Putting Software Testing Terminology to the Test

M.A.Sc. Seminar

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The Need for Standardized Terminology

- Engineering is applied science
- Scientific fields use precise terminology

$\Rightarrow$ SOFTWARE ENGINEERING

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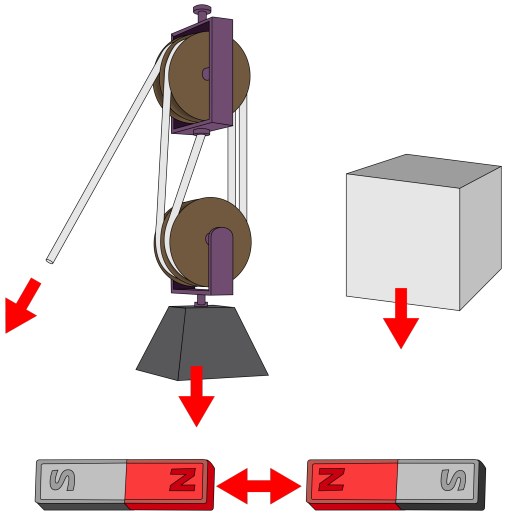
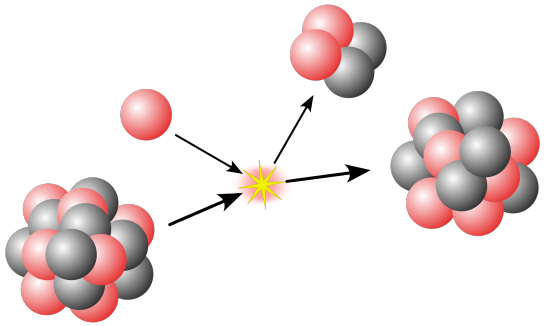
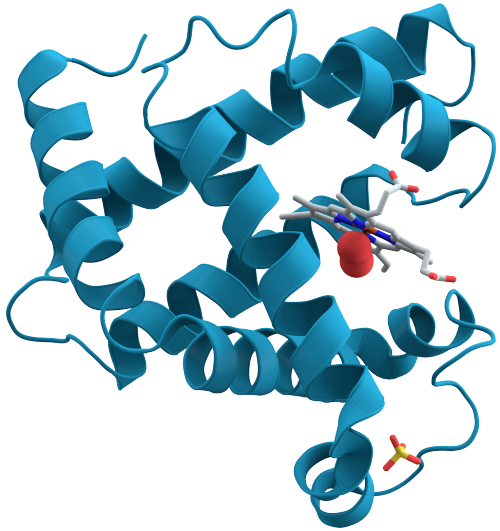


Penubag and Ramey (2010)



Kjerish (2016)



AzaToth (2008)

The Lack of Standardized Terminology

"The Problem"

- Unfortunately, a search for a systematic, rigorous, and complete taxonomy for software testing revealed that the existing ones are inadequate and mostly focus on the high-level testing process rather than the testing approaches themselves:
  - Tebes et al. (2020) focus on *parts* of the testing process (e.g., test goal, test plan, testing role, testable entity) and how they relate to one another,
  - Souza et al. (2017) prioritize organizing testing approaches over defining them, and
  - Unterkalmsteiner et al. (2014) focus on the "information linkage or transfer" (p. A:6) between requirements engineering and software testing and "do[] not aim at providing a systematic and exhaustive state-of-the-art survey of [either domain]" (p. A:2).

Unstandardized Standards

"The Problem" (cont.)

- Tours "guide[] testers through the paths of an application" by following a structure that is:
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  - quite general (ISO/IEC and IEEE, 2022, p. 34)
  - "organized around a special focus" (Hamburg and Mogyorodi, 2024)
- Load testing is "conducted to evaluate the behaviour of a test item under anticipated conditions of varying load" (ISO/IEC and IEEE, 2022, p. 5; 2017, p. 253), such as:
  - loads "between anticipated conditions of low, typical, and peak usage" (2022, p. 5)

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- Load testing is "conducted to evaluate the behaviour of a test item under anticipated conditions of varying load" (ISO/IEC and IEEE, 2022, p. 5; 2017, p. 253), such as:
  - loads "between anticipated conditions of low, typical, and peak usage" (2022, p. 5)
  - loads that are as large as possible (Patton, 2006, p. 86)

Unstandardized Standards

"The Problem" (cont.)

- Alpha testing is the "first stage of testing before a product is considered ready for commercial or operational use" (ISO/IEC and IEEE, 2017, p. 17) performed by:
  - "users within the organization developing the software" (p. 17)

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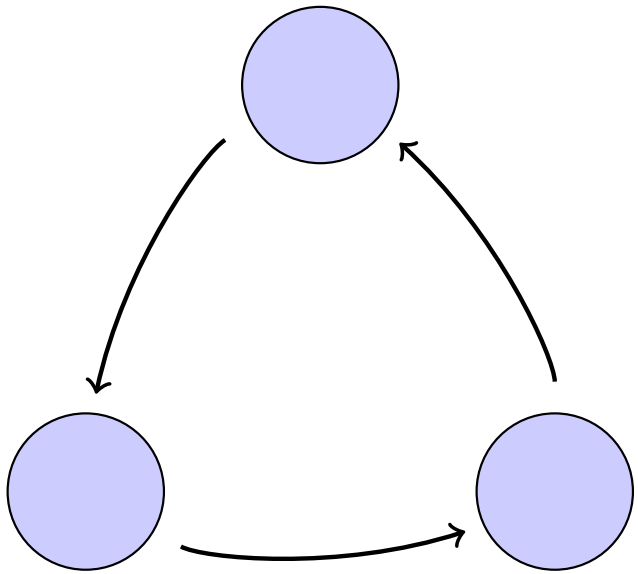
"Okay testing team, we want to conduct alpha testing on our product. What's our timeline? Budget? Sample size?"

Interorganizational

Schools, companies, etc.



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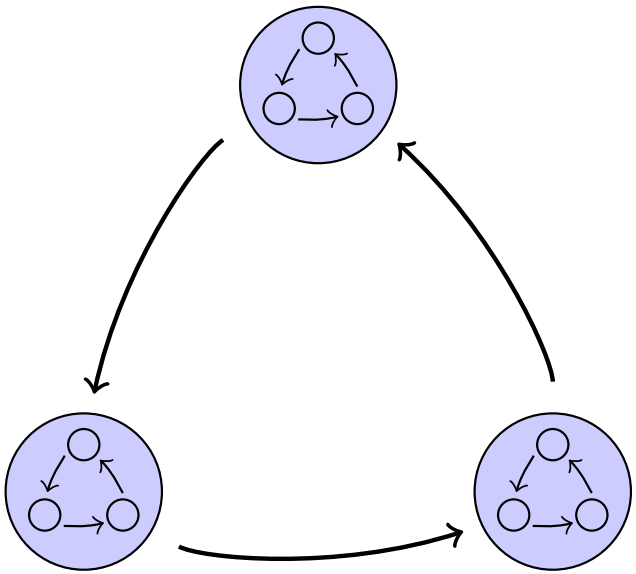

Intraorganizational

"Complete testing" could require the tester to:

- discover every bug,
- exhaust the time allocated,
- implement every planned test,
- . . . (Kaner et al., 2011, p. 7)

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Research Questions

Research Question 1

What testing approaches do the literature describe?

Research Question 2

Are these descriptions consistent?

