Literate Scientific Software & The Drasil Framework

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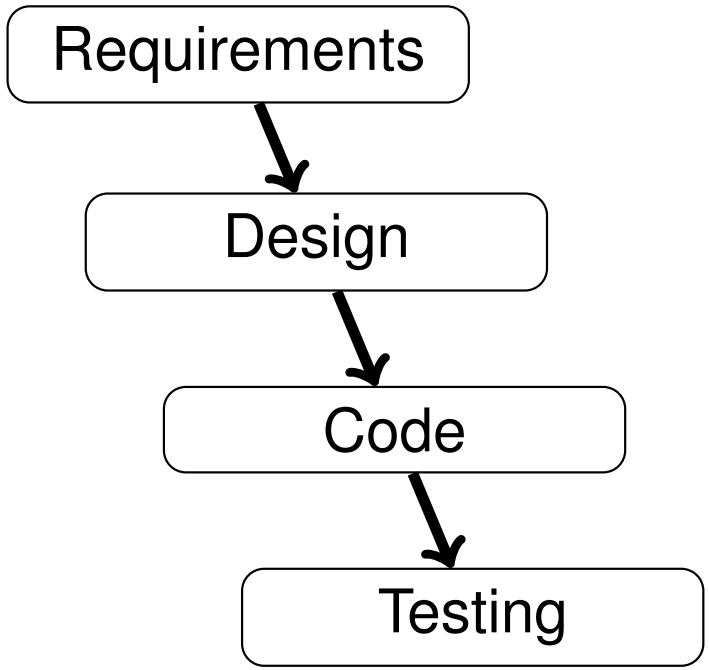
Overview

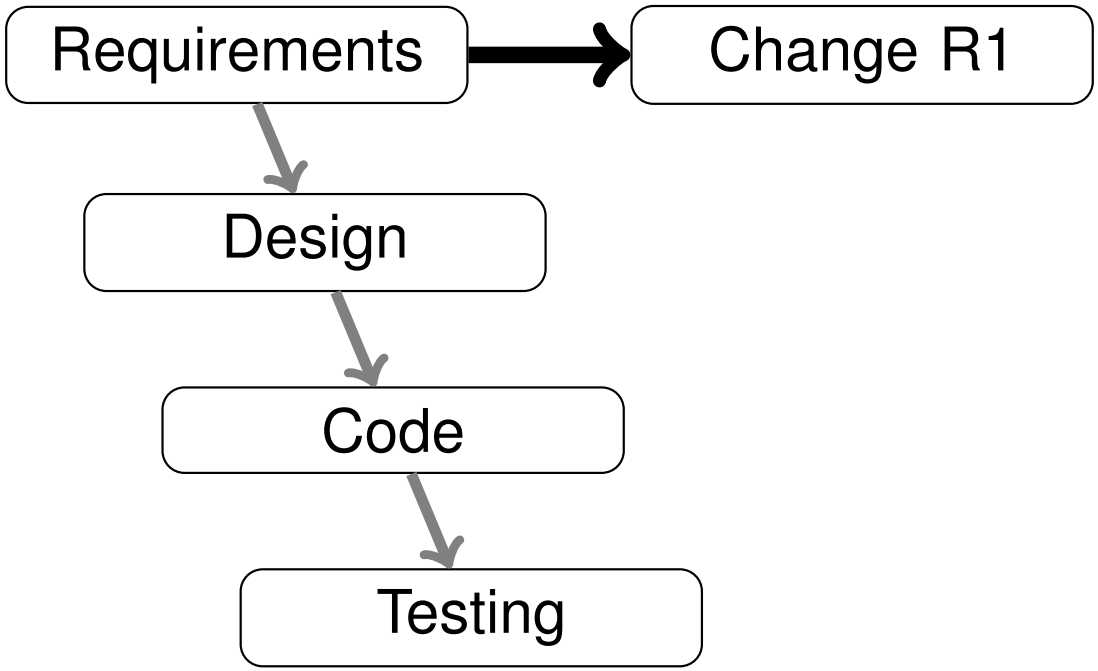
Fully Traceable Software

- Motivation
  - Improve verifiability, maintainability and reusability.
  - Save money and time
- One “source,” multiple views
  - Requirements
  - Design
  - Test Cases
  - Build instructions
  - ...

