ETERNITY: Functions- F2: *Tan(x)*

Implementation, Testing, and Release Management following Software Engineering Principles

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ABSTRACT

This project implements a Tan(x) calculator with both console and GUI interfaces. The calculator uses a Taylor series approximation for sine and cosine, adhering to strict coding standards, static analysis and semantic versioning. The development process covers design, implementation, testing, and release management using GitHub.

OBJECTIVES

- Implement a **Tan(x)** calculator using **Taylor series.**
- Provide console (D1) and GUI (D2) versions.
- Decision on Programming Style- **Google Java Style**
- Use **JDB Debugger** for Project Source Files
- Ensure **Java Accessibility API** in GUI.
- Maintain clean, standard-compliant code **(Checkstyle, PMD).**
- Apply **semantic versioning** with changelog.
- Perform unit testing with **JUnit**.
- Release and tag versions in **GitHub.**
- Adherence to **User Design Interface Principles**

DESCRIPTION

The function tan(x) is short for the tangent function, which is one of trigonometric functions (also called circular functions), which are real functions which relate an angle of a right-angled triangle to ratios of two side lengths. And it's widely used in all sciences that are related to geometry. [7]

Domain and Co-domain of Tan(x)

1. **Domain:** *x:* all real numbers except the values where x = π/2 + kπ, k ∈ Z (Since tan(x) = sin(x)/ cos(x), cos(x) = 0 when x = π/2 + kπ, k ∈ Z. If cos(x) = 0, tan(x) will be undefined).
2. **Co-domain:** *y:* all real numbers, R (In mathematics, the co-domain of a function is the set into which all of the output of the function is constrained to fall) [7]

