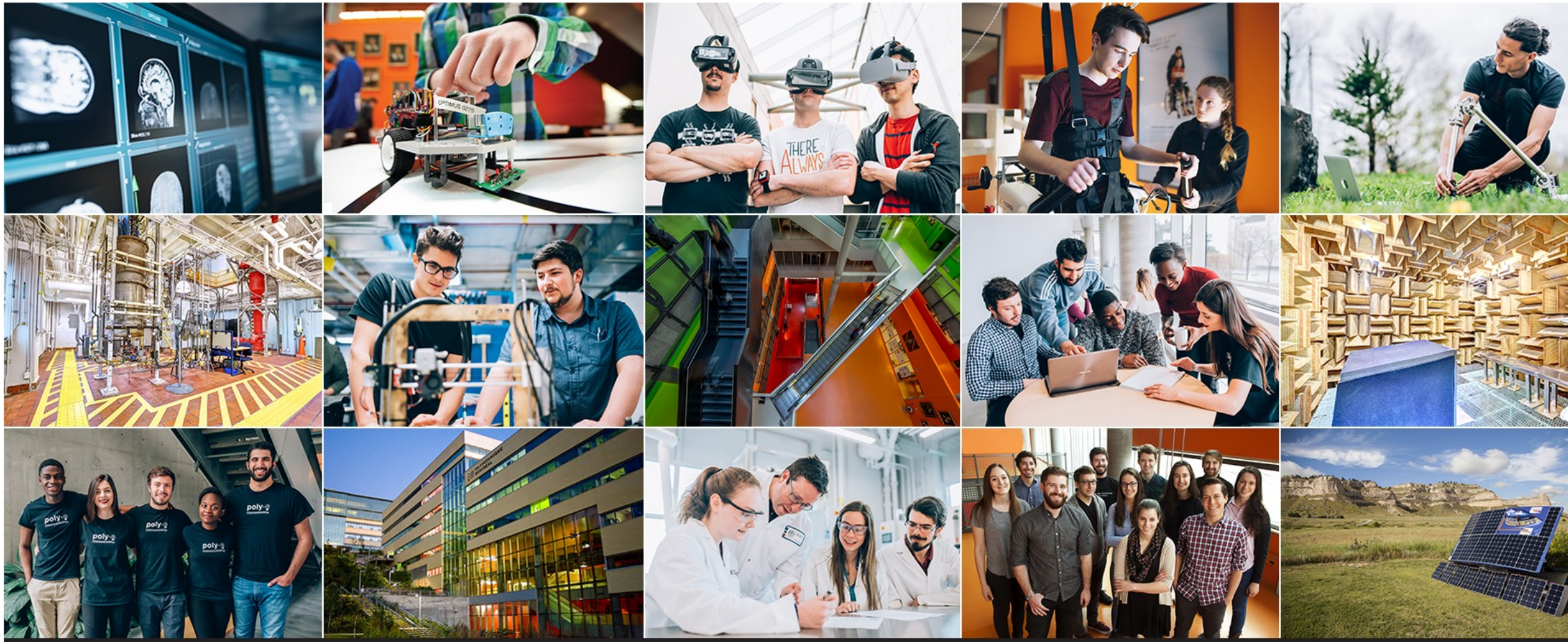

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INF[67]900E Lecture 4 – Writing Papers/Proposals

Dr. Bentley James Oakes

bentleyjoakes.github.io

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Last Lecture

1. Deliverables
2. Review process
3. Review structure
4. Review principles

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This Lecture

1. Plan your writing
2. Plan your research
3. Paper structure
4. Proposal structure

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Required Reading/Watching

https://www.microsoft.com/en-us/research/academic-program/write-great-research-paper/

