DRASIL

A Knowledge-Based Approach to Scientific Software Development

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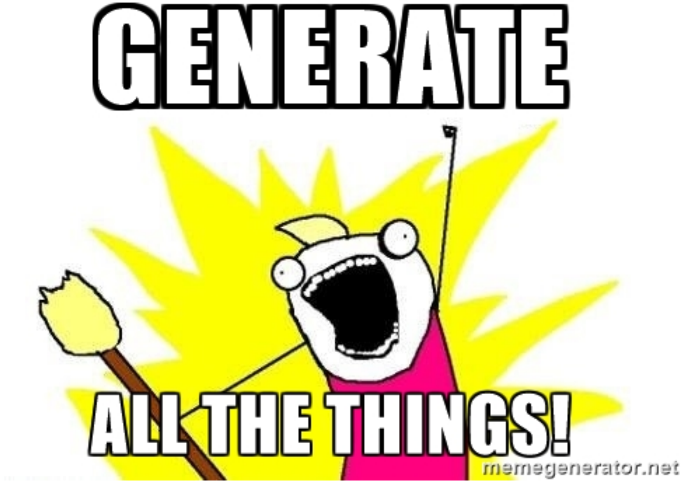
Literate Scientific Software Group, July 25, 2017

Background Context

- $\exists$ problems $\in$ D where
- $D = \{$ scientific computing, engineering computing $\}$
- Problems $=$ [
  - Inconsistent Software Requirement Specifications (SRS) across D
  - Inconsistency between code and documentation
  - Documentation is annoying to make and maintain
  - Hard to reuse code for different applications

  ]

The Goal



Purpose of Drasil

- Solve the four problems
- Promote
  - Reusability
    - Examples have fully documented code
    - Data base to build new examples
  - Maintainability
    - Make changes in one place, gets updated everywhere

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- Language and Rendering (Language.Drasil)
  - Code Generation: transition from Drasil to working code
  - Documentation Generation: transition from Drasil to human readable documentation
- Case Studies (Example.Drasil)
  - This part is where you would input equations, requirements, and output code and documentation

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- Drasil is intended to simplify the generation of documentation and code for scientific software
- Facilitate desirable software qualities such as traceability, verifiability, and reproducibility
- Case studies from which structural patterns and implicit relationships can be extracted, data can be captured, and core systems can be tested and implemented

Daily Tasks

- Finding patterns within examples $\Rightarrow$ sentence combinators
- Finding patterns between examples $\Rightarrow$ extraction of common sections, contents, and concepts

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- Opening/closing issues

Example

Var	Physical Constraints	Software Constraints	Typical Value	Typical Uncertainty
P_{btol}	$0.0 < P_{btol}$ and $P_{btol} < 1.0$	None	0.008	1.0e-3
TNT	$TNT > 0.0$	None	1	0.1
a	$a > 0.0$ and $\frac{a}{b} > 1.0$	$d_{min} \leq a$, $a \leq d_{max}$, and $\frac{a}{b} < AR_{max}$	1500.0 m	0.1
b	$b > 0.0$ and $b < a$	$d_{min} \leq b$, $b \leq d_{max}$, and $\frac{a}{b} < AR_{max}$	1200.0 m	0.1
w	$w \geq 0.0$	$w_{max} \leq w$ and $w \leq w_{min}$	42.0 kg	0.1
SD	$SD > 0.0$	$SD_{min} < SD$ and $SD < SD_{max}$	45.0 m	0.1

