# First Committee Meeting

## Progress Report

Jason Balaci

McMaster University

Oct. 21$^{st}$, 2021

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# Who am I?

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Me, Camping in Killarney Prov. Park, Fall 2019

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- I am **Jason Balaci**
- Graduate of *McMaster University*, holding...
  - Hons. Actuarial and Financial Mathematics (B.Sc.)
  - Minor in Computer Science
- Currently pursuing a thesis-based Master's of Computer Science (M.Sc) at *McMaster University*, under the supervision of **Dr. Jacques Carette**.

Me, Camping in Killarney Prov. Park, Fall 2019

# Overview of Progression Towards C.S. M.Sc.

## Course-related progression

- I'm required to complete[1][2]:

[1] https://academiccalendars.romcmaster.ca/preview_program.php?catoid=45&poid=23470&returnto=9166

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- Together, the courses completed satisfies the "Courses Requirement" as mentioned in the academic calendar[1] and the "Regulations for the Computer Science M.Sc. Program" document[2].

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- Attended a thesis defence to learn about what to expect from a thesis defence (and learn about their research).
- Supervisory committee is formed, and we are currently having our first supervisory committee meeting.
  - *Supervisor*: Dr. Jacques Carette
  - Dr. Spencer Smith
  - Dr. Wolfram Kahl

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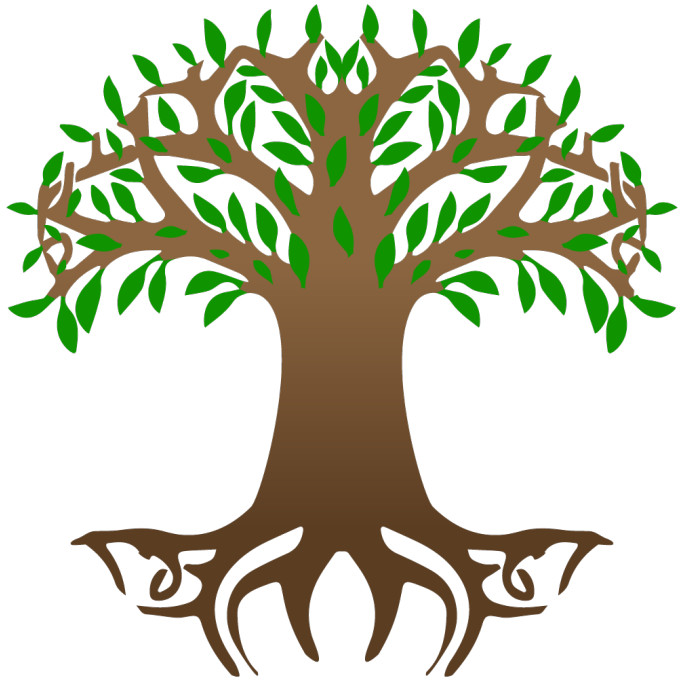
Drasil...



Drasil's Logo
[Carette et al., 2021b][Yggdrasil - Wikipedia, 2021]

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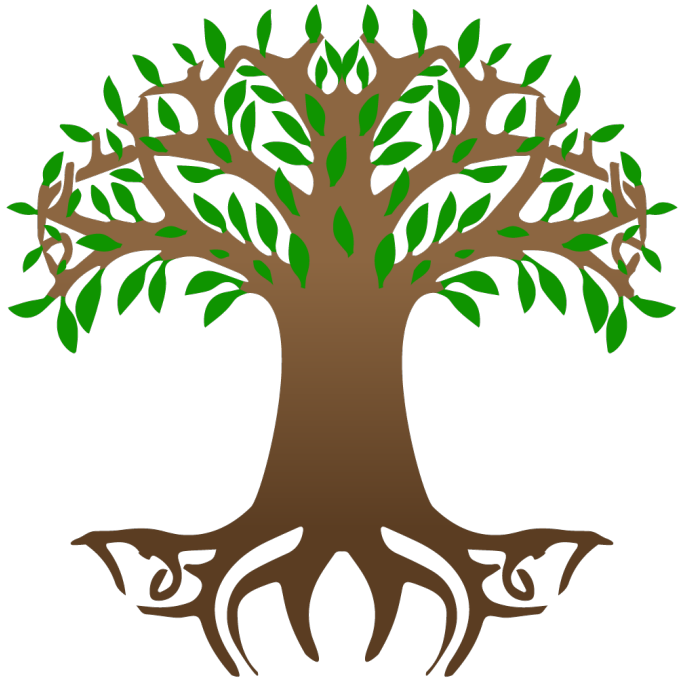

