Task 4: Comparison of Grad-CAM and LIME

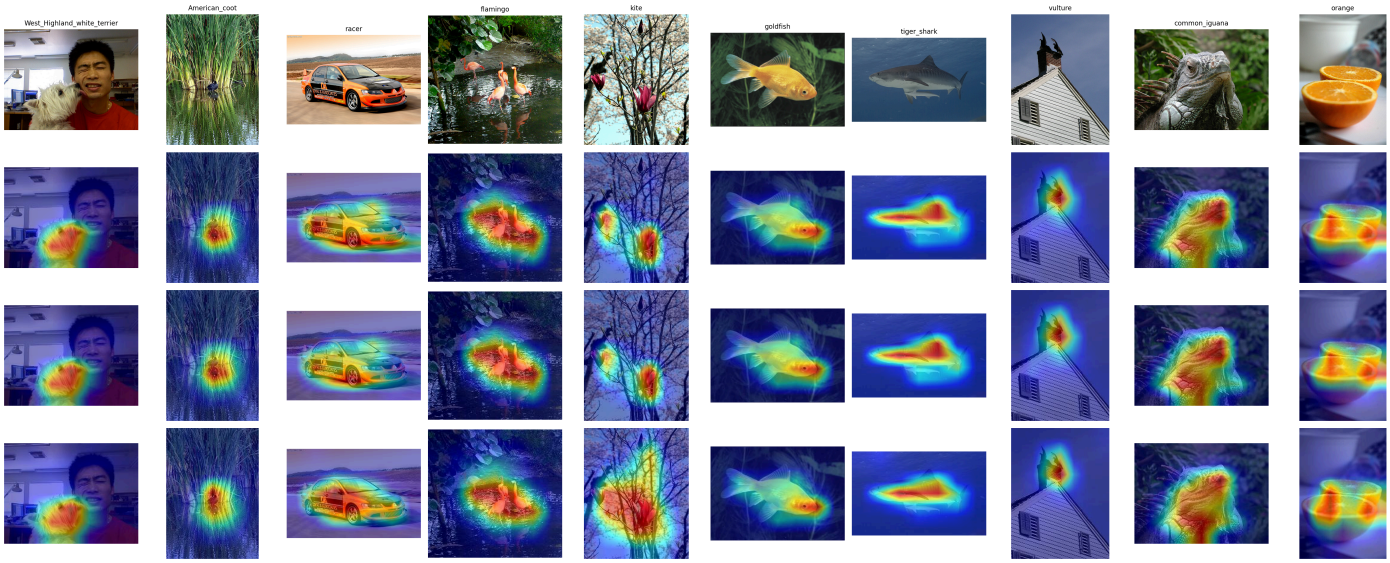
1. Objective

This task compares **Grad-CAM** and **LIME** explanations generated for 10 ImageNet images to understand the differences in their highlighted regions and interpretability.

2. Visual Results

- **LIME Results:**

- **Grad-CAM Results:**



3. Key Observations

3.1 Highlighted Region Patterns

- **Grad-CAM:** Produces heatmaps that emphasize broader, contiguous areas, often centered on the object but with less sharp boundaries.
- **LIME:** Highlights discrete superpixels with clear boundaries, providing a more segmented view of important object parts.

3.2 Object Complexity

- **Simple Objects (e.g., goldfish, orange):** Both methods largely agree on the object region. Grad-CAM covers the entire object, while LIME selects critical sections like fins or pulp.
- **Complex Scenes (e.g., kite, American_coot):** Grad-CAM spreads attention over multiple areas, sometimes blending with the background, while LIME focuses on specific object patches, resulting in lower overlap.

3.3 IoU Trend

- Informal observation suggests that IoU is **higher for simpler images** (e.g., goldfish, orange) and **lower for cluttered or multi-object scenes** (e.g., kite). This supports the idea that both methods align better when objects are well-separated and simple.

4. Insights

- **Interpretability:** LIME provides more precise boundaries, making it easier to interpret exact object parts contributing to predictions. Grad-CAM offers a global view of activation but is less localized.
- **Complementarity:** Using both methods together offers a balance of global attention (Grad-CAM) and fine-grained interpretability (LIME).

5. Conclusion

Grad-CAM and LIME differ mainly in **spatial resolution and region sharpness**. For simple images, their explanations are largely consistent, while in complex scenes, LIME captures localized object parts

more clearly, whereas Grad-CAM spreads activation across broader regions.