



# 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

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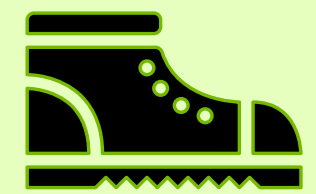




**Welcome!**



# 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



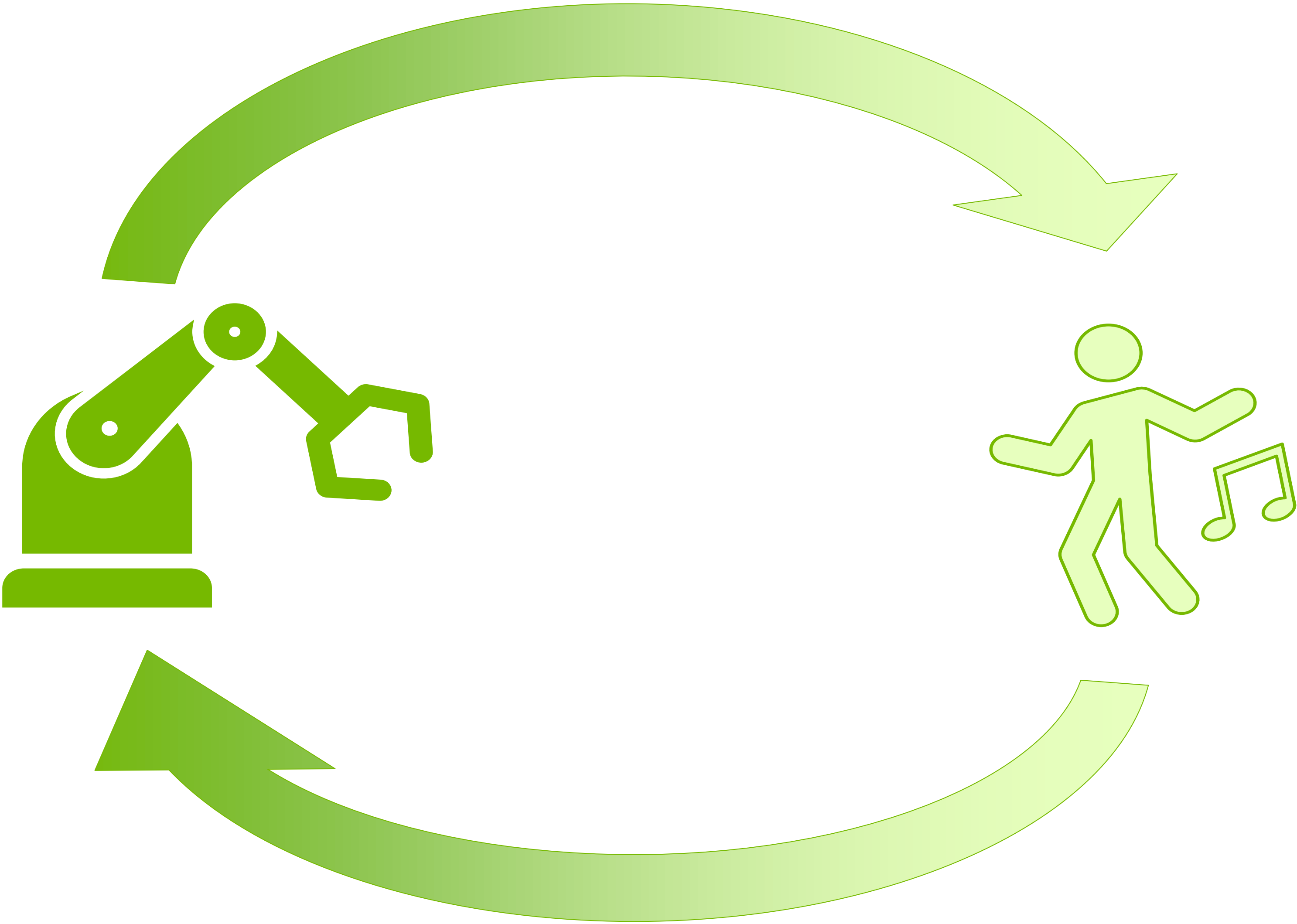


**Have Fun!**



# Human Vs Machine Learning

Relaxed Alertness



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

# Let's Get Started

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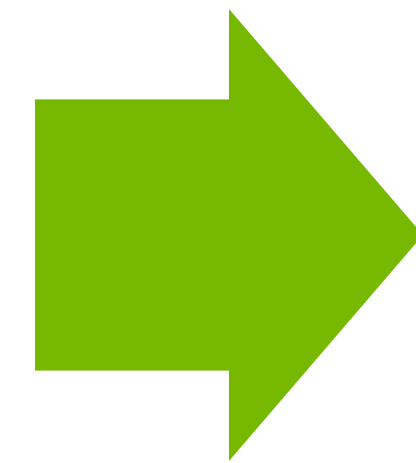


