



Report



Event: Faculty Development Program
Thrust Area: Artificial Intelligence
Theme: Machine Learning and Big Data
Date: 01 - 05 February 2021



Ramakrishna Mission Vivekananda
Educational and Research Institute

(Declared as deemed-to-be-university by Gol u/s 3 of UGC act 1956)
PO Belur Math, Dist Howrah, West Bengal, 711202

Education is the manifestation of perfection
already in man.

Abstract of the Sessional Talks in the FDP

PYTHON FOR DATA SCIENCE

Dr. Sudeep Mallick

The session starts with a general discussion of the popularity of python for various use cases citing the relevant the open source frameworks, which includes data science and data analytics. It is followed by a discussion on the basic syntax of python language such as data types, data structures, control flow, operators, expressions, functions, modules and exception handling. Next, a detailed discussion is attempted on the packages of python for data science and data analytics such as numpy for numerical computing and pandas for dataframe based data processing and data analysis. The session ends with a discussion on the most popular visualization libraries of python - matplotlib and seaborn.

BIG DATA TECHNOLOGIES

Dr. Sudeep Mallick

Overview of Big Data

The discussion starts with the need for big data computing and its industry definition, use cases and future road map. An overview of various big data frameworks, architectures and use cases is presented next.

Big Data with Hadoop

The session entails a detailed discussion of the distributed computing architecture and programming model made possible by Apache Hadoop and MapReduce. The programming constructs of MapReduce framework is discussed in some detail. It also highlights the use of Hadoop HDFS for distributed storage and importance of Hadoop Streaming for enabling programming with different programming languages.

Big Data with Spark

The session covers the architecture, use cases and programming model of Spark. Different components of Spark such as Spark RDD, DataFrame, SparkQL, Spark ML and MLlib are discussed. It is followed

by a detailed demonstration of the use of the Spark components using python language via the popular PySpark framework.

INTRODUCTION TO MACHINE LEARNING Br. Dripta

Machine Learning (ML) has become ubiquitous in our data rich world! ML based algorithms are playing a major role in our daily lives, e.g. image recognition, fraud detection, recommendation on e-commerce websites, spam filtering, web searches. Introduction to ML will cover some basic concepts that are essential for understanding of the different algorithms. First a short overview of the different types of ML tasks will be given. Then the concepts of the features, training-test datasets, loss functions for some tasks will be introduced. The bias-variance decomposition of the mean-squared loss function will be explained. The variation of bias and variance versus model complexity, and their implications on the generalization of models will be described along with introduction to ideas of under fitting and over fitting and ways to overcome these shortcomings. In this session, the participants will also be introduced to the concepts of K-fold cross validation, simple gradient descent based optimization, regularization.

ML METHODS AND MODELS Br. Dripta

Decision Trees

Decision Tree, a very widely used supervised learning framework because of its simplicity and ease of interpretability, can make predictions using a hierarchy of decision rules derived based on the features and the data. Information and the idea of entropy will be described in the beginning. The different criteria for evaluating the “informativeness” of features, in particular information gain, will be discussed and the method will be explained using an example. A brief introduction will be given to the idea of pruning decision trees. Also, an introduction will be given to the use of decision tree model for regression.

Ensemble Methods

Ensemble methods are powerful algorithms that combine multiple models to obtain improved predictive performance than what the constituent models could achieve by itself. These methods have achieved state-of-the-art results in several tasks. Some of major types of ensemble methods will be discussed in the sessions on Ensemble methods. First the Bagging algorithm will be presented. Then the shortcoming of the Bagging algorithm will be highlighted and the Random Forest method will be introduced. In one of the sessions another type of ensemble learning algorithm will be described where the ensemble model comprises a combination of weak learners that are sequentially added to address the shortcomings of earlier weak learners. This type of approach is known as Boosting. In particular, one very specific type of this model, Adaboost, will be described in detail, and some applications will be shown.

Support Vector Machine (SVM)

SVM is a popular and effective algorithm, primarily used in classification, that tries to learn a decision surface such that the training examples are as far away as possible from it. First the geometrical concepts of the hyperplane, distance of a point from a hyperplane will be discussed along with an introduction to the ideas of the geometric and functional margins. The hard and soft margin SVM models will be discussed and some intuition behind the use of kernels in SVM will be given. Some ideas regarding the extensions of the standard SVM method for classifying multiple classes (>2) will be also be presented.

Gaussian Process

Gaussian Process, a key model in the framework of Bayesian machine learning, can directly learn a distribution of non-linear functions that explains the data, and can make predictions with uncertainty. Such methods offer a principled approach for dealing with uncertainty which is essential for dealing with real-world data originating from environments that are noisy, dynamic and time-sensitive. The need for a probabilistic non-parametric approach for regression will be first presented. Then the intuition behind how the Gaussian process can be thought of as an infinite dimensional generalization of the multivariate Gaussian distribution will be discussed. The role of kernel functions in capturing structures in the data will be highlighted and some ideas and intuition will be given on making an appropriate choice of kernel functions while modelling using Gaussian process. A high-level coverage of the mathematics behind Gaussian process will be given and some real-world applications of the method will be discussed.