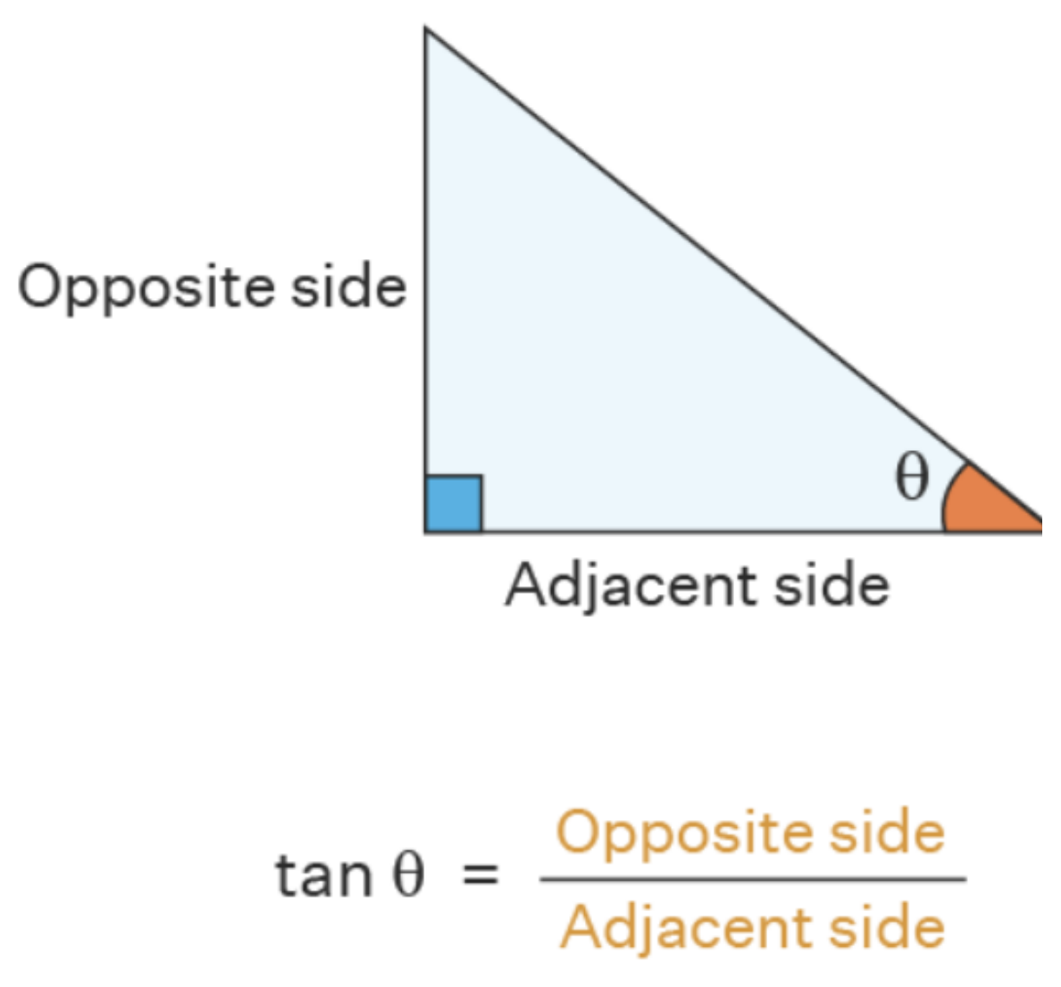


Figure 1: Tangent Function Formula [7]