Input Data Constraints

Example

```
s6_2_5_table1 = Table [S "Var", S "Physical Cons", S "Software Constraints", S "Typical Value",
  S "Uncertainty"] (mkTable [(\x -> x!!0), (\x -> x!!1), (\x -> x!!2), (\x -> x!!3),
   (\x -> x!!4)] [[(P $ plate_len ^. symbol), (P $ plate_len ^. symbol) +:+ S "> 0 and" +:+
   (P $ plate_len ^. symbol) :+: S "/" :+: (P $ plate_width ^. symbol) +:+ S "> 1",
   (P $ dim_min ^. symbol) +:+ S "<=" +:+ (P $ plate_len ^. symbol) +:+ S "<=" +:+
   (P $ dim_max ^. symbol) +:+ S "and" +:+ (P $ plate_len ^. symbol) :+: S "/" :+:
   (P $ plate_width ^. symbol) +:+ S "<" +:+ (P $ ar_max ^. symbol), S "1500" +:+
   Sy (unit_symb plate_len), S "10%"], [(P $ plate_width ^. symbol),
   (P $ (plate_width ^. symbol)) +:+ S "> 0 and" +:+ (P $ plate_width ^. symbol)
   +:+ S "<" +:+ (P $ plate_len ^. symbol), (P $ dim_min ^. symbol) +:+ S "<=" +:+
   (P $ plate_width ^. symbol) +:+ S "<=" +:+ (P $ dim_max ^.symbol) +:+ S "and" +:+
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   (P $ ar_max ^. symbol), S "1200" +:+ Sy (unit_symb plate_width), S "10%"],
   [(P $ pb_tol ^. symbol), S "0 <" +:+ (P $ pb_tol ^. symbol) +:+ S "< 1", S "-", S "0.008", S "0.1%"],
   [(P $ char_weight ^. symbol), (P $ char_weight ^. symbol) +:+ S ">= 0", (P $ cWeightMin ^. symbol)
   +:+ S "<" +:+ (P $ char_weight ^. symbol) +:+ S "<" +:+ (P $ cWeightMax ^. symbol), S "42" +:+
   Sy (unit_symb char_weight), S "10%"],[(P $ tNT ^. symbol), (P $ tNT ^. symbol) :+:
   S " > 0", S "-", S "1", S "10%"], [(P $ standOffDist ^. symbol), (P $ standOffDist ^. symbol)
   +:+ S "> 0", (P $ sd_min ^. symbol) +:+ S "<" +:+ (P $ standOffDist ^. symbol) +:+ S "<" +:+
   (P $ sd_max ^. symbol), S "45" :+: Sy (unit_symb standOffDist), S "10%"]])
```

```
s6_2_5_table1 :: Contents
s6_2_5_table1 = inDataConstTbl (gbInputDataConstraints)
```

Example

```
plate_len :: UncertQ
plate_len = uqcND "plate_len" (nounPhraseSP "plate length (long dimension)")
  lA metre Real
  [ physc $ \c -> c :> (Dbl 0),
    physc $ \c -> (c / (C plate_width)) :> (Dbl 1),
    sfwrc $ \c -> (C dim_min) :<= c,
    sfwrc $ \c -> c :<= (C dim_max),
    sfwrc $ \c -> (c / (C plate_width)) :< (C ar_max) ] (Dbl 1500) defaultUncrt
```

Figure

```
-- Creates the input Data Constraints Table
inDataConstTbl :: (UncertainQuantity c, SymbolForm c, Constrained c) => [c] -> Contents
inDataConstTbl qlst = Table ([S "Var"] ++ (isPhys $ physC (head qlst) qlst) ++
  (isSfwr $ sfwrC (head qlst) qlst) ++ [S "Typical" +:+ titleize value] ++
  (isUnc $ typUnc (head qlst) qlst))
  (map (\x -> fmtInputConstr x qlst) qlst)
  (S "Input Data Constraints") True
  where isPhys [] = []
        isPhys _  = [titleize' physicalConstraint]
        isSfwr [] = []
        isSfwr _  = [titleize' softwareConstraint]
        isUnc  [] = []
        isUnc  _  = [S "Typical Uncertainty"]
```

Figure

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  - Documentation (Module Guide, Software Requirements Specification)

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  - Once it's fixed, it is also fixed everywhere else

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    - Largest Example
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- GamePhysics
  - Most ambiguous example
  - SRS for a game physics library

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- Combination of chunks to grow information
- Related information should stem from one source (reduces duplication)

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- Git combined with haskell, allows us to make large changes while easily maintaining a working version of Drasil
- Git (when used properly) prevents catastrophic lose of work

End

For more information about Drasil and LLS visit our github page:
https://github.com/JacquesCarette/literate-scientific-software
You can even build a working version yourself!