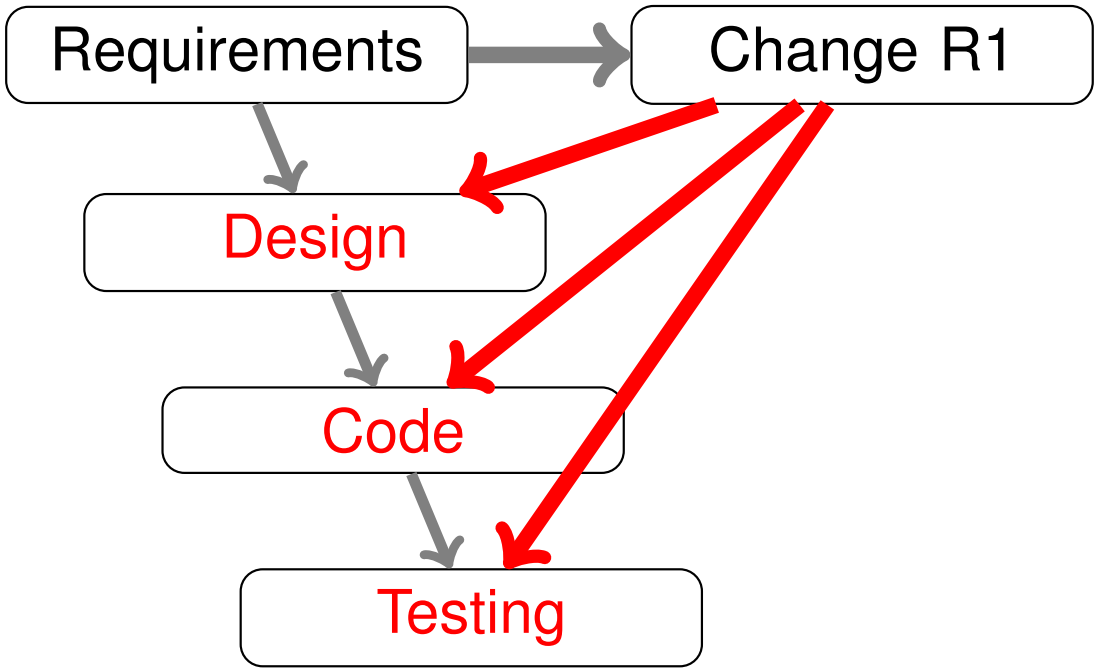
Motivation



Motivation



Motivation

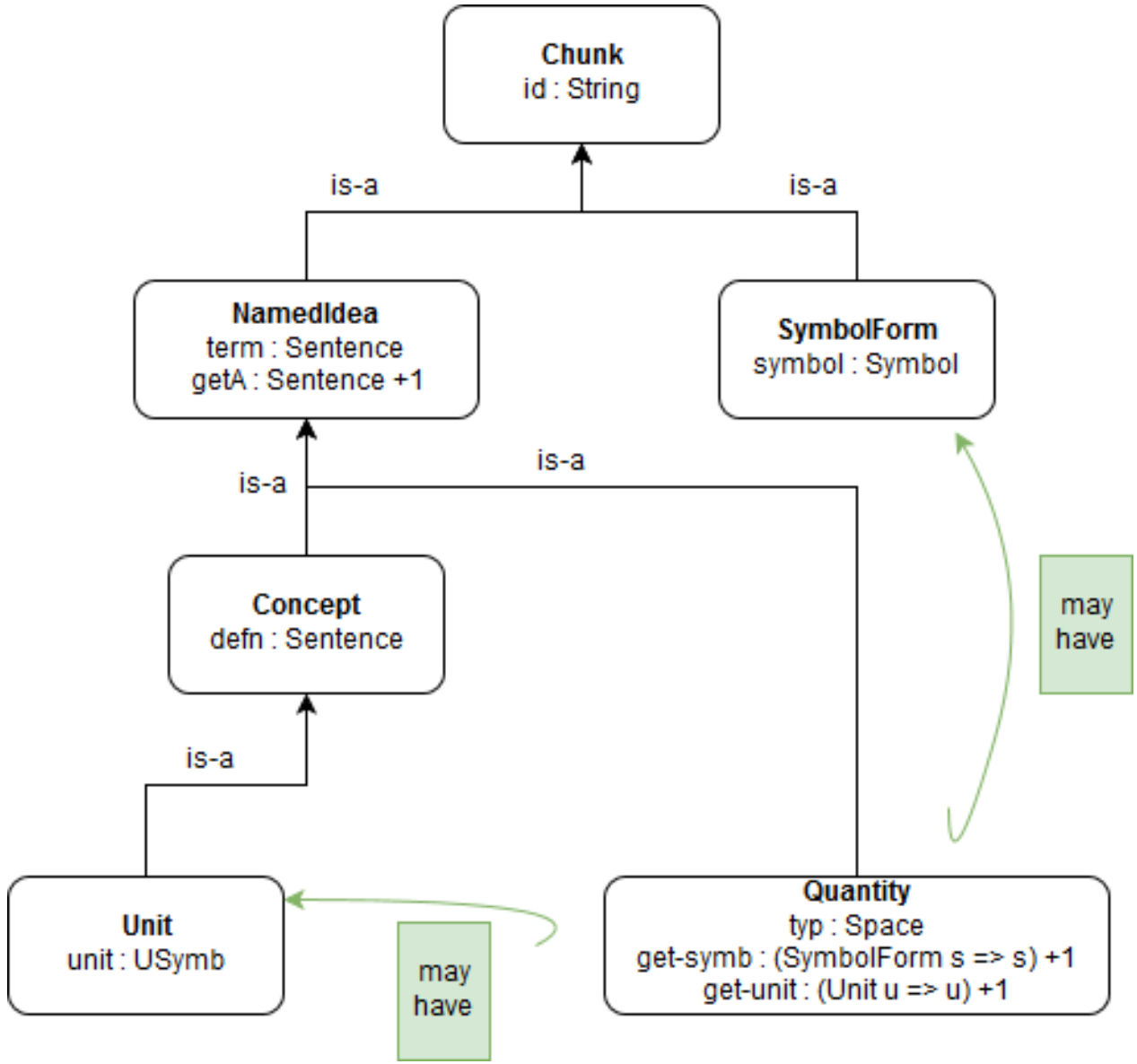


Last Time