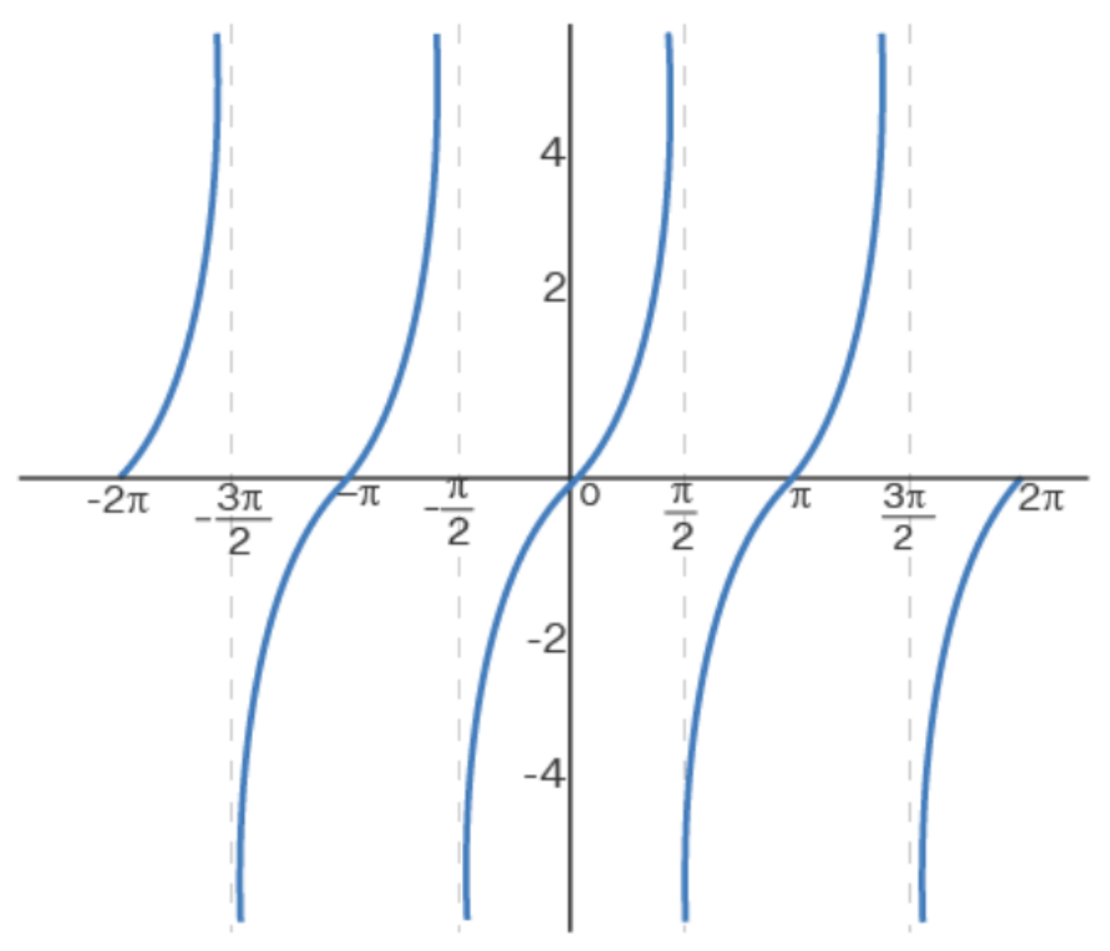
