Software Requirements Specification for Software Engineering: subtitle describing software

Team 6, EcoOptimizers

Nivetha Kuruparan
Sevhena Walker
Tanveer Brar
Mya Hussain
Ayushi Amin

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Date 1	1.0	Notes
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9 Functional Requirements

9.1 Functional Requirements

1. **Requirement:** The tool must accept Python source code files.

Fit Criteria: The tool successfully processes valid Python files without errors and provides feedback for invalid files.

2. **Requirement:** The tool must identify specific code smells that can be targeted for energy saving.

   Fit Criteria: The tool should be able to detect and report at least 80% of the follwing code smells using predefined rules or existing linters. Code smells include: Large Class (LC), Long Parameter List (LPL), Long Method (LM), Long Message Chain (LMC), Long Scope Chaining (LSC), Long Base Class List (LBCL), Useless Exception Handling (UEH), Long Lambda Function (LLF), Complex List Comprehension (CLC), Long Element Chain (LEC), Long Ternary Conditional Expression (LTCE).

3. **Requirement:** The tool must suggest at least one appropriate refactoring for each detected code smell to decrease energy consumption or indicate that none can be found.

   Fit Criteria: The suggested refactored code demonstrates a measurable improvement in energy measured in joules.

4. **Requirement:** The tool must implement an algorithm to choose the most optimal refactoring based on measured energy consumption.

   Fit Criteria: The algorithm evaluates multiple refactoring options and selects the one that results in the lowest energy consumption for the given code smell.

5. **Requirement:** The tool must produce valid refactored python code as output or indicate that no possible refactorings were found.

   Fit Criteria: The output code is syntactically correct and adheres to Python standards, validated by an automatic linter.

6. **Requirement:** The tool must report to the user any discrepancies between the original and suggested refactored code.

   Fit Criteria: Discrepancy reports to user clearly highlight differences in outputs

7. **Requirement:** The tool must allow users to input their original test suite as a required argument.

   Fit Criteria: Users can specify a path to their test suite, and the tool recognizes and utilizes it for testing the refactored code.

8. **Requirement:** The tool must ensure that the original functionality of the code is preserved after refactoring.

   Fit Criteria: The tool runs the original test suite against the refactored code, and passes 100% of the tests.

9. **Requirement:** The tool must be compatible with various Python versions and common libraries.

   Fit Criteria: The tool operates correctly with the latest two major versions of Python (e.g., Python 3.8 and 3.9) and commonly used libraries.

10. **Requirement:** The tool must generate comprehensive reports on detected smells, refactorings applied, energy consumption measurements, and testing results.

    Fit Criteria: Reports are clear, well-structured, and provide actionable insights, with users able to easily understand the results.

11. **Requirement:** The tool must provide comprehensive documentation and help resources.

    Fit Criteria: Documentation covers installation, usage, and troubleshooting, receiving positive feedback for clarity and completeness from users.

10 Look and Feel Requirements

10.1 Appearance Requirements

Insert your content here.

10.2 Style Requirements

Insert your content here.

11 Usability and Humanity Requirements

11.1 Ease of Use Requirements

1. **Requirement:** The tool must have an intuitive user interface that simplifies navigation and functionality.

   Fit Criteria: Users should be able to complete key tasks (e.g., parsing code, configuring settings) within three clicks or less.

2. **Requirement:** The tool should provide clear and concise prompts for user input.

   Fit Criteria: At least 90% of test users should report that prompts are straightforward and guide them effectively through the process.

11.2 Personalization and Internationalization Requirements

1. **Requirement:**The tool should allow users to customize settings to match their preferences (e.g., refactoring styles, detection sensitivity).

   Fit Criteria: Users should be able to save and load custom configurations easily.

2. **Requirement:** User guide must be available in French and English.

   Fit Criteria: French and english installation and use instructions available.

11.3 Learning Requirements

1. **Requirement:** The tool must have an availible youtube video demonstrating installation.

Fit Criteria: Youtube video present and easily accessible

2. **Requirement:** The tool should provide context-sensitive help that offers assistance based on the current user actions.

   Fit Criteria: Help resources should be accessible within 1-3 clicks.

11.4 Understandability and Politeness Requirements

1. **Requirement:** The tool should communicate errors and issues politely and constructively.

   Fit Criteria: User feedback should reflect that at least 80% of users perceive error messages as helpful and courteous, rather than frustrating or vague.

2. **Requirement:** The tool should provide context-sensitive help that offers assistance based on the current user actions.

   Fit Criteria: Help resources should be accessible within 1-3 clicks.

