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

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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

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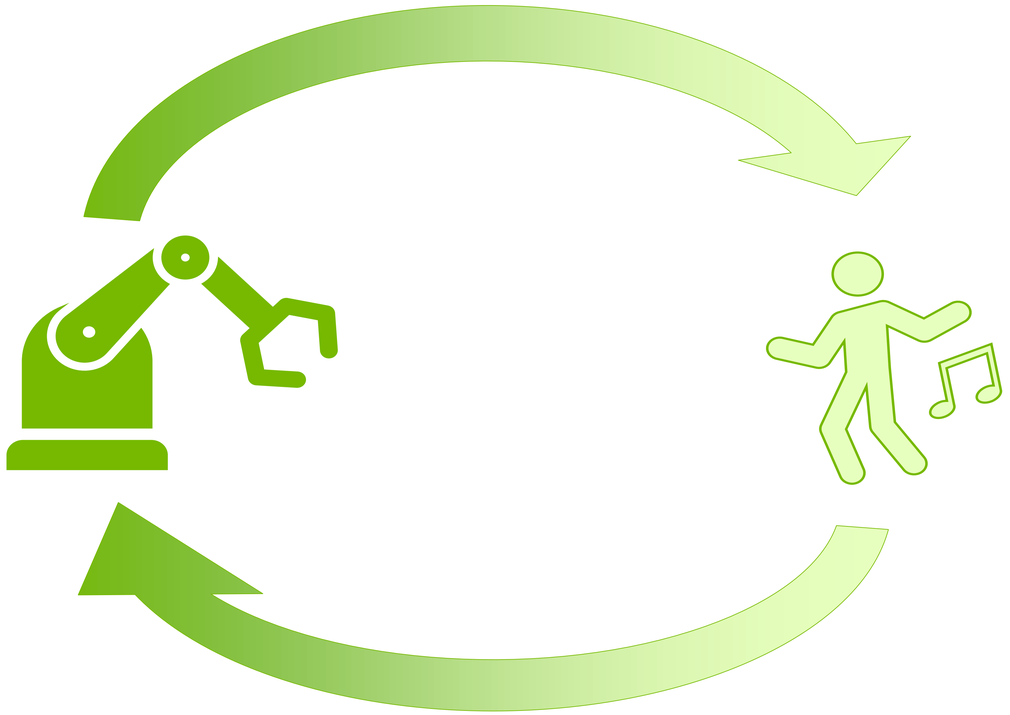
Have Fun!

Human Vs Machine Learning

Relaxed Alertness



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

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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

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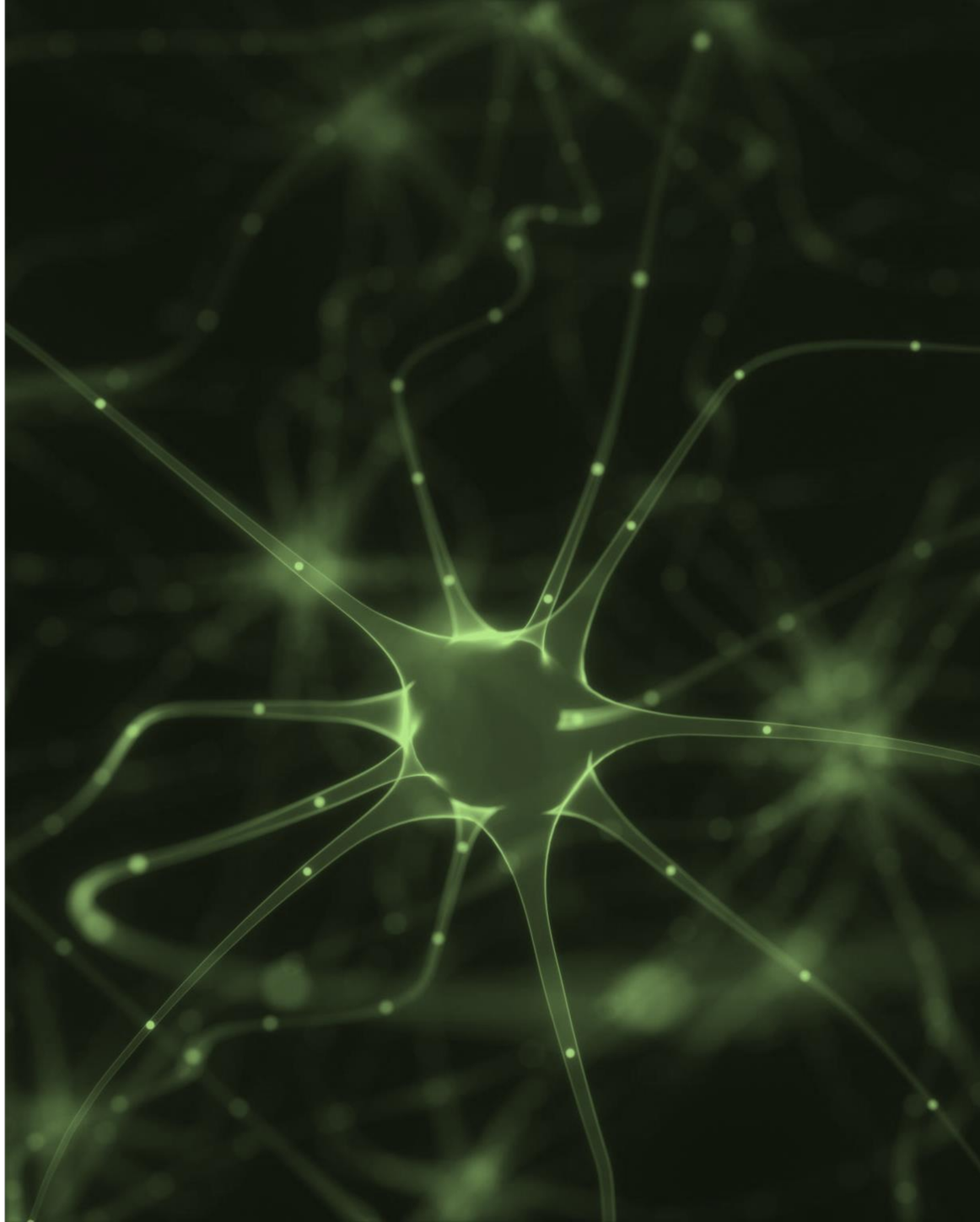
Early Neural Networks

