1. **Category One: Software Design and Engineering**
   1. Provide a clear, complete description of existing code **functionality**.
      1. What does the code do?

The Mobile App project has 3 main views. The first is a login screen, the second is a inventory viewing/editing screen and a new item creation screen. The code also contains some extra logic for saving and loading the items to a database.

* + 1. Focus on the features and functions of the existing code.

The App uses java and object oriented programming to create custom classes that extend core android features in order to add in pertinent changes to help the views and widgets solve the given problem of needing to Create read update and destroy data about a large set of items each in varying quantities. It uses Androids Views framework to display the content via multiple item activities, and fragments, each of which only implementing custom functionality by overriding the existing methods.

* 1. **Analyze** existing code using relevant code review criteria to support clearly stated findings.
     1. Use the checklist to review the code critically. This review might highlight weaknesses, such as not following secure coding best practices, having no error handling, code not being efficient, code that needs debugging, and so on. Not all the items on the checklist will be applicable, so review the ones that are applicable to your artifact.

For this first project I want to focus on the structure and documentation sections of the checklist since those are the most relevant to the goals of designing a software that can be used or improved on by other people.

While the code does adequately implement the requirements for the project that it was made for, I think it’s lacking in a lot of important things to make it market ready: the colors frequently clash making it hard to identify the relevant elements of the design, the flow requiring every user to login every time is detrimental to user experience and the inventory screen has no way to efficiently find items when there are a lot to search through.

I think that my code upholds the pertinent coding standards since the style of android development is unique but well documented in a way that makes it harder to stray from many of it’s conventions. I think that this also leads to well structured and uniformly styled code. All of the code included is code that gets run.

One thing my code is lacking in is testing and it has several outstanding warnings that do not affect the behavior in any obvious way but definitely indicate room for structural improvement. While I do use variables for most of the constant numerical values, the string values being used are defined in place which I believe newer versions of android have helped avoid by the use of definitional constant files. (these formatting files likely are also a good improvement to help with the stylistic issues mentioned above)

As for external libraries and storage, Android has a very well defined ecosystem that it’s very hard to work outside of. This not only helps with using appropriate packages for many given tasks but tools like SQLite are built in to make data storage efficient. The fact that this app was designed with the views framework instead of the Jetpack Compose framework is the only big deviation but this was part of the project requirements and therefore doesn’t make sense to change anyway.

There is a lack of adequate documentation for the project. Even if I do feel like the commenting for the code itself is fine, it functions more as notes on the roles of many of the functions in the program and could definitely be expanded. The thing I think is more worth review is the GitHub readme. While it does outline many of the key functions of the app from a user perspective it lacks some of the most important parts of a readme like describing how someone might go about building the project from the repo. Beyond that, the documentation will be hard to improve without clearer documentation goals. What am I documenting and why/for who. The readme allows new users to use the project but my code mostly follows best practices for the tools I’m using so unless I want to include an architecture diagram with my repo (which I don’t believe I do) deciding on discrete documentation tasks to work on for improvement will be difficult or even impossible.

* + 1. Target areas for improvement such as structure, logic, efficiency, functionality, security, testing, commenting, and documenting.

For now the 3 things I plan to improve for this project are: A- the GitHub documentation, telling users how to download and build the project for themselves. B- The use of resource constants to improve the adaptability of the project as well as help make the design changes surrounding theming to be easier. And C- some rudimentary testing to help with maintaining current functionality to help make it easier to improve the app further in the future.

* 1. Explain practical **enhancements** aligned with analysis findings in a clear and organized manner.
     1. Say what you plan to do in your enhancement. What specific skills will you demonstrate, and which of the five course outcomes will your enhancements support?

I plan to enhance this project through improvements to the design itself helping avoid tedious revisits to the login page or user inconveniences with searching for the item that they wish to edit. I think all the same pages should exist but if a user is logged in they should stay logged in for 30 days and not need to revisit the login page unless they explicitly logout. I will also add an element to the item list page to have a search bar that will help quickly filter through the items which can drastically improve the experience for users with large varieties of items that they plan to track.

1. **Category Two: Algorithms and Data Structures**
   1. Provide a clear, complete description of existing code **functionality.**
      1. What does the code do?

The code currently renders a 3D scene and then provides the user with an interactive way to adjust the position of many things in the scene as if they are exploring it. It does this by using many mesh primitives and a comprehensive rendering pipeline.

* + 1. Focus on the features and functions of the existing code.

This project uses OpenGL and C++ to render the 3D scene using an object oriented project structure that allows for the loading and manipulating of 3D primitives. There are a lot of rendering utility functions but a majority of the scene is rendered using one class.

* 1. **Analyze** existing code using relevant code review criteria to support clearly stated findings.
     1. Use the checklist to review the code critically. This review might highlight weaknesses, such as not following secure coding best practices, having no error handling, code not being efficient, code that needs debugging, and so on. Not all the items on the checklist will be applicable, so review the ones that are applicable to your artifact.

