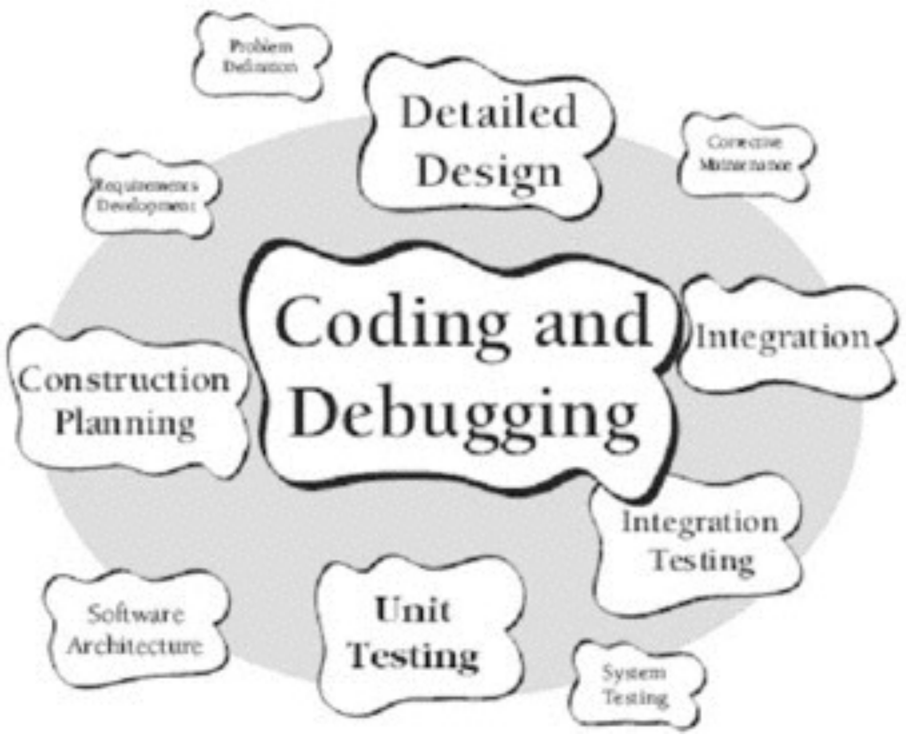


Software Construction

2016-2017
Tijs van der Storm
(storm@cwi.nl / @tvdstorm / @SoftwCons)

UNIVERSITEIT VAN AMSTERDAM

CWI

Introduction

Tijs van der Storm
(lectures + labs)

Ana Oprescu
(labs)

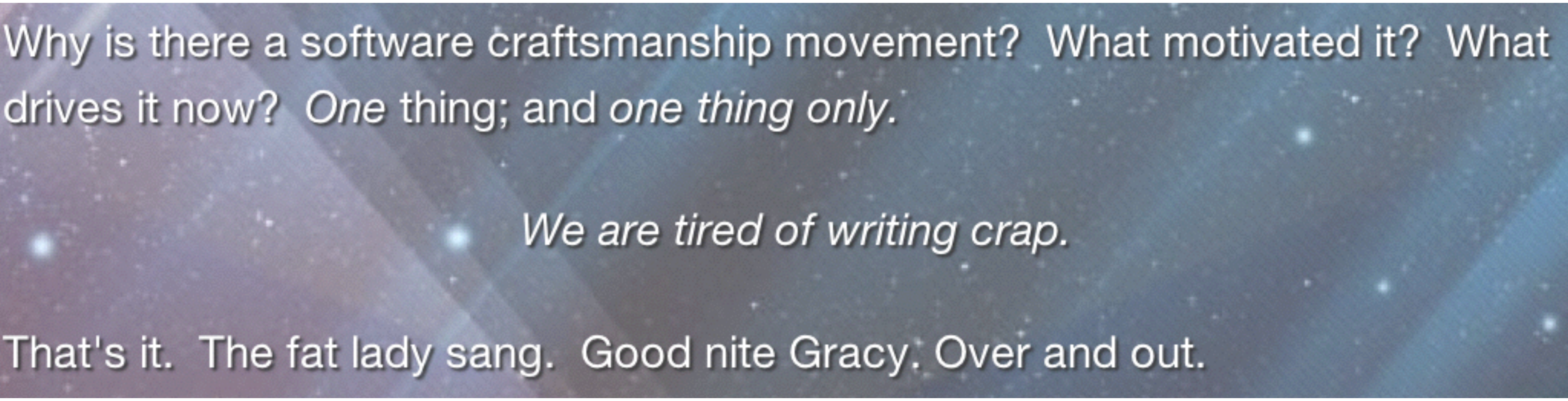
What this course is about

- You all know programming, right?
- But what is good code?
- How to *reason* about good code?
- What is *beautiful* code?
- Think about it.

This course is *not* about

- Data structures
- Algorithms
- Programming language X
- Paradigm X (though: OO)
- GUI programming
- Web applications
- Concurrency
- Performance
- Graphics programming
- Mathematics
- Computational complexity
- ...

Uncle Bob*



Why is there a software craftsmanship movement? What motivated it? What drives it now? *One* thing; and *one thing only.*

We are tired of writing crap.

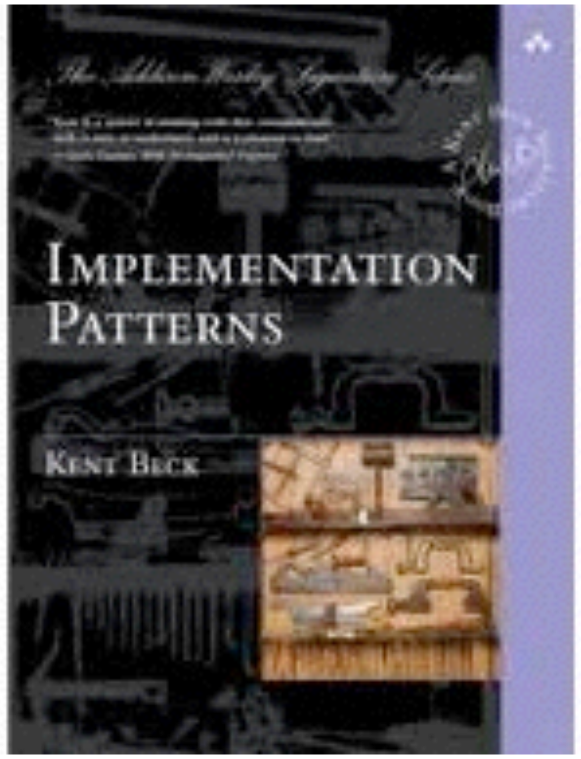
That's it. The fat lady sang. Good nite Gracy. Over and out.

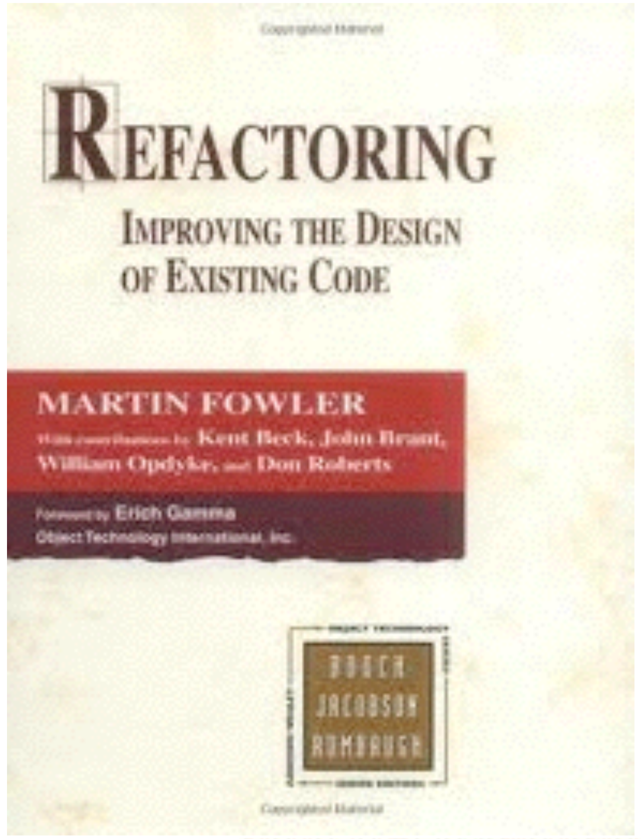
This course is *not* about the software craftmanship movement...

