

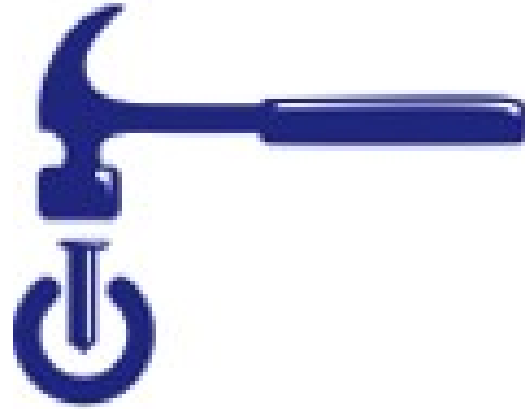
Welcome to Software Carpentry!

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If You Can't Reproduce It, Is It Still Science?

And how long will it take?

Paul Wilson

Inspired by Greg Wilson
Software Carpentry



Reality of Research Computing

- Many scientists spend most of their time developing, maintaining, or running software
 - Most don't consider themselves software engineers
 - Few have ever been taught how
 - Learned on-the-job
 - Tribal knowledge

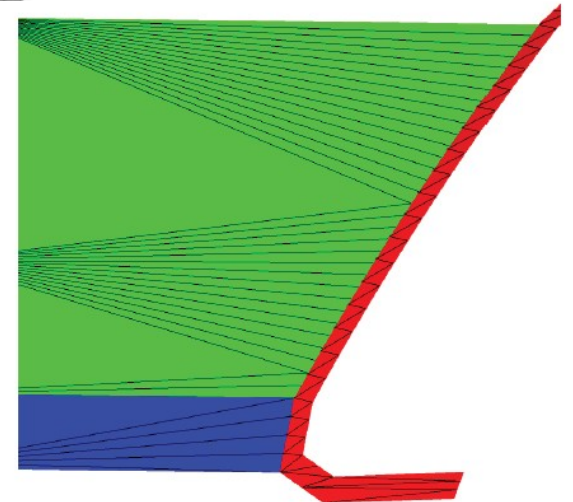
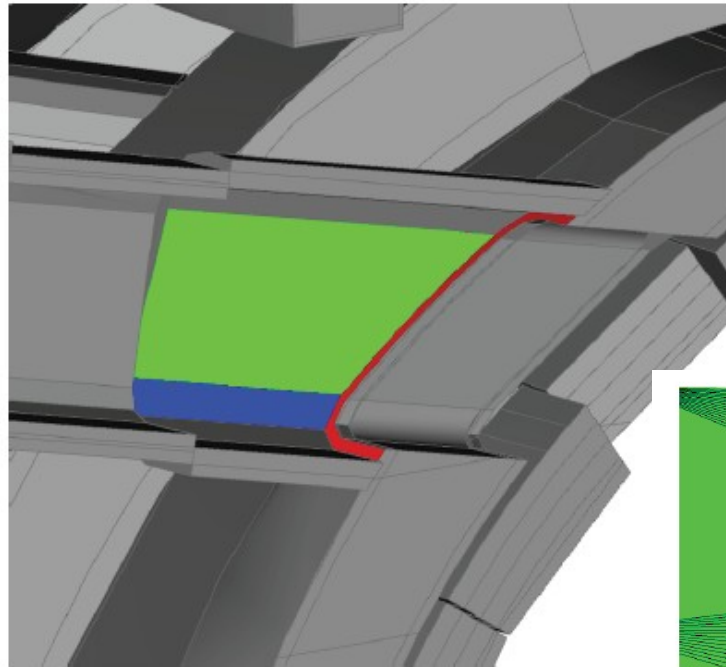
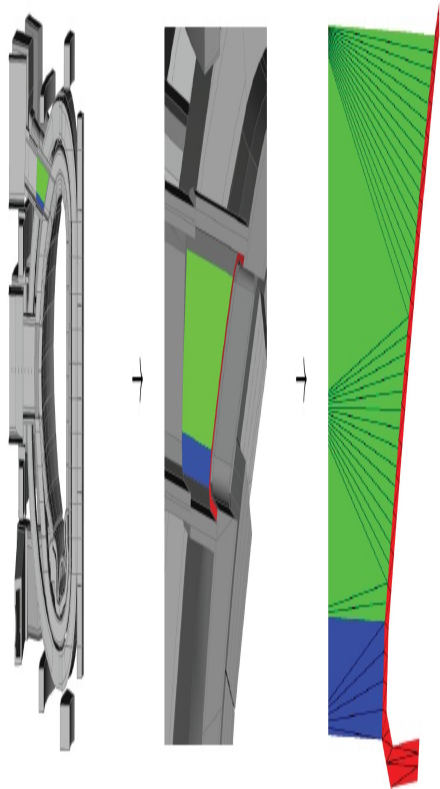


So What...