INTRODUCTION TO DEEP LEARNING

Br. Dripta

Deep Learning (Artificial Neural Networks) constitutes a family of ML models that are inspired from the biological neural networks. The introduction will deal with some of the ideas that are fundamental to development and understanding of complex models that have brought about breakthroughs in processing images, audio, video and text data. The simplest single layer neural network model and its shortcoming will be discussed. Then it will be shown how the consideration of a hidden layer enables a neural network model to achieve non-linear decision boundaries in classification. A simple regression model will also be discussed. An overview of the backpropagation algorithm, activation functions, and optimization algorithms for deep learning will also be given.

DATA PRE-PROCESSING IN R

Dr. Sudipta Das

R software is widely used in the field of machine learning and AI. In this course, we have discussed R software package starting from its installation. We have discussed preliminary arithmetic and logical operations on numbers, characters and matrices. We have also discussed various kinds of data structures uses in R, including data frame and list. Some basic commands used to plot data in R-software are also mentioned.

REGRESSION TECHNIQUES

Dr. Sudipta Das

Linear Regression

Linear regression is a statistical approach used to describe the simultaneous associations of one or several variables with one continuous outcome. In this talk, we take a business advertisement data and describe how to fit a regression model considering sales as the outcome variable and advertisement expenditures as the predictors. In addition to the regression model fit, we also discuss other important aspects of this approach including estimation and inference, variable selection in model building, and assessing model fit. We demonstrate the method of linear regression model building in R.

Logistic Regression

Logistic regression is a classification technique. It is used to explain the relationship between one dependent binary (categorical) variable and one or more nominal, ordinal, interval or ratio-level independent variables. In this lecture, we take a banking data and discussed how one can apply logistic regression

technique to classify a potential bank customer in one of the two categories, defaulter and non-defaulter based on the customer profile which includes income, credit card balance and student status. In the course, we also discuss other important aspects of logistic regression including estimation and inference, variable selection in model building, and assessing model fit. We demonstrate the method of logistic regression model building in R.

DEEP LEARNING TECHNIQUES

Br. Tamal

Convolutional Neural Networks: *a network that can 'see' patterns*

This early deep learning algorithm was mostly used on images or any data that can be represented as a matrix. These models have applications in a wide range of domains including image classification, object recognition, image segmentation, medical image analysis, and annotation. There are other domains where CNN performed equally well such as natural language processing, predicting the best move in gameplay data, music genre classification. In this session, various components that constitute a CNN and how these CNNs can be trained were shown. Starting with LeNet, a simple neural network, we will cover later models like AlexNet, VGGNet, Inception models, and their variants. A Keras implementation of the same was demonstrated and described.

Deep Learning in Computer Vision: *Another tale of synergy*

Deep learning methods, especially CNN have been used extensively in Computer Vision which has changed completely how computer vision used to be even a decade back. Deep learning not only has excelled the performance of traditional computer vision tasks but also has brought new applications of computer vision techniques, for example, face and gesture recognition and vision for autonomous vehicles. Various computer vision techniques were introduced and then shown how these techniques have either evolved or got incorporated into the deep learning algorithm itself. The other topics that were covered included object detection and segmentation.

Various object detection algorithm (e.g. R-FCN, Faster R-CNN, YOLO, and SSD) and semantic segmentation algorithms (e.g. U-Net, Mask RCNN, and DeepLab) were discussed in this session.

Recurrent Neural Network (RNN): *a network that can 'remember'*

Whereas CNNs are used on Spatial data, RNN, another generalization of the neural network, has become popular for its effectiveness on sequential or temporal data. Various RNN algorithms and their application were discussed. How this Vanial RNN can be trained and their drawbacks were elaborated and then long short-term memory (LSTM) algorithm was introduced in detail. How CNN and RNN can be used together for image captioning was also discussed and later demonstrated using Keras on the Flicker8K dataset.

Generative Adversarial Network (GAN): *a network that can innovate*

Generative Adversarial Networks are the latest deep learning sensation designed by Ian Goodfellow and his colleagues in 2014. In GANs, two neural networks contest with each other in a zero-sum game. GANs are 'creative' in nature as they can generate new data from a given training set. In this session, various components of GAN was discussed along with their applications.



