PSG INSTITUTE OF TECHNOLOGY AND APPLIED RESEARCH

NEELAMBUR COIMBATORE - 641042

Department of Computer Science and Engineering

Report for Five Days Faculty Development Program on

AI APPLICATIONS AND PRACTICAL INSIGHTS

Event Type: FDP

Event Title: AI Applications and Practical Insights

Date: 25.11.2024 - 29.11.224

Venue: CSE Seminar hall (E2 - 304)

Resource Persons:

1. Mr Venkatapathy Subramanian, Director Anaadi AI Center, Palani.
2. Dr B Gomathy, Professor/CSE, PSG iTech
3. Dr S Vaishnavi, AP/CSE, PSG iTech
4. Dr.V.Mahendran, an Assistant Professor CSE,at the Indian Institute of Technology, Tirupati.
5. Mr. Vivek Suresh, a Data Science Advisor from Enterprise Building Training Solutions Kochi.
6. Dr. U. Srinivasalu Reddy, a distinguished professor from NIT Trichy.
7. Dr PreethRaguraman, an Assistant Professor ,CSE at the Indian Institute of Information Technology Design and Manufacturing (IIITDM), Kancheepuram, Chennai.
8. Mr. SelvaVignesh, a Product Strategist, Coimbatore.
9. Mr. Jai Ganesh Suresh, senior AI Architect, Ericsson Chennai.

Coordinators:

1. Dr. B Gomathy, Professor/CSE
2. Dr. A. SunithaNandhini, AP (Sl. Gr.) CSE

The FDP was conducted for 5 days from 25.11.2024 to 19.12.2023. The FDP started with the welcome address by Dr R Manimegalai Professor & HoD/CSE. She welcomed the gathering and stated the significance of the PSGiTech and PSG CARE. She shared the importance of AI Applications in real life and practical insights which motivated to conduct to such FDPs. Dr. A. SunithaNandhini, AP (Sl. Gr.) CSE

introduced the resource person. Mr Venkatapathy Subramanian, Director - Anaadi AI Center delivered the Inaugural address. Totally 60 faculty members attended the FDP from various colleges.

Day 1: 25.11.2024

The sessions were handled by Mr Venkatapathy Subramanian, Director Anaadi AI CenterPalani.
He shared the key concepts of Field of AI in Ayurveda , Introduction to ML, DL & LLM and Dr.B.Gomathy (Sr,GR) CSE PSGiTech, she explained about Evolution of AI, ML Algorithms and Useful AI tools and Dr.S.Vaishnavi, Asst. Professor (Sr. Gr) shared the key concepts of Data Science and Data processing, ML types, evaluation metrics and classifications.

- Machine Learning and its types
- Artificial Neural Networks
- Large Language Models
- Natural Language Processing
- Data Science and its process
- AI tools for various applications.

Machine Learning (ML)has three main types:

1. **Supervised Learning**: Learns from labelled data to predict outcomes (e.g., classification, regression).
2. **Unsupervised Learning**: Finds patterns in unlabelled data (e.g., clustering, dimensionality reduction).
3. **Reinforcement Learning**: Learns by interacting with an environment to maximize rewards over time (e.g., game playing, robotics).

ML &Deep Learning (DL) are subfields of artificial intelligence, where ML focuses on algorithms to learn patterns from data, and DL leverages neural networks for complex tasks like image recognition. **Artificial Neural Networks (ANN)** mimic the human brain's structure to solve problems, **Large Language Models (LMM)** are advanced ANNs for understanding/generating human language, and **Natural Language Processing (NLP)** deals with the interaction between computers and human languages. Real Time examples and AI tools were discussed finally for real time applications.

Day 2: 26.11.2024

The forenoon sessions were handled by Dr.V.Mahendran, an Assistant Professor in the department of Computer Science and Engineering, at the Indian Institute of Technology, Tirupati. The afternoon sessions were handled by Mr Vivek Suresh Co-founder and CEO,Ylogx Private Ltd, Kochi.He took a hands-on session on NLP. They both covered the following topics:

Natural Language Processing (NLP):

Definition: Enables computers to process, understand, and communicate with human language. Challenge: Language is creative and complex, making it hard for computers to interpret nuance, context, and meaning. **NLP Tasks:**

1. **Information Retrieval**: Searching documents based on keywords.
2. **Information Extraction**: Extracting specific entities or data (e.g., names, dates) from documents.
3. **Language Generation**: Generating coherent text based on input (e.g., describing an image).
4. **Text Clustering**: Grouping documents into similar categories without predefined labels.
5. **Text Classification**: Assigning predefined categories to documents (e.g., spam vs. non-spam emails).
6. **Machine Translation**: Translating text from one language to another (e.g., English to French).
7. **Grammar Checkers**: Identifying and correcting grammatical errors.

Types of Models in NLP

1. **Sequential Models**: Focused on analyzing or generating sequences of text or data.
2. **Language Models**: Predict the probability of words or sentences, used for generative AI tasks.

