Team <Scentaur>

Ga Jun Young	(ga.young@ucdconnect.ie)
Royal Thomas	(royal.thomas@ucdconnect.ie)
Zheng Ju	(zheng.ju@ucdconnect.ie)
William Ikenna-Nwosu	(william.ikenna-nwosu@ucdconnect.ie)

1. Introduction

1.1 Vision of the Project

Scentaur is a Java-specific “code smell” detector. The team behind Scentaur believes that many current code smell detectors are not particularly easy to use and understand (i.e. JDeodrant and infusion). Thus, the team envisions Scentaur to be a user-friendly code smell detector tool. We want Scentaur to be accessible, performant, have clear data visualization and finally, to be reliable.

1.2 What Scentaur Hope to Achieve

- **Web-based:** Team Scentaur aims to make a web-based code smell detector tool. Providing a quick and easy way to detect smells and even enabling users to refactor fragments of code detected by Scentaur. Having Scentaur be a web-based product also allows us to reach a wider audience of users.
- **Performant:** Scentaur aims to reduce the amount of time required to detect smells unlike JDeodrant which takes a significant amount of time to detect smells; as it contains many types of detectors (22) along with the ability to refractor smelly code. As a result, Scentaur aims to use ***fewer Code Smell Detectors*** to ***increase performance***. It will detect code smells that are more frequently created by users.
- **Go-to product:** Since coding is being encouraged at a large scale to the general public, Scentaur can be the go-to software product for beginners to learn how to think about the software design phase of development. To give them an understanding and appreciation for writing maintainable code. To allow them to think about code on a higher level so they can make an immediate impact when working in teams together.
- **Reliability:** Testing can give one confidence that the code is ***functioning*** correctly. Source control gives one confidence that all team members are working on the same version of the code (***Communication*** is up to date). Scentaur should give users confidence that the system's (software) ***design*** is adaptable to change and if a change is made to the system that breaks functionality, it will be caught.

1.3 Main Goals of Project

Team Scentaur has set several main goals in mind. Here are the following:

1. To learn and understand the different types of code smells.
2. To understand and take responsibility in a larger team.
3. To enable Scentaur for future uses outside of the assignment background.
4. To enable easy implementations and execution of other code smells in the future.

1.4 Typical User Experience

A typical user would be able to open the website and upload their code directly without login. The system's detection of code smells and suggestions will be visible by **colour-coded indicators** followed by data visualization (available for download). For users to obtain their history of code smells/refactor suggestions, users must stay on the webpage without closing the web browser. Closing the web page will automatically close all data related to the user.

2. Specification

2.1 Analyze Project

The development of Scentaur uses **Gradle** allowing the team to freely import libraries outside of the standard, accelerate development and provide a better software. Scentaur is also planned to become a web-based application using **Spring**. Therefore, users are enabled to either submit a zip folder or java file directly to a web server. If a Zip folder is submitted, its contents will be extracted to a directory. Submitted Java files will be placed into a temporary directory.

Designate a folder directory to contain the location of where Scentaur should analyze the project.

- For testing purposes, Scentaur will sniff out code from the *"testProject"* directory.
    - Note: Purposely made code smells will be available in *"testProject".*
- This will be a temporary directory to enable multi-users to run Scentaur.

- Once a user is done with Scentaur, the contents of the directory are wiped.
- To analyze Scentaur itself use System.Properties("user.dir"); to obtain the string path of Scentaur's root directory.

In order to analyze the entire directory given, Scentaur will be using ***JavaParser.***

- A Parser class will take in the root directory path as a string.
- configureSymbolSolver method will set the symbols required to sniff out java files. [Reflection, Java file symbol]
- The constructor will call configureSymbolSolver and parse all source files based on JavaParser-JUG-Milano slides.
- Parser will have a method that returns the compilation units of all java files within its root and sub directories.
    - Note: Information on compilation units is given in **Software Overview**

2.2 Detect Code Smells

- An abstract Smell Superclass will generalize all code smells.
- Subdirectories will be made to accommodate smells that are categorized
    - These categories include:
        - Bloater, Abuser, Coupler, Dispensable
- The following interfaces will be made: *Smellable, Abusable, Bloatable, Coupleable and Dispensable* to ensure that we enable plug-and-play modules for the smells within the categories.