Research Question 3

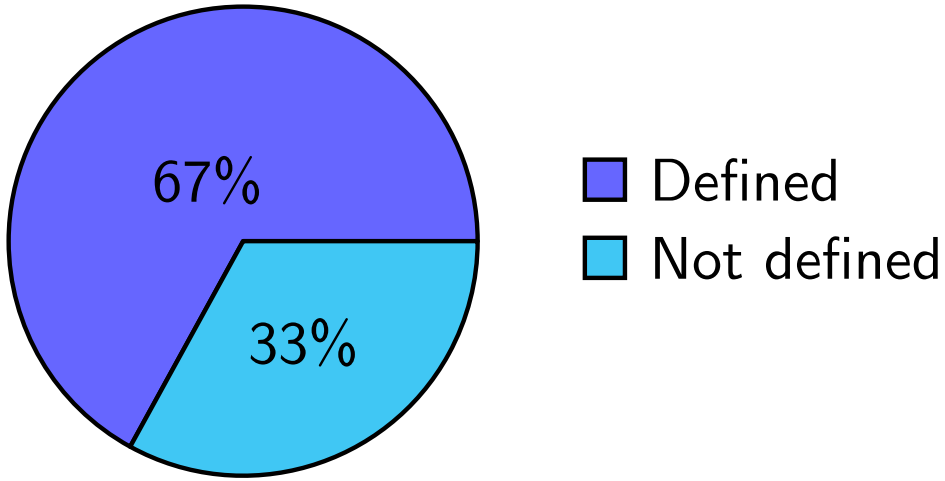
Can we systematically resolve any of these inconsistencies?

Research Questions

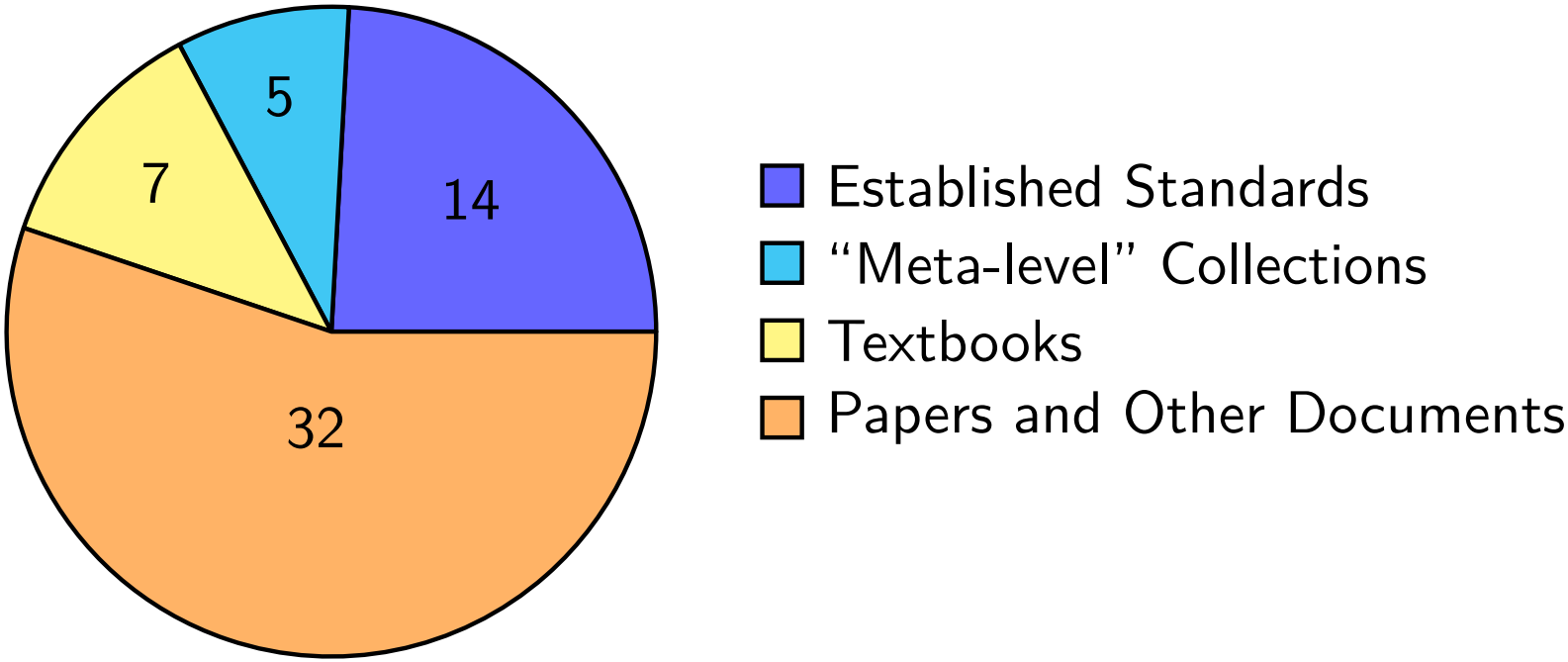
Research Question 1

What testing approaches do the literature describe?