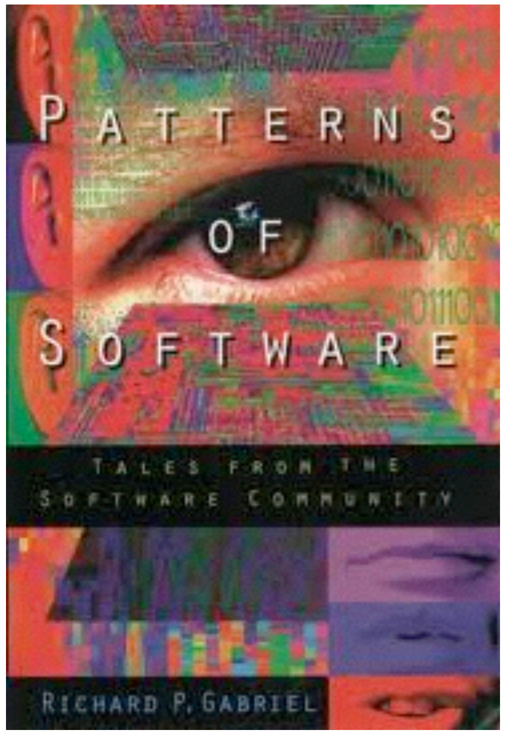
This course *is* about *not* writing crap.

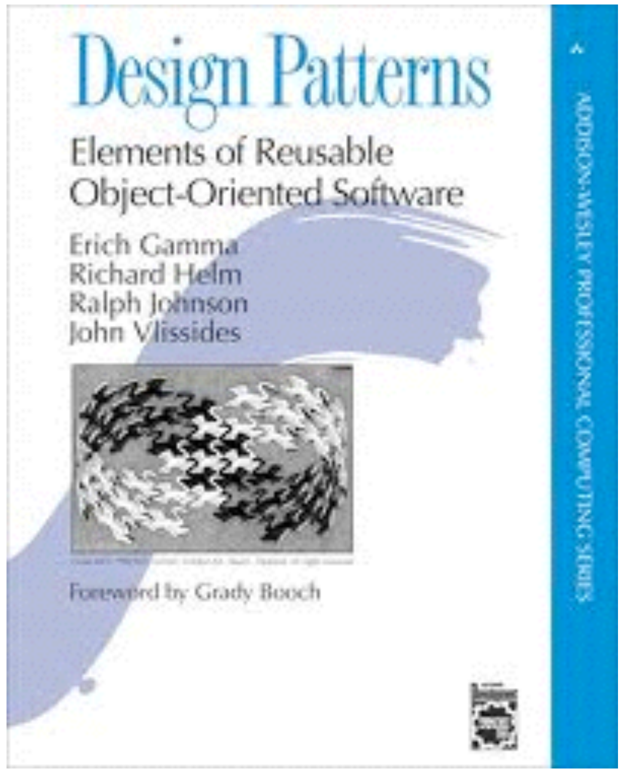
*Robert Martin, http://cleancoder.posterous.com/software-craftsmanship-things-wars-commandmen

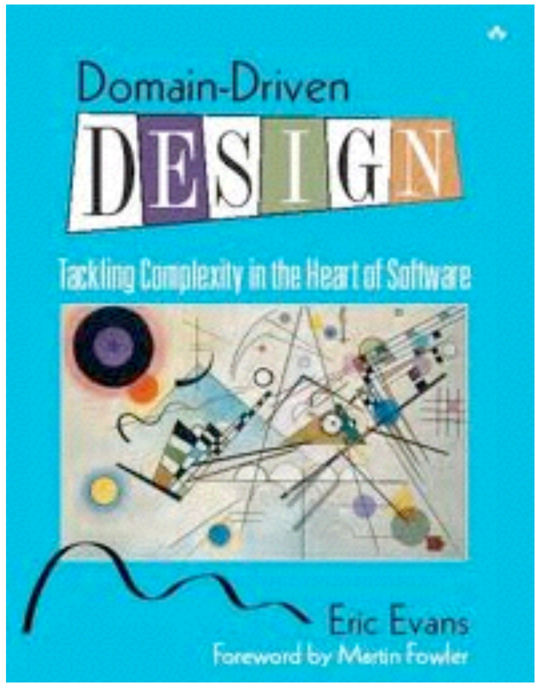
Representative books

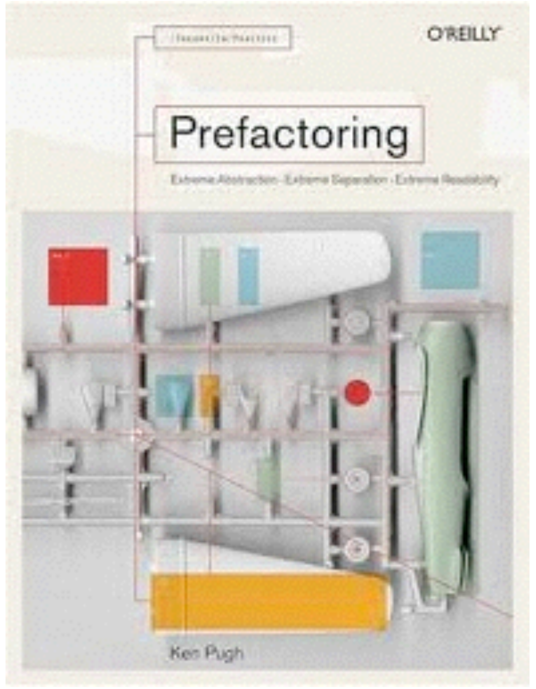


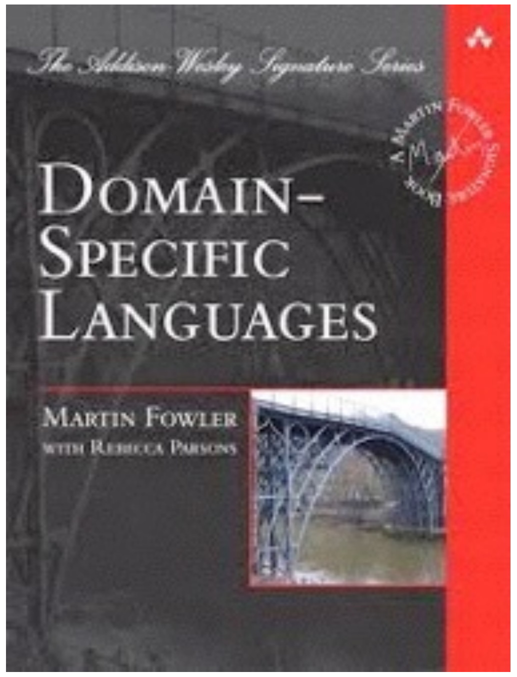

Refactoring
Improving the Design of Existing Code
Martin Fowler
With contributions by Kent Beck, John Brant, William Opdyke, and Don Roberts
Foreword by Erich Gamma
Object Technology International, Inc.
Booch Jacobson Rumbaugh