- Most results take longer to produce than they need to
 - Not because of a lack of computers
- Difficult to assess quality
 - Often measured by reproducibility
 - “System” doesn’t care

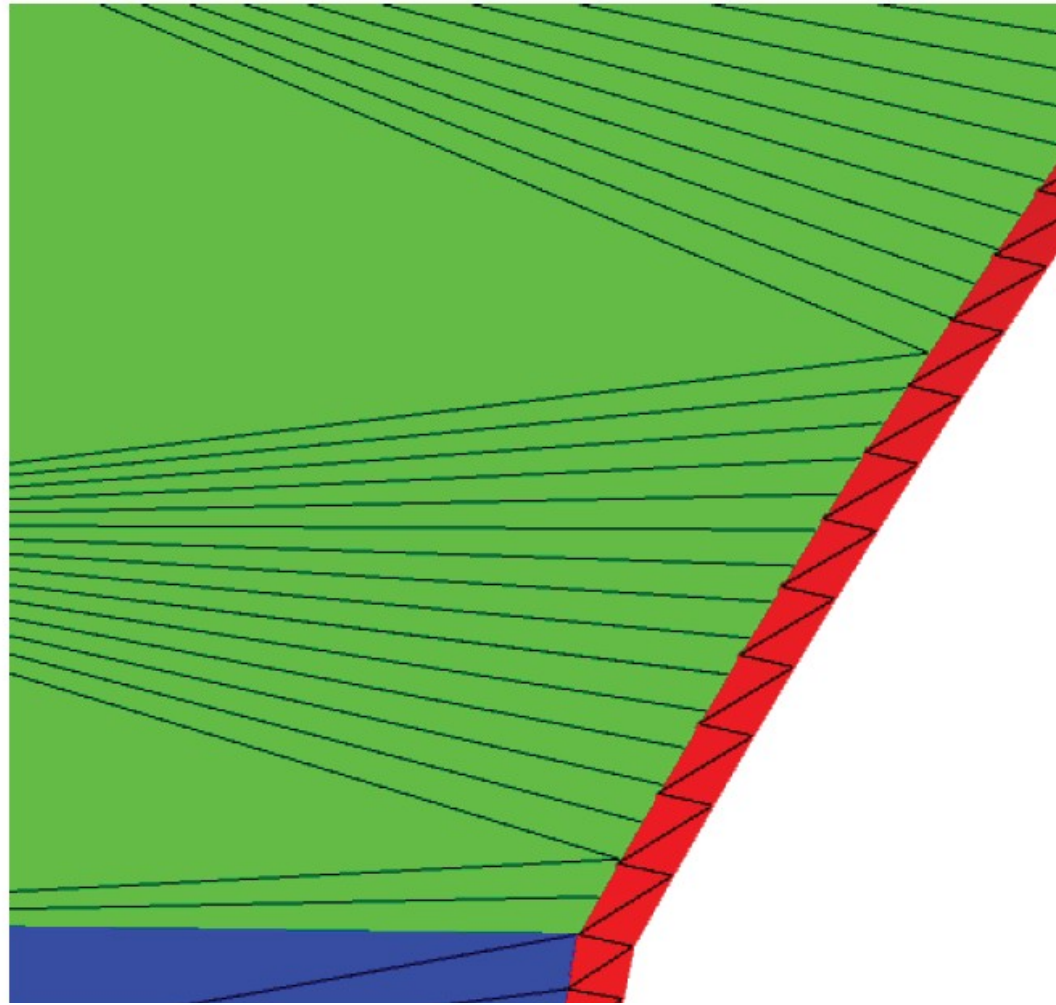


A Recent Story: Sealing a Faceted Geometry





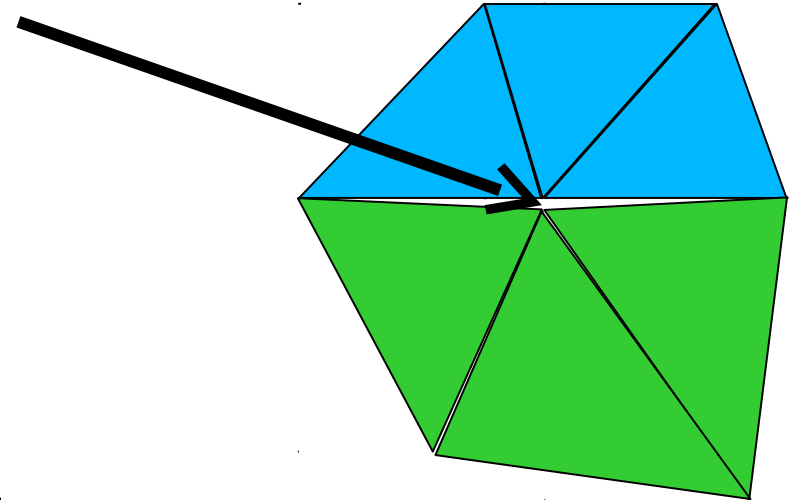
A Recent Story: Sealing a Faceted Geometry





A Recent Story: Sealing a Faceted Geometry

- Lost particles through “leaks”
- Reduce confidence in solution





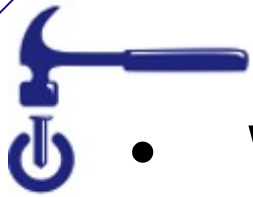
A Recent Story: Sealing a Faceted Geometry

Model	Particles Simulated [millions]	Lost Particles	
		Original	Robust
UW Nuclear Reactor	41	5649 ± 178	0
Advanced Test Reactor	74	141 ± 32	0
40° ITER Benchmark	225	67 ± 39	0
ITER TBM	205	665 ± 184	0
ITER Module 4	59	59 ± 19	0
ITER Module 13	79	450 ± 60	0
FNG Benchmark	1310	31273 ± 989	0
ARIES First Wall	4070	25 ± 18	0
HAPL IFE	286	65 ± 19	0
Z-Pinch Fusion	409	2454 ± 317	0



Software Carpentry to the Rescue

- Best practices used by the best software engineers whose business is development of quality software
 - They don't always have formal training
 - They don't always follow all the practices
 - Growing evidence supported by empirical studies



- Write software for people, not computers
- Automate repetitive tasks
- Use the Computer to Record History
- Make Incremental Changes
- Use Version Control
- Don't Repeat Yourself
- Plan for Mistakes
- First make it correct, then make it fast
- Document Design & Purpose
- Conduct Code Reviews



Two Days \neq Ten Practices

- Automate repetitive tasks
- Write software for people, not computers
- Don't Repeat Yourself (or Others)
- Make Incremental Changes/Use Version Control
- Plan for Mistakes
- Conduct Code Reviews



Make Incremental Changes Redux

- This applies to HOW you work
- Choose one practice
 - Implement it in your work
 - Share it with your lab group
 - Allow it to sink in
- Repeat

