Putting Software Testing Terminology to the Test

M.A.Sc. Seminar

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Department of Computing and Software

Fall 2024

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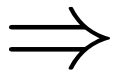
The Need for Standardized Terminology

- Engineering is applied science
- Scientific fields use precise terminology



SOFTWARE ENGINEERING

The Need for Standardized Terminology

- Engineering is applied science
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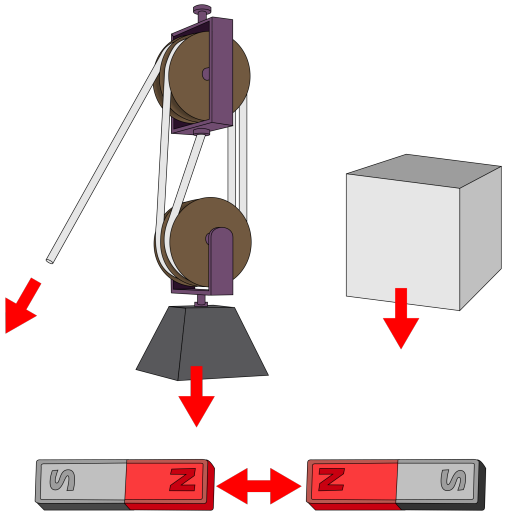
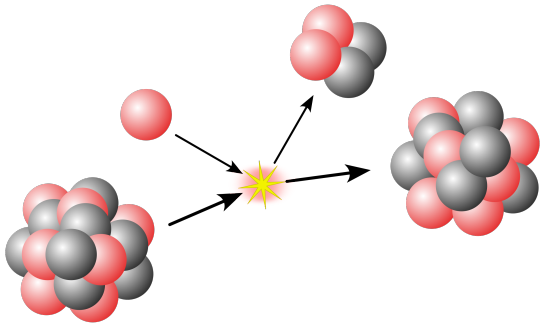
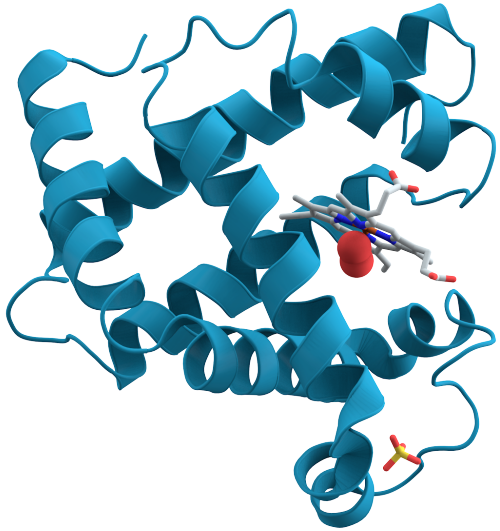
$\Rightarrow$ SOFTWARE ENGINEERING



Penubag and Ramey (2010)



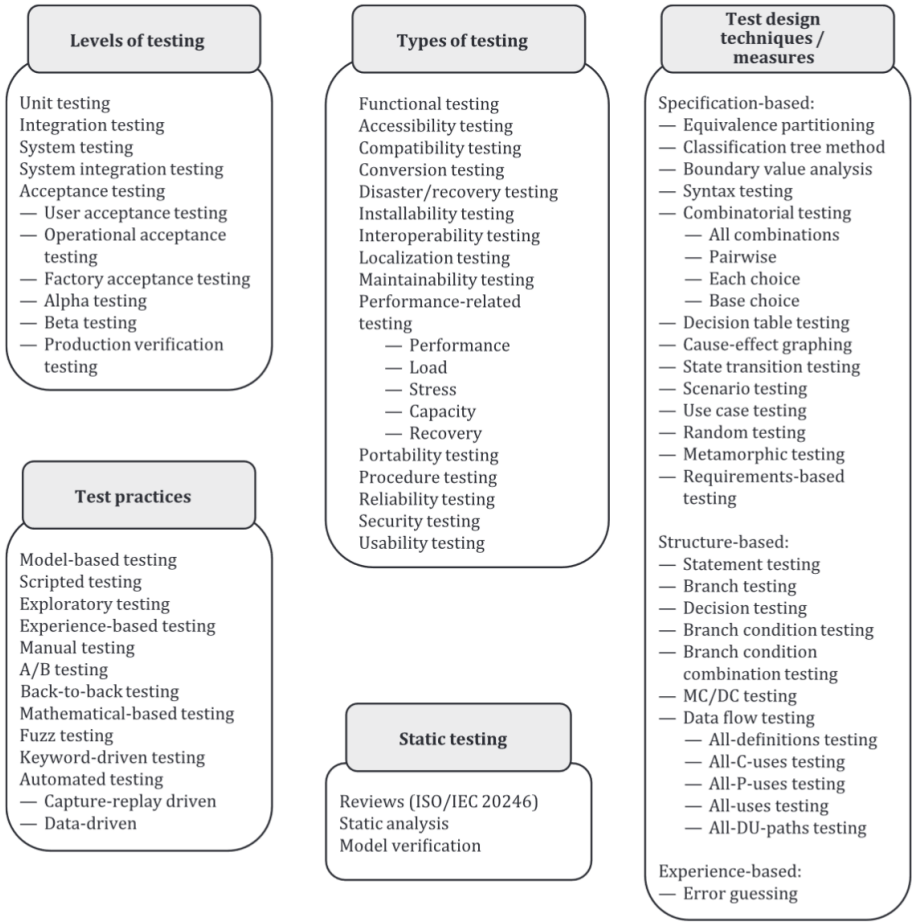
Kjerish (2016)



AzaToth (2008)

The Lack of Standardized Terminology

"The Problem"



(ISO/IEC and IEEE, 2022, Fig. 2)

The Lack of Standardized Terminology

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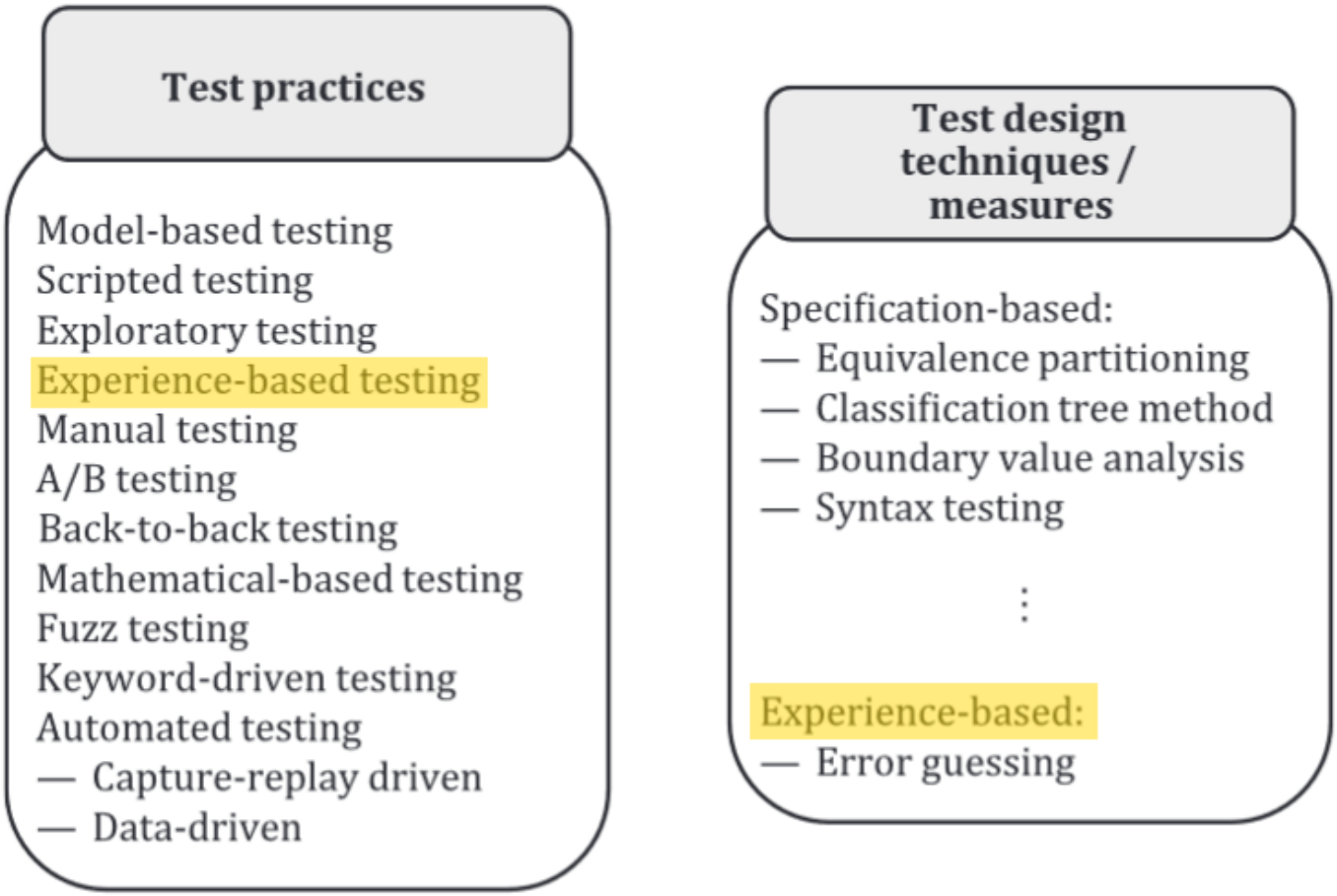

