Deep Learning for X-ray Applications

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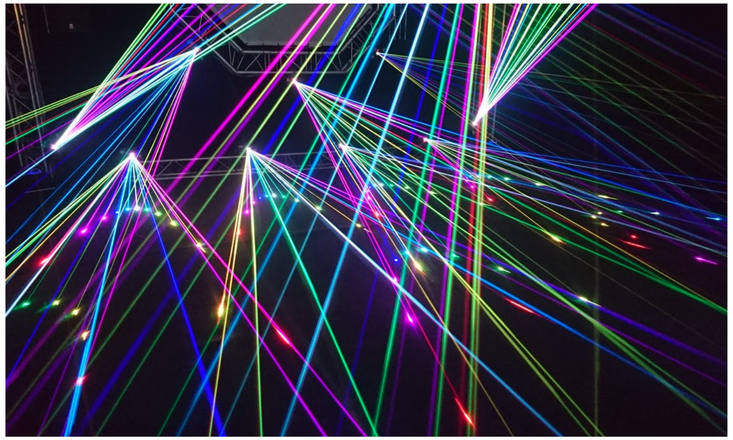
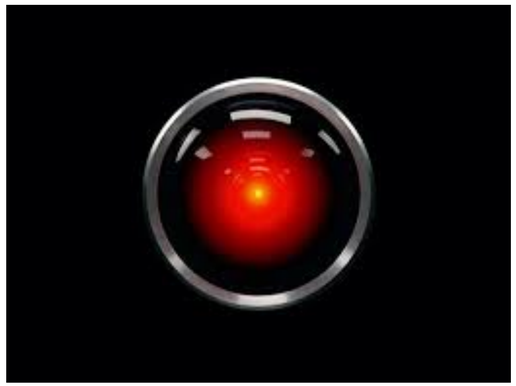
Dennis Trujillo

Tutorial goals…

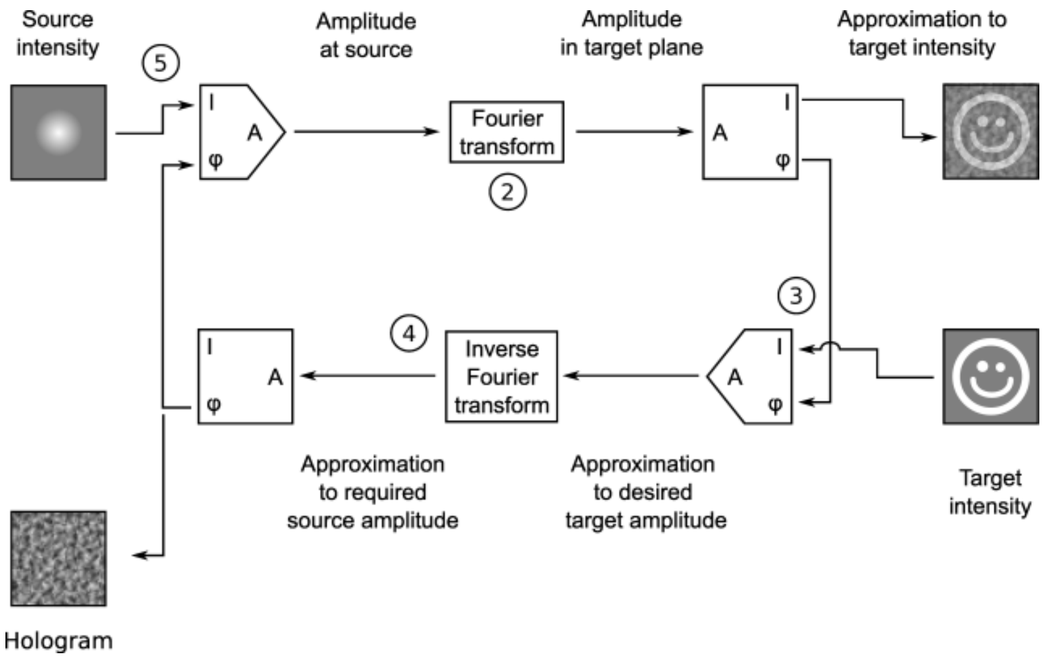
- Demonstrate how to simulate a coherent diffractive imaging dataset via numpy, scipy
- Utilize the Pytorch research model repository to load an existing CNN architecture
  - Data augmentation
    - Numpy object -> Pytorch objects
    - Rotation, horizontal/vertical flips
- Evaluate model performance
  - Accuracy scores
  - Confusion matrix

