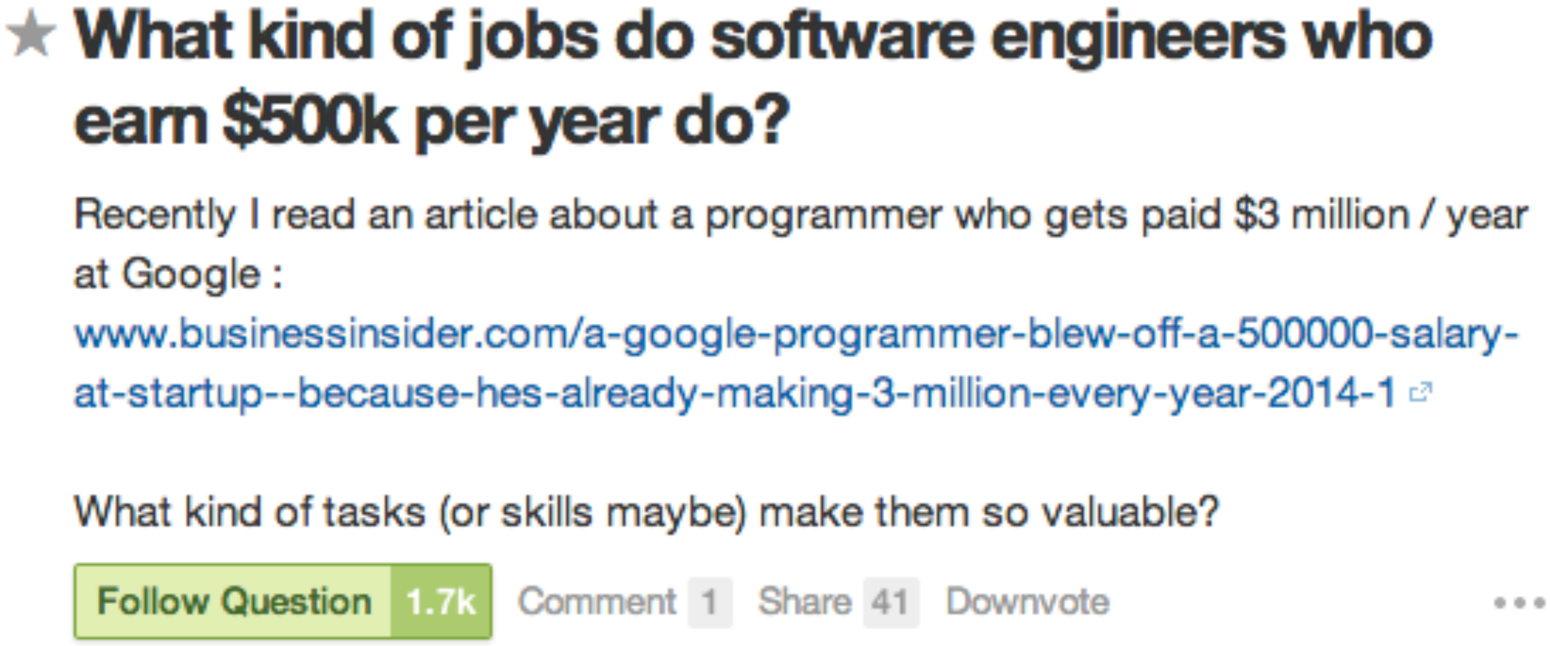


LOUIS BRANDY PAUSES before answering, needing some extra time to choose his words. “I’m going to get in so much trouble,” he says. The question, you see, touches on an eternally controversial topic: the future of computer programming languages.

Brandy is a software engineer at Facebook, and alongside a team of other Facebookers, he spent the last two years rebuilding the system that removes spam—malicious, offensive, or otherwise unwanted messages—from the world’s largest social network. That’s no small task—Facebook juggles messages from more than 1.5 billion people worldwide—and to tackle the problem, Brandy and team made an unusual choice: they used a programming language called Haskell.

http://www.wired.com/2015/09/facebooks-new-anti-spam-system-hints-future-coding/

Want to get rich?



