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CWI Lectures

Understanding and Simplifying Software

with the Rascal Meta-Programming Language

Jurgen J. Vinju

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Software is Complex

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- The principles of software are easy

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  - Just a bunch of computer instructions

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Instruments

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- Higher level programming
  - Model Driven Engineering
  - Domain Specific Languages

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- Program comprehension
  - Static & dynamic analysis
  - IDEs

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  - Measurement & benchmarking

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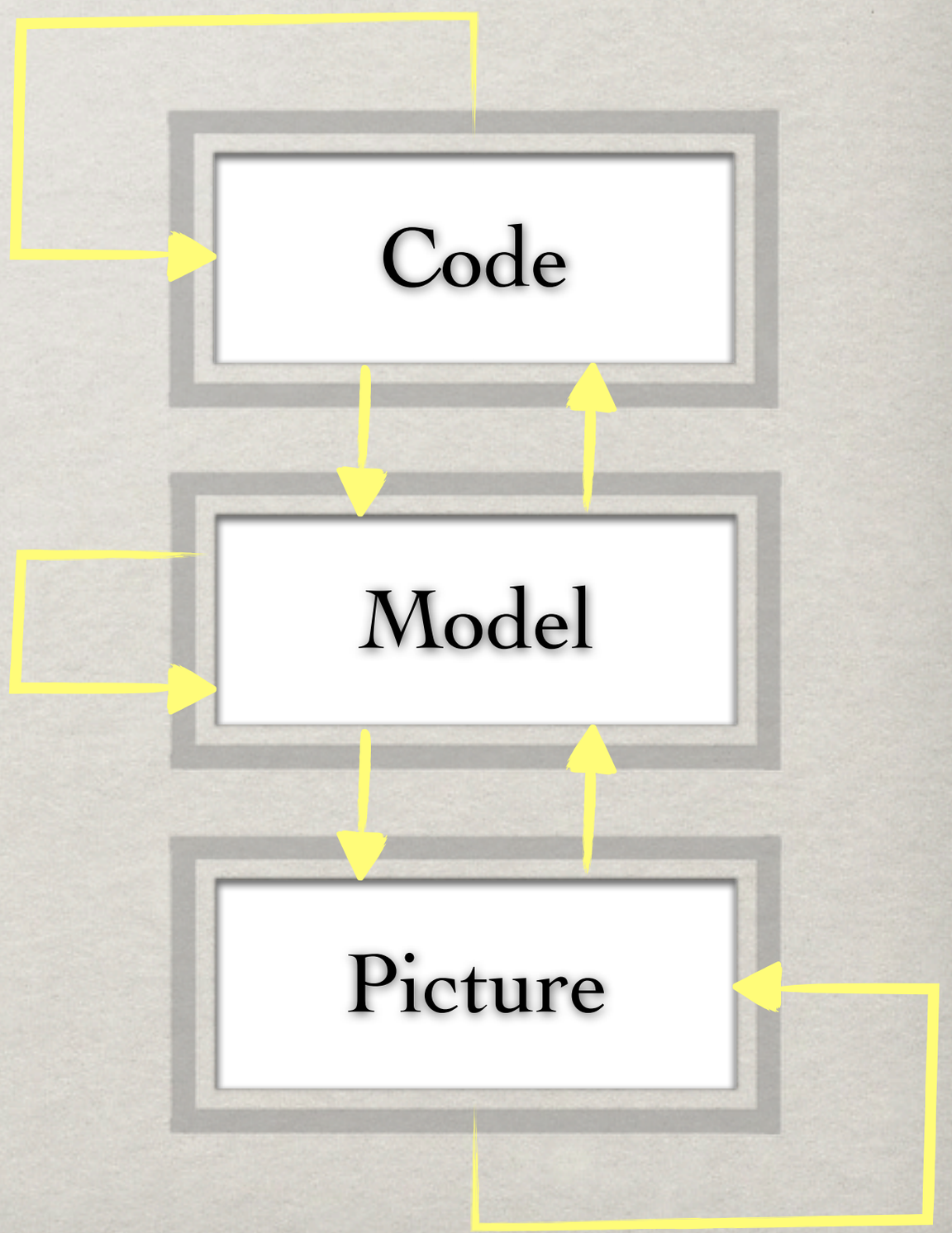

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PROBLEM

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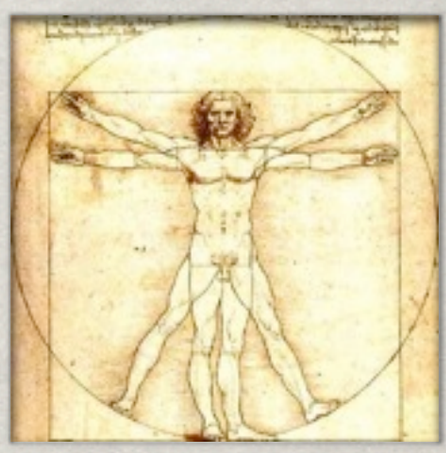

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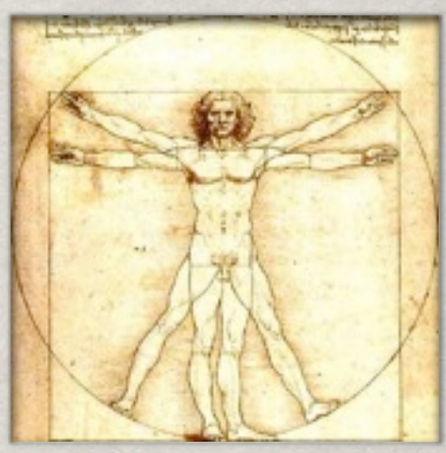
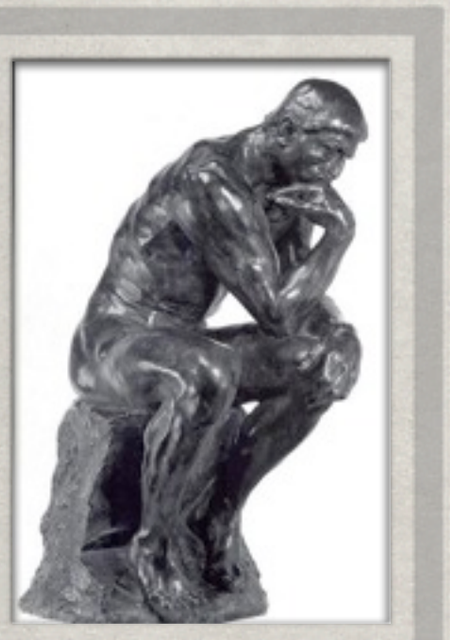
PROBLEM

- Instruments are costly
  - Diverse
  - Multi-disciplinary
  - Accurate/Efficient



Rascal

ENABLES



Research

Application

Rascal

A new tool every week

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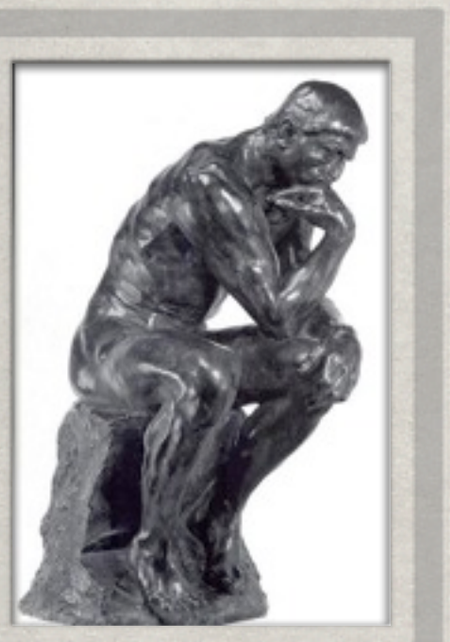

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Rascal

One-stop-shop

A new tool every week

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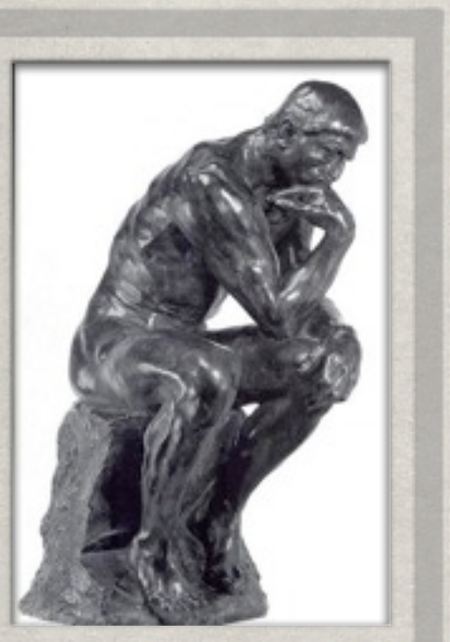

