




# Motivation and Overview

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Developing a Testing and Continuous Integration Strategy for your Team tutorial @ Exascale Computing Project Annual Meeting

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- **The requested citation the overall tutorial is: Gregory R. Watson and David M. Rogers, Developing a Testing and Continuous Integration Strategy for your Team tutorial, in Exascale Computing Project Annual Meeting, online, 2022. DOI: 10.6084/m9.figshare.19608927**
- Individual modules may be cited as *Speaker, Module Title*, in Better Scientific Software tutorial…

## Acknowledgements


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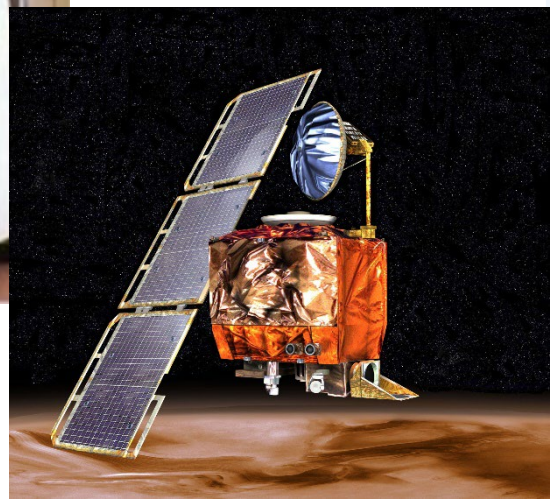
Science through computing is,
at best,
as credible as the software that produces it!

# High-Consequence Software-Related Scientific Failures

## Therac-25 (1985-1987)

- Computer-controlled radiation therapy system
- **Poor software design, development and testing practices** allowed flaws that let to at least six cases of substantial radiation overdoses, three fatal



## Mars Climate Orbiter (1999)

- Incorrect trajectory adjustment caused loss of the orbiter as it was supposed to enter Martian orbit
- Discrepancy in the units used in two different software components
- One component **didn't follow specifications**
- **Inadequate testing** at the interface
- Concerns raised earlier in the mission were ignored because they **weren't properly documented**

*Just two of many examples*

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# Challenges Developing Scientific Applications Today

## Technical

- All parts of the model and software system can be under research
- Requirements change throughout the lifecycle as knowledge grows
- Verification complicated by floating point representation
- Real world is messy, so is the software
- Increasing architectural diversity

## Sociological

- Competing priorities and incentives
  - Sponsors often care more about scientific publications than software per se
  - Balancing development and maintenance with research
- Limited resources
- Need for interdisciplinary interactions
  - Many different kinds of expertise to be successful

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# Best Practices for Scientific Software Development

## Baseline

- Invest in extensible code design
- Use version control and automated testing
- **Institute a rigorous verification and validation regime**
- **Define and enforce coding and testing standards**
- Clear and well-defined policies for
  - Auditing and maintenance
  - Distribution and contribution
  - Documentation

## Desirable

- Provenance and reproducibility
- Lifecycle management
- Open development and frequent releases

***This tutorial will focus primarily on scientific software as distinct from more generic software engineering best practices***

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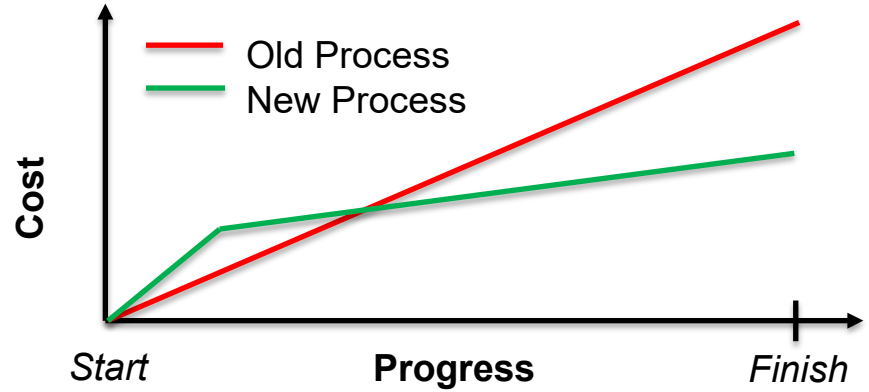
# Continual, Incremental Software Process Improvement

Target: your project should include "just enough" software engineering so that you can meet your short-term and longer-term scientific goals effectively

1. Identify your team's "pain points" in your software development processes
   - Help: RateYourProject assessment tool: https://rateyourproject.org/
2. Set a goal for something to improve
   - Target processes and behaviors, not just tasks
   - Pick something that you can address in a few months that will give you a noticeable benefit
3. Agree on a plan to address it, identify markers of progress and what is "done"
   - Write them down
   - Help: Progress tracking card examples: https://bssw-psip.github.io/ptc-catalog/catalog
4. Work your plan, track your progress
5. When you are done, celebrate…

…then pick a new pain point to address




*The new process costs something to implement, but it pays off over time*

Productivity and Sustainability Improvement Planning
https://bssw.io/psip

A goal of BSSw.io is to provide resources for improving your software processes. If you find useful resources that aren't on BSSw.io, consider contributing. Its easy and quick.

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# Agenda

The agenda is also available on the tutorial web page. Visit https://bssw-tutorial.github.io and click on the link for today's tutorial

| Time (EDT) | Module | Title | Presenter |
|---|---|---|---|
| 2:30 PM | 0 | Introduction and Setup | Gregory R. Watson (ORNL) |
| 2:35 PM | 1 | Motivation and Overview | Gregory R. Watson (ORNL) |
| 2:40 PM | 2 | Software Testing Introduction | Gregory R. Watson (ORNL) |
| 3:00 PM | 3 | Testing Complex Software | David M. Rogers (ORNL) |
| 3:25 PM | 4 | Continuous Integration | David M. Rogers (ORNL) |
| 3:55 PM | 5 | Summary | David M. Rogers (ORNL) |
| 4:00 PM | | *Adjourn* | |