Release 1.0

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Table of Contents

Project Description

This is a mobile application for android. The application is a memorization game where a single user is tasked to memorize the picture and the position of many different playing cards on the game board. Each playing card is faced down hiding their picture with the user only being able to select two cards at a time, revealing two pictures. Each card has an identical twin with the same picture but in a different location. If the user selects two cards with the identical picture then they will be awarded a match and those cards will disappear. If it's not a match those cards will flip back over hiding their picture, forcing the user to remember the positions of each picture. Eventually the user will find all matches and clear the board of cards. Once the board no longer contains any more cards and all matches are found the user will be presented with a screen displaying the time it took them to find all the matches. The goal is to find all matches on the board in the shortest possible time.

Features

- Single player “Traditional” Mode
    - In this mode the clock will start at 0 and then start counting up. The user will match each card with its pair until there are no more pairs left and the board is empty. The goal is to match all pairs of cards as fast as possible
- The Difficulty of Traditional mode can be changed from either easy, medium, or hard with the initial difficulty set to easy.
    - Easy difficulty consists of 6 cards
    - Medium difficulty consists of 12 cards
    - Hard difficulty consists of 20 cards
- The user can view instructions on the game, what it is, what each difficulty is and how traditional mode is played

End-Device/Requirements

This application was developed and tested on a Google Pixel 5 API 30 running Android 11. It can be used on any Android phone running Android 30 or higher.

Version Control

The memory matching game is version controlled using Git and its repository is hosted on GitHub. The repository for this project is at the following site:

https://github.com/steadows/Memory

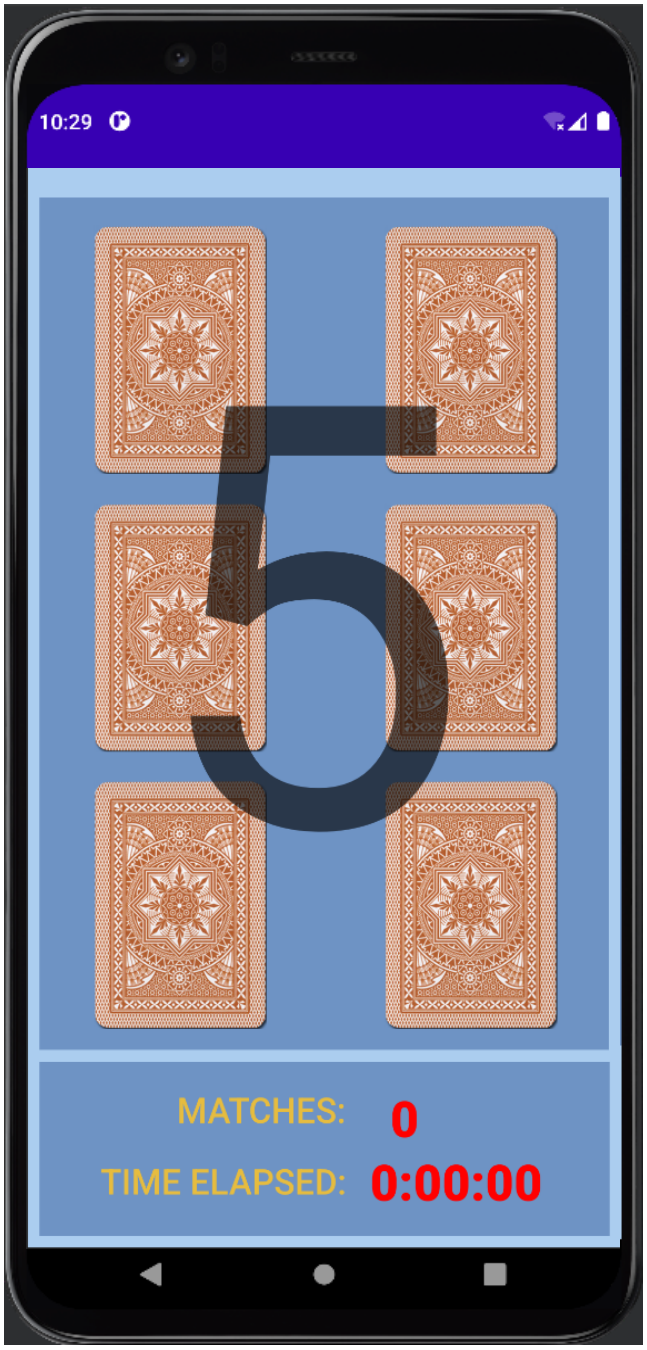
Screen Shots

Main Menu and SubMenu Screens

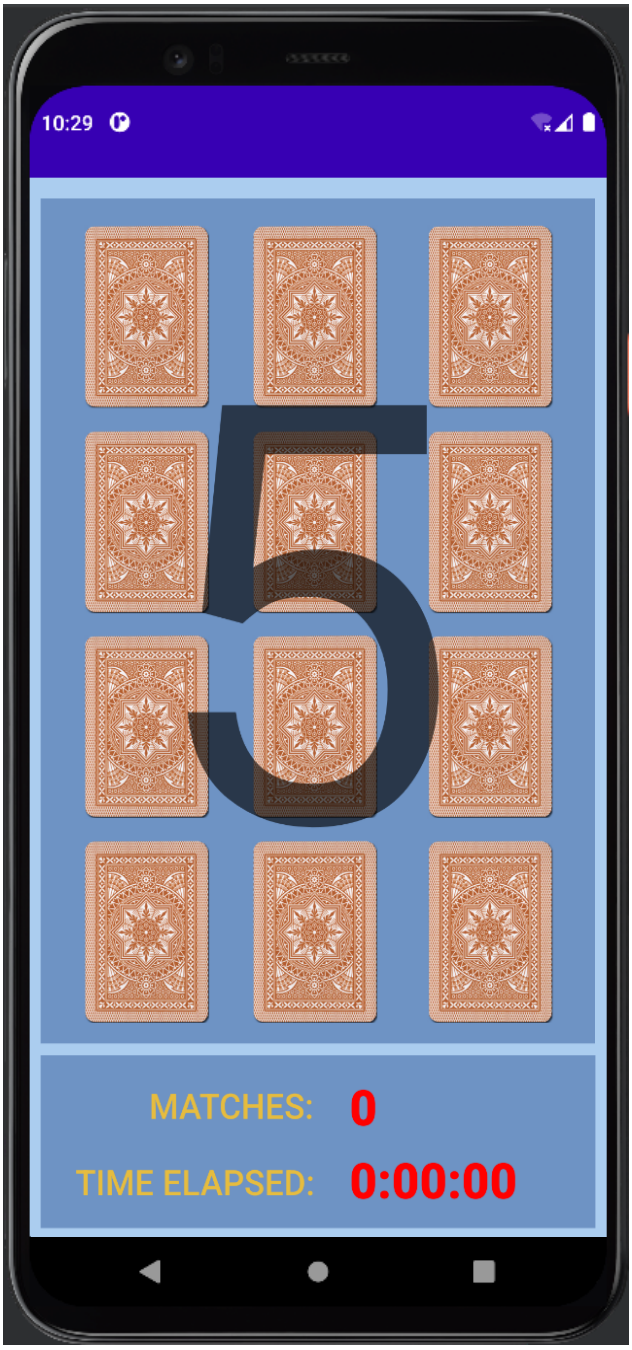
This screen is the Main screen. Its function is to welcome the user to the app and entice them to play

This screen is the Sub Menu screen. It allows the user to start the game, choose the difficulty, find the instructions, and return to the main menu.

