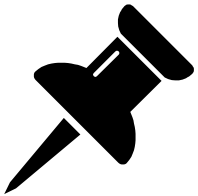
Introduction to Brain Data

Why is brain data so important?



- The blood-brain barrier prevents us from getting data from the brain through a blood test like we would for the liver or heart
- The brain is housed by a protective shell (the skull), which makes it difficult and more dangerous to invasively collect data
- Type of data we collect is non-invasive but difficult to understand at first glance

Types of data

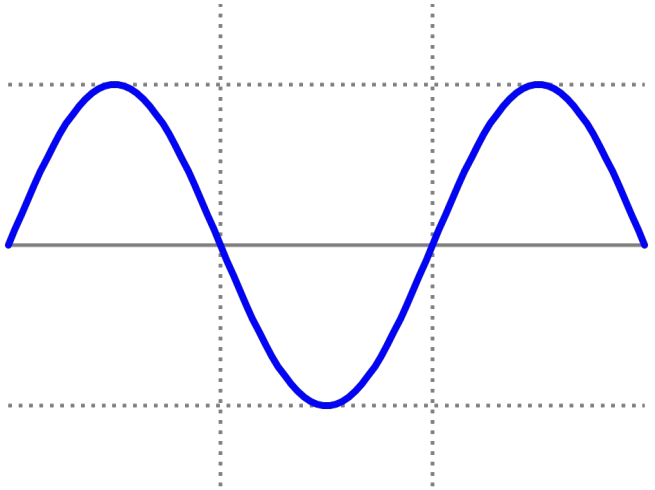
- **Signal data**
  - Biological signals (heart rate, ECG, brain waves)
- **Image data**
  - Spatial data that represents parts of the brain as voxels

Most of the data we work with is a mix of the two

The way we analyze them
are very different however

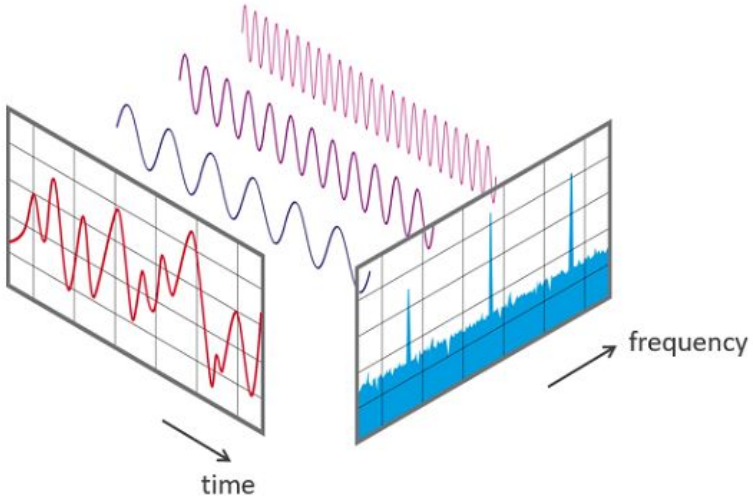
Introduction to Signals

- All signals are some form of a sinusoidal wave
- Using the property of superposition, we can decompose waves them to understand their properties better



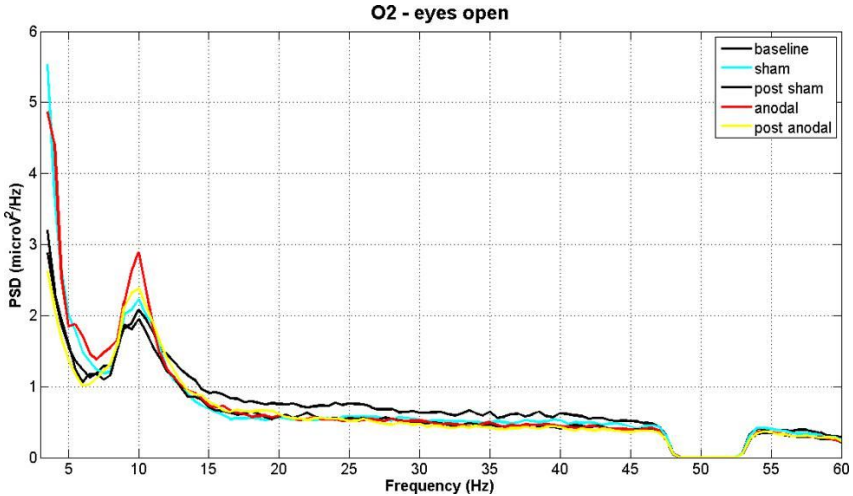
The Fast Fourier Transform
(The Chuck Norris of SP)

- An algorithm that allows us to decompose any signal into a frequency domain and identify the most prominent frequencies in a signal
- Greatly used in brain wave analysis - used for ADHD analysis to identify markers



