Software Analysis and Transformation with Rascal

BioAssist Meeting
Jan 11th, 2013
Jurgen Vinju

- Centrum Wiskunde & Informatica
- Programming languages and systems
  - Algol
  - Python
  - ASF+SDF, Rascal
  - MonetDB
- Where mathematics meets informatics
  - striving for fundamental (general) results
  - motivated by and applied in industry, government, and the sciences
- W3C
- Software Improvement Group (spin-off)
- Master Software Engineering @{Universiteit van Amsterdam, VU, HvA}

25 minutes

- What and why do we research software at CWI?
- How?
- Two possible discussions
  - Question: how is bio software unique?
  - Perspective: meta$\equiv$data programming?

Our team

Paul Klint

Jurgen Vinju

Tijs v/d Storm

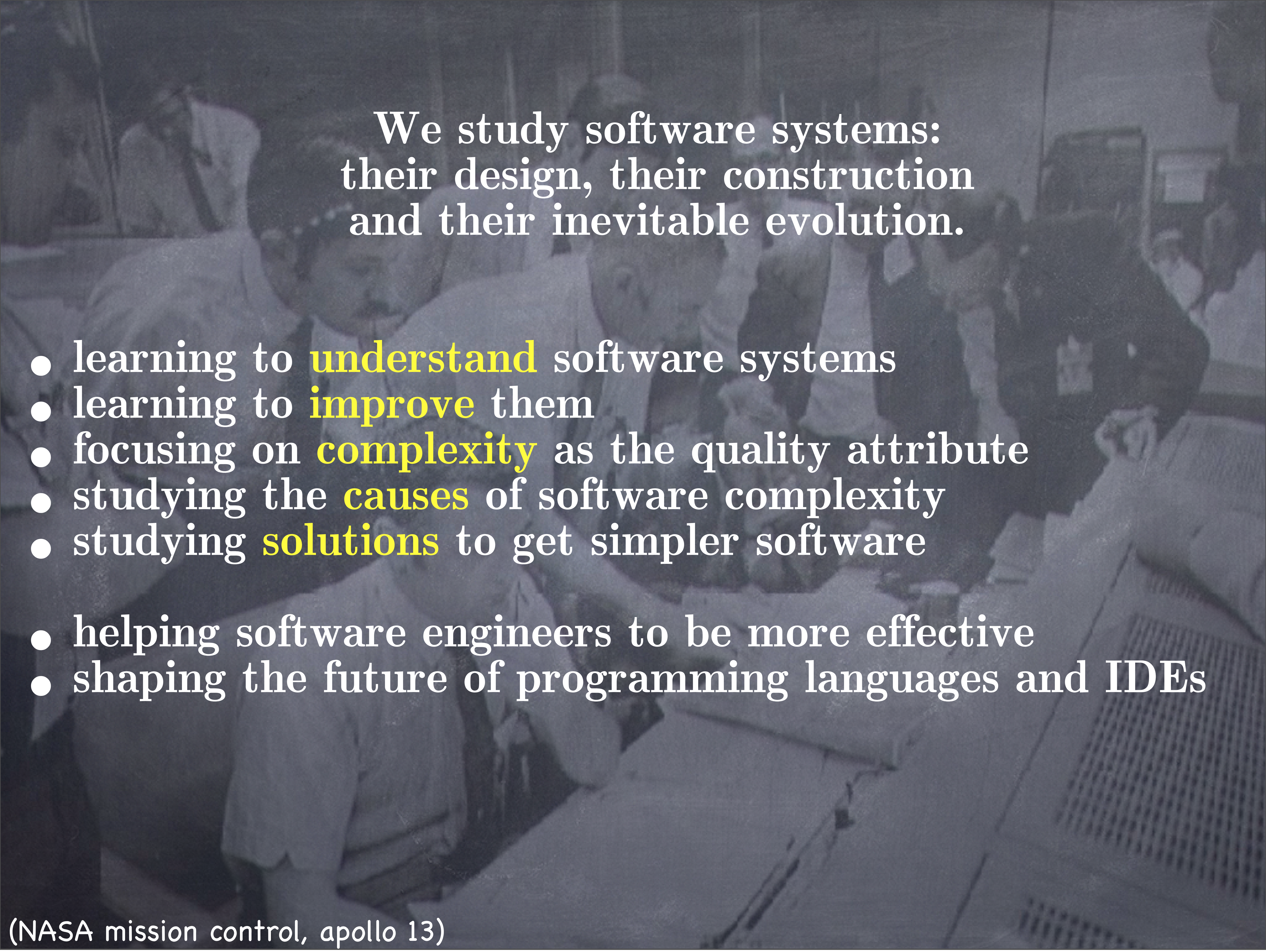
Bob Fuhrer

The problem with software is <u>not</u> in constructing it

(given sufficiently experienced architects & engineers)

The problem is in understanding existing software in order to improve it

(and a lot of software exists)

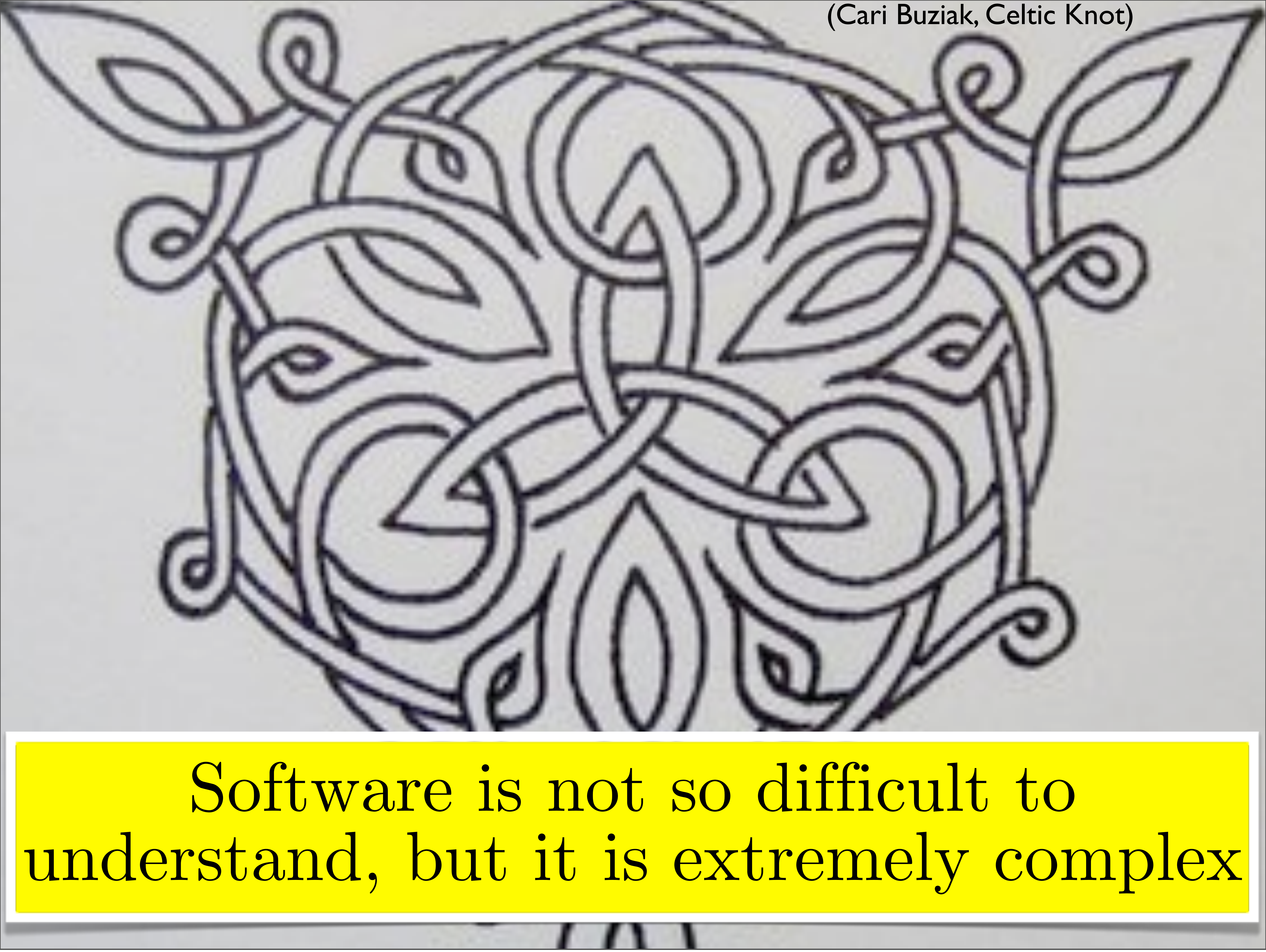


We study software systems: their design, their construction and their inevitable evolution.

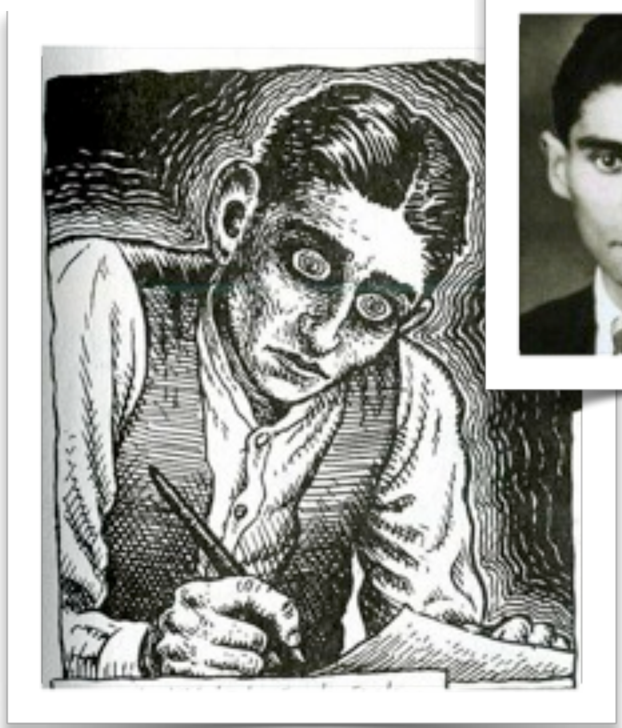
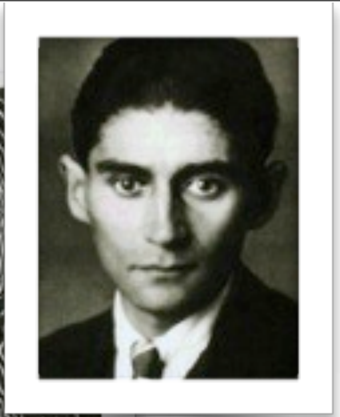
- learning to **understand** software systems
- learning to **improve** them
- focusing on **complexity** as the quality attribute
- studying the **causes** of software complexity
- studying **solutions** to get simpler software

- helping software engineers to be more effective
- shaping the future of programming languages and IDEs

(NASA mission control, apollo 13)


(Cari Buziak, Celtic Knot)

Software is not so difficult to understand, but it is extremely complex



Kafkaesque

Software - large and complex structures of computer instructions, <u>written and read by man</u>, executed by computers.