- 527 test approaches $\rightarrow$
- 76 software qualities



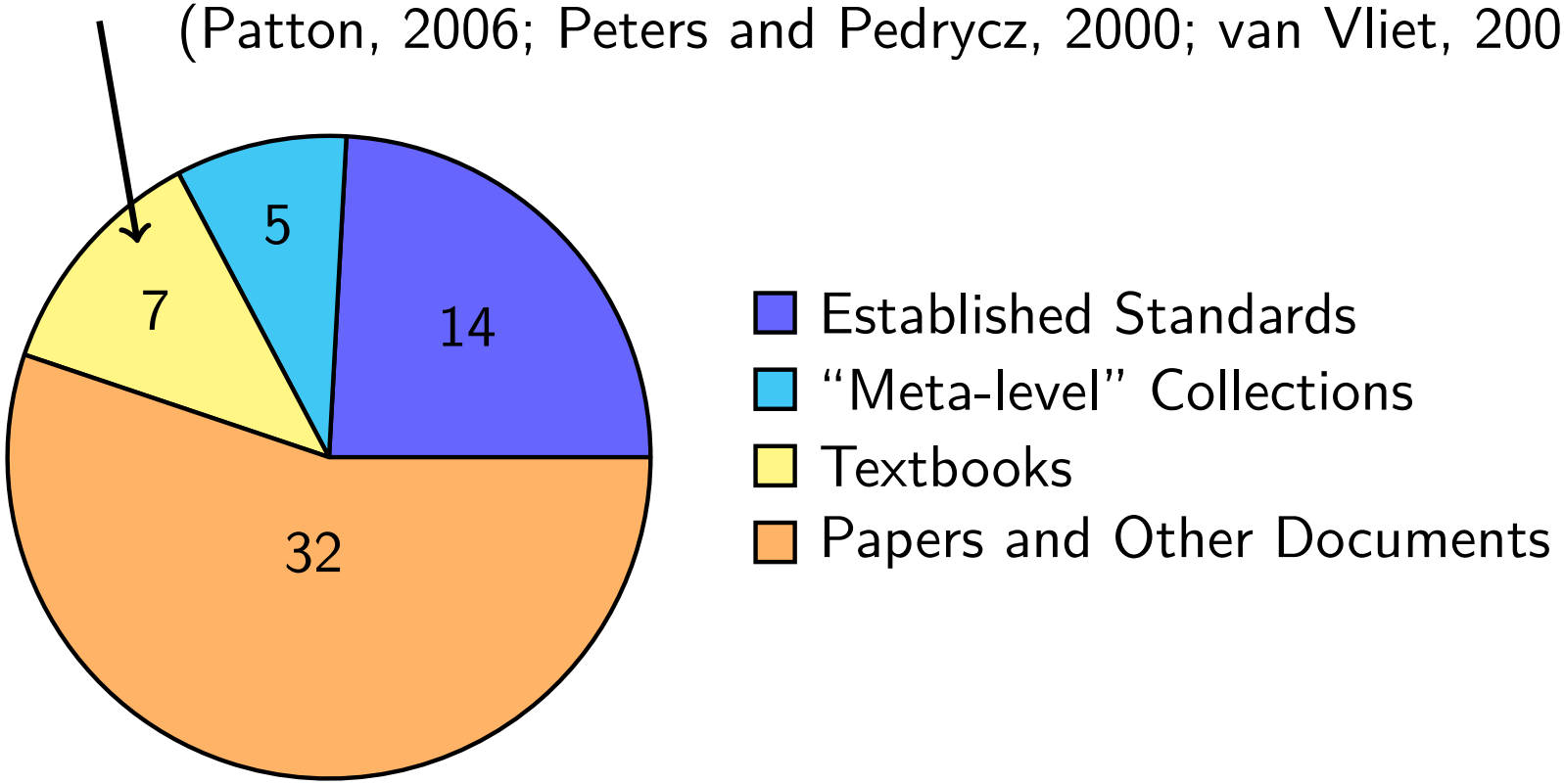
Methodology: Sources



Summary of how many sources comprise each source category.

Methodology: Sources

Textbooks trusted at McMaster were our ad hoc starting points (Patton, 2006; Peters and Pedrycz, 2000; van Vliet, 2000)



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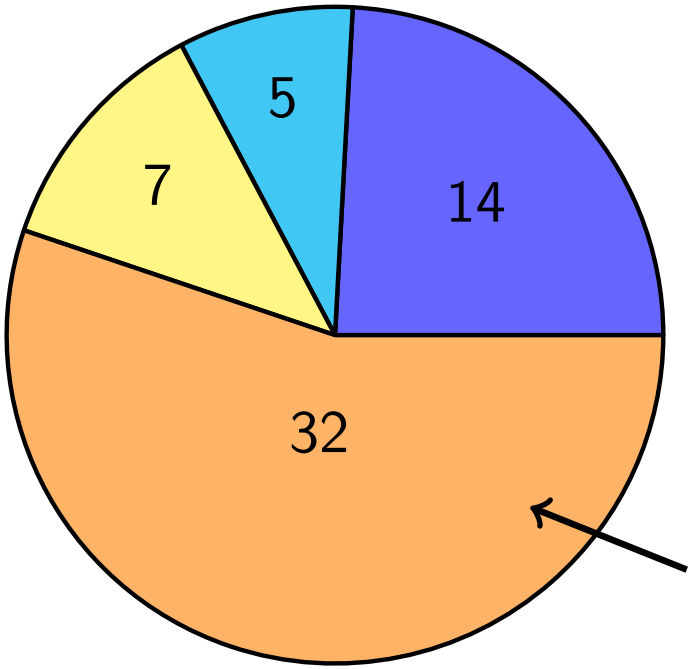
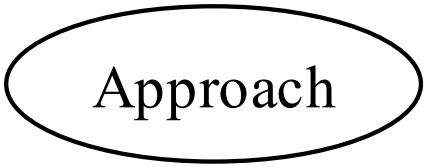


- Established Standards
- "Meta-level" Collections
- Textbooks
- Papers and Other Documents

Includes websites (LambdaTest, 2024; Pandey, 2023) and a booklet (Knüvener Mackert GmbH, 2022)

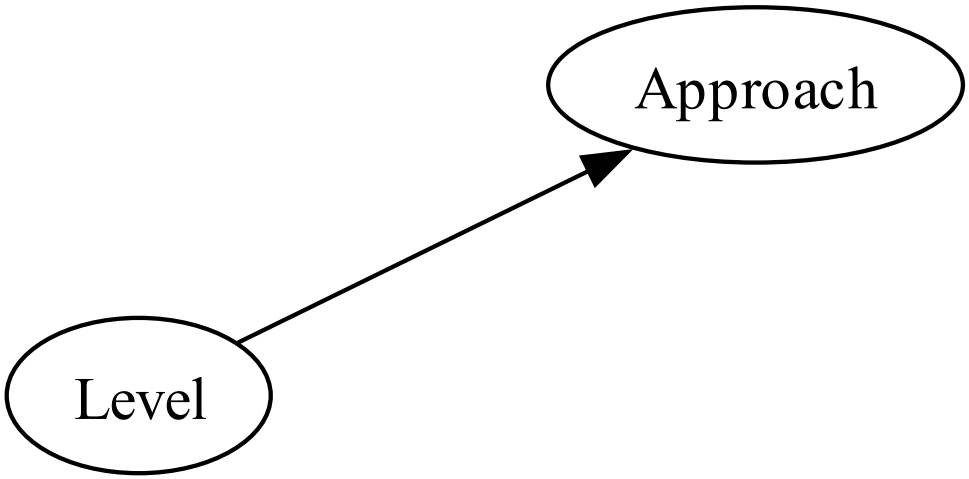
Summary of how many sources comprise each source category.

Methodology: Categories



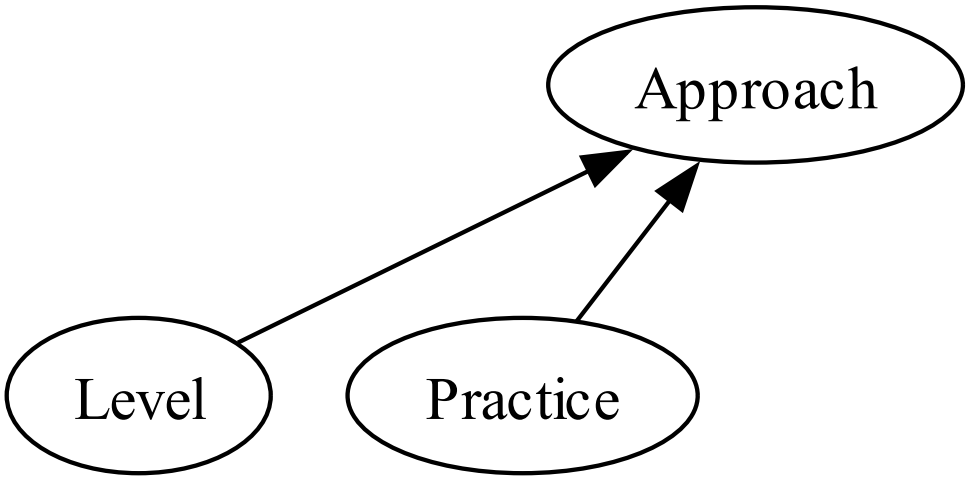
Approach: a "high-level test implementation choice" (ISO/IEC and IEEE, 2022, p. 10) used to "pick the particular test case values" (2017, p. 465)