Resource Persons, Schedule

Sessional Speakers



Dr. Sudipta
Das

Education

- PhD in Engineering, Indian Institute of Science
- BE Electrical Engineering, Jadavpur University
- ME Electrical Engineering, Jadavpur University

Experience

- Assistant Professor, RKMVERI, Belur
- Postdoctoral Fellow in the Applied Statistics Unit, Indian Statistical Institute, Kolkata

Research Interests

- reliability, survival analysis, multivariate analysis, probabilistic modeling



Dr.
Debapriyo
Majumdar

Assistant professor at the Indian Statistical Institute, Kolkata. The areas of his academic interest are search, data mining, natural language processing and deep learning. Prior to joining ISI, he obtained his doctoral degree from the Max-Planck-Institute for Informatics in Germany and then worked for IBM research in Bangalore for a few years. Outside work, he interests are in photography, drawing and driving.



Dr. Sudeep
Mallick

Education

- Fellow of IIM Bangalore
- BTech (Hons) in Electrical Engineering, IIT-BHU, Varanasi

Experience

- Architect, Infosys, Bangalore
- Author of Book on Enterprise Architecture, John Wiley, India
- Seven granted patents at the USPTO.
- IBM certified SOA Associate and SOA solution Designer.
- Sun certified Programmer for Java, TOGAF 8 Certified Architect
- SAS certified in Predictive Modeling using Enterprise Miner.
- Ten each teaching experience in teaching at various academic institutions such XIMB, IIT-KGP, BIMTECH Bhubaneswar



Br. Dripta

Education

- BTech Ocean Engg from IIT Kharagpur in 2012
- PhD, School of Mathematical Sciences in University College Dublin.

Experience

- Visiting researcher at Ecole Normale Supérieure Cachan (now ENS Paris-Saclay)
- Postdoctoral researcher at the Department of Engineering Science in University of Oxford for around 2 years.
- Currently Assistant Professor in RKMVERI, Belur, WB

Research interests

- Mathematical modeling and Machine learning.



Br. Tamal

Education

- BTech Computer Science from NIT Silchar
- PhD Computer Science, University of Buffalo, NY, USA


Experience

- Assistant Professor, University of Rochester, NY, USA (2016-18)
- Currently Assistant Professor in RKMVERI, Belur, WB

Research interests

- Artificial Intelligence, Decision Theory, Computer Vision, and Algorithms.
- Broader interests in Machine Learning, and Deep Learning.

Invited Speakers

	<p>Dr. Bimal Roy Padma Shree Awardee Head of R C Bose Centre for Cryptology and Security, Indian Statistical Institute, Kolkata</p>
	<p>Dr Tinku Acharya Fellow IEEE Founder & Managing Director, Videonetics Technology Pvt Ltd.</p>
	<p>Dr Pralay Mitra Associate Head, Centre for Computational and Data Sciences at the IIT Kharagpur Associate Professor of the Department of Computer Science and Engineering, IITKharagpur</p>
	<p>Dr Sriparna Saha Senior member of IEEE Associate Professor in the Department of Computer Science and Engineering IIT Patna</p>
	<p>Dr Zhaozheng Yin SUNY Empire Innovation Associate Professor in the AI Institute Department of Biomedical Informatics, and Department of Computer Science, at Stony Brook University</p>
	<p>Dr. Sumit Misra Associate Vice President RS Software (India) Ltd.</p>
	<p>Swami Samarpanananda Writer, Orator RKMVERI, Belur</p>

The FDP started with the holy chant of the universal prayer *sahanavavatu...* by Swami Dhyaganagamyanaanda, the HoD computer science. He briefly narrated the main thrust areas in which Ramakrishna Mission, the parent organization of RKMVERI, rendered selfless service to the society at large, and that RKMVERI is the first initiative of the Mission in setting up an university of the deemed-to-be-kind. He welcomed Dr. Bimal Roy who is a Padma Shree awardee to render the inaugural address.

Schedule

Date: 1 February'21

Speaker	Affiliation	Talk	Time
Dhyanyagamyanda	RKMVERI	Introduction	9:30-9:40am
Dr. Bimal Roy	ISI Kolkata	Inaugural Talk	9:40-10:00am
Dr. Tinku Acharya	Videonetics	AI for Bharat	10-11am
Dr. Sudipta Das	RKMVERI	Data pre-processing using R	11am-1pm
Dr. Sudeep Mallick	RKMVERI	Data pre-processing using Python	2-3pm / 4-5pm
Samarpanananda	RKMVERI	Life and Philosophy of life	3-4pm

Date: 2 February'21

Speaker	Affiliation	Talk	Time
Br. Dripta	RKMVERI	ML: Concepts; Demystifying ML	10-11 am
Dr. Sudipta Das	RKMVERI	ML Concepts: Simple Linear Regression	11-12 noon / 2-3pm
Dr. Pralay Mitra	IIT KGP	Applications of ML in Bio-informatics	12-1pm
Dr. Sudipta Das	RKMVERI	ML Concepts: Logistic Regression	3-4pm / 4-5 pm

