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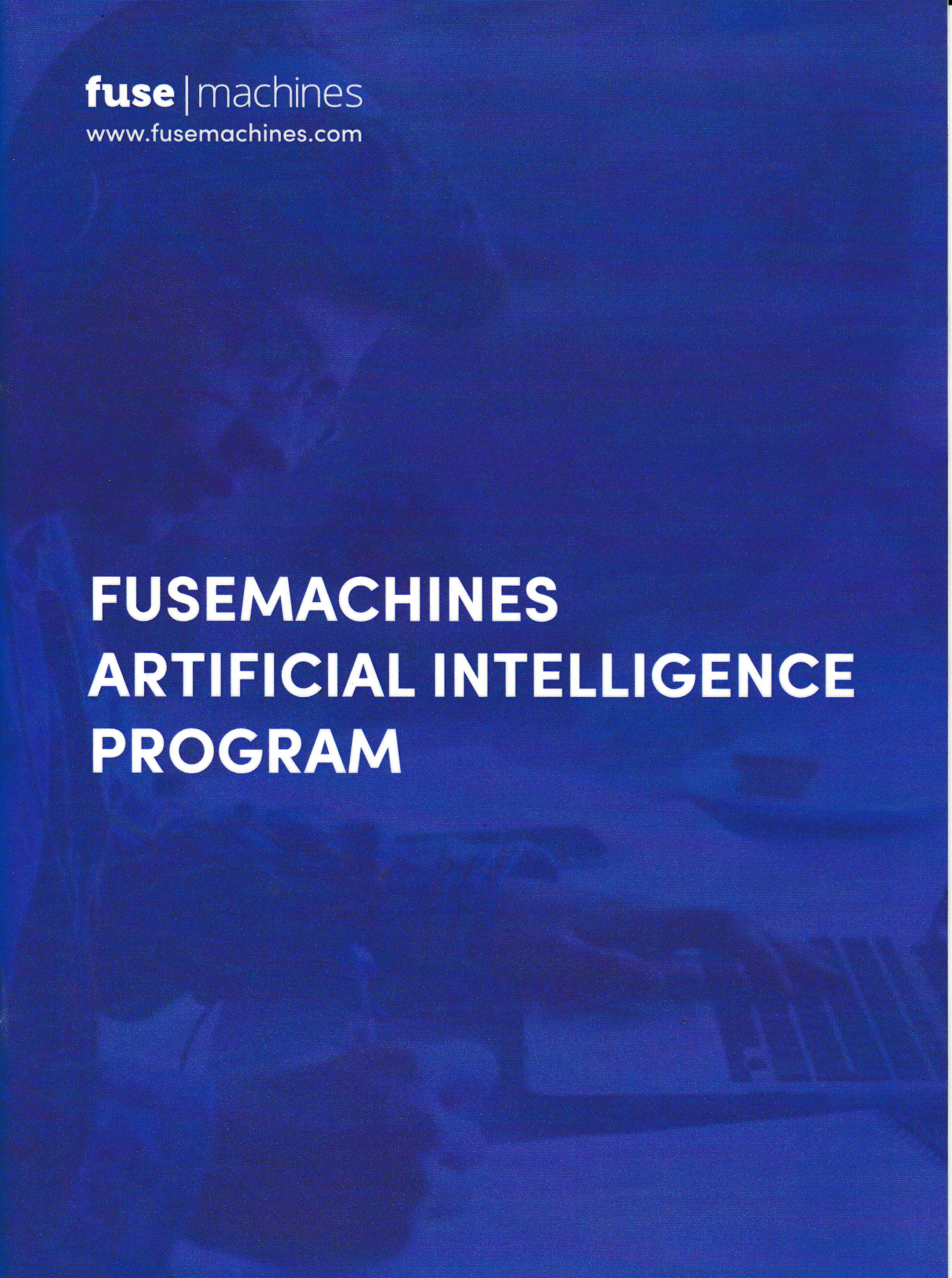
FUSEMACHINES ARTIFICIAL INTELLIGENCE PROGRAM



FUSEMACHINES ARTIFICIAL INTELLIGENCE PROGRAMS

Foundation in AI

The Fusemachines Foundation in AI is designed to enable students and engineers to begin their AI education base suitable for industry. This course provides a strong foundation in mathematical concepts of linear algebra, calculus, statistics, and Python programming language. This course also provides the foundation required to continue on to Fusemachines' Microdegree™ Program in Artificial Intelligence.