Easy and Medium Difficulty Screens



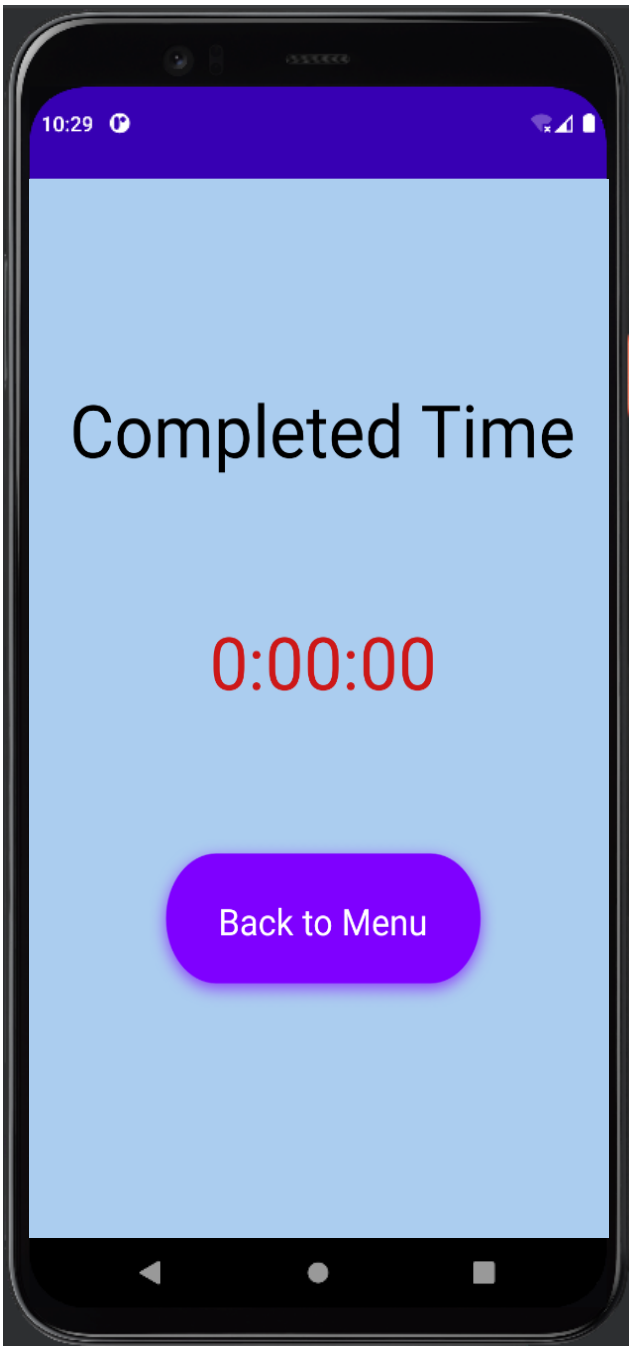
This screen shows what Easy difficulty looks like at the start. The user will try to match all 6 cards in the shortest time possible.



This screen shows what Medium difficulty looks like at the start. The user will try to match all 12 cards in the shortest time possible.

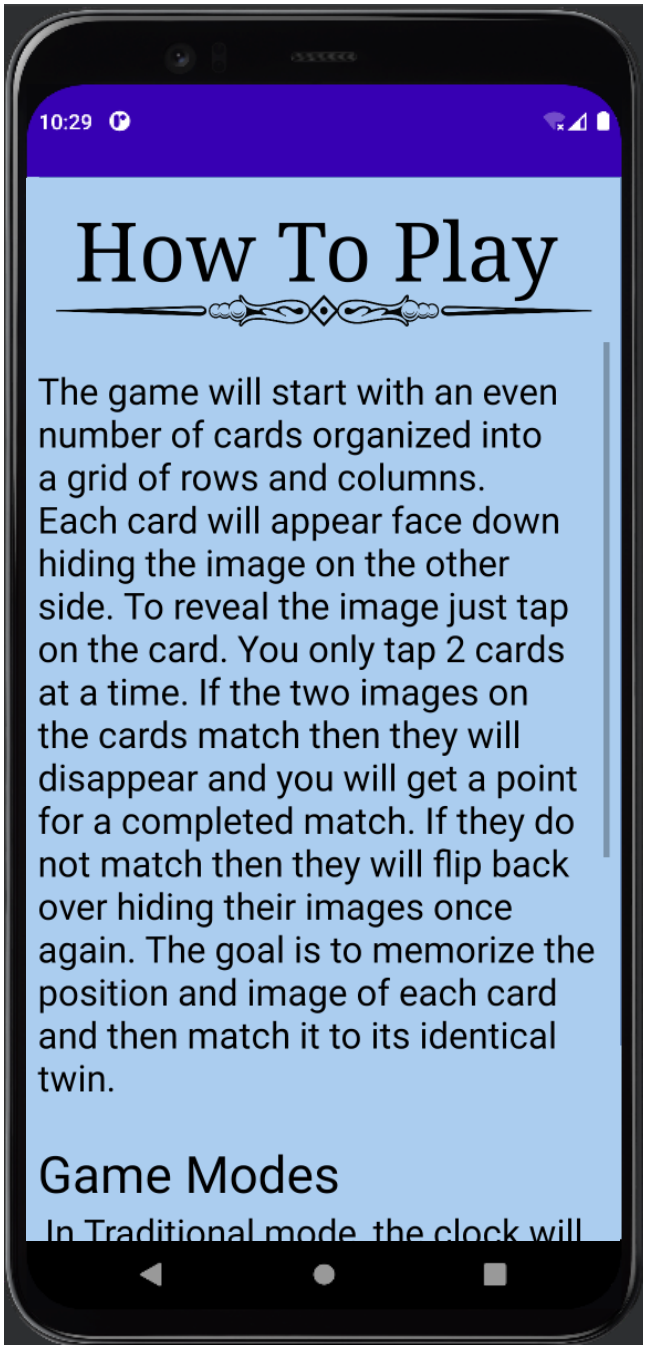
Hard Difficulty and Completed Screens

This screen shows what the Hard difficulty of the game looks like at the start. The user will try to match all 20 cards in the shortest time possible.

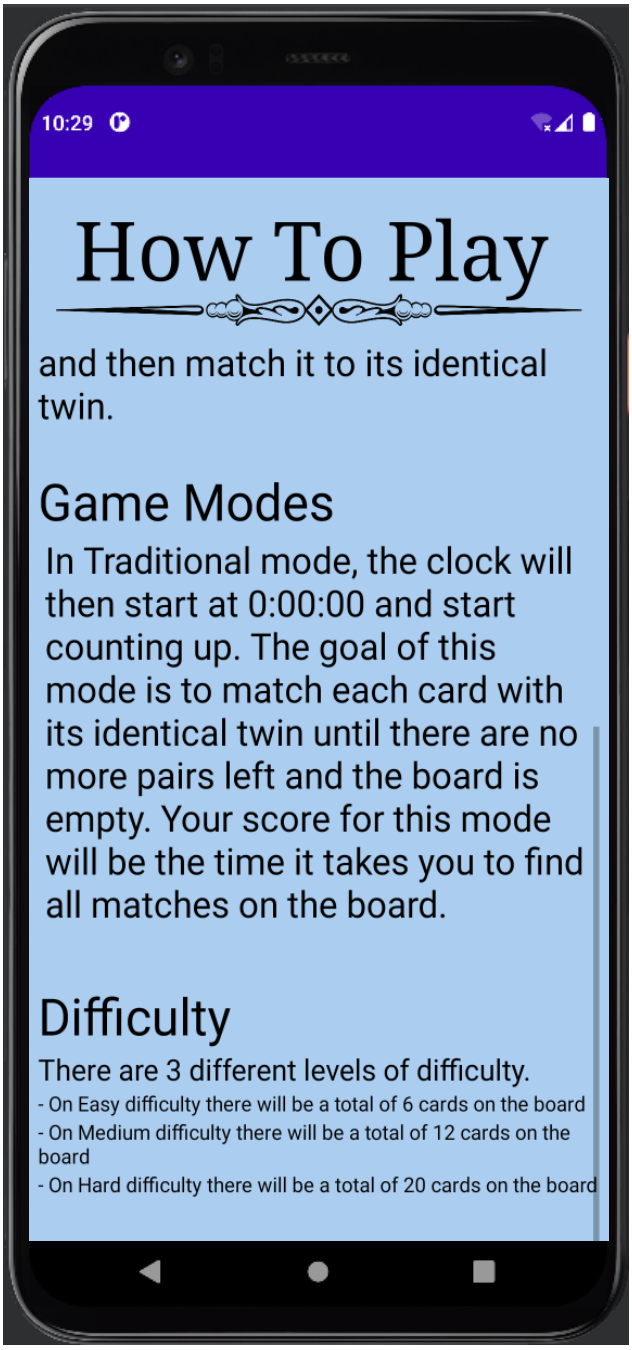


This screen shows the time it took the user to match all cards on the board together either on easy, medium, or hard difficulty.