Research

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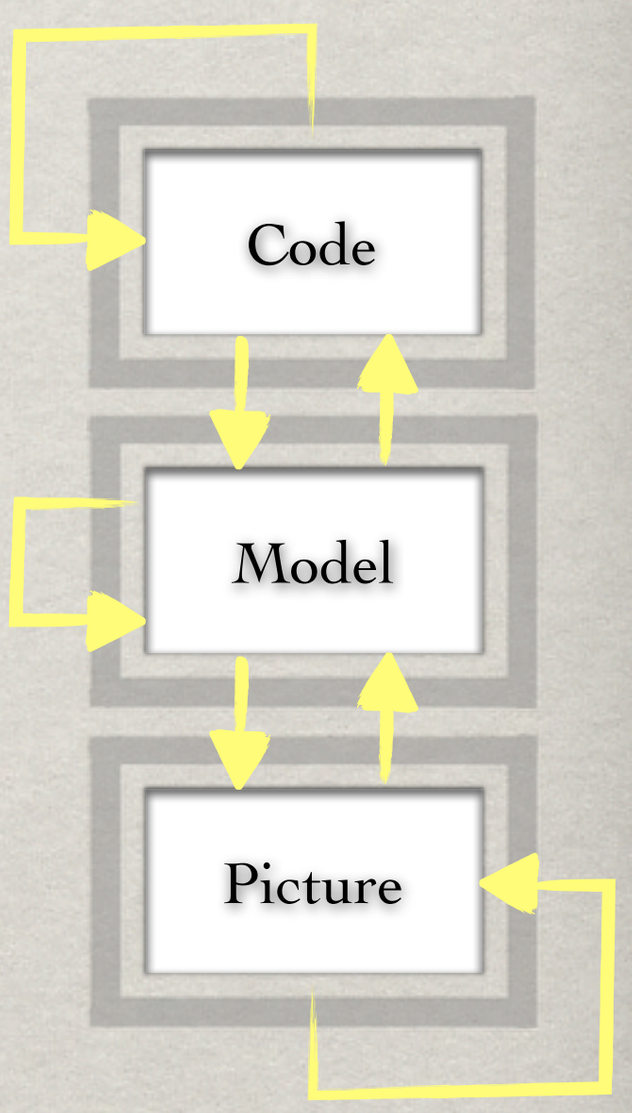
Rascal is EASY



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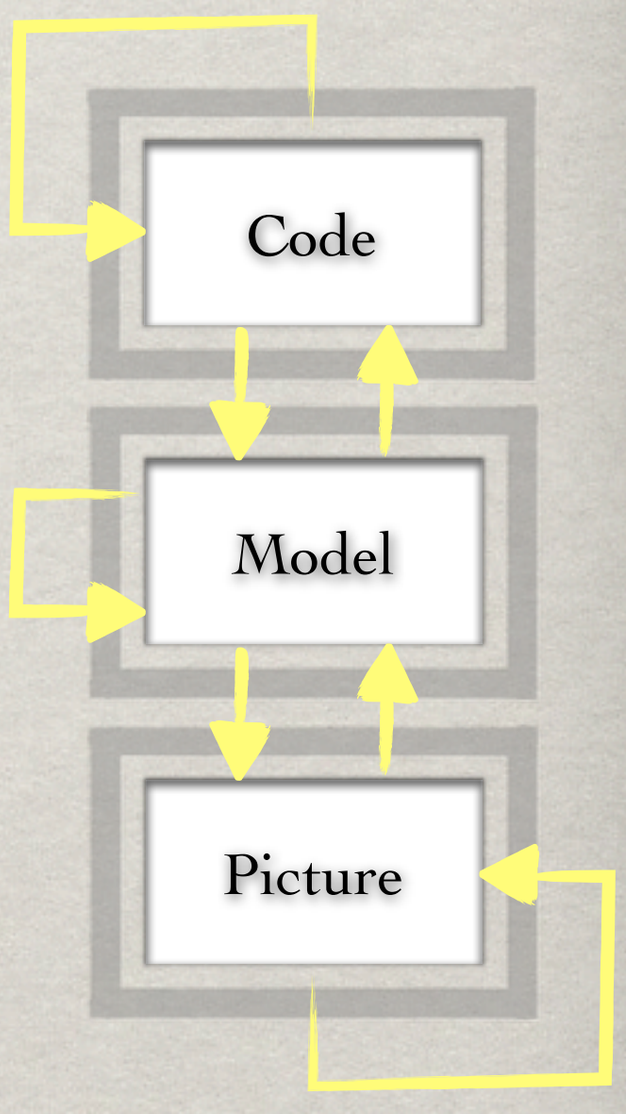
  - Create abstract relational models (like call graphs)



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  - Query abstract/concrete syntax trees
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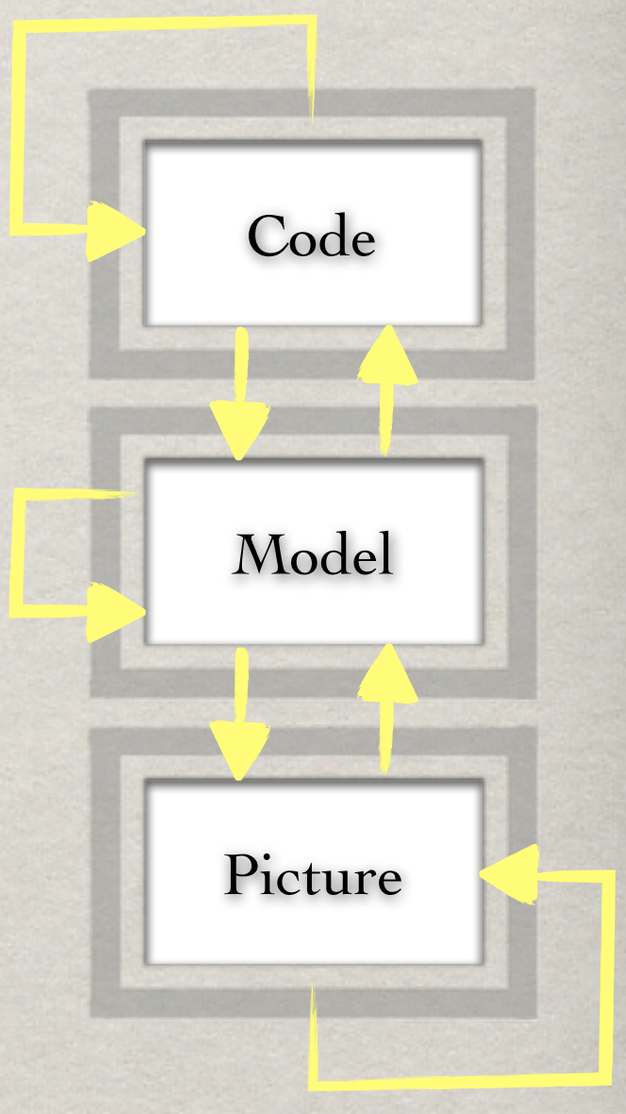

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  - Create abstract relational models (like call graphs)
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  - Query abstract/concrete syntax trees
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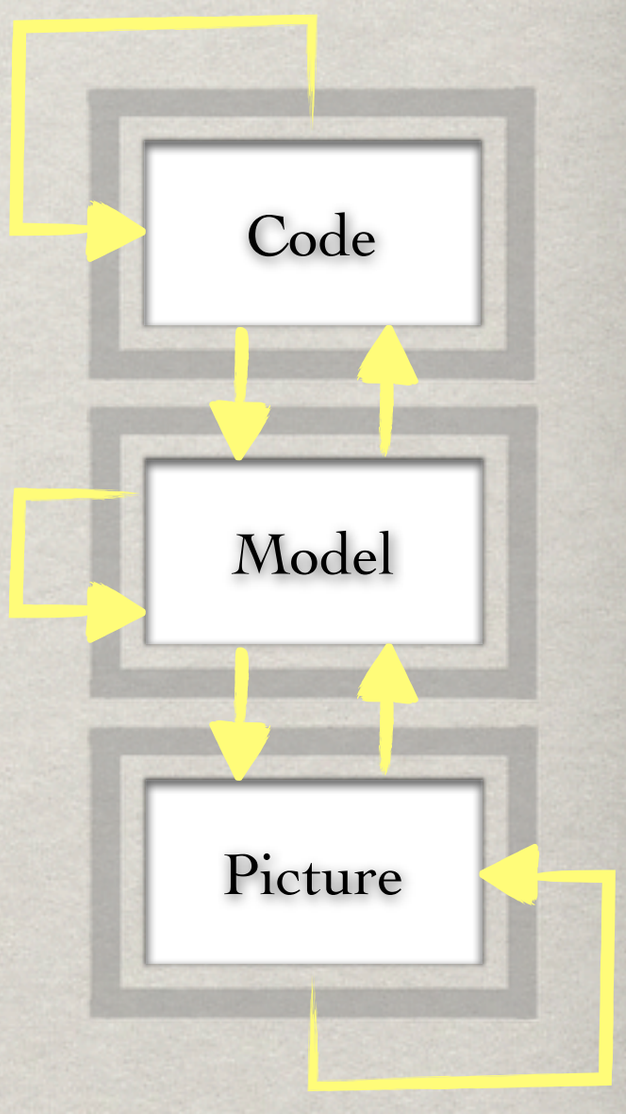
- **SY**nthesize
  - Generate code
  - Transform code
  - Produce data and visuals