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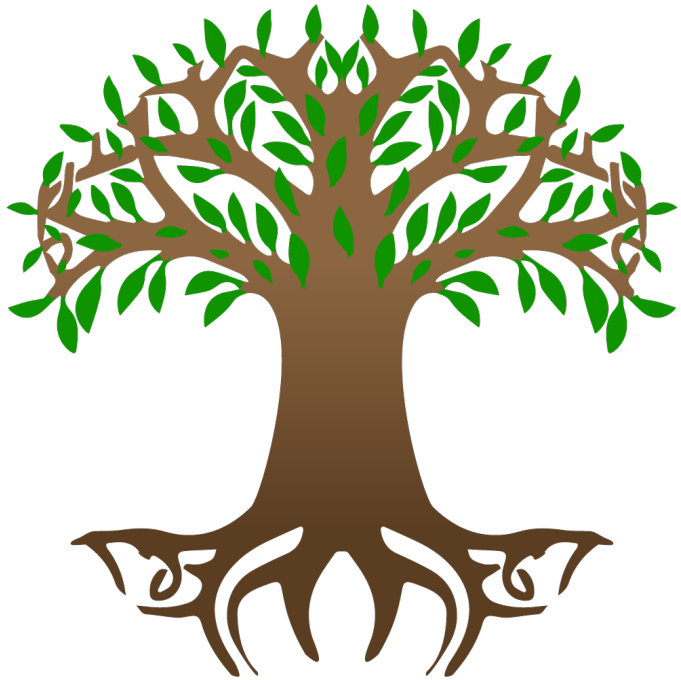

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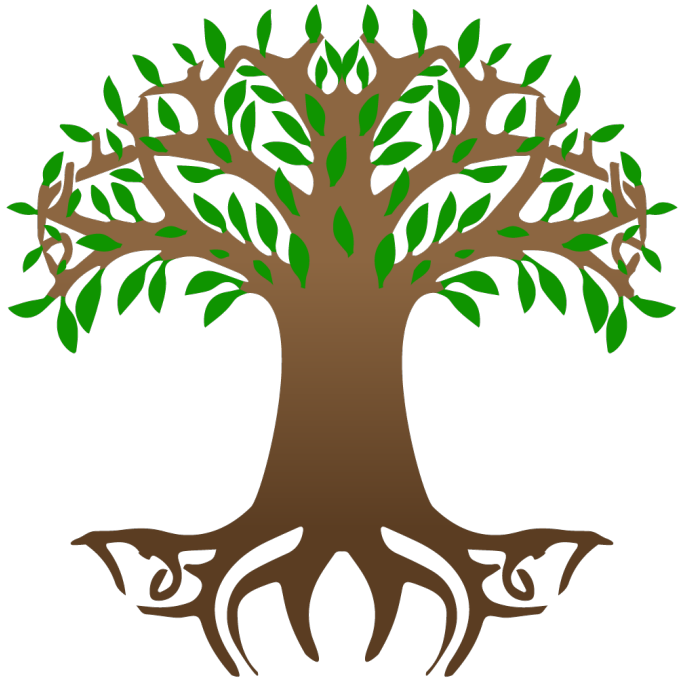

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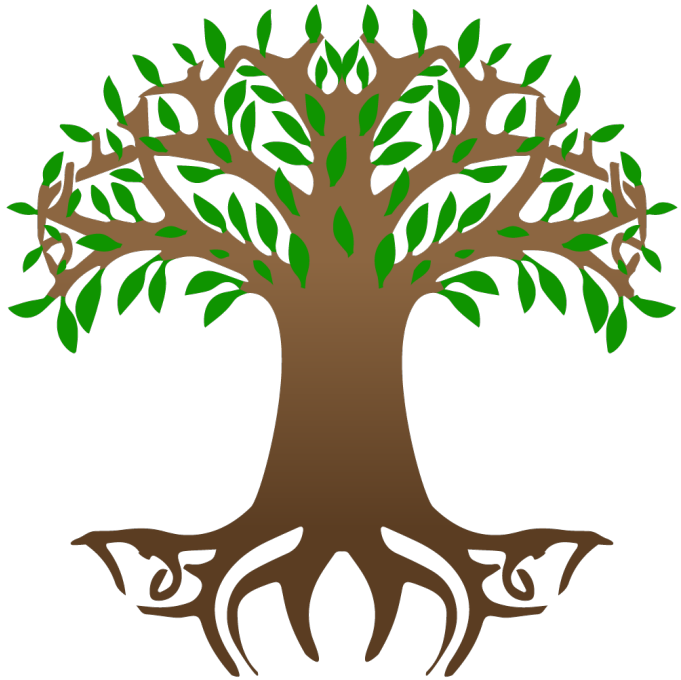

