Interpretable AI Solution for Brain Pattern Recognition

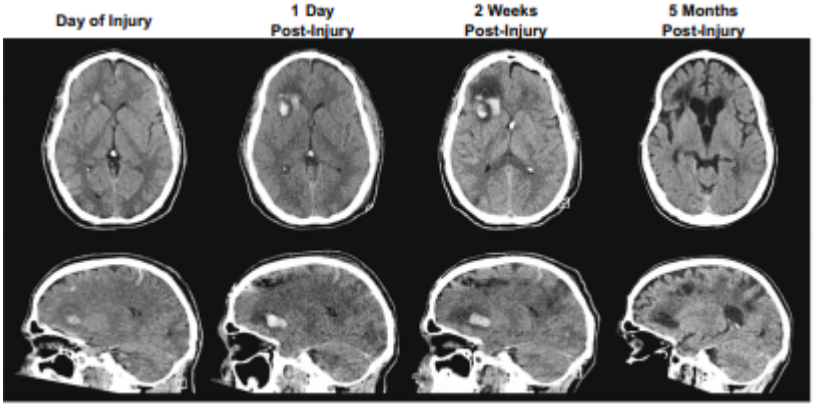
Brain injuries and cancers don't look the same as they come in different shapes and sizes. Figuring out how severe a tumor or lesion is can literally guide life-saving treatment. But severity isn't just about size. It depends on age, sex, density, and other hidden factors. The brain is *the* most important organ we've got, so every insight counts.

We want to create an **AI system that ranks how complex a brain injury or tumor case is**. Think of it as a severity "scorecard" that doctors can actually interpret, not just a black-box prediction.

How??
We'll start with **Variational Autoencoders (VAEs)**, which is deep learning method that can "disentangle" hidden factors behind the data. That means we can analyze *which* factor (size, age, density, etc.) really impacts severity.
If time allows, we'll even level up with newer methods like **β-VAE and Factor-VAE** for sharper results.

Data??
We can use public datasets to start with:

- **ENIGMA dataset**: brain lesion MRIs (dataset contain MRI scans (e.g. below) + Meta Information)
- **BraTs dataset**: brain tumor detection (Mostly MRI Scans similar to below)



Why It's Exciting??

- Its is not just training another image classifier, but working on **interpretable AI for healthcare**.
- Working on cutting-edge technology (representation learning, VAEs, interpretability).
- And beyond injuries/tumors, this could open doors to studying brain patterns behind things like **ADHD, anxiety, depression**.

Sources:

Olsen, A., Babikian, T., Bigler, E.D. *et al.* Toward a global and reproducible science for brain imaging in neurotrauma: the ENIGMA adult moderate/severe traumatic brain injury working group. *Brain Imaging and Behavior* **15**, 526–554 (2021).

Kingma, D. P., & Welling, M. (2013). Auto-encoding variational bayes. *arXiv preprint arXiv:1312.6114*.