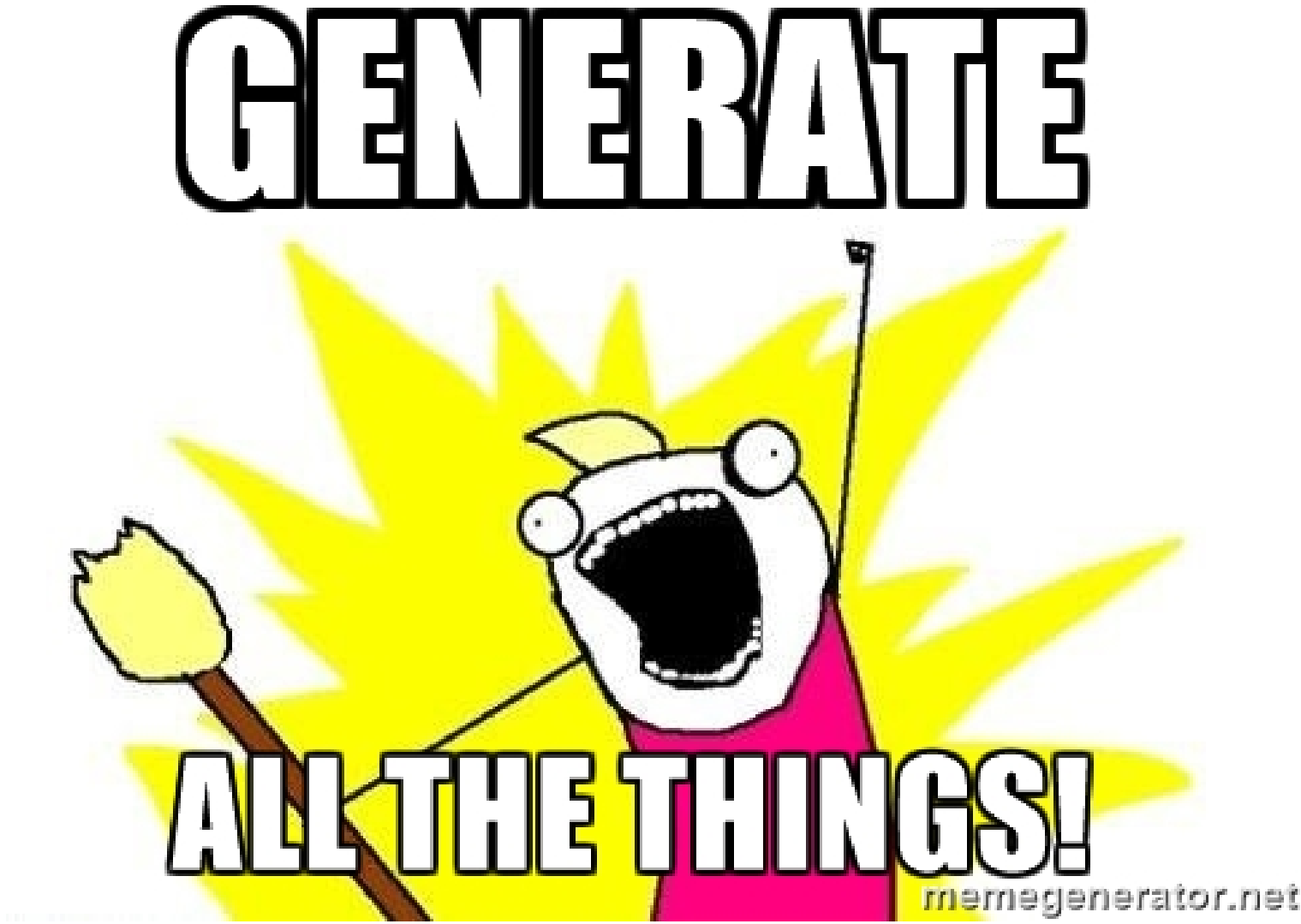
- Common Knowledge Database
- *Knowledge capture*, *chunks*, and *recipes*
- Steve
- Summer Students Phase 1
- Document Language