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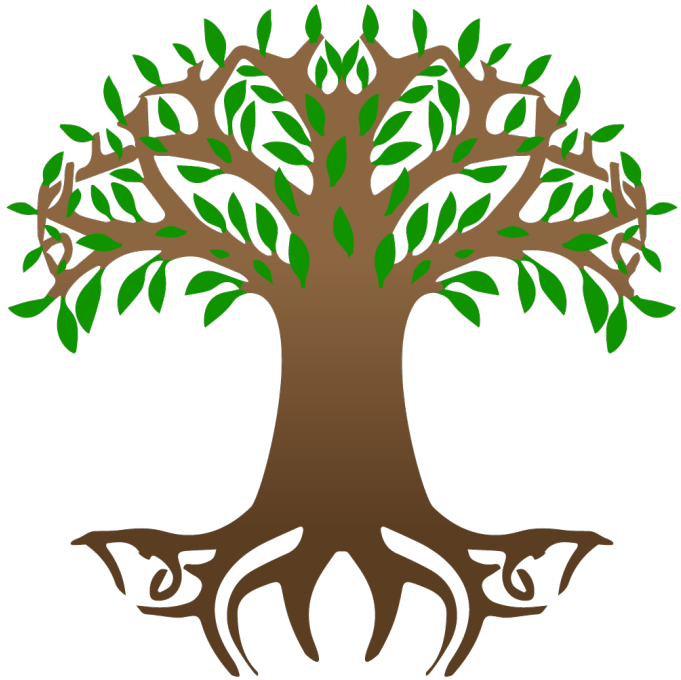

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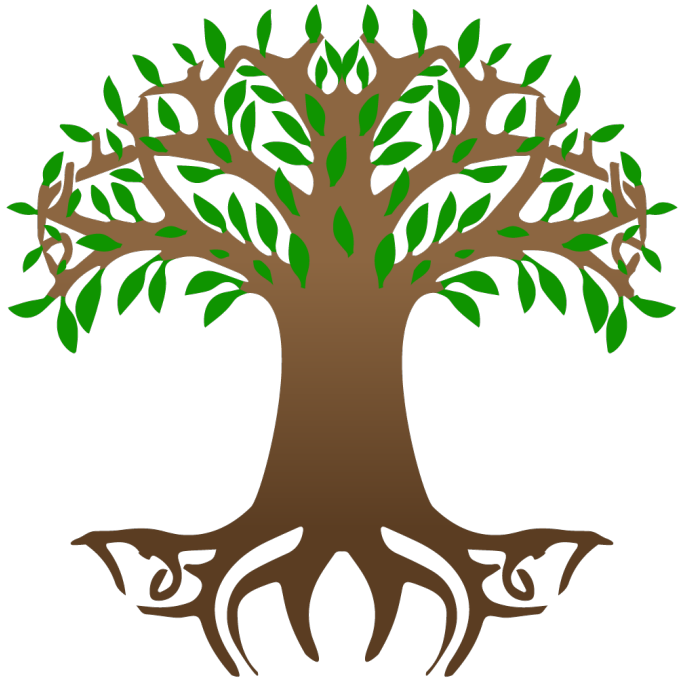