Date: 3 February'21

Speaker	Affiliation	Talk	Time
Br. Dripta	RKMVERI	Decision Tree	10-11 am
Br. Dripta	RKMVERI	Ensemble Learning: Bagging, Boosting	11-12 noon
Br. Dripta	RKMVERI	Ensemble Learning: Random forest	12-1 pm
Br. Dripta	RKMVERI	Support Vector Machine	2-3pm
Dr. Sriparna Saha	IIT Patna	Summarization Systems	3-4pm
Br. Dripta	RKMVERI	Gaussian Process	4-5pm

Date: 4 February'21

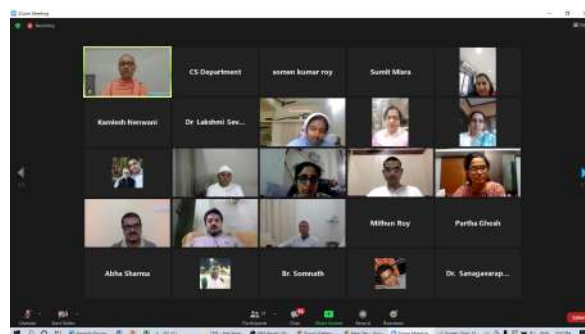
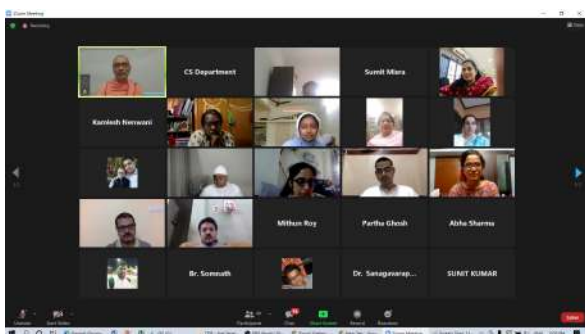
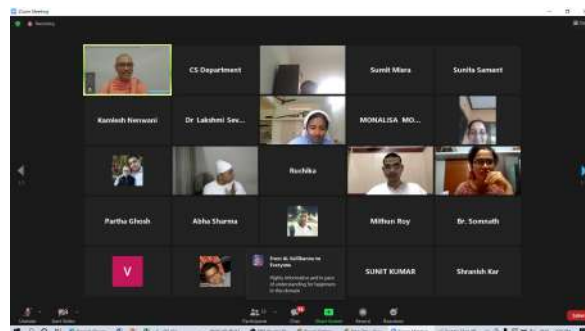
Speaker	Affiliation	Talk	Time
Dr. Debapriyo Majumdar	ISI Kolkata	Dimension Reduction	10-11 am
Dr. Debapriyo Majumdar	ISI Kolkata	Clustering	11-12 noon
Br. Dripta	RKMVERI	Introduction to Deep Learning: Multi layer perceptron, classification, back propagation, activation functions	12-1 pm
Br. Tamal	RKMVERI	Introduction to Deep Learning: CNN	2-3 pm
Br. Tamal	RKMVERI	Deep Learning in Computer Vision	3-4 pm
Dr. Zhaozheng Yin	Stony Brook	USA Microscopy Image Analysis to Aid Biological Discovery: Optics, Algorithms and Community	7-8pm

Date: 5 February'21

Speaker	Affiliation	Talk	Time
Br. Tamal	RKMVERI	Introduction to Deep Learning: RNN	10-11 am
Br. Tamal	RKMVERI	Introduction to Deep Learning: GAN	11-12 noon
Dr. Sudeep Mallick	RKMVERI	Overview of Big Data Technologies	12-1pm
Dr. Sudeep Mallick	RKMVERI	Data Processing Using Big Data Technologies: Map Reduce with Hadoop	2-3 pm
Dr. Sudeep Mallick	RKMVERI	Data Processing Using Big Data: PySpark	3-4 pm
Dr. Sumit Misra	RS s/w	Fraud and Risk Management System	4-5pm
VALEDICTORY			5-5:15pm

Online Participants

A few screenshots of the participants during the valedictory session.