Instructions Screen

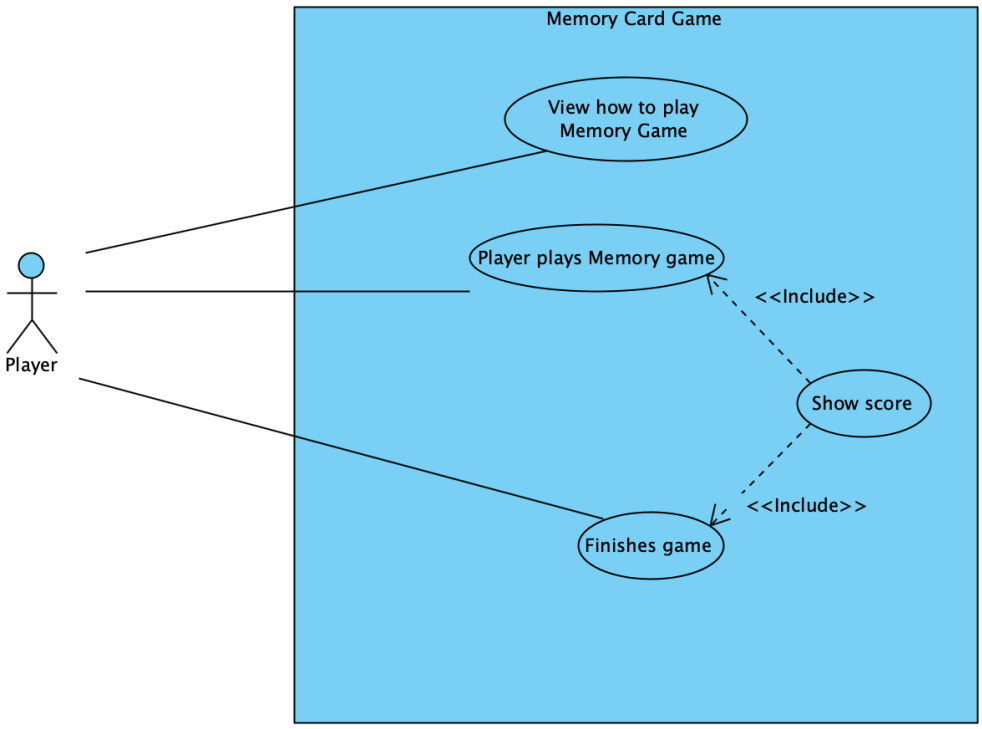


This screen displays the instructions on how to play the game. This purpose of this section on the screen is to describe the game and how to play traditional mode



This screen displays the instructions on how to play the game. This purpose of this section on the screen is to describe the different difficulty you can play in.

Use Case Diagram



Use Case Description

Play Traditional Game Mode Use Case

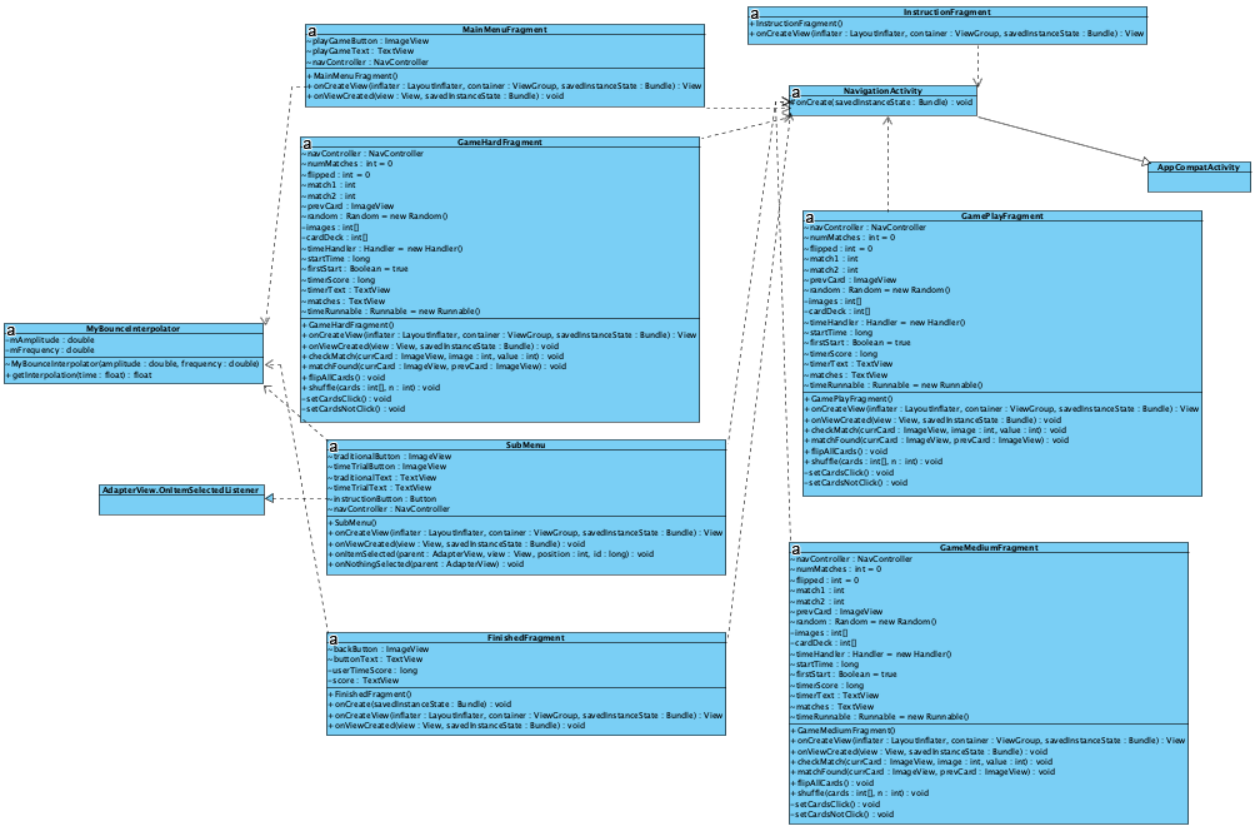
Name	Traditional Mode
ID	GamePlayFragment.java
Brief Description	The user enters traditional game play mode, which instantiates a board displaying several cards facing down. Users can then play the game of memory, interacting with cards on screen to make matches.
Actors	App User
Triggers	App Startup User selects ‘Play Game’ Button User chooses level of difficulty User selects ‘Traditional Mode’ Button
Preconditions	None

Primary Flow	1. User indicates difficulty level. 2. User selects “Traditional Mode” a. The 5 second countdown timer begins. b. After the countdown timer is done, the user can then begin selecting 2 cards at a time to collect two-of-a-kind matches. c. Gameplay time is shown in the ‘Time Elapsed’ field. 3. User selects two cards at a time to collect matches. 4. If two card selections aren't a match, cards are flipped back over to the original state. 5. If cards are a match, cards disappear from the board and the match counter is increased by one. 6. Game play ends when all cards are paired with matches. 7. End screen loads showing time of completion a. User is prompted to return to the main menu.
Alternate Flows	None
Minimal Guarantees	App will continue to run until all matches are collected.
Success Guarantees	No matches are left on board. Time of play is displayed.

View Game Instructions Use Case

Name	Click Here to learn how to play
ID	InstructionFragment
Brief Description	Describes the rules of the game and how to interact with the application to win the game.
Actors	App User
Triggers	App Startup User selects ‘Play Game’ Button User selects ‘Click Here to learn how to play’
Preconditions	None
Primary Flow	1. User selects the ‘Click Here to learn how to play’ button. 2. Instructions display on screen. 3. Users can scroll to view the entire screen. 4. Instruction screen can be excited by selecting the ‘back’ button on the device.
Alternate Flows	None
Minimal Guarantees	Users can view the full menu.
Success Guarantees	Users can continue onto gameplay.