Methodology: Categories



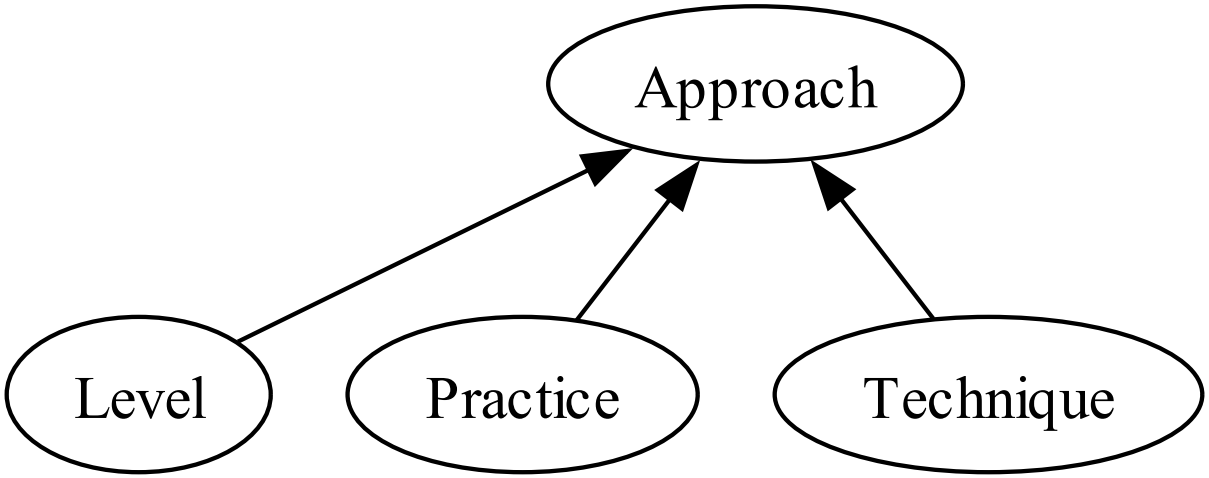
Level: a stage of testing with "particular objectives and . . . risks", each performed in sequence (ISO/IEC and IEEE, 2022, p. 12; 2021, p. 6)

Methodology: Categories



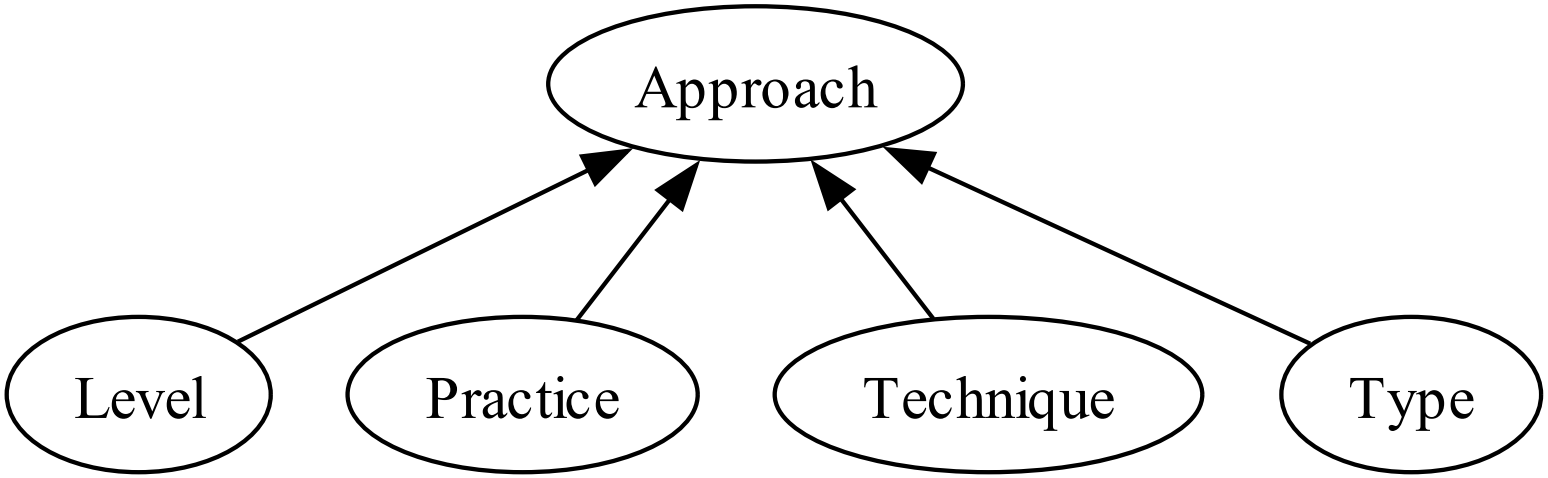
Practice: a "conceptual framework that can be applied to . . . [a] test process to facilitate testing" (ISO/IEC and IEEE, 2022, p. 14; 2017, p. 471)

Methodology: Categories



Technique: a "defined" and "systematic" (ISO/IEC and IEEE, 2017, p. 464) "procedure used to create or select a test model, identify test coverage items, and derive corresponding test cases" (2022, p. 11)

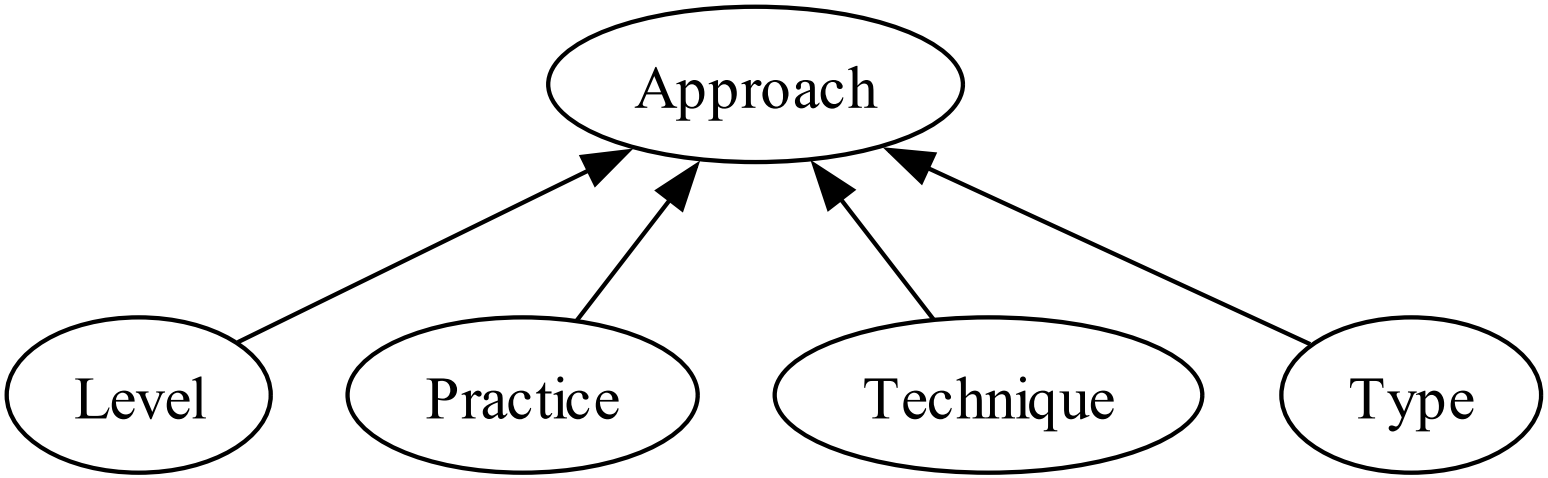
Methodology: Categories



Type: "Testing that is focused on specific quality characteristics" (ISO/IEC and IEEE, 2022, p. 15; 2021, p. 7; 2017, p. 473)