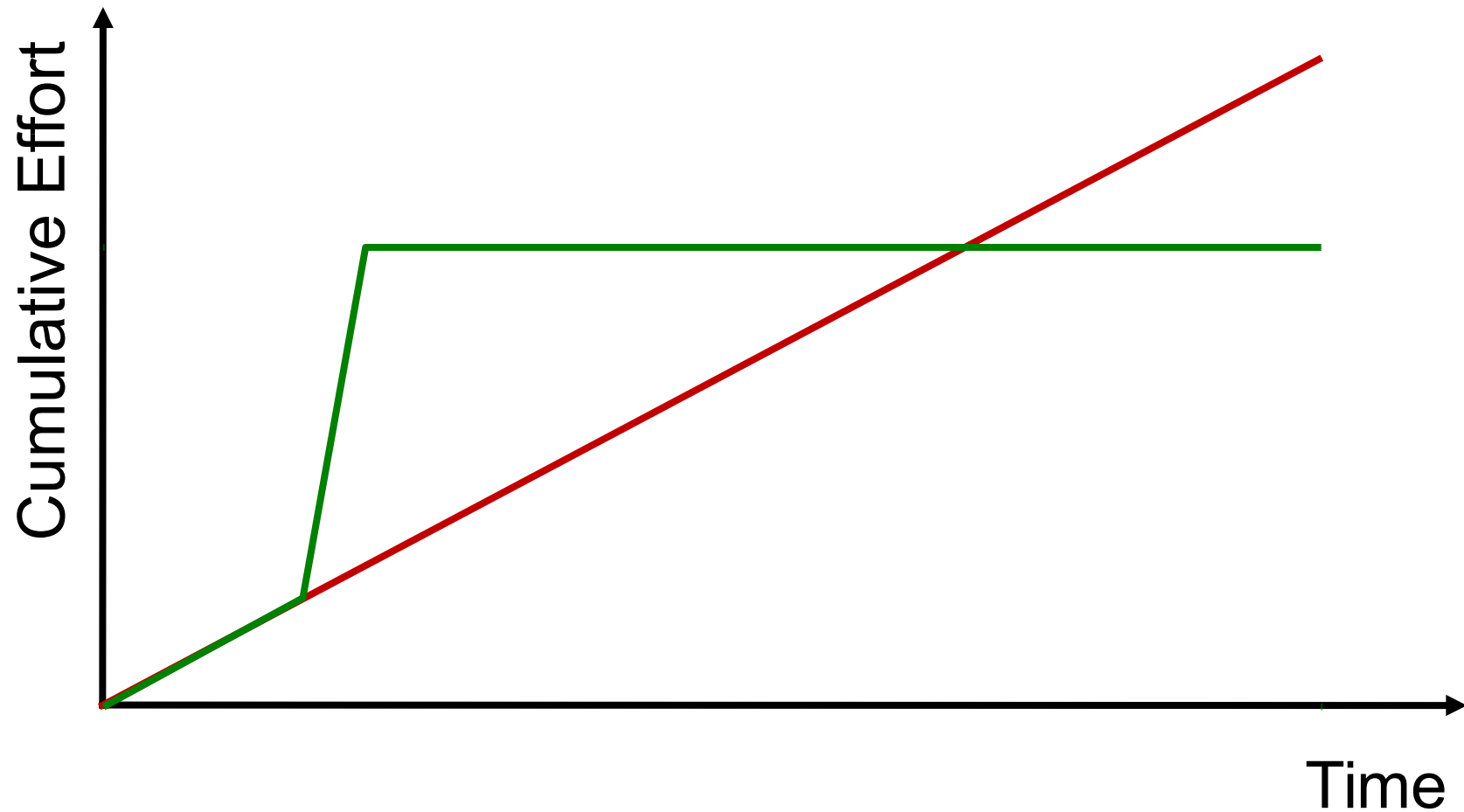


How to Choose Where to Start?

- It will depend on the nature of your work
- Consider the purpose:
 - Improve productivity
 - Improve quality



Thoughts on Productivity and Automation





Thoughts on Productivity and Automation

HOW LONG CAN YOU WORK ON MAKING A ROUTINE TASK MORE EFFICIENT BEFORE YOU'RE SPENDING MORE TIME THAN YOU SAVE?
(ACROSS FIVE YEARS)

		HOW OFTEN YOU DO THE TASK					
		50/DAY	5/DAY	DAILY	WEEKLY	MONTHLY	YEARLY
HOW MUCH TIME YOU SHAVE OFF	1 SECOND	<div><div>1</div></div> DAY	2 HOURS	30 MINUTES	4 MINUTES	1 MINUTE	5 SECONDS
	5 SECONDS	<div><div>5</div></div> DAYS	12 HOURS	2 HOURS	21 MINUTES	5 MINUTES	25 SECONDS
	30 SECONDS	<div><div></div><div></div><div></div><div></div><div></div></div> 4 WEEKS	<div><div>3</div></div> DAYS	12 HOURS	2 HOURS	30 MINUTES	2 MINUTES
	1 MINUTE	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div> 8 WEEKS	<div><div>6</div></div> DAYS	<div><div>1</div></div> DAY	4 HOURS	1 HOUR	5 MINUTES
	5 MINUTES	9 MONTHS	<div><div></div><div></div><div></div><div></div><div></div></div> 4 WEEKS	<div><div>6</div></div> DAYS	21 HOURS	5 HOURS	25 MINUTES
	30 MINUTES		6 MONTHS	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div> 5 WEEKS	<div><div>5</div></div> DAYS	<div><div>1</div></div> DAY	2 HOURS
	1 HOUR		10 MONTHS	2 MONTHS	<div><div>10</div></div> DAYS	<div><div>2</div></div> DAYS	5 HOURS
	6 HOURS				2 MONTHS	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div> 2 WEEKS	<div><div>1</div></div> DAY
	<div><div>1</div></div> DAY					<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div> 8 WEEKS	<div><div>5</div></div> DAYS