Thesis research: Reproducibility in Search-Based Software Engineering

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Outline

1. Introduction
2. Motivation
3. Progress So Far
4. Goal Requirement

Introduction

Search-Based Software Engineering (SBSE)

The term SBSE was first used in 2001 by Harman and Jones [1]

Trend in SBSE

Multi Objective Optimization (MOO)

Many-Objective Publications

Trend

$$\text{Minimize} \quad O(\vec{x}) = [O_1(\vec{x}), O_2(\vec{x}), \ldots, O_k(\vec{x})]$$

$$\text{Subject to} \quad G(\vec{x}) = [g_1(\vec{x}), g_2(\vec{x}), \ldots, g_m(\vec{x})] \geq 0$$
$$H(\vec{x}) = [h_1(\vec{x}), h_2(\vec{x}), \ldots, h_r(\vec{x})] = 0$$
$$\mathrm{x_i^L} \leq x_i \leq x_i^U, i = 1, \ldots, n$$

Where

$\vec{x} = \langle x_1, x_2, \ldots, x_n \rangle^T$ is a vector of decision variables;
k is the number of objectives O_i;
m inequality and r equality constraints
x_i^L and x_i^U are respectively the lower and upper bound for each decision variable x_i

Figure 1: Fig. 1. MOO Formalization

Sr. No.	Year	No. of Multi/Many Objective Optimization Problems Related Papers Published	Number of Papers
1	2005	1	1
2	2006	1	1
3	2007	1	1
4	2008	2	7
5	2009	7	7
6	2010	7	7
7	2011	10	10
8	2012	12	12
9	2013	18	20
10	2014	21	22
11	2015	19	20
12	2016	27	28
13	2017	25	26

Table 1: Number of Papers Published in Major Conferences and Journals in Recent Years [4]

Definition:

1. **SBSE** [1]
    - SBSE converts a software engineering problem into a computational search problem that can be tackled with a metaheuristic.
    - Some Examples are Tabu Search and Evolution Algorithms
2. **Metaheuristic** [2]
    - higher-level procedure or heuristic designed to find, generate, or select a heuristic (partial search algorithm) that may provide a sufficiently

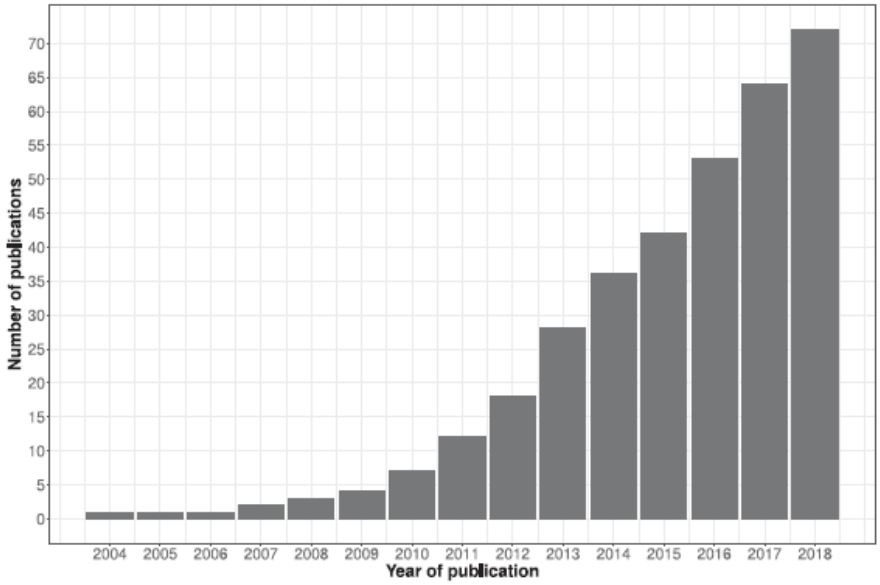

Figure 2: Fig. 2. Cumulative number of many-objective publications in SBSE (3)

Motivation

- Reproducibility computer science and other fields is a well-recognized problem.

- SBSE Falls under the same issues faced by the software engineering problems of reproducing and replicating code and algorithms
  - The Meta-Heuristic factor plays an important role in this matter
- Software engineering and computer scientists research does not fall under the same scrutiny of developers
  - Developers have to always check, refactor, and update their code on a continuous cycle
  - they have to work with ever changing team so interchangeability and exchange of codes has to smooth
  - create tests to validate the code
    - unit vs functional testing
  - Try not to reinvent the wheel
- As the number of SBSE publications increase, so does the need to validation
  - with the number of researches depending on previous work
- Simplify Scalability in SBSE
- Help Future research create easier reproducible and replicable code and results
- Test against real world valued attributed variability models

References

[1] M. Harman and B. F. Jones, "Search-based software engineering," Information and Software Technology, vol. 43, no. 14, pp. 833–839, Dec. 2001.

[2] L. Bianchi, M. Dorigo, L. M. Gambardella, and W. J. Gutjahr, "A survey on metaheuristics for stochastic combinatorial optimization," Nat Comput, vol. 8, no. 2, pp. 239–287, Jun. 2009.

[3] A. Ramírez, J. R. Romero, and S. Ventura, "A survey of many-objective optimization in search-based software engineering," *Journal of Systems and Software*, vol. 149, pp. 382–395, Mar. 2019.

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