



Fundamentals of Deep Learning

Part 1: An Introduction to Deep Learning



Agenda

- Part 1: An Introduction to Deep Learning
- Part 2: How a Neural Network Trains

- Part 3: Convolutional Neural Networks

- Part 4: Data Augmentation and Deployment

- Part 5: Pre-Trained Models

- Part 6: Advanced Architectures

To see lecture notes, make full screen
and click the “notes” button



Welcome!

The Goals of This Course



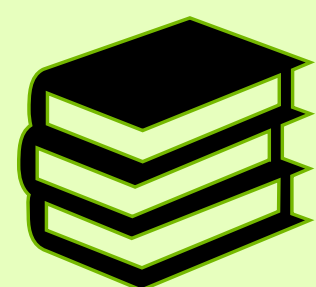
Get you up and on your feet quickly



Build a foundation to tackle a deep learning project right away



We won't cover the whole field, but we'll get a great head start



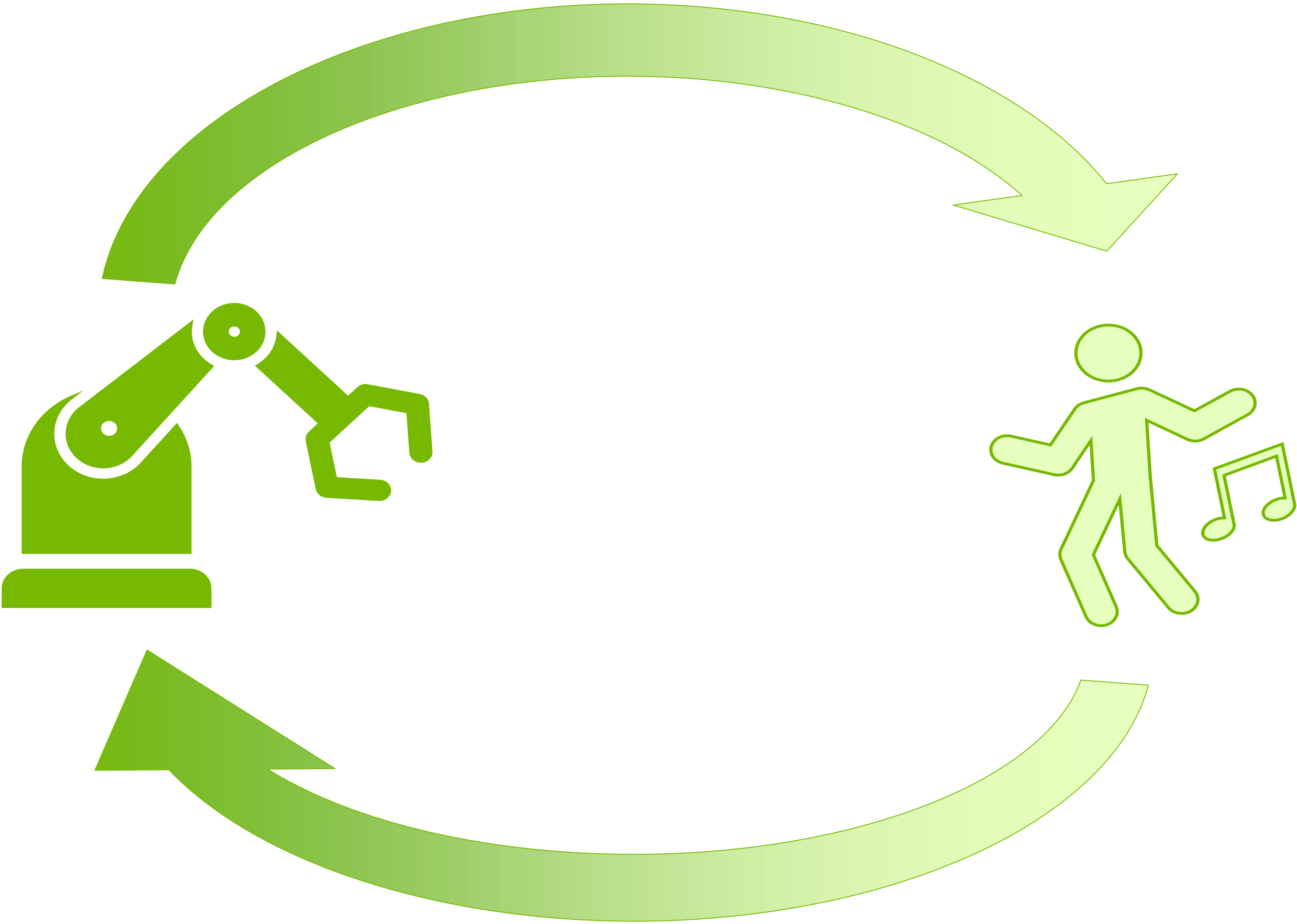
Foundation from which to read articles, follow tutorials, take further classes



Have Fun!