11.5 Accessibility Requirements

1. **Requirement:** The tool should provide high-contrast color themes to improve visibility for users with visual impairments.

   Fit Criteria: Users should have access to at least 1 high contrast theme.

2. **Requirement:** The tool should offer audio cues for important actions and alerts to assist users with use and navigation.

   Fit Criteria: At least 70% of users should report that the audio cues enhance their understanding of important notifications or actions.

12 Performance Requirements

12.1 Speed and Latency Requirements

1. **Requirement:** The tool must analyze and detect code smells in the input code within a reasonable time frame.

   Fit Criteria: The tool should complete the analysis for files up to 1,000 lines of code in under 5 seconds, and for files up to 10,000 lines in under 30 seconds.

2. **Requirement:** The refactoring process must be executed efficiently without noticeable delays.

   Fit Criteria: The tool should refactor the code and generate output in under 10 seconds for small to medium-sized files (up to 5,000 lines).

12.2 Safety-Critical Requirements

1. **Requirement:** The tool must ensure that no runtime errors are introduced in the refactored code that could result in data loss or system failures.

   Fit Criteria: The tool should pass all tests from the user-provided test suite after refactoring, confirming that the original functionality remains intact. The output code is syntactically correct and adheres to Python standards, validated by an automatic linter.

12.3 Precision or Accuracy Requirements

1. **Requirement:** The tool must reliably identify code smells with minimal false positives and negatives.

   Fit Criteria: Detection accuracy should exceed 90% when validated against a set of known cases.

2. **Requirement:** The tool must maintain the functionality of the original provided code in all its reccommended refactorings.

Fit Criteria: The tool should pass all tests from the user-provided test suite after refactoring, confirming that the original functionality remains intact.

3. **Requirement:** The tool must produce valid refactored python code as output or indicate that no possible refactorings were found.

   Fit Criteria: The output code is syntactically correct and adheres to Python standards, validated by an automatic linter.

12.4 Robustness or Fault-Tolerance Requirements

1. **Requirement:** The tool should gracefully handle unexpected inputs, such as invalid code or non-Python files.

   Fit Criteria: The tool should provide clear error messages and recover from input errors without crashing, ensuring stability.

2. **Requirement:** The tool must have fallback options if a specific refactoring attempt fails.

   Fit Criteria: In the event of a failed refactoring, the tool should log the error and propose alternative refactorings without stopping the process.

12.5 Capacity Requirements

1. **Requirement:** The tool should efficiently manage large codebases.

   Fit Criteria: The tool must process projects with up to 100,000 lines of code within 2 minutes, maintaining performance standards.

12.6 Scalability or Extensibility Requirements

1. **Requirement:** The tool should be designed to allow easy addition of new code smells and refactoring methods in future updates.

   Fit Criteria: New code smells or refactorings can be incorporated with minimal changes to existing code, ensuring that current functionality remains intact.

12.7 Longevity Requirements

1. **Requirement:** The tool should be maintainable and adaptable to future versions of Python and changing coding standards.

   Fit Criteria: The codebase should be well-documented and modular, facilitating updates with minimal effort.

13 Operational and Environmental Requirements

13.1 Expected Physical Environment

Insert your content here.

13.2 Wider Environment Requirements

Insert your content here.

13.3 Requirements for Interfacing with Adjacent Systems

Insert your content here.

13.4 Productization Requirements

Insert your content here.

13.5 Release Requirements

Insert your content here.

14 Maintainability and Support Requirements

14.1 Maintenance Requirements

Insert your content here.

14.2 Supportability Requirements

Insert your content here.

14.3 Adaptability Requirements

Insert your content here.

15 Security Requirements

15.1 Access Requirements

Insert your content here.

15.2 Integrity Requirements

Insert your content here.

15.3 Privacy Requirements

Insert your content here.

15.4 Audit Requirements

Insert your content here.

15.5 Immunity Requirements

Insert your content here.

16 Cultural Requirements

16.1 Cultural Requirements

Insert your content here.

17 Compliance Requirements

17.1 Legal Requirements

Insert your content here.

17.2 Standards Compliance Requirements

Insert your content here.

18 Open Issues

Insert your content here.

19 Off-the-Shelf Solutions

19.1 Ready-Made Products

- **Pylint:** A widely used static code analysis tool that detects various code smells in Python. It can be integrated into the refactoring tool to help identify inefficiencies in the code.
- **Flake8:** Linter that combines checks for style guide enforcement and code quality. Flake8 can assist in maintaining code standards while the tool focuses on energy efficiency.
- **PyJoule:** A tool for measuring the energy consumption of Python code. This product can provide essential data to evaluate the impact of refactorings on energy usage.