"marked by a senseless, disorienting, often menacing complexity..." (Infoplease.com)

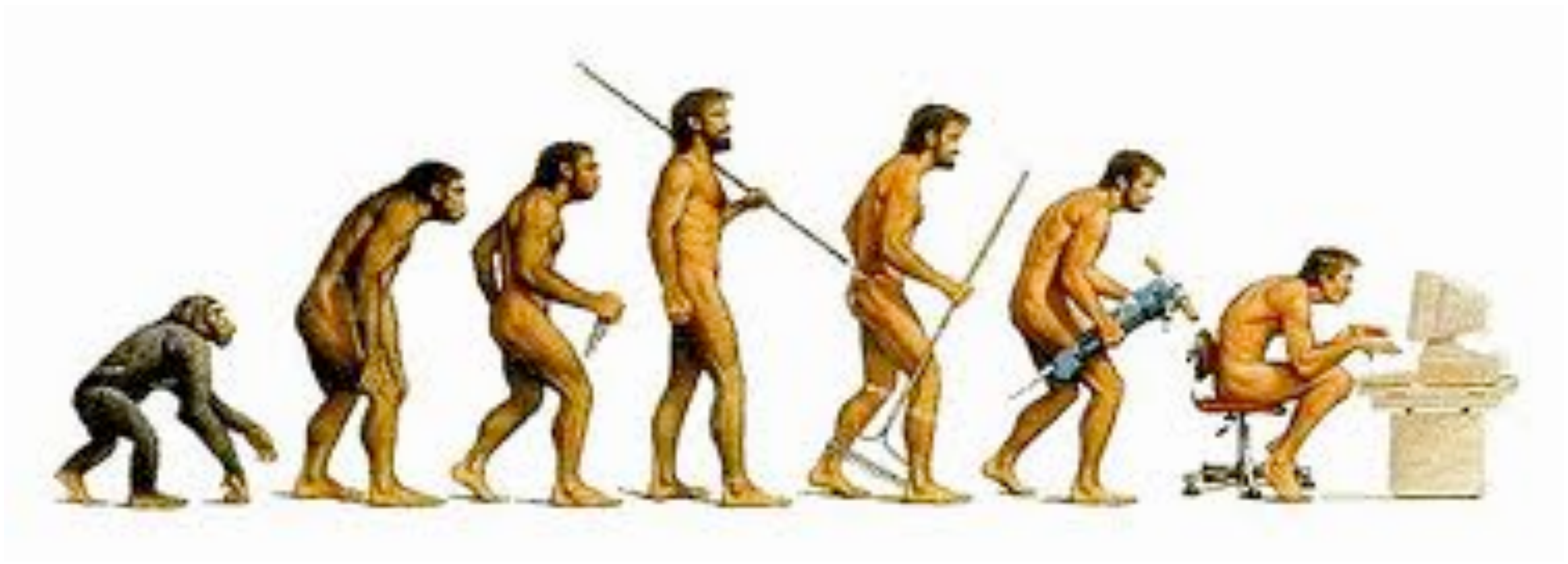
The source code of “ls”

3894 lines

367 ifs

174 cases

Solution...

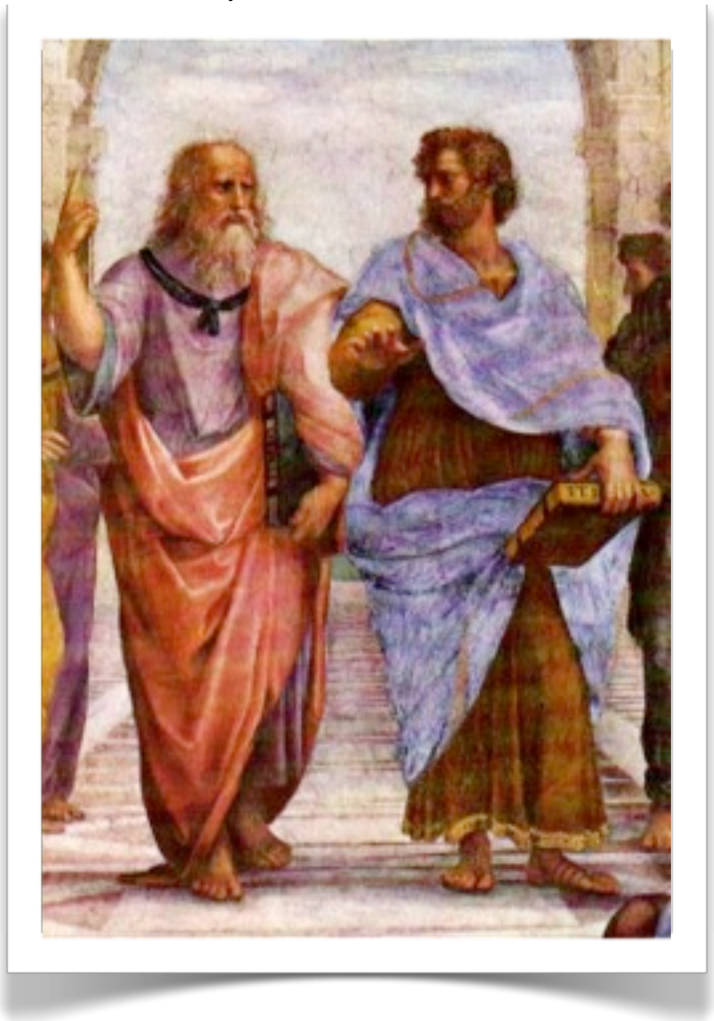


Tools

Transformation & Analysis

- (de)optimization
- GOTO removal
- Bug fixing (Y2K)
- Porting
- Refactoring ...
- Model-to-code
- Languages

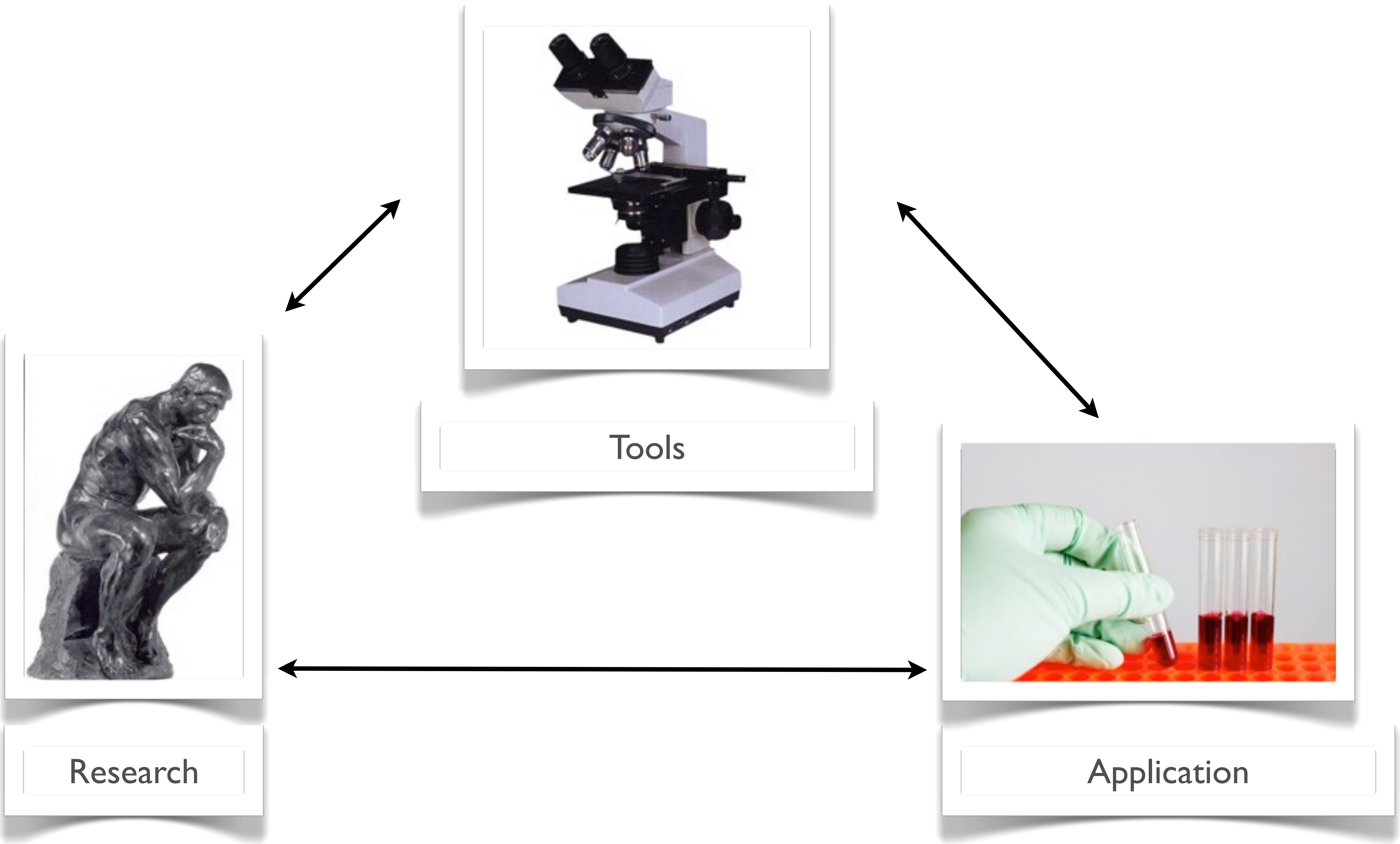
Raphael (1509)

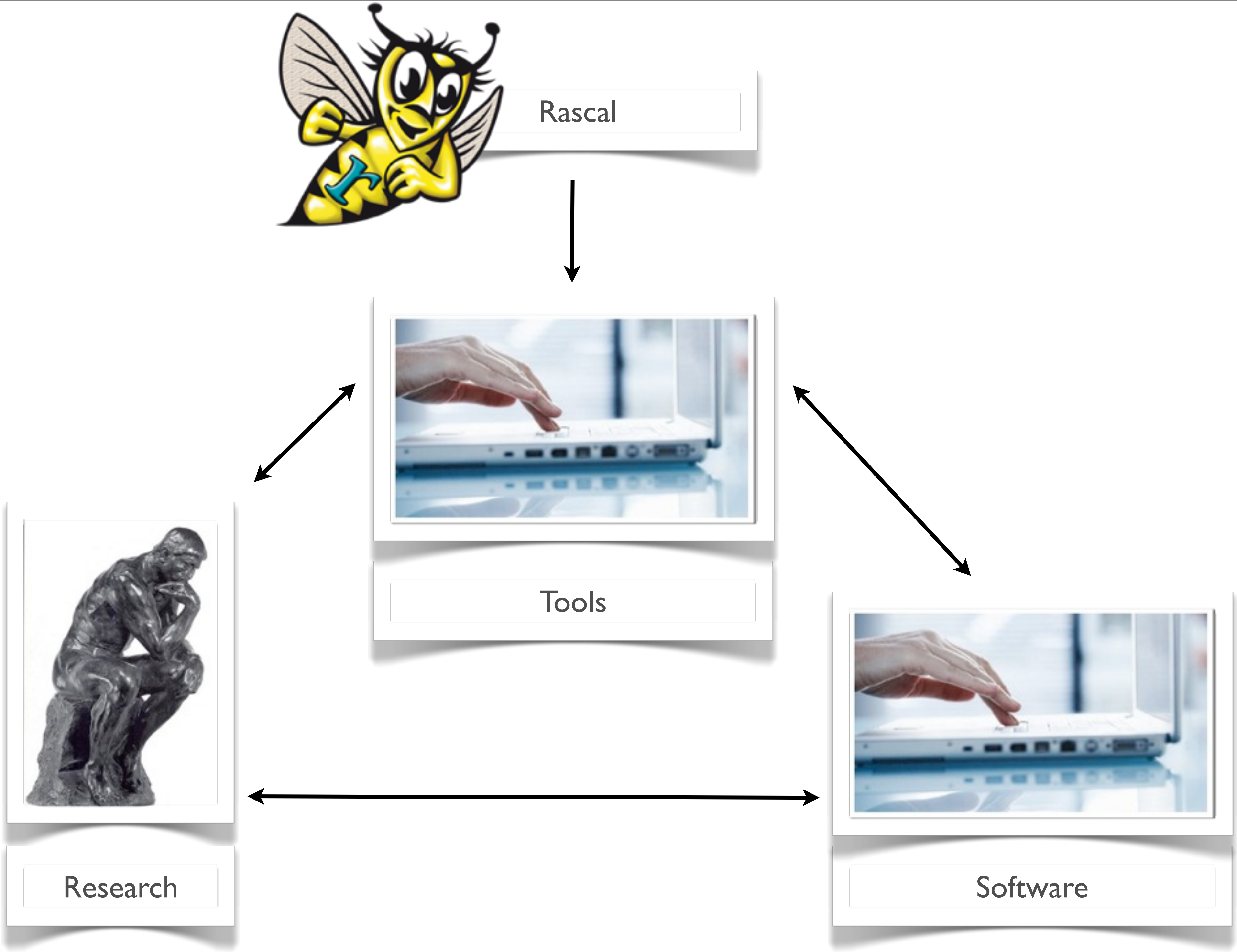


- Code-to-model
- Quality assessment
- Mining trends
- Dead code detection
- Bug detection
- Model checking
- Impact analysis