UML CLASS DIAGRAM



Static Source Code Analyzers

SonarLint

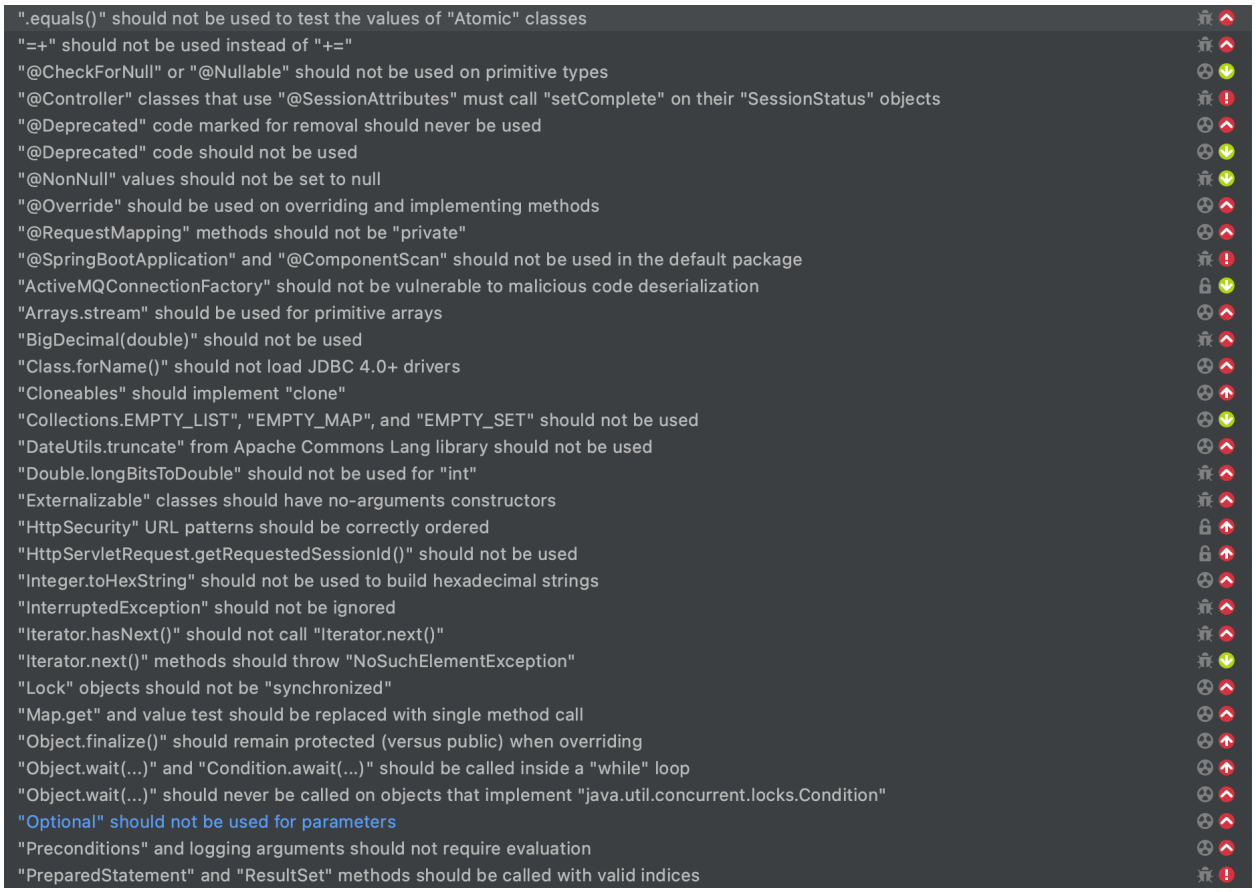
For app development using android studio as an IDE we found that the best code analyzer to use was Sonar Lint. By using SonarLint we were able to enforce uniform coding standards across the team allowing the code to be easily understood by everyone on the development team and anyone that will use it in the future. Conforming to SonarLint's coding standard also allows for the team to find potential bugs when adding new features and easily be able to fix them. All of the SonarLint coding standards that were used and checked for are below along with the level of significance indicator .

