DRASIL

A Knowledge-Based Approach to Scientific Software Development

Henry M, Aaron M, Maryyam N, Nicholas R, Dan S

McMaster University

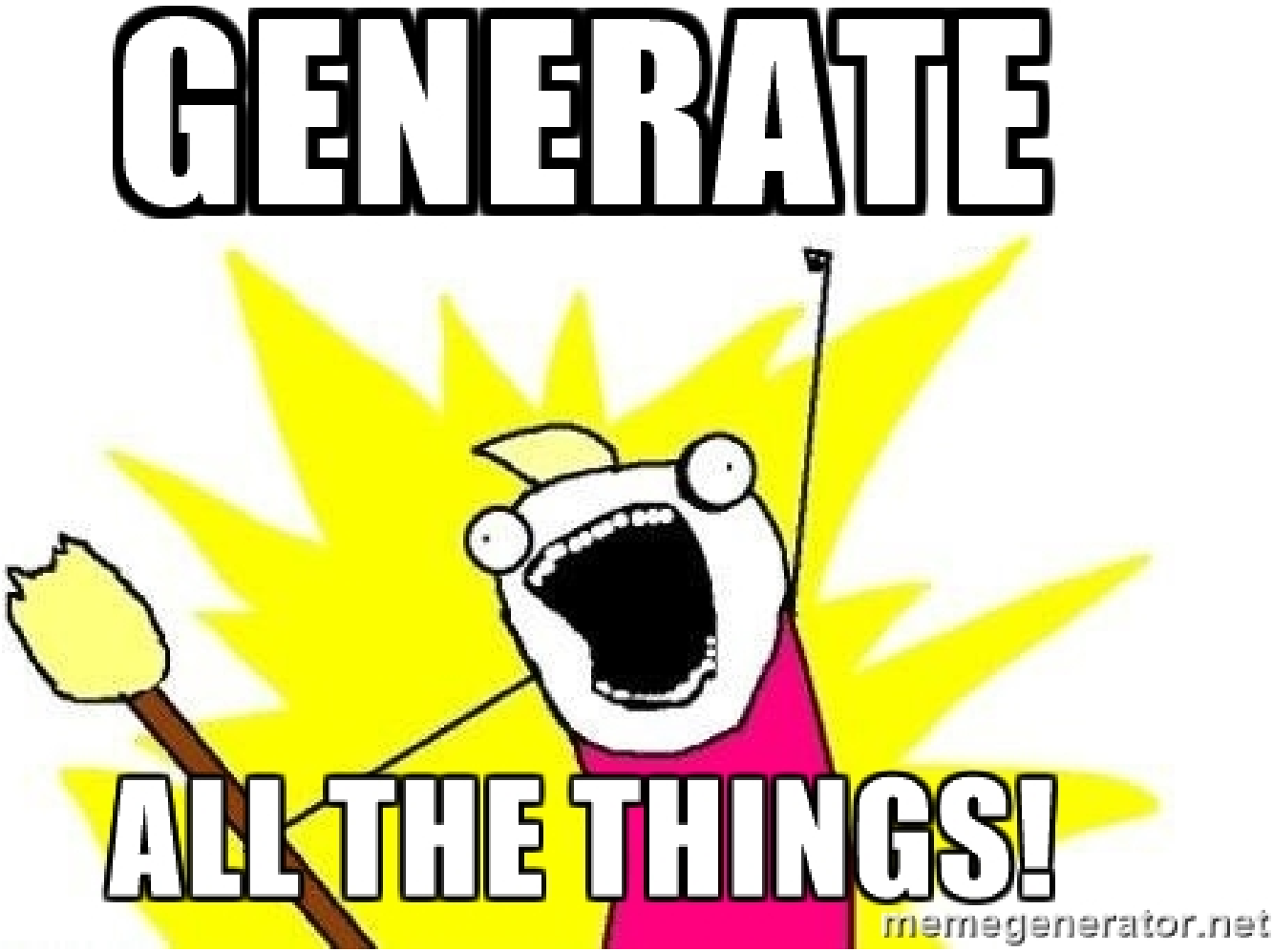
Literate Scientific Software Group, July 25, 2017

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

What is Drasil?

- Knowledge Capture (Data.Drasil)

What is Drasil?