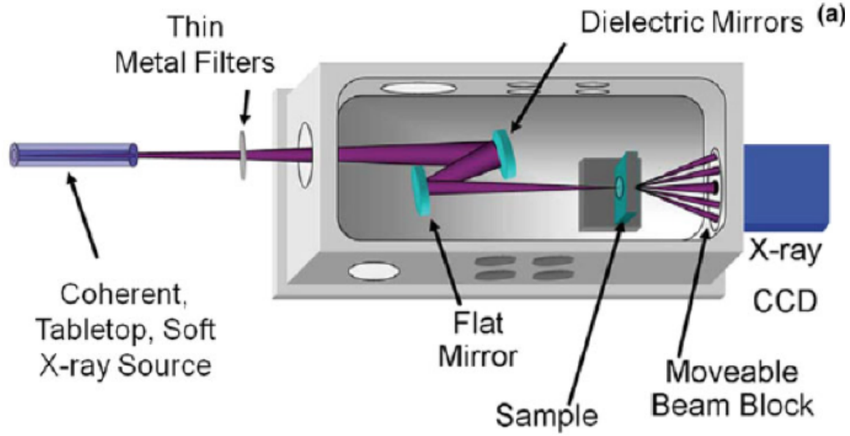


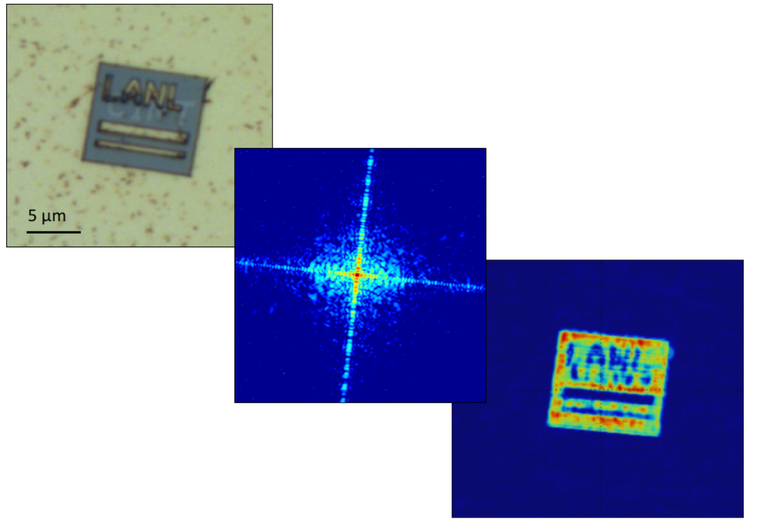


What is Coherent Diffractive Imaging?

A lensless imaging technique in which a diffraction image is produced from a test object and the object amplitude is recorded on a CCD. The phase is determined via an iterative phase retrieval algorithm.

