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Fusemachines AI Fellowship 2023

Latin America

A 6 month course to train, educate, and create advanced AI career opportunities

About the program:

Fusemachines Democratizing AI Education

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 engineers/ domain experts with AI and Data Science expertise.

Program Outcomes

1. Participants will garner data science and ML skills with hands-on experience in real world problems
2. Participants will develop a solid understanding of Artificial Intelligence, Machine Learning, and Deep Learning algorithms with an understanding of underlying math and programming practices.
3. Select and implement appropriate algorithms, libraries, frameworks, and techniques for different problems.
4. Run experiments to assess the performance, evaluate and compare different models to design and deploy an end-to-end pipeline

Course Schedule:

24 Weeks

20 weeks course work + 4 weeks Project work

Method of Teaching:

Pace of course: 12 hours/Week

- Lectures: 2 Hours/Week
- Self-study: 10 hours/Week

Blended Learning:

- Most of the content will be available online to be viewed on their own pace
- Online Live Discussion by Academics and Industry Experts weekly
- Programming Assignments
- Quizzes
- Final Examination
- Group Projects
- Paper reading sessions

Assessment Grading:

- Online (Quiz, Assignments)
- In-Class (Exams, Projects, Class Activities)

Course Prerequisites:

Engineering students, IT students [Final year], Graduates or professionals who:

- have taken courses on Linear Algebra, Probability, Statistics, and Basic Calculus
- have taken some programming and computer science courses
- are able to program in python
- Soft skills: Fluent in English, Good communication skills, Teamwork, learning attitude

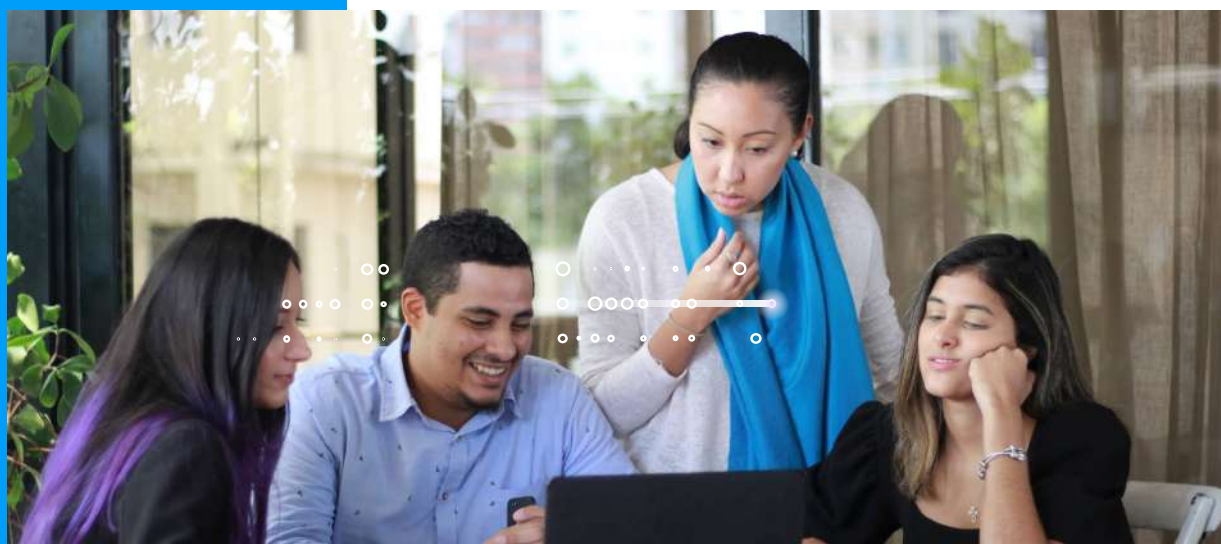
There will be an eligibility test to check if students have enough foundation skills to take the course.