A sample hierarchy is shown to display the hierarchy specification.

Smell extends *VoidVisitorAdapter<Void>* implements *Smellable*

Bloater extends *Smell* implements *Bloatable*

LongParameterList extends *Bloater*

VoidVisitorAdapter<Void> enables code smell detectors to visit nodes for a compilation unit related to the code smell. *E.g. LongParameterList visits methods of a class and checks if the method has a long parameter.*

- The following is possible due to the hierarchy above:

  Smell longParameterList = new LongParameterList();

2.3 Generate Report

The report will be available in multiple different forms.

- A Report class will take in all the smells that were detected
- It will have an object inside the report to enable calculations in generating data for the smells. This is to **show the distribution of different smells** that exist within the code.
- **Smell Analysis** object will contain some of the following calculations:
  - Sample text: Bloater Smells – 23

    LongParameterList – 15

    Long Method - 8
  - Generate percentages in terms of smells – root directory

    e.g. Bloater/Total Problems * 100%
  - Smells in each sub directory percentage.
- Furthermore, the report can be obtained in a text file. Displayed on a table like manner. The report can also generate classes in either text or java format with comments added to wherever the code smells existed.

2.4 Visualize the Code-Base & Identify Trouble-Spots

The code base is planned to be visualized on the web browser using Spring and CSS.

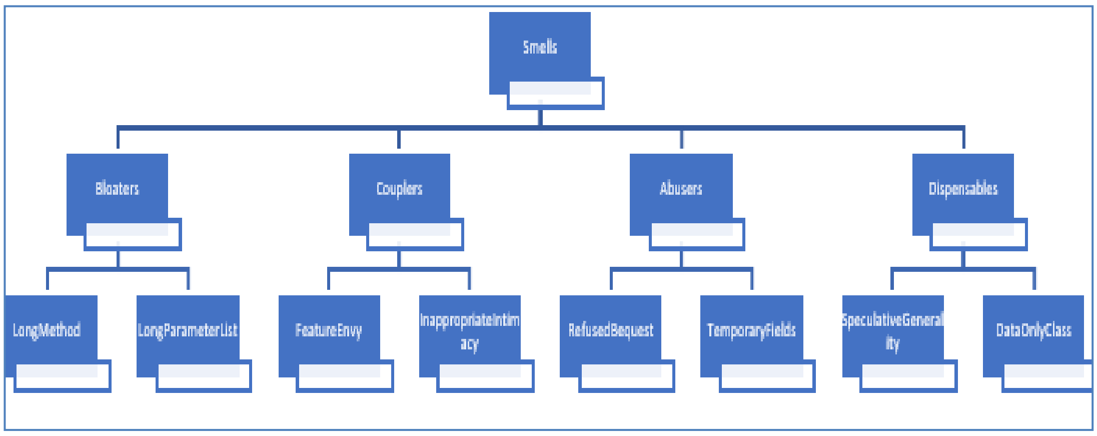
- Each smell will have its own identifying color in hexadecimal for CSS to interpret.

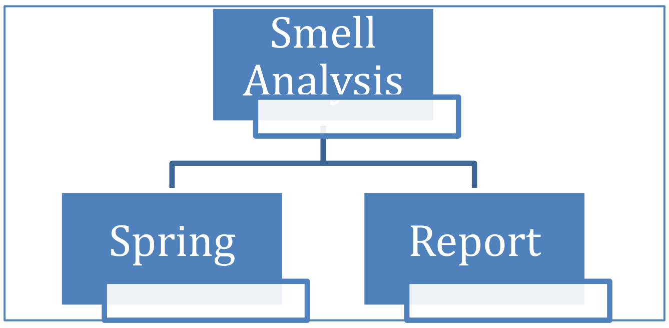
- Scentaur plans to visualize problems by either commenting problems above the smell or color coding the specific problems. Usage of node.line variable is required.
- A cross comparison will be shown where the left-hand side displays the original code and the right-hand side displays the updated version containing comments or highlighted text describing the code smell.
- Users will be enabled to choose different smells to detect from through a drop-down menu selection bar. The default option is the one where all smells are sniffed for.
- Percentages like the calculations in the report will be shown in terms of pie charts, histograms and other visual representations.