On Moodle

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Plan Your Writing

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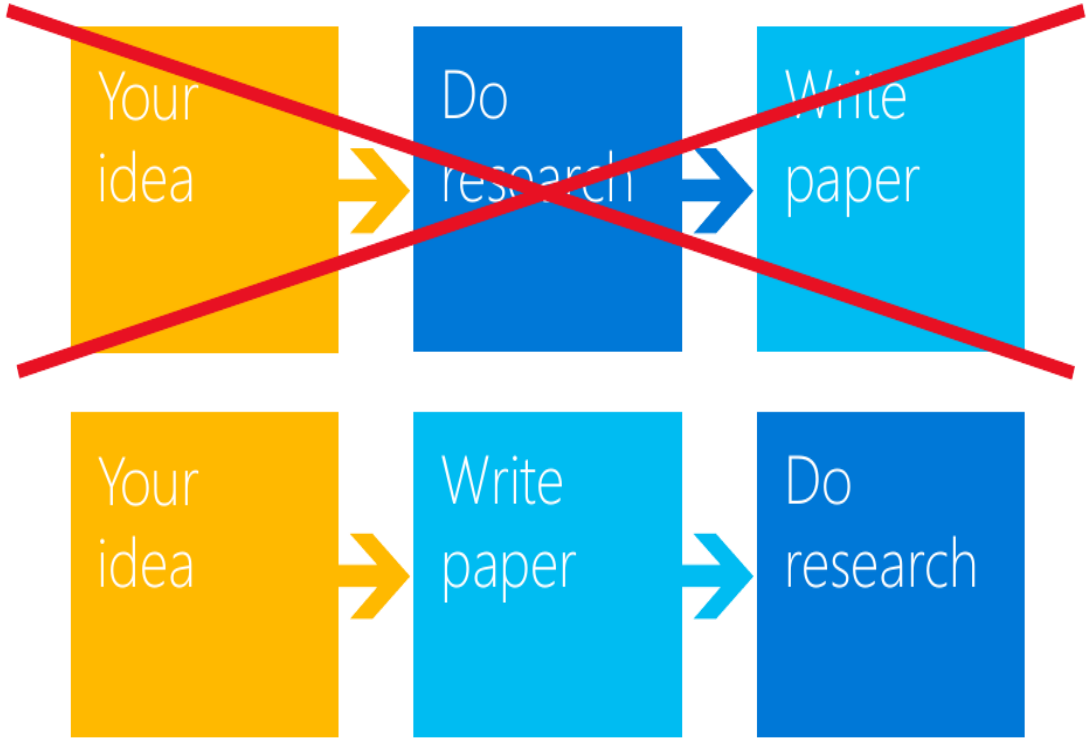
Plan Your Writing



- Forces us to be **clear**, **focused**
- Crystallises what we don't understand
- Opens the way to dialogue with others: reality check, critique, and collaboration

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Plan Your Writing

- What kind of document are you writing?
  - Paper, proposal, thesis

- What is the deadline?
  - Be deadline-driven

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How to Get Started?

- Find the right LaTeX format and structure

NSERC Online presentation and attachment standards

We want to make your experience of preparing and submitting your research using LaTeX as pain free as possible. To help support you we offer guidance and templates for journal articles, books, and conference proceedings.

LaTeX

Download the journal article template package (December 2023 version)

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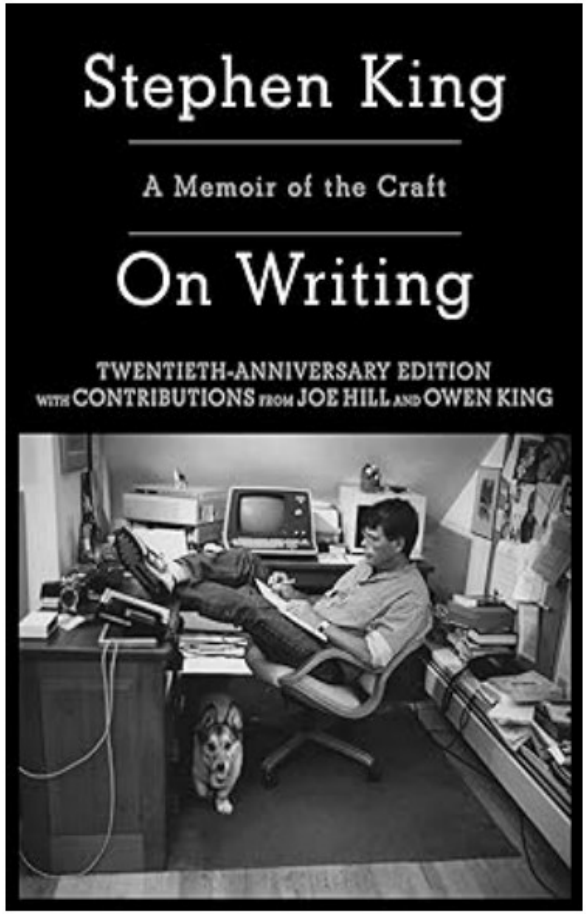
How to Get Started?

- Fill in the basic structure
  - Sections and sub-sections
- Write anything
  - Text is easy to change
  - Editing is **much** easier than writing!
  - Focus on 'drafts' for iteration
  - Iterate, iterate, iterate...



