A New Taxonomy of Software Testing Approaches

Seeking More Standardized Standards

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Goal

Taxonomy of software testing approaches

- Should be **systematic, rigorous, and "complete"**
- Application: **automatically generating test cases** in Drasil
- The **underlying domain** should drive the scope and prerequisites for generated test cases

Problem

Existing software testing taxonomies are inadequate

- Tebes et al. (2020): focuses on parts of the testing process (e.g., test goal, testable entity)
- Souza et al. (2017): prioritizes organizing testing approaches over defining them
- Unterkalmsteiner et al. (2014): focuses on knowledge transfer between development phases

Methodology

Since a taxonomy doesn't already exist, we should create one!

- Start from **"standard" resources** (e.g., IEEE [1], [2], [3], [4]; the SWEBOK Guide [5])
- **Collect** relevant information (over 500 testing approaches and 70 software qualities, along with their definitions) and **organize** it into spreadsheets
- *Note: static testing approaches are included, since they are sometimes included in "software testing" [1, p. 17], [3, p. 440], [5, p. 5-2]*
- Iterate this process until there are diminishing returns, implying that something approaching a **complete taxonomy** has emerged!
- Since there are many standardized documents about software testing (or software in general), **this should be trivial, no?**

In Our Experience...

NO.

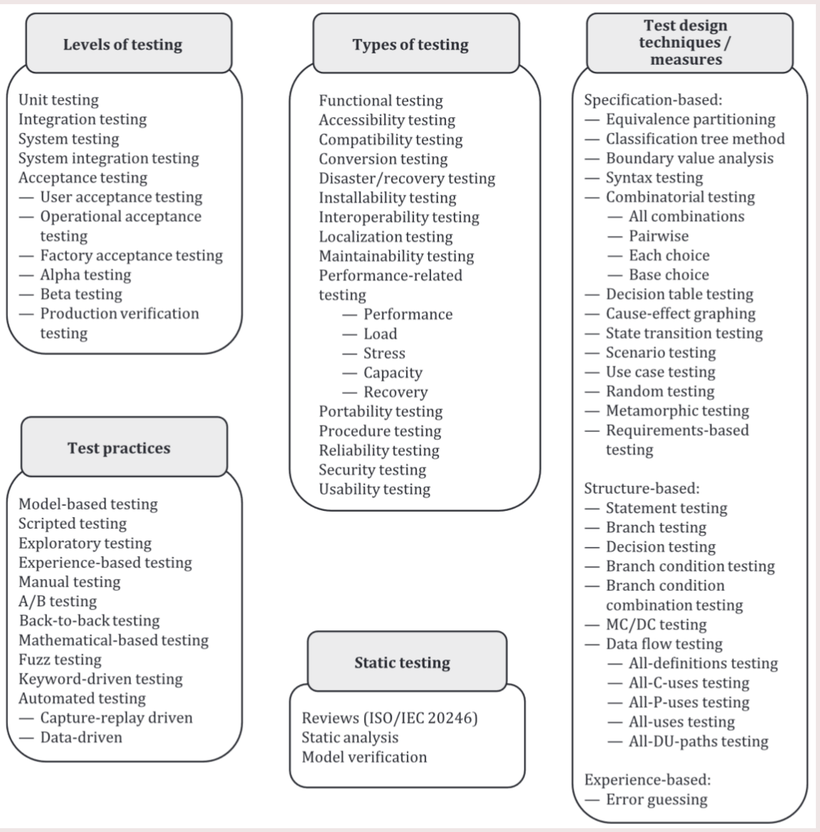

Figure 1: Classification of some "test approach choices" [1, p. 22].

The classification of testing approaches in Figure 1 *appears* logical but contains the following ambiguities:

- Experience-based testing is both a test design technique *and* a test practice
- Pairs of terms are not distinguished:
  - Disaster/recovery testing and recovery testing
  - Branch condition testing and branch condition combination testing
  - Operational acceptance testing and operational testing [3, p. 303]

More Examples

[1] and [2] are software testing standards that leave much unstandardized (see Figure 2)

- About 20% (23 out of 114) of testing approaches from these standards **do not have a definition**!
- Five of these were (at the very least) described in the previous version of this standard [4]
- Four were present in the same way in another IEEE standard [3] before this one was published

Having definitions does not mean they are useful; see Figure 3 for some good (bad?) examples

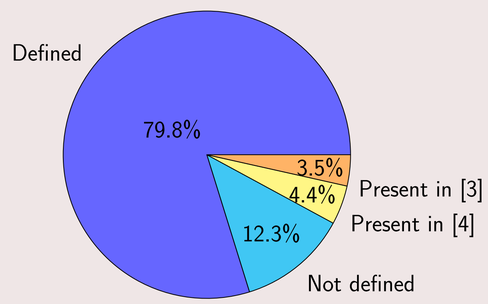

Figure 2: Breakdown of testing approach definitions in [1] and [2].

software element
1. system element that is software
cf. system element, software/system element

event sequence analysis
1. per

operable
1. state of

device
1. mechanism or piece of equipment designed to serve a purpose or perform a function
cf. platform

Figure 3: Less-than-helpful definitions [3, pp. 421, 170, 136, 301 (counterclockwise from top)]. Note: "equipment" is not defined, and "mechanism" is only defined as how "a function ... transform[s] input into output" [p. 270].

The SWEBOK Guide's Definition of "Scalability Testing"

"Scalability testing evaluates the capability to use and learn the system and the user documentation. It also focuses on the system's effectiveness in supporting user tasks and the ability to recover from user errors" [5, p. 5-9]

- This seems to define "usability testing" with elements of functional and recovery testing
- The SWEBOK Guide's definition of elasticity testing [5, p. 5-9] only cites a single source **that doesn't contain the words "elasticity" or "elastic"**!

Alpha testing is quite common, but there is disagreement on who performs it:

1. "users within the organization developing the software" [3, p. 17],
2. "a small, selected group of potential users" [5, p. 5-8], or
3. "roles outside the development organization" [6]

Conclusions & Future Work

- Current software testing taxonomies are **incomplete, inconsistent, and/or incorrect**
- Ideally, one will be built systematically from a large body of established sources
- We will continue investigating, analyzing, and structuring how the literature defines and categorizes software testing approaches
- This **broad and consistent taxonomy** will hopefully grow as the field of testing advances

References

[1] ISO/IEC and IEEE, "ISO/IEC/IEEE International Standard - Systems and software engineering –Software testing –Part 1: General concepts," *ISO/IEC/IEEE 29119-1:2022(E)*, Jan. 2022.

[2] ISO/IEC and IEEE, "ISO/IEC/IEEE International Standard - Software and systems engineering –Software testing –Part 4: Test techniques," *ISO/IEC/IEEE 29119-4:2021(E)*, Oct. 2021.

[3] ISO/IEC and IEEE, "ISO/IEC/IEEE International Standard - Systems and software engineering–Vocabulary," *ISO/IEC/IEEE 24765:2017(E)*, Sept. 2017.

[4] ISO/IEC and IEEE, "ISO/IEC/IEEE International Standard - Systems and software engineering –Software testing –Part 1: General concepts," *ISO/IEC/IEEE 29119-1:2013*, Sept. 2013.

[5] H. Washizaki, ed., *Guide to the Software Engineering Body of Knowledge, Version 4.0*. Jan. 2024.

[6] M. Hamburg and G. Mogyorodi, eds., "ISTQB Glossary, v4.3," 2024.

Acknowledgments

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