Adapted from (ISO/IEC and IEEE, 2022, Fig. 2)

The Lack of Standardized Terminology

"The Problem"

ISO/IEC/IEEE 29119-4 describes the experience-based test design technique of error guessing. Other experience-based test practices include (but are not limited to) exploratory testing (see 4.4.3.3), tours, attacks, and checklist-based testing.

Adapted from (ISO/IEC and IEEE, 2022, p. 34)

The Lack of Standardized Terminology

"The Problem" (cont.)

- Tours "guide[] testers through the paths of an application" by following a structure that is:
  - quite general (ISO/IEC and IEEE, 2022, p. 34)

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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)

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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)

The Lack of Standardized Terminology

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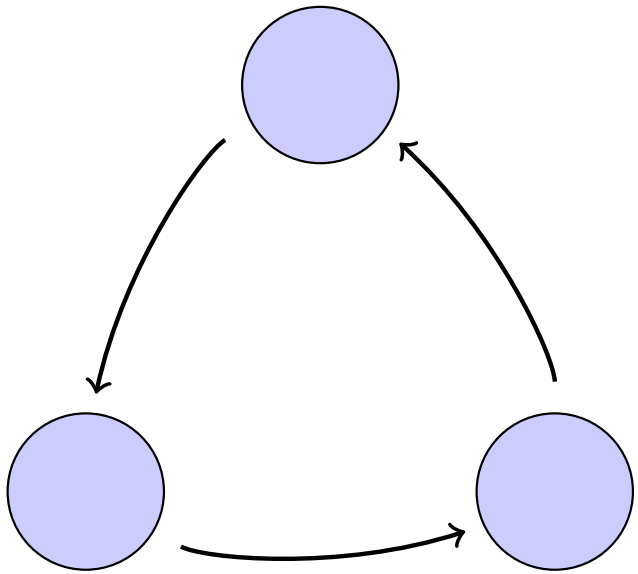
"Okay testing team, we want to conduct alpha testing on our product. What's our timeline? Budget? Sample size?"

Interorganizational

Schools, companies, etc.

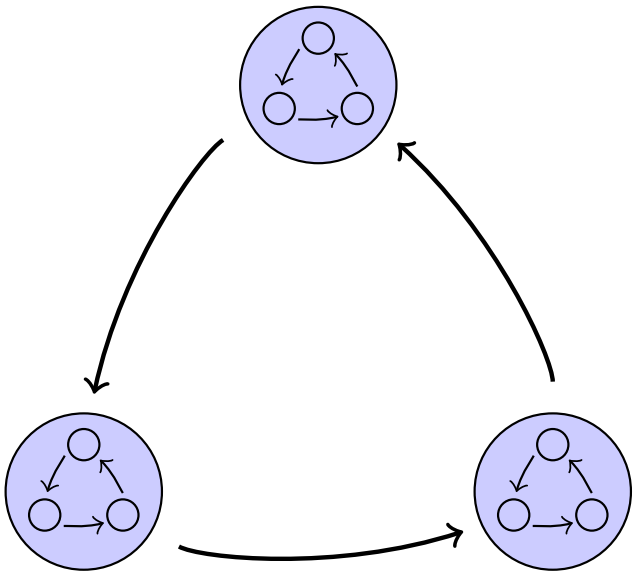


Barriers to Effective Communication

"The Problem" (cont.)

Interorganizational

Schools, companies, etc.



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)

Taxonomies to the Rescue?

"The Problem" (cont.)

- Existing software testing taxonomies:
  - Tebes et al. (2020)
  - Souza et al. (2017)
  - Unterkalmsteiner et al. (2014)

Taxonomies to the Rescue?

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Focus on:

The Testing Process
Organizing Terminology
Traceability between Stages

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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

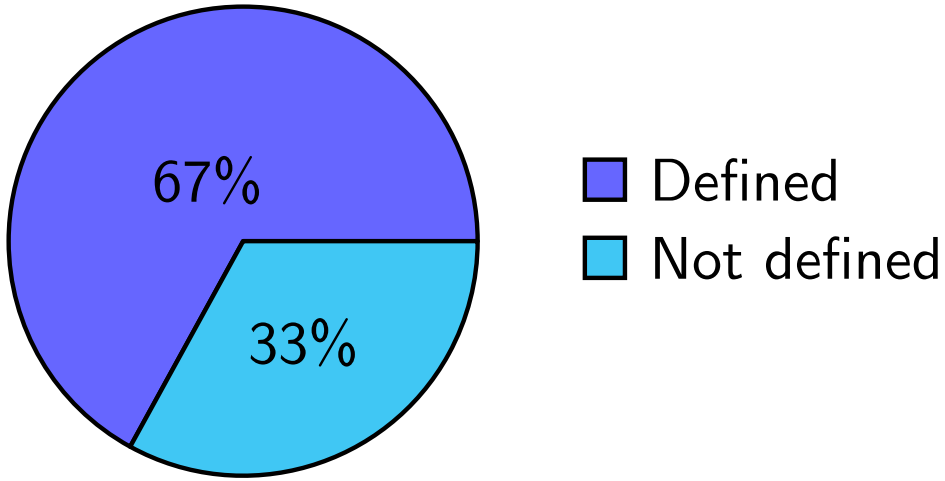
Can we systematically resolve any of these inconsistencies?

