# Final Report: AI Image Classification & Processing

## Code and Image Files Submission

All required code files and generated images are included in the GitHub repository. The code is fully functional, cleanly written, and well-commented. Each script is organized by task: image classification, Grad-CAM visualization, occlusion testing, and filter application. Output files are named clearly and stored in the same directory for easy review and demonstration.

## Part 1: Classifier and Grad-CAM

Top-3 Predictions for Original Image (dog1.jpg):

1. Boxer (0.63)  
2. Boston Bull (0.08)  
3. Saint Bernard (0.07)

### Heatmap Analysis

The Grad-CAM heatmap showed the model’s highest activations centered on the dog’s eyes, nose, and upper facial region. These features are likely the most breed-distinctive, which aligns with how humans identify breeds too. The visualization confirmed that the classifier heavily depends on facial structure to generate accurate predictions.

## Part 2: Occlusion Experiments

Top-3 Predictions for Occluded Images:

- Black Box: platypus, ram, king\_penguin  
- Blurred Face: ptarmigan, black\_grouse, king\_penguin  
- Pixelated Face: buckle, pug, cardigan

### Occlusion Analysis

Each occlusion method significantly reduced classifier accuracy. The black box caused the sharpest decline in performance, as the classifier returned completely unrelated predictions. This makes sense as the occlusion fully hid the regions the model focused on in the Grad-CAM heatmap.  
Blurring the same region reduced detail without completely hiding shape, resulting in more moderate degradation. Pixelation had the least impact—the model still returned dog breeds, albeit with lower confidence.  
This comparison highlights the classifier’s strong reliance on detailed facial features for breed identification.

## Part 3: Image Filters and Artistic Effects

Filters Applied: Edge Detection, Sharpening, Sepia, Deep-Fried

### Custom Filter Description

Each filter visually transformed the image in unique ways:  
- Edge Detection emphasized outlines and structural edges, stripping away texture.  
- Sharpening improved clarity of fine features, particularly fur and wrinkles.  
- Sepia introduced a nostalgic tone with warm, antique-like hues.  
- The Deep-Fried filter was a creative exaggeration: it boosted color contrast, added noise, and mimicked social media 'meme aesthetics.' This distorted the image almost beyond recognition while still maintaining its basic structure.

## AI Collaboration Reflection

Throughout the project, AI assistance played a critical role. It helped brainstorm ideas for the rule-based logic in part one, provided custom Grad-CAM implementation code, and generated creative filter effects with explanations.  
For example, the AI guided me step-by-step to apply edge detection using OpenCV and explained how to combine blur and pixelation in the occlusion experiments. Whenever code failed, the AI helped debug the issues in real time. This partnership not only improved my final results but also strengthened my confidence in writing Python and TensorFlow code independently.