Methodology: Graph Notation

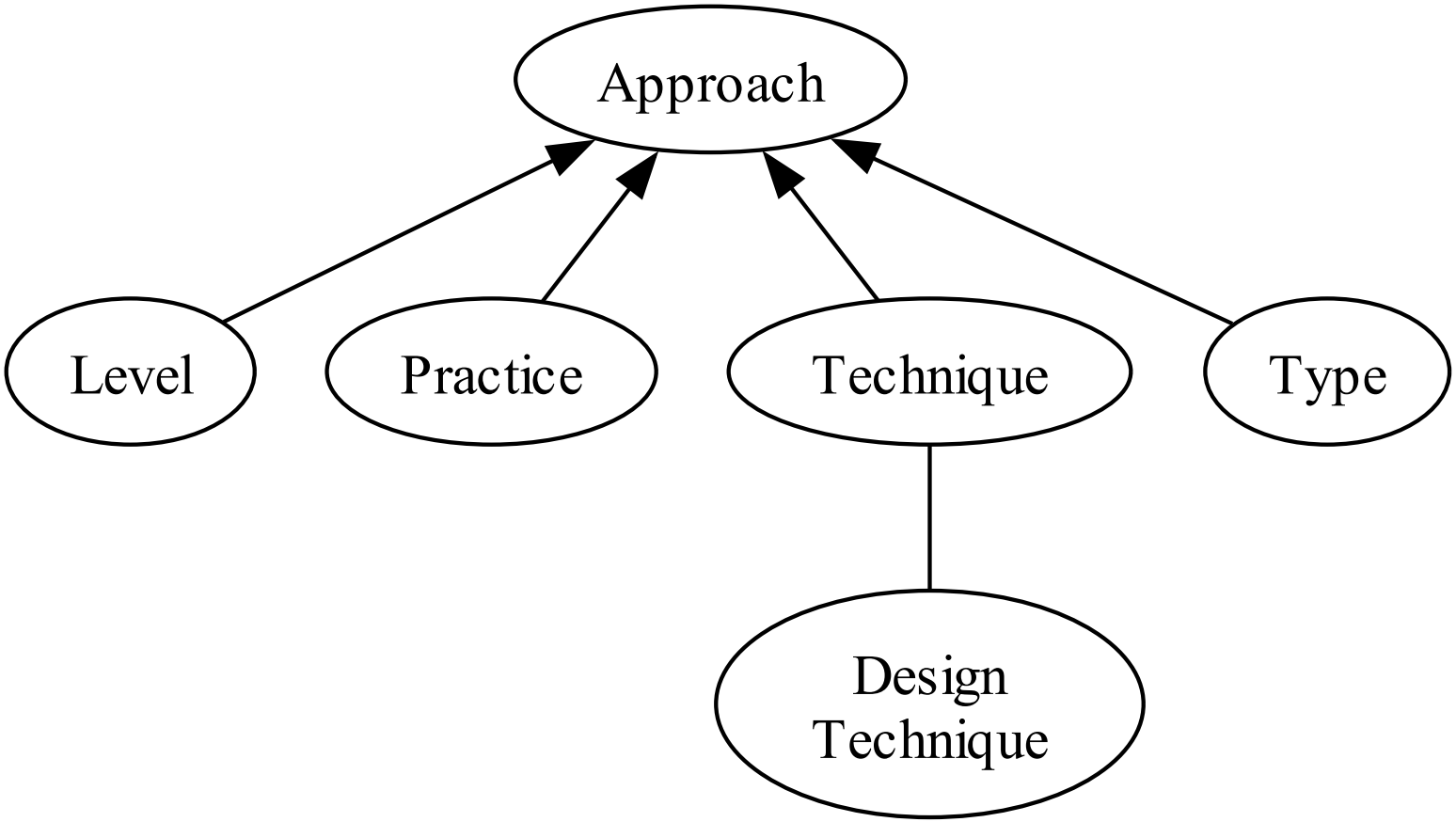
Relations



Arrows point from a *child* node to a *parent* node.

Methodology: Graph Notation

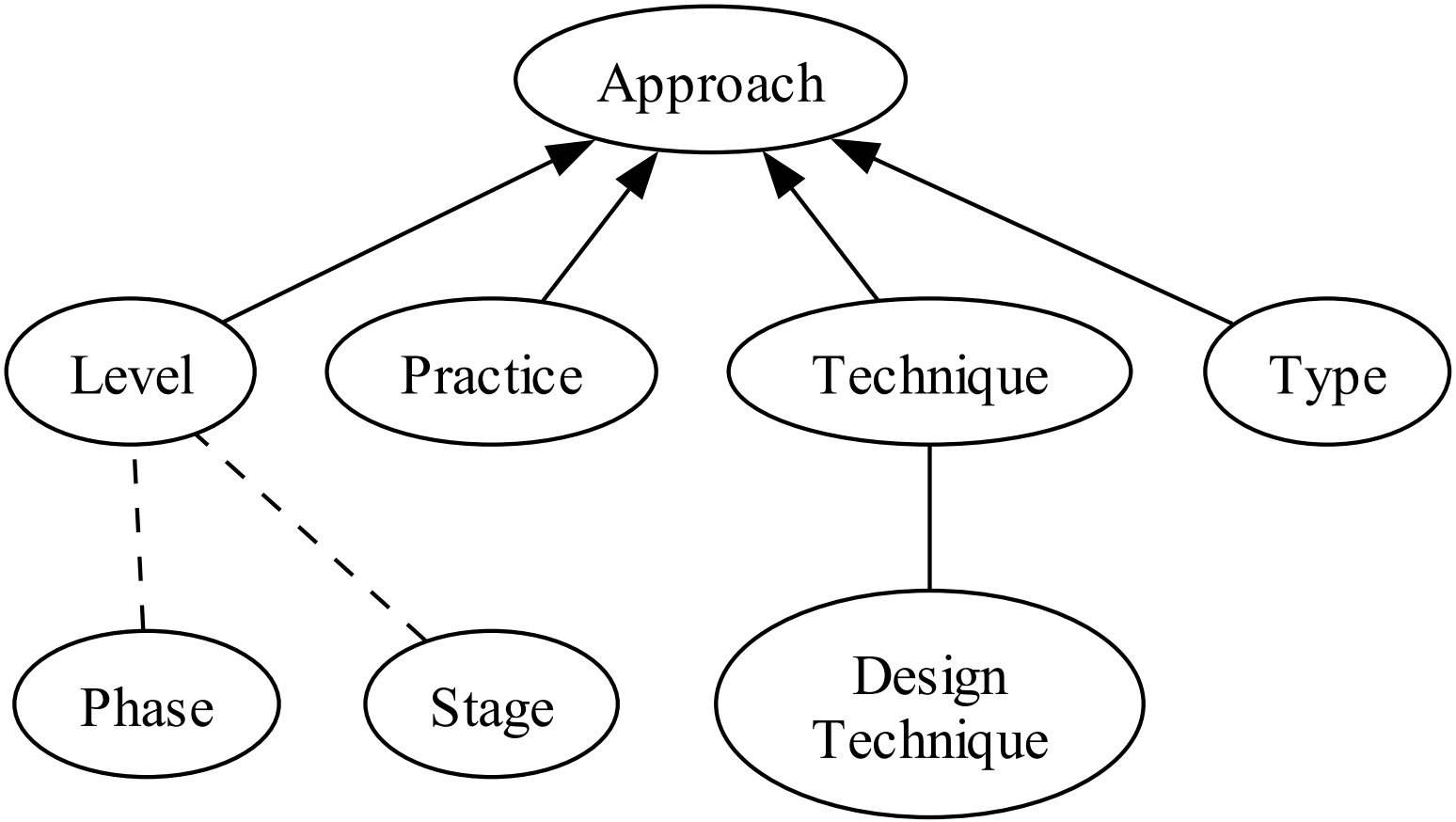
Relations



Lines without arrowheads connect *synonyms*.