Design Patterns
Elements of Reusable Object-Oriented Software
Erich Gamma
Richard Helm
Ralph Johnson
John Vlissides
Foreword by Grady Booch
Addison-Wesley Professional Computing Series

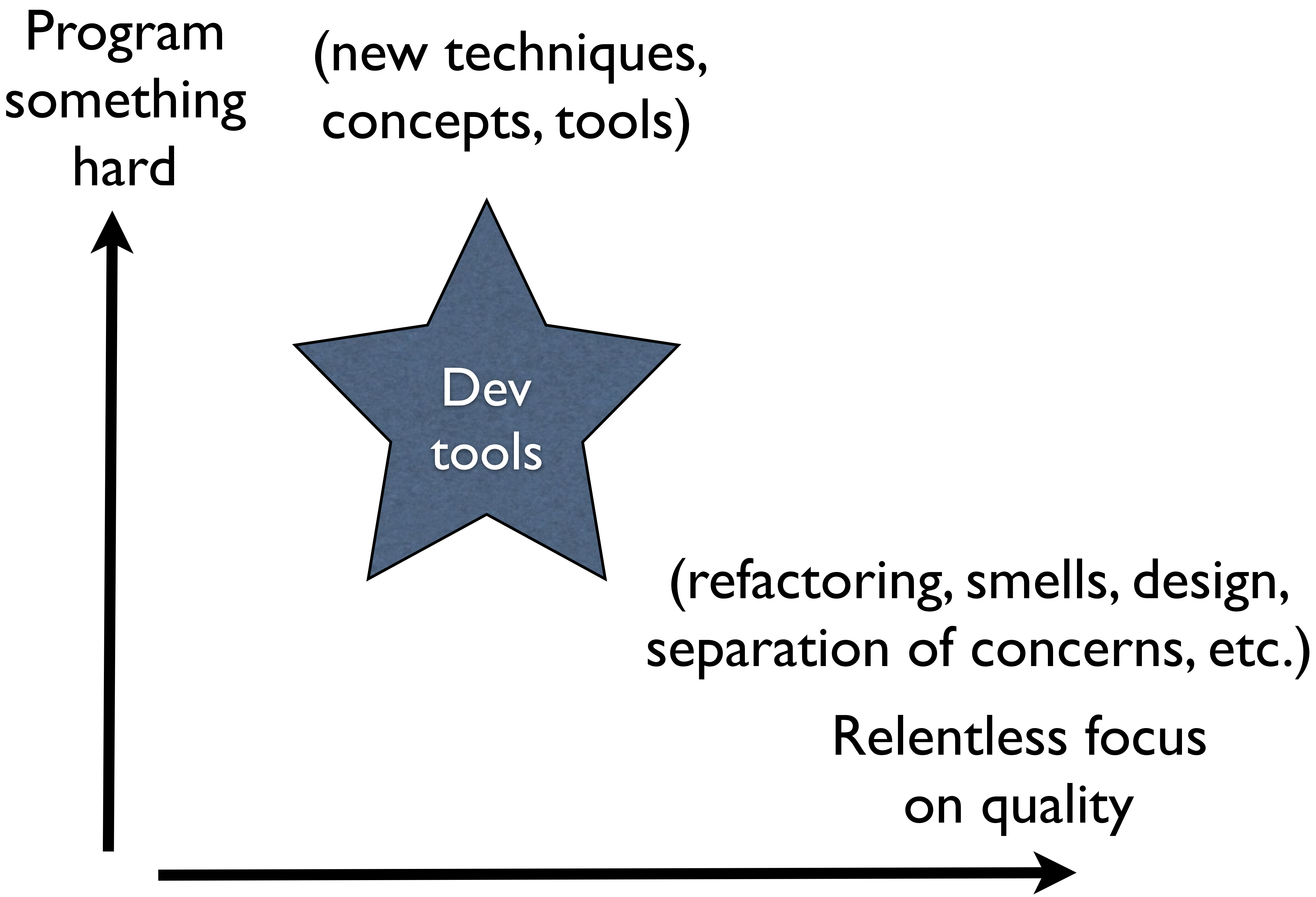

Domain-Driven Design
Tackling Complexity in the Heart of Software
Eric Evans
Foreword by Martin Fowler

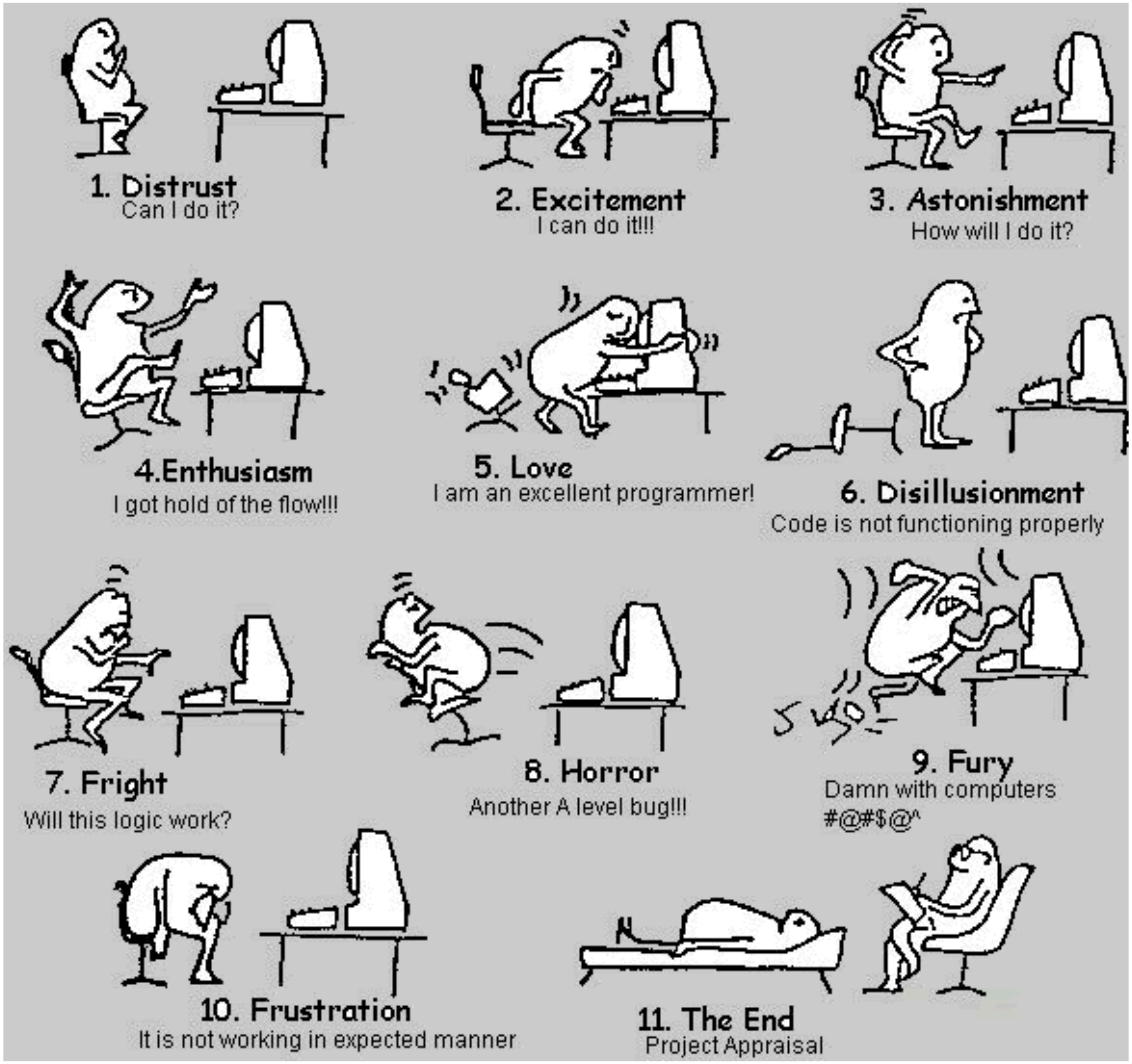

O'Reilly
Prefactoring
Extreme Abstraction · Extreme Separation · Extreme Readability
Ken Pugh