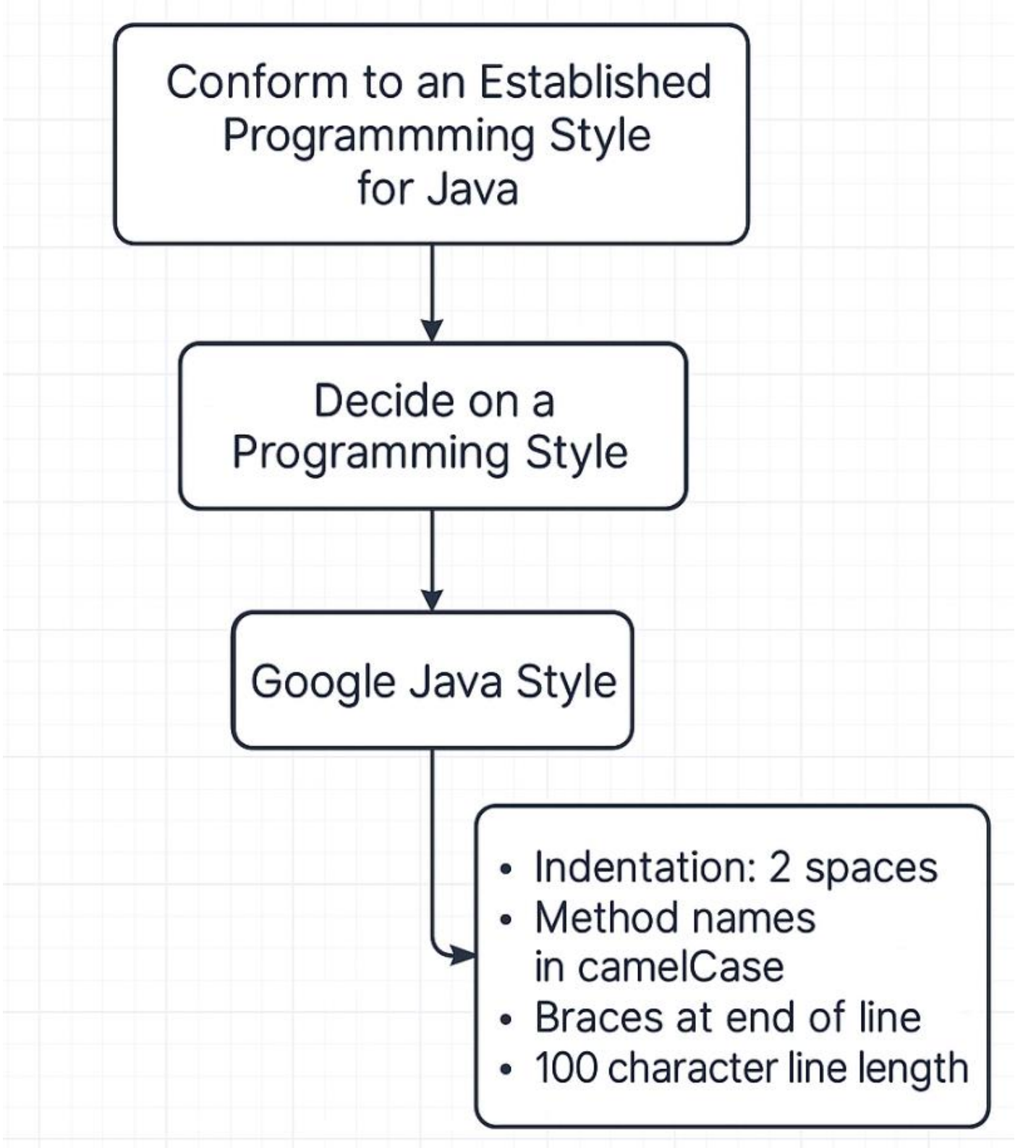