19.2 Reusable Components

- **Rope:** A library for Python that provides automated refactoring capabilities, helping streamline the process of improving code quality.

19.3 Products That Can Be Copied

- **SonarQube:** An open-source platform designed for continuous inspection of code quality. It helps developers manage code quality and security by analyzing source code to identify potential issues.Its architecture and methods for detecting code smells could be adapted to focus specifically on energy efficiency.

20 New Problems

20.1 Effects on the Current Environment

The introduction of the energy efficiency refactoring tool may lead to several changes in the current development environment. These effects include:

1. The tool temporarily increasing CPU and memory usage while running. The tool aims to optimize energy efficency in code however it takes energy to run - in large codebases this could be significant energy and impact the performance of other applications running concurrently.

2. The tool may have it's own dependencies that now need to be included in the app or installed into the current system. Think Pysmells, Pyjoule etc.

20.2 Effects on the Installed Systems

1. Existing systems may need to be evaluated for compatibility with the new tool. Older versions of python or other needed dependencies may not support the tool.

2. The refactoring process could lead to variations in the performance of existing applications

3. As the tool updates existing code, thorough testing will be needed to ensure everything still works correctly. This may require more effort from QA teams and additional time and resources to check the updated code.

20.3 Potential User Problems

1. Users may face difficulties in understanding how to effectively utilize the tool, particularly if they are not familiar with concepts like code smells and refactoring techniques. This learning curve may lead to initial frustration or reduced productivity.

2. Some users may be resistant to adopting new tools or processes, particularly if they perceive the existing workflows as sufficient. This resistance could hinder the tool's successful implementation and limit its overall effectiveness.

3. Users may misinterpret the output reports generated by the tool, such as energy savings or performance metrics. If users do not fully understand how to interpret these results, it could lead to incorrect conclusions about the tool's impact on their code.

4. There is a risk that users might become overly reliant on the tool for refactoring without fully understanding the underlying principles. This could result in poor coding practices if users do not engage in thoughtful analysis of the suggested changes.

20.4 Limitations in the Anticipated Implementation Environment That May Inhibit the New Product

1. **Limited Computational Resources:** Environments with restricted computational power may face challenges when running the tool, especially for large codebases. Limited resources could result in longer processing times or failures during analysis and refactoring.

2. **Lack of Test Coverage:** If existing codebases lack comprehensive test suites, validating the functionality of refactored code may become challenging. Without adequate tests, it will be difficult to ensure that the tool's changes do not introduce new issues.

20.5 Follow-Up Problems

1. **Ongoing Maintenance:** The tool will need regular updates to stay compatible with new programming languages or standards, adding to

the workload.

2. **Performance Trade-offs:** Users may find that while some refactorings improve energy efficiency, they could negatively impact other performance metrics, such as execution speed.

21 Tasks

21.1 Project Planning

Insert your content here.

21.2 Planning of the Development Phases

Insert your content here.

22 Migration to the New Product

22.1 Requirements for Migration to the New Product

Insert your content here.

22.2 Data That Has to be Modified or Translated for the New System

Insert your content here.

23 Costs

Insert your content here.

24 User Documentation and Training

24.1 User Documentation Requirements

Insert your content here.

24.2 Training Requirements

Insert your content here.

25 Waiting Room

Insert your content here.

26 Ideas for Solution

Insert your content here.

Appendix — Reflection

The information in this section will be used to evaluate the team members on the graduate attribute of Lifelong Learning. Please answer the following questions:

1. What knowledge and skills will the team collectively need to acquire to successfully complete this capstone project? Examples of possible knowledge to acquire include domain specific knowledge from the domain of your application, or software engineering knowledge, mechatronics knowledge or computer science knowledge. Skills may be related to technology, or writing, or presentation, or team management, etc. You should look to identify at least one item for each team member.

2. For each of the knowledge areas and skills identified in the previous question, what are at least two approaches to acquiring the knowledge or mastering the skill? Of the identified approaches, which will each team member pursue, and why did they make this choice?

Mya Hussain Reflection

1. *What knowledge and skills will the team collectively need to acquire to successfully complete this capstone project?*

    - Understanding of Python's performance characteristics and common code smells
    - Experience in using libraries like rope for automated refactoring and familiarity with integrating linters such as Pylint or Flake8 into the development workflow.
    - Ability to develop algorithms that analyze and compare different refactoring strategies, using tools like PyJoule for energy profiling.
    - Proficiency in JavaScript or TypeScript, as most VS Code extensions are developed using these languages.