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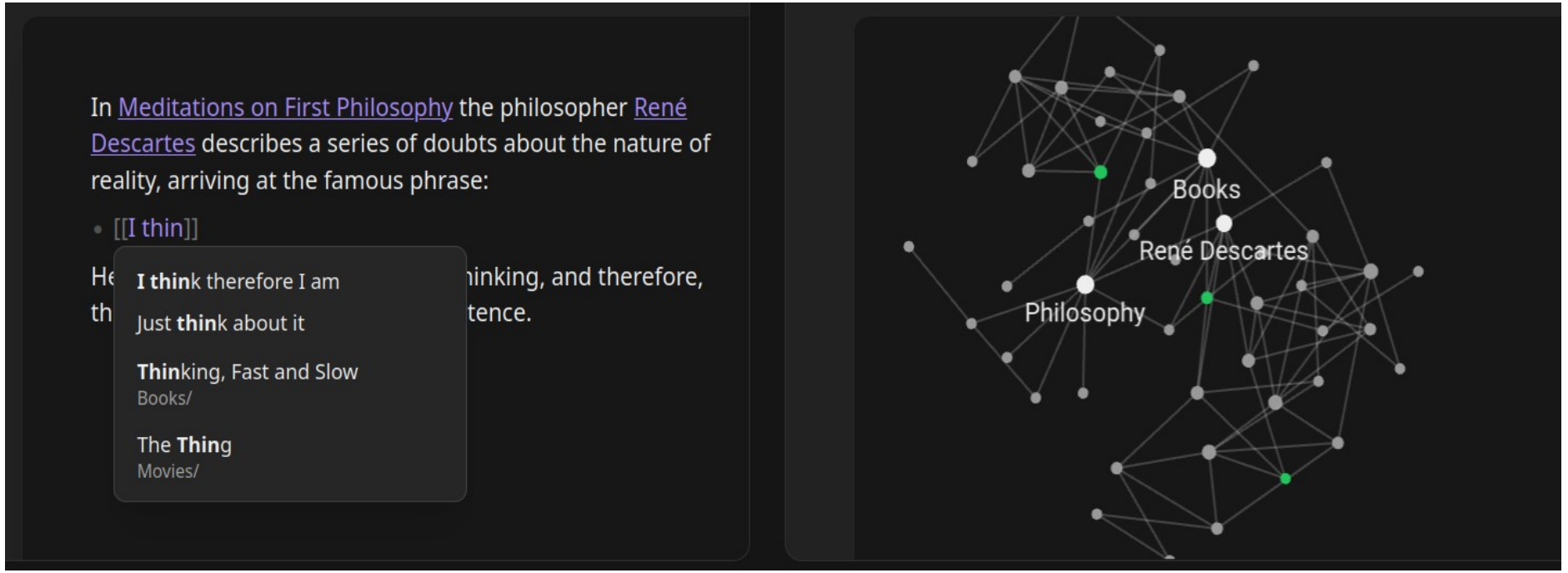
Journaling

Constantly and consistently record:
summaries, insights, new ideas, references

Zettelkasten – Connected pages
Tooling: Obsidian, Zettlr



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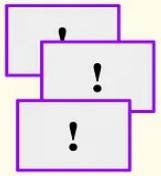
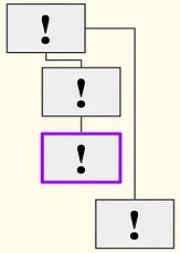
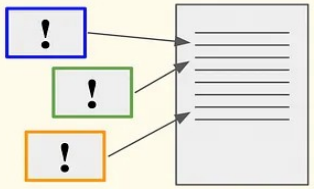
THE ZETTELKASTEN METHOD

Input	Digest	Organize	Outline/Output
Fleeting Notes: Take random notes as you go on about your day **Literature Notes**: Take notes of something you're reading, listening to, watching, observing	**Idea Notes:** Review fleeting/lit. notes and write *one idea per note*	**File Ideas:** Find a place to save the new ideas amongst existing ideas, so you can find them again in the future	**Reuse Ideas:** Let ideas you've collected over time inspire your next essay