Figure 2: Tangent Function Graph [7]

The graph of tan(x) has an infinite number of vertical asymptotes and is symmetric with respect to the origin. The tangent function is an odd function because tan(−x) = − tan(x) and tan(x) is not defined at values of x where cos(x) = 0. [7]

MATERIALS & METHODS

Tools & Technologies:
Java 17, Maven, JavaFX (GUI), JDB Debugger, PMD, Checkstyle, JUnit, Java Accessibility API, IntelliJ IDE, GitHub.



Conform to an Established Programmming Style for Java

Decide on a Programming Style

Google Java Style

- Indentation: 2 spaces
- Method names in camelCase
- Braces at end of line
- 100 character line length

Figure 3: Decision making using Mind map (Google Java Style) [5]

JDB Debugger

- Used JDB to step through TAN(x) program execution and inspect variable states. [3]
- Verified correct flow and handling of edge cases- *see GitHub repo(README.md) for details.*

Java Accessibility API

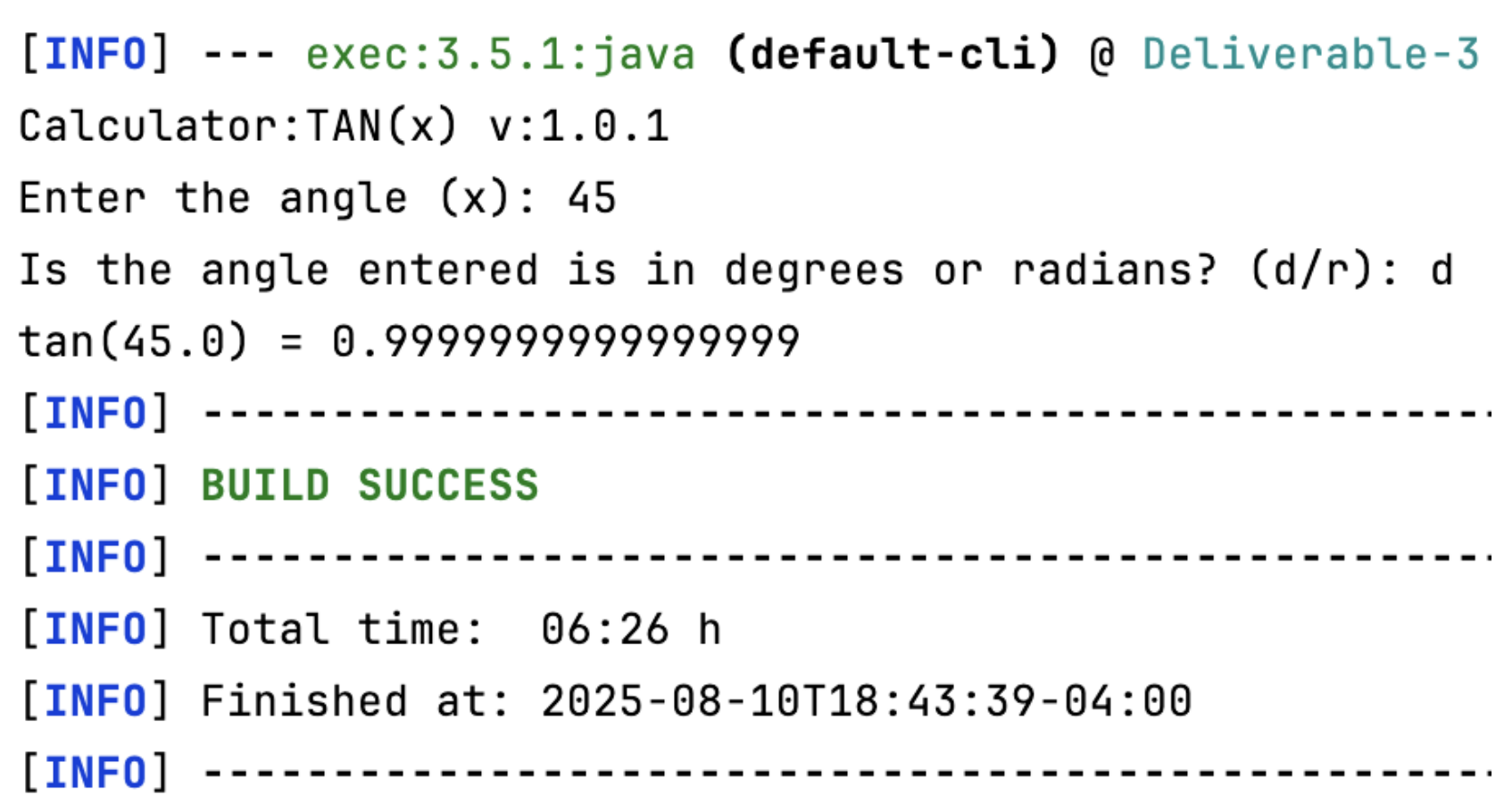
- Applied Accessible Context to make GUI components screen-reader friendly. [6]
- Ensured descriptive labels and keyboard navigation support- *see GitHub repo(README.md) for details.*