Human Vs Machine Learning

Relaxed Alertness



Human	Machine
Rest and Digest	Training
Fight-or-flight	Prediction

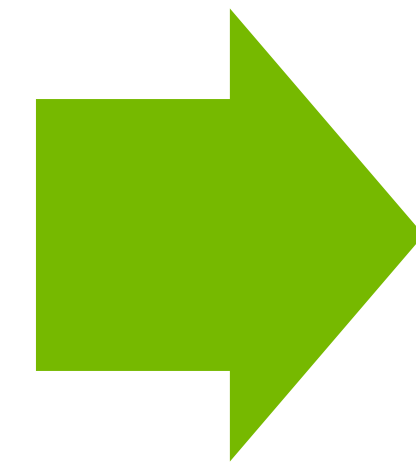
Let's Get Started



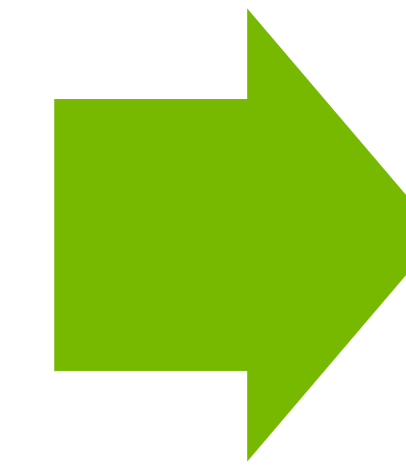
History of AI

Beginning of Artificial Intelligence

Computers are made in part to complete human tasks



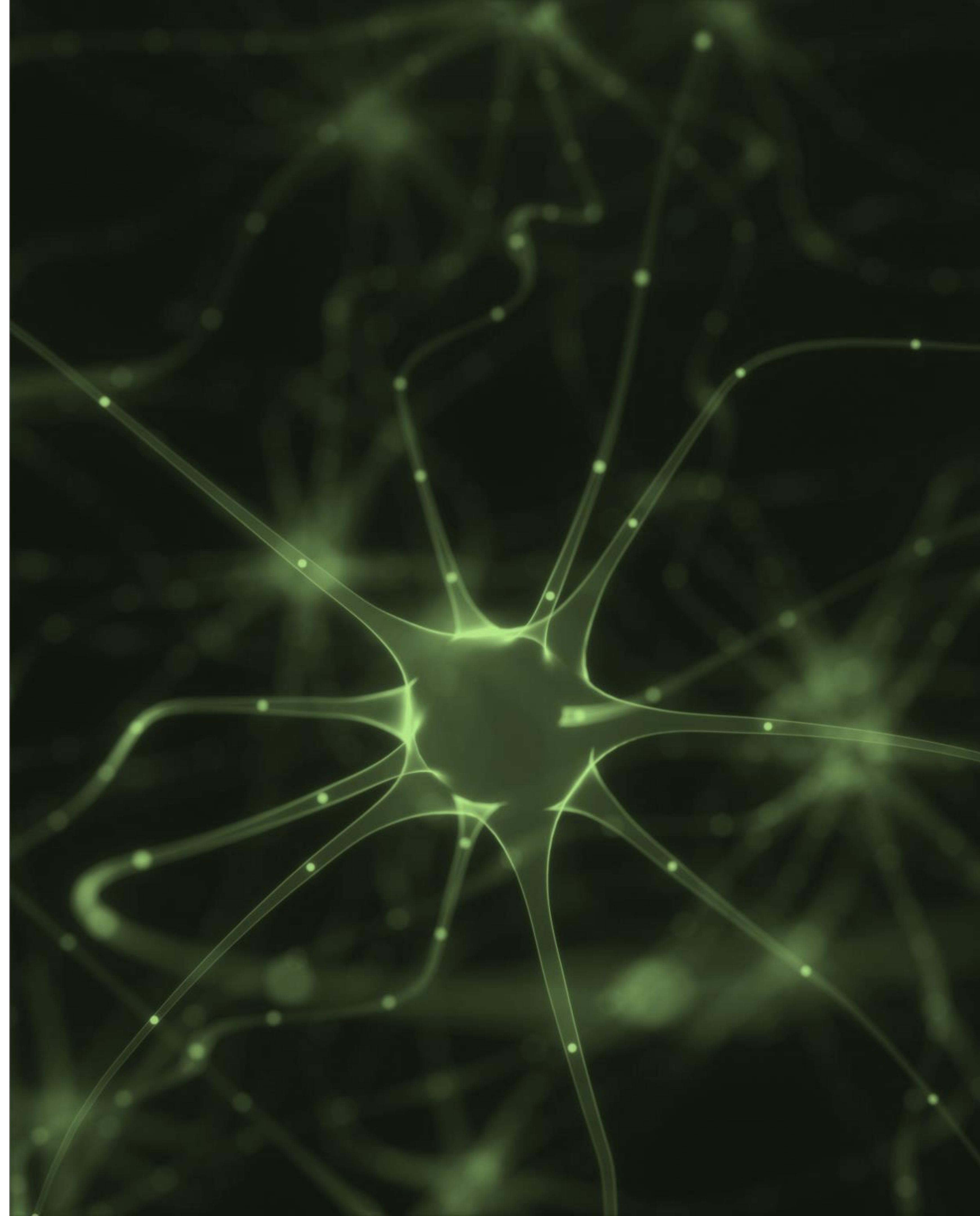
Early on, generalized intelligence looked possible