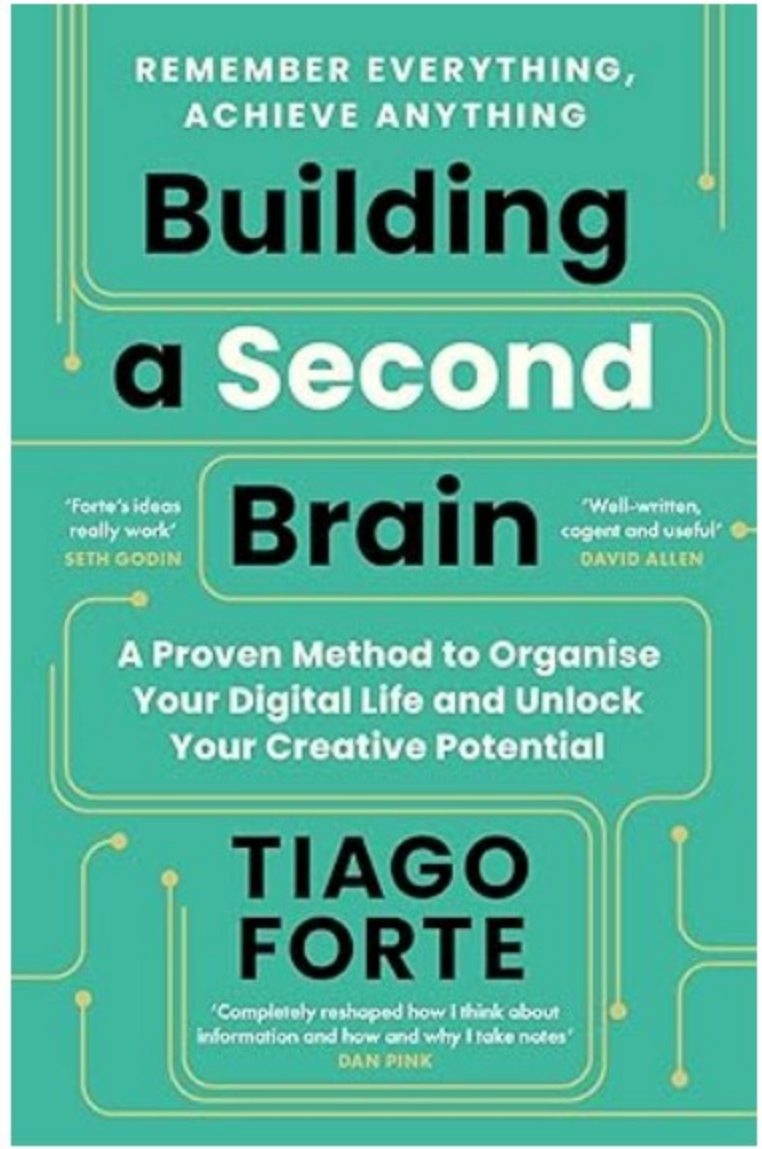






NIKLAS' GOAL: To facilitate ongoing conversations with himself over time.

https://feeei.substack.com/p/the-dirty-lil-secret-about-my-note



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Plan Your Research

Plan Your Research

- Your paper should have just one “ping”: one **clear, sharp idea**

  - Many papers contain good ideas, but do not distil what they are.
  - Make certain that the reader is in no doubt what the idea is. Be 100% explicit:
    - “The main idea of this paper is….”
    - “In this section we present the main contributions of the paper.”

Finding Ideas

How do you come up with that idea?

- Read, review, discussions, conferences…
- You will have many (too many) ideas
- Real problem is how to validate that idea?
  - That's research!

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Following Research Methodology

Finding Research Question(s)

Table 1. Types of software engineering research questions	
Type of question	**Examples**
Method or means of development	How can we do/create/modify/evolve (or automate doing) X? What is a better way to do/create/modify/evolve X?
Method for analysis or evaluation	How can I evaluate the quality/correctness of X? How do I choose between X and Y?
Design, evaluation, or analysis of a particular instance	How good is Y? What is property X of artifact/method Y? What is a (better) design, implementation, maintenance, or adaptation for application X? How does X compare to Y? What is the current state of X / practice of Y?
Generalization or characterization	Given X, what will Y (necessarily) be? What, exactly, do we mean by X? What are its important characteristics? What is a good formal/empirical model for X? What are the varieties of X, how are they related?
Feasibility study or exploration	Does X even exist, and if so what is it like? Is it possible to accomplish X at all?

Shaw, M. (2003, May). Writing good software engineering research papers. In 25th International Conference on Software Engineering, 2003. Proceedings. (pp. 726-736). IEEE.

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Connecting RQ to Evaluation

General Standard	Action Research	Benchmarking	Case Study	Case Survey
Data Science	Engineering Research	Experiments	Grounded Theory	Longitudinal
Meta Science	Mixed Methods	Optimization Studies	Qualitative Surveys	Quantitative Simulation
Questionnaire Surveys	Replication	Repository Mining	Systematic Reviews	

ACM SIGSOFT Empirical Standards for Software Engineering
https://www2.sigsoft.org/EmpiricalStandards/docs/

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Paper Structure

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Paper Structure

- Depends on type of research
- Depends on type of paper
  - Journals have 20-30 pages, conferences have 10 pages

1) Title
2) Abstract
3) Introduction
4) Background (for journal)
5) Approach
6) Evaluation set-up / results
7) Discussion
8) Related Work
9) Conclusion

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Most Important Part?