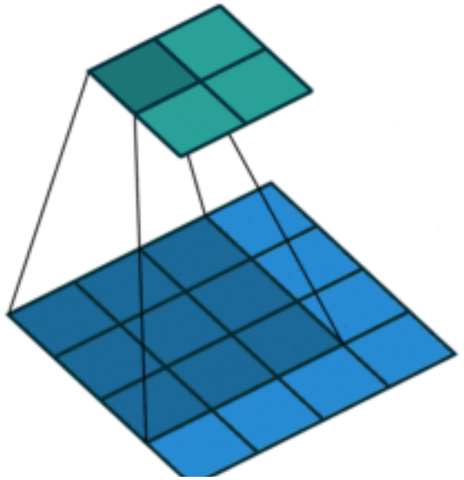


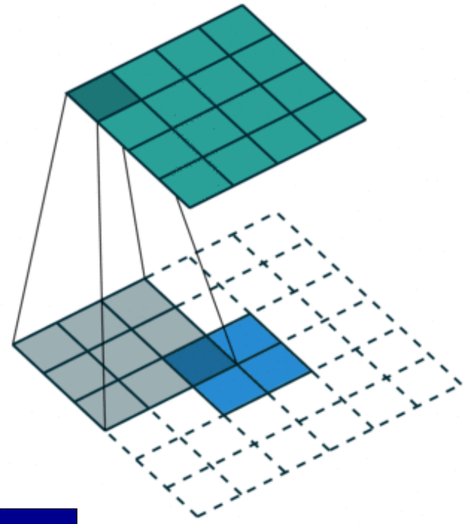


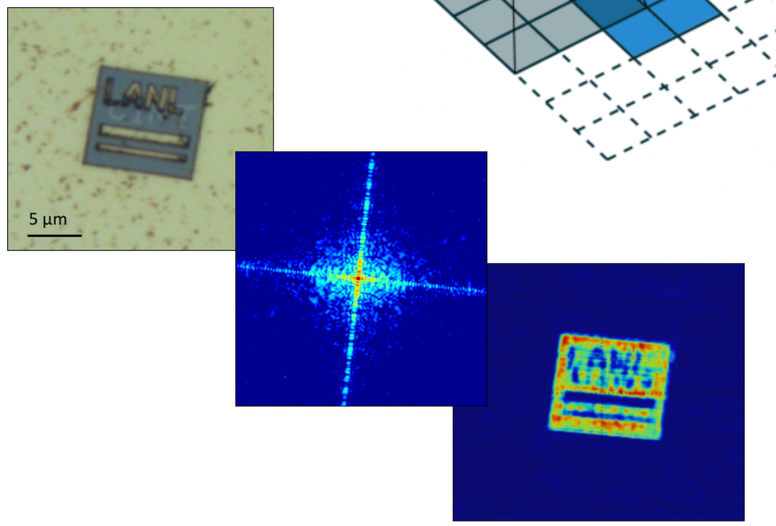


What is a CNN?

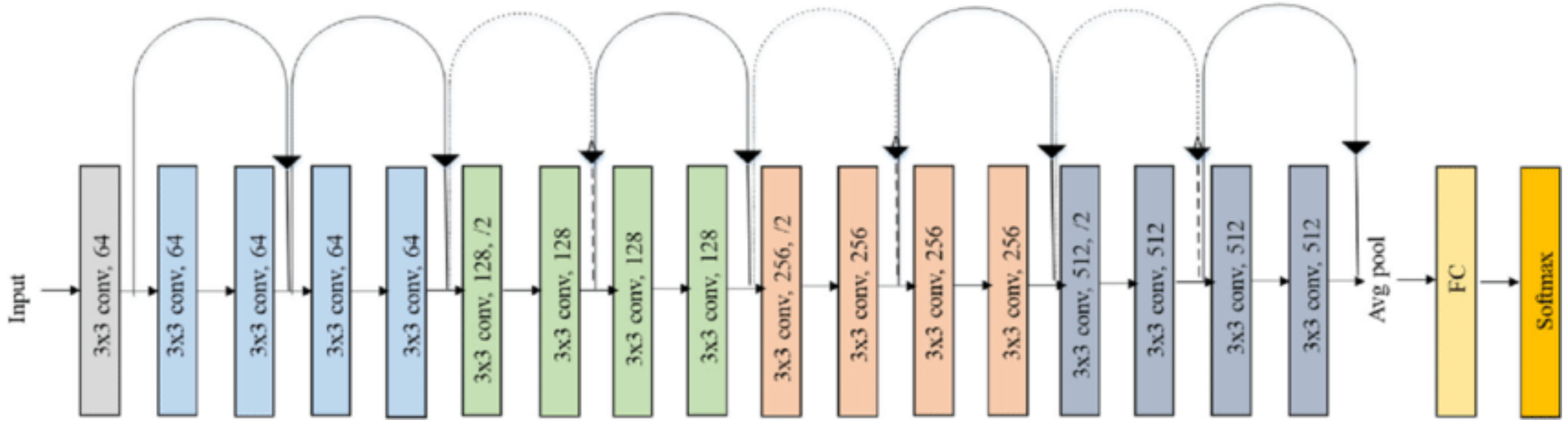
- Used for image classification, extract pixel-wise features determined, (edges, shapes, etc.)
- Convolutional Neural Networks (CNN): Implementation of neural network comprised of convolutional and deconvolutional layers.
- Convolution layer: Performs mathematical operations to produce a single value in the output feature map.
- Upsampling layer (Deconvolution): Refinement of the feature map, increase the dimensionality.
- Linear Layers







ResNet18



- ResNet-18 is a convolutional neural network that is 18 layers deep.
- Pretrained version of the network trained on more than a million images from the ImageNet database