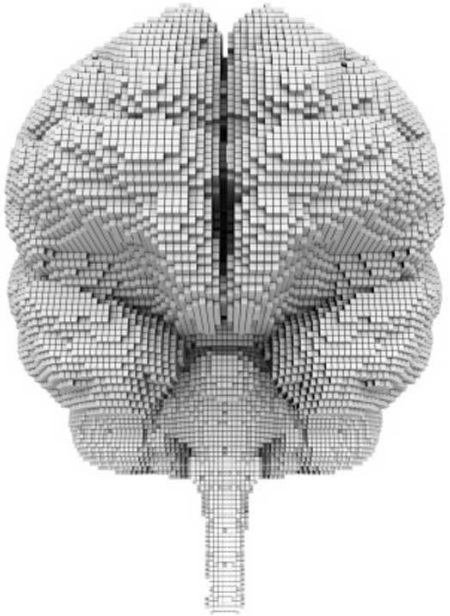
Application to EEG data

- The frequency of brain waves affects how they interact in the brain
- Used a FFT to find a higher prevalence of beta waves in students with ADHD



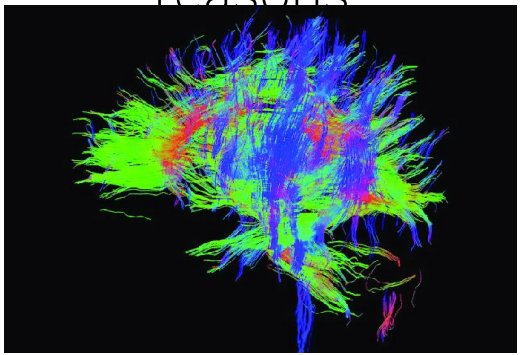
Introduction to Imaging Data

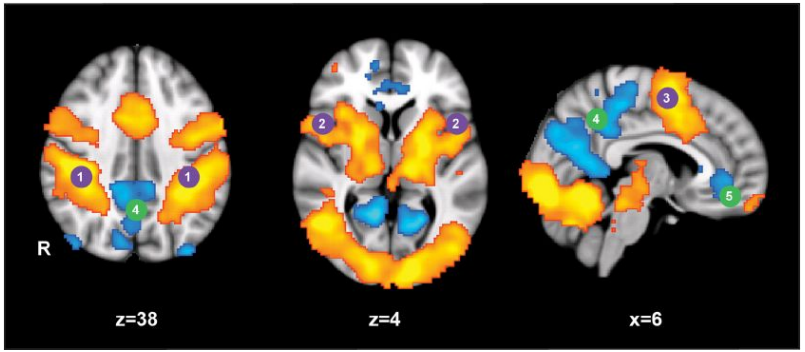
- We are concerned with 3D space when it comes to the brain
- To store spatial data, we use voxels (3D pixels)
- Voxels allow us to define regions of interest in the brain that we want to analyze



MRI

- Two main types of MRIs (diffusion tensor and functional)
  - We are concerned with both types for different reasons



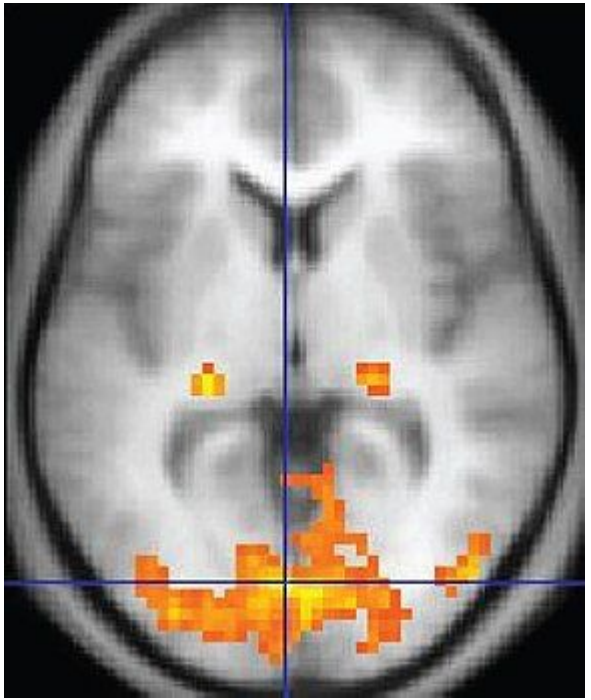


dMRIs

- Collects data based on the contrast of water molecules in the brain
- By finding their path we can generate white matter tracts in the brain to identify structural connectivity

fMRIs

- Concerned with BOLD (blood oxygen level dependent) signal of voxels and based on correlated signals, we create a connectivity matrix
- While certain parts of the brain may not be structurally connected, they may be functionally connected (requires the need for both fMRI and dMRI in analysis)



Recap

- Two types of data we analyze
  - Signals and images
- Signals come in all forms
  - Use algorithms to decompose signals and make sense of the data
- Imaging data
  - Two main types we analyze: fMRI and dMRI
  - Each has its own use in brain analysis

Questions?