1) Title
2) Abstract
3) Introduction
4) Background (for journal)
5) Approach
6) Evaluation set-up / results
7) Discussion
8) Related Work
9) Conclusion

Most Important Part - Intro

1) Title
2) Abstract
3) **Introduction**
4) Background (for journal)
5) Approach
6) Evaluation set-up / results
7) Discussion
8) Related Work
9) Conclusion

Introduction:

a) Context to the problem

b) What's the **specific problem** addressed**?**

c) Brief summary of the **approach**

d) **Contributions** and **research questions**

e) Structure of the paper

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Contributions Examples

the main contributions of this paper are: (a) an adaptation of the SBFL approach to the symbolic execution verification results, and (b) an empirical evaluation of the approach on a set of example model transformations.

This paper's contributions are therefore: (i) detailing how the ML-based FI process uses the available data within the SAHARA methodology to automatically produce hazardous situations, (ii) providing an example of the FI and SAHARA processes on a use case, including an indication of the approach performance, and (iii) a discussion of the benefits and drawbacks of placing ML-based FI within the SAHARA process.

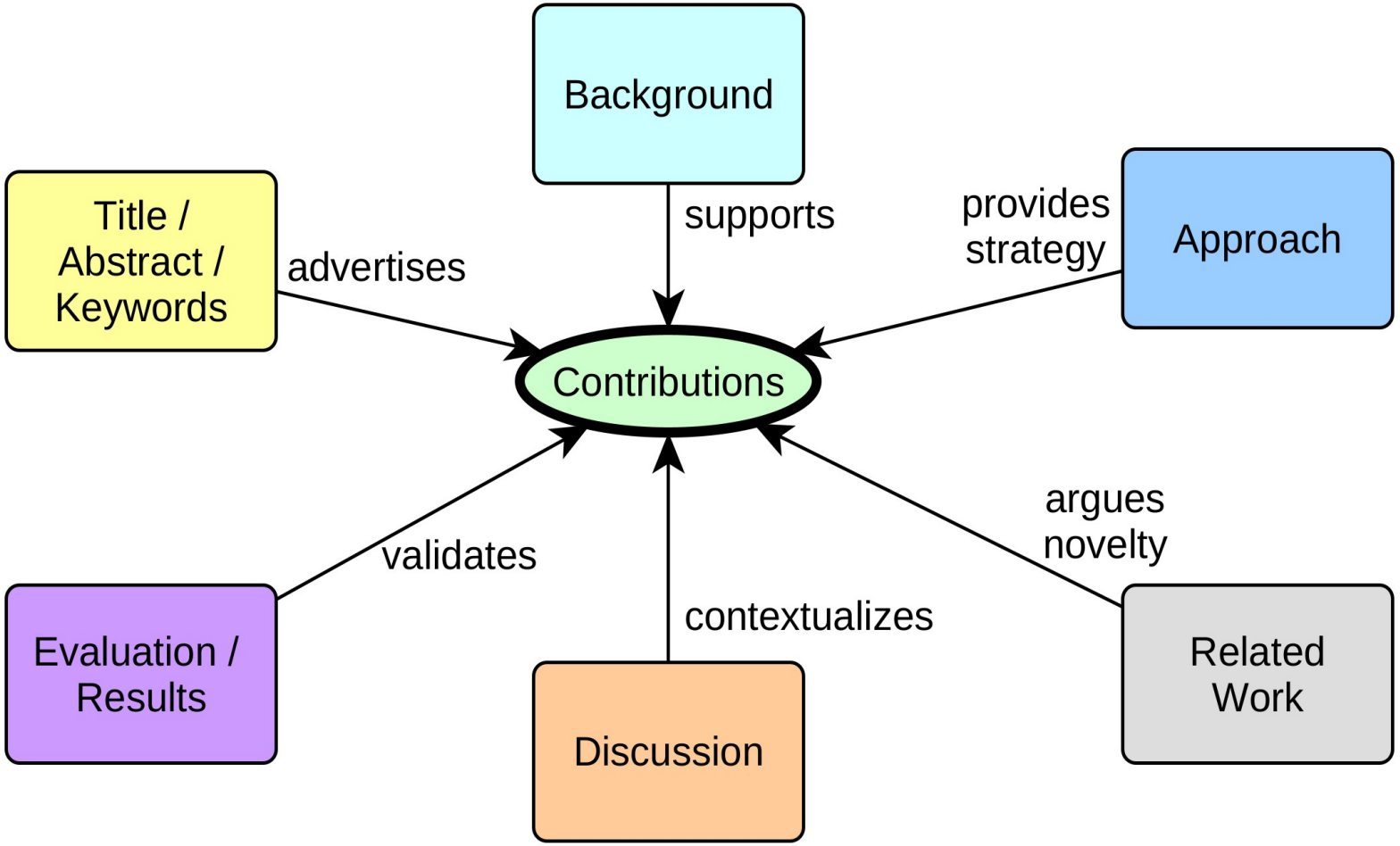
The core contributions of this paper are to explain the implementation of this contract-based approach on an industrial use-case, as well as provide examples of the benefits of this approach. Section II describes the industrial use-case,