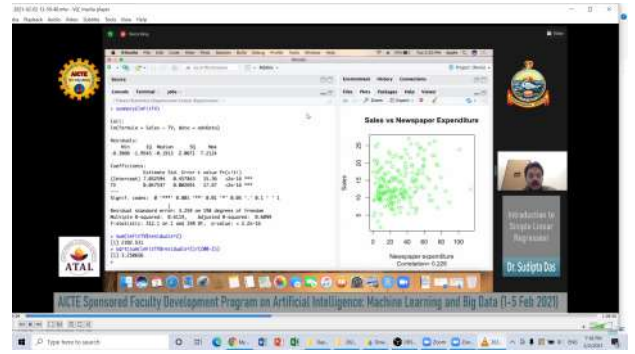


Screenshots of Sessional Talks

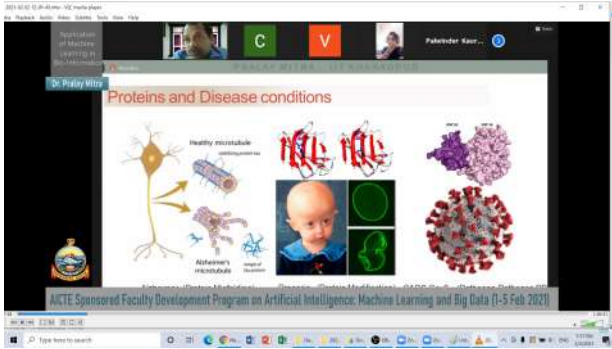
A brief tour of this 5-day FDP is shown in the following pictures.