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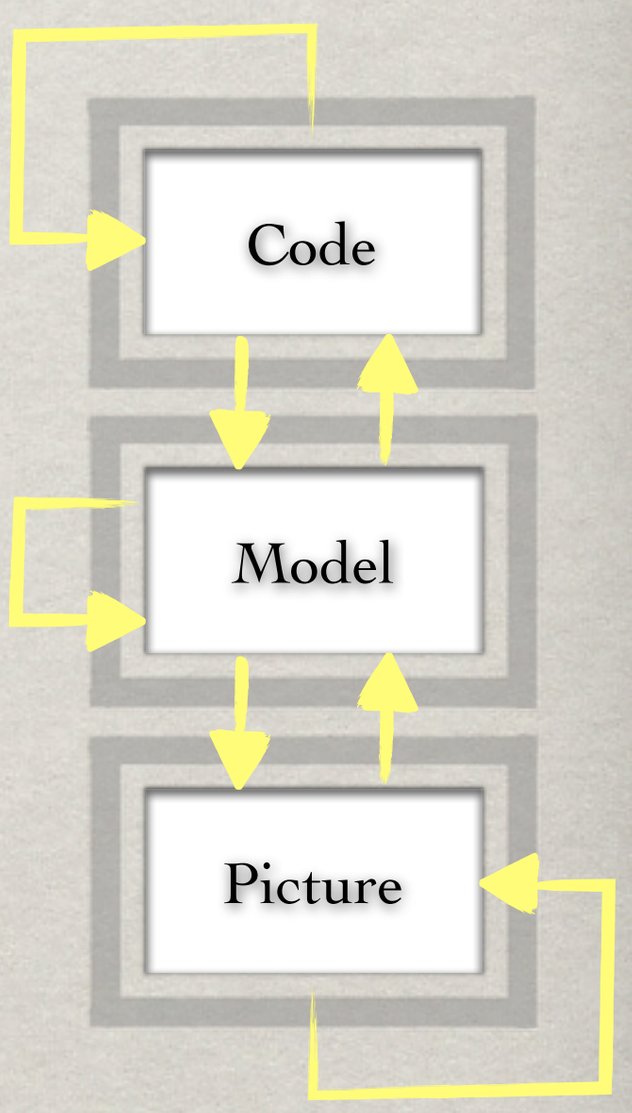

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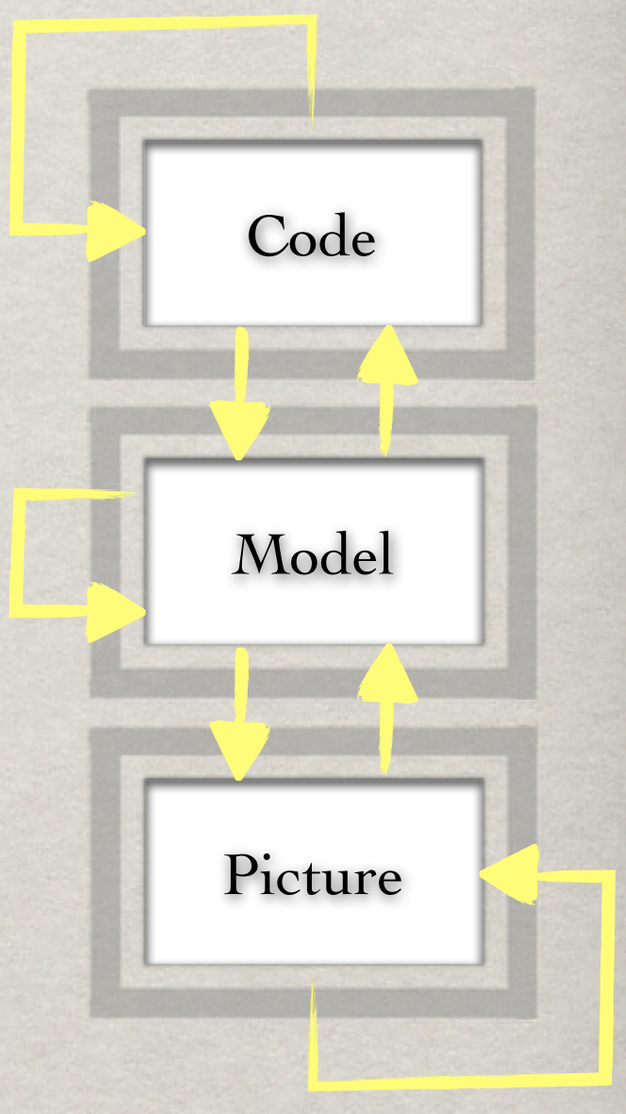

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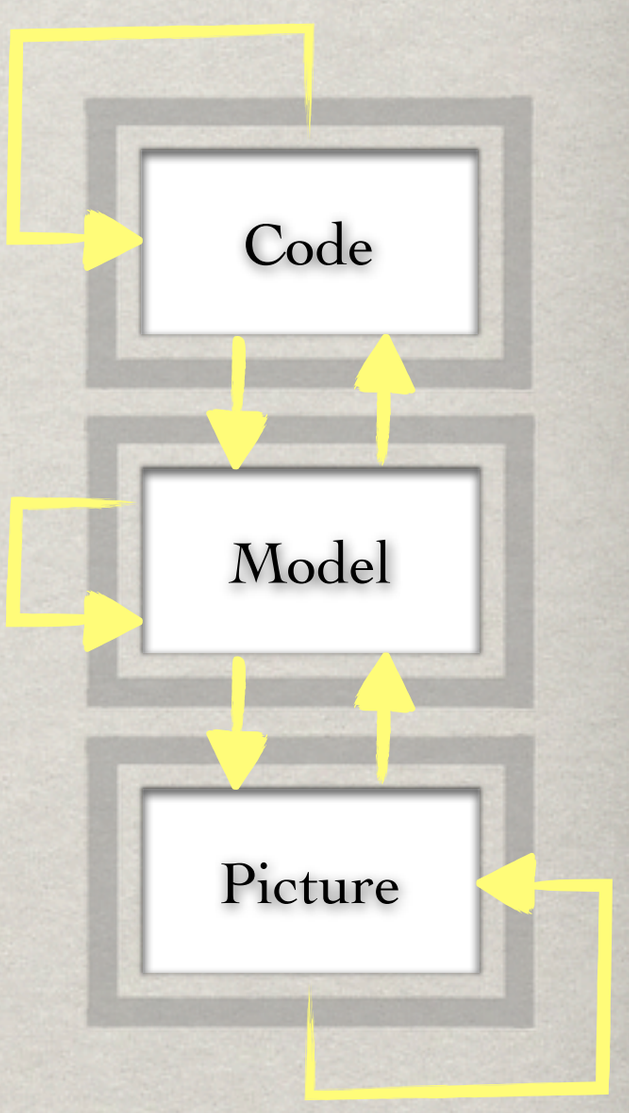
  - Backtracking, fixed point computation, ...



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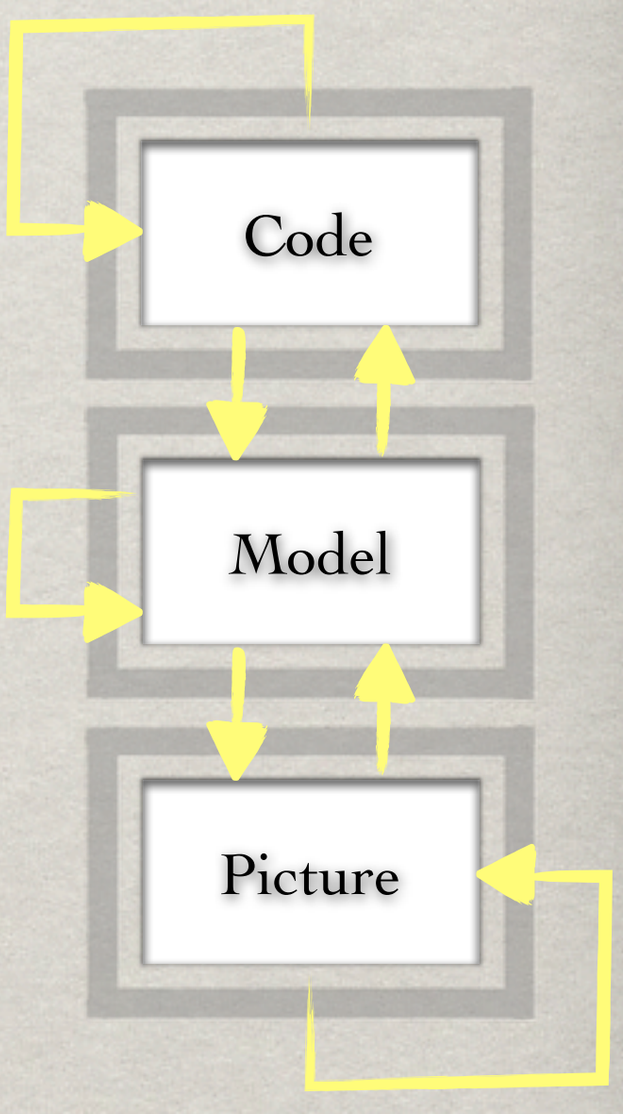
  - Fast context-free general top-down parsing
  - Pattern matching & generic traversal
- Analyze
  - Relational queries and comprehensions
  - Backtracking, fixed point computation, ...
- **SY**nthesize
  - String templates
  - Concrete syntax
  - Interactive visualization generator