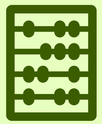
- Inspired by biology
- Created in the 1950’s
- Outclassed by Von Neumann Architecture



Expert Systems

Highly complex

Programmed by hundreds of engineers



Rigorous programming of many rules

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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

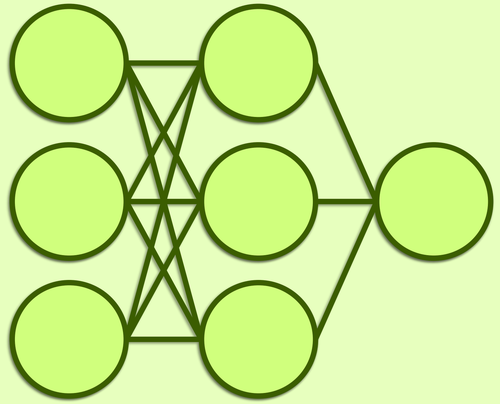
Computing Power

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



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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

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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

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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

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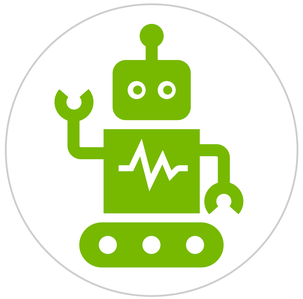
How Deep Learning is Transforming the World

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

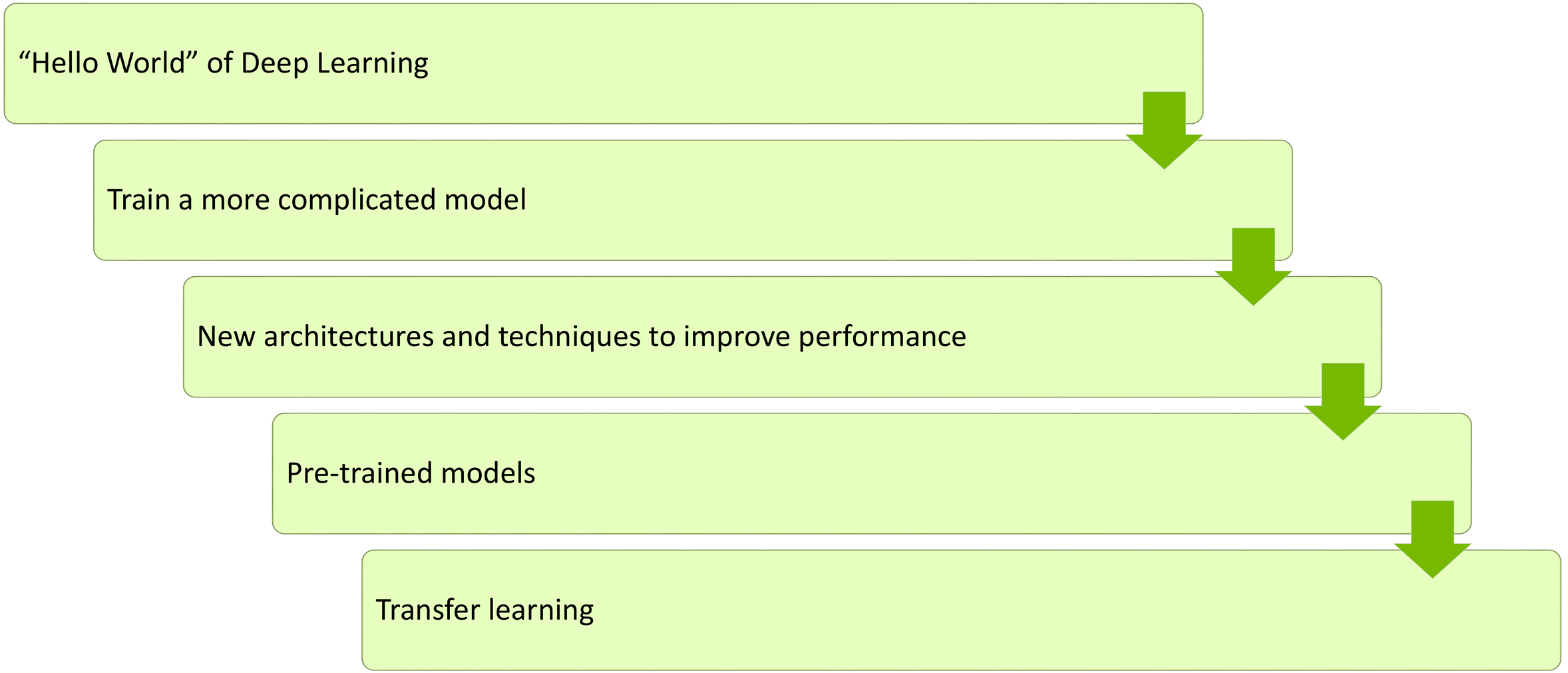
STOCK TRADING
ROBOTS

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



Platform of the Course

GPU powered cloud server

JupyterLab platform

Jupyter notebooks for interactive coding

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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

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Let’s Go!