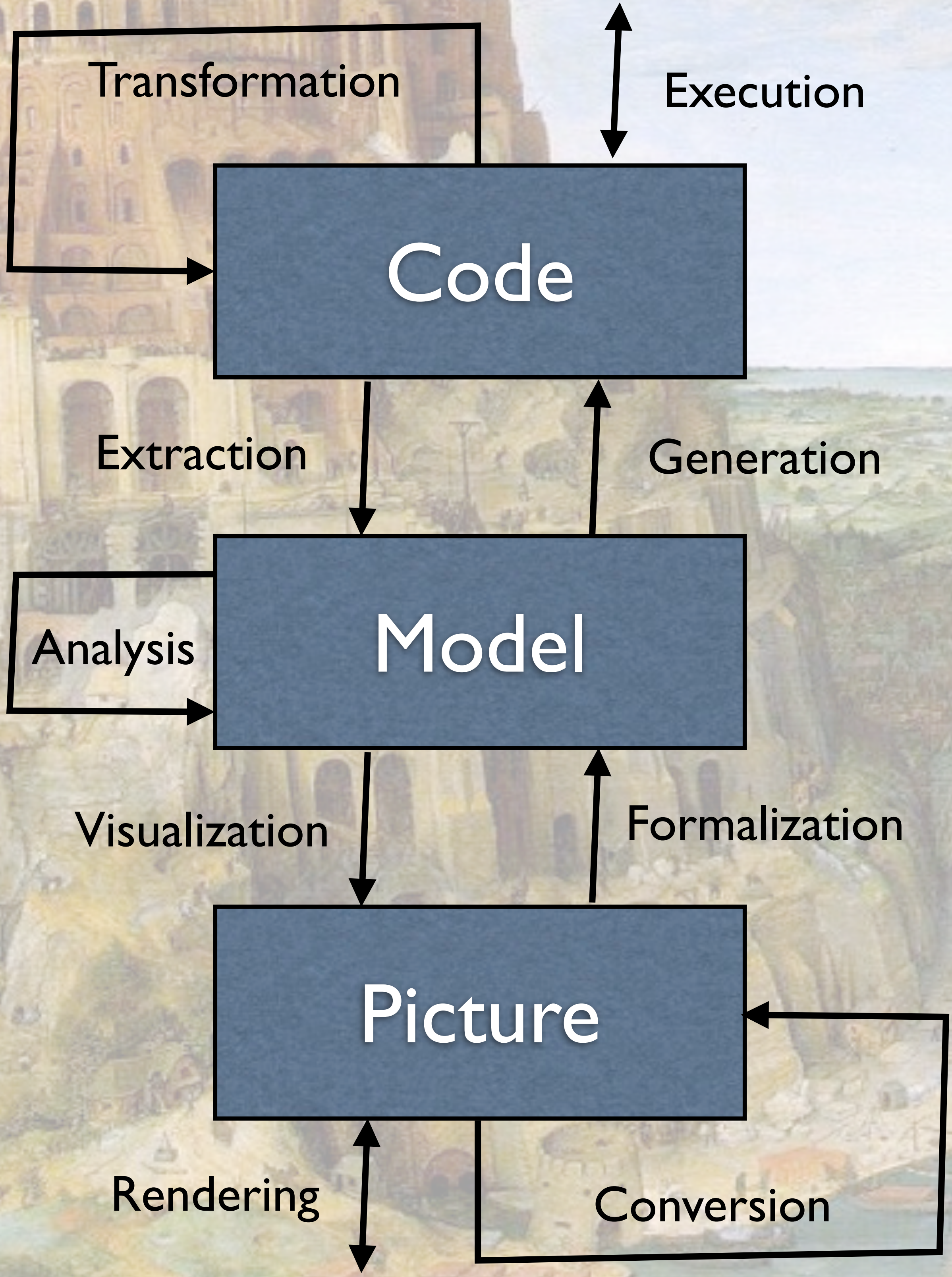
(etc)

“every week a new tool”




Rascal
Tools
Research
Software

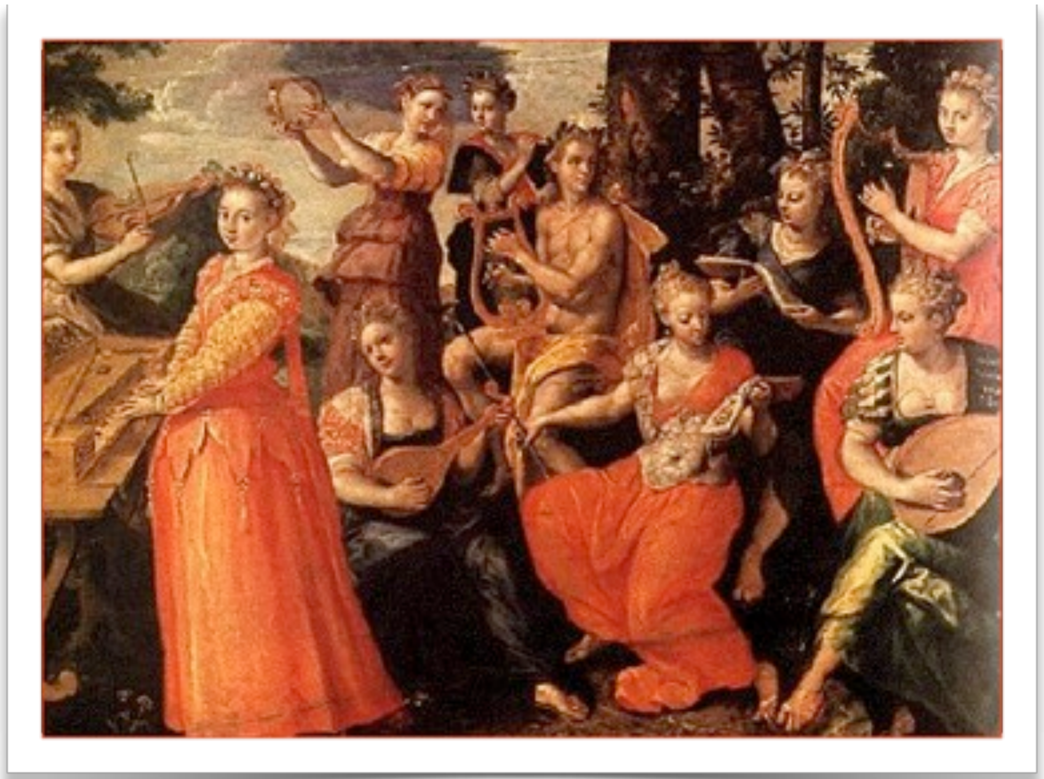
Rascal is a DSL for meta programming

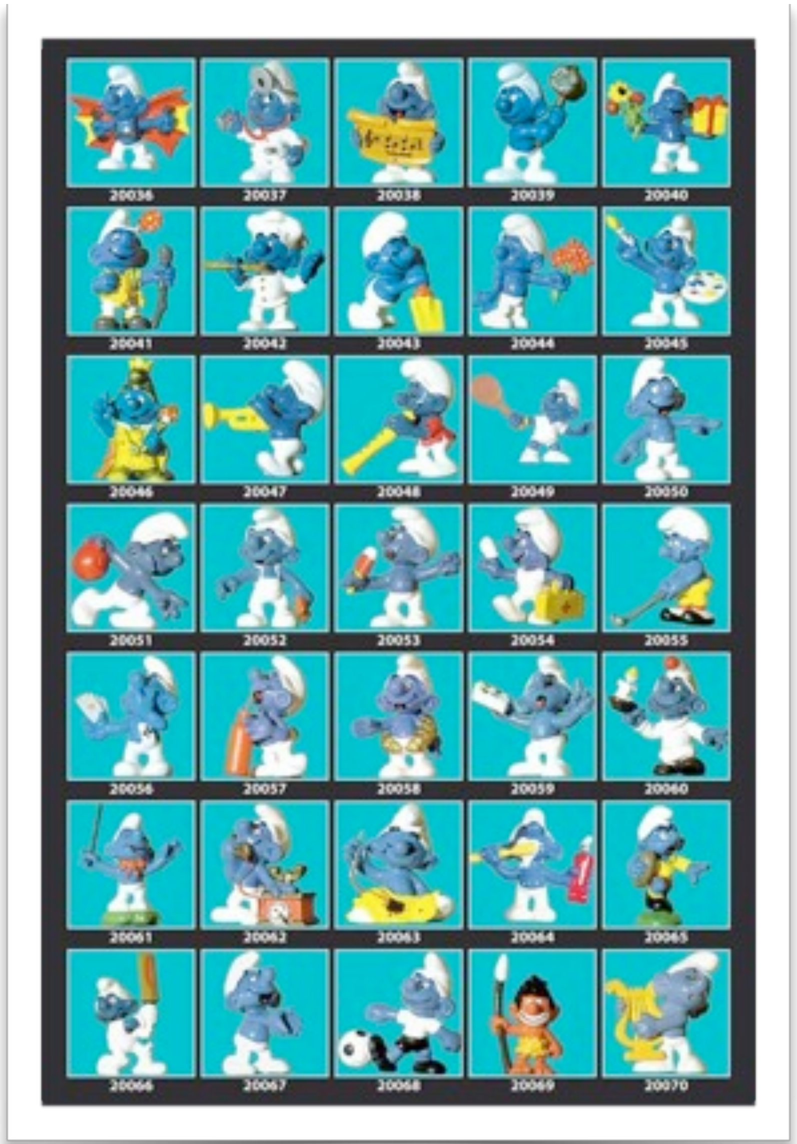


(Brueghel, Tower of Babel)