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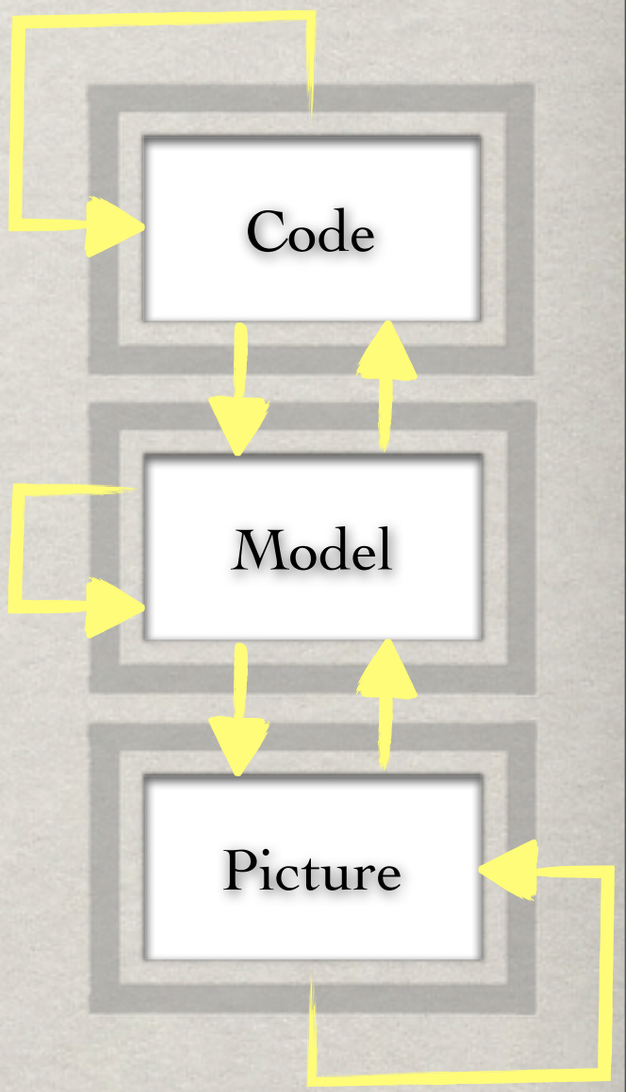
A one-slide DSL



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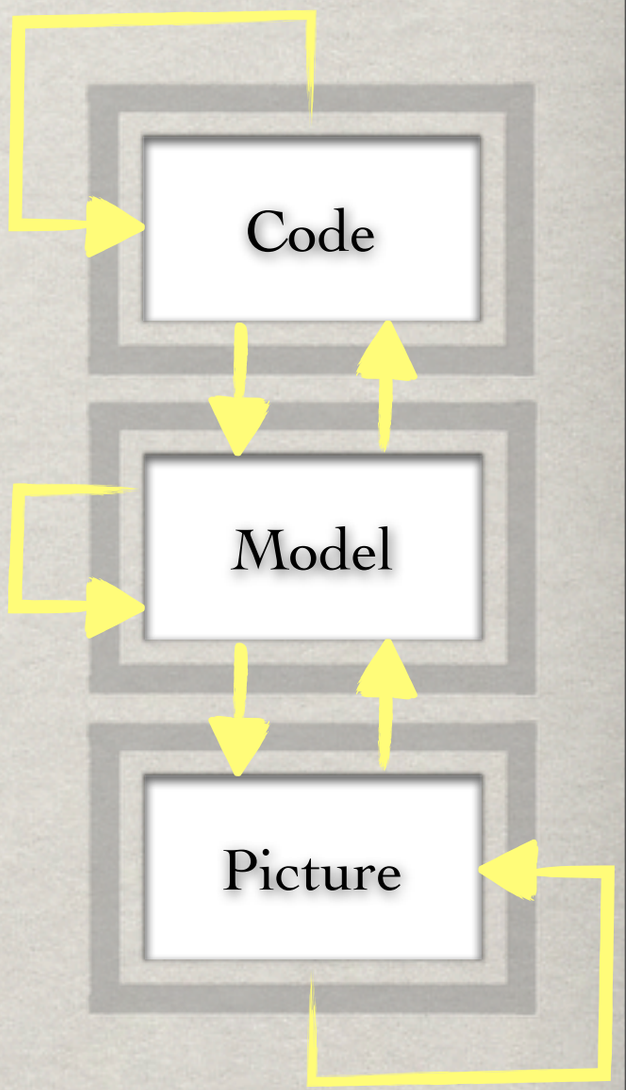
A one-slide DSL

```
metro {
   Centraal Waterloo Weesperplein Wibautstraat Amstel;
   Amstel Spaklerweg Overamstel Rai Zuid;
   Rai Zuid Amstelveenseweg Lelylaan Sloterdijk;
   Centraal Rokin FerdinandBol Zuid;
}
```



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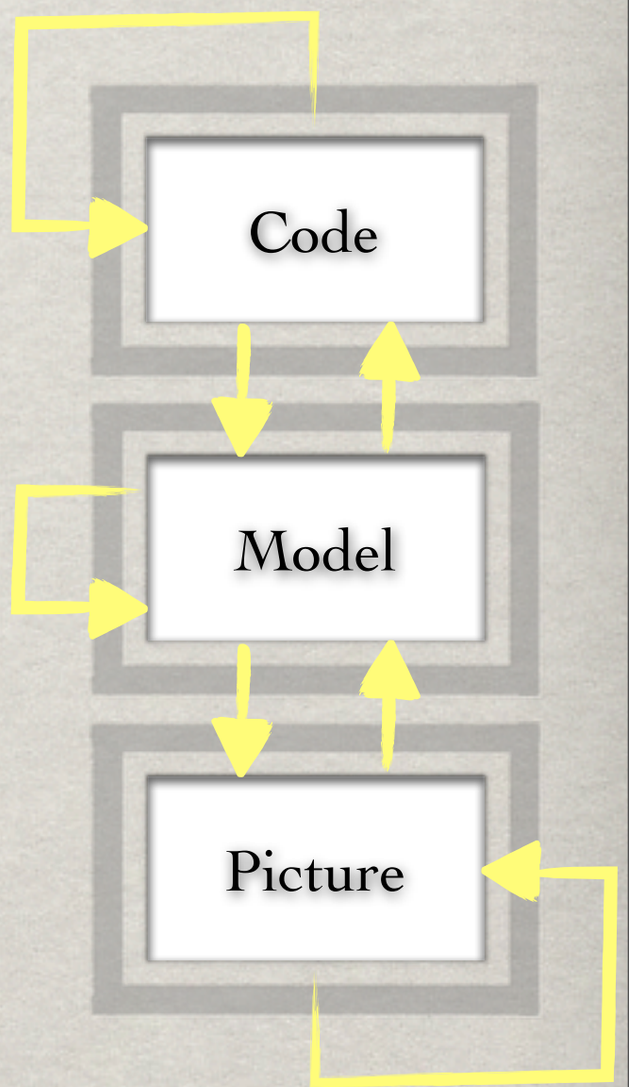
}
```