 - Indicates Minor Bug

 - Indicates Major Bug

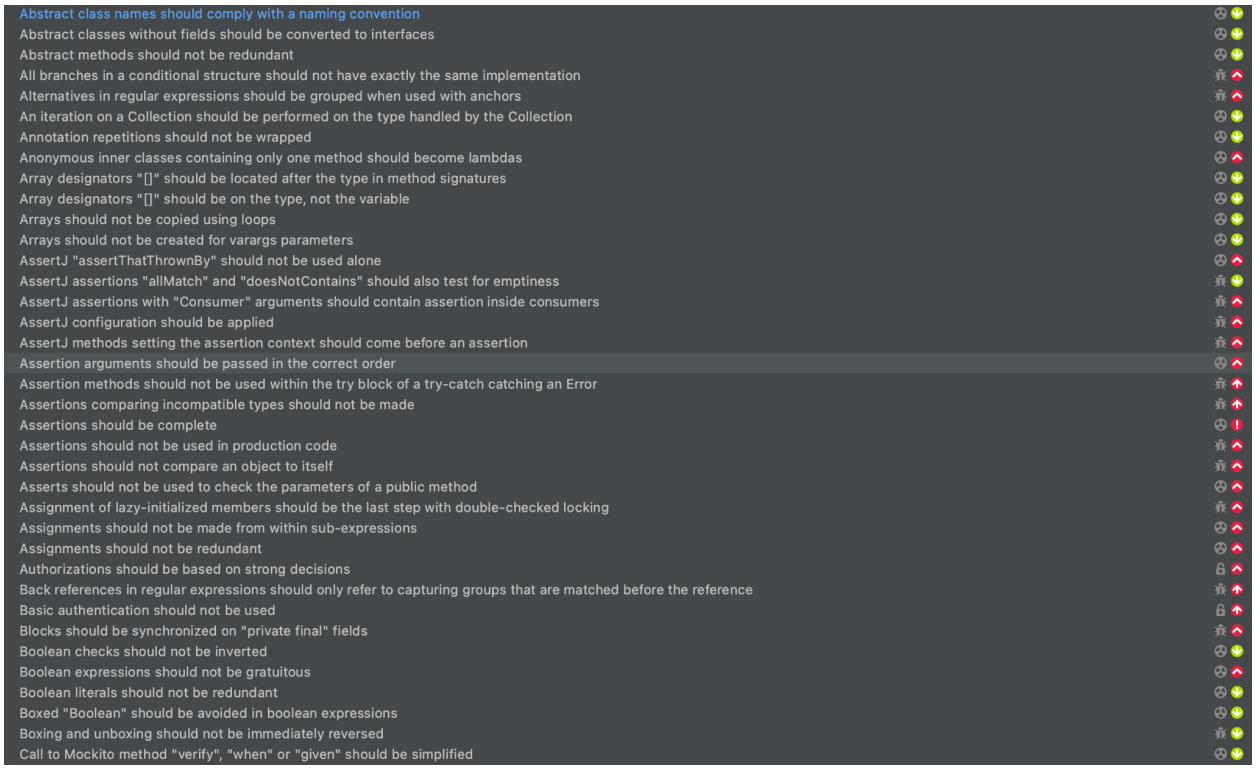
 - Indicates Critical Bug

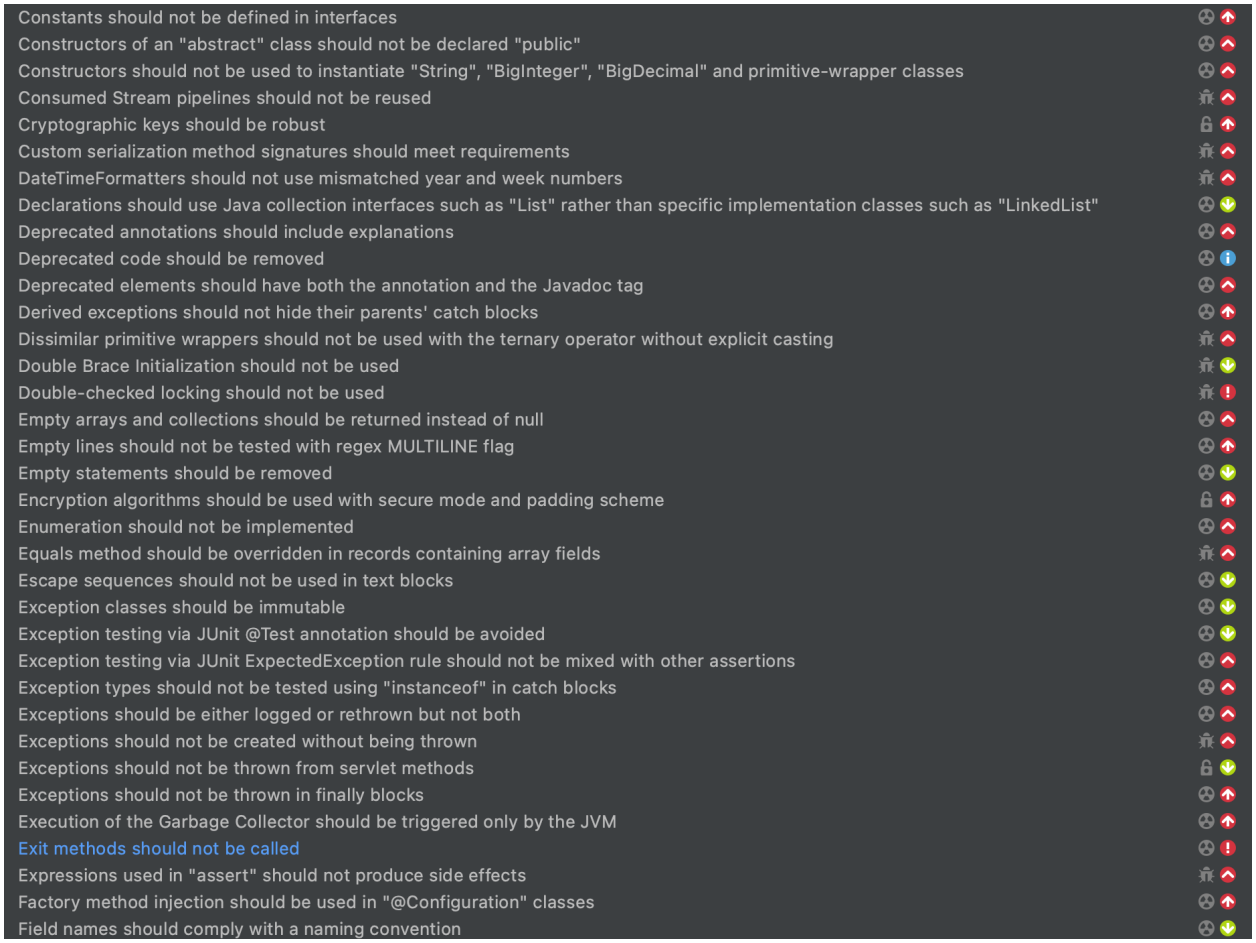
 - Indicates Information Blocking



"Random" objects should be reused
"ResultSet.isLast()" should not be used
"ScheduledThreadPoolExecutor" should not have 0 core threads
"SecureRandom" seeds should not be predictable
"Serializable" inner classes of non-serializable classes should be "static"
"StandardCharsets" constants should be preferred
"Stream" call chains should be simplified when possible
"Stream.peek" should be used with caution
"Stream.toList()" method should be used instead of "collectors" when unmodifiable list needed
"String" calls should not go beyond their bounds
"String#replace" should be preferred to "String#replaceAll"
"StringBuilder" and "StringBuffer" should not be instantiated with a character
"Thread.run()" should not be called directly
"Thread.sleep" should not be used in tests
"ThreadGroup" should not be used
"ThreadLocal" variables should be cleaned up when no longer used
"ThreadLocal.withInitial" should be preferred
"Threads" should not be used where "Runnables" are expected
"URL.hashCode" and "URL.equals" should be avoided
"catch" clauses should do more than rethrow
"clone" should not be overridden
"close()" calls should not be redundant
"compareTo" results should not be checked for specific values
"compareTo" should not be overloaded
"compareTo" should not return "Integer.MIN_VALUE"
"default" clauses should be last
"else" statements should be clearly matched with an "if"
"enum" fields should not be publicly mutable
"equals" method overrides should accept "Object" parameters
"equals" method parameters should not be marked "@Nonnull"
"equals(Object obj)" and "hashCode()" should be overridden in pairs
"equals(Object obj)" should be overridden along with the "compareTo(T obj)" method
"equals(Object obj)" should test argument type
"finalize" should not set fields to "null"
"for" loop increment clauses should modify the loops' counters
"for" loop stop conditions should be invariant
"getClass" should not be used for synchronization
"hashCode" and "toString" should not be called on array instances

"indexOf" checks should not be for positive numbers
"iterator" should not return "this"
"java.nio.Files#delete" should be preferred
"notifyAll" should be used
"null" should not be used with "Optional"
"private" methods called only by inner classes should be moved to those classes
"public static" fields should be constant
"read" and "readLine" return values should be used
"read(byte[],int,int)" should be overridden
"readObject" should not be "synchronized"
"readResolve" methods should be inheritable
"runFinalizersOnExit" should not be called
"static" base class members should not be accessed via derived types
"static" members should be accessed statically
"super.finalize()" should be called at the end of "Object.finalize()" implementations
"switch" statements should have "default" clauses
"switch" statements should have at least 3 "case" clauses
"switch" statements should not contain non-case labels
"switch" statements should not have too many "case" clauses
"throws" declarations should not be superfluous
"toArray" should be passed an array of the proper type
"toString()" and "clone()" methods should not return null
"toString()" should never be called on a String object
"volatile" variables should not be used with compound operators
"wait" should not be called when multiple locks are held
"wait", "notify" and "notifyAll" should only be called when a lock is obviously held on an object
"wait(...)" should be used instead of "Thread.sleep(...)" when a lock is held
"write(byte[],int,int)" should be overridden
"writeObject" should not be the only "synchronized" code in a class
'List.remove()' should not be used in ascending 'for' loops
'serialVersionUID' field should not be set to '0L' in records
A "for" loop update clause should move the counter in the right direction
A "while" loop should be used instead of a "for" loop
A conditionally executed single line should be denoted by indentation
A field should not duplicate the name of its containing class
A new session should be created during user authentication
A secure password should be used when connecting to a database


Abstract class names should comply with a naming convention
Abstract classes without fields should be converted to interfaces
Abstract methods should not be redundant
All branches in a conditional structure should not have exactly the same implementation
Alternatives in regular expressions should be grouped when used with anchors
An iteration on a Collection should be performed on the type handled by the Collection
Annotation repetitions should not be wrapped
Anonymous inner classes containing only one method should become lambdas
Array designators "[]" should be located after the type in method signatures
Array designators "[]" should be on the type, not the variable
Arrays should not be copied using loops
Arrays should not be created for varargs parameters
AssertJ "assertThatThrownBy" should not be used alone
AssertJ assertions "allMatch" and "doesNotContains" should also test for emptiness
AssertJ assertions with "Consumer" arguments should contain assertion inside consumers
AssertJ configuration should be applied
AssertJ methods setting the assertion context should come before an assertion
Assertion arguments should be passed in the correct order
Assertion methods should not be used within the try block of a try-catch catching an Error
Assertions comparing incompatible types should not be made
Assertions should be complete
Assertions should not be used in production code
Assertions should not compare an object to itself
Asserts should not be used to check the parameters of a public method
Assignment of lazy-initialized members should be the last step with double-checked locking
Assignments should not be made from within sub-expressions
Assignments should not be redundant
Authorizations should be based on strong decisions
Back references in regular expressions should only refer to capturing groups that are matched before the reference
Basic authentication should not be used
Blocks should be synchronized on "private final" fields
Boolean checks should not be inverted
Boolean expressions should not be gratuitous
Boolean literals should not be redundant
Boxed "Boolean" should be avoided in boolean expressions
Boxing and unboxing should not be immediately reversed
Call to Mockito method "verify", "when" or "given" should be simplified


Constants should not be defined in interfaces
Constructors of an "abstract" class should not be declared "public"
Constructors should not be used to instantiate "String", "BigInteger", "BigDecimal" and primitive-wrapper classes
Consumed Stream pipelines should not be reused
Cryptographic keys should be robust
Custom serialization method signatures should meet requirements
DateTimeFormatters should not use mismatched year and week numbers
Declarations should use Java collection interfaces such as "List" rather than specific implementation classes such as "LinkedList"
Deprecated annotations should include explanations
Deprecated code should be removed
Deprecated elements should have both the annotation and the Javadoc tag
Derived exceptions should not hide their parents' catch blocks
Dissimilar primitive wrappers should not be used with the ternary operator without explicit casting
Double Brace Initialization should not be used
Double-checked locking should not be used
Empty arrays and collections should be returned instead of null
Empty lines should not be tested with regex MULTILINE flag
Empty statements should be removed
Encryption algorithms should be used with secure mode and padding scheme
Enumeration should not be implemented
Equals method should be overridden in records containing array fields
Escape sequences should not be used in text blocks
Exception classes should be immutable
Exception testing via JUnit @Test annotation should be avoided
Exception testing via JUnit ExpectedException rule should not be mixed with other assertions
Exception types should not be tested using "instanceof" in catch blocks
Exceptions should be either logged or rethrown but not both
Exceptions should not be created without being thrown
Exceptions should not be thrown from servlet methods
Exceptions should not be thrown in finally blocks
Execution of the Garbage Collector should be triggered only by the JVM
Exit methods should not be called
Expressions used in "assert" should not produce side effects
Factory method injection should be used in "@Configuration" classes
Field names should comply with a naming convention

