Title: Deep diffusion models for decoding visual stimuli from brain scans

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Description

- We know little about how the brain's visual system encodes visual objects and how it pays attention to these objects in cluttered scenes.
- In this project, we will have human participants view and pay attention to particular objects or object features in cluttered scenes.
- We will simultaneously be recording function magnetic resonance imaging (fMRI) scans in the Siemens Prisma scanner at IISc. As a test-bed we will also use some existing databases with several thousand fMRI scans.
- From these scans, we will try to decode – classify and literally "reconstruct" – what the participant was viewing/paying attention to in the cluttered scene using deep neural networks, and deep generative models.
- The project will involve advanced generative modeling including instance conditioned GANs and deep diffusion models.

Additional reading

- Generic decoding of seen and imagined objects using hierarchical visual features
    - https://www.nature.com/articles/ncomms15037
- From voxels to pixels and back: Self-supervision in natural-image reconstruction from fMRI
    - https://proceedings.neurips.cc/paper/2019/file/7d2be41b1bde6ff8fe45150c37488ebb-Paper.pdf
- High-resolution image reconstruction with latent diffusion models from human brain activity
    - https://sites.google.com/view/stablediffusion-with-brain/