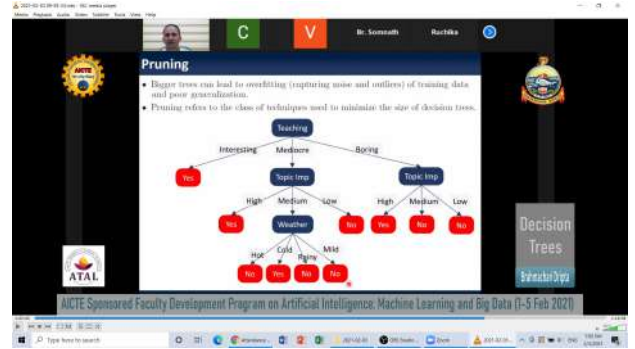
(i) Intro. to ML



(ii) Linear Regression



(iii) ML in Bioinformatics



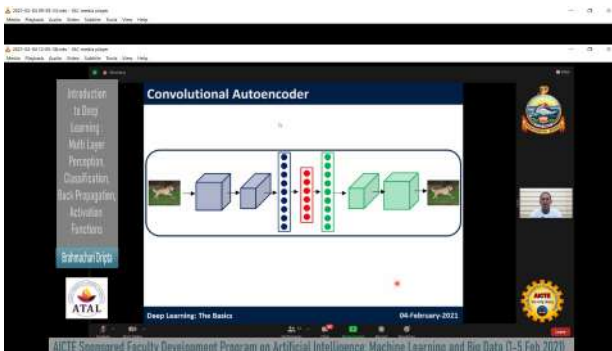
(iv) Decision Trees



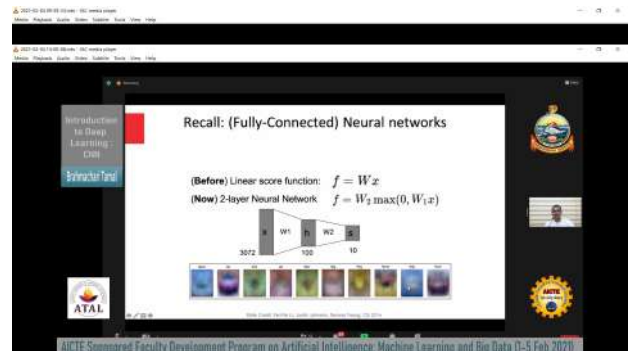
(v) Gaussian Process



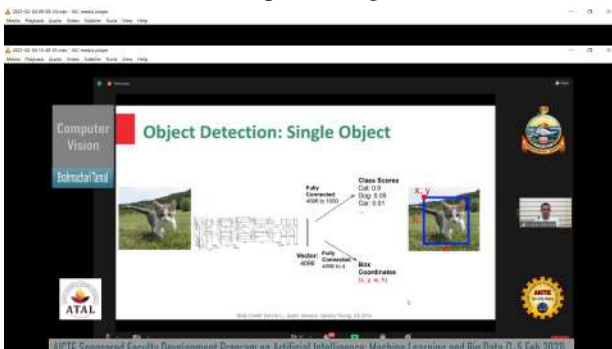
(vi) Summarization Systems



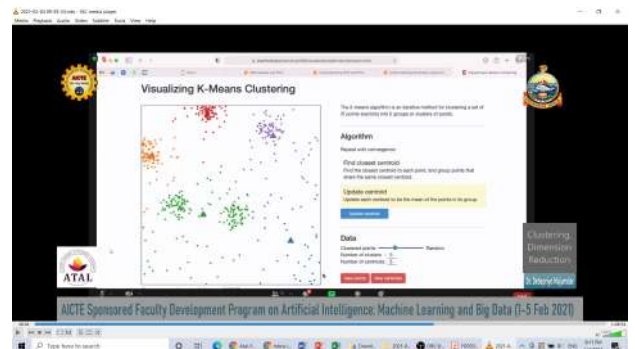
(vii) Deep Learning



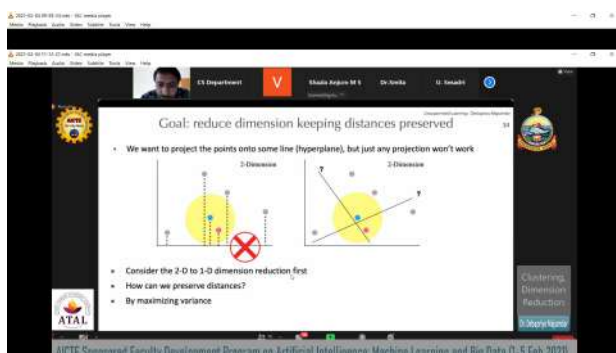
(viii) DL: CNN



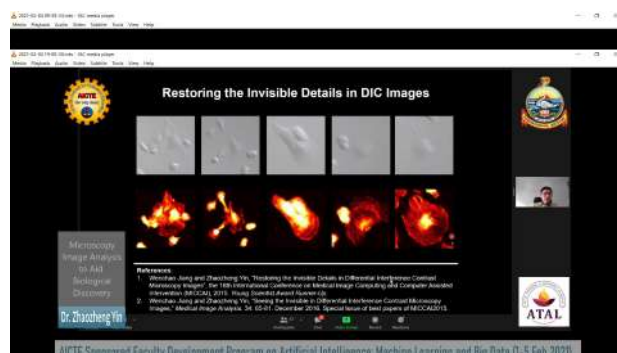
(ix) DL in Computer vision



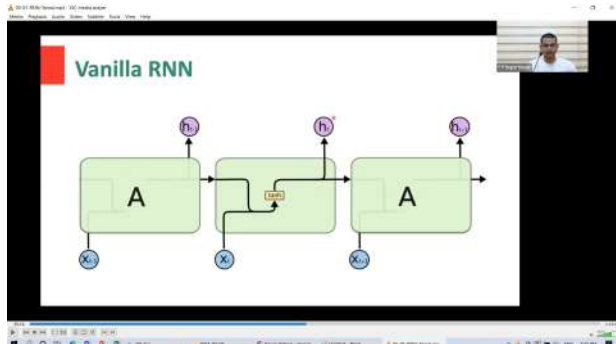
(x) Clustering



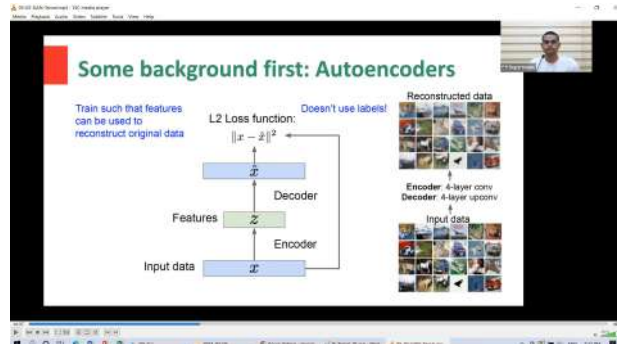
(i) Dimension Reduction



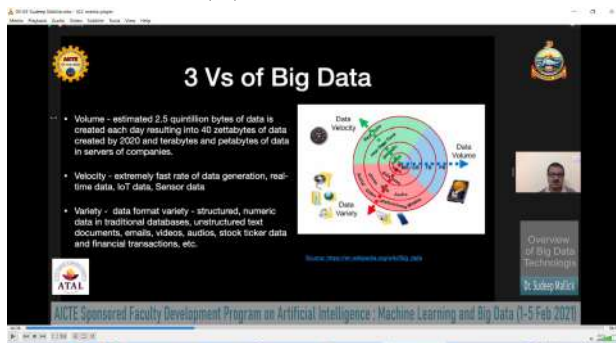
(ii) Biomedical image analysis



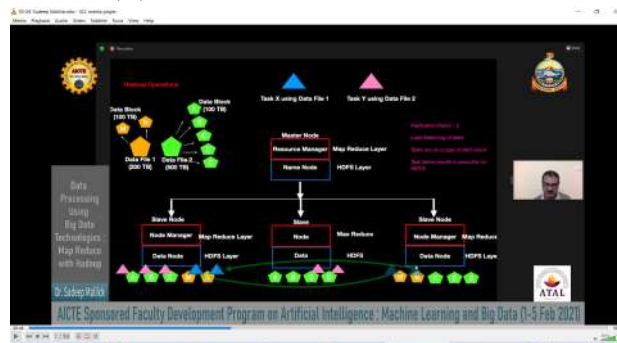
(iii) DL: RNN



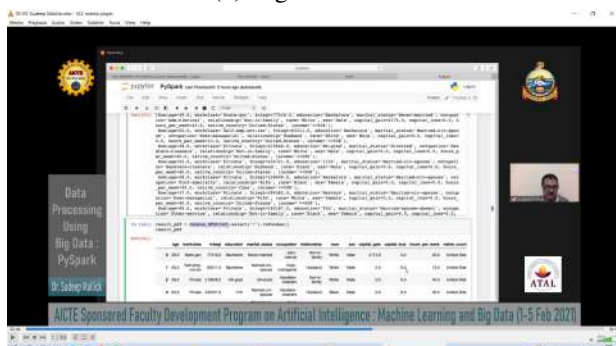
(iv) Generative Adversarial N/w



(v) Big Data



(vi) Big Data Tech: Hadoop



(vii) Big Data Tech: PySpark



(viii) Fraud and Risk Mgmt

Feedback during Valedictory

Dr. Laskshmi Sevukamoorthy

It was very profound for me for these five days, so enlightened [by] this ML technique, each session was so vivid, explanatory and covered so much of topics that I never expected. thank you so much, and thank you for all renowned the speakers. It was one of the best FDP I have attended. I have attended nearly 20 ATAL FDPs, but I think this is the best. I would like to say one word about this FDP and that is "Immense", So please let us know your future FDPs, thank you.

Monalisa Mohanty

we are very much inspired by the speaker Br. Dripta Sir. the way he spoke and the way he explained was very nice, so overall it was a very nice experience. Thank you so much sir.

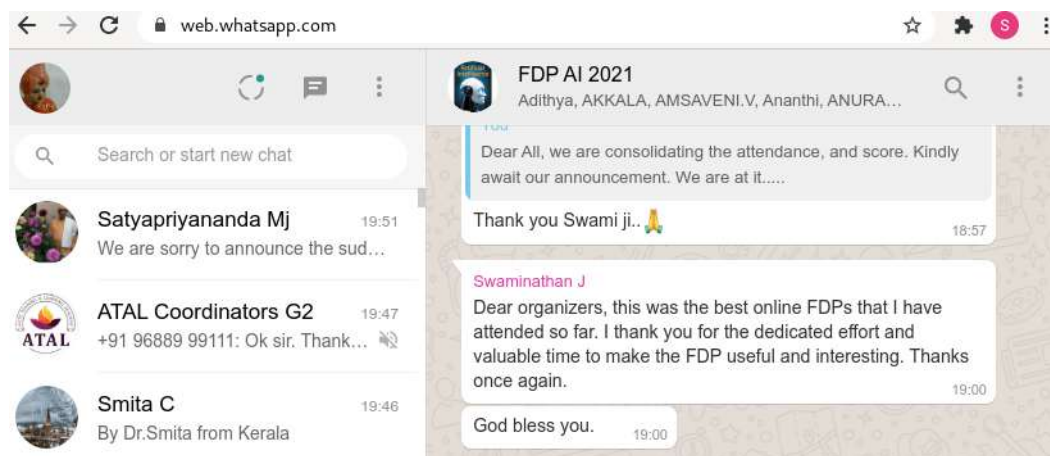
Somen Kumar Roy

First of all it was wonderful FDP from your side. All of the experts are very good in their field, all the sessions are excellent and very impressive and very good, in the field of machine learning as well as deep learning, I enjoyed and thank you once again.