- Knowledge Capture (Data.Drasil)
- Language and Rendering (Language.Drasil)
  - Code Generation: transition from Drasil to working code
  - Documentation Generation: transition from Drasil to human readable documentation

What is Drasil?

- Knowledge Capture (Data.Drasil)
- 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

Introduction

- Scientific and engineering computing has the potential to lead other fields of software with its solid knowledge base

Introduction

- Scientific and engineering computing has the potential to lead other fields of software with its solid knowledge base
- Drasil is intended to simplify the generation of documentation and code for scientific software

Introduction

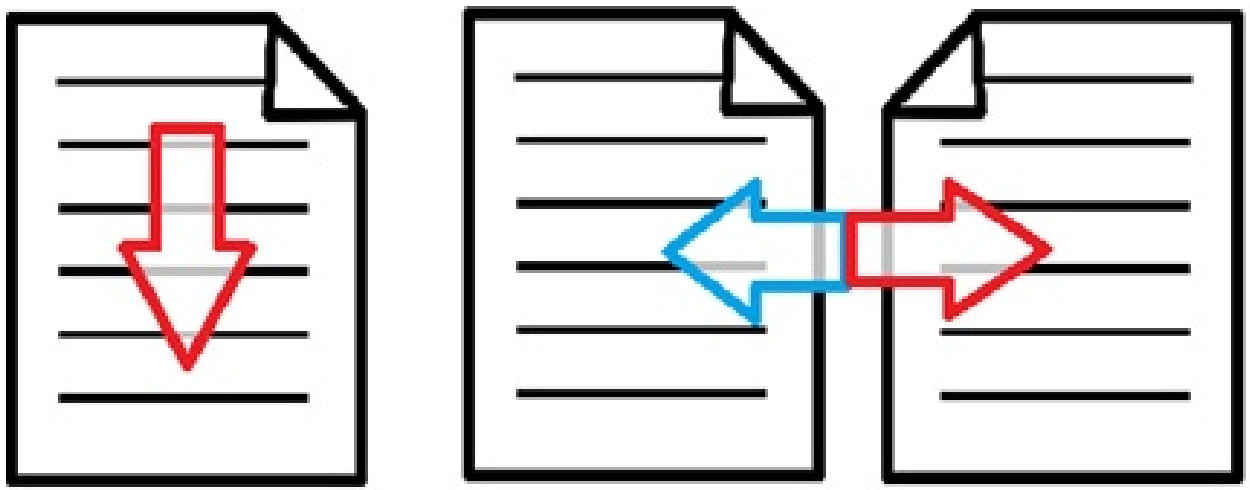
- Scientific and engineering computing has the potential to lead other fields of software with its solid knowledge base
- Drasil is intended to simplify the generation of documentation and code for scientific software
- Facilitate desirable software qualities such as traceability, verifiability, and reproducibility

Introduction

- Scientific and engineering computing has the potential to lead other fields of software with its solid knowledge base
- 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