Contributions and Structure This paper presents these specific contributions:

– Section 2: A high-level architecture relating a KG to DTs.

Contributions. Our contributions in this paper are: a) a formalization of the problem of breaking algebraic loops in co-simulations, b) an optimal, but costly, algorithm to solve it, and c) multiple cost-effective heuristic algorithms.

Paper Centres Around Contributions



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Title / Abstract / Keywords

EXAMINING MODEL QUALITIES AND THEIR IMPACT ON DIGITAL TWINS

ABSTRACT

Digital Twins (DTs) are built using modelling and simulation techniques in complex domains such as cyber-physical systems. However, further formal investigation is required for how a DT and the services it provides relate to the qualities of the models used by a service. Specifically, this article examines when a DT service can be said to have the qualities of *relevant*, *verifiable*, *substitutable*, and *faithful* based on the results of checking *properties* in comparison to the actual system. Using an incubator system as our running example, we show how a DT service relies on multiple models, present the consequences when these qualities are violated, and discuss strategies for adapting models to ensure these qualities.

Keywords: digital twins, verification, model quality, fidelity, substitutability, cyber-physical systems.

Oakes et al (2023, May). Examining Model Qualities and Their Impact on Digital Twins.
In 2023 Annual Modeling and Simulation Conference (ANNSIM) (pp. 220-232). IEEE.

How to construct a *Nature* summary paragraph

One or two sentences providing a **basic introduction** to the field, comprehensible to a scientist in any discipline.

Two to three sentences of **more detailed background**, comprehensible to scientists in related disciplines.

One sentence clearly stating the **general problem** being addressed by this particular study.

One sentence summarizing the main result (with the words "**here we show**" or their equivalent).

Two or three sentences explaining what the **main result** reveals in direct comparison to what was thought to be the case previously, or how the main result adds to previous knowledge.

One or two sentences to put the results into a more **general context**.

Two or three sentences to provide a **broader perspective**, readily comprehensible to a scientist in any discipline, may be included in the first paragraph if the editor considers that the accessibility of the paper is significantly enhanced by their inclusion. Under these circumstances, the length of the paragraph can be up to 300 words. (This example is 190 words without the final section, and 250 words with it).

During cell division, mitotic spindles are assembled by microtubule-based motor proteins[1,2]. The bipolar organization of spindles is essential for proper segregation of chromosomes, and requires plus-end-directed homotetrameric motor proteins of the widely conserved kinesin-5 (BimC) family[3]. Hypotheses for bipolar spindle formation include the 'push–pull mitotic muscle' model, in which kinesin-5 and opposing motor proteins act between overlapping microtubules[2,4,5]. However, the precise roles of kinesin-5 during this process are unknown. Here we show that the vertebrate kinesin-5 Eg5 drives the sliding of microtubules depending on their relative orientation. We found in controlled *in vitro* assays that Eg5 has the remarkable capability of simultaneously moving at ~20 nm s^{-1} towards the plus-ends of each of the two microtubules it crosslinks. For anti-parallel microtubules, this results in relative sliding at ~40 nm s^{-1}, comparable to spindle pole separation rates *in vivo*[6]. Furthermore, we found that Eg5 can tether microtubule plus-ends, suggesting an additional microtubule-binding mode for Eg5. Our results demonstrate how members of the kinesin-5 family are likely to function in mitosis, pushing apart interpolar microtubules as well as recruiting microtubules into bundles that are subsequently polarized by relative sliding. We anticipate our assay to be a starting point for more sophisticated *in vitro* models of mitotic spindles. For example, the individual and combined action of multiple mitotic motors could be tested, including minus-end-directed motors opposing Eg5 motility. Furthermore, Eg5 inhibition is a major target of anti-cancer drug development, and a well-defined and quantitative assay for motor function will be relevant for such developments.