3. Software Overview

3.1 Smell Overview

Below are simple schematic UML views of the planned Scentaur Design.





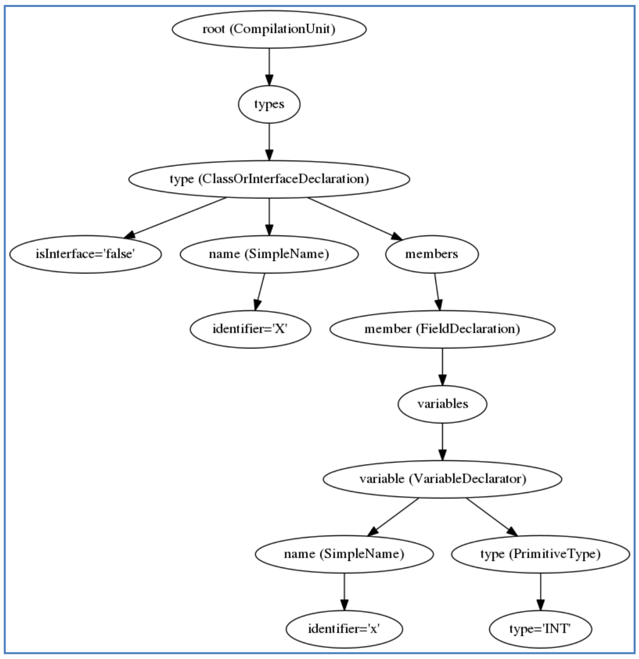
The Scentaur team are advised to follow these layouts. This will ensure that the team moves forward with Scentaur consistently and cooperatively towards a common goal. This hierarchy and structure provide a means to maintain a highly cohesive and low coupling software design.

Multiple interfaces have been built to date to ensure that team-members follow a set structure when designing code smells. The following code smell interfaces have been designed to date:

1. Smellable
2. Bloatable
3. Coupleable
4. Abusable
5. Dispensable

Smellable contains abstract methods which all smells should be capable of implementing. This is the general solution to all smells. Bloatable, Coupleable, Abusable and Dispensable are interfaces which are unique to their code smell category.

E.g. LongParameterList class will be Bloatable and therefore isBloatable().



Code smells detected are stored in a list of nodes which are specific to the JavaParser Abstract Syntax Tree. We use JavaParser.ast to enable the team to pinpoint exactly the sections of code which contains a smell.

Reference to JavaParser Inspection

From this diagram, we can observe that the JavaParser creates Compilation Units for each Java file. With this Compilation Unit we can obtain different nodes specific to the Java file such as variables, methods and comments. Scentaur uses this implementation by storing nodes with specific code smells in a list.

E.g. **Primitive Obsession** checks how many times a variable is used within that class. If the variable is a primitive obsession, then the variable will be stored as a node within a list in Smell.

This node is a very powerful object as it can also retrieve information such as the line it was declared in the Java file, the class it was declared in and the directory the node came from.

Furthermore, Scentaur allows team members to add more code smells without adding complicated dependencies. Code smells created will only have to appear in the code smell category that it belongs to and implement and inherit some interfaces/classes which all are smell related. The created smell object is then accepted by all the compilation units in the following way.

```
all.forEach(c -> {
    c.accept(longParameterList, null);
});
```

Note: all – List of compilation units.