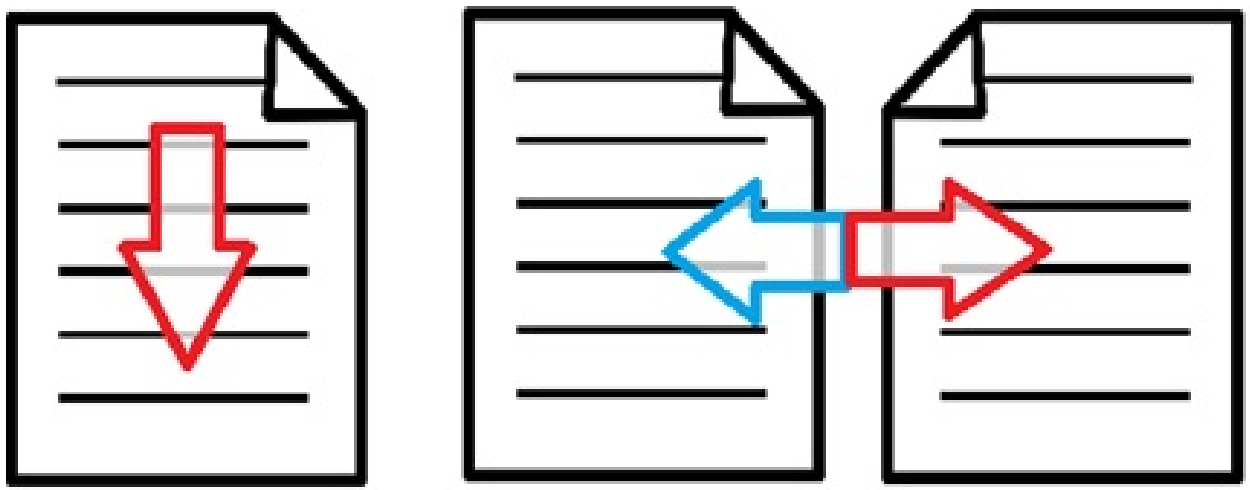
Daily Tasks

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



Daily Tasks

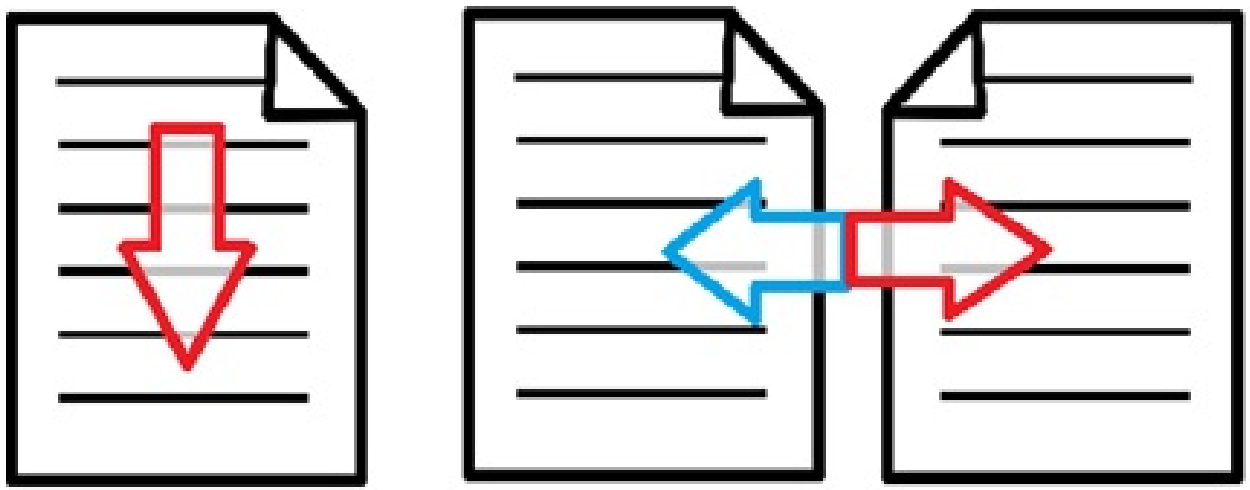
- Finding patterns within examples $\Rightarrow$ sentence combinators
- Finding patterns between examples $\Rightarrow$ extraction of common sections, contents, and concepts



- Knowledge extraction
- Duplication reduction
  - Function efficiency
  - Building chunks off of each other

Daily Tasks

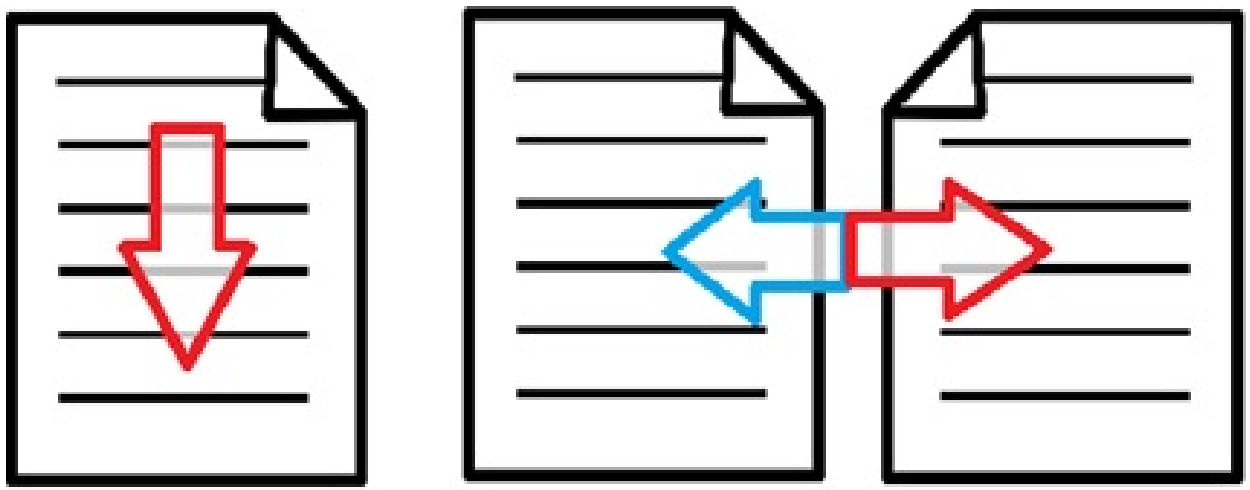
- Finding patterns within examples $\Rightarrow$ sentence combinators
- Finding patterns between examples $\Rightarrow$ extraction of common sections, contents, and concepts