# History of AI

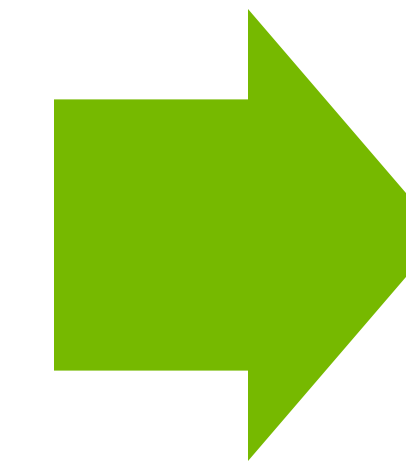


# Beginning of Artificial Intelligence

Computers are made in part to complete human tasks



Early on, generalized intelligence looked possible



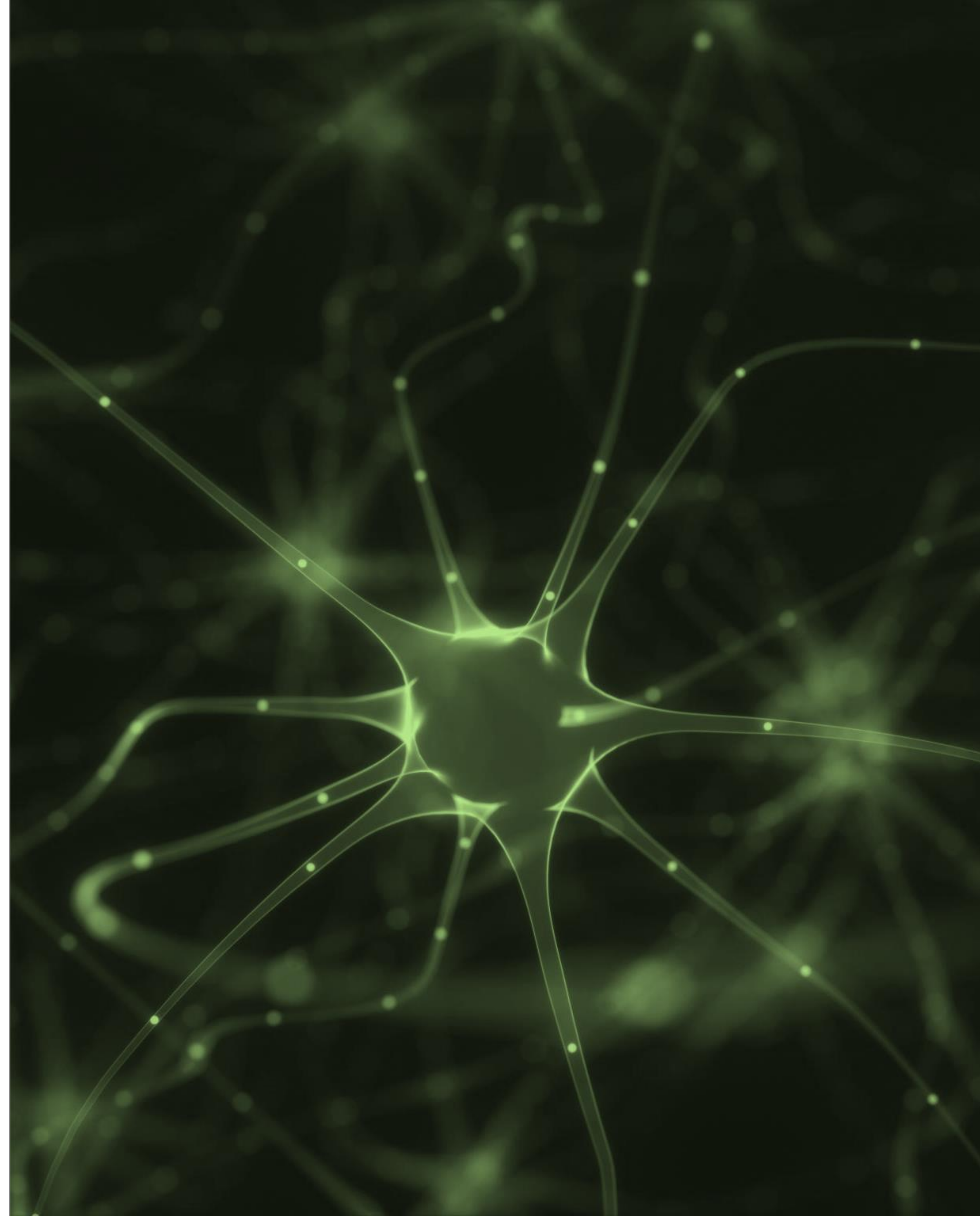
Turned out to be harder than expected



# Early Neural Networks

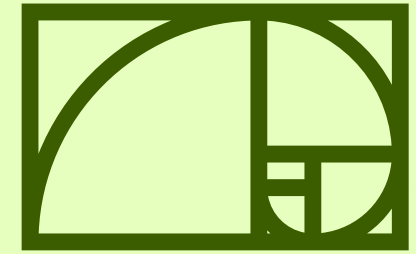
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- Inspired by biology
- Created in the 1950's
- Outclassed by Von Neumann Architecture





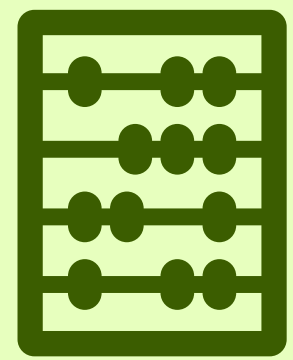
# Expert Systems



Highly complex



Programmed by hundreds of engineers



Rigorous programming of many rules



# Expert Systems - Limitations

What are these three images?







## How Do Children Learn?

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- 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

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- 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.



