**1) What motivated you to choose this topic for your capstone project?**

What motivated us to choose this project is primarily the need for a more detailed and product-centric solution for the current state-of-the-art research in aerial crop disease detection. While aerial crop disease detection is already quite effective, it lacks the level of detail that a farmer can readily perceive and interact with, as it is currently limited to only two dimensions. Moreover, as of now, there is no real interactive tool available for farmers, or even casual gardeners, to gain a better understanding of their plants.

**3) Can you describe the dataset you worked with? Where did you source it from?**

The dataset we are working with is the 'Plant Disease Classification Merged Dataset' from Kaggle, which is a comprehensive dataset containing various 2D plant profiles with multiple diseases. We will perform some data engineering to convert our 2D data into 3D format to enable training our 3D object detection model. Furthermore, we plan to continuously update our models by implementing MLOps techniques to acquire real-time data from scanned and verified plants, thereby enhancing the accuracy of our models. Initially, our focus will be solely on tomato plants and the disease known as blight.

**7) Which algorithms or models did you consider? Why did you choose the one(s) you used?**

For our two objectives, which are disease classification and severity segmentation, we will utilize a fine-tuned 3D YOLO4 model on our engineered 3D leaf dataset for disease detection, and a 3D U-Net segmentation model to identify and segment blight disease on tomato plant leaves. We chose the 3D YOLO4 model because it is well-established for 3D object detection and already has a proven 3D variant. Consequently, we have opted to fine-tune this model for our 3D object detection task.

As for our choice of the 3D U-Net segmentation model, it is based on successful implementations and our prior knowledge of the U-Net architecture. Regarding the possibility of using a 2D U-Net instead of a 3D version, we have not yet made a final decision. Adopting a 2D U-Net would necessitate the transformation of our 3D data into 2D, adding an extra step to the process. However, the 2D version would be computationally less intensive. Both of these model choices may be subject to change after successful project completion, should we identify areas for potential improvement.

**12) Which tools, libraries, or frameworks did you use for this project?**

For our tools, we will be employing Blender, Unity, Xcode, and Firebase. As for libraries, we will utilize Python's libraries such as NumPy, Pandas, and TensorFlow, alongside pre-trained 3D YOLO4 and 3D U-Net models. In terms of programming languages, our work will primarily involve Python and C#, with the possibility of incorporating SQL as needed.

**15) What were the key findings or outcomes from your project?**

Key findings we have discovered so far include the importance of having high-quality data and the value of synthetic simulation data. A significant aspect of our project involves the transition of our data from 2D to 3D. This transformation is a delicate process that must accurately replicate the real-world geometry, shape, and physics of leaves.

Another noteworthy discovery is the significance of making products easily accessible to users. The integration of our iOS app with the iPhone's LiDAR scanner is a potent combination. It provides us with a real-time data source, offers widespread accessibility as it can be readily available on people's mobile devices, and introduces a novel concept.

**19) Who are the end-users of your project, and how can they benefit from it?**

The end users we primarily target are farmers, aligning with our ultimate project goal of developing an advanced aerial crop disease platform that incorporates drone technology, LiDAR, and possibly advanced imaging. However, with the introduction of our user-friendly iOS app, individuals with an iPhone can also actively participate in our product. This includes amateur gardeners as well as farmers seeking a more personalized platform.