Research Questions

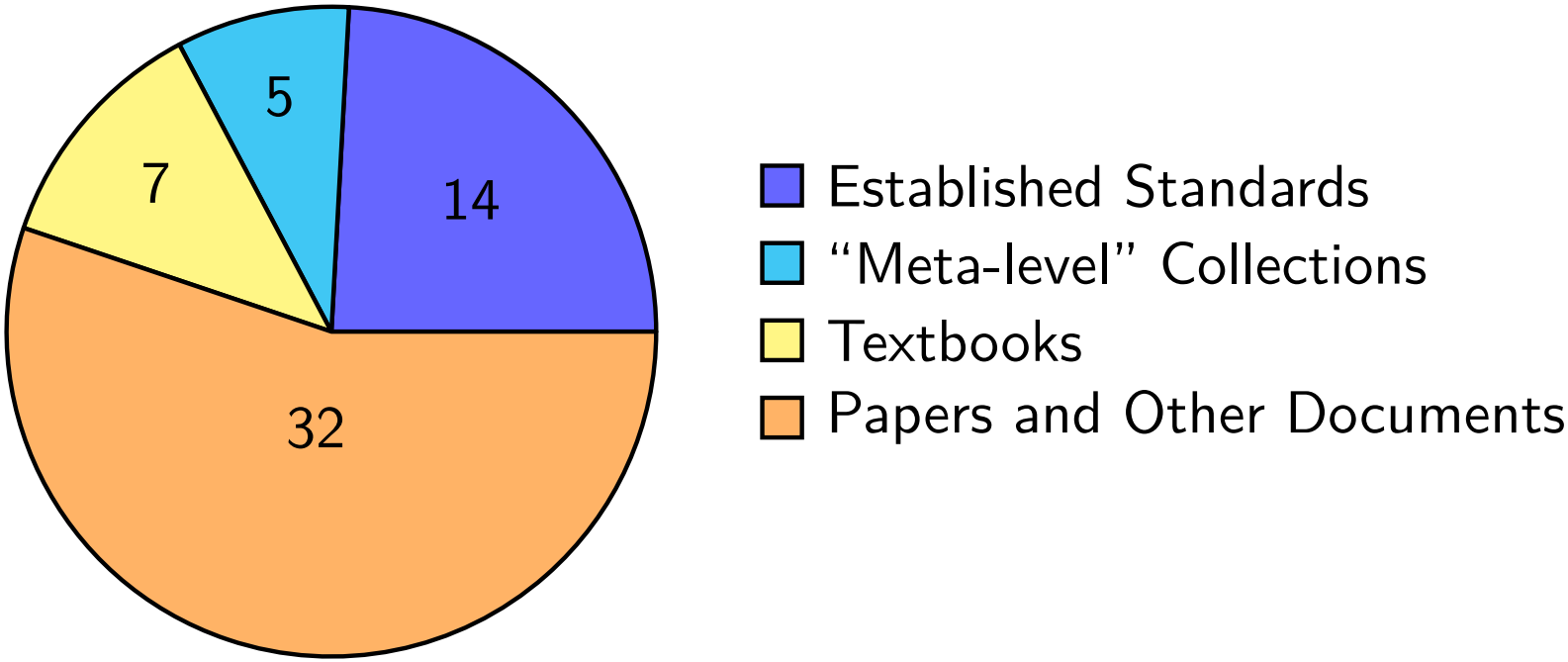
Research Question 1

What testing approaches do the literature describe?

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



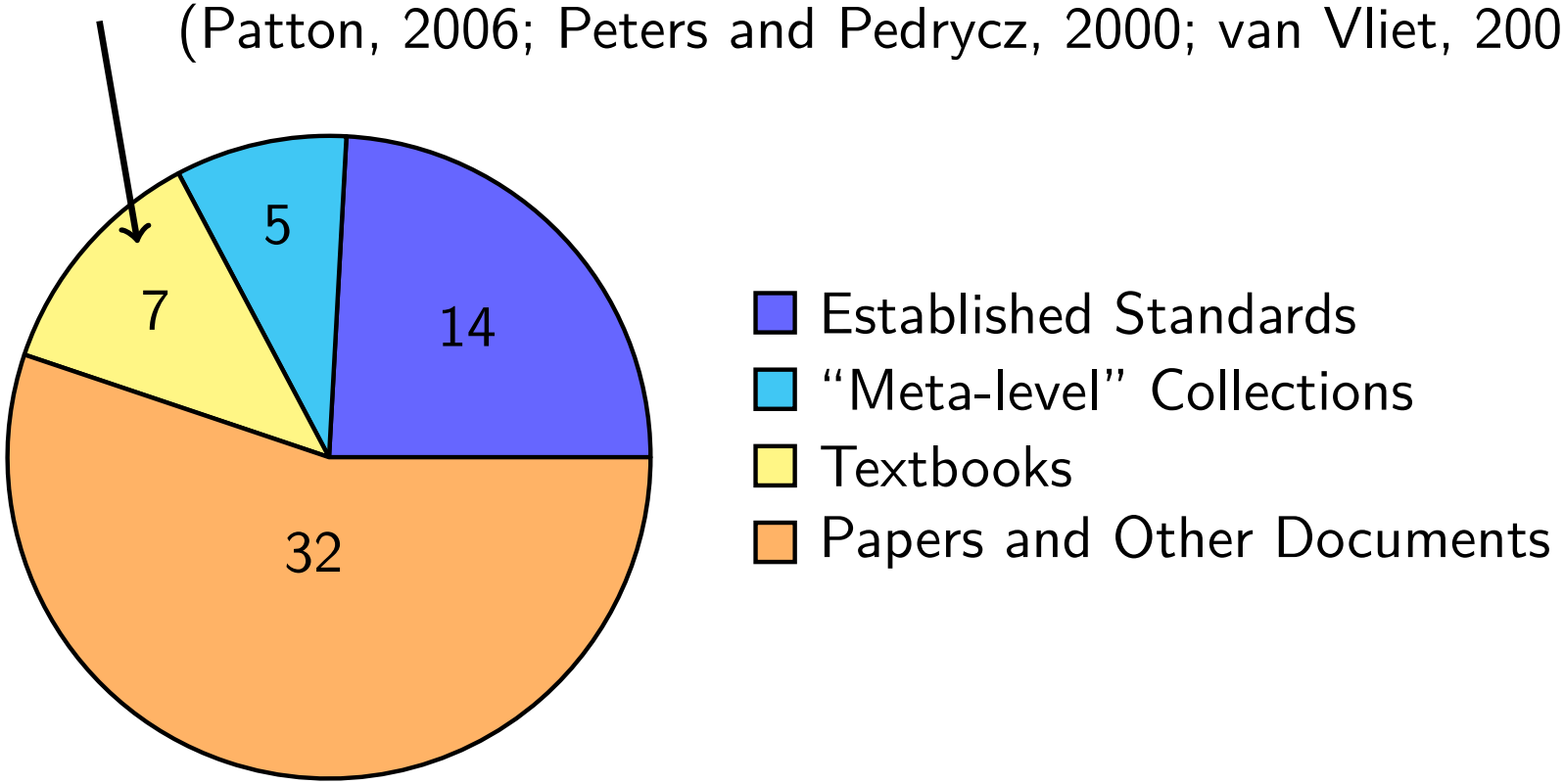
Methodology: Sources



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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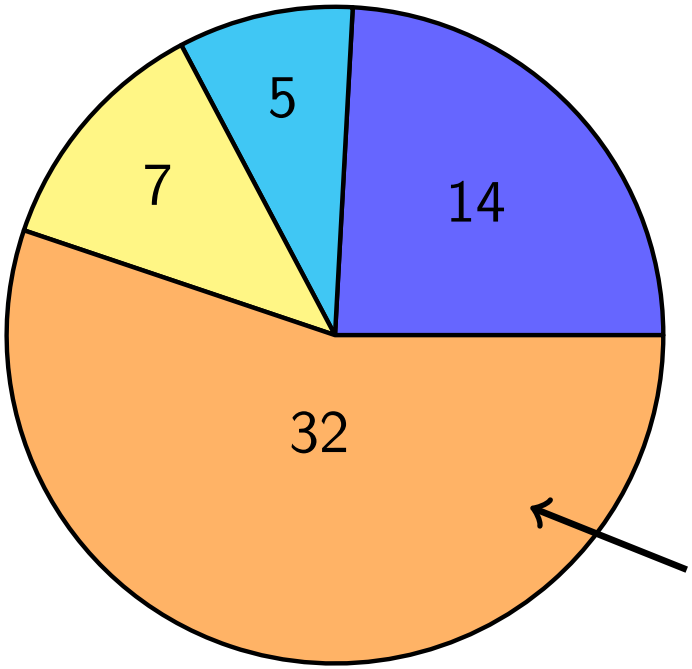
Methodology: Sources

