Francesco Altiero

Change-Aware Regression Test Prioritization with Tree Kernels

Tutor: Prof. Adriano Peron

co-Tutor: Prof. Anna Corazza

Cycle: XXXVI

Year: 2022

My background

- MSc degree in **Computer Science** (July 2020) @ DIETI UNINA
  - MSc Thesis: *Source Code Similarity using Abstract Syntax Trees and Partial Tree Kernels*
- ITEE Ph.D. started in **November, 2020**
  - Ph.D. fellowship funded by **UNINA**

My Research Group on Prioritization topic:

Prof. Adriano Peron
DIETI - UNINA

Prof. Anna Corazza
DIETI - UNINA

Prof. Sergio Di Martino
DIETI - UNINA

Luigi L. L. Starace
ITEE - UNINA

Research field of interest

Software Testing

- The set of practices aimed to *verify and validate* the software.

- Testing is automatized by *implementing test cases* used to *verify* units and modules of the source code.

- The execution of test suite helps developers to *identify* and *correct* such unintended behavior.

Test Suite

Test 1	Test 2	Test 3	Test 4	Test 5
✔	✔	✘	✔	✘

Summary of study activities

	Courses	Seminars	Research	Tutorship
Second Year	14	5.4	44	0
Expected	10-20	5-10	30-45	0-1.6

Courses Attended:
- **Imprenditorialità Accademica**, held by Prof. Pierluigi Rippa, Dip. Ingegneria Industriale, UNINA
- **Neural Networks and Deep Learning**, held by Prof. Giorgio Carlo Buttazzo, Scuola Superiore Sant'Anna, Pisa
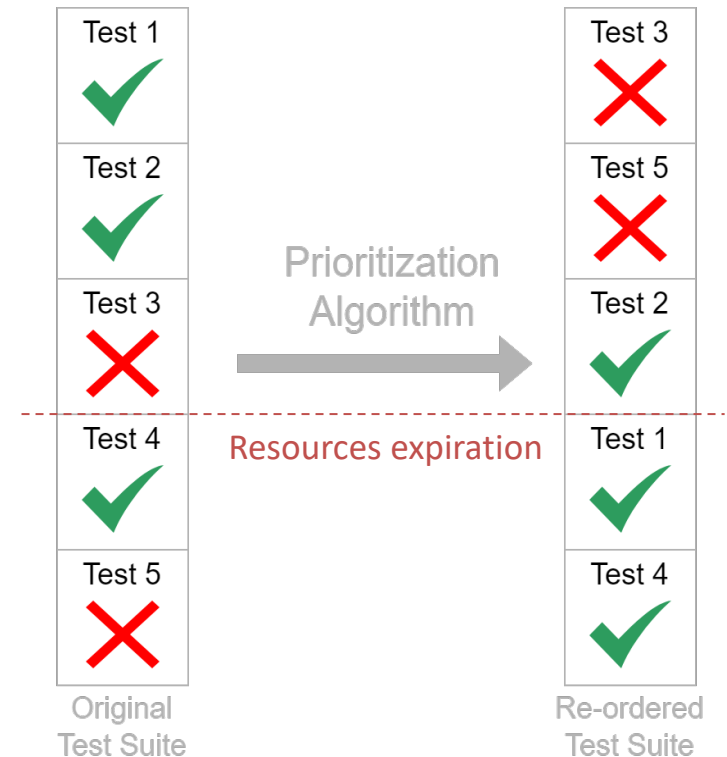
Workshop and Conferences Attended:
- **Ital-IA 2022** Workshop, 10.02.2022 @ Turin, Italy, in virtual mode
- **19th International Conference on Mining Software Repositories (MSR22)**, 18-20.05.2022 @ Pittsburgh, PA, USA, in virtual mode
- **48th Euromicro Conference Series on Software Engineering and Advanced Applications (SEAA22)**, 31.08-2.09.2022 @ Maspalomas, Gran Canaria, Spain

Research activity: Overview 1/2

Regression Test Prioritization: Given a test suite, produce a *permutation* of test-cases which *maximizes* some desirable property.