Recap - Knowledge Capture

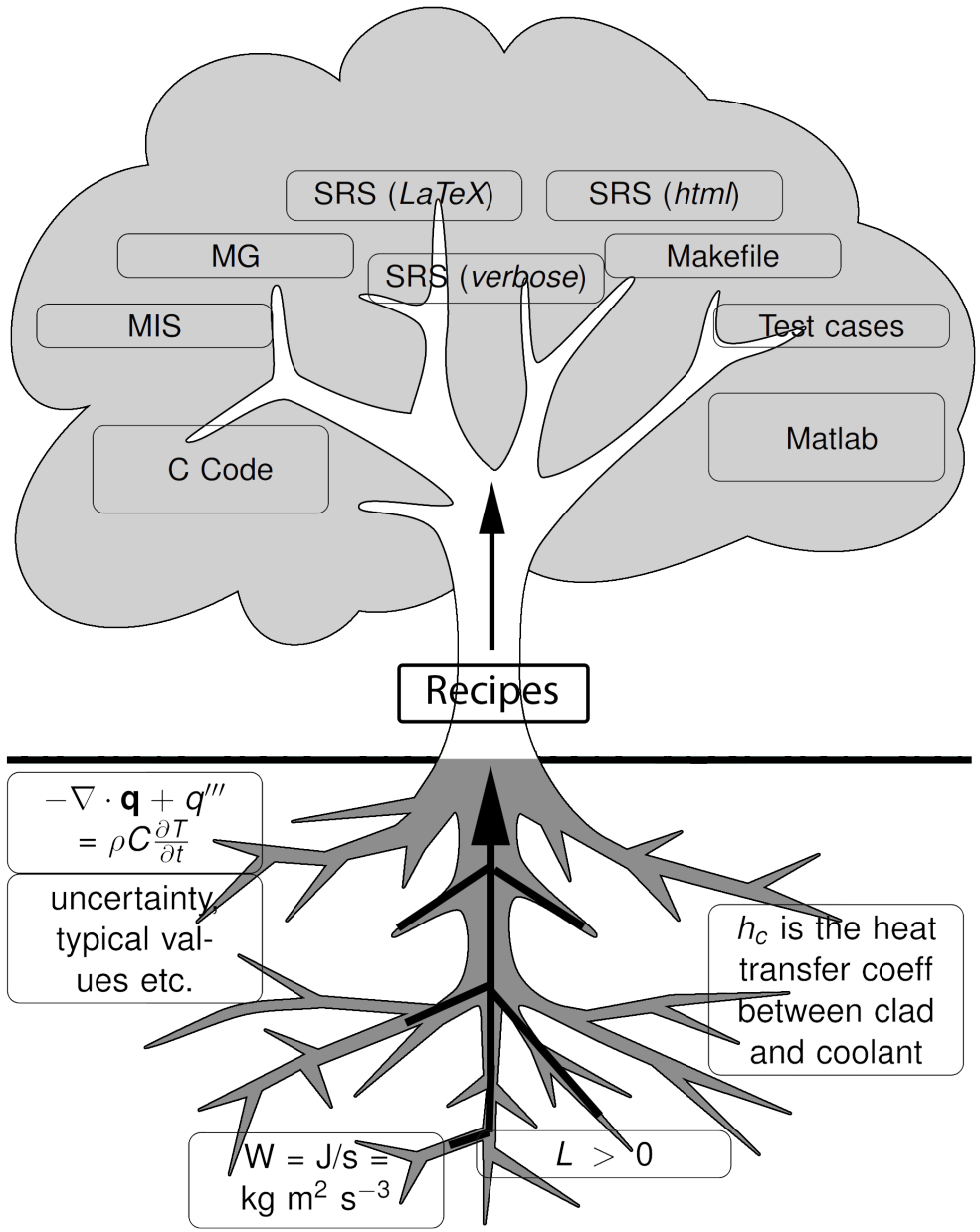
Recap - Chunks



Recap - Generation



Drasil


SRS (LaTeX)
SRS (html)
MG
SRS (verbose)
Makefile
MIS
Test cases
Matlab
C Code
Recipes
$-\nabla \cdot \mathbf{q} + q''' = \rho C \frac{\partial T}{\partial t}$
uncertainty, typical values etc.
h_c is the heat transfer coeff between clad and coolant
W = J/s = kg m^2 s^{-3}
$L > 0$

What's New

Summer Students Phase 2

- Example clean-up
- Knowledge extraction (common + specific)
- Pattern finding

What's New

Data.Drasil

Common Knowledge base expanded! Now includes:

1. Documentation
2. Thermodynamics
3. Computation
4. Physics
5. Math
6. Solid Mechanics

and more!

What's New

Yuzhi and Devi

New graduate students as of September 2017.

- Reviewed and updated stable versions of current examples
- Implementing Document Language through examples.
- . . . and more to come!

Design Changes

New Knowledge Capture Mechanisms

We are able to capture much more information in a ‘useful’ form

1. Theories
2. Assumptions
3. Requirements
4. Instance Models

...

Design Changes

Document Language – Old (Recipes)

```
RefSec (RefProg intro [
  TUnits,
  tsymb" s1_2_intro (TermExcept [norm_vect]),
  TAandA]) :
map Verbatim [s2, s3, s4, s5, s6, s7]

s2 = Section ... ... ...
s3 = Section ... ... ...
s4 = Section ... ... ...
s5 = Section ... ... ...
s6 = Section ... ... ...
s7 = Section ... ... ...
```

Design Changes

Document Language – New (Recipes)

```
RefSec (RefProg intro
  [TUnits, tsymb [TSPurpose, SymbOrder], TAandA]) :
IntroSec ( IntroProg (startIntro ...) (short gLassBR)