Intro

Introduction:

a) Context to the problem

b) What's the **specific problem** addressed**?**

c) Brief summary of the **approach**

d) **Contributions** and **research questions**

e) Structure of the paper

Background

- Usually only for journal articles
- Mention the fundamental topics in the article needed to understand the approach

2 Background

This section introduces the background necessary for this paper. In particular, it briefly presents: (a) the model transformation used as a running example, (b) the DSLTrans transformation language used in our work, (c) the symbolic execution verification approach for proving contracts and the SyVOLT tool which takes as input DSLTrans transformations and (d) the basics of SBFL for model transformations.

Oakes et al (2023). Fault localization in DSLTrans model transformations by combining symbolic execution and spectrum-based analysis. Software and Systems Modeling, 1-27.

Approach

- Detail the proposed approach, and try to include an overview diagram

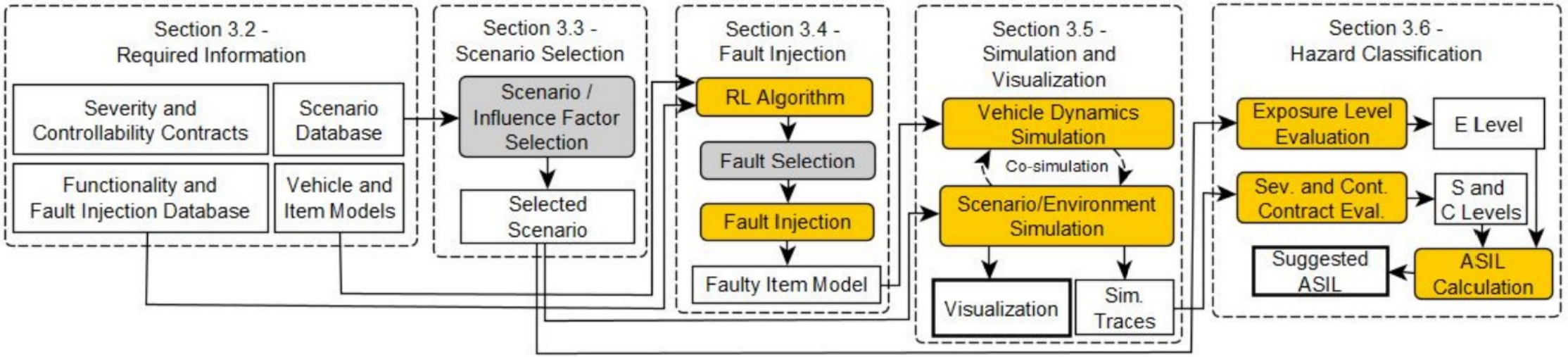


Fig. 3: The overall SAHARA architecture and workflow (adapted from [21]). Yellow blocks are automatic actions, and gray blocks are manual actions.

Oakes et al. (2021, August). Machine Learning-Based Fault Injection for Hazard Analysis and Risk Assessment. In International Conference on Computer Safety, Reliability, and Security (pp. 178-192).

Evaluation / Results

4 Evaluation setup

This section sets up the evaluation of our approach by first defining the research questions (RQs). Then, the experimental setup is explained to detail the different example transformations, contracts, mutants and techniques used for suspiciousness-based rankings computations. The evaluation metrics used for answering each RQ are explained, and the prototype implementation and execution environment are also introduced.

Oakes et al (2023). Fault localization in DSLTrans model transformations by combining symbolic execution and spectrum-based analysis. Software and Systems Modeling, 1-27.