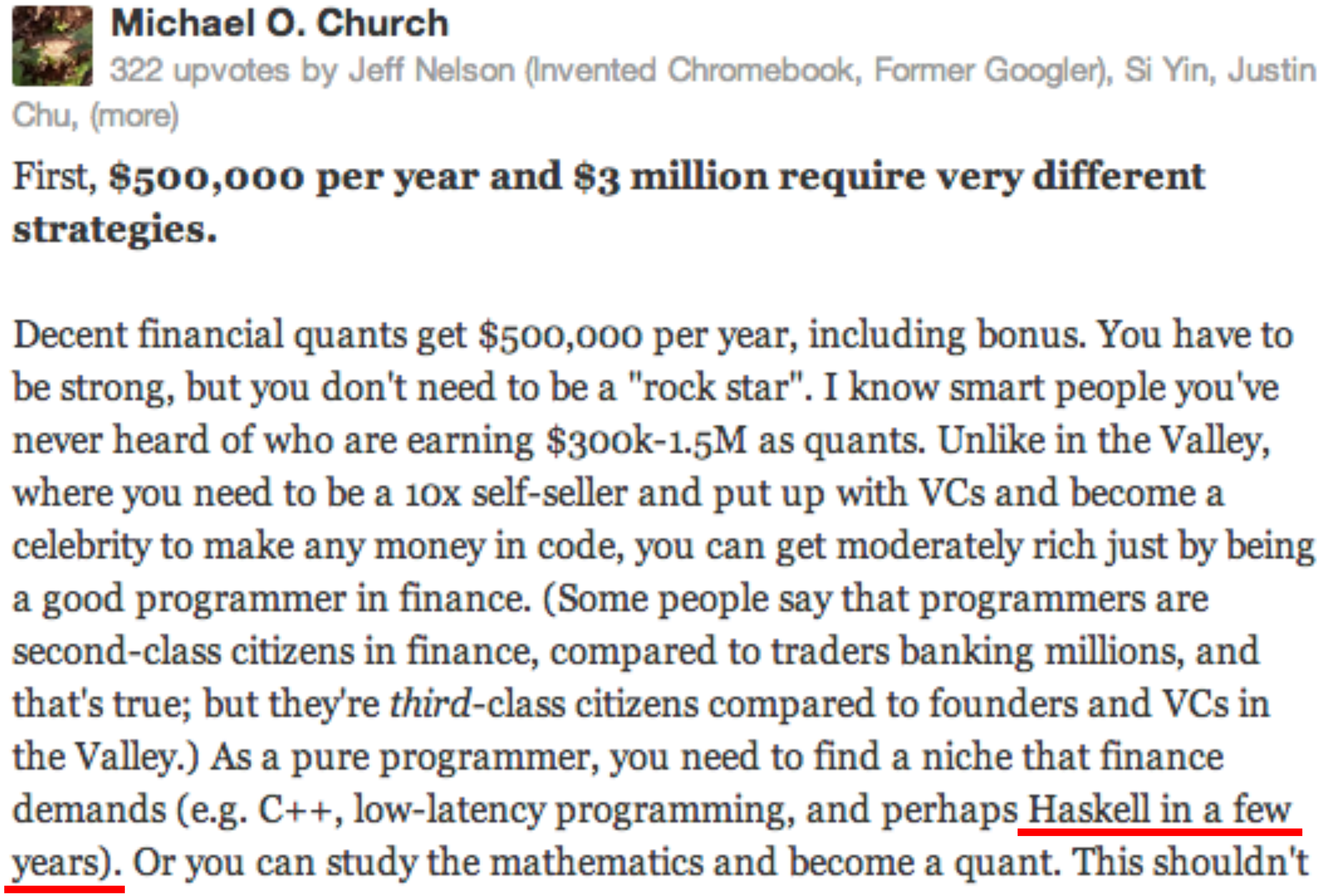
★ What kind of jobs do software engineers who earn $500k per year do?

Recently I read an article about a programmer who gets paid $3 million / year at Google : www.businessinsider.com/a-google-programmer-blew-off-a-500000-salary-at-startup--because-hes-already-making-3-million-every-year-2014-1

What kind of tasks (or skills maybe) make them so valuable?

http://www.quora.com/What-kind-of-jobs-do-software-engineers-who-earn-500k-per-year-do

Learn Haskell!



Michael O. Church

322 upvotes by Jeff Nelson (Invented Chromebook, Former Googler), Si Yin, Justin Chu, (more)

First, **$500,000 per year and $3 million require very different strategies.**

Decent financial quants get $500,000 per year, including bonus. You have to be strong, but you don't need to be a "rock star". I know smart people you've never heard of who are earning $300k-1.5M as quants. Unlike in the Valley, where you need to be a 10x self-seller and put up with VCs and become a celebrity to make any money in code, you can get moderately rich just by being a good programmer in finance. (Some people say that programmers are second-class citizens in finance, compared to traders banking millions, and that's true; but they're *third*-class citizens compared to founders and VCs in the Valley.) As a pure programmer, you need to find a niche that finance demands (e.g. C++, low-latency programming, and perhaps Haskell in a few years). Or you can study the mathematics and become a quant. This shouldn't

Java Script: The World's Most Misunderstood Programming Language [1]

"JavaScript's C-like syntax, including curly braces and the clunky **for** statement, makes it appear to be an ordinary procedural language. This is misleading because JavaScript has more in common with functional languages like Lisp or Scheme than with C or Java."

Redux

- **Three Principles**
  - Single source of truth
  - State is read-only
  - Changes are made with pure functions

IMMUTABLE

```
const evenSquares =
   Seq.of(1,2,3,4,5,6,7,8)
     .filter(x => x % 2 == 0)
     .map(x => x * x);
```

[1] http://www.crockford.com/javascript/javascript.html