A Brief Introduction to Deep Learning and Computer Vision

J.S. Blum

Department of Radiology, Washington University in St. Louis School of Medicine

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Outline

About Me

1. **About:**
I am a researcher at the Mallinckrodt Institute of Radiology in Washington University in Saint Louis. I received a BA in Applied Mathematics and Statistics at WashU, advised by Sheng-Kwei Song (Radiology) and Donsub Rim (Mathematics).
Github: @jacobblum

2. **Research Interests:**
My interests are in inverse problems and computational applications in medical imaging: coupled-physics imaging (NMR/dMRI), proton dynamics, deep learning, high performance computing.

3. **Some Selected Publications/ Software:**

- **simDRIFT: a software package for massively parallel forward simulation of diffusion weighted MRI on biophysically accurate tissue systems**
J. Open Source Softw. (2023)

- **Diffusion basis spectrum imaging provides insights into cervical spondylotic myelopathy pathology**
Neurosurgery (2022)

- **Analysis of combined clinical and diffusion basis spectrum imaging metrics predicts the outcome of chronic cervical spondylotic myelopathy following cervical decompression surgery**
J. of Neurosurgery: Spine (2022)

- **Diffusion Basis Spectrum Imaging Distinguishes High Grade Glioma Treatment Effect From Tumor Progression**
Neuro-Oncology (2023)

- **Utility of Diffusion Basis Spectrum Imaging in Quantifying Baseline Disease Severity and Prognosis of Cervical Spondylotic Myelopathy**
Spine (2022)

What Are Images: ND-Arrays

Definition

Diverse mathemtaical descriptions of obejcts and images can be unifed by the imaging equation.

$$\mathbf{g} = \mathcal{H}\mathbf{f} \tag{1}$$

Where $\mathbf{g}$ is the image, $\mathbf{f}$ the imaging object, and $\mathcal{H}$ the imaging system. For example ...

Figure 1: The Imaging system (a camera) produces a discretized represtnation of the imaging object. Typically, this is can be thought of as a 2D array

What do we do with Images: Image Processing

There is an enormous demand for image processing in a diverse range of application areas including biomedical imaging, autonomous systems, and reomote sensing.

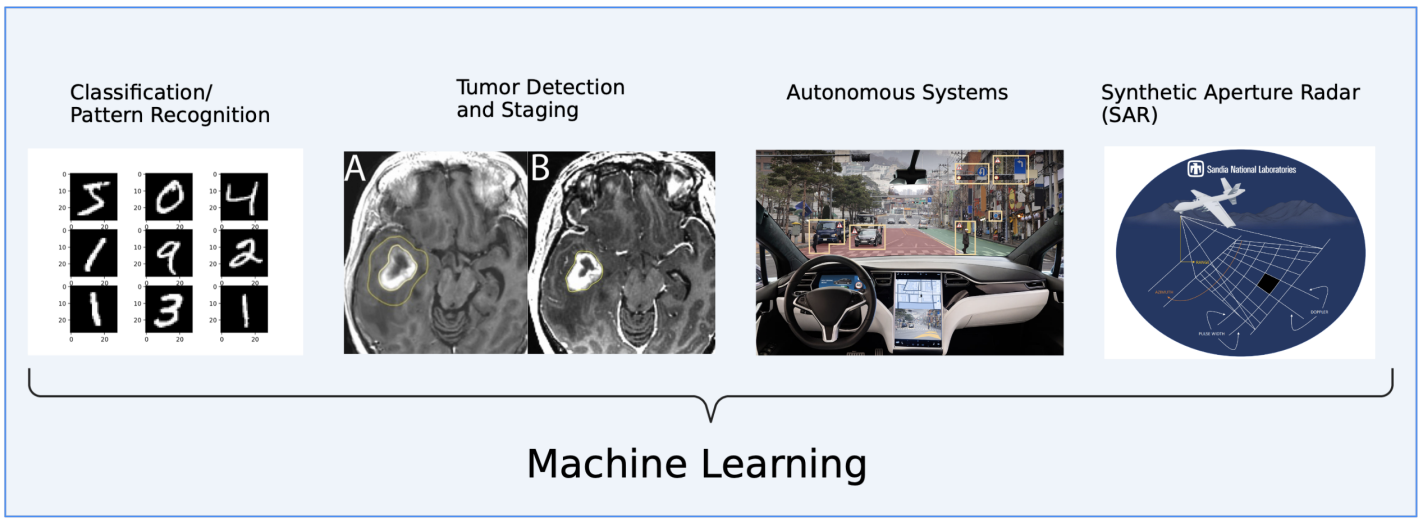

Figure 2: (Left) MNIST Dataset, a common benchmark for image classication models; T2W/FLAIR images of GBM with ML guided segmentation; A self driving car using computer vision; A SAR system on a UAV

Tools for Image Processing