Test	Scenario	Input	Expected	Result
TC-1	Tan in degrees	45°, d	≈ 1.0	Pass
TC-2	Tan in radians	π/4, r	≈ 1.0	Pass
TC-3	Undefined tan	90°, d	"Not Defined"	Pass
TC-4	Invalid mode	10, x	Error msg	Pass
TC-5	sin(π/2)	π/2	≈ 1.0	Pass
TC-6	cos(0)	0	≈ 1.0	Pass
TC-7	tan(π/4)	π/4	≈ 1.0	Pass
TC-8	Undefined tan	π/2	Exception	Pass

Table 1: Unit Test Coverage (JUnit)

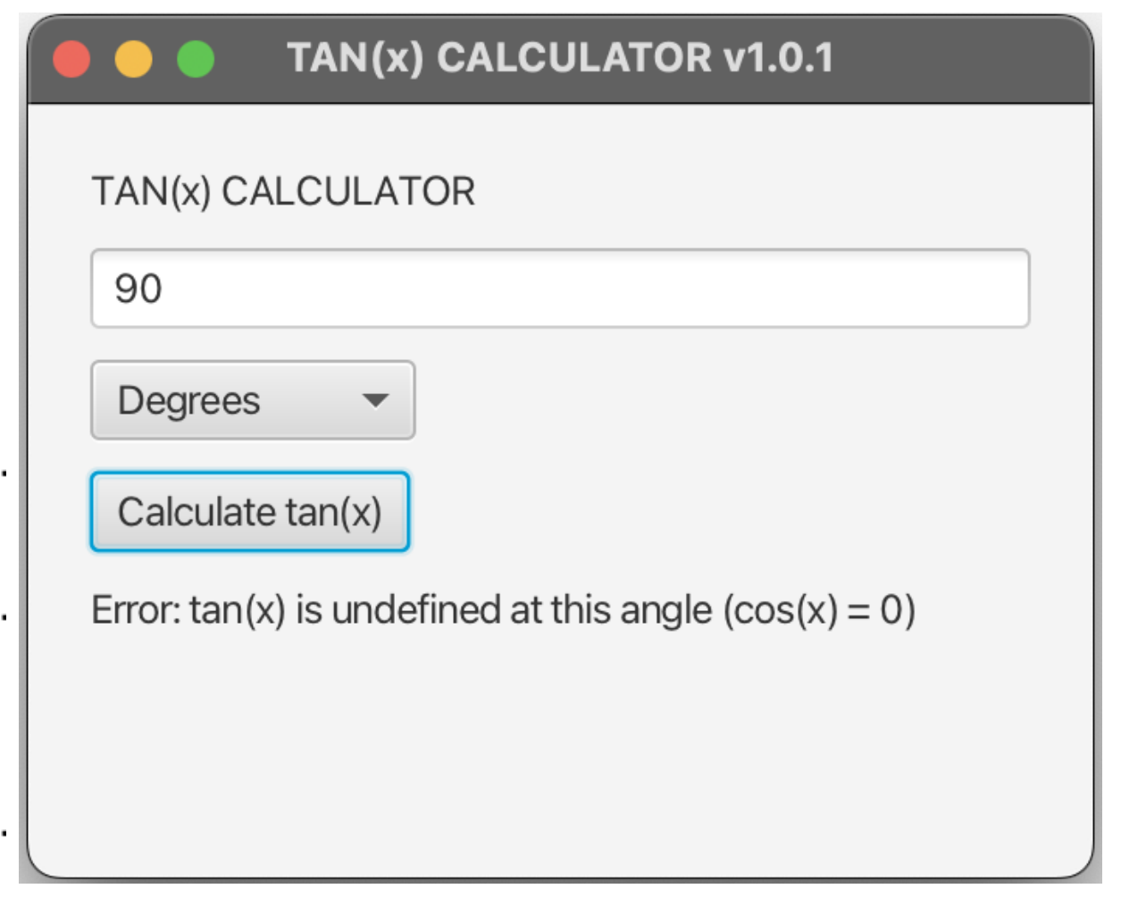
RESULTS

- **D1 & D2 Outputs:** Correct TAN(x) calculations in both console and GUI implementations.
- **JUnit Tests:** Achieved **100% pass rate** across all unit tests.
- **PMD & Checkstyle:** No violations; code adheres to Google Java Style.
- **GitHub Release & Tags:** Implemented Semantic Versioning with tagged releases for each milestone.
- **UI Design Principles:** GUI built following established user interface design principles for clarity and usability- *see GitHub repo(README.md) for details.*



```
[INFO] --- exec:3.5.1:java (default-cli) @ Deliverable-3
Calculator:TAN(x) v:1.0.1
Enter the angle (x): 45
Is the angle entered is in degrees or radians? (d/r): d
tan(45.0) = 0.9999999999999999
[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESS
[INFO] ------------------------------------------------------------------------
[INFO] Total time:  06:26 h
[INFO] Finished at: 2025-08-10T18:43:39-04:00
[INFO] ------------------------------------------------------------------------
```

Figure 4: Modified D1 (Console O/P)