Program Duration- 1/2nd Semester (can be selected concurrently or done in semesters)

- Introduction to Computer Science for AI - 1 Semester
- Mathematics for AI - 1 Semester

Microdegree™ in AI

A Microdegree™ program for Artificial Intelligence is an accelerated learning program in Artificial Intelligence. The Microdegree™ program is created by the leading US university faculty members and AI industry experts. It is specifically designed to upskill an engineer with AI expertise. This program offers four core courses - Machine Learning (ML), Deep Learning (DL), Computer Vision (CV), and Natural Language Processing (NLP).

Program Duration- 12 Months Total

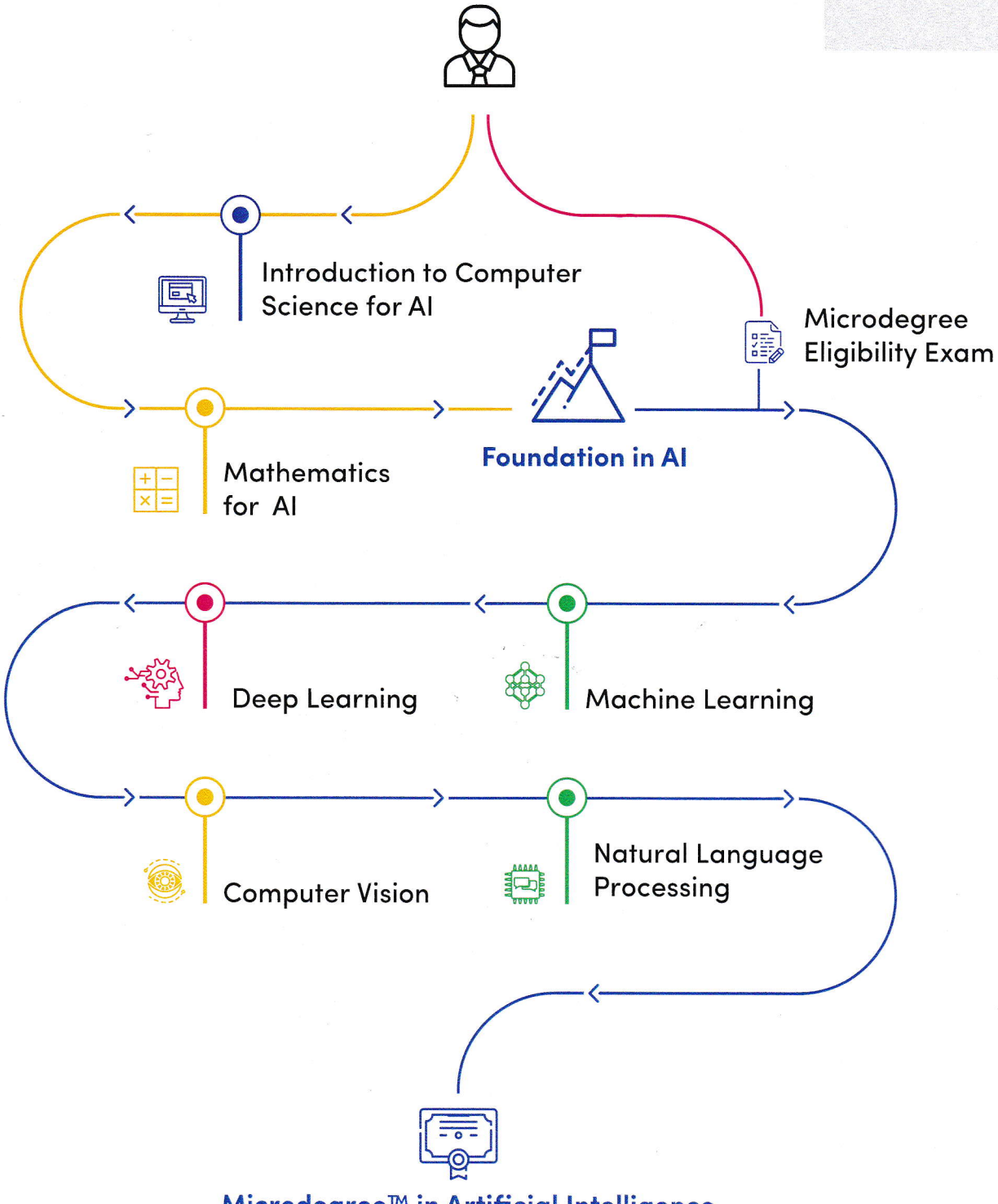
- Machine Learning
- Deep Learning
- Computer Vision
- Natural Language Processing