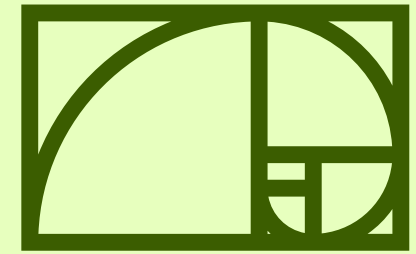
Turned out to be harder than expected

Early Neural Networks

- Inspired by biology
- Created in the 1950's
- Outclassed by Von Neumann Architecture



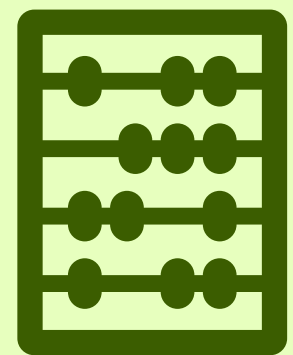
Expert Systems



Highly complex



Programmed by hundreds of engineers



Rigorous programming of many rules

Expert Systems - Limitations

What are these three images?





How Do Children Learn?

- Expose them to lots of data
- Give them the “correct answer”
- They will pick up the important patterns on their own



The Deep Learning Revolution

Data

- Networks need a lot of information to learn from
- The digital era and the internet has supplied that data



Computing Power

Need a way for our artificial “brain” to observe lots of data within a practical amount of time.