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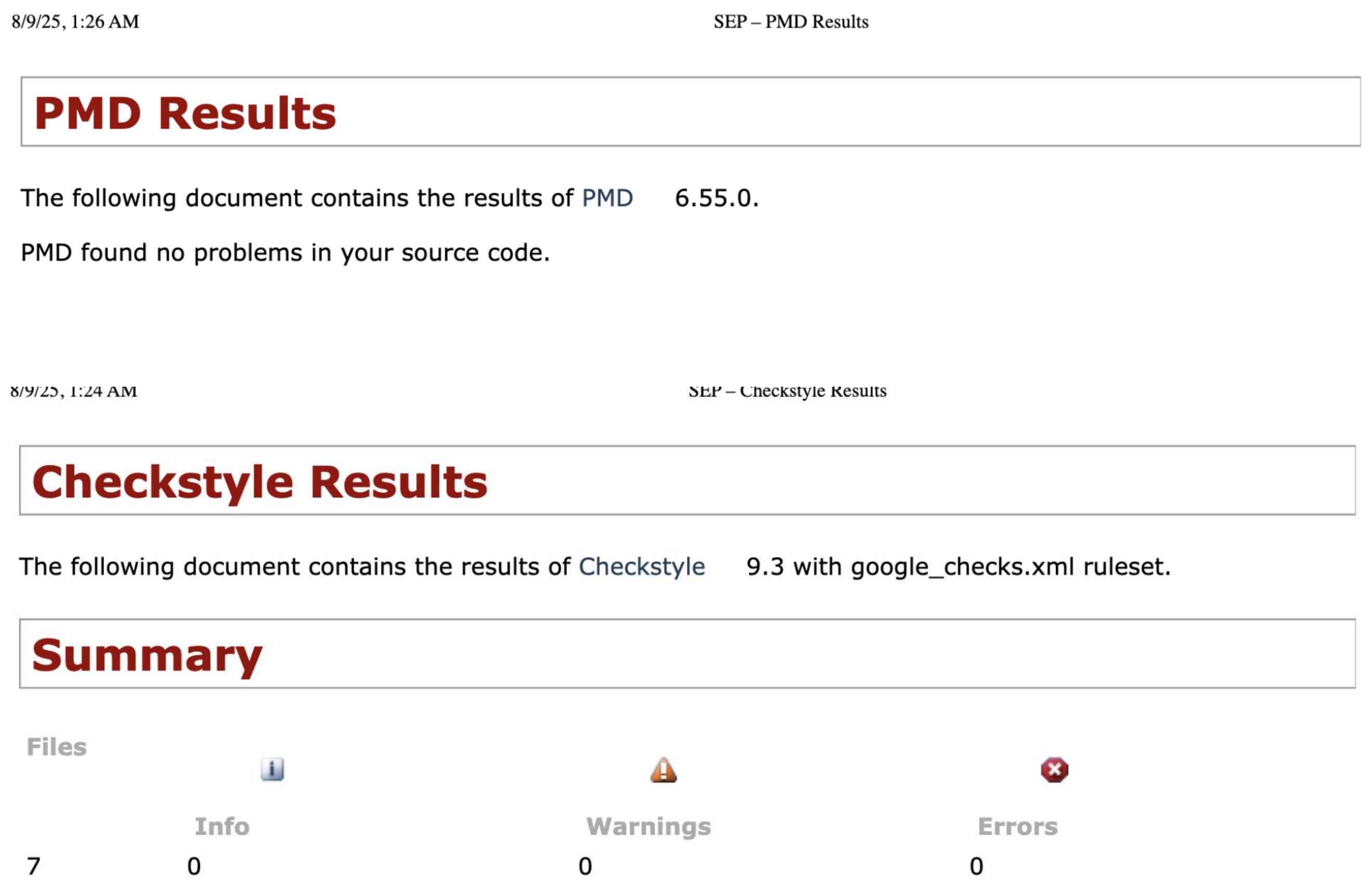
Error: tan(x) is undefined at this angle (cos(x) = 0)

Figure 5: Modified D2 (GUI via. JavaFX)



8/9/25, 1:26 AM SEP – PMD Results

PMD Results

The following document contains the results of PMD 6.55.0.

PMD found no problems in your source code.

8/9/25, 1:24 AM SEP – Checkstyle Results

Checkstyle Results

The following document contains the results of Checkstyle 9.3 with google_checks.xml ruleset.

Summary

Files	Info	Warnings	Errors
7	0	0	0

Figure 6: PMD & Checkstyle with zero violations [1] [2]

Version	Date	Changes
1.0.0	7th Aug, 2025	Initial console & GUI, semantic versioning
1.0.1	10th Aug, 2025	Updated D1 banner text

Table 2: Semantic Versioning (v1.0.0) [4]

CONCLUSION

This project successfully implemented the **TAN(x)** function with full adherence to coding, testing, debugging, and documentation best practices. From initial console-based development (D1) to enhanced modular design (D2) and comprehensive deliverables in D3, the work demonstrates strong application of **software engineering principles**.

Key Takeaways:

- Accomplished 100% JUnit test pass rate with thorough edge-case coverage.
- Enforced Google Java Style via Checkstyle and validated with PMD static analysis.
- Utilized JDB debugger to step through and verify program logic.
- Incorporated Semantic Versioning with GitHub releases and tags.
- Applied User Interface Design Principles and Java Accessibility API for inclusivity.
- Clear documentation, structured commits, and modular architecture support future enhancements.

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6. Oracle, "Java Accessibility Overview," *Java SE 21 Documentation*. [Online]. Available: https://docs.oracle.com/en/java/javase/21/access/java-accessibility-overview.html#GUID-17F9FD40-E191-41CE-BCF9-D956F1EF5111__JAVAACCESSIBILITYAPI-98866269. [Accessed: Aug. 10, 2025].
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Scan the QR for GitHub Repository [Tan(x)]

GitHub Repository Link [Tan(x)]