1. **Conceptual Understanding:**

* What is the main difference between image classification and object detection? How is this difference evident in the output of this exercise?
  + Image Classification: Labels an image based off of the main focus. For example: house, car, dog.
  + Object Detection: Identifies and labels multiple objects in an image. If there is an image of a horse in a barn it may label the horse, hay, stable, etc.
  + Difference in Output: In this exercise, the output demonstrates object detection by not only identifying the main objects (ex: car, horse, bird) but also labeling surrounding objects in the frame.
* Explain why we chose the SSD MobileNet V2 model for this task. What are its advantages and limitations, especially in the context of limited computational resources?
  + SSD MobileNet V2 was chosen because it works better with limited computational resources.
  + Advantages: speed, highly effective, real-time detection, accuracy in object detection, great for limited computational resources.
  + Limitations: not as accurate as larger models, hard time detecting small objects.

1. **Code Interpretation:**

* Describe the role of the find\_images\_with\_classes function. Why is it useful when working with a large dataset like COCO?
  + It helps to find images with specific objects, it works like a filter. It is useful in COCO (Common Objects in Context) because it is such a large dataset with so many images, using the “find\_images\_with\_classes” function limits the images to help find what you’re looking for.
* In the plot\_detections function, how does the threshold value (threshold=0.5) impact the number of objects displayed?
  + The threshold value dictates the amount of images shown based off the confidence of the images. For example, if the threshold is .5 then less false images will be shown versus the threshold being at .3.
* Explain how the heatmap visualization helps you understand the model's confidence in its detections.
  + It uses the intensity of the colors in an image. Colors with more bright colors have more confidence and colors with dimmer colors have less confidence.

1. **Observing Results and Limitations:**

* Run the exercise multiple times. Which types of objects does the model tend to detect more accurately? Which ones are more challenging? Can you explain why?
  + Tensorflow seemed to identify the objects well. Pascal seemed to identify images but label them wrong. A car was labeled a boat, a woman on a horse was labeled as a television.
* Observe the bounding boxes. Are there any instances where the boxes are inaccurate or miss the object entirely? What factors in the images might be contributing to these errors?
  + There are many instances where the boxes are not correctly identifying the objects. I am thinking that in the instance where the cars are mislabeled as any type of object that can transport you.
* How would you expect the accuracy of the model to change if we had used the entire Pascal VOC 2007 dataset instead of a small subset? Why?
  + If we used the entire dataset I feel like the images would be a lot more accurate. With a wider dataset and more images, the model has the opportunity to be more accurate.

1. **Critical Thinking:**

* How could you modify the code to detect a specific set of objects, like only animals or only vehicles?
  + You could do this by adjusting the filtering process mentioned, the “find\_images\_with\_classes”.
* If you wanted to train your own object detection model, what steps would you need to take? What are some challenges you might encounter?
  + First you would need to decide on and find the images you wanted to use in the dataset. Then choose the model you want to use, such as TensorFlow, Pascal, etc. From there you would train and test, as we did in the assignment. The challenges you may face would be the amount of time, with the larger models it can take more time and effort to complete the datasets. It would take a lot more resources and computer space.
* Given the limitations of this model, in what real-world scenarios might it still be useful for object detection?
  + It is still good for smaller electronics like smartphones and tablets. It is also good when you do not want to reply or deploy too many resources or take up too much space.