Aptitude test:

- Programming; Python programming
- Maths: Linear Algebra, Calculus, Probability, and Statistics
- Computer Science topics: DSA, Algorithms, Database
- Software Development skills: Git, REST, SQL
- IQ and Problem-solving
- Behavioral Questions

Instructor/ TAs:

- **Academics and Industry experts from various parts of the world**
- **Fusemachines AI Engineers**
- **Fusemachines employees**



Program Features

- **Live Online Lectures and Guest Lecture**
  - Weekly Lecture Sessions
  - Recordings of live classes available
- **Access to AI Enabled Online Classroom Platform**
  - Course Videos
  - Reading Materials
  - Programming Notebooks
  - Practice Quizzes
  - Graded Programming Assignments
  - Proctored exams
- **Monthly newsletter [Announcements, reminders, news]**
- **Case Studies and Paper reading**
- **Group Projects**
- **Kaggle Competitions**
- **Student Community Forum, Fuse classroom platform, and Discord forum**
- **Access on Mobile and Desktop**
- **Certificate of Completion**

Enrollment Steps

Step 1

Online Application

Fill out and submit the Application Form with relevant details.

Step 2

Online Proctored Entrance Test

After your application is approved, you will sit down for an online entrance test designed to evaluate your foundational skills for enrollment in the program.

Step 3

Interview of Shortlisted Candidates

Shortlisted candidates who passed the entrance test will be called for an interview.

Step 4

Enrollment and Onboarding

After a successful interview, you will be onboarded and enrolled in the program!

Syllabus

Week 1
Introduction to AI/ML and Data Science

After completing this module, students should be able to:

- Show and understanding of artificial intelligence, machine learning, and deep learning and other relevant terminologies
- Describe different categories of AI, the types of machine learning and their applications
- Understand the concept of Agents such as Search Agent, Adversarial agents and so on
- Write a search agent to solve search problems

Assignment

- Solve boat crossing puzzle using search Agents

Week 2
Data Wrangling

After completing this module, students should be able to:

- Recognized different data types and data attributes
- Scrape data from the internet
- Clean data quality issues in datasets
- Apply data normalization and scaling
- Deal with data outliers and anomalies
- Visualize dataset using different plots

Assignment

- WebScraping Wikipedia pages
- Exploratory Data Analysis (EDA): Analyze and visualize a dataset to gain insights and discover patterns.

Syllabus

Week 3
Regression & Classification

After completing this module, students should be able to:

- Define basic machine learning terminologies,
- Create a linear regression model for predicting continuous values from data
- Create a logistic regression model for predicting classes,
- Write gradient descent algorithm (Stochastic and Batch Gradient Descent) to train the linear regression and logistic regression model,
- Evaluate the performance of regression and classification models,
- To find out and improve Overfit or Underfit model,
- Implement regularization to improve model performance,
- Build, train and evaluate Regression and Classification models with Scikit-learn.

Assignment

- Build a regression model to predict students' final grade
- Customer Churn Prediction: Build a classification model to predict customer churn based on historical data.

Week 4
Popular ML Models

After completing this module, students should be able to:

- Interpret and visualize the decision surface of an overfitted decision tree.
- Analyze how noise can cause the decision tree to go unnecessarily deep.
- Learn how to handle categorical and continuous features when using Naive Bayes.
- Understand the concept of prior and posterior probabilities in Naive Bayes and their role in the classification process.
- Describe Margin Classifier, the slack variables and implement the SVM with slack variables.
- Understand linearly separable and non-linearly separable data.
- Search the nearest neighbor using the K-D Tree algorithm.
- Implement K-NN algorithm for classification and recognize the effect of variation in K-values
- Benchmarking models

Assignment

- Build a model that can predict multiple genres of a movie based on its plot summary or other relevant features.

Syllabus

Week 5
Clustering

After completing this module, students should be able to:

- Examine the effect of centroid initialization in convergence and describe the various initialization methods in K-means clustering
- Explain and implement DIANA algorithm (Agglomerative, BRICH)
- Explain density-based clustering and Exemplify terminologies such as ϵ-neighborhood, density, core points, boundary points, outliers, density reachability, and connectivity.
- Explain the statistical cluster validation methods

Assignment

- Market segmentation: Cluster customers based on their purchasing behavior or demographic data to identify distinct customer groups.