The three challenges

Multi-disciplinary

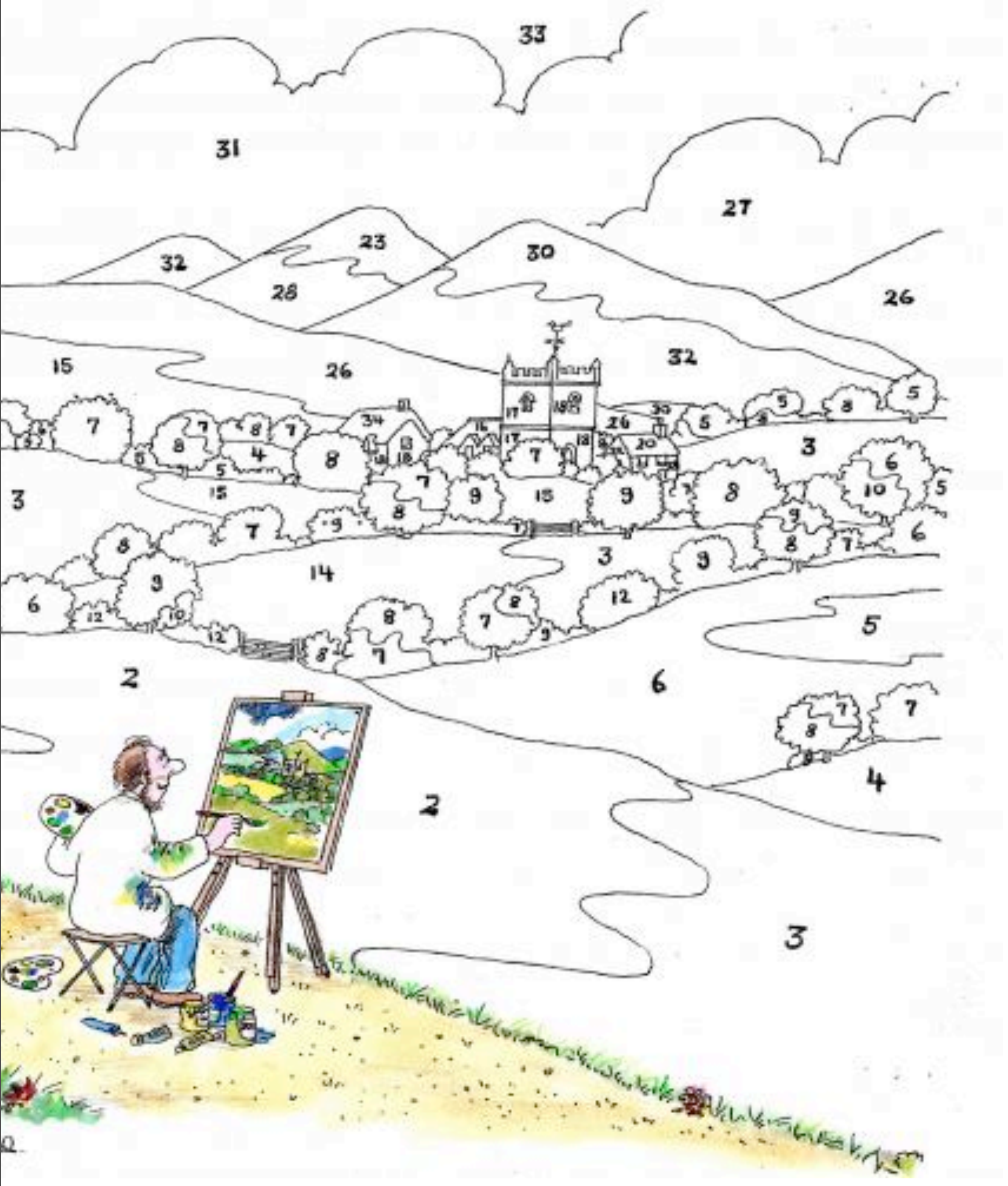




Diversity

Precision vs Efficiency

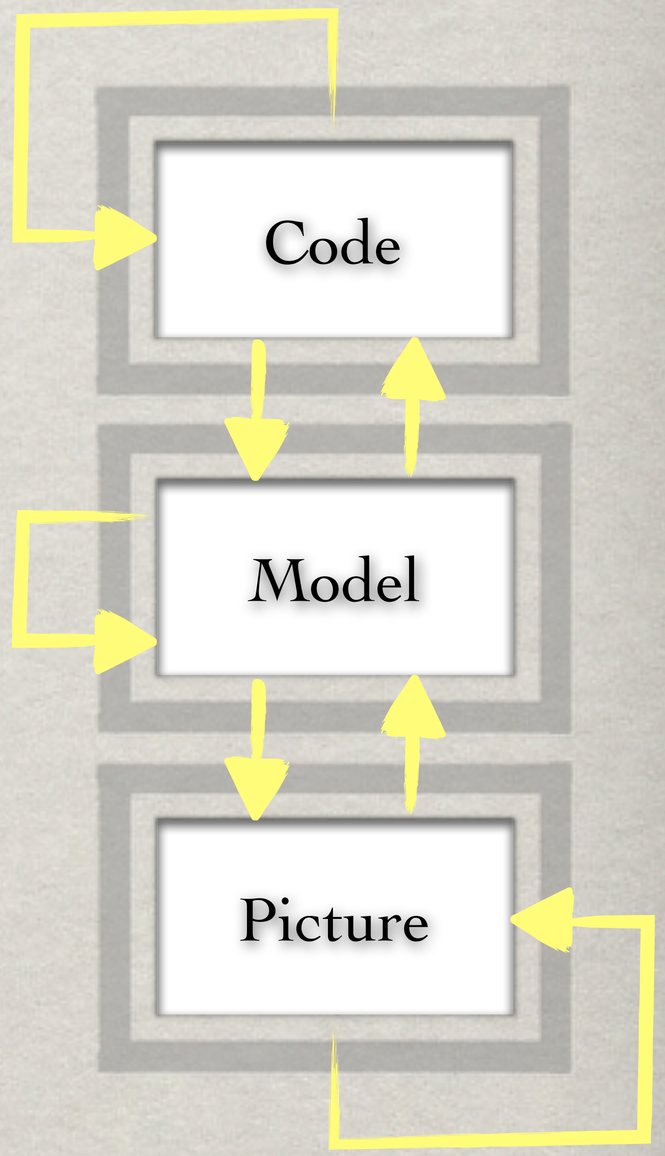
The key point of Rascal is that it is a <u>one-stop-shop</u>; no hacking stuff together, just one consistent, typed, and safe environment for meta-programming for "any" language.



D.I.Y.

- That's the goal
- We teach Rascal (master)
- We use Rascal
- Caveat: "Experimental"

highlight: A one-slide DSL



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metro {
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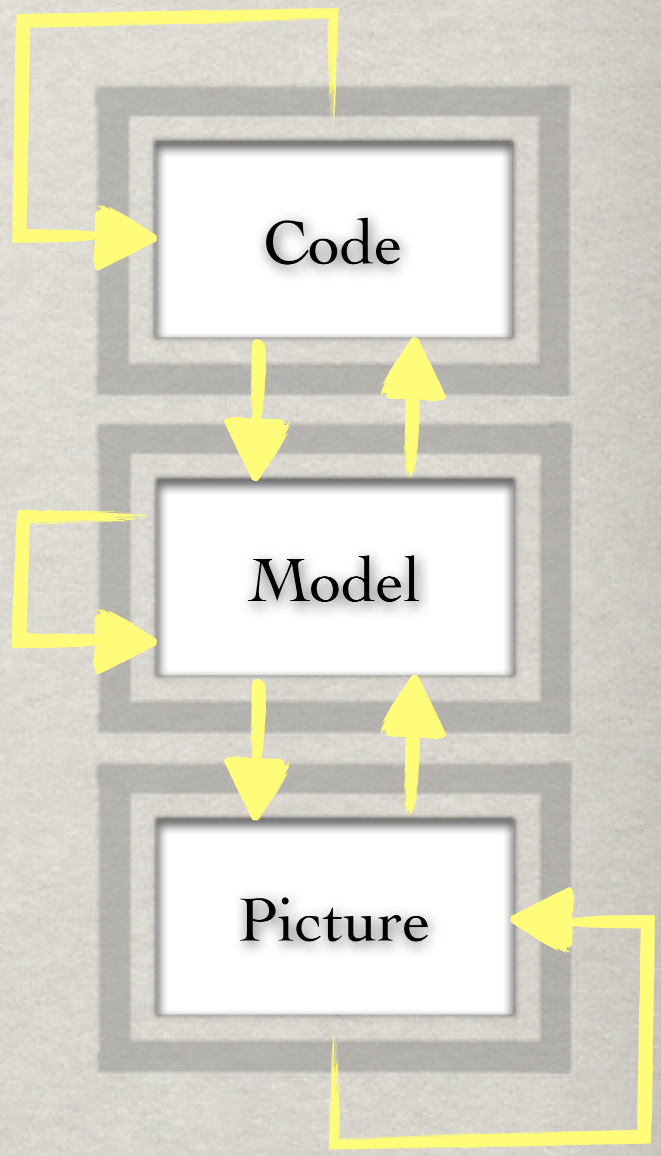
  Centraal Rokin FerdinandBol Zuid;
}
```



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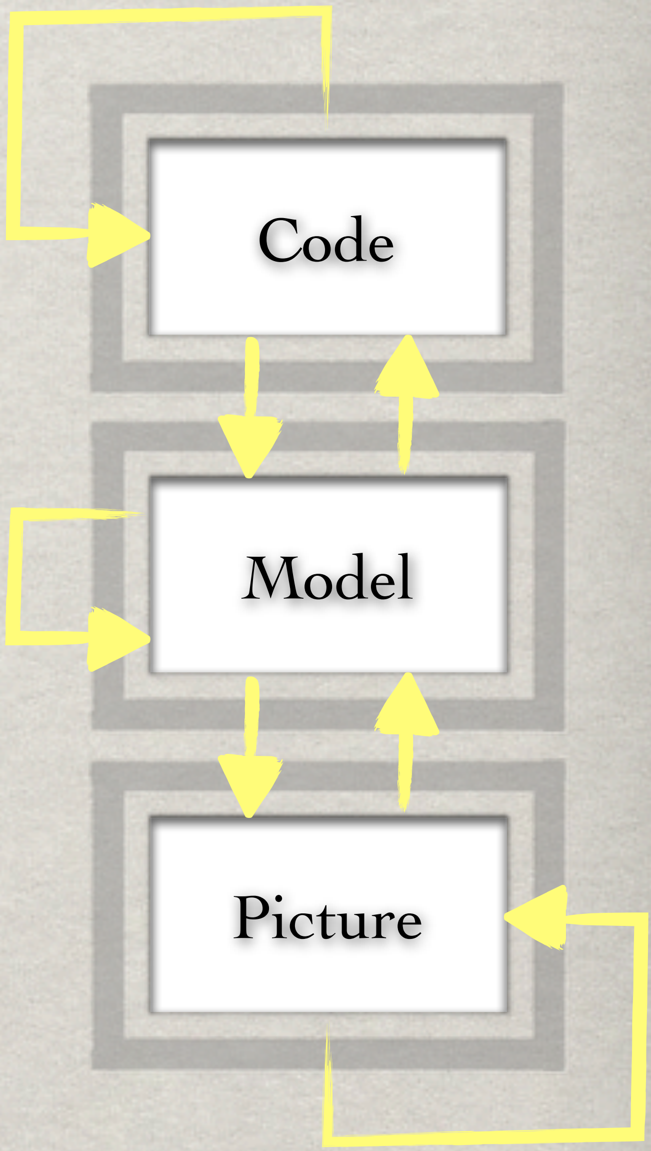

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{ <“Centraal”, “Waterloo”>,
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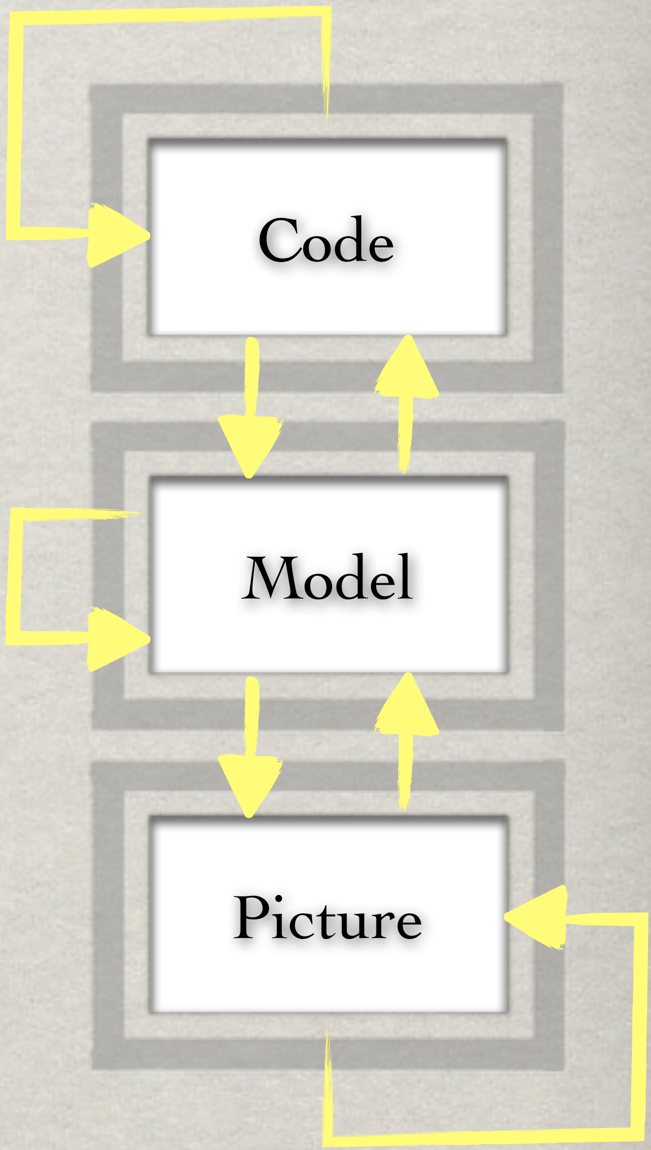
```



