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Project/Thesis Proposal

Select one:
CTC 492 __ ITC 492 __ CSC 492 __ CSC 590 ✓ CSC599 __

Track: Computer Science (M.S.) **Semester:** Fall **Year:** 2025

Title: Brain Tumor Segmentation Using UNet and Foundation Models

Prepared by: Naushik Beladiya Date: 09/03/2025

Dr. Sahar Hooshmand	_____	_____
Faculty advisor	*Signature*	*Date*
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Committee member	*Signature*	*Date*
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Committee member	*Signature*	*Date*

Proposal Description: (one to two pages)

CSC 590 Project/Thesis Proposal

Title: Brain Tumor Segmentation Using UNet and Foundation Models

Prepared by: Naushik Beladiya

Background

Brain tumor segmentation is vital for diagnosis, treatment planning, and disease monitoring. Manual annotation of MRI scans is labor-intensive and inconsistent. Deep learning models such as **UNet** have achieved strong results in medical image segmentation. Recently, **foundation models like MedSAM** have demonstrated transfer learning capabilities, providing more accurate and efficient segmentation.

With my background in **AI/ML, computer vision, and cloud-native systems**, this project leverages both traditional CNNs and foundation models to evaluate their comparative performance on brain tumor MRI scans.

Problem to be Solved

This project addresses the problem:

How do **foundation models (MedSAM)** compare with **traditional CNNs (UNet)** in brain tumor segmentation accuracy, efficiency, and generalizability?

Two approaches will be implemented:

1. A **baseline UNet model** trained from scratch.
2. A **fine-tuned MedSAM foundation model** on the same dataset.

Justification

- **Healthcare Impact:** Automated segmentation reduces radiologist workload and improves patient care.
- **Technical Relevance:** Combines **computer vision, deep learning, and transfer learning**, aligning with current AI trends.
- **Novelty:** Few studies directly compare CNNs and foundation models for this task.

- **Feasibility:** Public datasets (Task01_BrainTumour, BraTS) are available, and cloud platforms ensure training scalability.
- **Skills Fit:** My experience with **TensorFlow, PyTorch, AI-driven platforms, and scalable cloud solutions** makes the project achievable within the semester.

Expected Results

- A **baseline UNet model** and a **fine-tuned MedSAM model**.
- **Quantitative metrics**: Dice score, IoU, precision, recall.
- **Visual segmentation outputs** for qualitative analysis.
- A **comparative study** highlighting trade-offs between CNNs and foundation models.
- A complete **GitHub repository** with code, datasets, and reproducibility scripts.
- A **final report (40–50 pages)** as required.

Feasibility

- **Datasets:** Public medical imaging datasets (MSD, BraTS).
- **Infrastructure:** Training on AWS/GCP with Docker and CI/CD pipelines.
- **Timeline (12 weeks):**
    - Weeks 1–3: Literature review & data prep.
    - Weeks 4–6: Train baseline UNet.
    - Weeks 7–9: Fine-tune MedSAM.
    - Weeks 10–11: Evaluate & visualize results.
    - Week 12: Finalize analysis, report, and presentation.

This plan aligns with CSC-590 milestones.