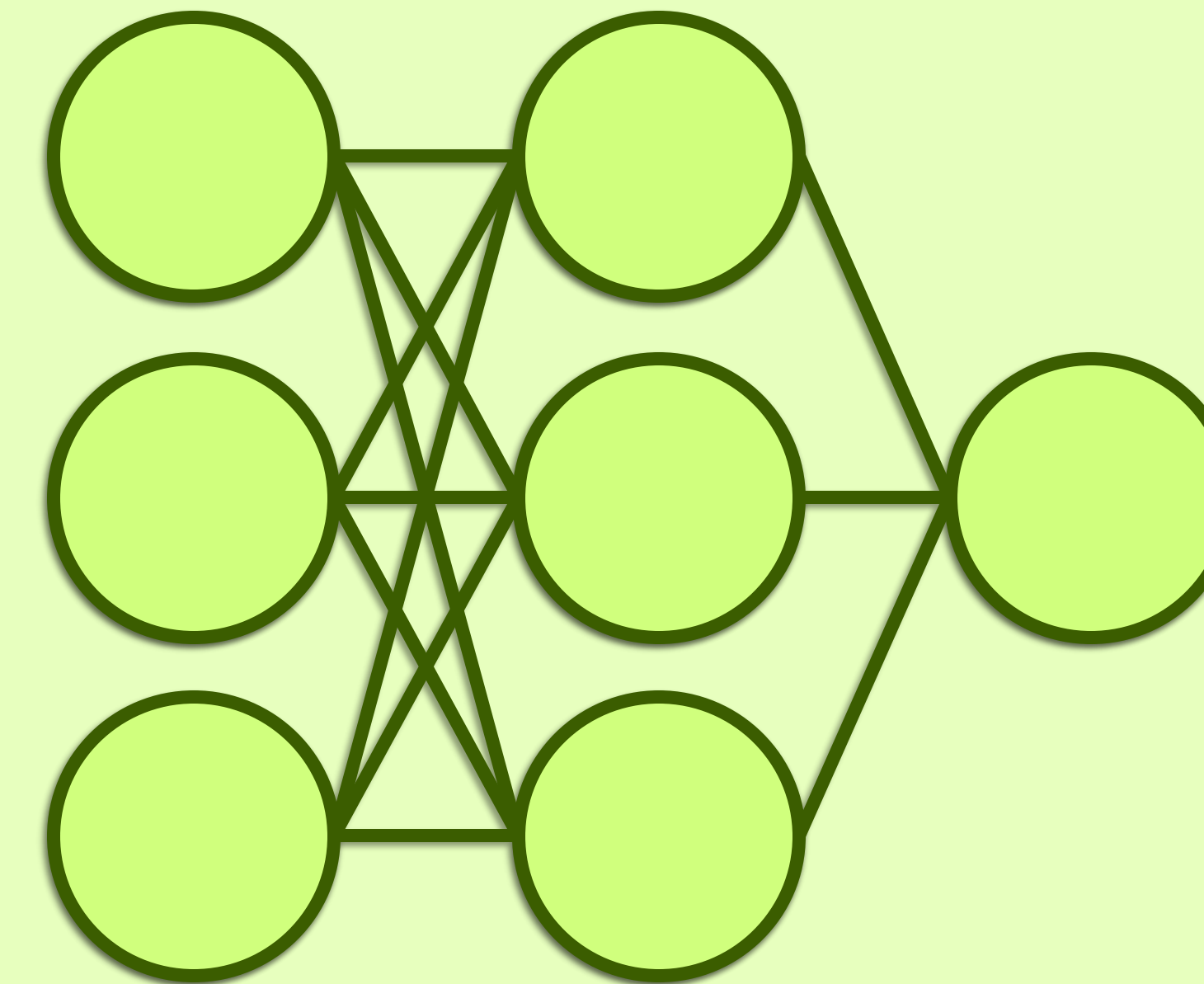


# The Importance of the GPU

**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

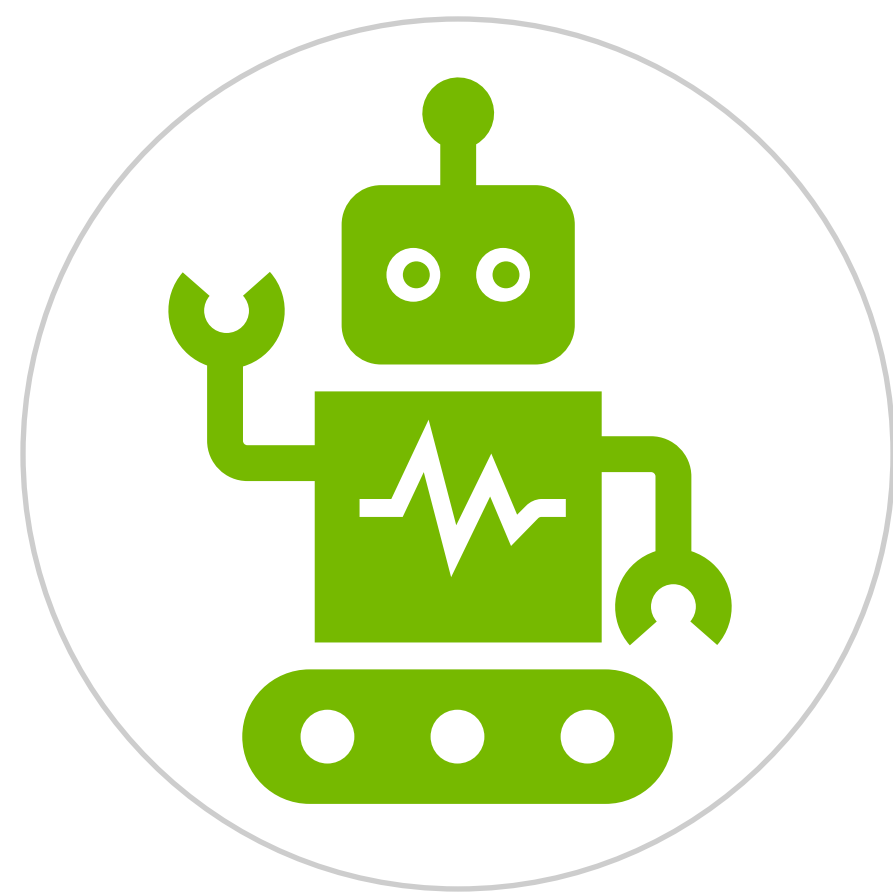




# **How Deep Learning is Transforming the World**



# 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

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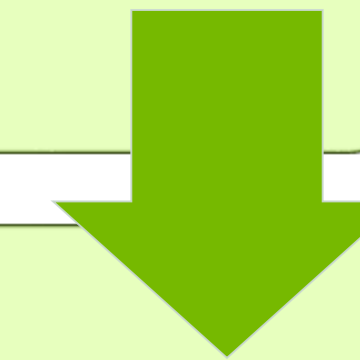
- Get comfortable with the process of deep learning
- Exposure to different models and datatypes