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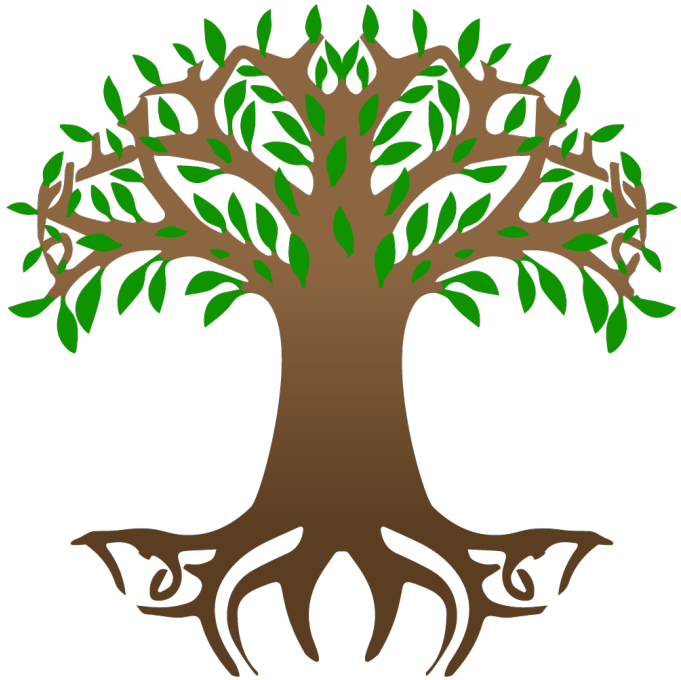

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  - By creating different kinds of "printers", we can use a stable knowledge-base to generate software that solves "well understood" problems.
- Drasil currently focuses on building research software, generating Software Requirement Specification documents (SRS) in both LaTeX and HTML (with MathJaX), code to solve a problem, README files, Makefiles, graphs, etc.

# Drasil Case Studies

[1] https://jacquescarette.github.io/Drasil/#Sec:Examples

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**The Drasil website is also generated by Drasil!**

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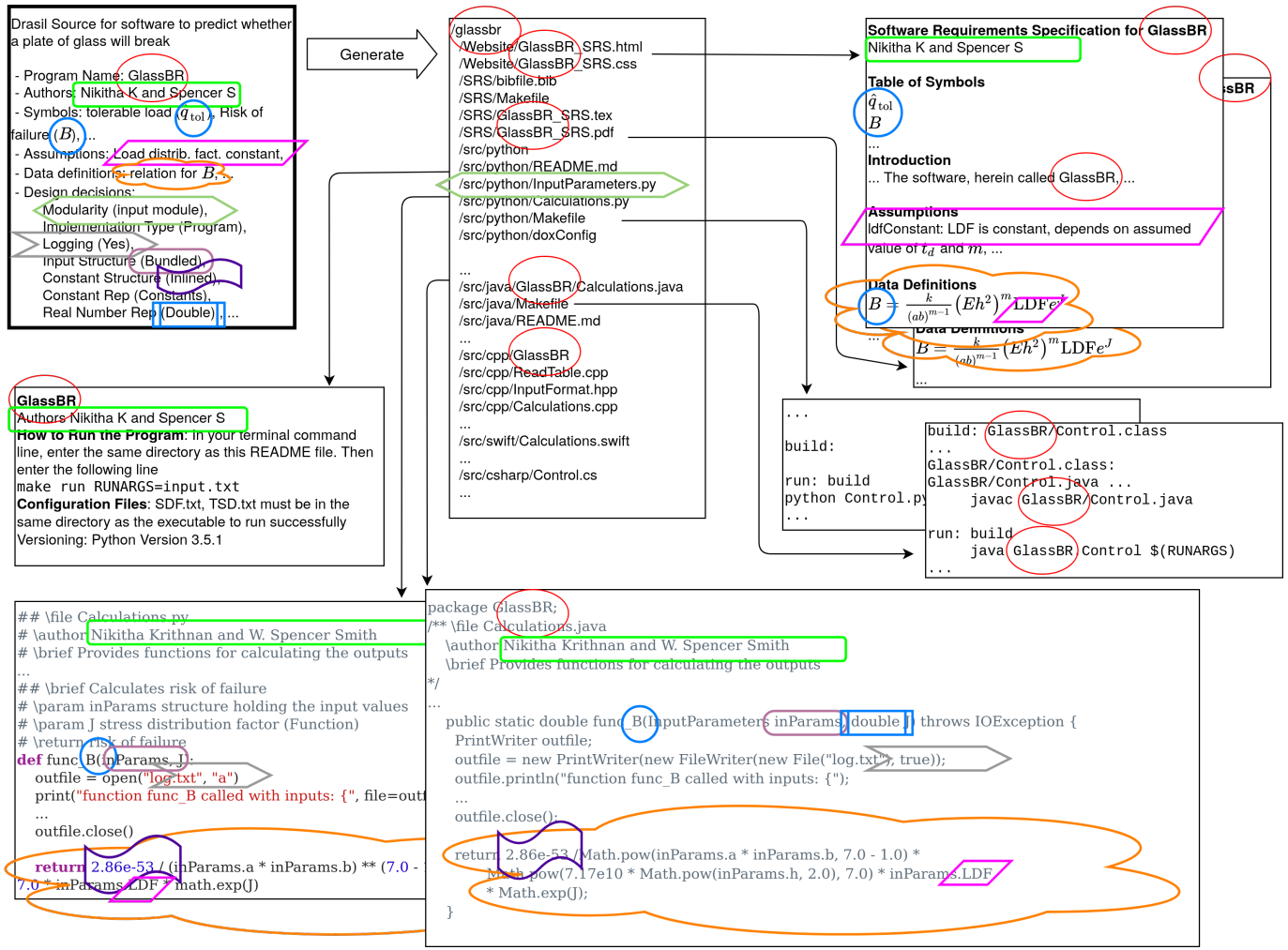
# Taking a closer look at one of the examples: GlassBR