The Addison-Wesley Signature Series
Domain-Specific Languages
Martin Fowler
with Rebecca Parsons
A Martin Fowler Signature Book

Learning goals

- Create good low level designs
- Produce clean, readable code
- Reflect upon techniques, patterns, guidelines etc.
- Assess the quality of code
- Apply state of the art software construction tools


Program something hard
(new techniques, concepts, tools)
Dev tools
(refactoring, smells, design, separation of concerns, etc.)
Relentless focus on quality



http://candraadi.wordpress.com/2012/10/17/programmer/

This course

- Quality comes first
- Be your own worst critic
- Refactor mercilessly
- Aim to become code literati
- Better to read code, than to write code
- If it works it’s not good enough

If it works, it’s not good enough

If it works, it's not good enough

If it works, it’s not good enough

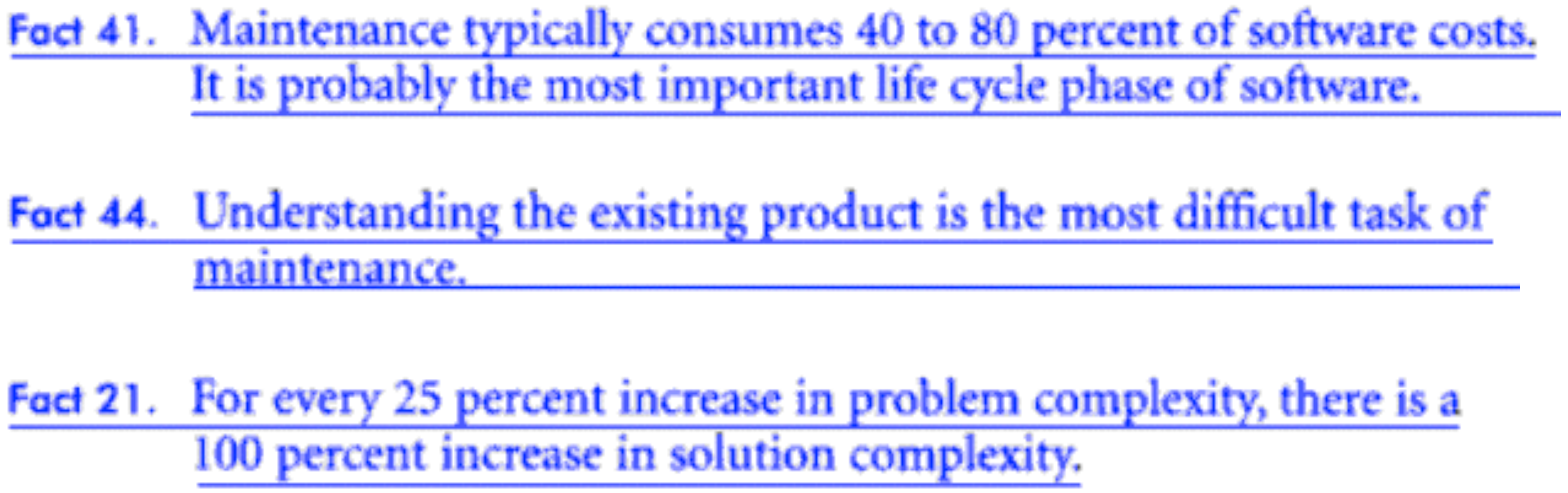
If it works, it’s not good enough

If it works, it’s not good enough

If it works, it's not good enough

Working code is necessary, but not sufficient

Why?



Fact 41. Maintenance typically consumes 40 to 80 percent of software costs. It is probably the most important life cycle phase of software.

Fact 44. Understanding the existing product is the most difficult task of maintenance.

Fact 21. For every 25 percent increase in problem complexity, there is a 100 percent increase in solution complexity.

Robert Glass, *Facts and fallacies of Software Engineering*, Addison-Wesley 2003

Overview

- Lectures
- Theory: papers + book
- Exam: lectures + papers + book
- Lab assignment: implement a little language
- Concluding