Case insensitive Unicode regular expressions should enable the “UNICODE_CASE” flag
Case insensitive string comparisons should be made without intermediate upper or lower casing
Catches should be combined
Chained AssertJ assertions should be simplified to the corresponding dedicated assertion
Character classes in regular expressions should not contain the same character twice
Character classes should be preferred over reluctant quantifiers in regular expressions
Child class fields should not shadow parent class fields
Child class methods named for parent class methods should be overrides
Cipher Block Chaining IVs should be unpredictable
Cipher algorithms should be robust
Class members annotated with "@VisibleForTesting" should not be accessed from production code
Class names should comply with a naming convention
Class names should not shadow interfaces or superclasses
Class variable fields should not have public accessibility
Classes extending java.lang.Thread should override the "run" method
Classes from "sun.*" packages should not be used
Classes named like "Exception" should extend "Exception" or a subclass
Classes should not access their own subclasses during initialization
Classes should not be compared by name
Classes should not be empty
Classes that override "clone" should be "Cloneable" and call "super.clone()"
Classes with only "static" methods should not be instantiated
Cognitive Complexity of methods should not be too high
Collapsible "if" statements should be merged
Collection constructors should not be used as java.util.function.Function
Collection sizes and array length comparisons should make sense
Collection.isEmpty() should be used to test for emptiness
Collections should not be passed as arguments to their own methods
Comma-separated labels should be used in Switch with colon case
Composed "@RequestMapping" variants should be preferred
Conditionally executed code should be reachable
Conditionals should start on new lines
Consecutive AssertJ "assertThat" statements should be chained
Constant names should comply with a naming convention

Fields in a "Serializable" class should either be transient or serializable
Fields in non-serializable classes should not be "transient"
Files opened in append mode should not be used with ObjectOutputStream
Functional Interfaces should be as specialised as possible
Future keywords should not be used as names
Generic exceptions should never be thrown
Generic wildcard types should not be used in return types
Getters and setters should access the expected fields
Getters and setters should be synchronized in pairs
Hashes should include an unpredictable salt
Identical expressions should not be used on both sides of a binary operator
IllegalMonitorStateException should not be caught
Inappropriate "Collection" calls should not be made
Inappropriate regular expressions should not be used
Inheritance tree of classes should not be too deep
Inner class calls to super class methods should be unambiguous
InputSteam.read() implementation should not return a signed byte
Insecure temporary file creation methods should not be used
Instance methods should not write to "static" fields
Interface names should comply with a naming convention
Intermediate Stream methods should not be left unused
Ints and longs should not be shifted by zero or more than their number of bits-1
Invalid "Date" values should not be used
JUnit assertTrue/assertFalse should be simplified to the corresponding dedicated assertion
JUnit assertions should not be used in "run" methods
JUnit rules should be used
JUnit test cases should call super methods
JUnit4 @Ignored and JUnit5 @Disabled annotations should be used to disable tests and should provide a rationale
JUnit5 inner test classes should be annotated with @Nested
JUnit5 test classes and methods should have default package visibility
JUnit5 test classes and methods should not be silently ignored
JWT should be signed and verified with strong cipher algorithms
Java features should be preferred to Guava
Java parser failure
Jump statements should not be redundant

Jump statements should not occur in "finally" blocks
LDAP connections should be authenticated
Labels should not be used
Lambdas containing only one statement should not nest this statement in a block
Lambdas should be replaced with method references
Local variable and method parameter names should comply with a naming convention
Local variables should not be declared and then immediately returned or thrown
Local variables should not shadow class fields
Locks should be released
Loggers should be named for their enclosing classes
Loop conditions should be true at least once
Loops should not be infinite
Loops should not contain more than a single "break" or "continue" statement
Loops with at most one iteration should be refactored
Map "computeIfAbsent()" and "computeIfPresent()" should not be used to add "null" values.
Map values should not be replaced unconditionally
Maps with keys that are enum values should be replaced with EnumMap
Math operands should be cast before assignment
Members ignored during record serialization should not be used
Method names should comply with a naming convention
Method overrides should not change contracts
Method parameters, caught exceptions and foreach variables' initial values should not be ignored
Methods "wait(...)", "notify()" and "notifyAll()" should not be called on Thread instances
Methods and field names should not be the same or differ only by capitalization
Methods of "Random" that return floating point values should not be used in random integer generation
Methods returns should not be invariant
Methods setUp() and tearDown() should be correctly annotated starting with JUnit4
Methods should not be empty
Methods should not be named "tostring", "hashcode" or "equal"
Methods should not be too complex
Methods should not call same-class methods with incompatible "@Transactional" values
Methods should not have identical implementations
Methods should not have too many parameters
Methods should not have too many return statements
Methods should not return constants

Min and max used in combination should not always return the same value
Mobile database encryption keys should not be disclosed
Mocking all non-private methods of a class should be avoided
Modifiers should be declared in the correct order
Multiline blocks should be enclosed in curly braces
Multiple variables should not be declared on the same line
Mutable fields should not be "public static"
Names of regular expressions named groups should be used
Neither "Math.abs" nor negation should be used on numbers that could be "MIN_VALUE"
Nested "enum"s should not be declared static
Nested blocks of code should not be left empty
Nested code blocks should not be used
Non-constructor methods should not have the same name as the enclosing class
Non-primitive fields should not be "volatile"
Non-public methods should not be "@Transactional"
Non-serializable classes should not be written
Non-serializable objects should not be stored in "HttpSession" objects
Non-thread-safe fields should not be static
Null checks should not be used with "instanceof"
Null pointers should not be dereferenced
Null should not be returned from a "Boolean" method
Nullness of parameters should be guaranteed
Objects should not be created only to "getClass"
Only one method invocation is expected when testing checked exceptions
Only one method invocation is expected when testing runtime exceptions
Only static class initializers should be used
OpenSAML2 should be configured to prevent authentication bypass
Operator "instanceof" should be used instead of "A.class.isInstance()"
Optional value should only be accessed after calling isPresent()
Overrides should match their parent class methods in synchronization
Overriding methods should do more than simply call the same method in the super class
Package declaration should match source file directory
Package names should comply with a naming convention
Packages containing only "package-info.java" should be removed
Parameters should be passed in the correct order

Parentheses should be removed from a single lambda input parameter when its type is inferred
Parsing should be used to convert "Strings" to primitives
Passwords should not be stored in plain-text or with a fast hashing algorithm
Pattern Matching for "instanceof" operator should be used instead of simple "instanceof" + cast
Permitted types of a sealed class should be omitted if they are declared in the same file
Persistent entities should not be used as arguments of "@RequestMapping" methods
Primitive wrappers should not be instantiated only for "toString" or "compareTo" calls
Primitives should not be boxed just for "String" conversion
Printf-style format strings should be used correctly
Printf-style format strings should not lead to unexpected behavior at runtime
Private fields only used as local variables in methods should become local variables
Public constants and fields initialized at declaration should be "static final" rather than merely "final"
Raw byte values should not be used in bitwise operations in combination with shifts
Raw types should not be used
Records should be used instead of ordinary classes when representing immutable data structure
Redundant casts should not be used
Redundant constructors/methods should be avoided in records
Redundant pairs of parentheses should be removed
Reflection should not be used to check non-runtime annotations
Reflection should not be used to increase accessibility of classes, methods, or fields
Reflection should not be used to increase accessibility of records' fields
Regex alternatives should not be redundant
Regex boundaries should not be used in a way that can never be matched
Regex lookahead assertions should not be contradictory
Regex patterns following a possessive quantifier should not always fail
Regexes containing characters subject to normalization should use the CANON_EQ flag
Regular expressions should be syntactically valid
Regular expressions should not be too complicated
Regular expressions should not overflow the stack
Related "if/else if" statements should not have the same condition
Reluctant quantifiers in regular expressions should be followed by an expression that can't match the empty string
Repeated patterns in regular expressions should not match the empty string
Resources should be closed
Restricted Identifiers should not be used as Identifiers
Return of boolean expressions should not be wrapped into an "if-then-else" statement