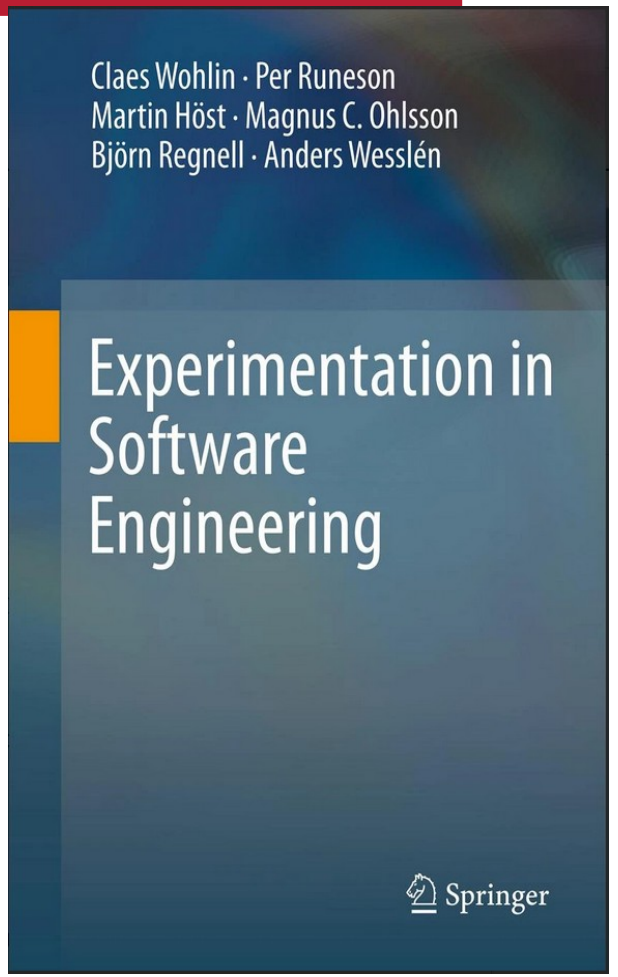
Discussion

- Often missing from papers and leads to rejection

- My structure:
  - **Benefits** of the approach
    - Based on the evaluation, argue that results are good
  - **Limitations** of the approach
    - Anticipate reviewer’s objections
  - **Threats to validity**

Threats to Validity

- **Conclusion validity**
  - Threats to obtaining conclusions from results
  - Ex. Are stats reliable and powerful enough, any random heterogeneity of subjects, repeatable?
- **Internal validity**
  - Threats that might affect the results
  - Ex. Sufficient metrics to evaluate approach, ensuring that approach was performed correctly
- **Construct validity**
  - Threats of the approach not matching the theory
  - Ex. Metrics not matching problem to be studied
- **External validity**
  - Threats to generalization, Ex. Subset of population studied



Wohlin, C., Runeson, P., Höst, M., Ohlsson, M.C., Regnell, B.: Experimentation in Software Engineering. Springer, Berlin (2012)

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Writing Proposals

Writing Proposals

- Proposals are different to papers
- Papers are about **explaining** an idea and your approach
- Proposals are about ***selling*** an idea and your approach

In a proposal, you are *asking for money*
You must have:

- A clear idea, which is important to fund
- Know what others have done
- Clear objectives
- Clear approach and a feasible timeline
- Written this in a short amount of text

Writing Proposals

1) Here is a **problem**
2) It's an **important problem** (evidence...)
3) We have a **promising idea** (evidence...)
4) We are a **world-class team** (evidence...)
5) Here is what we **hope to achieve**, and how we'll know if we have **succeeded**.
6) Here is a **plan** of how we're going to get from our idea to that destination
7) Give us the **money**. Please.

https://www.microsoft.com/en-us/research/academic-program/how-to-write-a-great-research-proposal/

Writing Proposals

1. Set the context for research or the problem to be solved (say that the field is important),
2. Say what you are going to do and why it is important.
3. Say how you are going to do it.
4. Talk about impact and future work.

https://www.uregina.ca/gradstudies/assets/docs/ppt/GraduateStudentConference/NSERC.pdf

Proposal Structure

Outline of proposed research (one page maximum)

Overview: Provide a detailed description of your proposed research project for the period during which you will hold the award. Be as specific as possible.

Background: Provide background information to position your proposed research within the context of current knowledge in the field.

Objectives and Hypothesis:
State the objectives and hypothesis,

Approach: and outline the experimental or theoretical approach to be taken (citing literature pertinent to the proposal) and the methods and procedures to be used.

Impact: State the significance of the proposed research to a field or fields in the health sciences, natural sciences and/or engineering or social sciences and/or humanities, as appropriate.

Proposal Deliverable

- Deadline: Feb 29th, 23:59
- One page text, one page references
- Must fit NSERC presentation guidelines (see syllabus)

- Evaluation (through peer-review):
  - Required structure (see last slide)
  - Attention-capturing (dynamic language, active voice)
  - Captures state-of-the-art
  - Clear objectives
  - Clear methodology
  - Feasibility
  - Impact (how does this benefit other researchers/Canada/industry)

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NSERC Discovery Evaluation

Merit of the Proposal	Proposed research program is clearly presented, is **extremely original** and **innovative** and is **likely to have impact** by **leading to groundbreaking advances** in the area and/or **leading to a technology or policy** that addresses socio-economic or environmental needs.
	Long-term vision and **short-term objectives** are **clearly defined**.
	The methodology is **clearly defined** and **appropriate**.

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Proposal Examples

- https://research.viu.ca/cgs-m-examples
  https://figshare.com/articles/online_resource/Bernhardt-CGS-M-NSERC_pdf/17058125/1

- Note that these examples may not have the right structure.

- Please post others on the discussion forum!

THANK YOU!

Topics:

- 1. Plan your writing
- 2. Plan your research
- 3. Paper structure
- 4. Proposal structure

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