Language Models: Assign probabilities to the next word or sentence in a sequence. A**pplications**: Generative AI (e.g., text completion, corrections).**Examples**: **N-gram Model**: Represents sequences of *n* words using probabilities. **Data Structure**: A probability table with rows (previous words) and columns

(next word). **Bag of Words Model**: Represents text as a collection of word occurrences without regard to order, useful for classification tasks like sentiment analysis.

Learning Methods for NLP Models

- **Supervised Machine Learning**: Trains models using labelled data (e.g., text with predefined sentiments).
- **Types of Classification Models**:
    1. **Generative Classifiers**: Model how each class generates input data and predicts the most likely class. Example: **Naive Bayes Classifier**.
    2. **Discriminative Classifiers**: Focus on learning the boundary between classes by extracting features from input data. Example: **Logistic Regression**.

Key Techniques in NLP:

1. **Tokenization**: Breaking text into smaller units (tokens) like words or characters.
2. **Stop Word Removal**: Eliminating common words (e.g., "the", "is") that don't carry much meaning.
3. **Stemming & Lemmatization**: Reducing words to their root forms (e.g., "running" → "run" for stemming, "better" → "good" for lemmatization).
4. **Part-of-Speech (POS) Tagging**: Assigning grammatical labels (e.g., noun, verb) to words.
5. **Named Entity Recognition (NER)**: Identifying entities like names, organizations, and locations in text.
6. 

7. 

Word Embeddings:

Word embeddings represent words as high-dimensional vectors, capturing semantic and syntactic relationships, unlike TF-IDF, which focuses on word frequency. Techniques like Word2Vec (CBOW and Skip-Gram) are used to create these embeddings. **Code Example Highlights:**

- Tokenization splits text into words.
- Stop word removal filters out irrelevant words.
- Stemming and lemmatization reduce words to their base forms.
- POS tagging identifies word categories, and chunking identifies meaningful units like noun phrases.

Various algorithms like BoW, TF-IDF, and BM25 help in analyzing and retrieving information from text data.

NLP Applications:

- **Text Classification**: Sentiment analysis, spam detection, language detection, etc. ● **Entity Extraction**: Named and custom entity extraction.

- **Information Retrieval**: Search, information extraction, and question answering. ● **Advanced Tasks**: Language conversion, speech-to-text, text summarization, etc.

Day 3: 27.11.2024

The third day of the Faculty Development Program featured an enlightening forenoon session conducted by **Dr. U. Srinivasalu Reddy**, a distinguished professor from **NIT Trichy**. The session delved into the expansive domains of **Data Science** and **Artificial Intelligence (AI)**, covering the following topics.

1. **Data Science Techniques:**
    - **Linear and Multiple Regression:** Explained their significance in predictive modelling. Evolution of AI: Traced its development through various milestones.
2. **Artificial Intelligence Overview:Core Applications of AI - Prediction**, Classification, and Clustering. **Expert Systems** and **Intelligent Systems**.
    - **Artificial Neural Networks (ANN):** Highlighted **backpropagation** and the evolution into **Deep Neural Networks (DNN)**. oOptimization Algorithms:
        - **Genetic Algorithms (GA)**, **Particle Swarm Optimization (PSO)**, **Ant Colony Optimization (ACO)**.
        - Discussed **Computational Intelligence (CI)** and **Swarm Intelligence**
3. **AI Applications in Real-Life:**
    - Comparing AI with human senses: **Computer Vision** (eyes), **E-Nose** (smell), **Speakers** (sound), and **Smart Home Applications** (touch). Ex : Smart Home
4. **Data Analysis Frameworks:**
    - **Descriptive Analysis:** Metrics like **AUC (Area Under Curve)** for performance evaluation.
    - **Predictive Analysis:** AI's role in forecasting trends.
    - **Prescriptive Analysis:** Data-driven decision-making and recommendations.

The third day of the Faculty Development Program featured an insightful and interactive afternoon session conducted by **Mr. Vivek Suresh**, a Data Science Advisor from Enterprise Building Training Solutions, Kochi. The session focused on the dynamic and rapidly evolving field of **Computer Vision**, blending theoretical concepts with practical demonstrations to provide a comprehensive learning experience.


GPS Map Camera
Neelambur, Tamil Nadu, India
Highway, Avinashi Rd, Coimbatore, Neelambur, Tamil Nadu 641062, India
Lat 11.064947°
Long 77.093253°
27/11/24 09:52 AM GMT +05:30
Google

Highlights of the Session:

Image Processing:

- Discussed foundational techniques for improving image quality and usability.
- Covered methods like **resizing** images to fit processing requirements and **filtering** to enhance specific features or reduce noise.

Feature Extraction:

- Explained the importance of identifying distinct patterns and attributes in images, which are crucial for applications such as facial recognition and scene understanding.
- Demonstrated techniques to extract meaningful features that enable machine learning models to interpret visual data.