KEY FEATURES OF THE PROGRAM

- Classes run by AI industry experts
- Curriculum developed by university professors, PhDs, and industry experts
- Immersive courses with video lectures, quizzes, assignments, and projects
- Hands-on 50+ real life projects
- Codehub-the Proprietary Coding Platform used to complete course projects
- Online learning platform
- Webinar sessions by domain expert PhDs
- Opportunities to get involved in research projects
- Access to forum, moderated by industry experts
- Opportunities to utilize resources at Fusemachines AI Center

ENABLING QUALITY AI EDUCATION IN NEPAL

LEARNING PATH



OUTCOMES FROM THE COURSE

Outcomes from Foundation in AI

- Design, implement, test, debug, and document programs in Python
- Understand different concepts related to computer science required for AI
- Build Strong Programming and Mathematical foundation to take advanced AI courses

Outcomes from Microdegree™ in AI

- Ability to rapidly produce prototype machine learning models using most of the common ML libraries such as Tensorflow, Scikit Learn with a deep understanding of the underlying concepts
- Deep understanding of all topics covered in 4 courses including their mathematical concepts
- Ability to read academic journals and implement classical to state-of-the-art ML algorithms

WHO SHOULD ENROLL

For Foundation in AI

- Students with basic knowledge of computer science and mathematics
- +2 completed

For Microdegree™ in AI

- Basic knowledge of linear algebra and calculus
- Knowledge of probability and statistics
- Programming experience in Python
- Experience implementing computer science algorithms and object-oriented programming
- The ability to run programs and interpret output from a command line terminal or shell

FOUNDATION IN AI

INTRODUCTION TO COMPUTER SCIENCE FOR AI

Approx. 96 hrs in class +self-study

KEY OUTCOMES

- Get acquainted with the basics of computer science required for Artificial Intelligence
- Get a sound grasp of programming concepts such as OOP, Data-Structures and Algorithm analysis
- Get started in building application for desktop and web

1. Introduction to the Course

1.1 Introduction to the Course

1.2 Introduction to AI

1.3 Introduction to ML

2. Basics of Computer Systems

2.1 Introduction to the Module

2.2 Digital information and Digital Logic

2.3 Basics of Computer Architecture

2.4 Basics of Computer Networks

2.5 Basics of Operating Systems

2.6 Module Summary

3. Introduction to Python Programming

3.1 Introduction to the Module

3.2 Python Programming

3.3 Object-Oriented Programming

3.4 Web scraping

3.5 Numpy

3.6 Pandas

3.7 Matplotlib

3.8 Module Summary

4. Data Structures and Algorithms Analysis

4.1 Introduction to the Module

4.2 Data Structure

4.3 Algorithms Analysis

4.4 Code Optimisation

4.5 Module Summary

5. Database

5.1 Introduction to the Module

5.2 SQL

5.3 NOSQL

5.4 Module Summary

6. Building Applications

6.1 Introduction to the Module

6.2 Software Development Life Cycle

6.3 GUI Programming

6.4 Web Frameworks

6.5 Version Control

6.6 Module Summary

MATHEMATICS FOR AI

Approx. 96 hrs in class +self-study

KEY OUTCOMES

- Have a sound mathematical foundation required for Artificial Intelligence
- Relate basic concepts of mathematics such as linear algebra, probability, and calculus to Machine Learning.