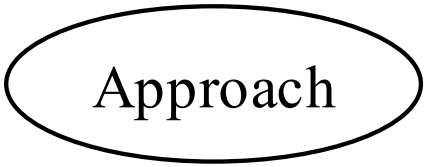


- Established Standards
- "Meta-level" Collections
- Textbooks
- Papers and Other Documents

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

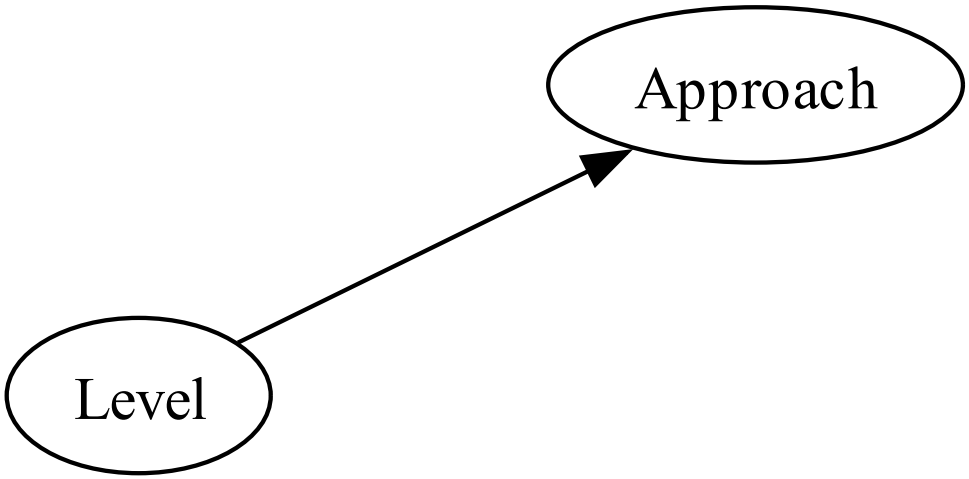
Summary of how many sources comprise each source category.

Methodology: Categories



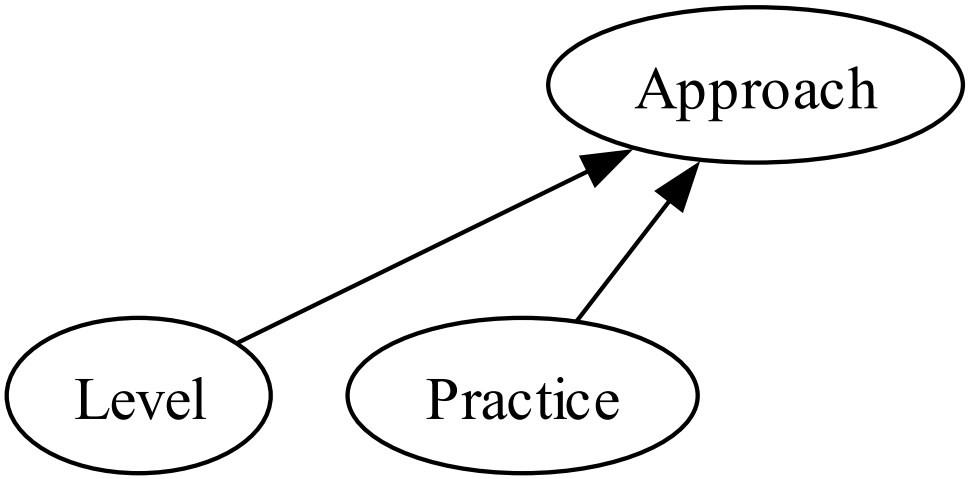
Approach: a "high-level test implementation choice" (ISO/IEC and IEEE, 2022, p. 10) used to "pick the particular test case values" (2017, p. 465)

Methodology: Categories



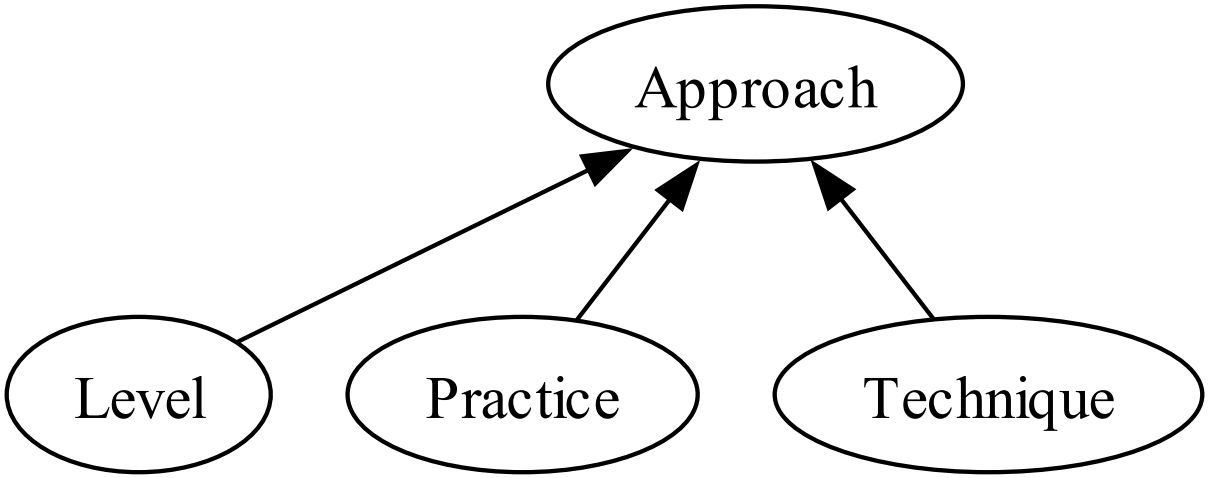
Level: a stage of testing with "particular objectives and . . . risks", each performed in sequence (ISO/IEC and IEEE, 2022, p. 12; 2021, p. 6)

Methodology: Categories



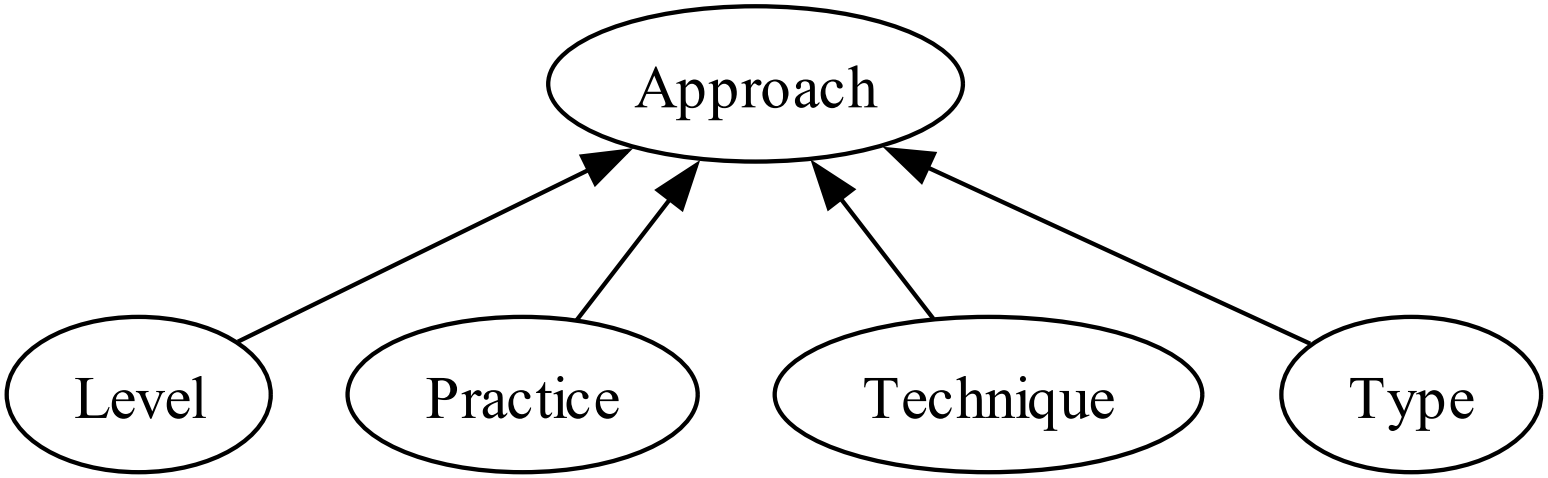
Practice: a "conceptual framework that can be applied to . . . [a] test process to facilitate testing" (ISO/IEC and IEEE, 2022, p. 14; 2017, p. 471)