```
{ <“Centraal”, “Waterloo”>,
```



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{ <“Centraal”, “Waterloo”>,
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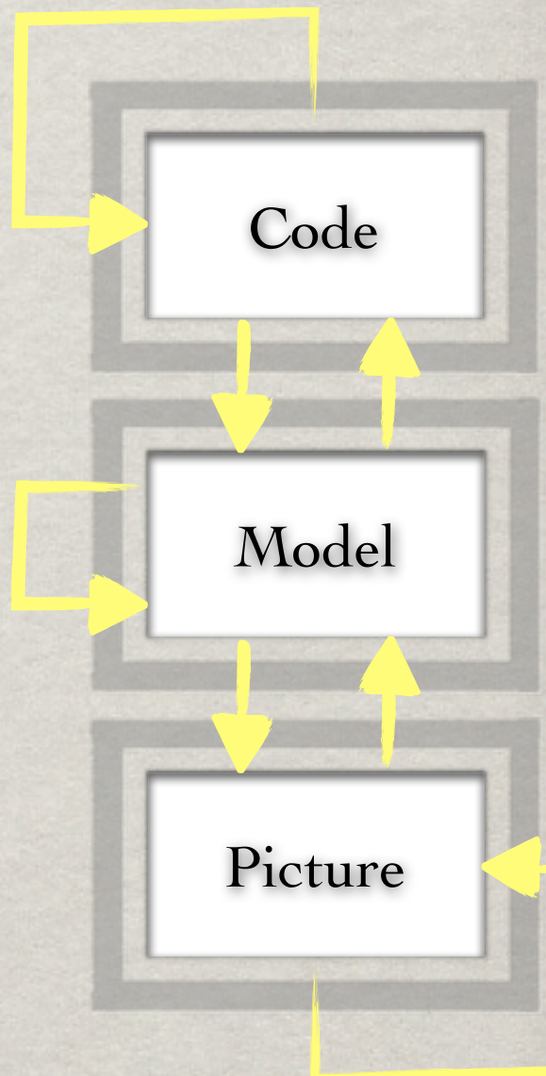

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}
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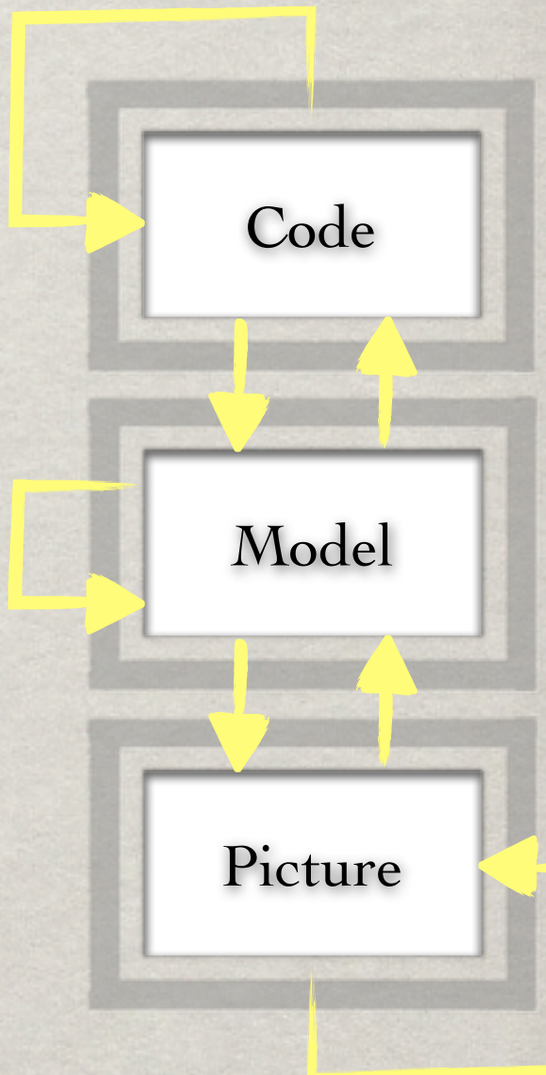
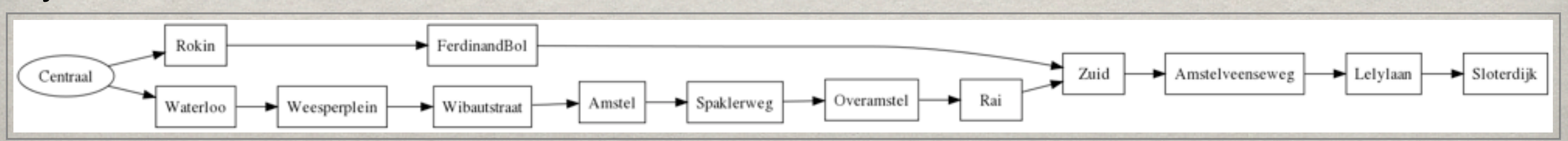
```
{ <“Centraal”, “Waterloo”>,
  <“Waterloo”,” Weesperplein”>, … }
```

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





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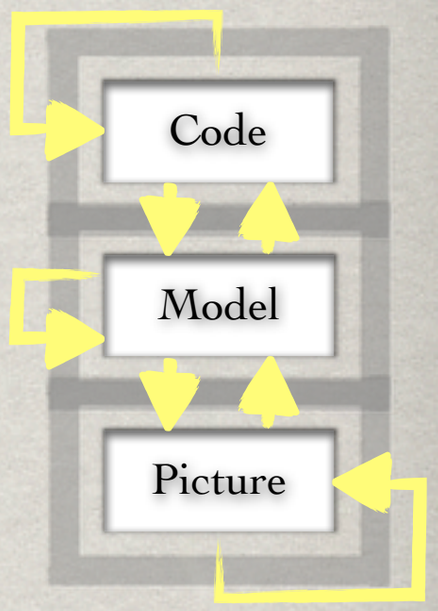

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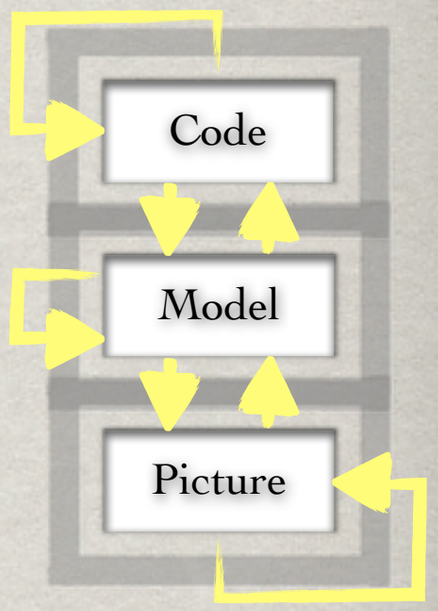


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A one-slide DSL

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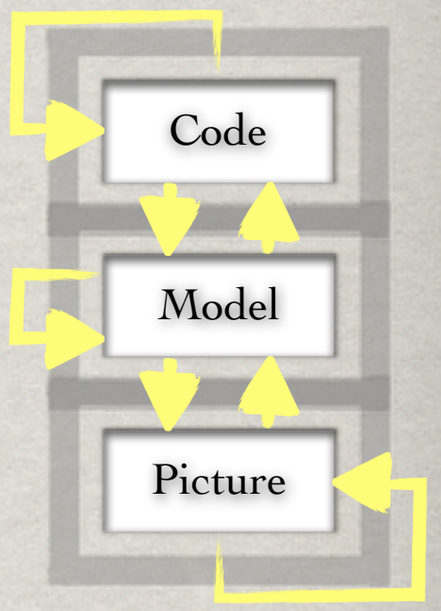

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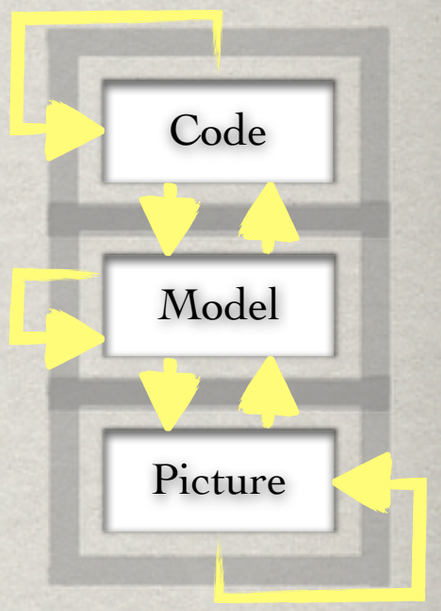

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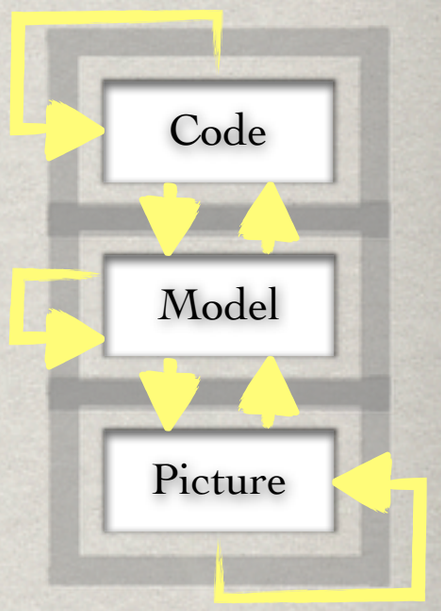

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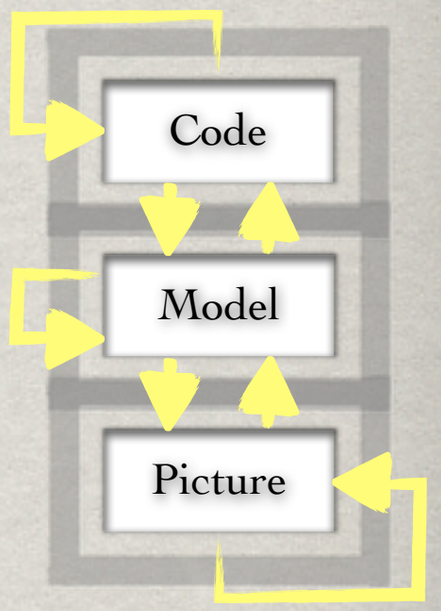