To accept more code smells a simple addition of c.accept("code smell object", null); is called. Thus, allowing Scentaur to smell "code smell object" and longParameterList in this case.

The Scentaur team has also generated a testProject directory which contains sample code that we can test for code smells. Specifically made code smells are present in this directory. To detect code smell within Scentaur a simple change of root directory path to System.Property("user.dir"); is called.

3.2 Report Overview

The report class will be taking an array of smell objects that are not null (smells that are present within the java files). The report will be capable of generating a text file containing a table of relevant code smell data. For the report to generate these data it will need a calculation object that will calculate statistical analysis of the code smells present.
This statistical object will perform some of the following calculations: average

testing, range, occurrences etc. Which is then supplied back to the report to use when generating a text file.
The report is also capable of generating Java files. This is possible because the nodes stored in the smell objects can return their compilation unit.

3.3 Spring Visualization

As the team is mainly focused on the standard concept of the program much knowledge of Spring will come after everything else is implemented. If time is the issue the team may plan to create a UI instead (As Spring is a new concept to the team); this ultimately puts us back. However, we have one team member who has some knowledge of Spring. A general idea on how to solve this visualization problem is included in the specification.

4. Major Responsibilities and Work Breakdown

4.1 Major Responsibilities

Having a diverse team from various backgrounds, we were able to divide work among the members based on their expertise utilizing their best abilities.

1. **Lead Designers**
   Gajun Young and William Ikenna-Nwosu are responsible for overall design and identifying major classes. They were able to use well thought out and concrete class hierarchy structure to make the project as a whole much easier to develop. As the project progresses, Gajun and Will play the lead in terms of designing the software, coordinating the team and making necessary adjustment. William had the role in deciding carefully what hierarchy the software would follow along with Zheng.
2. **Reflection API**
   Zheng Ju and Royal Thomas implemented the reflection API. The team used actions provided within JavaParser to reflect on the code and extract various information from objects. The system has a wide variety of functionalities to allow proper analysis of classes, methods and other java objects.

3. **File Analysis**

   Gajun Young and Royal Thomas are in charge of making an interface between the user and the software to allow users to upload files, folders and entire projects onto the server which will then be parsed by the system to generate reports. The file is then passed onto other classes (Parser) for further analysis.

4. **Smell Detection**

   Smell detection is broken up into four parts and two members oversee each,

   1. **Bloaters -** Zheng and William.
   2. **Abusers -** Gajun and Royal.
   3. **Couplers –** William and Gajun.
   4. **Dispensables –** Royal and Zheng.

5. **Interface Design**

   Zheng and William were able to implement interfaces ensuring that each smell acted as a plug and play module. Knowing what each smell detector should be able to do, we were able to properly exploit polymorphism without worrying how each module is implemented on its own.

6. **Code Analysis**

   Royal and Gajun are responsible for calling the detectors onto the java files one at a time to produce reports. They have implemented a system that takes in user files and after parsing them – they are sent to each smell detector to generate reports. The report is then relayed back to the user through the GUI interface.