  [IPurpose (s2_1_intro_p1 document gLassBR glaSlab),
   IScope incScoR endScoR,
...
GSDSec (GSDProg2 [UsrChars ...], SystCons [] []]) :
ScpOfProjSec (ScpOfProjProg ...) :
SSDSec (SSDProg
  [SSDProblem (PDProg ... [s6_1_1, s6_1_2, s6_1_3])
  , SSDSolChSpec
    (SCSProg
      [ TMs ([Label] ++ stdFields) [t1IsSafe]
      , GDs [] [] HideDerivation -- No Gen Defs for GlassBR
      , DDs ... , IMs ... ])]) :
ReqrmntSec (ReqsProg [
  FReqsSub s7_1_list,
  NonFReqsSub [performance] (gBRpriorityNFReqs) :
...
AuxConstntSec (AuxConsProg gLassBR auxiliaryConstants) :
Bibliography gbCitations :
AppndxSec (AppndxProg [s12_intro, fig_5, fig_6]) : []
```

Results

Document Language – New (Recipes)

{GlassBR_SRS.html (or .tex)}

Results to Date

Sanity Checking

SSP Example (Issue #348)

$$S_i = \frac{P_i}{FS} \qquad FS = \frac{S_i}{\tau_i}$$

Where did τ_i come from?

Were S_i and P_i swapped?

- τ_i was not defined anywhere in the documents
- Found with Drasil – undefined symbols throw errors
- Equation based on concepts – symbols automatically retrieved

Results to Date

Sanity Checking Cont'd

- Stricter (more formalized) approach reveals hidden errors.
- Fixing these kinds of errors is easy thanks to tool support from Drasil

Results to Date

Conceptual Inconsistencies

What do our documents “mean”?
DD vs IM stuff here. Conceptually confused in the documentation. Understandable by a human, but causes unexpected problems when explained to a machine.

Next Steps

What next?

- Recipe language
- Clean up examples
- Abstraction
- More examples
- More artifacts – Module Guide
- Design Language

Thank You!