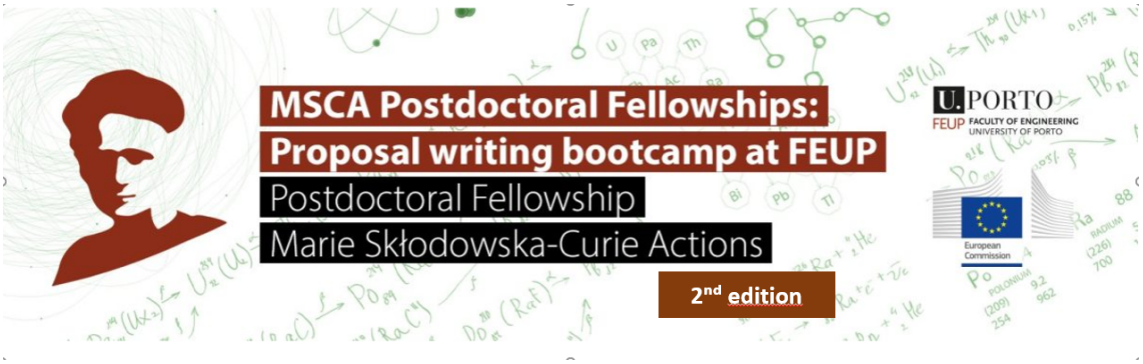
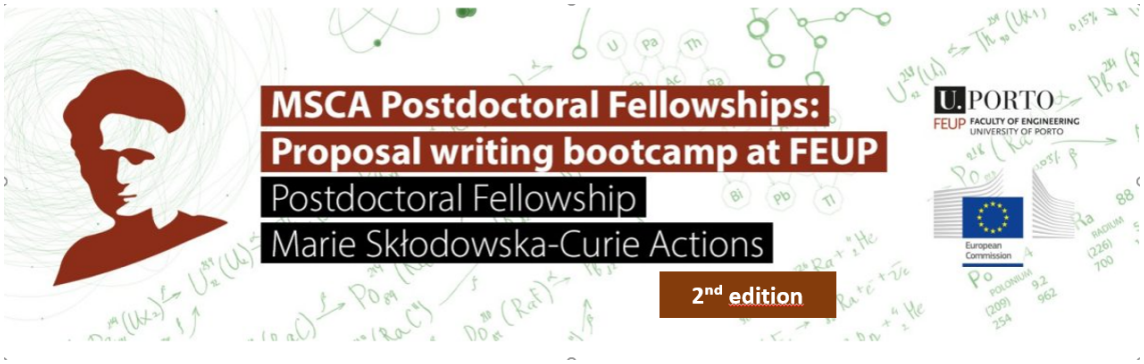


SUPERVISOR INFORMATION	
First and Last name	José Campos
URL of supervisor webpage	https://jose.github.io
Department	Department of Informatics Engineering
Field(s) of research	Quantum Computing, Quantum Software Engineering, Software Testing & Debugging
PROJECT PROPOSAL	
Title (optional)	Harnessing the Power of Quantum Computing to Solve Software Engineering Problems

Brief project description

As software systems grow increasingly complex, the challenges of ensuring their quality and reliability become more pronounced. Software testing and debugging are critical processes in software engineering, yet the computational difficulty of NP-hard problems hinders them. For instance, the problem of finding the set of artificial faults (i.e., mutants) that lead to equivalent mutants or the problem of finding the set of lines of code that are responsible for a software failure. Although several classical approaches have been proposed to address these NP-hard problems [1, 2], or better said, to find an approximated solution, they struggle to handle these problems at scale efficiently and to find the optimum solution. Quantum computing, with its ability to process vast solution spaces and solve classes of problems exponentially faster, presents a groundbreaking opportunity to solve these problems. Thus, this project seeks to harness the unique capabilities of quantum computing to address these problems, advancing the state of the art in software engineering.

In a nutshell, this project aims to leverage the transformative capabilities of quantum computing to tackle NP-hard problems in software engineering, specifically in software testing (concretely, mutation testing) and software debugging (concretely, fault localization). By exploring existing quantum algorithms (e.g., QAOA), this project seeks to develop novel and efficient quantum-enhanced techniques that surpass the capabilities of classical approaches. The research conducted in the context of this project will bridge the gap between theoretical advancements in quantum computing and practical applications in software engineering. It is worth pointing out that others (e.g., [3, 4]) have already shed some light on using quantum computing to solve combinatorial optimization problems in software engineering.



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[3] Hager Hussein, Ahmed Younes, Walid Abdelmoez. “Quantum algorithm for solving the test suite minimization problem”. In Cogent Engineering, 8(1). https://doi.org/10.1080/23311916.2021.1882116

[4] Xinyi Wang, Shaukat Ali, Tao Yue, and Paolo Arcaini. “Quantum Approximate Optimization Algorithm for Test Case Optimization”. In IEEE Transactions on Software Engineering, 2024. https://ieeexplore.ieee.org/abstract/document/10715683/