

NPRG075

Assignment & How to do programming language research

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Lectures: Monday 12:20, S7

➔ <https://d3s.mff.cuni.cz/teaching/nprg075>



Assignment

Requirements & expectations

Assignment

What the course page says

-  Complete a small independent project
-  Use one of the methodologies discussed
-  Study or design an aspect of system
-  Produce a brief report about your work

Scope of the project

Formal quantification

- Course is 3 ECTS credits
- Credit is 20-30 hours of work
- $75 - (12 * 1.5 + 10) = 47$

What does this mean

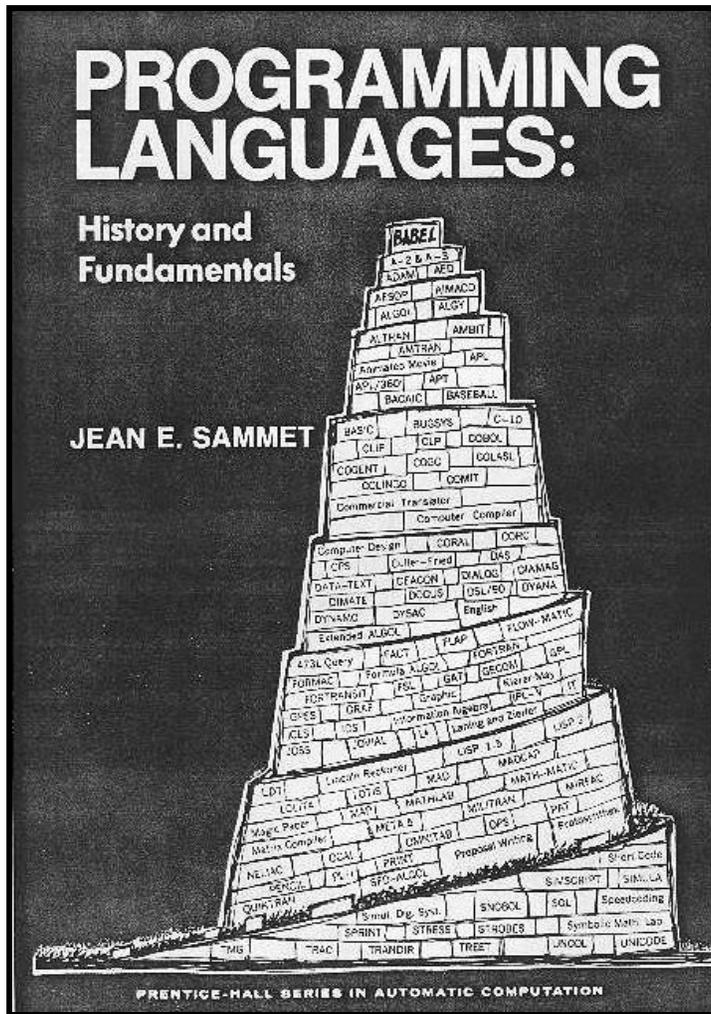
- About a week of actual work
- Includes all stages of the project
- Idea, research, implementation, write-up



Project

Research and implementation

-  Depends on the methodology!
-  Writing code, formal models, design patterns
-  Analysing past or contemporary systems
-  Sketching a new idea for a design
-  You cannot write much code in two days!



Programming language?

Anything involved in instructing the computer!

Language, programming environment, runtime system, framework, library, command line tool or AI Small aspect or a feature!

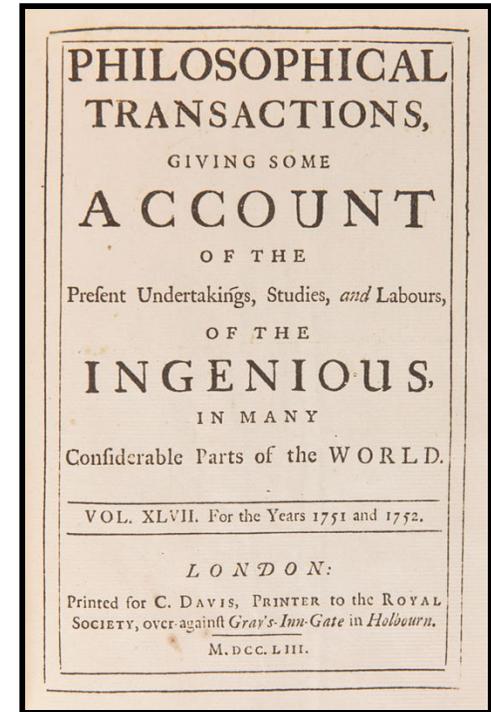
Writing a report

Communicate your work

- What is the main idea?
- What did you do, learn, conclude?
- Think a brief research paper

Research paper

- First thing anyone looks at (often)
- Shorter for design, longer for analysis
- From lab report to an essay
- [How to write a research paper](#) by SPJ





It is your project

Do something you actually care about

Reuse & overlap is encouraged!

Thesis, other courses, work project, hobby topic, blog post, workshop paper

Programming languages

How to do research?