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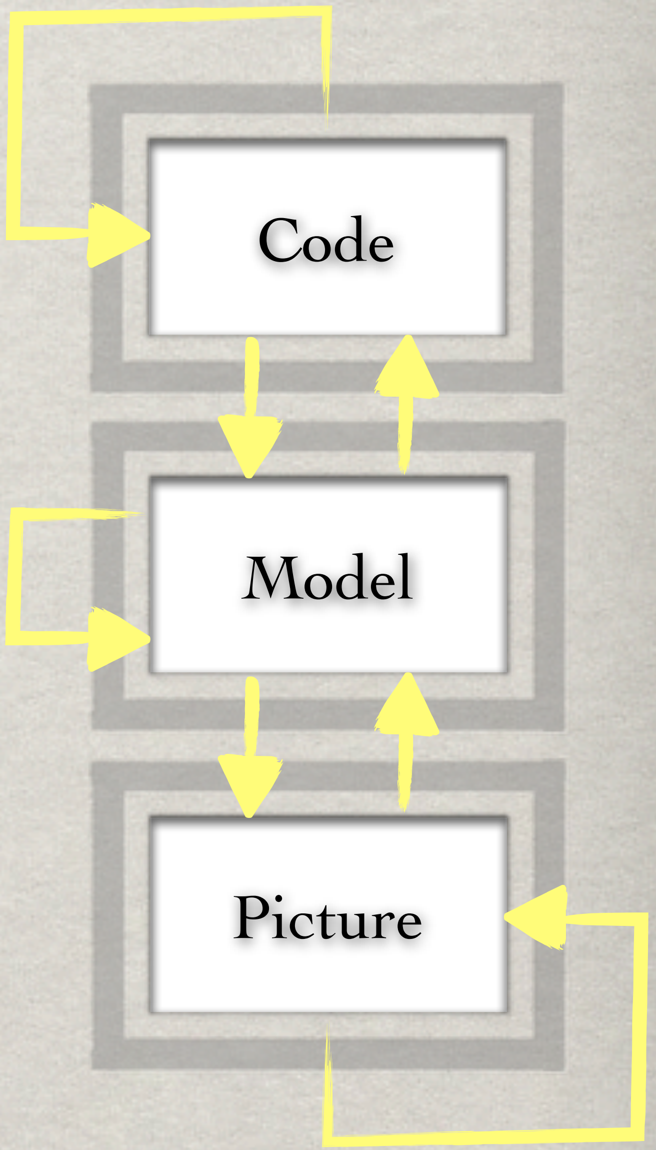
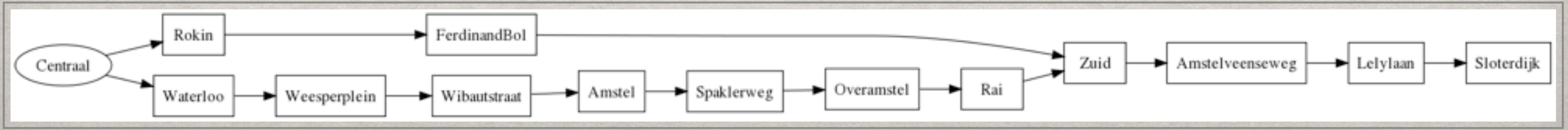
}