- Often applied when the execution of the whole set of tests is unfeasible due to constraints.

- Benefits of testing activity are high even if the execution is abruptly interrupted.

- Of particular importance to **software companies** having strict time-to-market times.

Test 1 ✔
Test 2 ✔
Test 3 ✖
Test 4 ✔
Test 5 ✖

Original Test Suite

Prioritization Algorithm

Resources expiration

Test 3 ✖
Test 5 ✖
Test 2 ✔
Test 1 ✔
Test 4 ✔

Re-ordered Test Suite

Research activity: Overview 2/2

- **Objective**

  Propose and evaluate novel prioritization techniques leveraging structural similarity of changes in the code using **Tree Kernels** on **Abstract Syntax Trees**

- **Methodology**

  1. Collect **datasets** to perform experiments
  2. Prioritize test cases **covering code units with high rate of change**
  3. Statistically **evaluate performances** using common metrics to **compare *with state-of-the-art approaches***

Research Products: Datasets

❑ **ICSE16 dataset**

- ▪ **33** software versions across **6** open-source Java projects
- ▪ Source code and per-test coverage reports
- ▪ Faults **injected artifically** through software **mutation**
- ▪ Projects were used in a well-known paper [1] and recollected

❑ **ReCover dataset**

- ▪ **228** software versions across **22** open-source Java projects
- ▪ Collected through an *ad-hoc* designed **mining tool**
- ▪ Source code and per-test coverage reports
- ▪ **Real-world** faults

[1] Y. Lu *et al*., "How Does Regression Test Prioritization Perform in Real-World Software Evolution?," *2016 IEEE/ACM 38th International Conference on Software Engineering (ICSE)*, 2016, pp. 535-546, doi: 10.1145/2884781.2884874.

Research Products: TCP approaches

- **Genetic-Diff Prioritization**
  - A **genetic algorithm** approach to TCP
  - Novel objective function: **APTC on changes**
  - Novel crossover operator: **Churn-Priority Crossover**
  - Better APFD performance than other state-of-the-art Genetic approaches

- **Quotient-Set Prioritization**
  - Partition test-suite in **equivalence classes** according to the structural changes test cases cover
  - Test cases are taken from equivalence classes in a **round-robin** fashion
  - Enhances the performances of the sole **Tree Kernel** prioritization

Papers

[P1]	F. Altiero, A. Corazza, S. Di Martino, A. Peron, L. L. L. Starace, "Fine-grained Source Code Similarity with Tree Kernels to Support Software Testing,", *Ital-IA 2022 – Convegno Nazionale CINI sull'Intelligenza Artificiale (ITAL-IA22)*, 2022. **Status: Published online**
[P2]	F. Altiero, A. Corazza, S. Di Martino, A. Peron and L. L. L. Starace, "ReCover: a Curated Dataset for Regression Testing Research," *2022 IEEE/ACM 19th International Conference on Mining Software Repositories (MSR)*, 2022, pp. 196-200, doi: 10.1145/3524842.3528490. **Status: Published**
[P3]	F. Altiero, G. Colella, A. Corazza, S. Di Martino, A. Peron and L. L. L. Starace, "Change-Aware Regression Test Prioritization using Genetic Algorithms," *48th Euromicro Conference Series on Software Engineering and Advanced Applications (SEAA22)*, 2022. **Status: Accepted and in Publication**

Next Year…

- Extend the empirical evaluation to projects with *real faults*
  - Perform the evaluation on *ReCover*
  - Collect other projects to increase the generality of studies
- Refine strategies to consider also *semantical changes* along with *structural changes*
  - e.g., tuning Tree Kernels to highlight more error-prone changes
- Define methods to not depend on code coverage
  - In some context coverage reports are not updated at the same pace as the software does

Thanks for your attention!

Any questions? Mail me at francesco.altiero@unina.it

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