Week 6
Ensemble Methods

After completing this module, students should be able to:

- Decompose errors into bias, variance, and noise, and identify their causes in a model's poor performance.
- Explain ensemble methods and understand why they work, emphasizing the importance of diversity and accuracy within ensembling.
- Explain bagging and bootstrapping, understand why averaging reduces variance, and list the advantages of bagging.
- Understand random forest and differentiate it from bagging, listing the steps involved in creating a random forest.
- Distinguish boosting from bagging, explain boosting as a sequential weighted averaging technique, and discuss its working with an algorithm.
- Understand the working of and use XGBoost, CatBoost and LightGBM

Assignment

- AirBnB guest arrival prediction using tree-based methods
- Random Forest classifier: Use the Random Forest algorithm to build an ensemble of decision trees for classification tasks.
- Gradient Boosting regression: Implement Gradient Boosting to create an ensemble of weak learners for regression tasks.

Syllabus

Week 7
Neural Networks

After completing this module, students should be able to:

- Describe the basics of neural networks and correlate it with biological neurons (this may also be redundant because of deep learning content)
- Examine and recognize the problems where the use of Neural network is appropriate
- Explain how Perceptron Learning Algorithm helps to learn the parameter for the perceptron
- Explain why multi-layer perceptron are universal approximator
- Use tensorflow / Pytorch to perform basic tensor computation

Assignment

- Implement artificial neural networks to predict the number of sales for a company based on the advertisement platforms like TV, Radio and Newspaper.

Week 8
Image Processing, Feature Detection & Matching

After completing this module, students should be able to:

- Understand the principles of image formation, camera geometry, and digital camera components
- Apply projective transformations, perspective transformations, and multi-view geometry concepts to perform translation, scaling, rotation, and projections in both 2D and 3D spaces.
- Perform various image processing operations, including pixel transformations, histogram analysis, noise removal, filtering, sharpening, deblurring, resizing, and morphology.
- Used algorithms and filters for edge detection, feature detection and matching techniques, including corner detection using the Harris Corner Detector and scale-invariant feature detection using SIFT.

Assignment

- Edge detection: Implement algorithms like Canny edge detection or Sobel operator to detect edges in images.
- Image segmentation using clustering: Apply clustering techniques like K-means or Mean Shift to segment images into different regions or objects.

Syllabus

Week 9
CNN & Transfer Learning

After completing this module, students should be able to:

- Visualize the convolution operation in a CNN and point out the distinguishing features of a CNN in comparison with an ANN
- Explain the architecture and working principles of CNNs, including convolutional layers, pooling layers, and fully connected layers.
- Explain different CNN seminal architecture (VGG, ResNet, InceptionNet) and analyze their importance.
- Identify, select and fine-tune appropriate pre-trained CNN models for different image analysis tasks.
- Application of CNN in Computer vision

Assignment

- Image classification with pre-trained models: Fine-tune a pre-trained CNN model like VGG or ResNet on a new dataset for a specific classification task.
- Object detection: Use a pre-trained CNN model like YOLO or SSD to detect and localize objects in images or videos.

Week 10
Deploying ML models

After completing this module, students should be able to:

- Build a machine learning pipeline: Create an end-to-end pipeline that includes data ingestion, preprocessing, model training, and deployment in a production environment
- Implement a RESTful API using a web framework and Handle incoming requests and route them appropriately.
- Determine whether the API should be public or private and Implement authentication and authorization mechanisms
- Document API endpoints and functionality Consider rate limiting and other usage control measures
- Select appropriate Deployment Strategies for a given use case: Recreate, Shadow, Canary, Blue/Green

Assignment

- Deploy a Machine Learning model engine with REST API or using streamlit

Syllabus

Week 11
Object Detection and Segmentation

After completing this module, students should be able to:

- Develop a comprehensive understanding of object recognition and localization concepts, including image classification, object detection, and the use of bounding boxes and performance metrics.
- Understand the problem of computer vision addressed by segmentation and differentiate between different types of segmentation techniques such as watershed algorithm, K-means clustering, and mean shift clustering.
- Use object detection architectures such as Faster R-CNN, YOLO (You Only Look Once), and SSD (Single Shot MultiBox Detector) and Segmentation architectures such as U-Net, Mask R-CNN, and DeepLab

Assignment

- Perform Object Detection and Segmentation on Popular dataset

Week 12
Recurrent Neural Networks and Transformers

After completing this module, students should be able to:

- Understand the fundamentals of RNN, including the structure of recurrent units, the computational graph, and backpropagation in RNNs.
- Gain knowledge of seminal architectures such as Long Short-Term Memory Networks (LSTMs) and Gated-Recurrent Units (GRUs).
- Understand the concept of attention in neural networks, including the motivation behind using attention mechanisms to address the limitations of sequence-to-sequence architectures.
- Learn the different types of attention and Explain transformers, and analyze how it surpasses architecture like LSTM and GRU.

Assignment

- Language translation: Build a sequence-to-sequence model using a recurrent neural network or transformer architecture to translate sentences between languages.
- Text generation: Train a recurrent neural network model to generate text, such as writing poetry or generating dialogue.

Syllabus

Week 13
Natural Language Processing

After completing this module, students should be able to:

- Understand the relationship between language and knowledge, delve into morphology and tagging, syntax and parsing, and explore lexical semantics using resources like WordNet.
- Clean, Transform and preprocess text Data
- Describe the TF-IDF model and implement it using sk-learn.
- Describe Naive Bayes Classifier in the context of text classification
- Analyze the problems with using RNN for the long sentences
- State the difference between using RNN and CNN for the same NLP task.

Assignment

- Implementation of POS Tagging from Scratch

Week 14
Language Models & LLMs

After completing this module, students should be able to:

- Explain Markov Models, Markov Assumptions and find out when to use Markov Models
- Discuss n-gram models and apply MLE to estimate n-gram probabilities and discuss generalization issues in n-grams
- Evaluate language models using perplexity
- Understand how neural networks are used in language modeling in contrast to n-gram language modeling
- Appraise the semantic property of word embeddings: analogy reasoning with a classic example of king-man+woman=queen
- Understand Large Language Models & pre-training LLMs
- Understand the current issues and limitations with LLMS: Hallucinations, inconsistency, model drift, size and training time
- Use Prompt Engineering for in context learning at inference time
- Decide on pre-trained model or pre- training and fine-tuning a custom model for specific use cases

Assignment

- Transfer learning of LLM for text Summarization, Open Domain Chatbot etc

Syllabus

Week 15
Deep Unsupervised Learning

After completing this module, students should be able to:

- Classify different types of generative models into a certain taxonomy
- Learn about explicit and implicit density estimation, and Boltzmann Machines (RBM).
- Recall autoencoders and extend their idea and intuitively understand and explain variational autoencoders(VAE), and reparameterization tricks.
- Understand and Train Latent Variable Models
- Understand normalizing flows and implement models with normalizing flows RealNVP NICE Glow

Assignment

- Autoencoders for image denoising: Implement an autoencoder model to denoise images corrupted with noise or artifacts.

Week 16
GANs and Diffusion Model

After completing this module, students should be able to:

- Visualize how mode collapse occurs during the training of GANs
- Explain how a poor and great discriminator behavior affects the training process in GANs
- Interpret why tracking the performance of GANs is difficult.
- Explore Generative Adversarial Networks(GANs), analyze their limitations, and understand different types of GANs (CGAN, WGAN, DCGAN)
- Explore the cutting-edge world of diffusion-based generative AI.
- Gain deep familiarity with the diffusion process and the models driving it

Assignment

- Paper Reading and Implementation of Generative Adversarial Nets
- Create your own diffusion model from scratch.