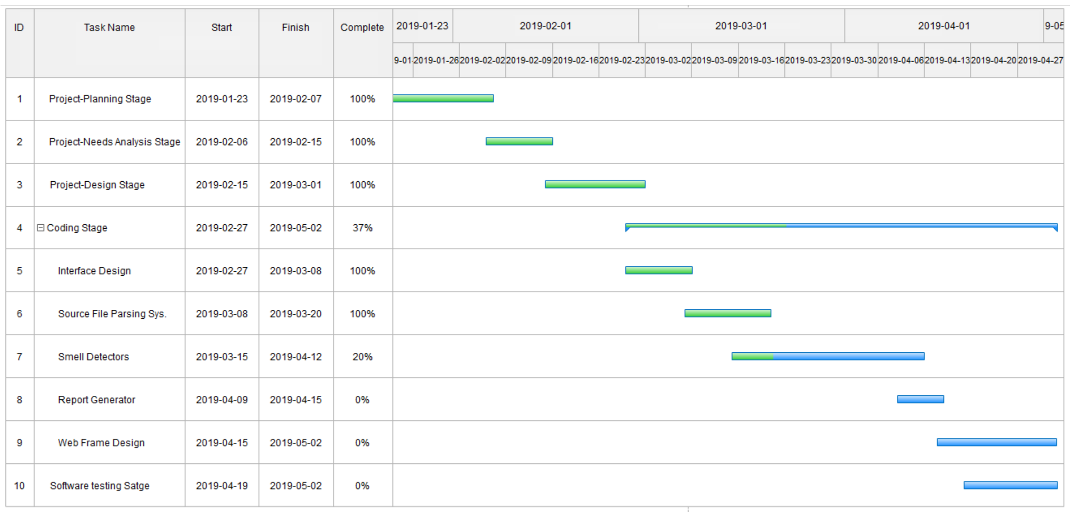
7. **Smell Visualization**

   The entire team is responsible for the implementation of smell visualization. The ideal plan is to be able to print out the code for each file after the process and point out to the users the issues through color codes implemented using CSS libraries and html.

8. **GUI Interactions**

   Like smell visualization, the entire team is responsible for the GUI interactions. As a team, we are hoping to form an entire web service capable of receiving projects from a user onto an HTML page which will be then processed by a Java backend (Spring). We are going to implement various CSS and JavaScript libraries to make it very user-friendly while being simple and well structured.

4.2 Development Plan & Progress



ID	Task Name	Start	Finish	Complete
1	Project-Planning Stage	2019-01-23	2019-02-07	100%
2	Project-Needs Analysis Stage	2019-02-06	2019-02-15	100%
3	Project-Design Stage	2019-02-15	2019-03-01	100%
4	⊟ Coding Stage	2019-02-27	2019-05-02	37%
5	Interface Design	2019-02-27	2019-03-08	100%
6	Source File Parsing Sys.	2019-03-08	2019-03-20	100%
7	Smell Detectors	2019-03-15	2019-04-12	20%
8	Report Generator	2019-04-09	2019-04-15	0%
9	Web Frame Design	2019-04-15	2019-05-02	0%
10	Software testing Satge	2019-04-19	2019-05-02	0%

5. Team Communication

For better communication between team members, several Apps such as Slack, Messenger and Discord, were used by team Scentaur. A GitHub Project Board was also used. Apart from online communication, face-to-face group meetings were scheduled for each week. Usually, decisive agreements such as project interface design and user interface selection, were reached during the face-to-face meeting.

5.1 Messenger

In order to make the software development more specific, smooth and efficient, for general discussion, Messenger was our primary platform to share ideas. Questions were carefully discussed and addressed by the group. However, given the rudimentary nature of the platform, it was not used as a primary method to record crucial communication information.

5.2 Discord

Discord was where we conduct daily Scrums, Spring Planning, Sprint reviews and Spring retrospectives. It ended up being a very user-friendly group voice chat platform to conduct these meetings. Team Scentaur had 3 channels in total. General channel was used for general talk. Team members discussed advantages and disadvantages, agreements and disagreements of the project and real-time ideas, information or links found were shared immediately here. Screen sharing was highly encouraged because it is a good way for every team member to give and receive advice and help. This platform allows team Scentaur to ensure group work and communication are pushed in progress simultaneously. Another two channels were for sub-groups. Our 4-member team was divided into 2 2-member sub-groups during different period of development. These channels were used for sub-groups to work on specific modules of the project. Therefore, different modules can be developed at the same time.

5.3 Slack

Basically, real-time information was shared during the group discussion, but any of the useful or important materials were also posted on Slack. Team Scentaur used Slack primarily to record the progress of the project. Only critical decisions or task assignment were pushed on Slack. Usually, team members were not allowed to talk on Slack. This makes Slack a clean and useful reference for team members to investigate.