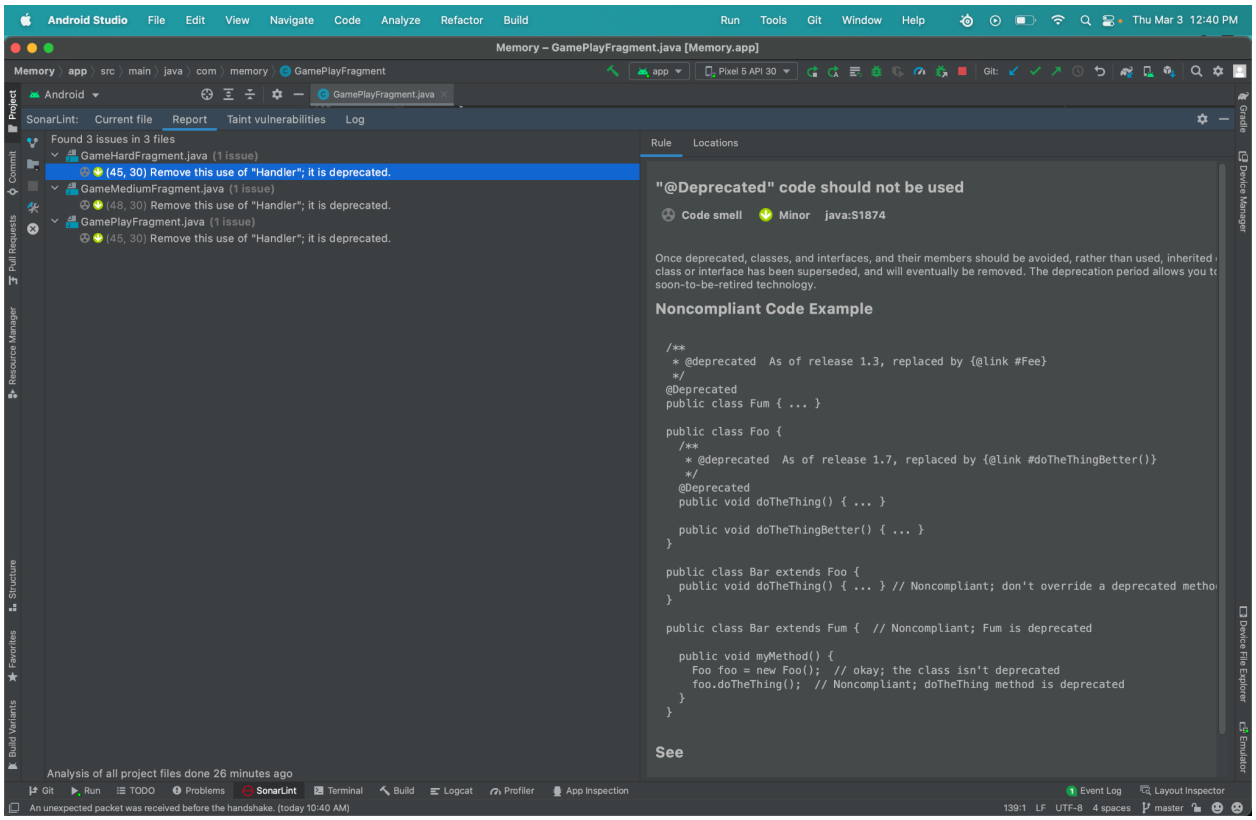
Return values from functions without side effects should not be ignored
Return values should not be ignored when they contain the operation status code
Sections of code should not be commented out
Server certificates should be verified during SSL/TLS connections
Server hostnames should be verified during SSL/TLS connections
Servlets should not have mutable instance fields
Short-circuit logic should be used in boolean contexts
Silly String operations should not be made
Silly bit operations should not be performed
Silly equality checks should not be made
Silly math should not be performed
Similar tests should be grouped in a single Parameterized test
Simple string literal should be used for single line strings
Single-character alternations in regular expressions should be replaced with character classes
Standard outputs should not be used directly to log anything
Static fields should not be updated in constructors
Static non-final field names should comply with a naming convention
String literals should not be duplicated
String multiline concatenation should be replaced with Text Blocks
String offset-based methods should be preferred for finding substrings from offsets
String.valueOf() should not be appended to a String
Strings and Boxed types should be compared using "equals()"
Strings should not be concatenated using '+' in a loop
Subclasses that add fields should override "equals"
Switch arrow labels should not use redundant keywords
Switch cases should end with an unconditional "break" statement
Synchronization should not be done on instances of value-based classes
Synchronized classes Vector, Hashtable, Stack and StringBuffer should not be used
Ternary operators should not be nested
Test classes should comply with a naming convention
Test methods should not contain too many assertions
TestCases should contain tests
Tests method should not be annotated with competing annotations
Tests should be stable
Tests should include assertions

Text blocks should not be used in complex expressions
The Object.finalize() method should not be called
The Object.finalize() method should not be overridden
The default unnamed package should not be used
The diamond operator ("<>") should be used
The non-serializable super class of a "Serializable" class should have a no-argument constructor
The regex escape sequence \cX should only be used with characters in the @-_ range
The signature of "finalize()" should match that of "Object.finalize()"
The value returned from a stream read should be checked
Throwable and Error should not be caught
Track uses of "FIXME" tags
Track uses of "TODO" tags
Try-catch blocks should not be nested
Try-with-resources should be used
Two branches in a conditional structure should not have exactly the same implementation
Type parameter names should comply with a naming convention
Type parameters should not shadow other type parameters
URIs should not be hardcoded
Unary prefix operators should not be repeated
Unicode Grapheme Clusters should be avoided inside regex character classes
Unnecessary imports should be removed
Unused "private" classes should be removed
Unused "private" fields should be removed
Unused "private" methods should be removed
Unused assignments should be removed
Unused labels should be removed
Unused local variables should be removed
Unused method parameters should be removed
Unused type parameters should be removed
Utility classes should not have public constructors
Value-based classes should not be used for locking
Values should not be uselessly incremented
Vararg method arguments should not be confusing
Variables should not be self-assigned
Weak SSL/TLS protocols should not be used

Week Year ("YYYY") should not be used for date formatting
Whitespace and control characters in literals should be explicit
Whitespace for text block indent should be consistent
XML parsers should not allow inclusion of arbitrary files
XML parsers should not be vulnerable to Denial of Service attacks
XML parsers should not be vulnerable to XXE attacks
XML parsers should not load external schemas
XML signatures should be validated securely
Zero should not be a possible denominator

Result of SonarLint

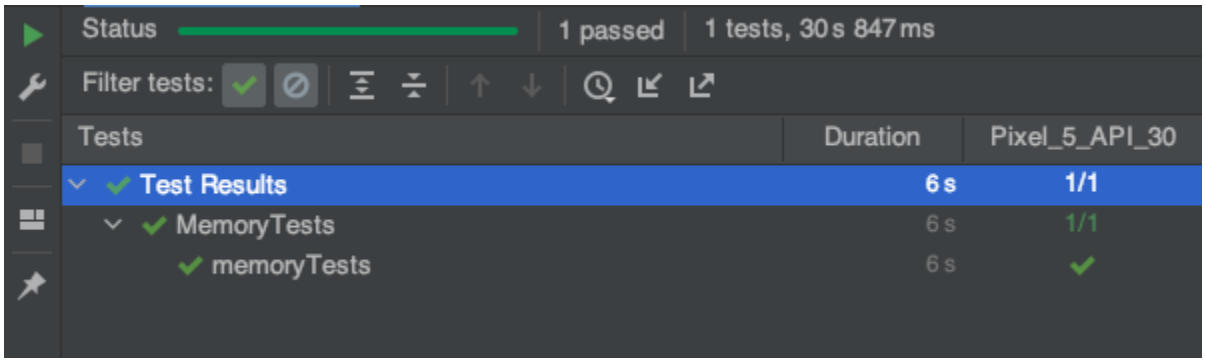
This is the result of running SonarLint rules throughout whole project:



Each of the different difficulty screens uses a handler to allow for there to be a runnable object in the code. This runnable object is the timer and its function is to run continuously keeping track of the total time playing the game. SonarLint says it should not be used because it is deprecated. This is not correct and the handler must be used in order for the timer to function properly. For this reason and because it's only a minor bug it was decided that this wasn't a “true” issue and can be ignored.