{ <“Centraal”, “Waterloo”>,
  <“Waterloo”,” Weesperplein”>, … }

digraph Metro {
   node [shape=box]
   Centraal -> Waterloo
   Waterloo -> Weesperplein ...
   Centraal [shape=ellipse]
}
```





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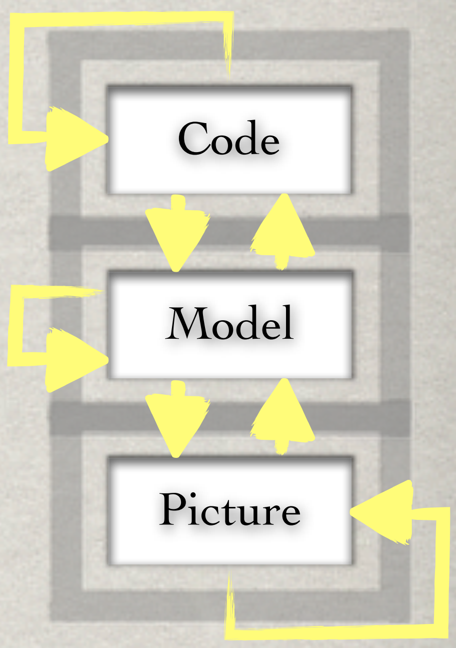

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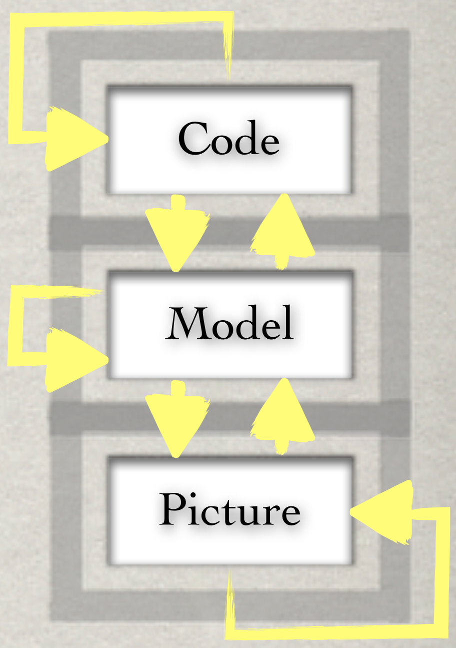

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module Metro
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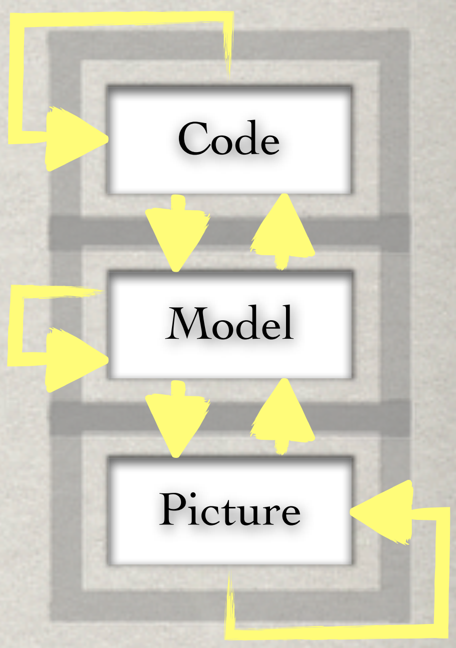
A one-slide DSL



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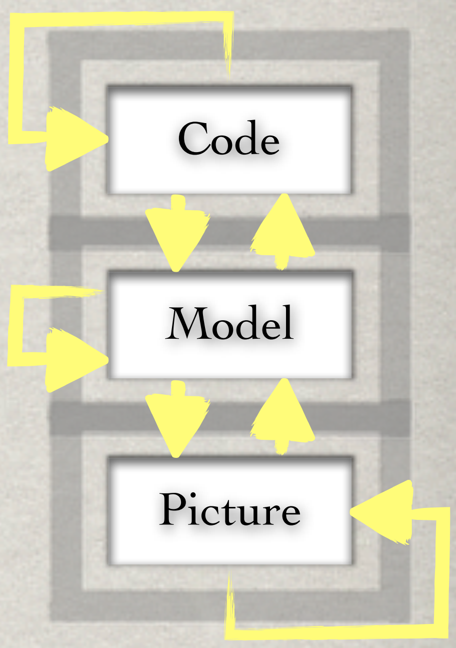

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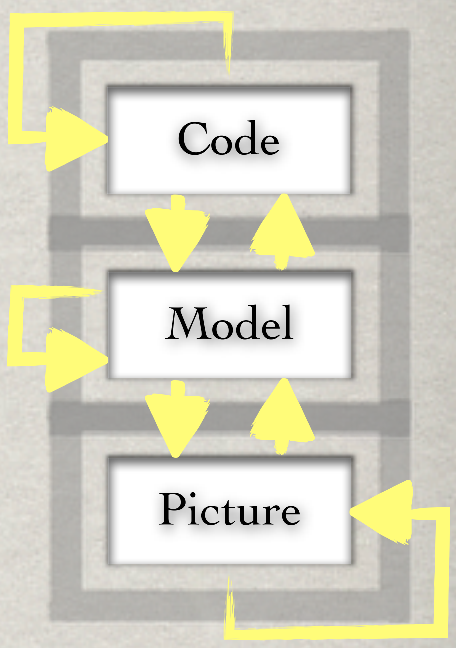

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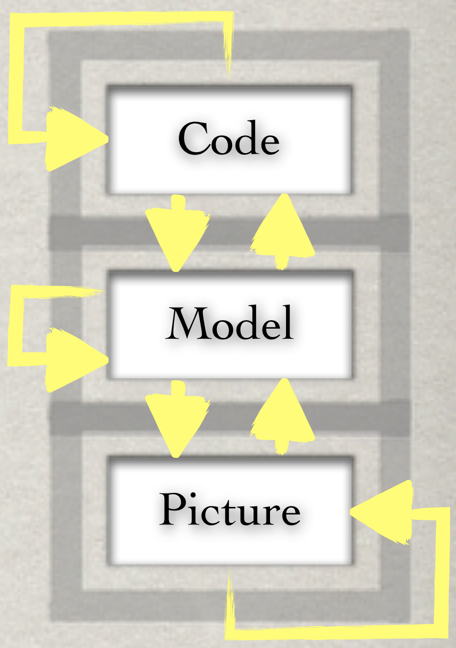

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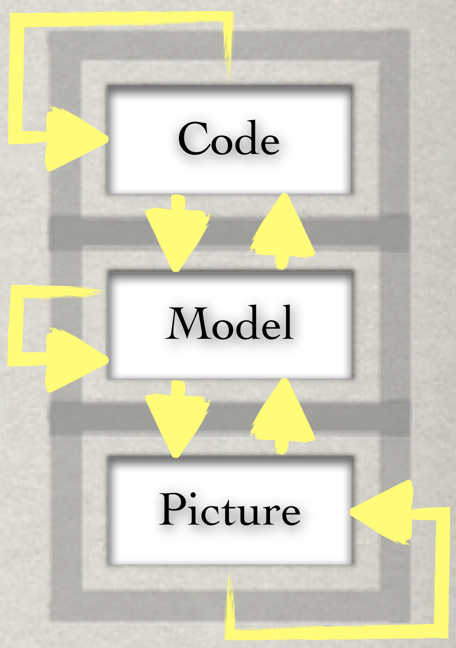

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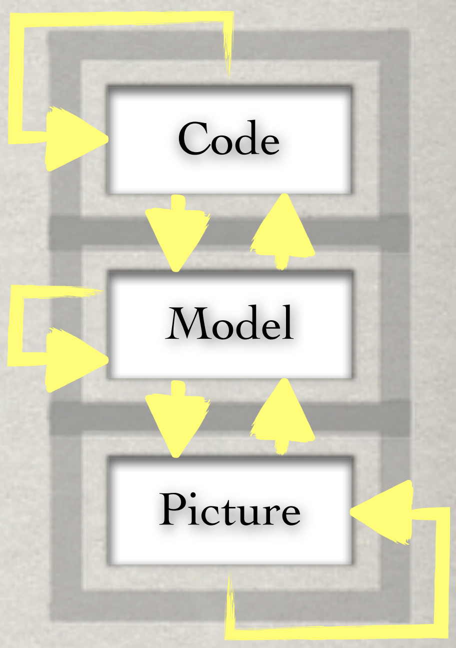

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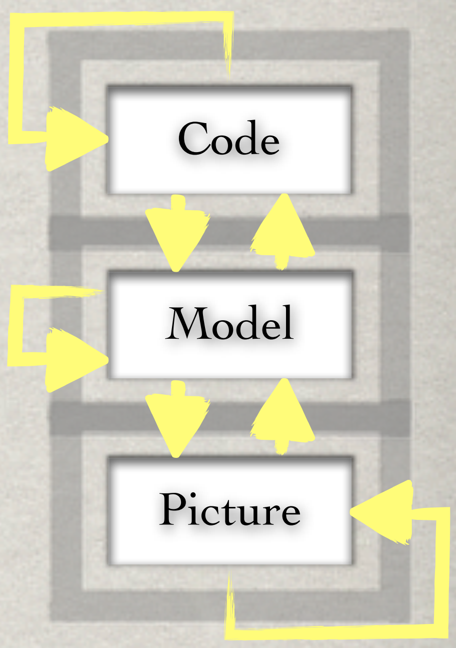

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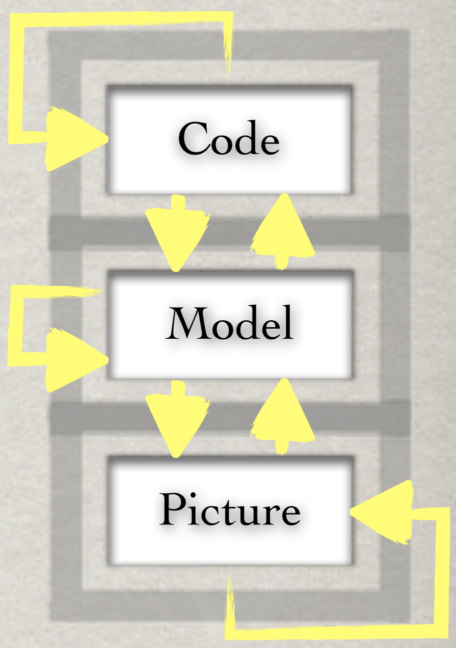

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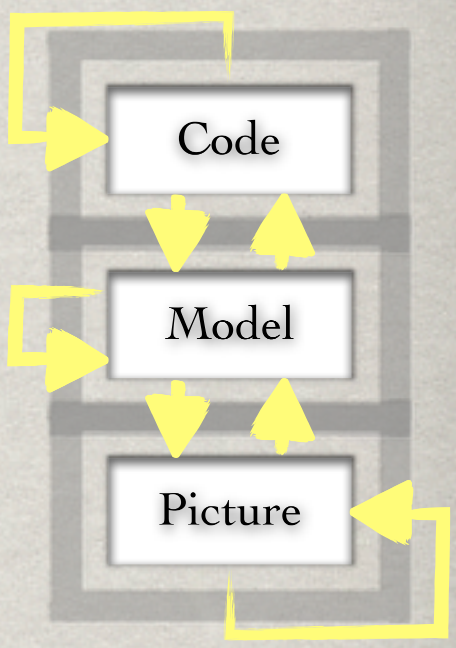

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A one-slide DSL

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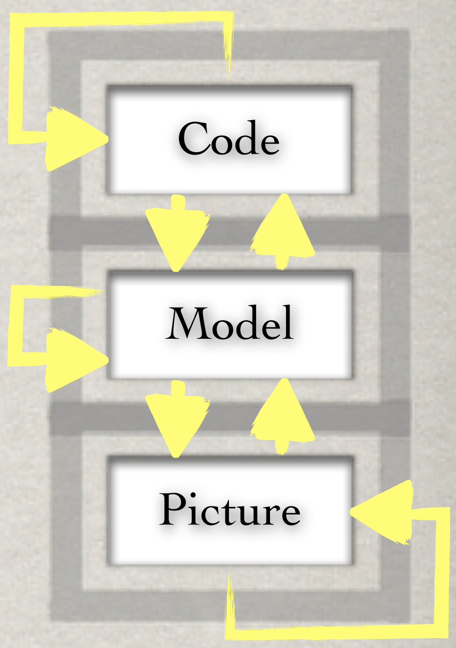

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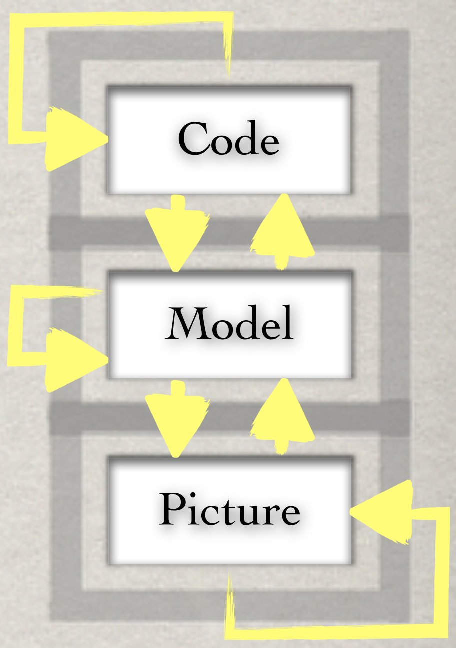