5.4 GitHub Project Board

GitHub Project Board was used as a Scrum board to assign responsibilities and to track progress. Using the board, we began by producing an MVP (Minimum Viable Product) which was able to detect a few smells and read files in and parse them. Incrementally, we added more and more features onto this to produce better software. This helped us review the software and the path we are taking each time we ran a sprint.

5.5 GitHub

During the development, GitHub was used for version control, scrum board and issue/bug tracking. The version control system helped us pull back commits that had issues and made it simpler for us to share our code with each other. The GitHub issues section was used to report bugs, issues and possible enhancements which was not communicated during the daily meets.

Team Scentaur holds team meetings frequently. The weekly meeting is fixed on Wednesday and other meetings are held if necessary, on campus. During the break, daily talk on Messenger is compulsory. Team Scentaur needs to have knowledge of everyone's work progress. Voice meetings are planned. Usually once every 3 or 4 days but team Scentaur will hold a voice meeting every day when a topic requires a discussion.

6. Concluding Remarks

The team's philosophy behind Scentaur is simple. We work together as one collaborative unit, ensuring everyone on the team understands each other and moves towards a common goal.

6.1 Note Worthy

1. Scentaur as a project will be following normal guidelines such as using JavaDoc for documentation purposes.
2. To enable tidy and maintainable code, we have distinct packaging paths.
3. Scentaur uses a plugin called Gradle to allow the team to develop the software at a faster rate. We're also using external libraries such as JavaParser to help the team to parse Java files conveniently.
4. JavaParser uses abstract syntax trees. We as the developers can then dive into the tree to find compilation units of each Java file obtaining the nodes that are required for different smell detectors.
5. Scentaur's USP (Unique Selling Point) is that it is a web-based application. It is intended for all audiences who wish to detect smell in Java. Users are provided data visualizations to show smell present in their code.

6.2 Challenges

1. JavaParser is a new library for the team to understand. No members had any knowledge of the library before working on Scentaur. Thus, we tackled this by studying online material and looking through the API to understand the usage of JavaParser.
2. Spring is convoluted and difficult to grasp at a glance. It will take a considerable amount of time to learn. If things don't go as planned, we will make a judgement call and build a simple GUI instead.
3. Although we would like to refactor code, automatically refactoring the code is complex and time-consuming. If time is an issue, Scentaur will only detect code and offer refactoring suggestions.

Acknowledgements

The Scentaur report was an equally contributed effort. A breakdown is as follows:

Name [Contribution %]	Responsibilities
Ga Jun Young [25%]	Introduction, Specification, Software Overview, Conclusion Remarks, Editing
Royal Thomas [25%]	Introduction, Team Communication, Major Responsibilities & Breakdown
Zheng Ju [25%]	Introduction, Team Communication, Major Responsibilities & Breakdown
William Ikenna-Nwosu [25%]	Introduction [Compile], Software Overview, Conclusion Remarks, Proof Read and Editing

References

Sandi Metz (2017), *Code Refactoring: Learn Code Smells And Level Up Your Game!.* Available at: https://www.youtube.com/watch?v=D4auWwMsEnY (Accessed: 18th March 2019)

Federico Tomassetti (2017), *JavaParser-JUG-Milano.* Available at: https://tomassetti.me/wp-content/uploads/2017/12/JavaParser-JUG-Milano.pdf

Alexander S., Gerhard F., Marina P. (2006 – 2019), Code Smells, Available at: https://sourcemaking.com/refactoring/smells

Danny V.B (2018), *Inspecting an AST,* Available at: https://javaparser.org/inspecting-an-ast/

Thanis P., Amanda D., Eduardo F., Cláudio S. (2017), *Journal of Software Engineering Research and Development*, Available at: https://jserd.springeropen.com/articles/10.1186/s40411-017-0041-1

Mantyla, M. V., Lassenius C.(2006), *Subjective Evaluation of Software Evolvability Using Code Smells: an Empirical Study.*

Available at: http://mikamantyla.eu/BadCodeSmellsTaxonomy.html