- Knowledge extraction
- Duplication reduction
  - Function efficiency
  - Building chunks off of each other
- Implement new functions/types created by supervisors

Daily Tasks

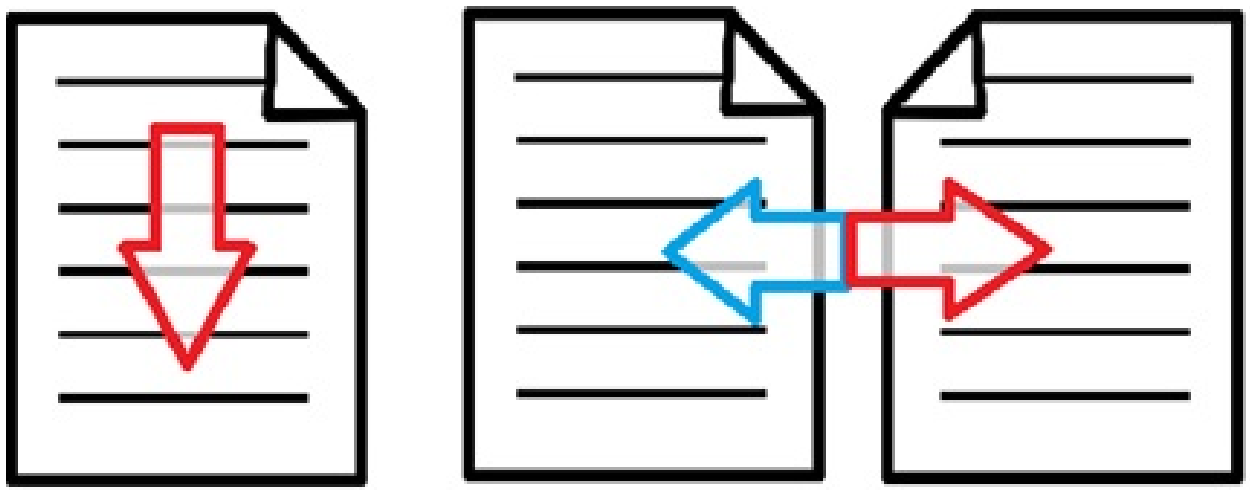
- Finding patterns within examples $\Rightarrow$ sentence combinators
- Finding patterns between examples $\Rightarrow$ extraction of common sections, contents, and concepts



- Knowledge extraction
- Duplication reduction
  - Function efficiency
  - Building chunks off of each other
- Implement new functions/types created by supervisors
- Code cleanup and bug fixing

Daily Tasks

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



- Knowledge extraction
- Duplication reduction
  - Function efficiency
  - Building chunks off of each other
- Implement new functions/types created by supervisors
- Code cleanup and bug fixing
- Opening/closing issues

Ease of Use

- Input:

Ease of Use

- Input:
  - Equations (DataDefs, Instance Models)

Ease of Use

- Input:
  - Equations (DataDefs, Instance Models)
  - Requirements

Ease of Use

- Input:
  - Equations (DataDefs, Instance Models)
  - Requirements
  - Assumptions

Ease of Use

- Input:
  - Equations (DataDefs, Instance Models)
  - Requirements
  - Assumptions
- Output:

Ease of Use

- Input:
  - Equations (DataDefs, Instance Models)
  - Requirements
  - Assumptions
- Output:
  - Code that fits the requirements and assumptions

Ease of Use

- Input:
  - Equations (DataDefs, Instance Models)
  - Requirements
  - Assumptions
- Output:
  - Code that fits the requirements and assumptions
  - Documentation (Module Guide, Software Requirements Specification)

Errors in Drasil?