1. Introduction to the Course

1.1 Introduction to the Course

2. Linear Algebra

2.1 Introduction to the Module

2.2 Scalars, Vectors & Tensors

2.3 Operations on Vectors and Matrices

2.4 Norms and Determinants

2.5 Linear Combinations, Independence, basis

2.6 Vector Spaces and Subspaces

2.7 Linear Equation

2.8 Transpose and Permutation

2.9 Orthogonality

2.10 Eigenvectors and Values

2.11 Singular Value Decomposition

2.12 Linear Transformation

2.13 Applications of Linear Algebra

2.14 Module Summary

3. Probability and Statistics

3.1 Introduction to Module

3.2 Conditional and Joint Probabilities

3.3 Independence

3.4 Bayes Theorem

3.5 Probability Distributions

3.6 Probability Mass Function and Probability Density Function

3.7 Expectation and Covariance

3.8 Bayesian Probabilities

3.9 Binary and Multinomial Variables

3.10 The Gaussian Distribution

3.11 Curve Fitting

3.12 Exponential Family and Estimation of Parameters

3.13 Module Summary

4. Information Theory

4.1 Introduction to Module

4.2 Information Measures

4.3 Relative Information and Mutual Information

4.4 Data Compression

4.5 Typicality

4.6 Module Summary

5. Calculus and Optimisation

5.1 Introduction to the Module

5.2 Derivatives and Gradients

5.3 Analyzing Functions

5.4 Multivariate Calculus

5.5 Laplacian, Jacobian & Hessian
5.6 Matrix Calculus
5.7 Taylor's Theorem
5.8 Conditions for Local Minima
5.9 Convexity
5.10 Module Summary

6. Numerical Computation

6.1 Introduction to the Module
6.2 Numerical Linear Algebra
6.3 Overflow and Underflow
6.4 Poor Conditioning
6.5 Gradient-Based Optimisation
6.6 Gradient-Free Optimisation
6.7 Constraint Optimisation
6.8 Module Summary

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CERTIFICATE OF FOUNDATION IN AI

Fusemachines AI School

PROGRAM CERTIFICATE

This is to certify that

Manjul Prasad Joshi

has successfully completed the program

Foundation in Artificial Intelligence

May 2019

Dr. Sameer Maskey
CEO and Founder, Fusemachines Inc.

This Certificate was digitally signed by fuse.ai
Certificate No.: fa-02YD06P8 | Certificate URL: fuse.ai/fa-02YD06P8

Certificate of Foundation in AI

MICRODEGREE™ IN AI

COURSE I
MACHINE LEARNING

Approx. 72 hrs in class +self-study

KEY OUTCOMES

- Able to rapidly produce Machine learning prototypes in different scenarios
- Understand the concepts of Machine Learning and its abilities
- Use the most common Machine Learning libraries and modify them as per the needs

Module 1: Introduction

1.1 Introduction to the Course
1.2 Introduction to Course Logistics
1.3 Introduction to Fuse Codehub

Module 2: Python and Prerequisites

2.1 Introduction to Module
2.2 Introduction to Python
2.3 Object-oriented programming in Python
2.4 Numpy
2.5 Pandas
2.6 Plotting