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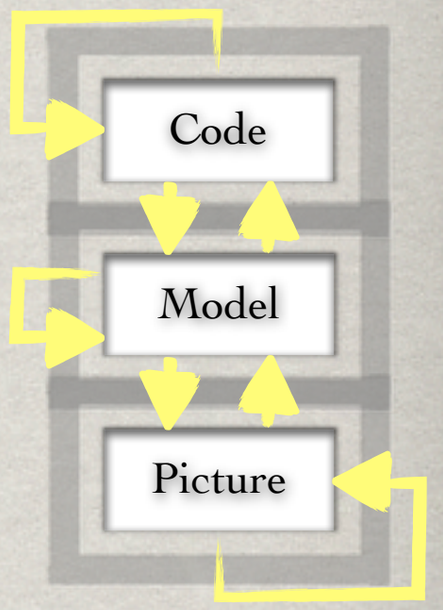


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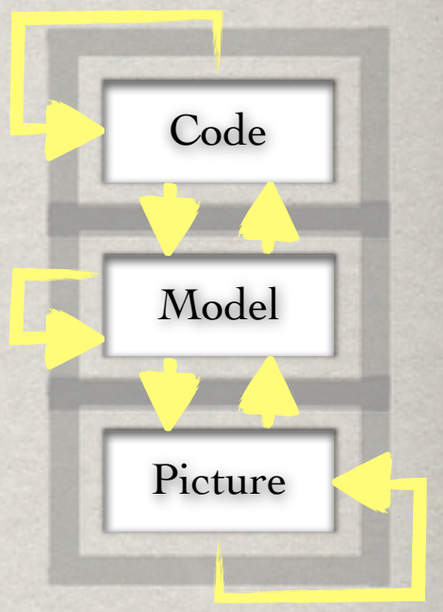
A ONE-SLIDE DSL

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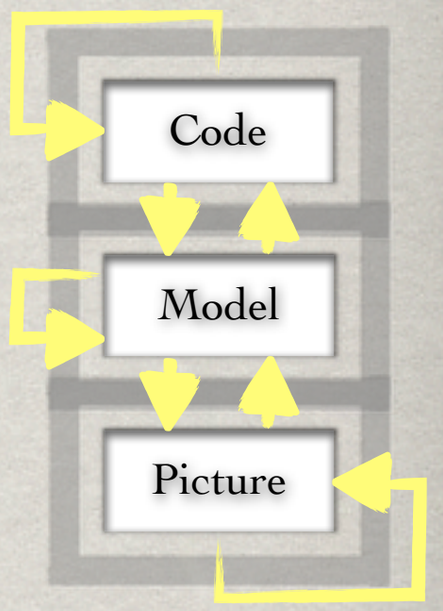


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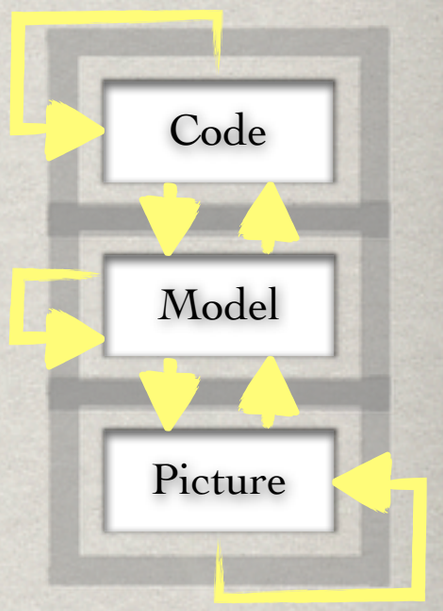


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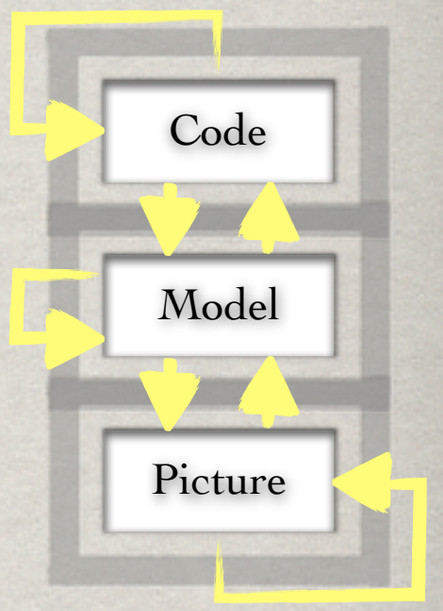


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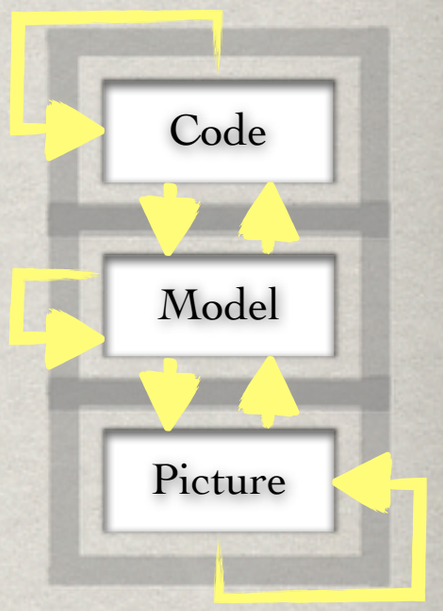


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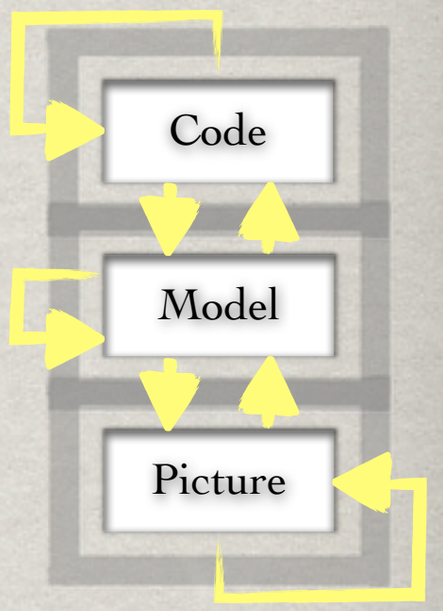


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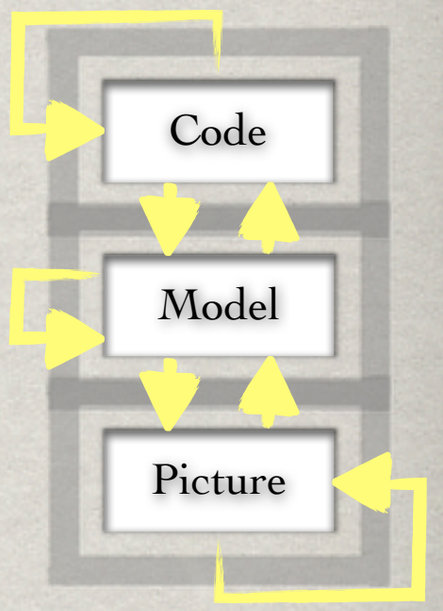


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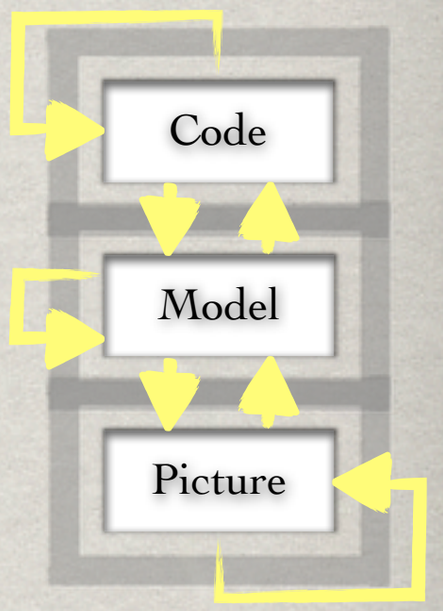
A ONE-SLIDE DSL

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start syntax System = “metro” “{“ Track* tracks “}”;
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layout WS = [\ \t\n\r]*;

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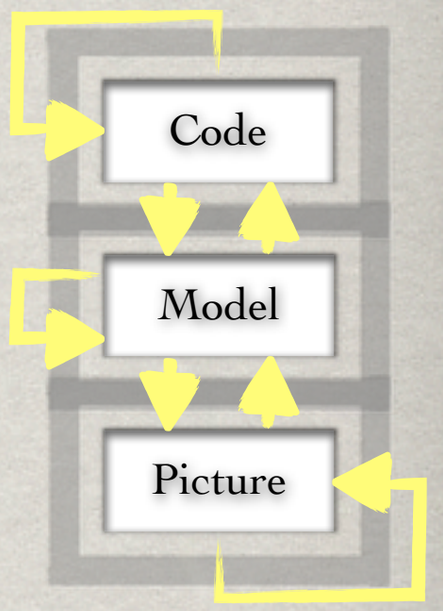