## GlassBR Generates Code!




Knowledge flow from "knowledge-base"/source to artifacts, by Dr. Spencer Smith

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After all,

- They're all covered under "well understood" domains!
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Generating view-only data (e.g., SRS documents) is considerably easier than generating artifacts that are "evaluated" in some way or another (e.g., compilation/interpretation/static analysis). These are largely different "printers".

A few, notable, blocking problems:

- Confidently generating usable software artifacts without strong type information places significant stress on developers, resulting in a higher likelihood of bugs in artifacts.

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A few, notable, blocking problems:

- Confidently generating usable software artifacts without strong type information places significant stress on developers, resulting in a higher likelihood of bugs in artifacts.
- Existing "theories"/"*Models"[1] don't expose enough information. They must be enriched, so that we can better interact with, and understand them.

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# Goal #1: Typed Expression Language

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- We want to ease developer cognitive load when writing expressions, as they will need to ensure their expressions are coherent, or else various problems (type, syntax, etc) can occur at runtime (of generated software artifacts).

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- Add extra functionality to existing expression languages safely, allowing for new data types to be introduced.
- Adding type information to expressions shouldn't be a burden!
- Decomposing/splitting vocabularies so that we can impose restrictions on allowed terms, while not causing problems for interoperability.

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  - CodeExpr is a clone of Expr, with a few extra functionalities for GOOL.
  - Created a "typed tagless final" [Carette et al., 2009] smart constructor encoding for writing expressions in Expr, and/or ModelExpr.

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- Adjusting containers to allow for expressions with a type variable.
- Adding the final type signatures, using Haskell GADT syntax.

# Goal #2: Theory Discrimination – "ModelKinds"

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## Problem Description

- "RelationConcepts" were heavily used in both displaying expressions, and code generation. They are essentially "Relation"s ("Expr"s) with a natural language description of them.
- "RelationConcept"s don't contain enough information on their own to be a core component usable in general code generation.
- If the "shape" of the expressions are not uniform, then writing more "interpreters"/"views"/code generators for them required difficult pattern analysis. It's also not a total-conversion.

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- We should be able to easily add extra "ModelKind" variants.

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- Considerable number of "theories"/"*Models" have been restructured, but there are still many that are pending classification.
  - Most are best to be done once we have a typed expression language (so that we can better handle expressions that involve collections), and the rest are differential equation-related models (primarily Dong's domain).

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## What are the next steps?

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## What are the next steps?

- Understanding what kinds of needs we have for "collections", pushing this information back into the typed expression language (once that is fully typed), and then creating model containers for these models.
- For the differential equation-related models, we will need to build appropriate models for each possible kind.

# Acknowledgements

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- Dr. Smith created the GlassBR figure earlier shown.
- Drasil has had significant development by past (and present) authors. Their public notes in the issue tracker, and their works (in particular, that of Brooks' thesis) have been especially helpful in learning about Drasil.

# Fin.

Thank you!

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