Task 2 Key Findings

- **Image-by-Image Analysis Highlights:**
    - **American Coot:**
        - **Grad-CAM:** Focused on the coot's reflection.
        - **Ablation-CAM:** Similar to Grad-CAM but with a slightly broader, more intense highlight.
        - **Score-CAM:** Pinpointed the coot's head and body, demonstrating high accuracy in identifying salient features.
    - **Kite (Misclassified as Spoonbill):** The model incorrectly classified a tree with pink flowers.
        - **Grad-CAM & Ablation-CAM:** Concentrated on individual flowers.
        - **Score-CAM:** Showed a broader, more connected activation covering both flowers and the space between them. This revealed the model's misinterpretation by focusing on these floral features.
    - **Tiger Shark:**
        - **Grad-CAM & Ablation-CAM:** Highlighted disconnected areas (head and dorsal fin), with Ablation-CAM showing higher intensity.
        - **Score-CAM:** Provided a continuous activation from the head to the dorsal fin, indicating a more uniform distribution of importance across these features.
- **General Observations & Comparisons:**
    - **Overall Similarity, Subtle Differences:** All three methods generally highlighted similar important regions, but differed in **specificity, spread, and intensity**.
    - **Intensity & Concentration: Score-CAM** often offered the most **"pinpoint" explanations** with higher concentration and intensity (e.g., focusing on the bird in "American Coot"). Ablation-CAM was typically more intense than Grad-CAM but less concentrated than Score-CAM. Grad-CAM generally had a broader spread.

- **Completeness & Continuity: Score-CAM** frequently produced **more continuous heatmaps**, connecting different parts of an object (e.g., "Tiger Shark"). Grad-CAM and Ablation-CAM sometimes showed fragmented activations.
- **Contextual vs. Object-Centric Focus:** Grad-CAM and Ablation-CAM occasionally included more contextual elements (e.g., reflection for "American Coot"). **Score-CAM** tended to be more **object-centric**, focusing directly on the main subject.
- **Interpretability & Accuracy:** For correct predictions, Score-CAM often provided the most **interpretable explanations** due to its focused and continuous activations. Even for misclassifications, all methods consistently highlighted the features that led to the model's (incorrect) prediction.
- **Consistency in Incorrect Predictions:** When the model misclassified, all CAM methods consistently showed which features contributed to that specific (incorrect) classification, emphasizing their role in revealing the model's "reasoning."

Conclusion

This analysis revealed the strengths and subtle distinctions of Grad-CAM, Ablation-CAM, and Score-CAM in explaining deep neural network predictions. **Score-CAM often stood out with its concentrated, object-centric focus, leading to highly interpretable explanations.** Ablation-CAM provided a good balance of intensity and spread, while Grad-CAM offered a general understanding of the model's focus with broader activations.