Code Coverage

To make sure the application runs correctly we used Espresso, a tool known to write concise, automated and reliable Android UI tests. We used espresso to test the Main screen, sub menu screen, and the instructions screen to make sure that each screen displayed their proper elements each and every time the app is run. These are the test files used to insure each screen was working properly:




```java
@LargeTest
@RunWith(AndroidJUnit4.class)
public class MemoryTests {

    @Rule
    public ActivityTestRule<NavigationActivity> mActivityTestRule = new ActivityTestRule<>(NavigationActivity.class);

    @Test
    public void memoryTests() {
        ViewInteraction textView = onView(
                allOf(withId(R.id.Play_button_text), withText("Play Game"),
                        withParent(allOf(withId(R.id.main_menu_layout),
                                withParent(withId(R.id.nav_host_fragment)))),
                        isDisplayed()));
        textView.check(matches(isDisplayed()));

        ViewInteraction appCompatImageView = onView(
                allOf(withId(R.id.play_game_button), withContentDescription( text: "sets screen back to submenu"),
                        childAtPosition(
                                allOf(withId(R.id.main_menu_layout),
                                        childAtPosition(
                                                withId(R.id.nav_host_fragment),
                                                position: 0)),
                                position: 8),
                        isDisplayed()));
        appCompatImageView.perform(click());

        ViewInteraction textView2 = onView(
                allOf(withId(android.R.id.text1), withText("EASY"),
                        withParent(allOf(withId(R.id.spinner), withContentDescription( text: "CHOOSE MODE"),
                                withParent(withId(R.id.frameLayout)))),
                        isDisplayed()));
        textView2.check(matches(isDisplayed()));

        ViewInteraction spinner = onView(
                allOf(withId(R.id.spinner), withContentDescription( text: "CHOOSE MODE"),
                        withParent(allOf(withId(R.id.frameLayout),
                                withParent(withId(R.id.nav_host_fragment)))),
                        isDisplayed()));
        spinner.check(matches(isDisplayed()));

        ViewInteraction imageView = onView(
                allOf(withId(R.id.Traditional_button), withContentDescription( text: "sets screen back to submenu"),
                        withParent(allOf(withId(R.id.frameLayout),
                                withParent(withId(R.id.nav_host_fragment)))),
                        isDisplayed()));
        imageView.check(matches(isDisplayed()));
```

```
        ViewInteraction imageView2 = onView(
                allOf(withId(R.id.Time_trial_button), withContentDescription( text: "sets screen back to submenu"),
                        withParent(allOf(withId(R.id.frameLayout),
                                withParent(withId(R.id.nav_host_fragment)))),
                        isDisplayed()));
        imageView2.check(matches(isDisplayed()));

        ViewInteraction button = onView(
                allOf(withId(R.id.Instruction_button), withText("Click Here to learn how to play"),
                        withParent(allOf(withId(R.id.frameLayout),
                                withParent(withId(R.id.nav_host_fragment)))),
                        isDisplayed()));
        button.check(matches(isDisplayed()));

        ViewInteraction imageView3 = onView(
                allOf(withId(R.id.Traditional_button), withContentDescription( text: "sets screen back to submenu"),
                        withParent(allOf(withId(R.id.frameLayout),
                                withParent(withId(R.id.nav_host_fragment)))),
                        isDisplayed()));
        imageView3.check(matches(isDisplayed()));

    }

    private static Matcher<View> childAtPosition(
            final Matcher<View> parentMatcher, final int position) {

        return new TypeSafeMatcher<View>() {
            @Override
            public void describeTo(Description description) {
                description.appendText("Child at position " + position + " in parent ");
                parentMatcher.describeTo(description);
            }

            @Override
            public boolean matchesSafely(View view) {
                ViewParent parent = view.getParent();
                return parent instanceof ViewGroup && parentMatcher.matches(parent)
                        && view.equals(((ViewGroup) parent).getChildAt(position));
            }
        };
    }
}
```

The tests above ensured the appearance of buttons that are essential to app operation.

- On the Main Menu screen we made sure that the ‘Play Game’ button appeared. This is the entry to the game that allows the actor to engage with our app.
- When we moved to the Sub Menu screen, we had to be sure that the drop down menu that allowed the actor to select what mode they wanted to play appeared. This is crucial for the app to choose which fragment to choose next. Also, we needed to be sure that the ‘Traditional Mode’ and the ‘Back to Main Menu’ buttons were visible.
- The Traditional Mode button allowed the user to engage in the game in the difficulty level they desired. The Back to Main Menu button allowed the user to do just that, go back to the Main Menu.

- Lastly, We had to make sure that the user had access to the rules of the game, as well as the rules of engagement with the app. This is why we made a test to ensure that the ‘Click Here to learn how to play’ button appeared.

The goal for a memory card game is to create a board of randomized cards. Because of the randomness of each object on the screen there was no way of running automated testing through the objects on the game board. To test these screens and some sort of code coverage over them we manually did tests by hand making sure each of the elements on each screen functions properly. By doing dozens of tests each we gained confidence that this part of the code is “covered” and working.

Responsibilities & Reflections

Matt Ferretti

Responsibilities:

- Scrum Master
- Coding the game logic of the app
- Creating the look of each GUI screen
- Implementing and making code comply with SonarLink rules
- Documentation Editor

Reflection:

Early on I knew that I wanted to design some sort of game that could be played. My first thought was to create a Euchre game. However, when discussing with my group it was agreed upon that we all wanted to design a game but neither of them knew how to play Euchre. We were all familiar with memory games and played them when we were younger. Also, all of us were in agreement that it would be cool if we could do it on mobile and so it was decided that we were going to do a memory game for android.

I've never designed any application and have never even interacted with android studio before so this was a whole new experience for me. In the first two weeks there was only discussions of how the app will function, not much implementation and after these two weeks work for the project completely halted. Eventually I took it upon myself to code most of the application myself. I continued to work on the code alone until the middle of February where Steve began to put his work into the project. He pitched in an added better randomization in the app and while I was in charge of the app he took charge of the diagrams and test cases. The work for this version of the app was uneven but I hope that will change in the next release. I've felt like I've learned so much about android app development and I'm proud at how much I was able to implement into this application. But I know I'm just getting my foot through the door and there's much more I can learn. I already have ideas on features I want to add to this app for the next release like a leaderboard, another mode and leveling system. This project has only just piqued my interest in mobile application development and I plan to continue to learn more about it even after the project is over.

Steve Meadows

Responsibilities:

- Randomization algorithms for game logic
- Writing test units
- Generating UML diagrams
- Collaborator on Use Case Diagram
- Writing Use Case Descriptions
- Implementing use of Scrum board
- Documentation Contributor

Reflection:

Experience is the best teacher. This was one of those moments for me where I was able to see the tools and applications we have been studying come together. This was certainly a challenge and will continue to be, but I'm sure that we can keep creating ideas and press the project forward.

It seemed early on that we were all headed in a direction where we wanted to create some sort of card game. We floated a few ideas but finally landed on Memory. This was a game we were all familiar with and that we felt comfortable pulling out of abstraction and putting into more of a concrete form.

I was initially thinking more toward a desktop game, but one of our team members felt comfortable using Android Studio, and we all felt it might offer a bit of versatility to add some more features. We soon figured out that Android Studio was a vast program and dialed back on some of our loftier ambitions. I have very limited experience working with GUI based programming, so for me, there was a steep learning curve and I'd hoped to glean as much experience as possible to be able to utilize some take-aways and learn from my group partners. I was, however, able to use my algorithm writing skills to help adapt the code to build a fully random card deck for the game.

All-in-all, this was a great learning experience in building something from scratch, using tools to plan and manage a project, and gaining experience using tools to test and standardize code.

Isabel Albaitis

Responsibilities:

- UI design and implementation
- Creating use case diagrams
- Handling screen transitions
- Implementation of passing data between screens
- Solving Android-specific issues

When we first started this project, I knew I wanted to create a mobile app. At first I wanted to create an iOS app, but since we all were familiar with Java. It had seemed that my whole group thought it would be the easiest for all of us to implement given our skills. I was the only one, however, who had any experience building an Android app, so I took the lead on solving Android-specific issues as they arose.

My first main responsibility was designing the GUI of the game board and how to pass the data generated by the user's interactions to the different screens. For me, a major learning curve was learning how the specific architecture of our app affected different diagrams and testing.

I think that the members of this group complemented each other's gaps in knowledge. Personally, I had never created a game before, so this was a major learning experience for me, so I was able to learn from them in those aspects. I generally enjoyed taking the lead on Android-specific responsibilities such as the UI implementation, handling, and validating user-generated data. I think that this was also a good experience for me to be able to learn how to follow a process of developing a program, and how to automate the process using external tools.