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)

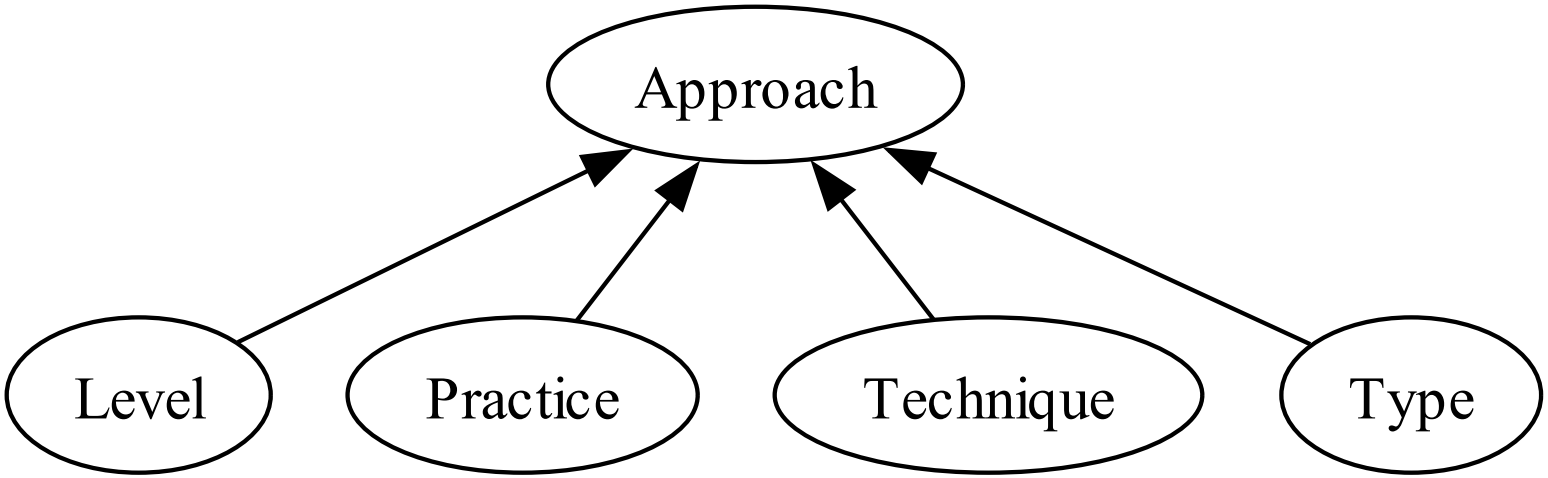
Methodology: Categories



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

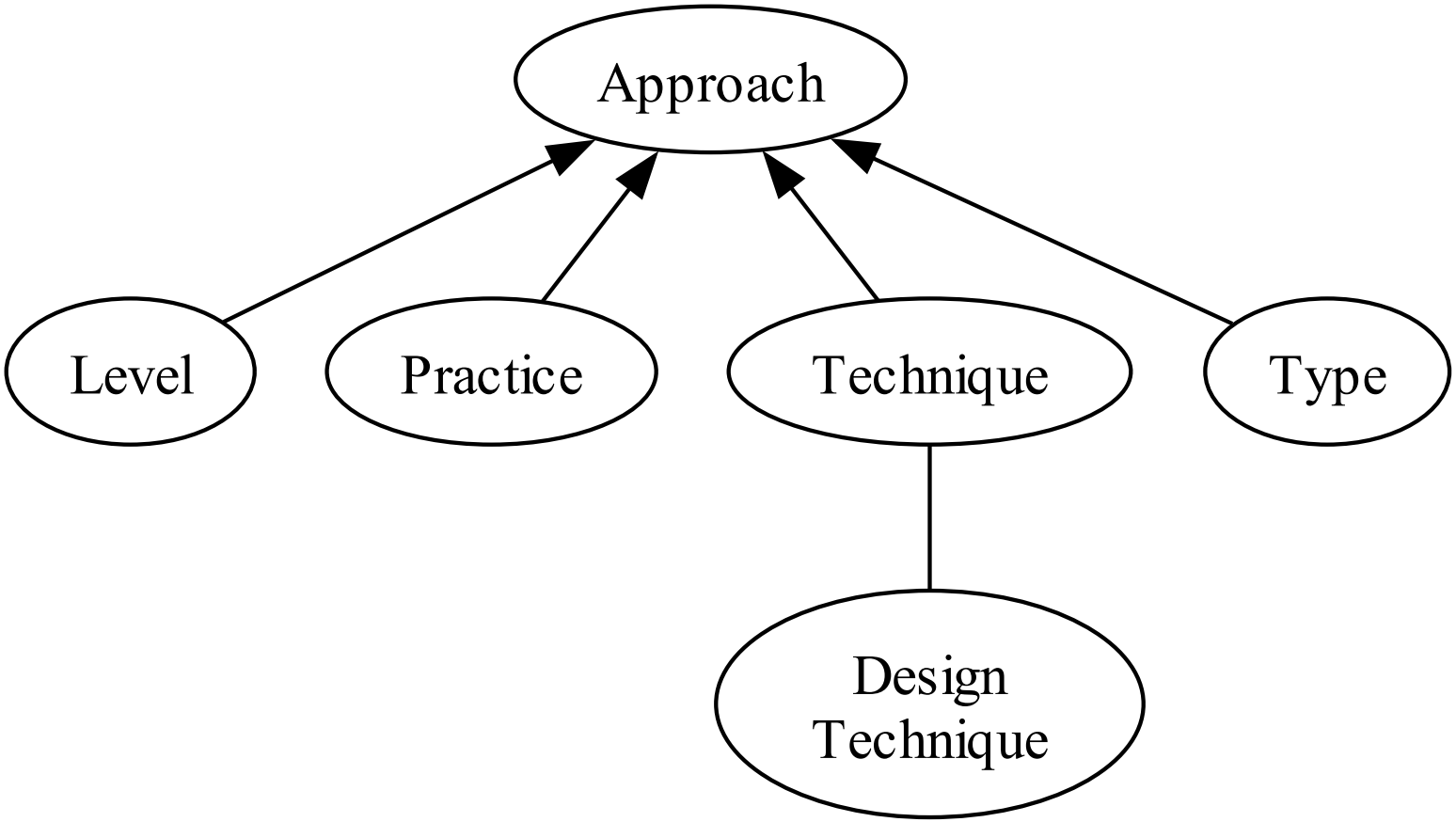
Relations



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

Methodology: Graph Notation

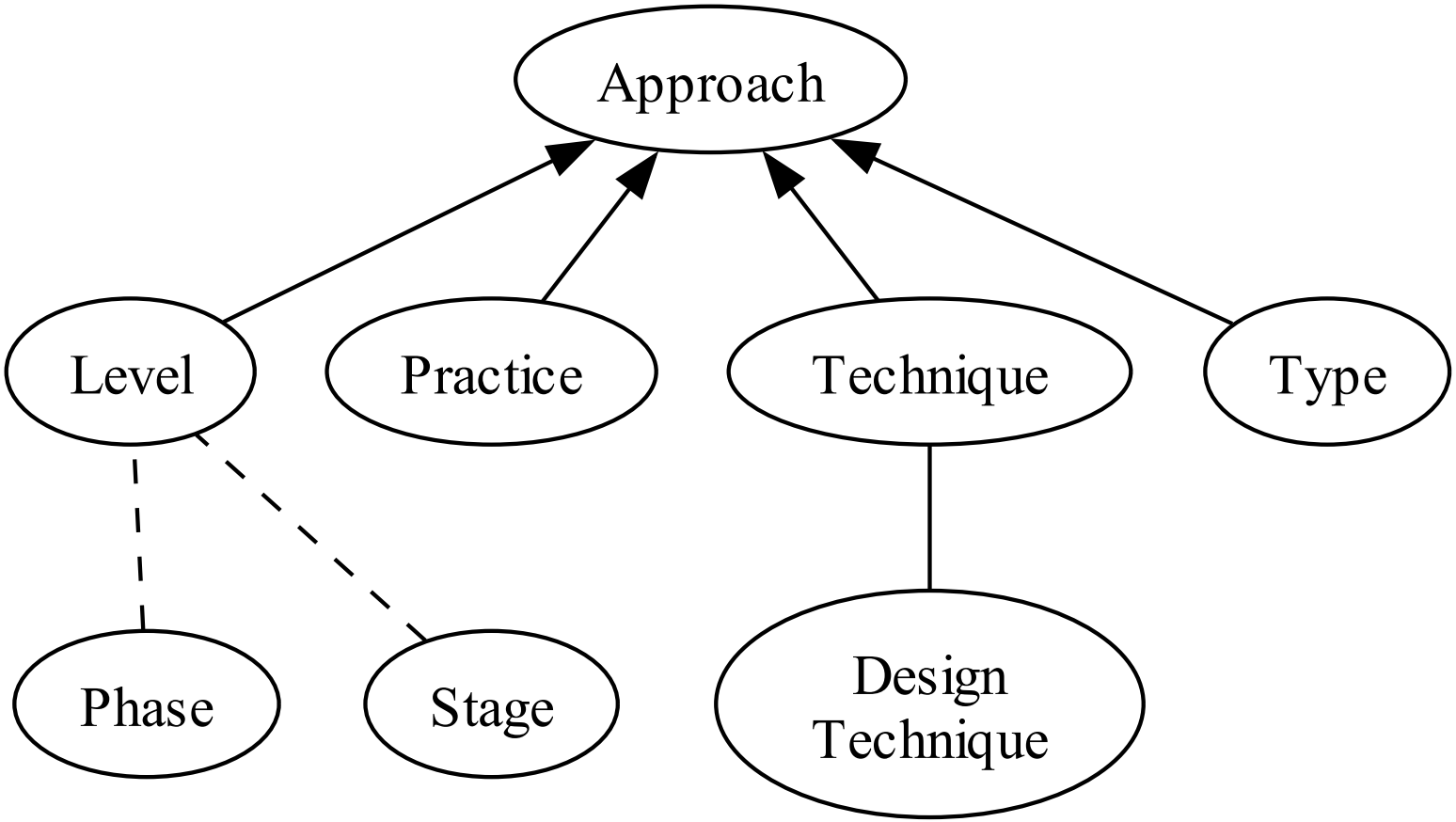
Relations



Lines without arrowheads connect *synonyms*.