Programming

Getting research ideas

- 🙄 Frustration - fix a problem I'm facing!
- 😊 Methodology - use a method I like for something
- 😐 User-centric - identify what others need
- 😵 Analytical - understand something properly

Fix a problem I have

Example problems

- Client-server programming is hard
[Write webs as single F# program?](#)
- Managing large PHP repo is hard
[Add types and an efficient VM to PHP?](#)



How to do this

- Use your knowledge expertise!
- "Look I did this cool thing!" is not research claim
- Describe design, formal model, positioning, evaluation



Spiralling abstraction

Web programming is hard
Write a new language!

Creating languages is hard
Define a formal model!

Defining models is hard
Use category theory!

Category theory is hard
Use category theory...?

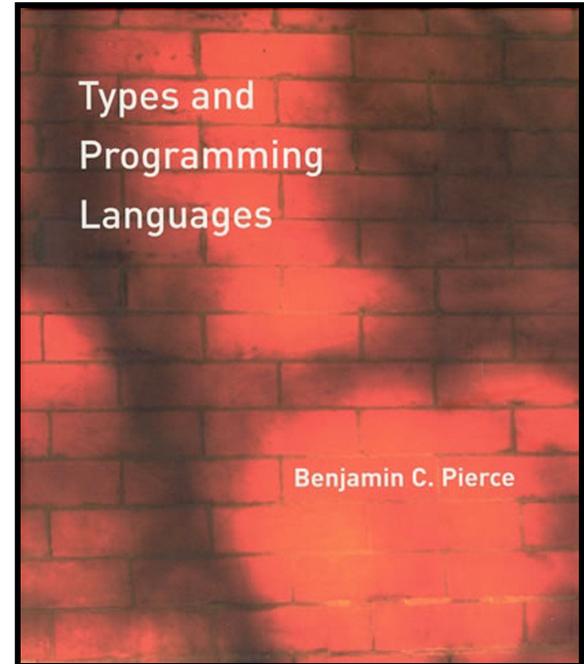
Use a method I like

Example methods

- Types for correctness
[Check network communication](#)
- Close reading of code
[Look at BASIC, UNIX, etc.](#)

How to do this

- Find problem to fit a method
- Reshape problem so that method applies
- May be hard to motivate for new methods



User-centric programming research

Example areas

- Developer tools
[How programmers search? reCode](#)
- Data journalists
[Interactive documents language Idyll](#)

How to do this

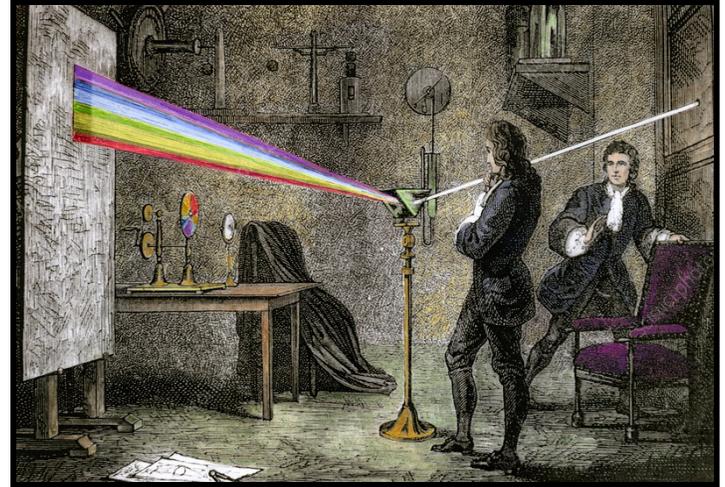
- Small-scale formative interviews
- Analyse answers & define design goals
- (Implement and evaluate solution.)



Understand something properly

Example problems

- Modern web frameworks
[A formal semantics of React](#)
- Empirical code studies
[Large-scale analysis of GitHub](#)



How to do this

- Start by being confused or surprised!
- Formalization, reproduction, comparative analysis
- Result should make the matter clear

Research methods

Ways of looking at programming

Methods: Historical study

-  Evolution of a programming concept
How has a concept changed over time?
-  Cultures of programming analysis
Do different communities talk about a thing differently?
-  Close look at a past system
In-depth analysis of how something in the past worked

Methods: Design and culture

- A** Critical study of interesting source
Close look at a clever hack, famous snippet, etc.
- 田** Design of a pattern language
How to design a specific kind of application or system
- 🌲** Exploring a design metaphor
Programming as architecture, writing, gardening, etc.

Methods: Empirical and formal

 Empirical analysis of source code

How do different kinds of source code differ?

 Small experimental user study

Formative interview or small usability study

\neq Formal semantics or a model

Of something confusing, like React state management

\times_1 Type system design description

Small but confusing feature like overload resolution

Methods: Heuristic analysis



Notation analysis using cognitive dimensions

Comparative analysis of two possible notations



System analysis using technical dimensions

Evaluation of non-standard programming environment



Design or explanation using cognitive model

Programmer misconceptions, design for cognitive fit

Conclusions

Final tips

Reading

How to write a research paper

- By Simon Peyton-Jones
- tinyurl.com/nprg075-paper (PDF)

Why should you read this?

- Report is like a mini-paper
- Not all advice applies, but...
- Good hints on writing, structure, etc.