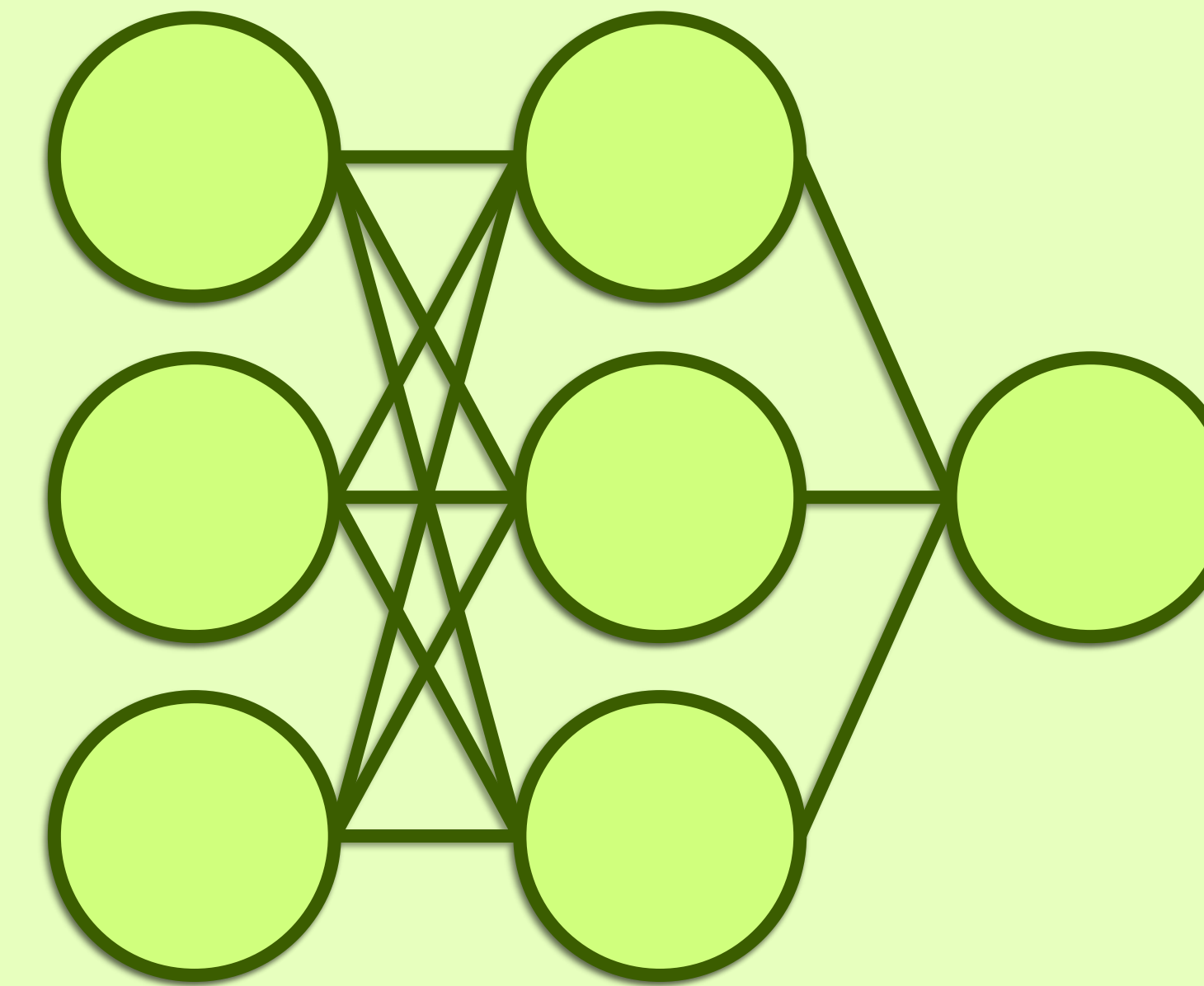


The Importance of the GPU

A Rendered Image



A Neural Network





What is Deep Learning?

“

Deep learning flips traditional
programming on its head

”

Traditional Programming

Building a Classifier

1

Define a set of rules for classification

2

Program those rules into the computer

3

Feed it examples, and the program uses the rules to classify

Machine Learning

Building a Classifier

1

Show model the examples with the answer of how to classify

2

Model takes guesses, we tell it if it's right or not

3

Model learns to correctly categorize as it's training. The system learns the rules on its own



This is a Fundamental Shift

When to Choose Deep Learning

Classic Programming

If rules are clear and straightforward,
often better to program it

Deep Learning

If rules are nuanced, complex, difficult
to discern, use deep learning

Deep Learning Compared to Other AI

Depth and complexity of networks

Up to billions of parameters (and growing)