Methodology: Graph Notation

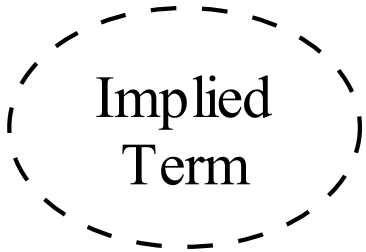
Relations



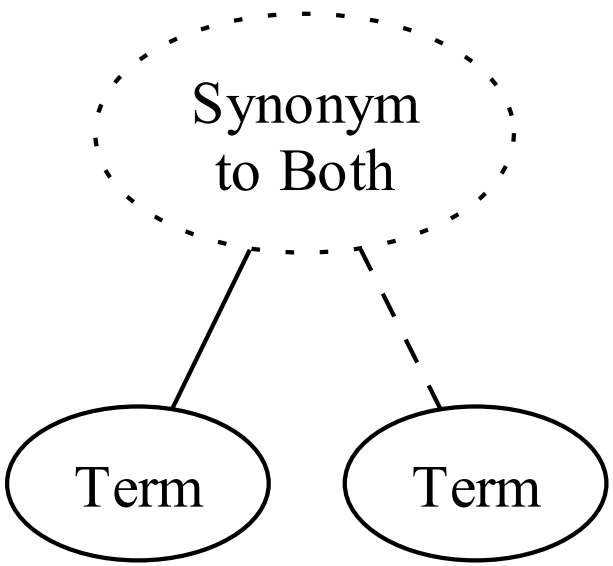
Dashed lines indicate a relationship is *implied*.

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 Approaches

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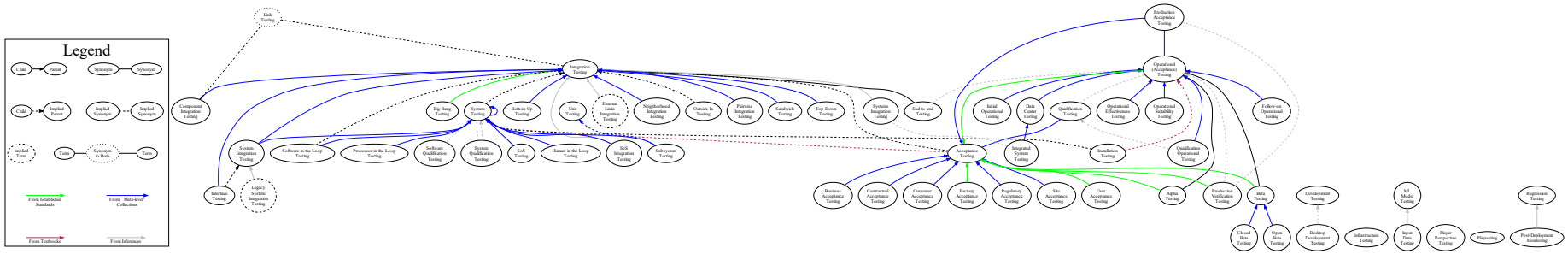
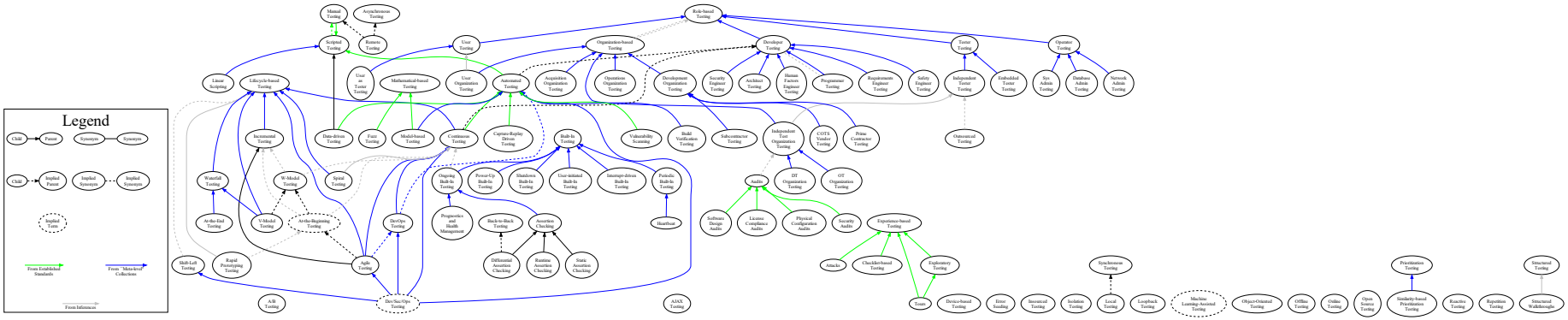
```
! Dimension too large.
```

