**Title: Deep Vision Showdown - Procom ‘25**

**Team: ADPM**

**1. Introduction**

* **Challenge:** Improve pain management after surgery by identifying anatomical structures in sonography images.
* **Goal:** Develop a segmentation model that optimizes treatment and recovery while minimizing heavy medication use.

**2. Objective**

* Develop a segmentation model to identify specific anatomical structures in medical sonography images.
* Utilize a dataset of expert-annotated images where structures of interest are manually identified.

**3. Methodology**

**Dataset & Preprocessing**

* Dataset consists of sonography images with ground truth annotations.
* Images resized to **(448, 608)** for consistency.
* **Augmentations applied:** Flipping, contrast adjustments for better generalization.
* Ground truth masks stored using **Run-Length Encoding (RLE)** for efficient storage.

**Model Training**

* **Deep Learning Model:** Trained over **100 epochs**.
* **Evaluation Metric:** Dice coefficient.
* **Loss Function:** Binary Cross-Entropy + Dice Loss.
* **Optimizer:** Adam for effective weight adjustments.
* **Performance Improvement:** Loss decreased steadily over epochs.

**4. Performance Evaluation**

**Results from Training**

* **Initial Dice Score:** 0.0302
* **Final Dice Score:** 0.8682
* **Best Dice Score:** 0.8807 (at epoch 96)

**Training Loss Trend:**

* + From **0.6052** to **0.3177**
  + Best loss: **0.3169** (epoch 99)

**Evaluation Metrics**

* **Precision & Recall:** Measures segmentation reliability.
* **Confusion Matrix:** Classification performance between background and lesion regions.
* **Accuracy Score:** Overall segmentation effectiveness.
* **Classification Report:** Summarizes precision, recall, and F1-score for different classes.

**5. Results & Model Predictions**

* **Steady loss reduction and Dice coefficient improvement**.
* **Final Dice Score of 0.8682** after 100 epochs.
* **Validation using classification metrics** confirmed strong model performance.

**Example Predictions**

| **Original Image** | **Ground Truth** | **Model Prediction** |
| --- | --- | --- |
| ![img1] | ![gt1] | ![pred1] |
| ![img2] | ![gt2] | ![pred2] |
| ![img3] | ![gt3] | ![pred3] |

**6. Conclusion & Future Work**

**Conclusion**

* The model successfully enhanced the identification of anatomical structures in sonography images.
* **Significant gains in Dice score** and **loss reduction** throughout training.
* Future improvements include hyperparameter tuning, advanced architectures, and post-processing.

**Future Work**

* **Implement U-Net++ or DeepLabV3+** for enhanced segmentation.
* **Explore attention mechanisms** to improve feature extraction.
* **Increase dataset diversity** for better generalizability.
* **Optimize model inference time** for real-time clinical applications.