

FMitF: Track I: Generative Neural Network Verification in Medical Imaging Analysis

NSF Award # 2220401

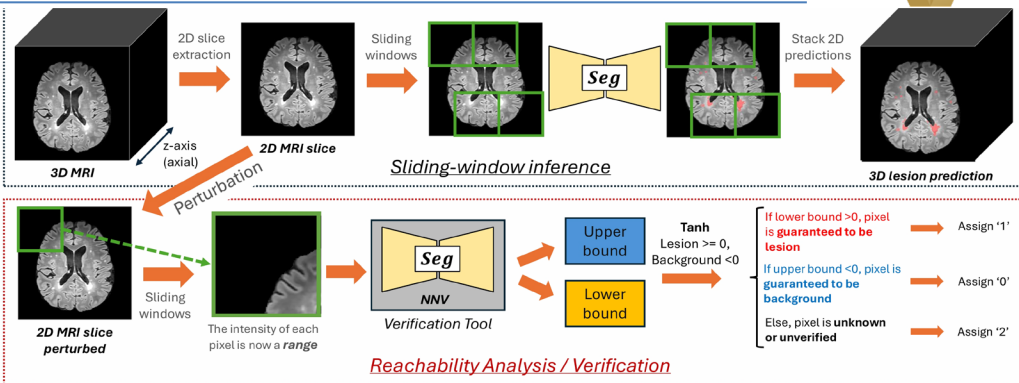
Taylor T. Johnson (PI), Ipek Oguz (Co-PI), Meiyi Ma (Co-PI), Daniel Moyer (Collaborator)

Challenge:

- Ensuring Robustness in Healthcare AI
- Formal Guarantees in Safety-Critical Domains
- Pioneering Formal Verification in Medical Imaging

Scientific Impact:

- First Formal Verification for Medical Image Segmentation: This work is the first to apply formal verification to medical image segmentation models.
- Verification of 3D MRI Volumetric Data: The study extends formal verification techniques to high-dimensional 3D MRI data, tackling a complex task like MS lesion segmentation.
- Demonstrating Worst-Case Guarantees: The project provides formal guarantees on worst-case performances for segmentation models under different adversarial transformations.



Solution:

- Develop formal specification framework to describe robustness of computer vision tasks.
- Develop robustness verification & falsification methods in medical imaging analysis computer vision tasks
- Explore robustness in generative tasks and models
- Evaluate verification methods on medical scans of different types (e.g., MRIs, CTs, etc.) from different sites.

Broader Impact and Broader Participation:

- Characterization of medical imaging analysis models with formal methods may help improve trust as a verification & validation methodology.
- Co-organization of International Verification of Neural Networks Competition (VNN-COMP), held with CAV.
- Tutorials on NNV at EMSOFT'23, IAVVC'23, and DSN'24, and Upcoming tutorial with medical imaging community(SPIE'25)
- Undergraduate research internships and Immersive Projects at Vanderbilt