Methodology: Graph Notation

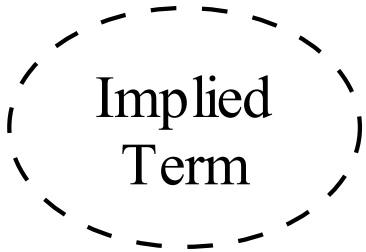
Relations



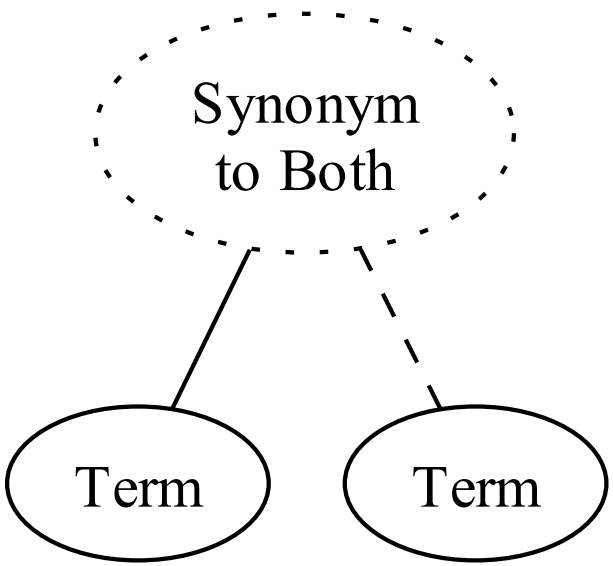
Dashed lines indicate a relationship is *implied*.

Methodology: Graph Notation

Terms

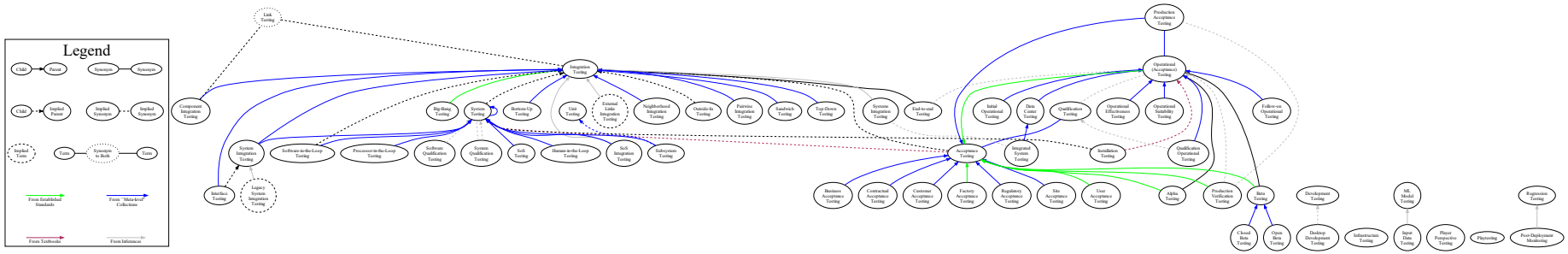


Dashed outlines indicate a term is *implied*.

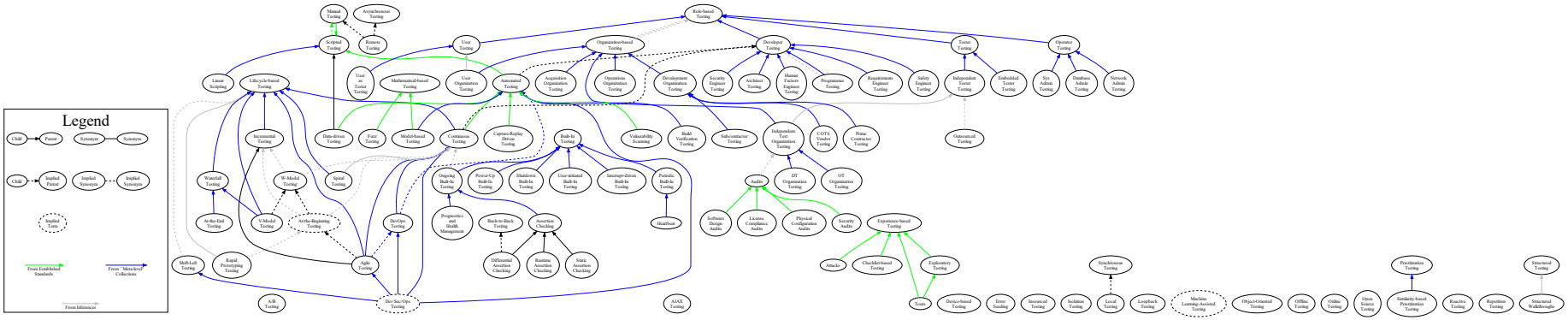


Dotted outlines indicate a term is a *synonym* to more than one term.