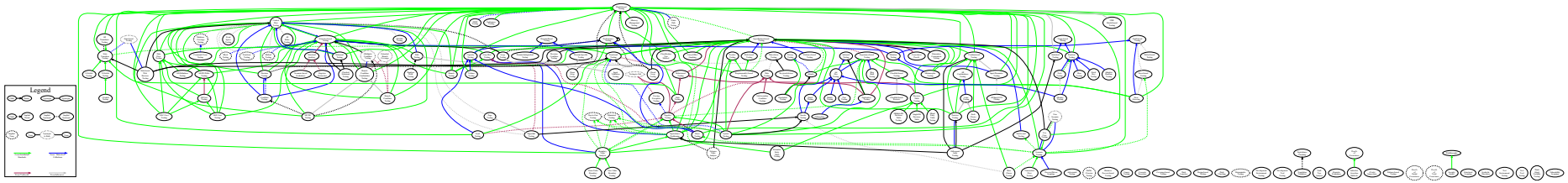
Graph of Test Levels



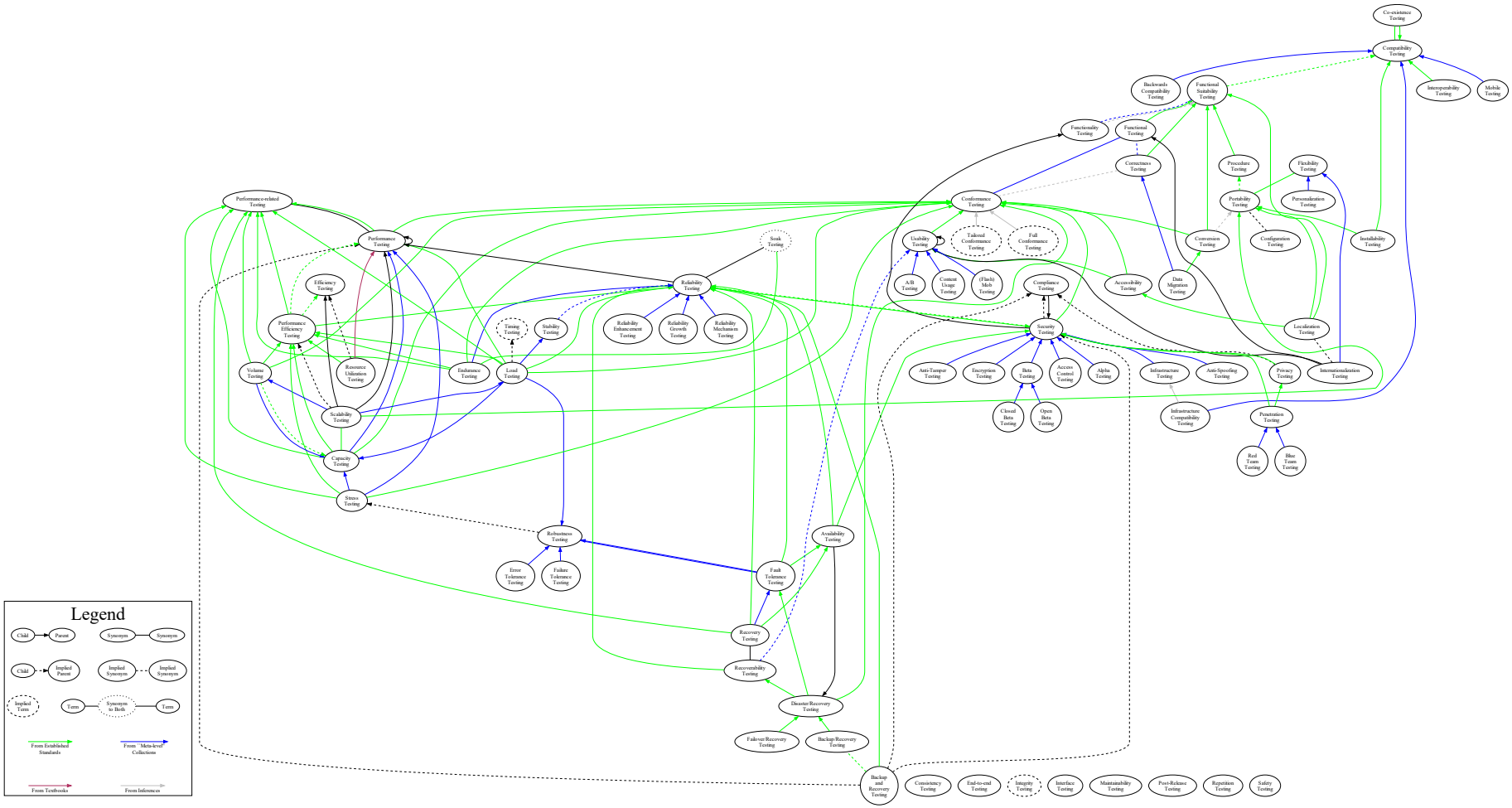
Graph of Test Practices



Graph of Test Techniques

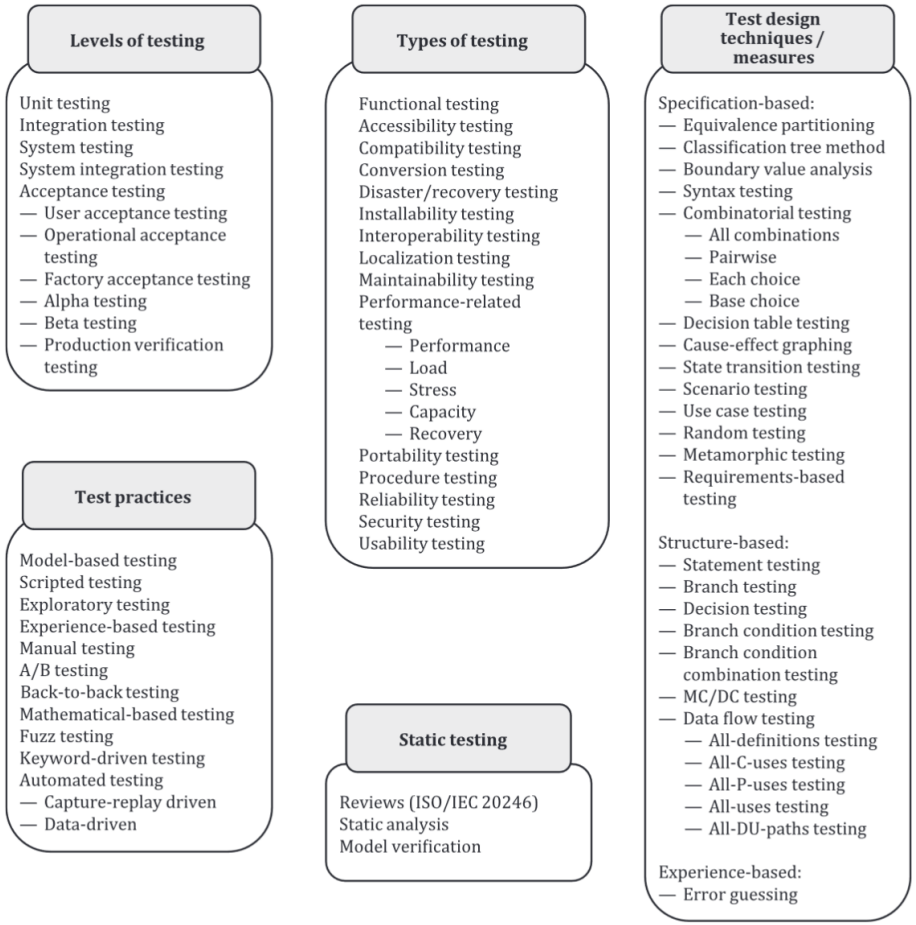


Graph of Test Types



Methodology: Graph Notation

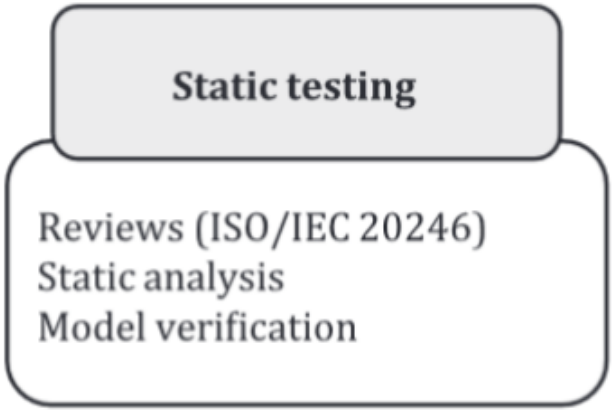
Static Testing



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

Methodology: Graph Notation

Static Testing



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Methodology: Graph Notation

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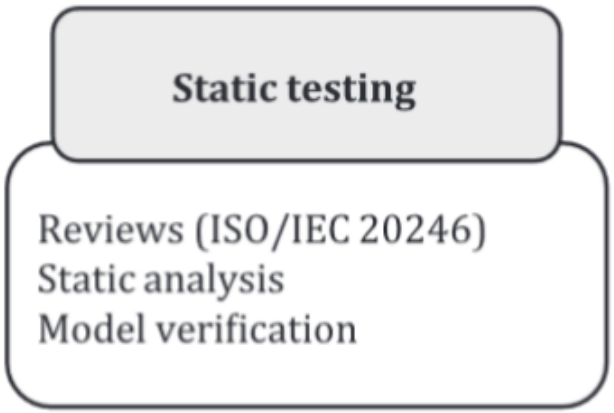

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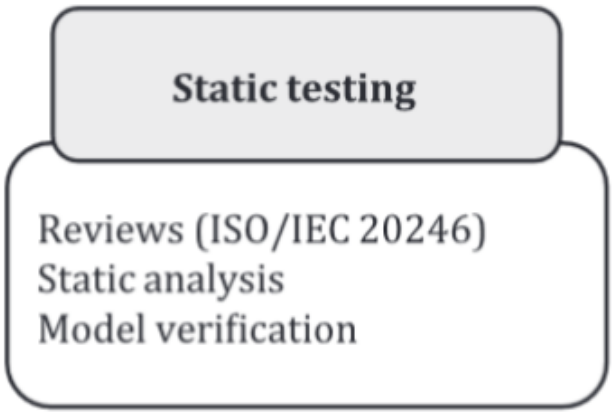

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- Static testing *is* quite distinct from dynamic testing, but this does not necessarily make it an orthogonal category

Methodology: Graph Notation

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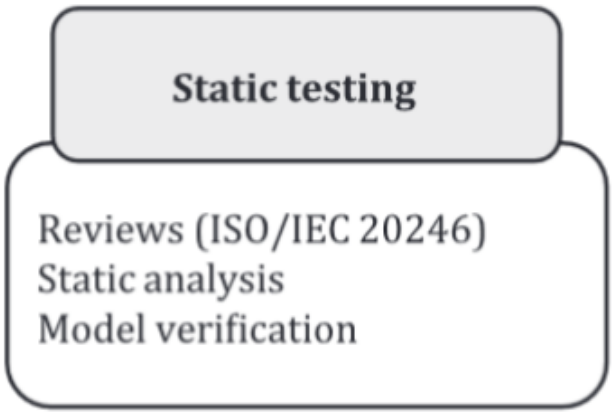

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- While our focus is on dynamic testing, we include static testing in our research for completeness