Lectures

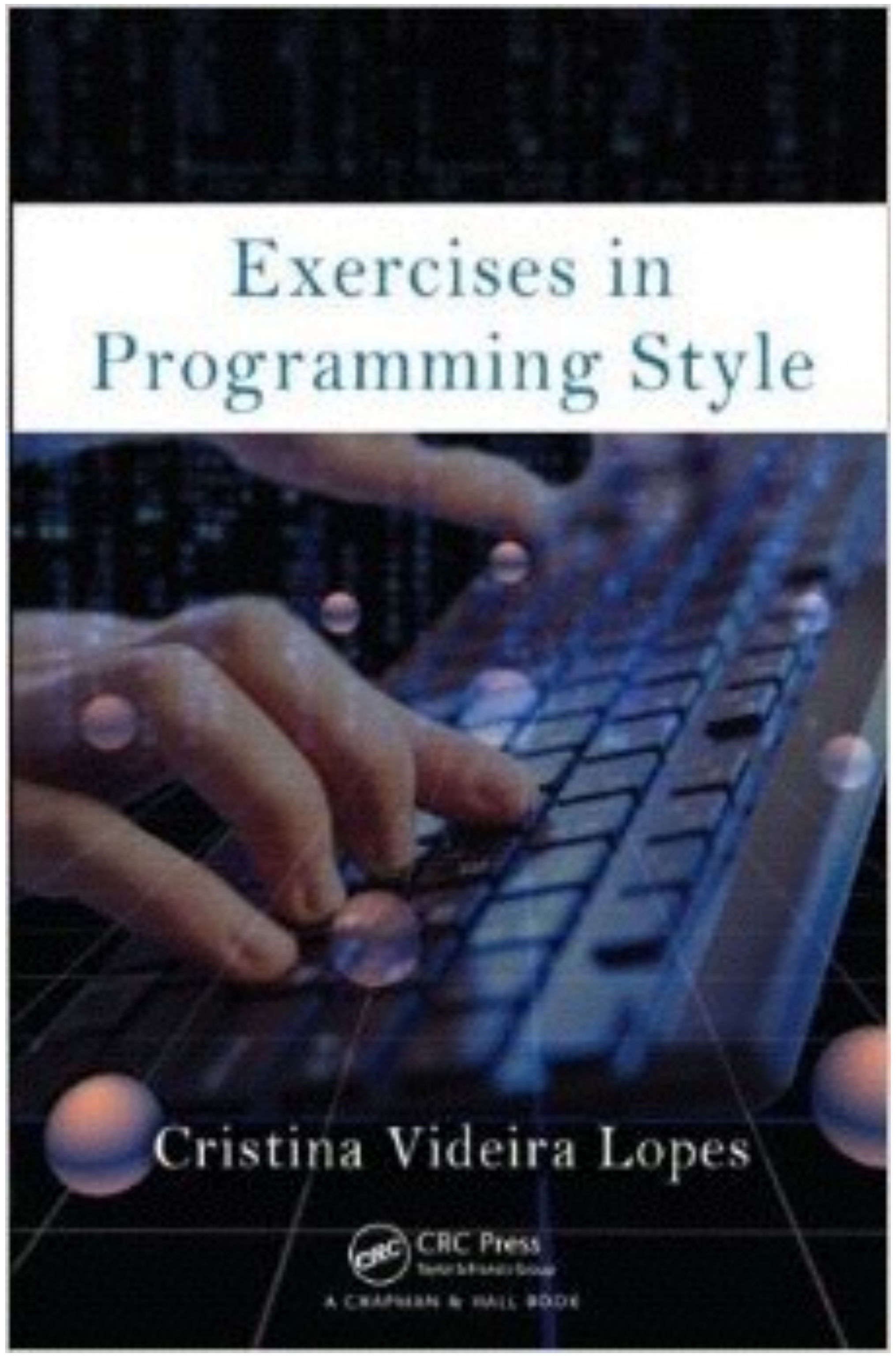
Topics of the lectures

- Syntax analysis: grammars, parsers
- Programming styles, design principles etc.
- Code quality: tangling, scattering, duplication, smells, refactoring, layout
- Modularity: information hiding, separation of concerns, encapsulation, dependency
- ....

Syllabus

- Karl J. Lieberherr, Ian M. Holland, *Assuring Good Style for Object-Oriented Programs*, 1989, LieberherrHolland8
- D. L. Parnas, *On the criteria to be used in decomposing systems into modules* , 1972, Parnas72
- W. Wulf and Mary Shaw, *Global variable considered harmful*, 1973, WulfShaw84.
- John Hughes, *Why functional programming matters*, 1990 Hughes89
- Robert C. Martin, *Design principles and design patterns*, Martin00.
- Erich Gamma, Richard Helm, Ralpha Johnson, John Vlissides, *Design Patterns: Abstraction and Reuse of Objec Oriented Design*, ECOOP 93 GammaEtAl93
- Kent Beck and Martin Fowler, *Bad Smells in Code* (Chapter 3, *Refactoring*)
- Kent Beck, A theory of programming, (Chapter 3, *Implementation Patterns*)
- Kent Beck, *Aim, fire*, IEEE Software, Beck01
- Jeff Bay, *Object Calisthenics*, Bay.
- Ward Cunningham, *The CHECKS Pattern Language of Information Integrity*, checks
- Kernighan, Plauger, *Programming Style: Examples and Counterexamples*, 1974 kernighanPlauger
- Gregor Kiczales, John Lamping, Anurag Mendhekar, Chris Maeda, Cristina Videira Lopes, Jean-Marc Loingtier, John Irwin, *Aspect-Oriented Programming*, KiczalesEtAl97
- James Noble, *Arguments and Results*, Noble97

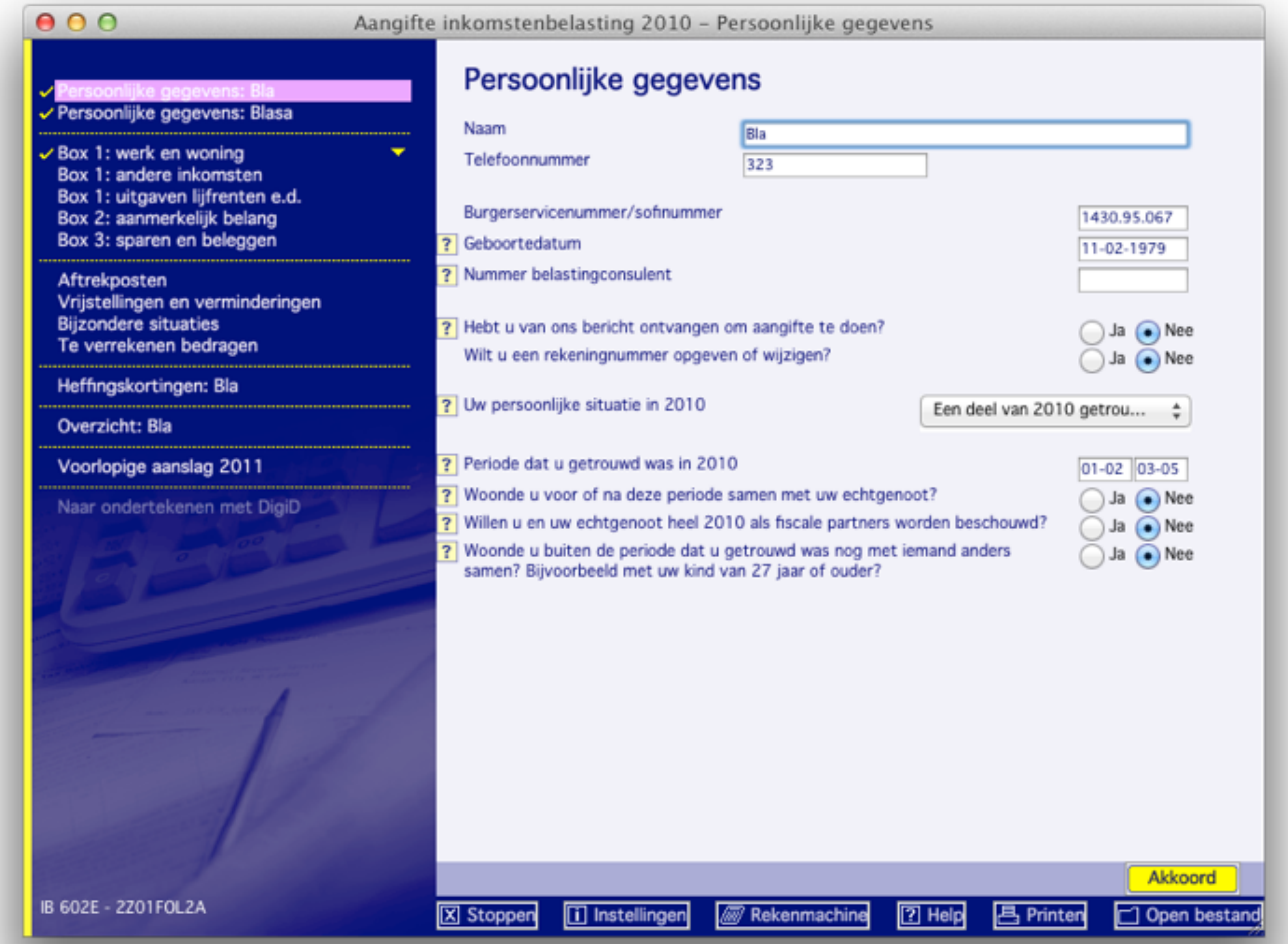
Book: EiPS


Exercises in Programming Style
Cristina Videira Lopes
CRC Press
A CHAPMAN & HALL BOOK

Final exam

- Open book exam
- Must have grade > 5.5
- Based on
  - Exercises in Programming Style
  - Lecture material
  - Syllabus

Lab assignment



Aangifte inkomstenbelasting 2010 – Persoonlijke gegevens

✓ Persoonlijke gegevens: Bla
✓ Persoonlijke gegevens: Blasa

✓ Box 1: werk en woning
Box 1: andere inkomsten
Box 1: uitgaven lijfrenten e.d.
Box 2: aanmerkelijk belang
Box 3: sparen en beleggen

Aftrekposten
Vrijstellingen en verminderingen
Bijzondere situaties
Te verrekenen bedragen

Heffingskortingen: Bla

Overzicht: Bla

Voorlopige aanslag 2011

Naar ondertekenen met DigiD

IB 602E - 2Z01FOL2A

Persoonlijke gegevens

Naam	Bla
Telefoonnummer	323
Burgerservicenummer/sofinummer	1430.95.067
? Geboortedatum	11-02-1979
? Nummer belastingconsulent	
? Hebt u van ons bericht ontvangen om aangifte te doen?	Ja [✓ Nee]
Wilt u een rekeningnummer opgeven of wijzigen?	Ja [✓ Nee]
? Uw persoonlijke situatie in 2010	Een deel van 2010 getrou...
? Periode dat u getrouwd was in 2010	01-02 03-05
? Woonde u voor of na deze periode samen met uw echtgenoot?	Ja [✓ Nee]
? Willen u en uw echtgenoot heel 2010 als fiscale partners worden beschouwd?	Ja [✓ Nee]
? Woonde u buiten de periode dat u getrouwd was nog met iemand anders samen? Bijvoorbeeld met uw kind van 27 jaar of ouder?	Ja [✓ Nee]

Form **1040** Department of the Treasury—Internal Revenue Service (99)
U.S. Individual Income Tax Return 2012
OMB No. 1545-0074 IRS Use Only—Do not write or staple in this space.