Ruchika

It was really a nice session, myself Ruchika from Delhi. The experts were too good in their subjects, we get to learn number of things. We expect a wonderful FDP again from your side, because I have attended other ATAL FDPs, but this was really the best for me. And moreover you were so punctual, that was very impressive, very very impressive...This is an FDP which at least I am going review again,

A snapshot from the WhatsApp group messages,



Thanks Giving

Among several eloquent and appreciative feedback we received during the 5-days' sessions, it is worthwhile to note the following one.

Sir, I am Leena Thomas from Kerala, This FDP was very wonderful. The thing is that while reading the book we have no way to get clarifications even if the doubts are a small one. However, even for such small doubts we got a chance to clear from the experts of this FDP,. It was only because this FDP was held online I was able to attend the FDP from your institution, as because being in Kerala I have no chance to come to kolkata. I think this online FDP is a blessing for me to attend these sessions, and also looking forward to more FDPs from your institutions.

The stress on the above feedback is clearly on the interactive online process. This is how every learner must be feeling because of the holy initiative of AICTE in forming the ATAL academy and promoting FDPs through online mode.

Also, during this online initiative of AICTE it is probably the first time a higher education institution like RKMVERI who are not under the ambit of AICTE are given the chance to take part in hosting FDPs, because of A++ accreditation by NAAC. We sincerely thank AICTE to have expanded a bit of their front including RKMVERI in their fold and enabling us to host online FDP sessions.