Syllabus

Week 17
Foundational Models and Generative AI

After completing this module, students should be able to:

- Understand the concept of foundation models and in context learning
- Learn the principles of transfer learning and how pre-trained models can be leveraged as foundation models.
- Adapt and fine-tune foundation models to suit the requirements of specific tasks.
- Identify limitations, potential biases, and ethical considerations associated with using foundation models.

Assignment

- Fine-tune a foundation model for sentiment analysis on a dataset of customer reviews.
- NER: Train a foundation model to identify and classify named entities in a text corpus.
- Fine-tune a foundation model to classify images into different categories.

Week 18
Reinforcement Learning

After completing this module, students should be able to:

- Discuss the Importance of RL and the type of problem to be solved using Reinforcement Learning.
- Understand the k-armed bandit problem, the Markov property, Policy Iteration and Value Iteration for solving MDP
- Solve the Bellman equations for small MRPs to determine the values of state
- Solve the Bellman equations for small MDPs
- Formulate various prediction and control algorithms of monte carlo
- Explain the Q-Learning algorithm
- Explain the Expected Sarsa and It's relationship between Sarsa and Q-Learning

Assignment

- Tic-Tac-Toe Game Agent

Syllabus

Week 19
Reinforcement Learning (continued)

After completing this module, students should be able to:

- Distinguish continuous problems methods from tabular methods, explain various methods such as coarse coding, tile coding.
- Understand the Monte Carlo Methods, Model-free, and how Temporal Difference (TD) combines Monte Carlo (MC) method and Dynamic Programming (DP)
- Understand DQN architecture, Double DQN, Dueling DQN, different policy gradient algorithms along with advantages and pitfalls.
- Understand the working of the Actor-Critic, and the problem with continuous action space, and explain how DDPG solves it.
- Gym ecosystem and RLib

Assignment

- Stock market prediction with Double DQN

Week 20
ML as a Services

After completing this module, students should be able to:

- Understand the concept of ML as a Service
- Use apis to access ML services from different providers - OpenAI, AWS, GCP, Azure.
- Use AWS SageMaker, Google Cloud Machine Learning Engine, and Microsoft Azure Machine Learning.
- Train and deploy ML Models from cloud providers

Assignment

- Developing ML product with Cloud services

Syllabus

Week 19
MLOps

After completing this module, students should be able to:

- Understand ML in production, its operational workflow and its components. Discuss knowing, labeling and validating data.
- Understand feature engineering & preprocessing and discuss their various techniques in detail.
- Discuss filter, wrapper and embedded feature selection methods.
- Understand the fundamental concepts and definitions of Neural Architecture Search (NAS) and auto-ML.
- Monitor model and data for Model Stability and Drift
- Configure Logging, Monitoring and Triggers for deployment

Assignment

- Predicting data drift and model drift

Week 22 - Week 24

Project Work, Project Presentation and Exams

Kickstart your AI career today!

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- Full Scholarship
- Job Placement
- AI Certification

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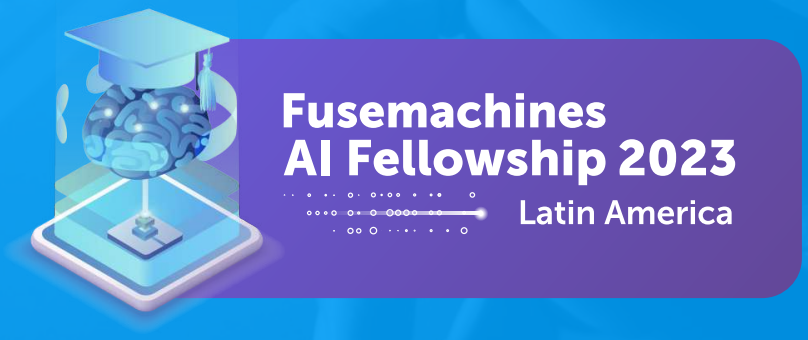

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