I believe that this project will focus on the use of variables, arithmetic operations, as well as loops and branches. These three categories fit the best with what I think of as algorithmic programming.

I believe that the use of variables is fairly good. While there are some numbers used in place, it is only this way to change things like positions when calling many of the same functions over and over. While this could be put into a list or something and loaded, at least for now this kind of redesign would only make the code less readable. For variables that are reused regularly they are properly aliased so that reuse and change can be done much easier. Because this is written in C++ the types are very well defined and there are no unused variables or function stubs.

All of the points made in the arithmetic operations section of the checklist seem to be avoided by most of the data being computed being in the same floating point data type. The project is doing some complex math but I think it’s good that it avoids reusing the results of calculations more than once or twice which prevents compounding errors.

The great majority of the code is run in a rendering loop. Because of the vast amount of data that needs to be processed every frame, the breakdown of the problem into internal functions and then utility functions and sub-loops does make the code very readable and efficient with how much gets done in relatively few lines of code. There is also the separation of different problem components like lighting, loading, and mesh rendering that help with localizing each loop which also makes it easier to avoid the kinds of problems listed from occurring within any given loop.

* + 1. Target areas for improvement such as structure, logic, efficiency, functionality, security, testing, commenting, and documenting.

I don’t believe that this code can be meaningfully improved from what it is already, instead I think the challenge will be to maintain these norms as the architecture changes to accommodate the features required for my planned enhancements to this project. Keeping the variables clear and concise, the arithmetic understandable and error free, as well as the control flow efficient and communicative.

* 1. Explain practical **enhancements** aligned with analysis findings in a clear and organized manner.
     1. Say what you plan to do in your enhancement. What specific skills will you demonstrate, and which of the five course outcomes will your enhancements support?

I want to add some features that will allow for the rendering of other 3D models from files. I think depending on how much time I have for this I may stop it at just having the program read in a 3D model that it can place in the scene with the push of a button or allowing for users to load their own 3D models into the scene via some process that I’ll also need to add like a drag and drop feature or command line argument. Either way the new 3D model should be easy enough to store in one of the object classes, however having multiple custom 3D models might require some more complex thought. I also have to consider the algorithms for parsing the 3D model files that either I could write or I could look for a package to perform for me. Luckily I think that more minor things like the GitHub documentation are already to my personal liking so I will likely only need minimal changes to that if any at all.

1. **Category Three: Databases**
   1. Provide a clear, complete description of existing code **functionality**.
      1. What does the code do?

This code builds 3 components: a server, a user client and an admin client. Together these 3 components allow for data on travel packages to be stored in a database, served to users, and updated by administrators.

* + 1. Focus on the features and functions of the existing code.

The code uses the MEAN tech stack (MongoDB, express server, angular web framework, and Node JS runtime). By using this tech stack we get access to a lot of powerful functionality while staying firmly within the JS/Typescript language ecosystem. This allows for a REST Api to allow for the server application to respond to uniform and authenticated requests from both the user and admin clients.

* 1. **Analyze** existing code using relevant code review criteria to support clearly stated findings.
     1. Use the checklist to review the code critically. This review might highlight weaknesses, such as not following secure coding best practices, having no error handling, code not being efficient, code that needs debugging, and so on. Not all the items on the checklist will be applicable, so review the ones that are applicable to your artifact.

The defensive programming seems applicable to this project because the secure validation of the server API and secure access to the admin client are important features in the operation of the program.

There are many boxes on the checklist that focus on low level security issues to do with things like memory leaks or dangling pointers that are impossible since NodeJS is responsible for these processes instead of our code. I think that there are set error handling routines in several of the calls such as the error handler in app.js and several error handler lambdas in the angular code.

The data validation questions are a more complex topic because JavaScript has loose typing. Admittedly that mostly just makes data requests but having well defined types for the server API would help prevent errors. I think that the risks of these issues are minimal at least in this application because the data is rather flat and most of it is client facing anyway. I could see how in a database storing more complex data some of these practices might be vulnerabilities.

* + 1. Target areas for improvement such as structure, logic, efficiency, functionality, security, testing, commenting, and documenting.

I think that security vulnerabilities in web dev especially are something I can often struggle with so doing research on some good practices beyond the uniformly implemented ones like CORS or security tokens that are already implemented as part of this projects requirements could help with finding more concrete steps to take towards the goal of security beyond just identifying things that could be vulnerable.

* 1. Explain practical **enhancements** aligned with analysis findings in a clear and organized manner.
     1. Say what you plan to do in your enhancement. What specific skills will you demonstrate, and which of the five course outcomes will your enhancements support?

The enhancement I’m thinking of is something simple like a shopping cart that allows for users to select multiple items at once on the web client. In implementing this, I would need to add a new view that can display a list of items that have been saved to and can be edited by the local client software. I believe that the way I implement will likely be medium to low quality since web dev is one of the aspects of software engineering I’m least interested in and have the lowest drive to work on, but it will also provide a good opportunity to master a skill that I do want to be capable in with things like database queries and interfaces.