Coordinator

Swami Dhyaganamyananda

Associate Professor and Head

Department of Computer Science

Ramakrishna Mission Vivekananda Educational and Research Institute

PO Belur Math, Dist Howrah, 711202, West Bengal

List of confirmed participants for the FDP on AI held between 1-5 February

SNo	Name	Email	Phone	Designation	Specialisation	Institute
1	Abha SHARMA	abha_sharma31@yahoo.com	9893948272	Assistant Professor	Data Mining	Maulana Azad National Institute of Technology
2	Adithya	adithyash05@gmail.com	9591724635	Student	AI	TUB
3	Ajay Mali	maliyajay602@gmail.com	9636632400	Lecture	Computer science	Rnt pg college kapasan
4	Ajit Janardan Rangdal	ajitrangdal@gmail.com	9270307002	Assistant Professor	Library Automation	Shri Havagiswami Mahavidyalay, Udgir
5	Akkala Sivaram Prasad	sivaramprasad_a@pace.ac.in	9642463105	Assistant Professor	Mathematics	PACE Institute of Technology and Sciences
6	AL.Vallikannu	vallikannu@hindustanuniv.ac.in	9789668280	Associate Professor	Mobile Adhoc Networking and IoT	HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE
7	AMSAVENI.V	amsaveni@niuniv.com	9894252632	Associate Professor	AI, Image Processing,Fuzzy Logic	Noorul Islam Centre for Higher Education, Kumaracoil
8	ANANTHI V P	ananthi.gasc89@gmail.com	9568455680	Assistant Professor	FUZZY SET THEORY AND APPLICATIONS	GOBI ARTS & SCIENCE COLLEGE
9	Anit Kumar Ghosal	anit.ghosal@gmail.com	9038499213	Assistant Professor	Computer Sc	Ramkrishna Mahato Govt Eng College
10	ANURADHA N	jshreeanu@gmail.com	9789889498	Assistant Professor	Computer Science	Subbalakshmi Lakshmiathy College of Science
11	Anushree Bhattacharjee	anushreemtech@gmail.com	6290077211	STATISTICAL ENGINEER	STATISTICS	Apollonius Computational Business Solutions OPC Pvt. Ltd
12	archana tomar	archna.tomar@itmgoi.in	9755285163	Assistant Professor	DBMS	ITM gwaior
13	Arjan Singh	arjunsinghcse@gmail.com	9057221823	Assistant Professor	Computer Science	Suresh Gyan Vihar University Jaipur
14	ARJUN MUKHERJEE	diwaker120@gmail.com	9455360967	Assistant Professor	Computer Science and Engineering	Saraswati Higher Education and Technology College of Engineering and Management,Varanasi
15	AVINASH GUPTA	avinashg.mnnit@gmail.com	9889017937	Professor	Computer Science	Babu Banarasi Das Institute of Technology & Management
16	Ayonija Pathre	ayo.pathre@gmail.com	9340683488	Assistant Professor	Cse	RNTU
17	Battula Siva Kondaiah	sivakondaiah@gmail.com	9676674858	Assistant Professor	COMPUTER SCIENCE	TELLAKULA JALAYYA POLISETTY SOMASUNDARAM COLLEGE
18	Bhagyalaxmi Behera	bhagyalaxmibehera@soa.ac.in	9861045701	Assistant Professor	Optical Communication System	Institute of Technical education and Research
19	Br. Somnath	br.somnath.rkm@gmail.com	7980320150	Research Scholar	Biophysics	Ramakrishna Mission Vivekananda Educational and Research Institute
20	C Nalini	nalinichiti@gmail.com	9052347019	Associate Professor	Computer Science	SPW Polytechnic College
21	Chandrani Borah	chandraniborah123@gmail.com	8876733307	Assistant Professor	Computer networking, graphics, digital system	Jorhat engineering college
22	chennuru R purushotham	purushothamchennuru@gmail.com	8309503662	Assistant Professor	computer science and engineering	madanapalle institute of technology and science
23	Cherukuri Krishnaveni	veninagesh9@gmail.com	9912892942	Assistant Professor	MTech	VIGNAN DEGREE AND PG COLLEGE
24	D M Abhinay Kanth	abhinaykanth@gmail.com	9966371416	Assistant Professor	CSE	MADANAPALLE INSTITUTE OF TECHNOLOGY AND SCIENCE, MADANAPALLE
25	DARURI VENUGOPAL	principalsig@gmail.com	7702051911	Professor	MATHEMATICS	OPJS UNIVERSITY
26	Deepamala N	deepamalan@rvce.edu.in	9742002251	Associate Professor	Networking and NLP	RVCE
27	Devika G	sgdevika@gmail.com	9844045568	Assistant Professor	Computer science &Engineering	Government engineering college KRPET
28	Dheeraj Joshi	dheeraj@biet.ac.in	9030139404	Assistant Professor	Mechanical Engineering	Bharat Institute of Engineering and Technology
29	Dinesh Kumar	sahni.dinesh@live.com	9816538973	Assistant Professor	CSE	Vaageswari College of Engineering
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