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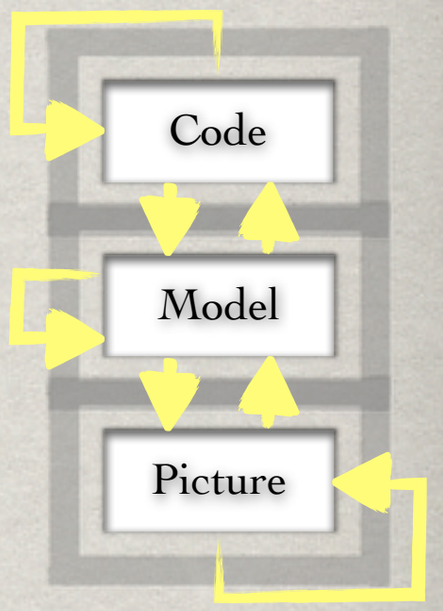


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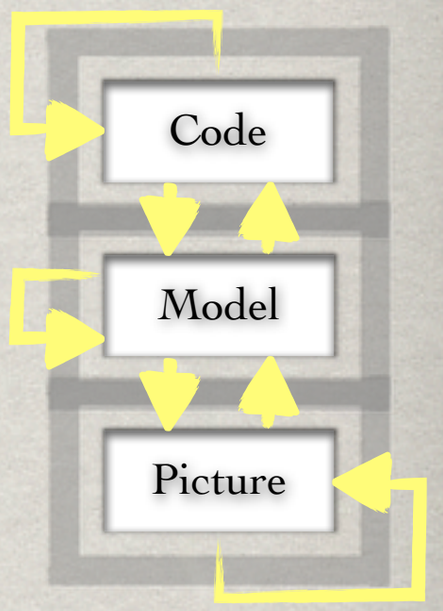


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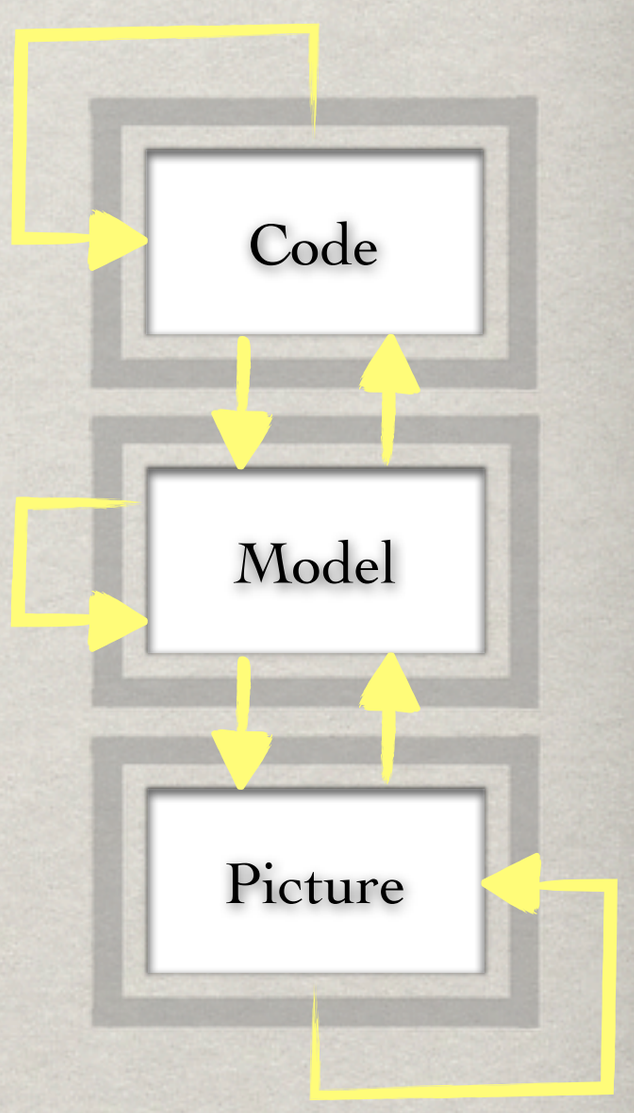
CWI

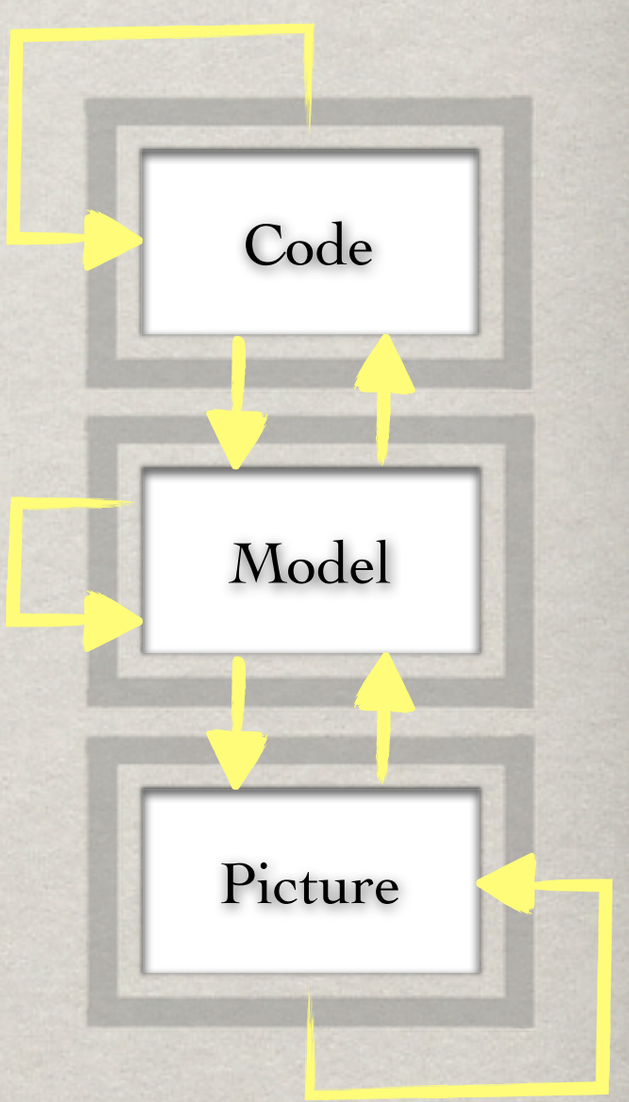
A ONE-SLIDE DSL



CWI

A ONE-SLIDE DSL

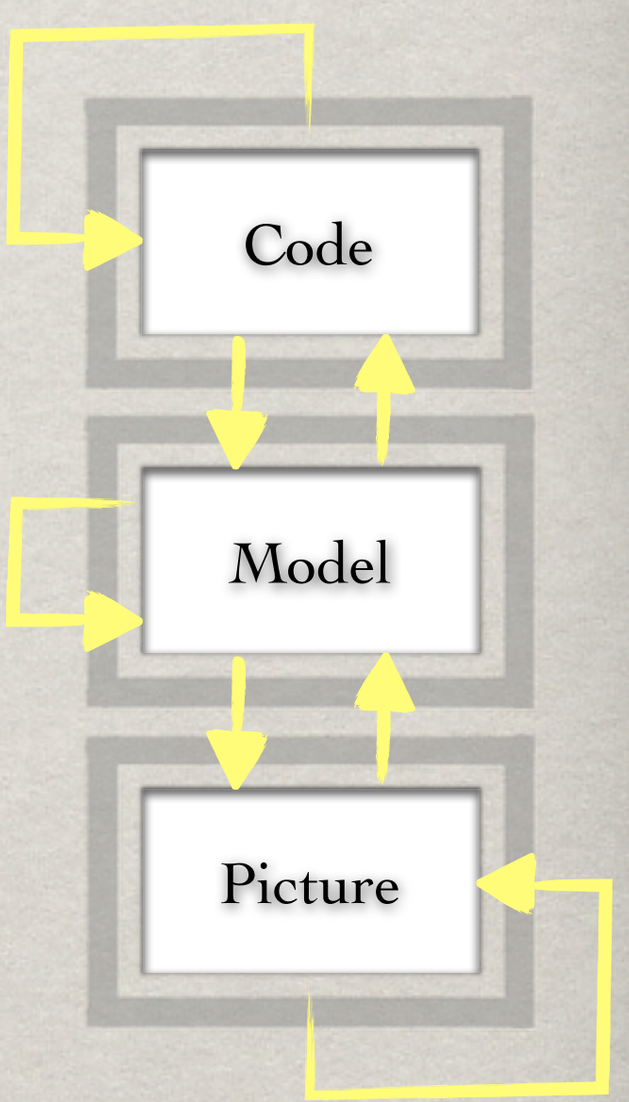
- What is the point?
  - Rapid tool development
  - No boilerplate
  - No glue
  - No magic
  - Done. Next!



CWI

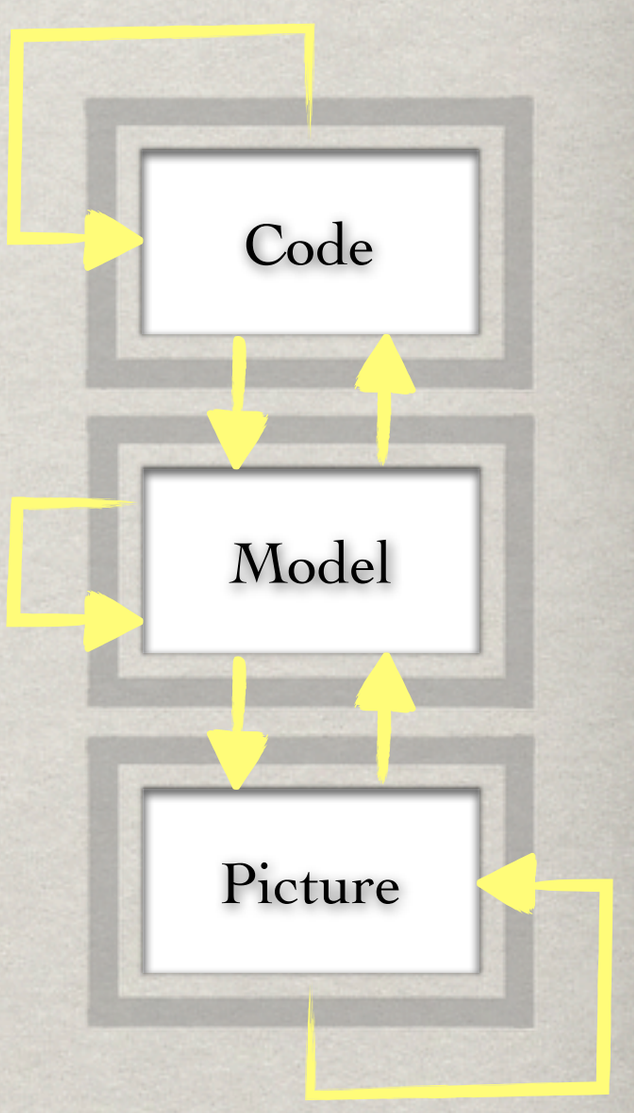
A ONE-SLIDE DSL

- 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



CWI

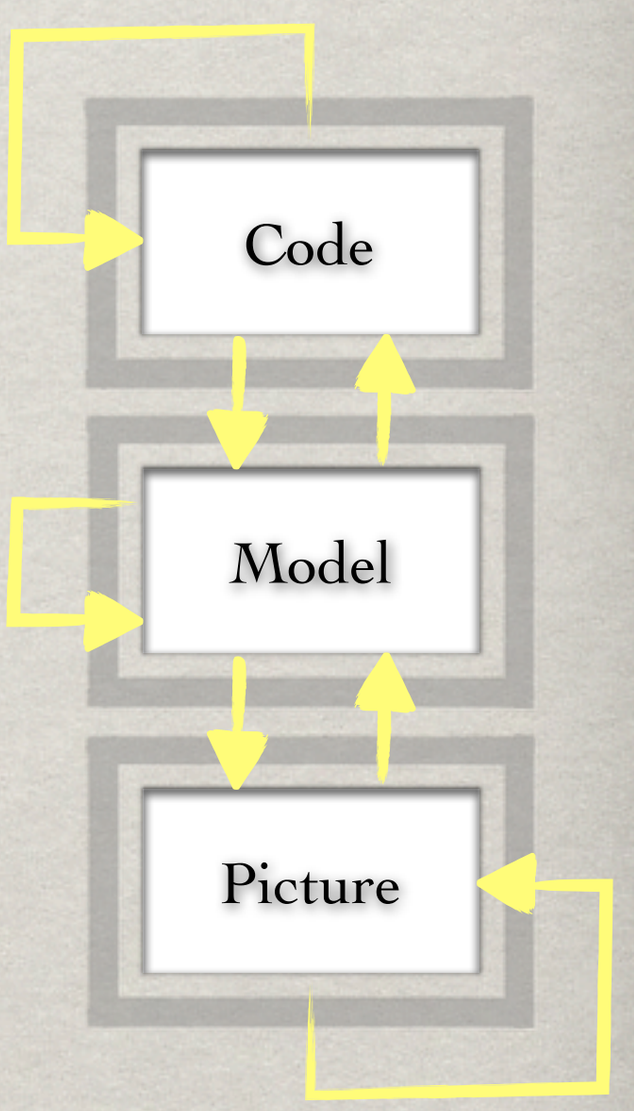
Library development



CWI

Library development

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



CWI

Library development

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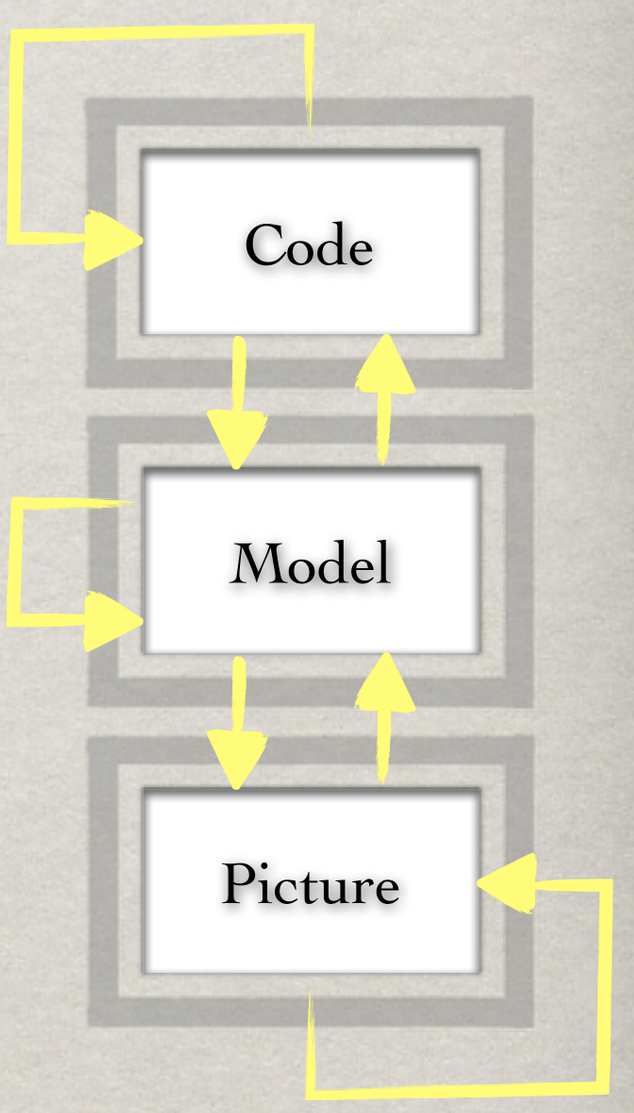
- **Front-ends** for programming languages



Library development

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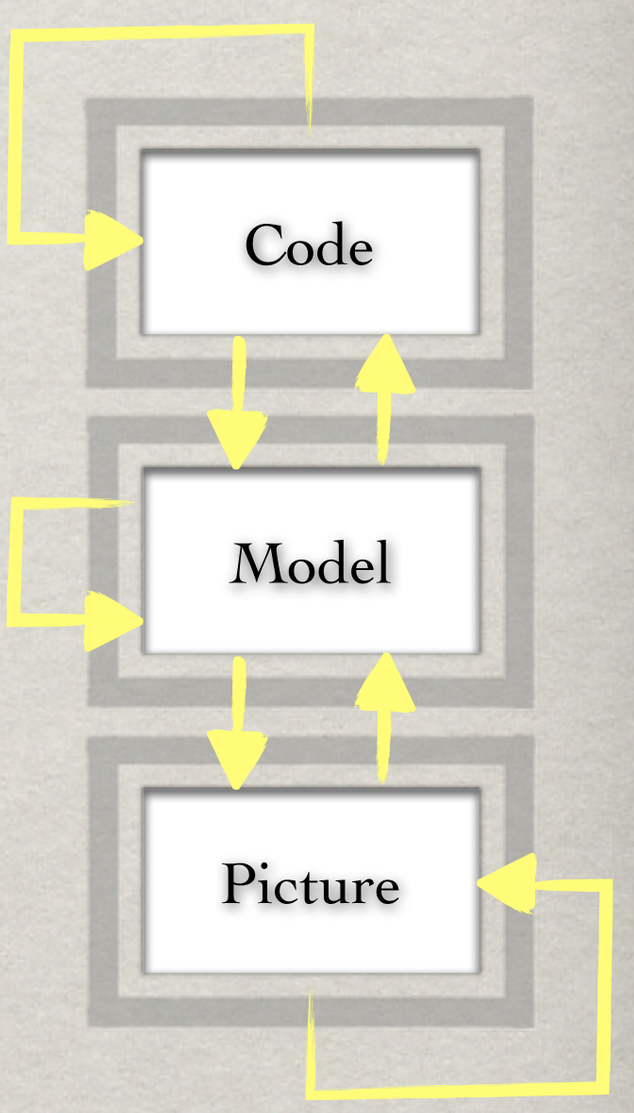
- **Front-ends** for programming languages