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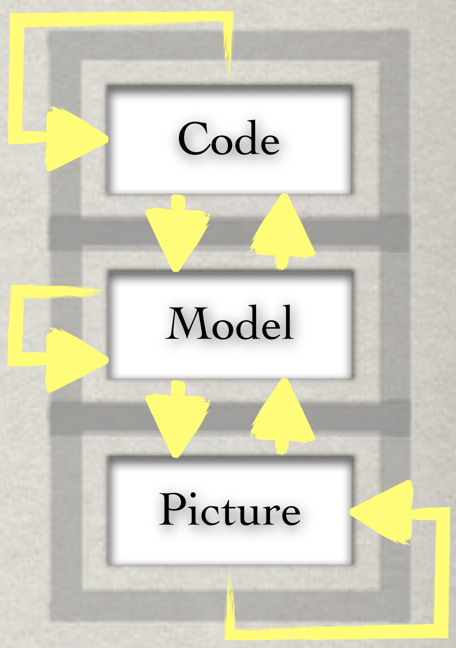

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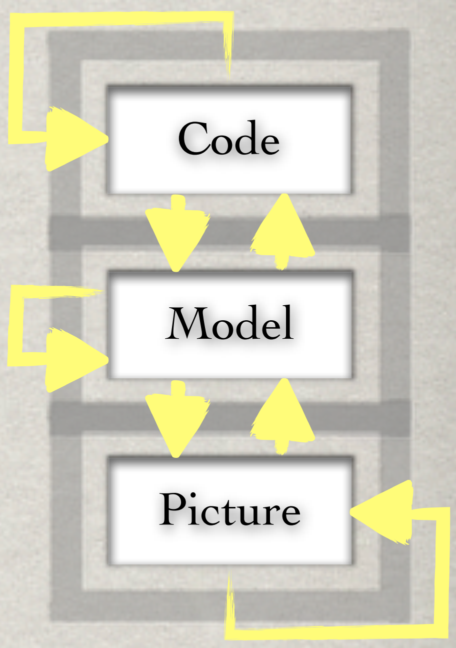
A ONE-SLIDE DSL



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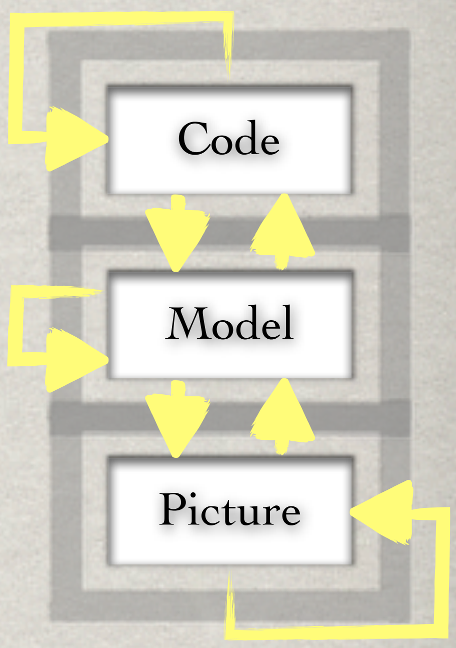
A one-slide DSL



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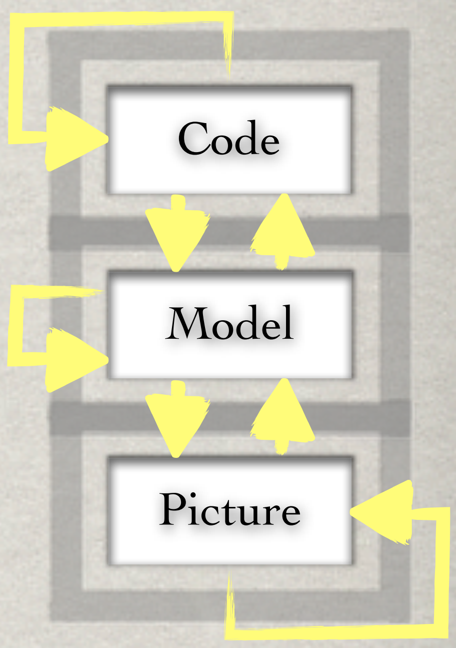

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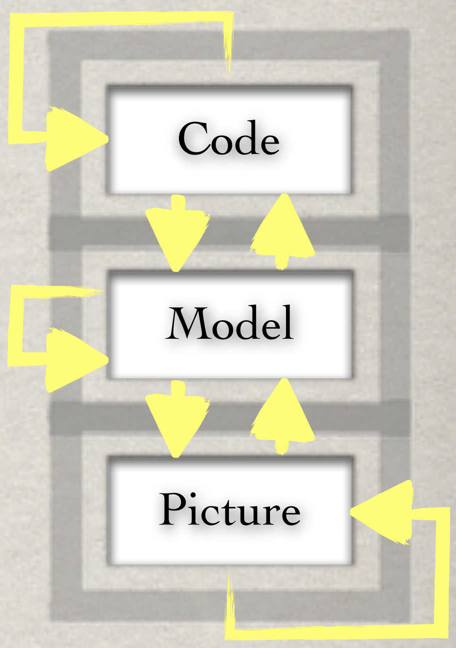
A ONE-SLIDE DSL



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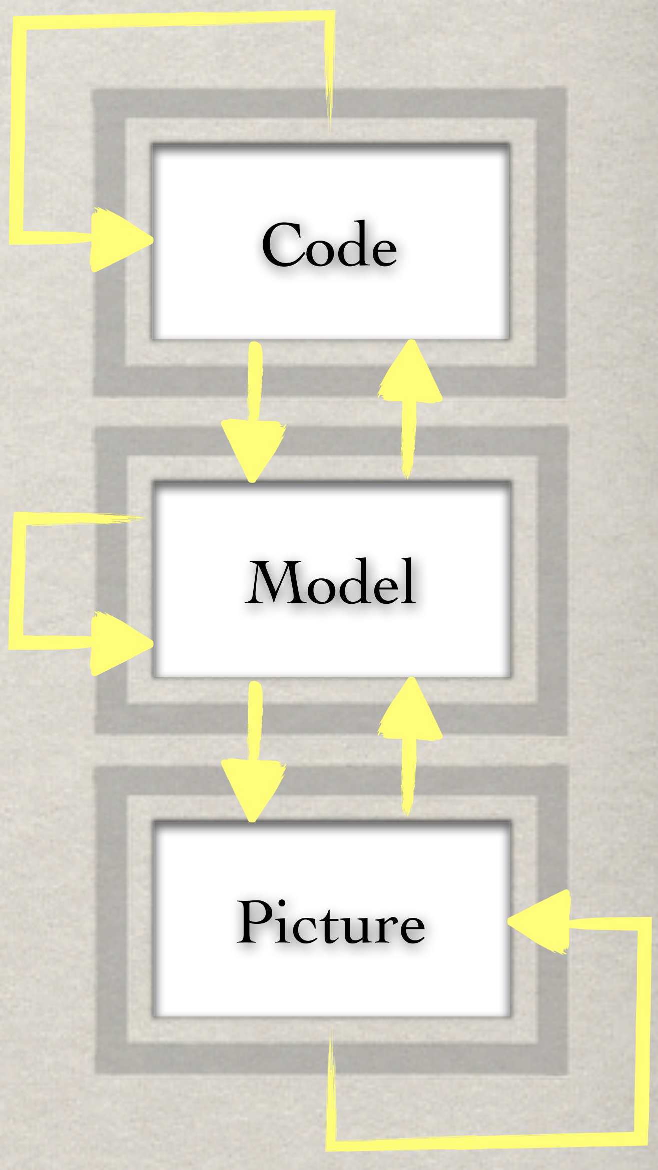
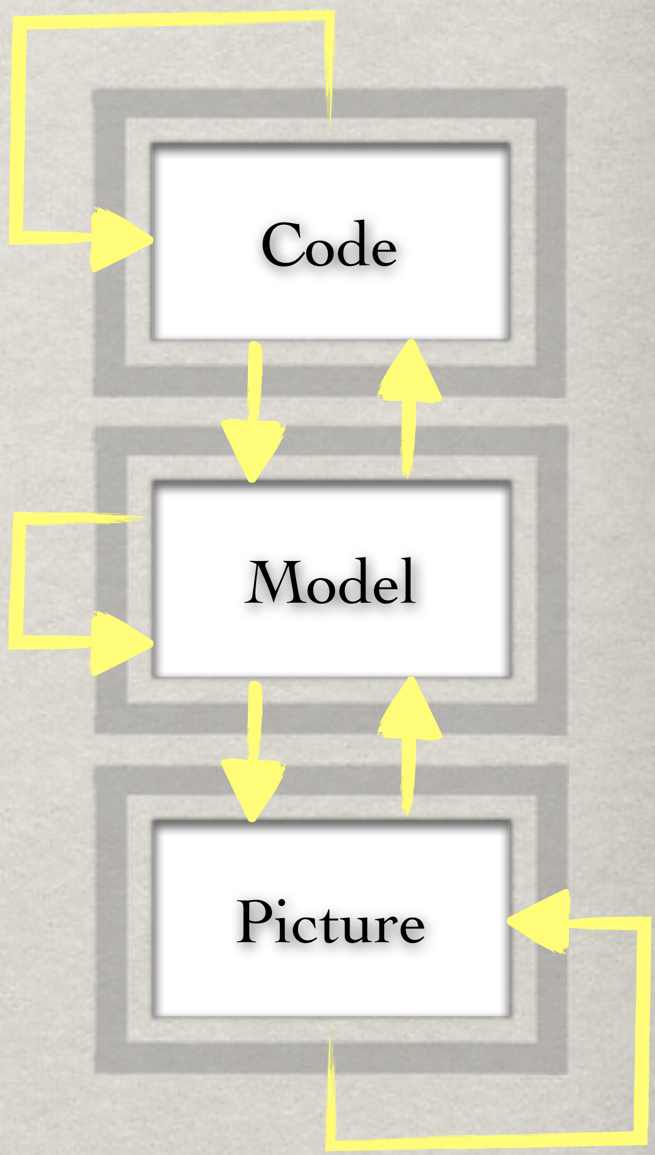


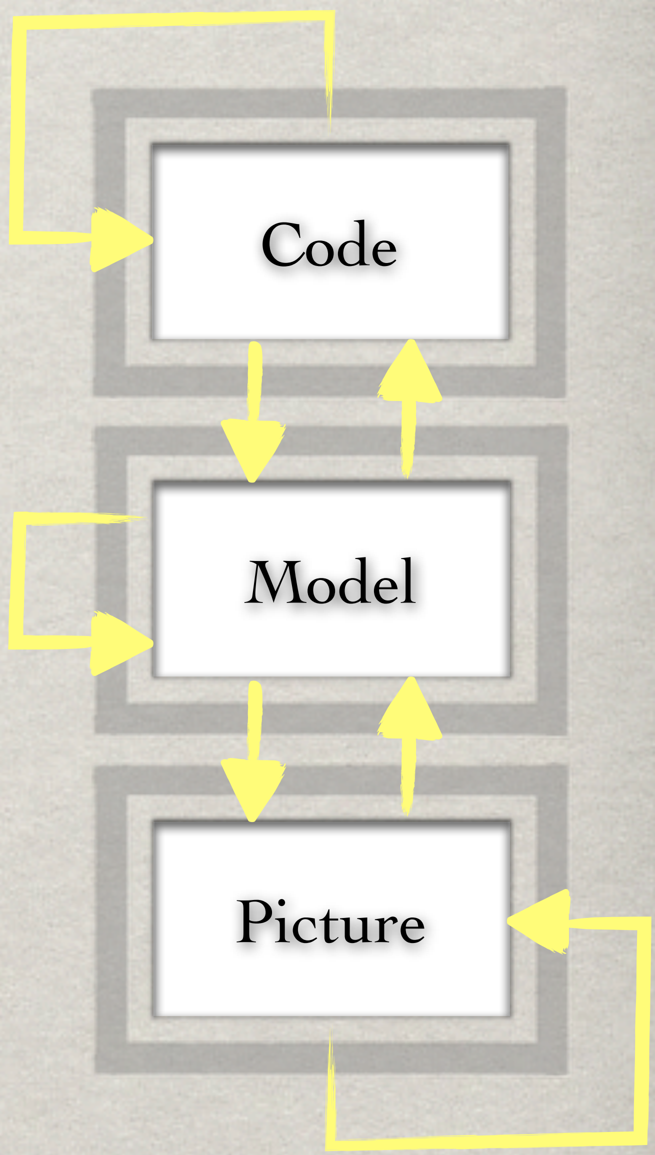
A ONE-SLIDE DSL

- What is the point?
  - Rapid tool development
  - No boilerplate
  - No glue
  - No magic
  - Done. Next!

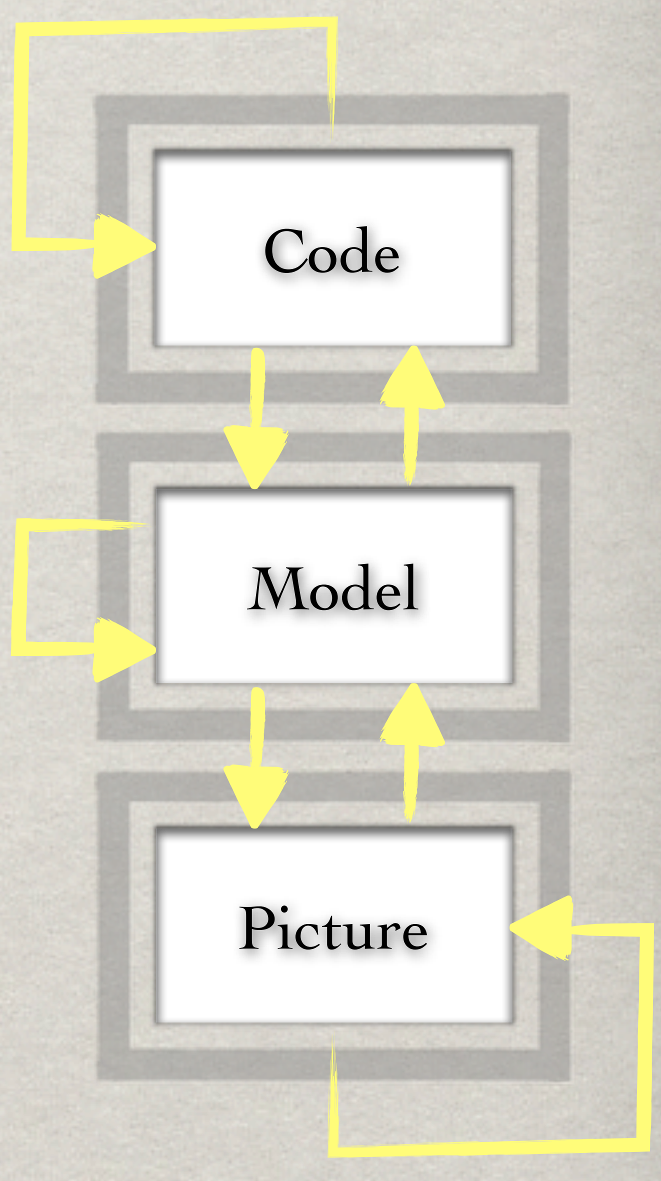


A ONE-SLIDE DSL

- What is the point?
  - Rapid tool development
  - No boilerplate
  - No glue
  - No magic
  - Done. Next!
- This works for
  - all kinds of meta-programming tools
  - all kinds of languages

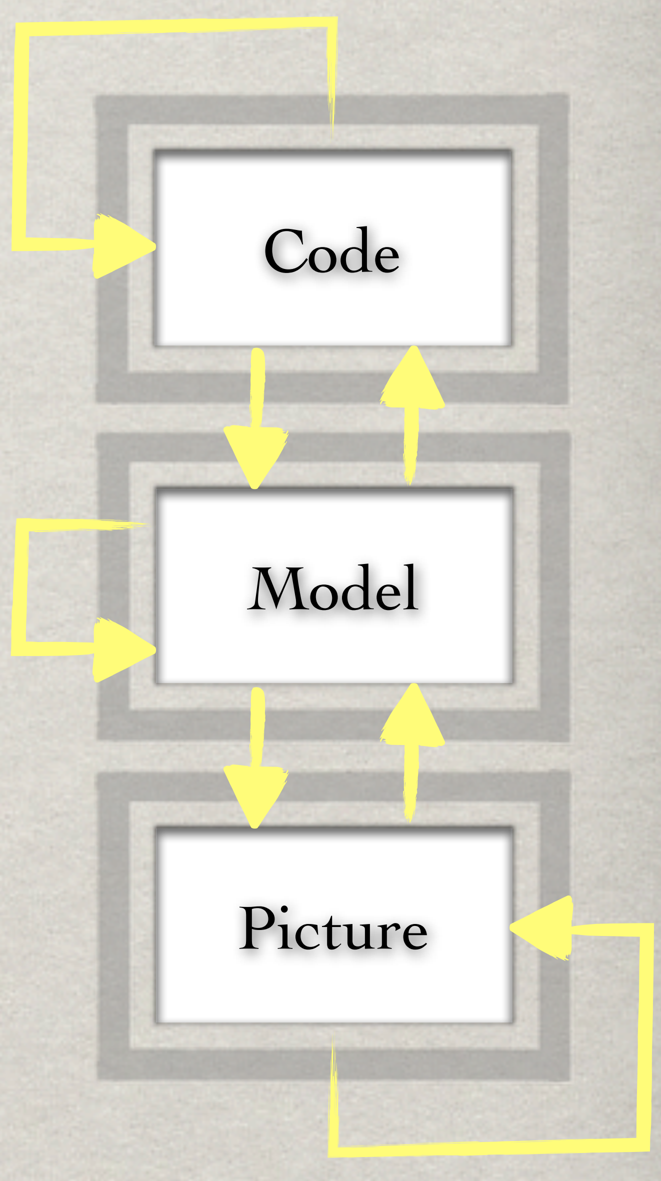


Library development



Library development

- **Type-safe** access to resources such as bug databases, version management systems, spreadsheets, webservices



Library development

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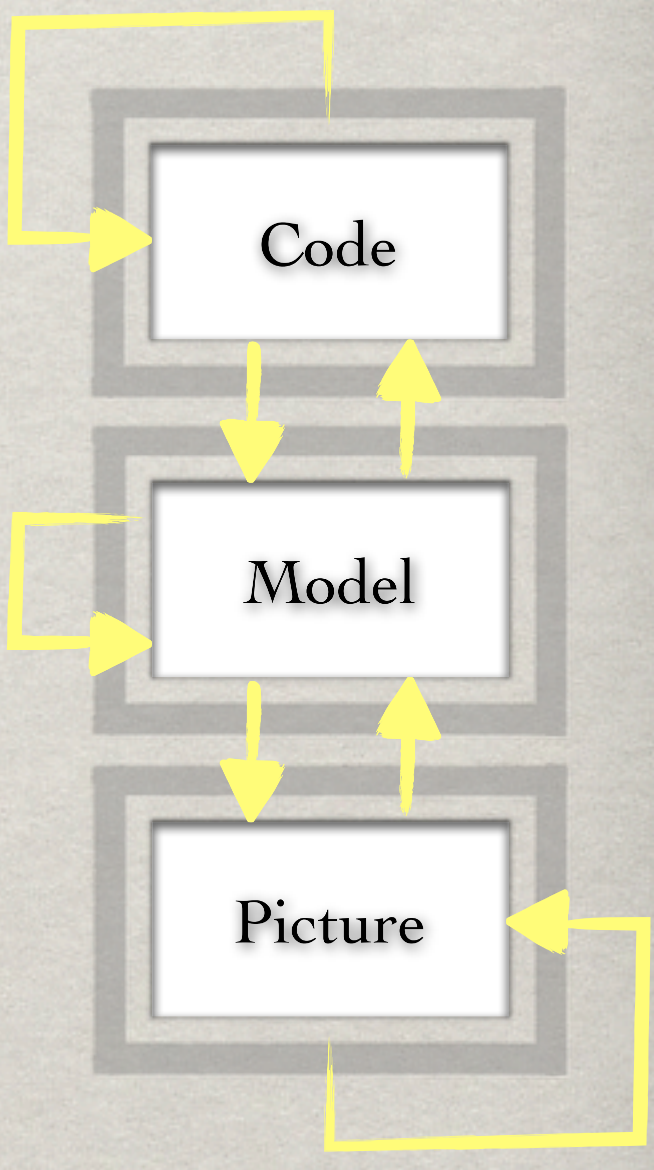
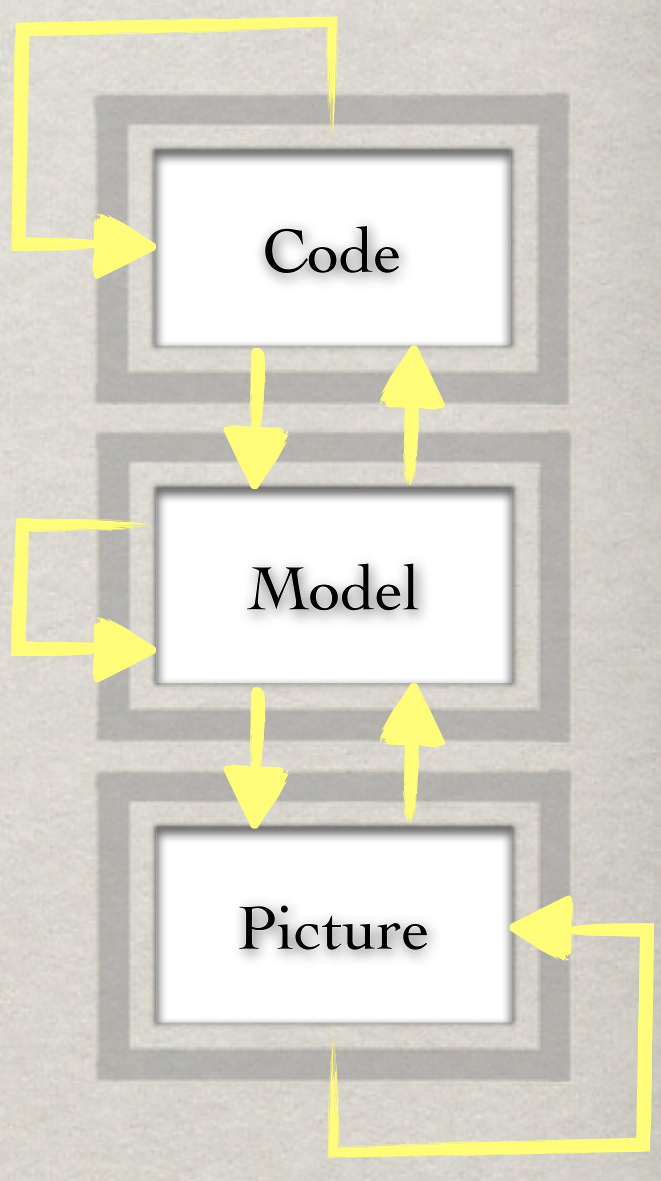
- **Front-ends** for programming languages



Library development

- **Type-safe** access to resources such as bug databases, version management systems, spreadsheets, webservices