For the year Jan. 1–Dec. 31, 2012, or other tax year beginning , 2012, ending , 20 See separate instructions.

Your first name and initial	Last name	**Your social security number**
If a joint return, spouse's first name and initial	Last name	**Spouse's social security number**
Home address (number and street). If you have a P.O. box, see instructions.	Apt. no.	▲ Make sure the SSN(s) above and on line 6c are correct.
City, town or post office, state, and ZIP code. If you have a foreign address, also complete spaces below (see instructions).		**Presidential Election Campaign** Check here if you, or your spouse if filing jointly, want $3 to go to this fund. Checking a box below will not change your tax or refund. ☐ **You** ☐ **Spouse**
Foreign country name	Foreign province/state/county	Foreign postal code

Filing Status
Check only one box.

1 ☐ Single
2 ☐ Married filing jointly (even if only one had income)
3 ☐ Married filing separately. Enter spouse's SSN above and full name here. ▶
4 ☐ Head of household (with qualifying person). (See instructions.) If the qualifying person is a child but not your dependent, enter this child's name here. ▶
5 ☐ Qualifying widow(er) with dependent child

Exemptions
6a ☐ **Yourself.** If someone can claim you as a dependent, **do not** check box 6a . . . . .
b ☐ **Spouse** . . . . }

Boxes checked on 6a and 6b

c **Dependents:**

(1) First name Last name	(2) Dependent's social security number	(3) Dependent's relationship to you	(4) ✓ if child under age 17 qualifying for child tax credit (see instructions)
			☐
			☐
			☐
			☐

If more than four dependents, see instructions and check here ▶ ☐

No. of children on 6c who:
• lived with you
• did not live with you due to divorce or separation (see instructions)
Dependents on 6c not entered above

d Total number of exemptions claimed . . . . **Add numbers on lines above ▶**

Income
Attach Form(s) W-2 here. Also attach Forms W-2G and 1099-R if tax was withheld.

If you did not get a W-2, see instructions.

Enclose, but do not attach, any payment. Also, please use **Form 1040-V.**

7	Wages, salaries, tips, etc. Attach Form(s) W-2		7
8a	**Taxable** interest. Attach Schedule B if required		8a
b	**Tax-exempt** interest. **Do not** include on line 8a . . .	8b	
9a	Ordinary dividends. Attach Schedule B if required		9a
b	Qualified dividends	9b	
10	Taxable refunds, credits, or offsets of state and local income taxes		10
11	Alimony received		11
12	Business income or (loss). Attach Schedule C or C-EZ		12
13	Capital gain or (loss). Attach Schedule D if required. If not required, check here ▶ ☐		13
14	Other gains or (losses). Attach Form 4797		14
15a	IRA distributions . 15a	b Taxable amount . . .	15b
16a	Pensions and annuities 16a	b Taxable amount . . .	16b
17	Rental real estate, royalties, partnerships, S corporations, trusts, etc. Attach Schedule E		17
18	Farm income or (loss). Attach Schedule F		18
19	Unemployment compensation		19
20a	Social security benefits 20a	b Taxable amount . . .	20b
21	Other income. List type and amount		21
22	Combine the amounts in the far right column for lines 7 through 21. This is your **total income** ▶		22

Adjusted Gross Income

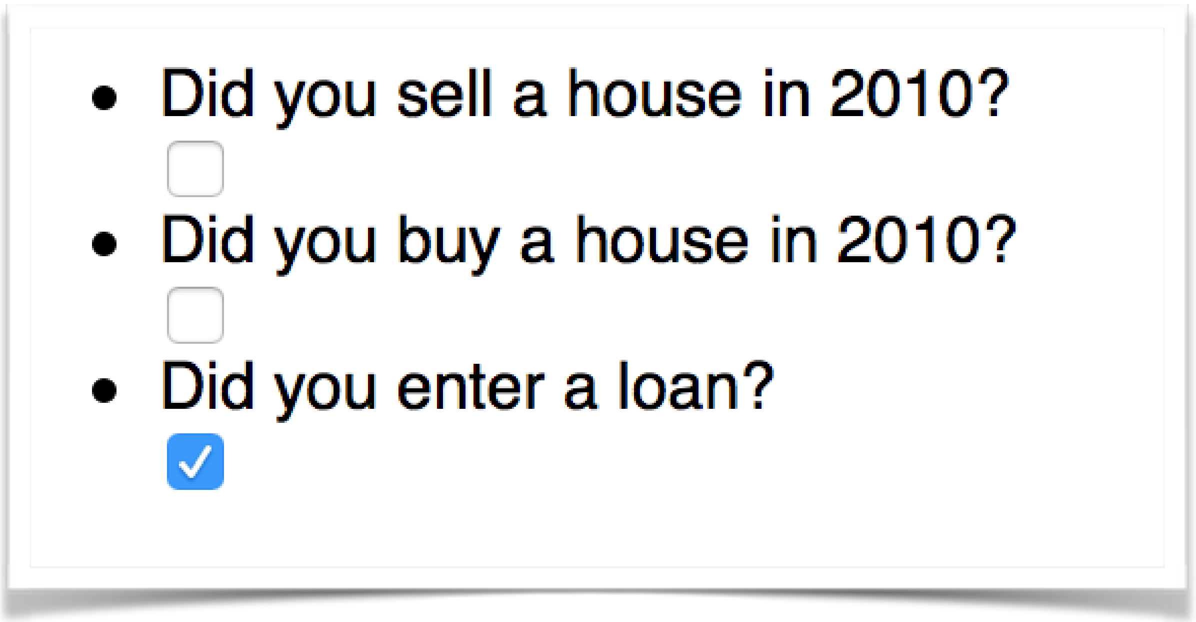
23	Reserved	23	
24	Certain business expenses of reservists, performing artists, and fee-basis government officials. Attach Form 2106 or 2106-EZ	24	
25	Health savings account deduction. Attach Form 8889 .	25	
26	Moving expenses. Attach Form 3903	26	
27	Deductible part of self-employment tax. Attach Schedule SE .	27	
28	Self-employed SEP, SIMPLE, and qualified plans . .	28	
29	Self-employed health insurance deduction	29	
30	Penalty on early withdrawal of savings	30	
31a	Alimony paid **b** Recipient's SSN ▶	31a	
32	IRA deduction	32	
33	Student loan interest deduction	33	
34	Reserved	34	
35	Domestic production activities deduction. Attach Form 8903	35	
36	Add lines 23 through 35		36
37	Subtract line 36 from line 22. This is your **adjusted gross income** . . . . . ▶		37

Part 1: Questionnaire Language (QL)