- **Generic analyses**; statistics, constraints, satisfiability, …



CWI

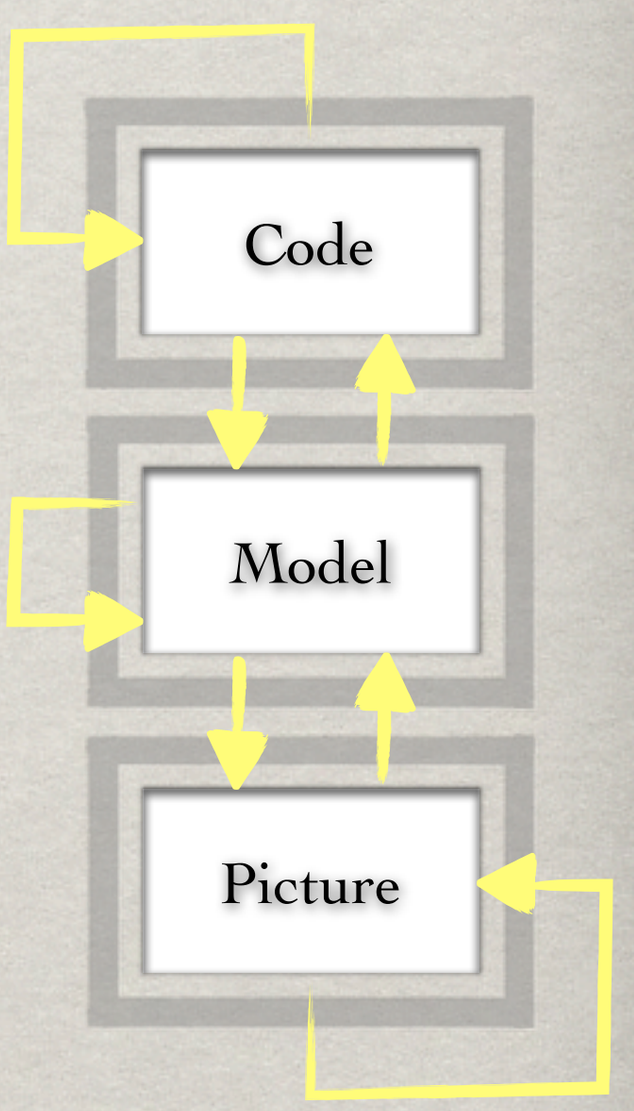
Library development

- **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, …)



CWI

State of the art

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- Rascal is **beta** quality, *alpha* guarantees

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State of the art

- Rascal is **beta** quality, *alpha* guarantees
- Experience
- Software Evolution/Construction at UvA & OU
- Bachelors Amsterdam University College (AUC)
- Applications in SWAT (see **posters**)

CWI

State of the art

- Rascal is **beta** quality, *alpha* guarantees
- Experience
  - Software Evolution/Construction at UvA & OU
  - Bachelors Amsterdam University College (AUC)
  - Applications in SWAT (see **posters**)
- Currently applying lessons-learned

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FOR RESEARCH IN ANALYSIS AND SYNTHESIS OF COMPLEX SOFTWARE ARTIFACTS

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Software may be hard but Rascal is easy for research in analysis and synthesis of complex software artifacts

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