- **Front-ends** for programming languages
- **Generic analyses**; statistics, constraints, satisfiability, …



Library development

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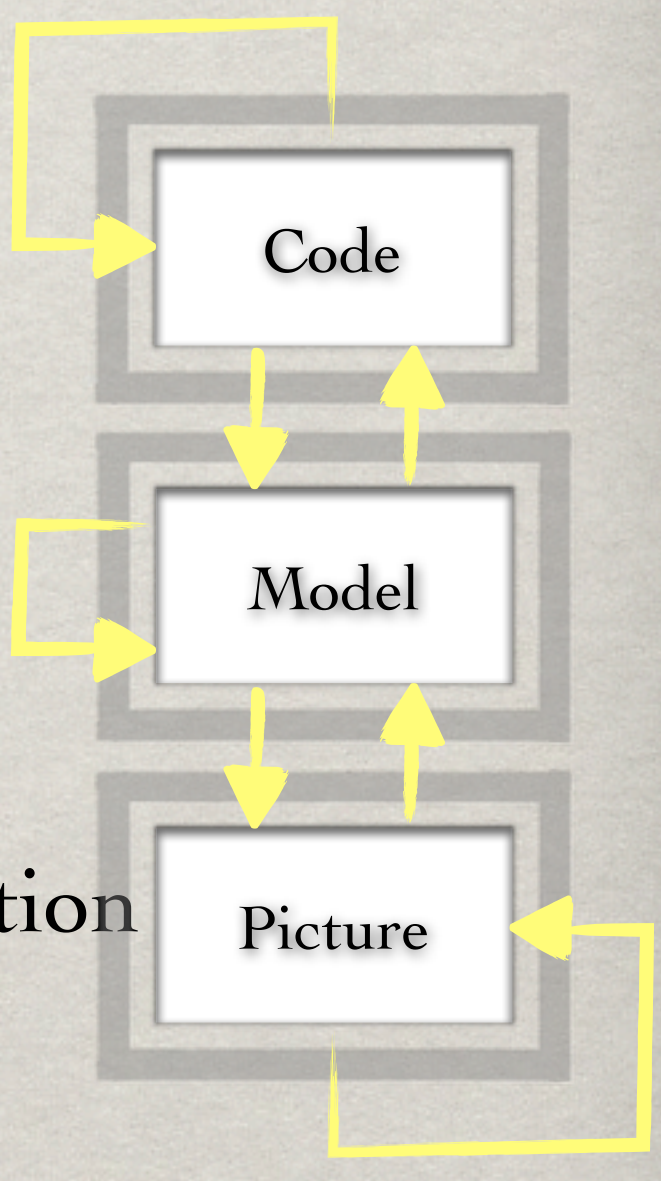
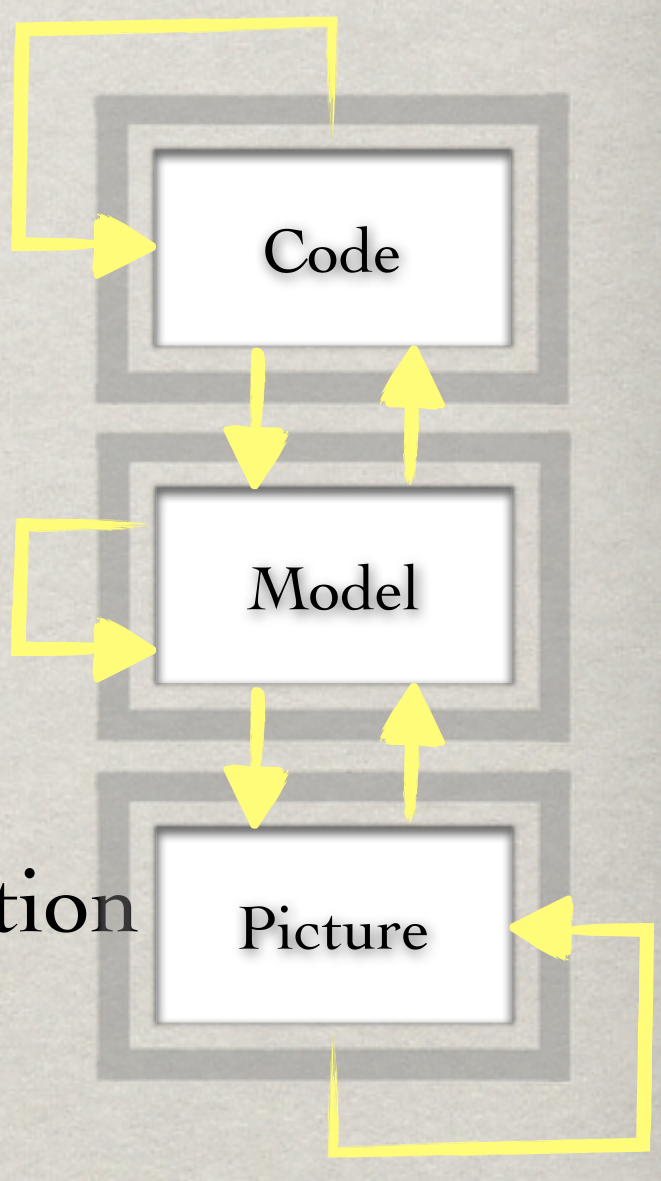
- **Visualization:** one-stop-library for any visualization (graph, chart, browser, …)



Library development

- **Type-safe** access to resources such as bug databases, version management systems, spreadsheets, webservices
- **Front-ends** for programming languages
- **Generic analyses**; statistics, constraints, satisfiability, …
- **Visualization:** one-stop-library for any visualization (graph, chart, browser, …)
- (this is our main challenge at the moment)



Current applications

- PHP, Lua static analysis of dynamic languages
- Modular/Language parametric refactoring
- Grammar engineering
- Domain specific languages
  - Pacioli - Computational auditing
  - Derric - Digital Forensics
- Design pattern diagnostics

Take home messages

- http://www.rascal-mpl.org
  - for DYI tool building
  - open-source
- CWI - SWAT
  - studies real software (for example yours)
  - builds tools
- UvA Master Software Engineering
  - part-time (2 year), full-time (1 year)
  - (to be developed) “deep track” - domain specific SE tracks

Discussion

- For meta programming source code is data
- and, source code is big!
- so, is meta programming like big data?
- Common challenges, common solution patterns?
- Are meta programming solutions relevant for bd?
- Are big data solutions relevant for meta prog?
- {C,sh,w}ould Rascal be extended to big data use cases?