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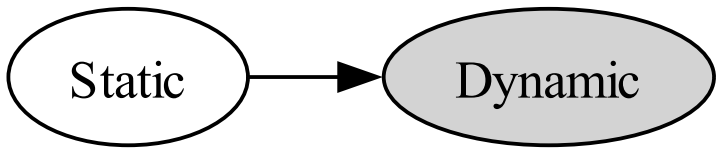
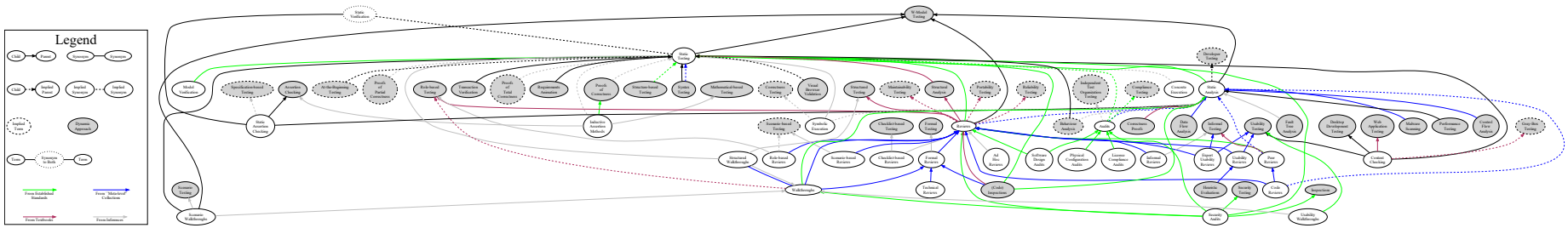
- When considering static testing in isolation, terms with gray backgrounds are related *dynamic approaches*



Graph of *Static* Test Approaches



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)

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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

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

Methodology: Procedure

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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

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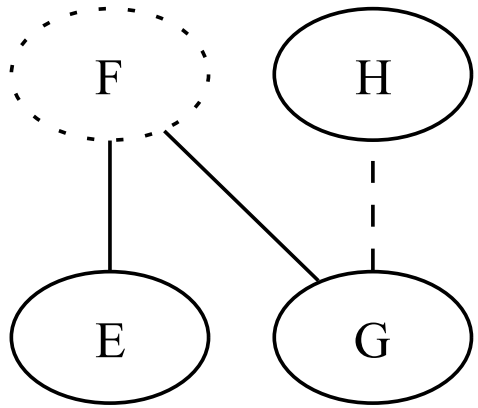
G	F (Author, 0002), H (implied by 0000)
H	X



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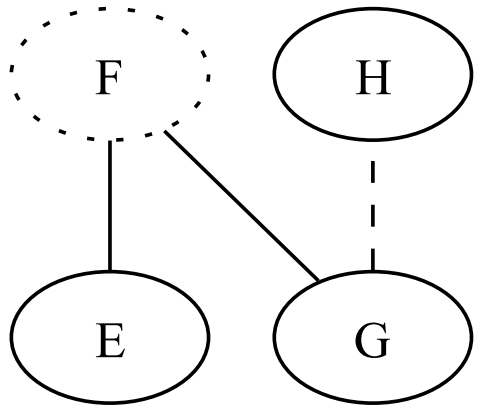

- The following four are the most prominent examples of the ten identified automatically:

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

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- The past and current Drasil team have created a truly amazing framework!

Thank you!

Questions?

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