Module 3: Introduction to Machine Learning

3.1 Introduction to Machine Learning
3.2 General Ideas on ML Projects

Module 4: Sklearn Building Blocks

4.1 Introduction to Sklearn
4.2 The Concept of Overfitting
4.3 Pipelining and Hyperparameter Search
4.4 Data Preprocessing and Model Persistence
4.5 Imbalanced Theory and Metrics

Module 5: Supervised Machine Learning

5.1 Linear Regression
5.2 Logistic Regression
5.3 Naive Bayes
5.4 Ensemble Methods
5.5 Tree Algorithms
5.6 Support Vector Machines
5.7 Multi-Class
5.8 Sklearn Features

Module 6: Unsupervised Machine Learning

6.1 Dimensionality Reduction
6.2 Clustering Algorithms
6.3 Gaussian Mixture
6.4 Outlier Detection
6.5 Recommender System

Module 7: Time Series Analysis

7.1 Time Series Analysis Theory
7.2 Time Series Analysis Practical

Module 8: Computer Vision with OpenCV

8.1 Image Processing
8.2 Computer Vision

Module 9: Reinforcement Learning

9.1 Introduction to Reinforcement Learning
9.2 Model, Policy, Value Function
9.3 Policy Search
9.4 Exploration vs Exploitation

COURSE II
DEEP LEARNING

Approx. 72 hrs in class +self-study

KEY OUTCOMES

- Have a sound mathematical and programming foundation required for building Deep Learning Models
- Understand the concepts of Deep Learning and its applications
- Able to get started in building Deep Learning models and deploy those models in Production

Module 1: Maths Review for Deep Learning

1.1 Introduction to Linear Algebra
1.2 Probability and Information Theory
1.3 Statistical Learning Foundational Concepts
1.4 Optimization Basics (Calculus)
1.5 Machine Learning Review

Module 2: Introduction to Deep Learning

2.1 Why Deep Learning
2.2 Building Blocks of Deep Learning

Module 3: MLP and Back Propagation

3.1 Multilayer Perceptrons (MLPs)
3.2 Back Propagation
3.3 Error Metrics
3.4 Frameworks

Module 4: Optimization Fundamentals

4.1 Concept of Optimisation
4.2 Overcoming Vanishing Gradients
4.3 Optimization Methods
4.4 Architecture Search

Module 5: Regularization

5.1 Classic Approaches
5.2 Modern Tricks
5.3 Other Techniques

Module 6: Convolutional Networks

6.1 Fundamentals
6.2 Seminal Architectures
6.3 Seminal Architectures Object Detection
6.4 Current Research on CNNs

Module 7: Recurrent Neural Networks

7.1 Fundamentals
7.2 Building Blocks of Deep Learning
7.3 Current research on RNNs

Module 8: Attention and Neural Computers

8.1 Neural Attention
8.2 Attentive Encoder-Decoders
8.3 Neural Computers
8.4 Current Research on Neural Attention

Module 9: Generative Models

9.1 Graphical models
9.2 AutoEncoders
9.3 Implicit Models and Machine Games
9.4 Seminal GANs
9.5 Current Research on GANs

Module 10: Deep Reinforcement Learning

10.1 RL Fundamentals
10.2 Q-learning
10.3 Temporal-Difference Learning

10.4 Policy Gradient
10.5 Challenges in RL
10.6 Evolution Strategies
10.7 Current RL Research
10.8 Applications

Module 11: DL in Production

11.1 Deep Learning Hardware
11.2 Interpretability
11.3 Evaluation and Debugging DL Models
11.4 Deployment
11.5 Evaluation and Monitoring AI Systems
11.6 Production Management
11.7 Interoperability
11.8 Scalability

Module 12: Deep Learning Applications

12.1 Machine Comprehension
12.2 Machine Translation
12.3 Speech Recognition
12.4 Image/Video Captioning
12.5 Deep RL for Games
12.6 Deep RL for Robotics

COURSE III
COMPUTER VISION

Approx. 72 hrs in class +self-study

KEY OUTCOMES

- Have a sound background in traditional as well as state-of-the-art Computer Vision Techniques
- Understand the concepts and applications of Computer Vision
- Able to get started in building Computer Vision Models and deploy those models in Production

