

Research Software Engineering Skills for Computer Scientists and Software Engineers

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February 29, 2024



How I became a Research Software Engineer

How it started: LearnLib

- Library for automata learning algorithms
- Developed and maintained at chair of programming systems (Bernhard Steffen), TU Dortmund for 20+ years
- My contributions start 2008
- Open source since 2013
- Widely used by other researchers
- Currently: DFG funding for research tools

Research and Service

- AEC Chair of ISSTA 2014
- Tool Chair of TACAS 2020
- Talk at deRSE 2023
- NFDI4Ing seed funding, BMBF QuARUm

Since then: Serial Tool Builder

- LearnLib
- AutomataLib
- RaLib
- JDart
- JConstraints
- PSYCO
- GDart
- STARS
- ...

<https://github.com/LearnLib>
<https://github.com/tudo-aqua>
<https://github.com/psycopaths>

(All tools with multiple collaborators)

$$\text{RSE Skills} = \{\text{skill} \in \text{RSE} \setminus (\text{CS} \cup \text{SE})\}$$

Are there particular RSE skills?

- ① Two perspectives on RSE
- ② Preliminary lists of skills
- Not the result of a proper study!
- I searched the web for job postings
- Read the existing articles on RSE a.o., the essay by Bernhard Rumpe

<https://rumpe.github.io/essay/Research-Software-Engineering/>



PRINCETON UNIVERSITY
careers

located in Princeton, NJ with the possibility for some
commitments. This is not a remote position.

Responsibilities

Job responsibilities will include a subset of the following, depending upon the individual's background:

- Collaborate with our diverse team to help develop and improve large AI models, helping conduct experiments, analyze results, and co-author research publications.
- Develop, maintain, and improve our shared infrastructure for training / fine-tuning and prompting large AI models.
- Maintain software libraries/environment/Github repositories and support model use.
- Provide support for use of the group's infrastructure.

us a desirable workplace for colleagues from around the world. Our reward and benefits, and ways of working enable those who join us to have enriching careers, matched by an excellent work-life balance.

ABOUT THE ROLE

The Swansea Academy of Advanced Computing at Swansea University is seeking to appoint a Research Software Engineer to support projects in lattice quantum field theory. The role will involve development of software and training to support reproducible data analysis, development of benchmarks for high-performance computing, and optimisation of simulation software for HPC.

The successful candidate should be familiar with good practice in research software engineering and high-performance computing, in addition to having a PhD in lattice quantum field theory or equivalent experience in this area.

Salary
£38,205 to £44,263 per annum

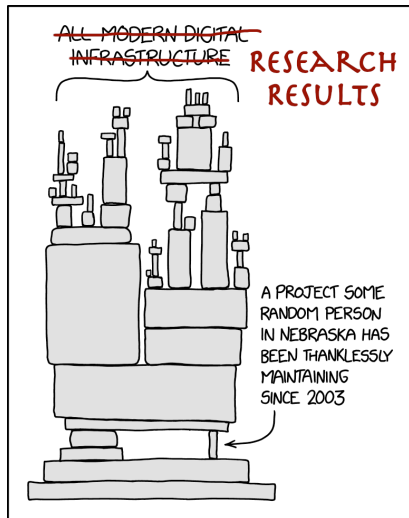
Faculty/Directorate
Faculty of Science and Engineering

Location
Bay Campus, Swansea

Closing Date
5 Mar 2024

Interview Date
15 Mar 2024

Research Software: Just another Domain?



Domain-Specific Knowledge

Analysis

- Research Comprehension

Design and Implementation

- Data Science
- Differential Equations
- Numerical Algorithms
- HPC
- ...

Test

- Benchmarks and Validation

Research Software: Not just another Domain!



Researcher

- Computational Research Experiments
- Grant Applications
- Publications + Presentations

OSS Maintainer

- Open-Source Software (Licenses, Releases, ...)
- Community Building
- Educational Content



New Process Models

- Software will generate new ideas about subject domain
- Frequent lapses of funding
- PhD student collaborators

New SW Architectures and Artefacts

- SW Arch: Between Framework and Prototypes
- Benchmarking Infrastructure
- Benchmark Sets

Conclusions and Working Directions

Summary

- Research relies on Software
 - Software needs Engineering
 - We need Research Software Engineering
-
- RSE is not just another domain!
 - Much to learn about SE for RSE

Working Directions

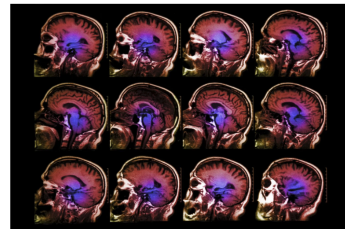
- Actually study / interview research software engineers
- Develop SW arch. / patterns and process models
- Develop RSE education: [SE + R] or [R + SE] or both?

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Bug in fMRI software calls 15 years of research into question

Popular pieces of software for fMRI were found to have false positive rates up to 70%



ISTOCK

A bug in the software used by researchers to interpret fMRI data could invalidate fifteen years worth of neuroscientific research, a paper claims.

Three of the most popular pieces of software for fMRI – SPM, FSL and AFNI – were all found to have false positive rates of up to 70 per cent. These findings could invalidate “up to 40,000 papers”, researchers claim.

<https://www.wired.co.uk/article/fmri-bug-brain-scans-results>