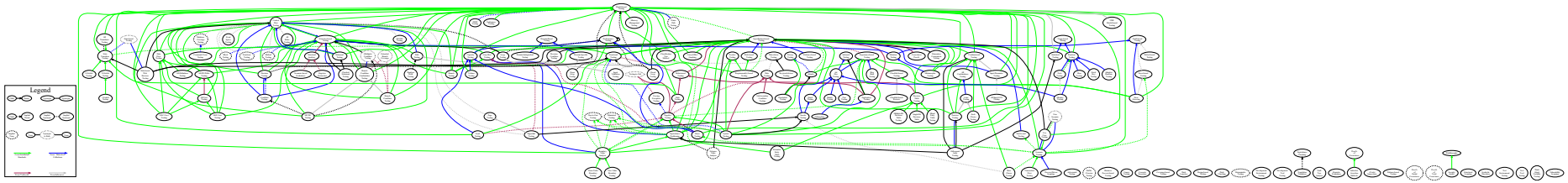
Graph of Test Levels



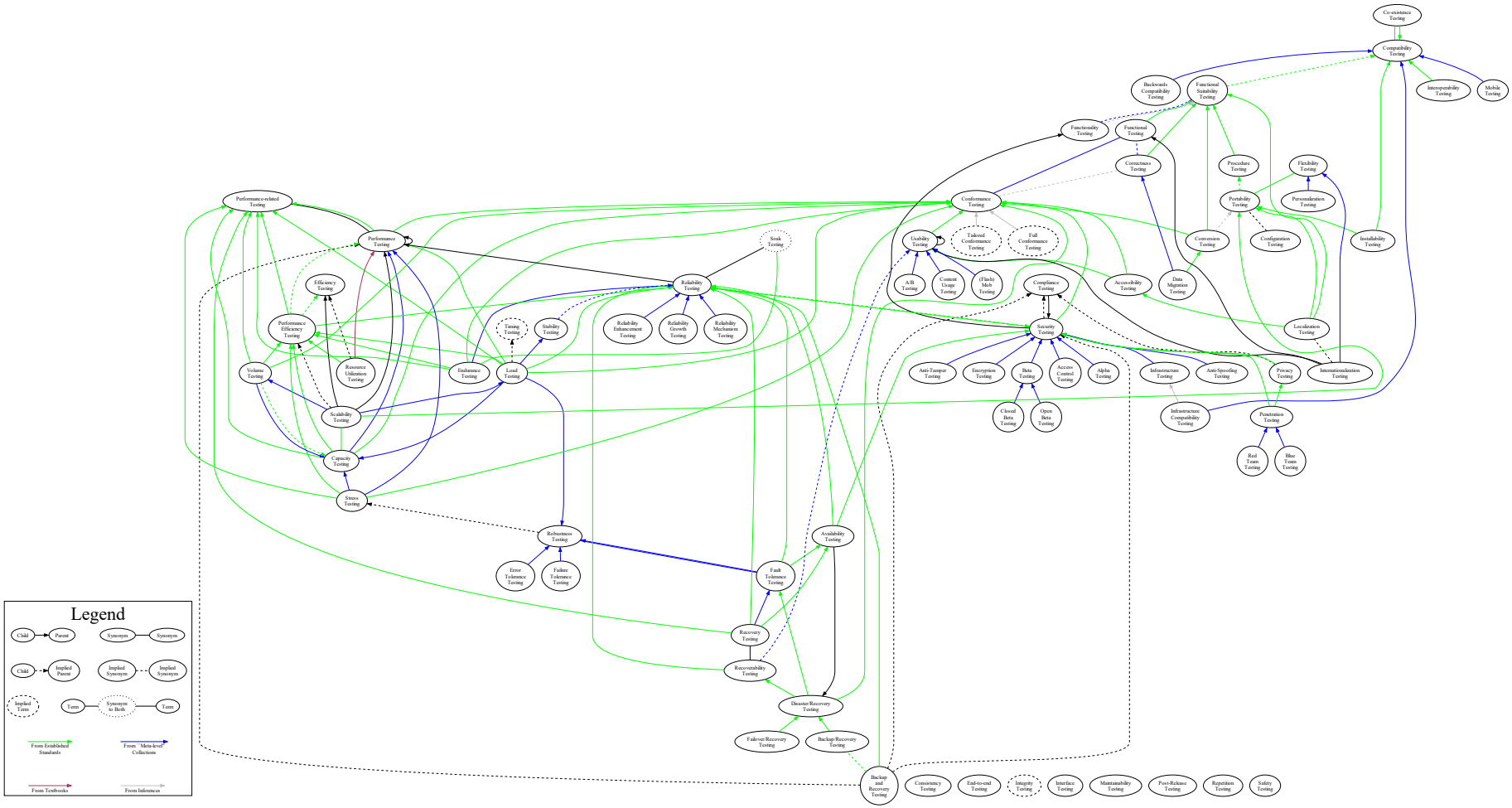
Graph of Test Practices



Graph of Test Techniques

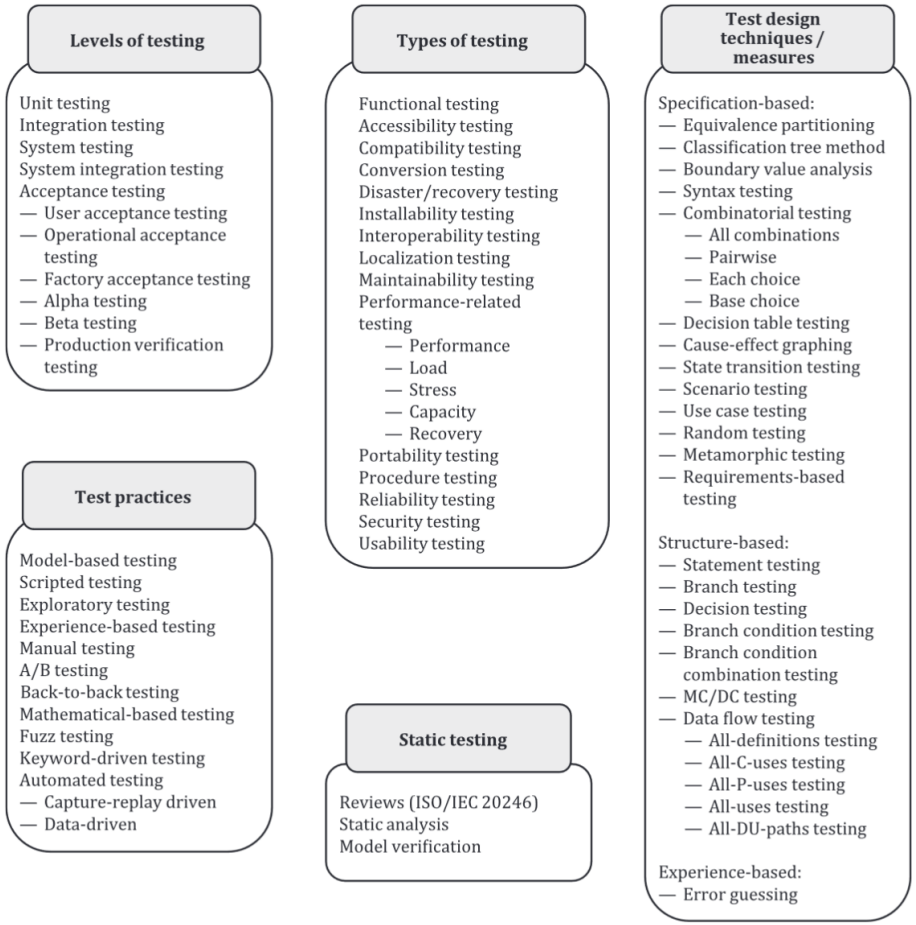


Graph of Test Types



Methodology: Graph Notation

Static Testing



Example test approach choices (ISO/IEC and IEEE, 2022, Fig. 2).

Methodology: Graph Notation

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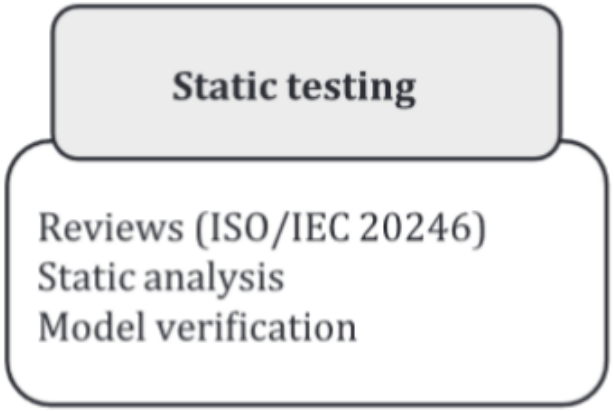

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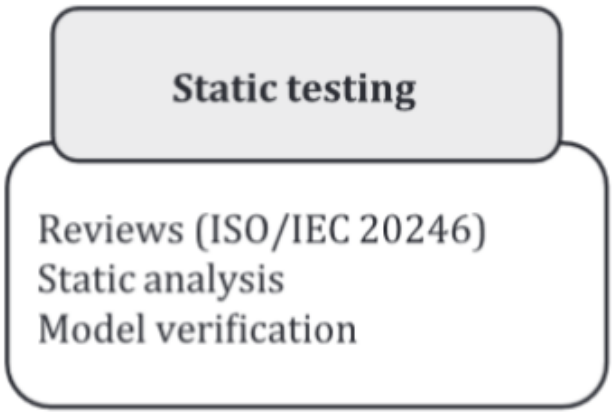