- Get a jump-start to tackle your own projects



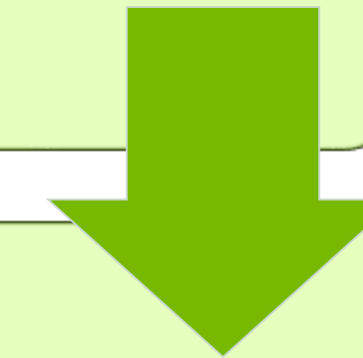


# Structure of the Course

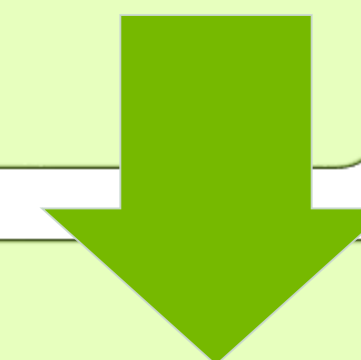
“Hello World” of Deep Learning



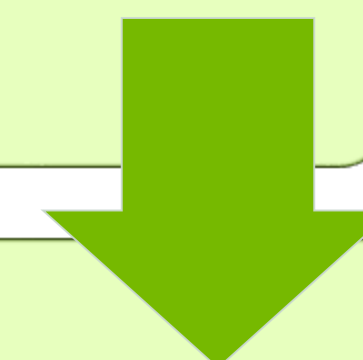
Train a more complicated model



New architectures and techniques to improve performance



Pre-trained models



Transfer learning



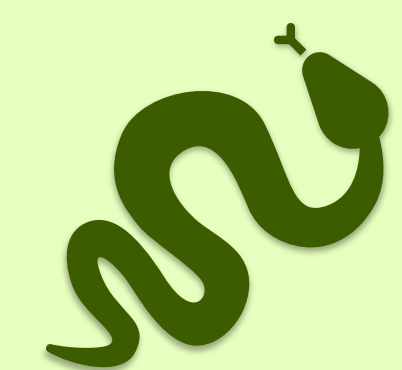
# Platform of the Course



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!**