- Catching and correcting errors in software:

Errors in Drasil?

- Catching and correcting errors in software:
  - If there is an error, it will be everywhere

Errors in Drasil?

- Catching and correcting errors in software:
  - If there is an error, it will be everywhere
  - Easy to spot

Errors in Drasil?

- Catching and correcting errors in software:
  - If there is an error, it will be everywhere
  - Easy to spot
  - Once it's fixed, it is also fixed everywhere else

Case Study Contributions

- Each member assigned a case study as well as tasks and issues
- SWHS
  - Largest Example
  - ODEs

Case Study Contributions

- Each member assigned a case study as well as tasks and issues
- SWHS
  - Largest Example
  - ODEs
- NoPCM
  - Builds off pre-existing SWHS example

Case Study Contributions

- Each member assigned a case study as well as tasks and issues
- SWHS
  - Largest Example
  - ODEs
- NoPCM
  - Builds off pre-existing SWHS example
- GlassBR
  - General definition's omitted

Case Study Contributions

- Each member assigned a case study as well as tasks and issues
- SWHS
  - Largest Example
  - ODEs
- NoPCM
  - Builds off pre-existing SWHS example
- GlassBR
  - General definition's omitted
- SSP
  - Indexing
  - Sophisticated math
  - Diversity of symbols

Case Study Contributions

- Each member assigned a case study as well as tasks and issues
- SWHS
  - Largest Example
  - ODEs
- NoPCM
  - Builds off pre-existing SWHS example
- GlassBR
  - General definition's omitted
- SSP
  - Indexing
  - Sophisticated math
  - Diversity of symbols
- GamePhysics
  - Most ambiguous example
  - SRS for a game physics library

Daily Tasks

- Finding patterns within examples $\Rightarrow$ sentence combinators

Daily Tasks

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

Daily Tasks

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

Daily Tasks

- Finding patterns within examples $\Rightarrow$ sentence combinators
- Finding patterns between examples $\Rightarrow$ extraction of common sections, contents, and concepts
- Knowledge extraction
- Reduce duplication
  - Function efficiency
  - Building chunks off of each other

Daily Tasks

- Finding patterns within examples $\Rightarrow$ sentence combinators
- Finding patterns between examples $\Rightarrow$ extraction of common sections, contents, and concepts
- Knowledge extraction
- Reduce duplication
  - Function efficiency
  - Building chunks off of each other
- Implement new functions/types created by supervisors

Daily Tasks

- Finding patterns within examples $\Rightarrow$ sentence combinators
- Finding patterns between examples $\Rightarrow$ extraction of common sections, contents, and concepts
- Knowledge extraction
- Reduce duplication
  - Function efficiency
  - Building chunks off of each other
- Implement new functions/types created by supervisors
- Code cleanup and bug fixing

Daily Tasks

- Finding patterns within examples $\Rightarrow$ sentence combinators
- Finding patterns between examples $\Rightarrow$ extraction of common sections, contents, and concepts
- Knowledge extraction
- Reduce duplication
  - Function efficiency
  - Building chunks off of each other
- Implement new functions/types created by supervisors
- Code cleanup and bug fixing
- Opening/closing issues

Collaboration via Github

GitHub

Collaboration via Github

Git is a version control system, github is a git repository hosting service that is free.

- Git allows us to collaborate effectively, even when team members are not in the same location

Collaboration via Github

Git is a version control system, github is a git repository hosting service that is free.

- Git allows us to collaborate effectively, even when team members are not in the same location
- Git combined with haskell, allows us to make large changes while easily maintaining a working version of Drasil

Collaboration via Github

Git is a version control system, github is a git repository hosting service that is free.

- Git allows us to collaborate effectively, even when team members are not in the same location
- 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!