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Methodology: Graph Notation

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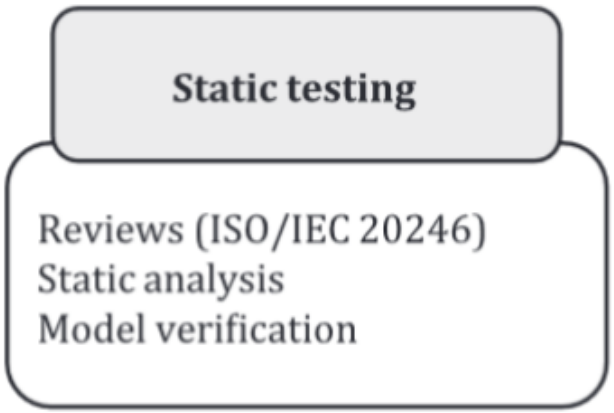

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Methodology: Graph Notation

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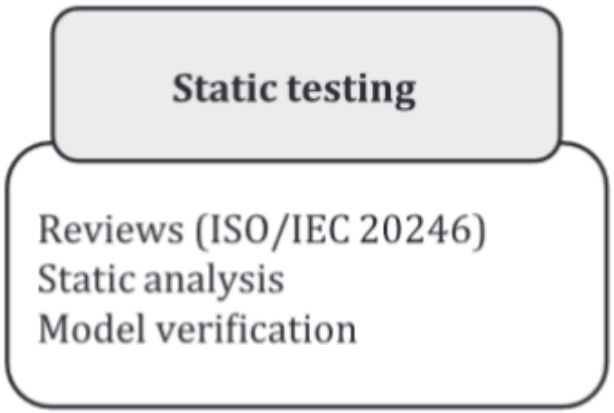

Example test approach choices. Adapted from (ISO/IEC and IEEE, 2022, Fig. 2)

- While our focus is on dynamic testing, we include static testing in our research for completeness
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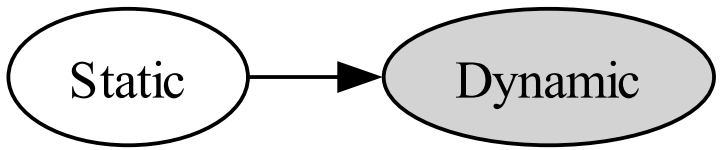
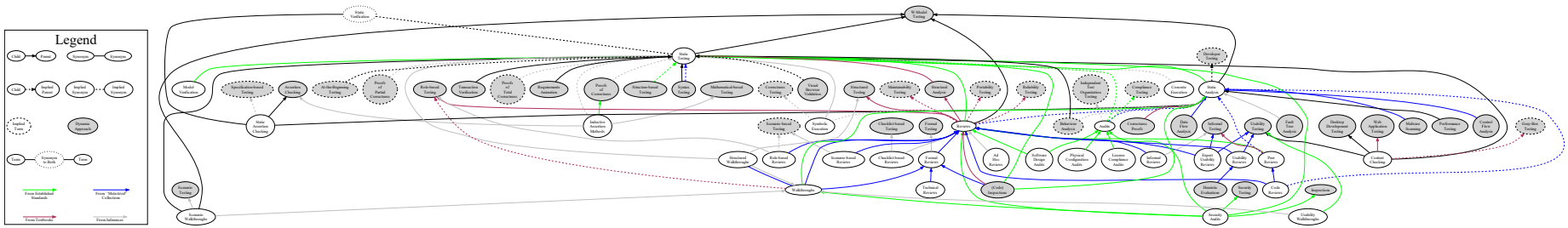
- When considering static testing in isolation, terms with gray backgrounds are related *dynamic approaches*



Graph of *Static* Test Approachs



Methodology: Procedure

Approaches

- A row is created for each test approach, such as the following which is based on (ISO/IEC and IEEE, 2022)

Name	Category	Definition	Parent(s)	Synonym(s)
A/B Testing	Practice (p. 22)	Testing "that allows testers to determine which of two systems or components performs better" (p. 1)	Statistical Testing (pp. 1, 35), ...	Split-Run Testing (pp. 1, 35)

Methodology: Procedure

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- This information is gathered from sources by looking for
  - Glossaries
  - Testing-related terms
  - Terms described *by* other approaches
  - Terms that *imply* other approaches

Methodology: Procedure

Other Information

- It seems that the existence of a software quality implies the existence of a test type associated with it

Methodology: Procedure

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Methodology: Procedure

Other Information

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- Some test approaches use shared or complicated terminology
- For each of these, we record its
  - Name
  - Definition
  - Precedence for a related test type (only for qualities)
  - Synonym(s)

Methodology: Procedure

- Recording these data in a consistent format allows for graphs to be generated according to a certain logic

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- It also allows for subsets of discrepancies to be identified

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Research Question 2

Are these descriptions consistent?

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Automated Discrepancies

- Some terms are given as a synonym to two (or more) disjoint, unrelated terms, making the relation between the given synonyms ambiguous

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- Some terms are given as a synonym to two (or more) disjoint, unrelated terms, making the relation between the given synonyms ambiguous
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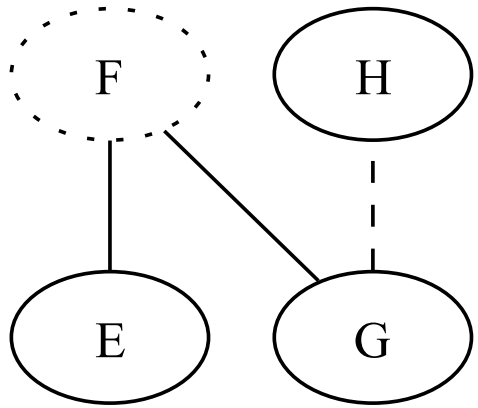
Name	Synonym(s)
E	F (Author, 0000; implied by 0001)
G	F (Author, 0002), H (implied by 0000)
H	X



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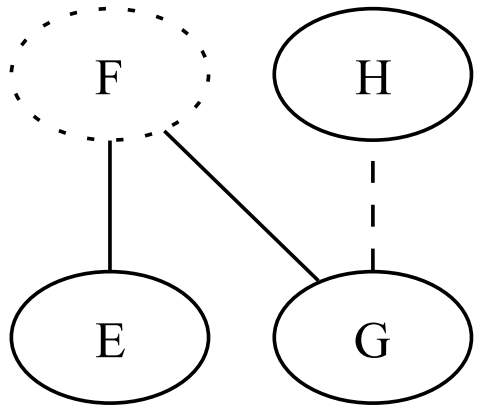

- The following four are the most prominent examples of the ten identified automatically:

Automated Discrepancies

1. **Invalid Testing:**
   - Error Tolerance Testing (Kam, 2008, p. 45)
   - Negative Testing (Hamburg and Mogyorodi, 2024; implied by ISO/IEC and IEEE, 2021, p. 10)
2. **Soak Testing:**
   - Endurance Testing (ISO/IEC and IEEE, 2021, p. 39)
   - Reliability Testing (Gerrard, 2000a, Tab. 2; 2000b, Tab. 1, p. 26)
3. **User Scenario Testing:**
   - Scenario Testing (Hamburg and Mogyorodi, 2024)
   - Use Case Testing (Kam, 2008, p. 48) (although "an actor can be a user or another system" (ISO/IEC and IEEE, 2021, p. 20))
4. **Link Testing:**
   - Branch Testing (implied by ISO/IEC and IEEE, 2021, p. 24)
   - Component Integration Testing (Kam, 2008, p. 45)
   - Integration Testing (implied by Gerrard, 2000a, p. 13)

Acknowledgment

- Dr. Smith and Dr. Carette have been great supervisors in the past and have, both then and now, provided me with valuable guidance and feedback
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- The past and current Drasil team have created a truly amazing framework!

Thank you!

Questions?

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