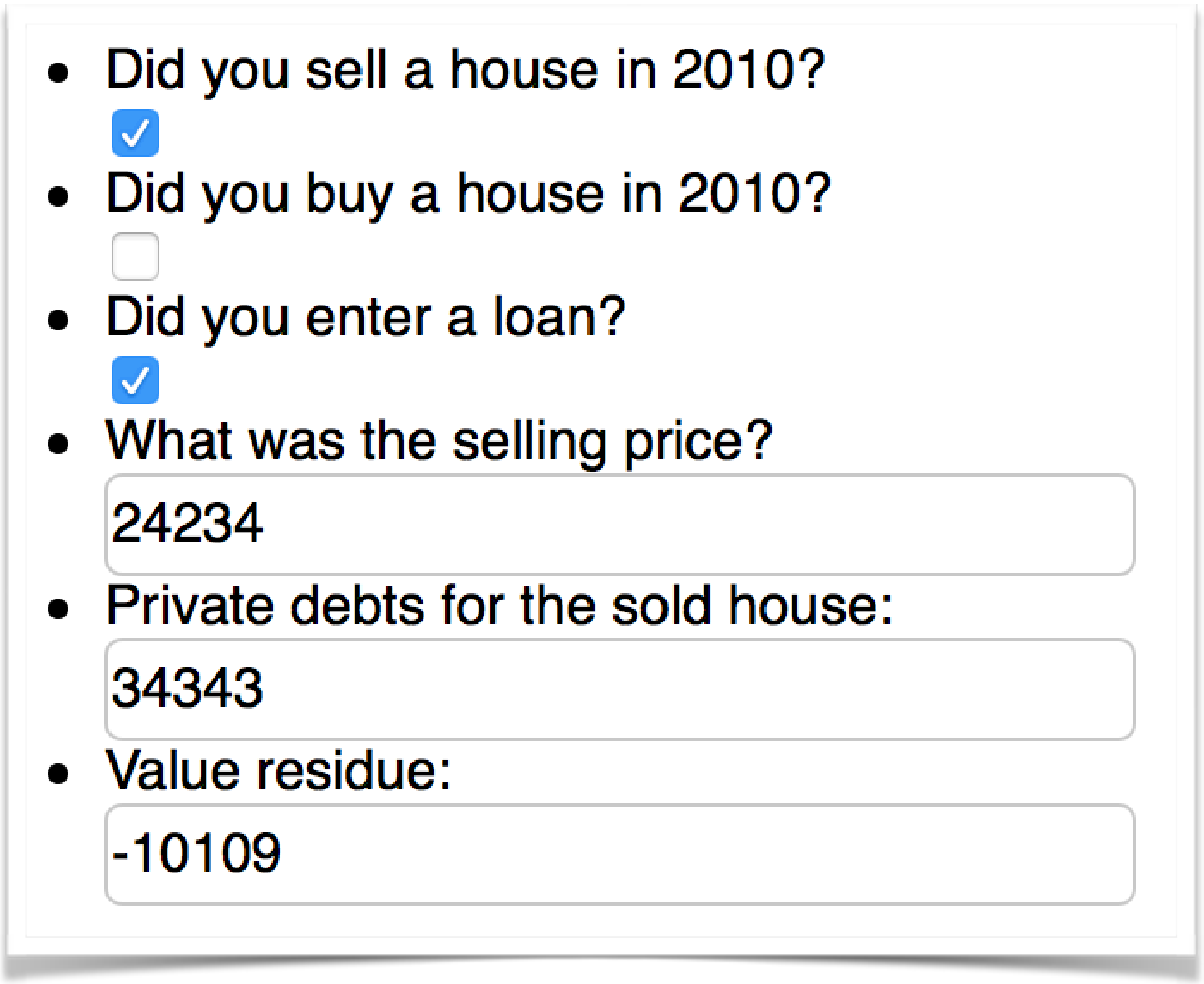
```
form taxOfficeExample {
  "Did you sell a house in 2010?"
    hasSoldHouse: boolean
  "Did you buy a house in 2010?"
    hasBoughtHouse: boolean
  "Did you enter a loan?"
    hasMaintLoan: boolean

  if (hasSoldHouse) {
    "What was the selling price?"
      sellingPrice: money
    "Private debts for the sold house:"
      privateDebt: money
    "Value residue:"
      valueResidue: money =
        (sellingPrice - privateDebt)
  }
}
```

Describe the logic of interactive questionnaires



- Did you sell a house in 2010?
  ☐
- Did you buy a house in 2010?
  ☐
- Did you enter a loan?
  ✓



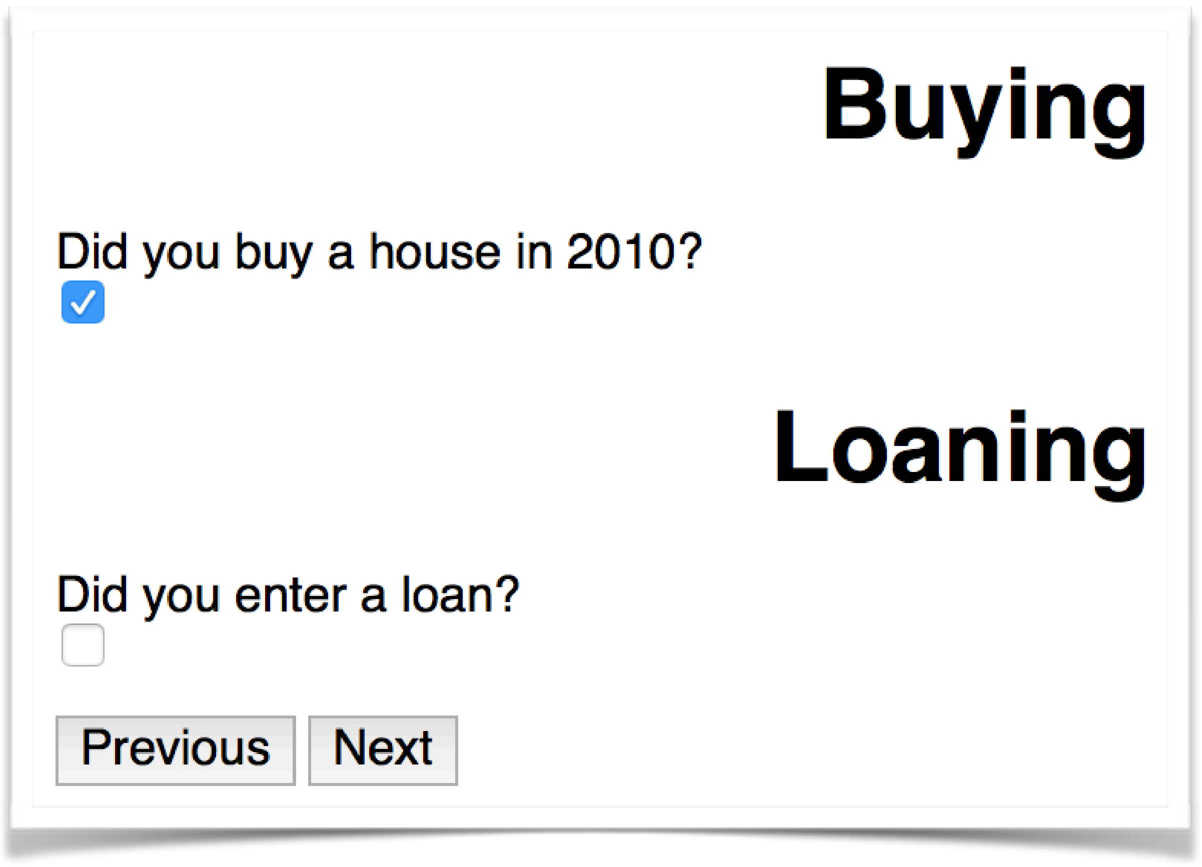
- Did you sell a house in 2010?
  ✓
- Did you buy a house in 2010?
  ☐
- Did you enter a loan?
  ✓
- What was the selling price?
  24234
- Private debts for the sold house:
  34343
- Value residue:
  -10109