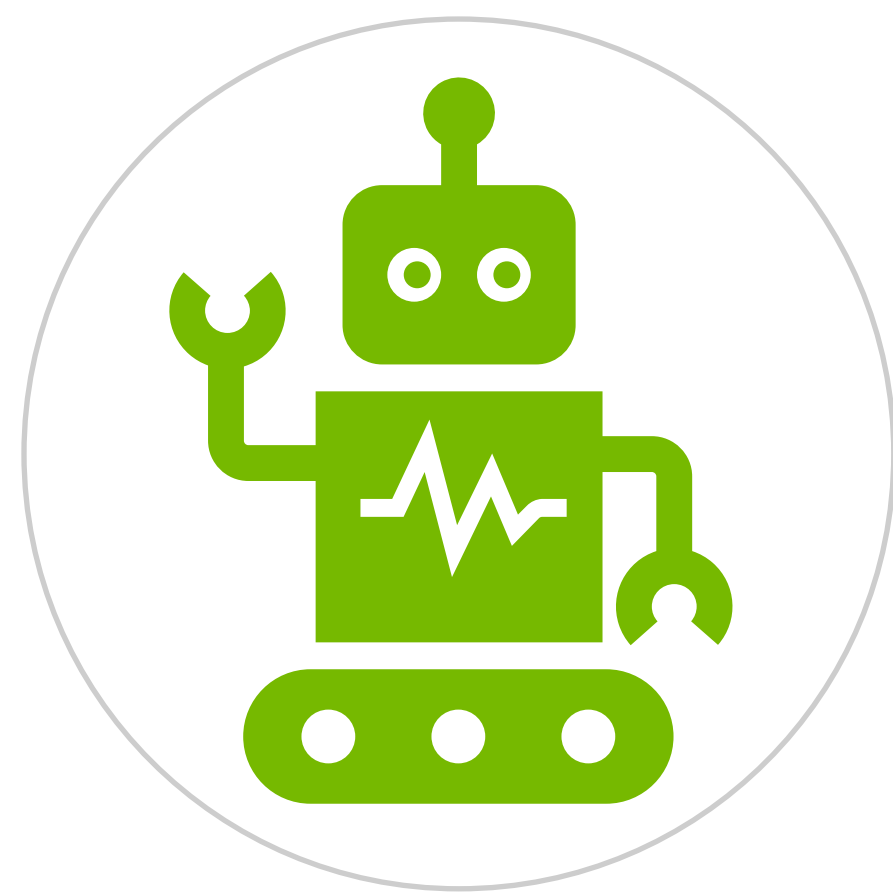
Many layers in a model

Important for learning complex rules



How Deep Learning is Transforming the World

Computer Vision



ROBOTICS AND
MANUFACTURING



OBJECT DETECTION



SELF-DRIVING CARS

Natural Language Processing



REAL-TIME
TRANSLATION



VOICE
RECOGNITION



VIRTUAL ASSISTANTS

Recommender Systems



CONTENT CURATION



TARGETED
ADVERTISING



SHOPPING

Reinforcement Learning



ALPHAGO BEATS
WORLD CHAMPION
IN GO



AI BOTS BEAT
PROFESSIONAL
VIDEOGAMERS



STOCK TRADING
ROBOTS



Overview of the Course

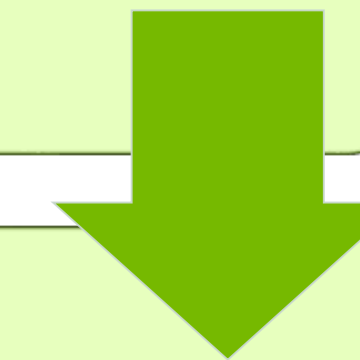
Hands on Exercises

- Get comfortable with the process of deep learning
- Exposure to different models and datatypes
- Get a jump-start to tackle your own projects

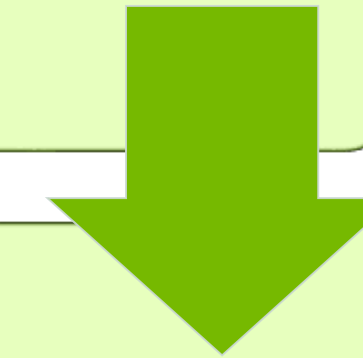


Structure of the Course

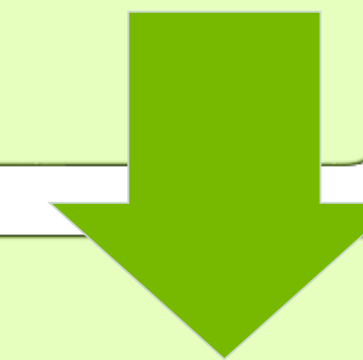
“Hello World” of Deep Learning



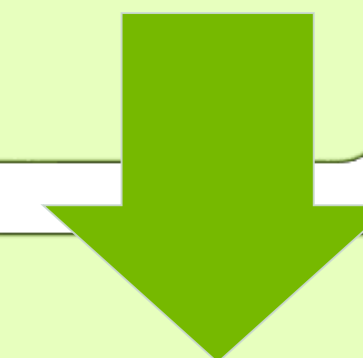
Train a more complicated model



New architectures and techniques to improve performance



Pre-trained models



Transfer learning

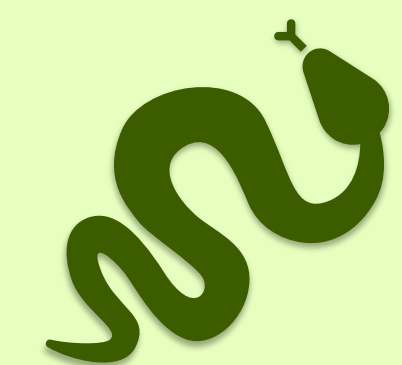
Platform of the Course



GPU powered cloud server



JupyterLab platform



Jupyter notebooks for interactive coding

Software of This Course

- Major deep learning platforms:
 - TensorFlow + Keras (Google)
 - PyTorch (Meta)
 - MXNet (Apache)
- We'll be using PyTorch
- Good idea to gain exposure to others moving forward





First Exercise: Classify Handwritten Digits

Hello Neural Networks

Train a network to correctly classify handwritten digits

Historically important and difficult task for computers

Try learning like a Neural Network

Get exposed to the example, and try to figure out the rules to how it works



Let's Go!