Module 1: Introduction to Computer Vision

1.1 Computer Vision Overview
1.2 Image Formation
1.3 Library and Frameworks

Module 2: Image Processing and Feature Detection

2.1 Edge Detection
2.2 2D Shapes
2.3 Morphological Processing
2.4 Feature Detection
2.5 Feature Descriptors
2.6 Frequency Domain Analysis

Module 3: Image Classification and Object Recognition

3.1 Traditional Computer Vision Methods
3.2 Deep Learning in Image Classification
3.3 Deep Learning in Object Detection

Module 4: Segmentation

4.1 Region Segmentation
4.2 Deep Learning based Semantic Segmentation

Module 5: 3D Vision

5.1 3D Geometry
5.2 Multiview Reconstruction
5.3 Structure From Motion
5.4 Shape-from-X
5.5 3D Reconstruction
5.6 Visual Ontologies
5.7 Deep Learning Based 3D Reconstruction

Module 6: Motion and Video

6.1 Optical Flow
6.2 Dense Motion Estimation
6.3 Tracking: Parametric Models
6.4 Tracking: Non-parametric models
6.5 Approaches to Video Classification
6.6 Applications of Video Classification
6.7 Activity Recognition

Module 7: Generating Synthetic Images

7.1 Image-Based Rendering
7.2 Generative Adversarial Networks
7.3 Current Applications

Module 8: Scene Understanding and Context and Content based Image Retrieval

8.1 Global Scene Representations
8.2 Scene Recognition
8.3 Grammars for Objects and Scenes
8.4 Image Retrieval and Matching

Module 9: Computer Vision Applications

9.1 Self-Driving Cars
9.2 Automatic Inspection
9.3 Pose and Behaviour Recognition
9.4 Medical Applications
9.5 Visual Surveillance

COURSE IV
NATURAL LANGUAGE PROCESSING

Approx. 72 hrs in class +self-study

KEY OUTCOMES

- Have a sound background in traditional as well as state-of-the-art Natural Language Processing Methods
- Understand the concepts and applications of Natural Language Processing
- Get started in building NLP based Models and deploy those models in Production

Module 1: Introduction to NLP

1.1 Tools and Frameworks

1.2 Text Normalization

1.3 Text Classification

1.4 Text Clustering

Module 2: Language Models

2.1 Language Modeling

2.2 Neural Language Model

Module 3: Markov Models

3.1 Regular Expression and Finite State Automata

3.2 Markov Models and Hidden Markov Model

3.3 Maximum Entropy Markov Model

Module 4: Syntax & Parsing

4.1 Tagging

4.2 Context-Free Grammars

4.3 Parsing

4.4 Lexicalized and Probabilistic Parsing

4.5 Dependency Parsing

Module 5: Semantic Role Labeling

5.1 Semantic Role Labeling

Module 6: Semantics

6.1 Lexical Semantics

6.2 Word Sense Disambiguation

Module 7: Information Extraction

7.1 Information Extraction

7.2 Entity Extraction

7.3 Relationship Extraction

Module 8: Machine Translation

8.1 Syntax-Based Statistical Machine Translation

8.2 Neural Machine Translation

Module 9: Neural Network based NLP

9.1 Word Embeddings

9.2 Recurrent Neural Networks

9.3 Recursive neural networks

9.4 Convolutional neural networks

9.5 Natural Language Generation

9.6 Transformers and Self-Attention For Generative Models

Module 10: Reinforcement Learning for NLP

10.1 Introduction to Reinforcement Learning

10.2 Policy Based RL

10.3 Value Based RL

10.4 Examples of RL for NLP

Module 11: Applications

10.1 Text Summarization

10.2 Machine Translation

10.3 Speech Translation

10.4 Question Answering

10.5 Dialogue Systems (Chatbots)

10.6 Multi-Modal Systems