QLS

Language for styling questionnaires

```
stylesheet taxOfficeExample
  page Housing {
    section "Buying"
      question hasBoughtHouse
        widget checkbox
    section "Loaning"
      question hasMaintLoan
  }

  page Selling {
    section "Selling" {
      question hasSoldHouse
        widget radio("Yes", "No")
      section "You sold a house" {
        question sellingPrice
          widget spinbox
        question privateDebt
          widget spinbox
        question valueResidue
        default money {
          width: 400
          font: "Arial"
          fontsize: 14
          color: #999999
          widget spinbox
        }
      }
    }
    default boolean widget radio("Yes", "No")
  }
```

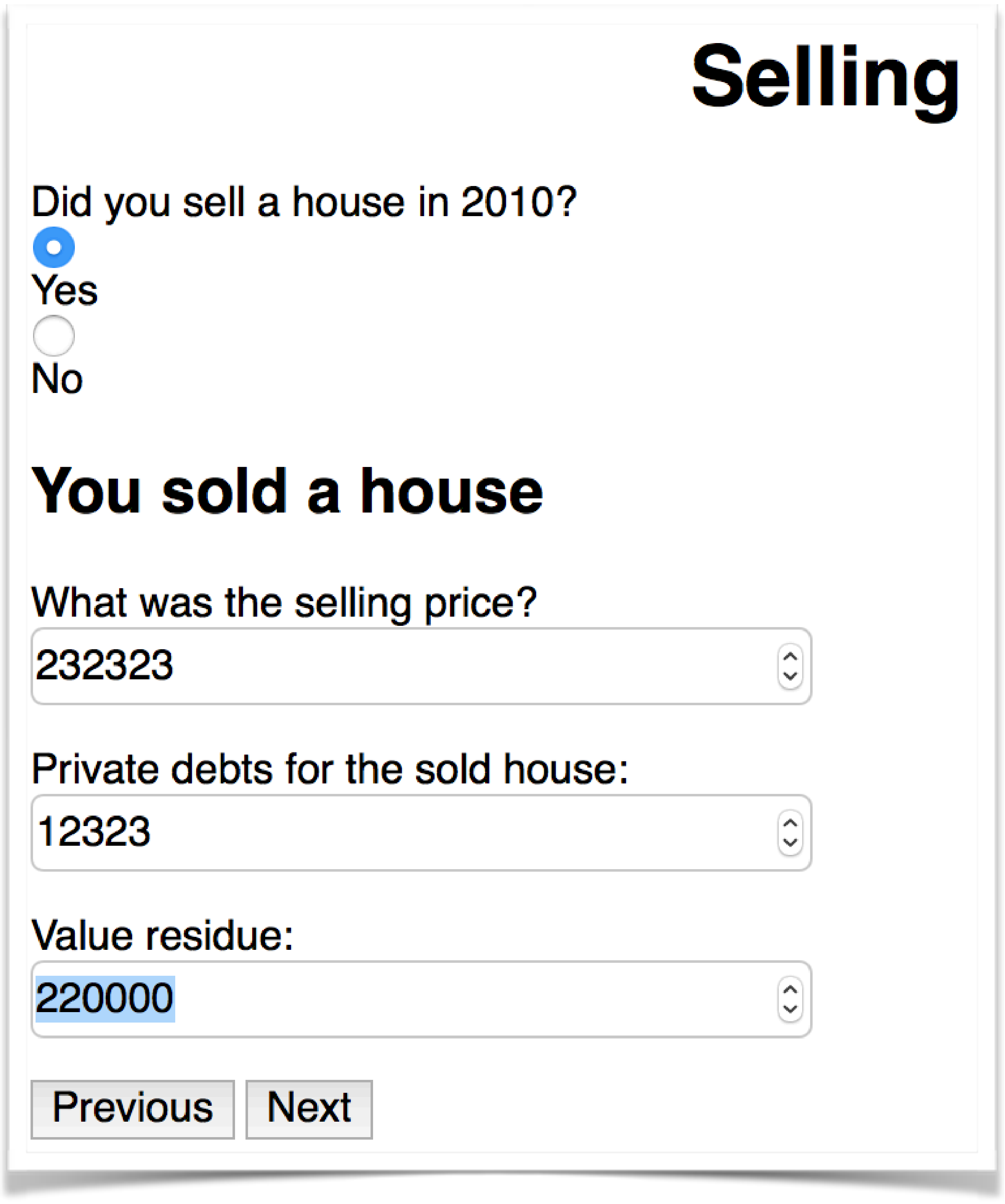


Buying

Did you buy a house in 2010?
✓

Loaning

Did you enter a loan?
☐



Selling

Did you sell a house in 2010?
[✓ Yes]
No

You sold a house

What was the selling price?	232323
Private debts for the sold house:	12323
Value residue:	220000

Part 1: QL

- Parser: text to abstract syntax tree (AST)
- AST hierarchy
- Type checker/Wellformedness checker
- Expression evaluator
- Renderer as GUI
  (interpreter! Not a compiler)

Part 2: QLS

- Parser: text to abstract syntax tree (AST)
- AST hierarchy
- Wellformedness checker WRT QL program
- Renderer as stylized GUI
- Challenge: modular implementation
- QL **should** work standalone (w/o QLS)

No server-side web apps!

- server/client distinction is a distraction
- essentially code generation all over the place

Programming language

- Java, C#, Javascript, Typescript, Haskell, Scala, Clojure, Erlang, Smalltalk/Pharo, Ruby, Python, Go, Dart, Swift, Objective-C, F#, Rust, Elm, …
- Java: you may want to use one of the provided parsing skeletons for expressions in QL
  - *Rats!*, Jacc, ANTLR

Github

- Assignment to be completed *in teams of 2*
- https://github.com/software-engineering-amsterdam/myriad-ql
- Use of this repository is **required**!
- Commit often!

“Hour of code”

- During lab sessions (Mon 14:00/Tue 9:15)
- Convene in single room
- 2 persons per session present their code.
- No slides. Code.
- Constructive feedback and criticism.
- Let’s help each other.

Grading of lab assignments

- Functionality
- Tes
- Simplicity
- Modularity
- Layout and style
- Separation of concerns

Simplicity

Some advice up-front

- Naming, layout, indentation
- Encapsulation, modularity, separation of concerns, reuse
- Don’t repeat yourself (DRY)
- Library and tool selection and use
- Unit testing

More advice

- Use asserts sensibly
- No global, static, non-final variables
- You ain’t going to need it (YAGNI)
- Avoid premature optimization
- Use comments for rationale
- *Compiling **and** working code*

Grading (ctd.)

- First part: your grade is *indicative*
  - incentive to improve your code
- Second part: we review all code
  - this will be your *final* grade for the lab
- Grading is on-site: *you* show your code
- Grade is less important than personal improvement

Passing this course

- Be present at all lectures
- Be present during lab sessions
- Pass the the exam with grade > 5.5
- Pass lab assignment with grade > 5.5
- Final grade: average of lab and exam
- NOTE: both grades need to be > 5.5

Concluding

- All information is on Github
- Primary contact = storm@cwi.nl
- Please follow @SoftwCons

What’s next

- For the coming days
  - make up your mind on language
  - start checking out parser generators
  - start coding!