Object Detection:

- Provided an overview of methods to detect and localize objects within an image or video.
- Highlighted applications in fields like surveillance, autonomous vehicles, and retail. **Image Segmentation:**
- Explored the process of dividing an image into multiple meaningful regions for more detailed analysis.
- Showed how segmentation is used in medical imaging, satellite image processing, and computer-aided design.

Affine Transformation:

- Introduced concepts of geometric transformations like rotation, scaling, translation, and shearing.
- Discussed how these transformations ensure image alignment and consistency across various applications.

OpenCV (Open-Source Computer Vision Library):

- Presented the capabilities of OpenCV for handling and processing images effectively.
- Walked participants through examples of using OpenCV for visualization, manipulation, and analysis of image data.

Practical Approach: The session emphasized hands-on learning, with participants exploring real-world applications of computer vision techniques. Activities included working on image datasets to apply processing, segmentation, and object detection algorithms.

Day 4: 28.11.2024

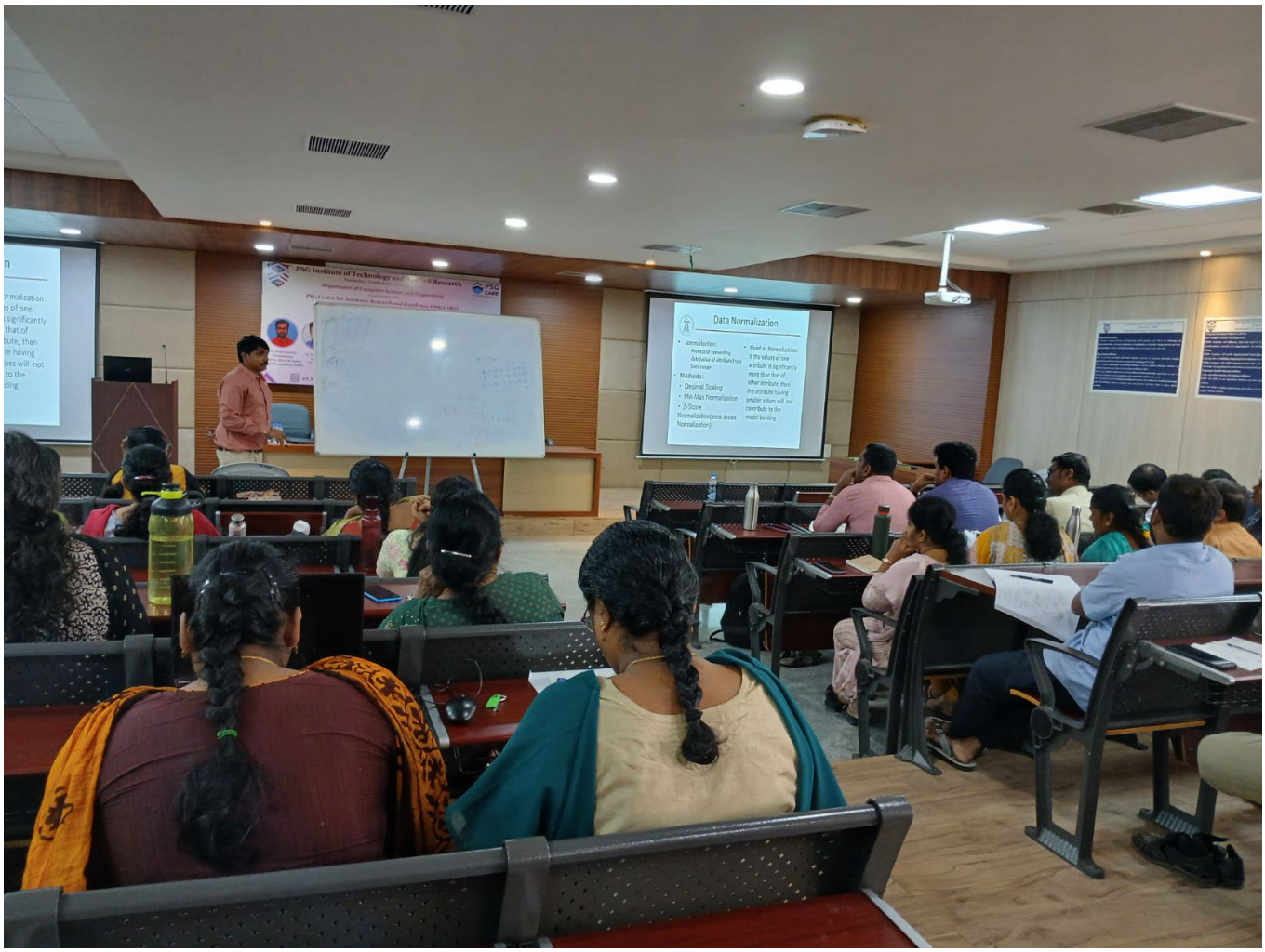
The forenoon session of the fourth day Faculty Development Program was handled by **Dr Preeth Raguraman**, an Assistant Professor in the Department of Computer Science and Engineering at the esteemed Indian Institute of Information Technology Design and Manufacturing (IIITDM), Kancheepuram, Chennai.

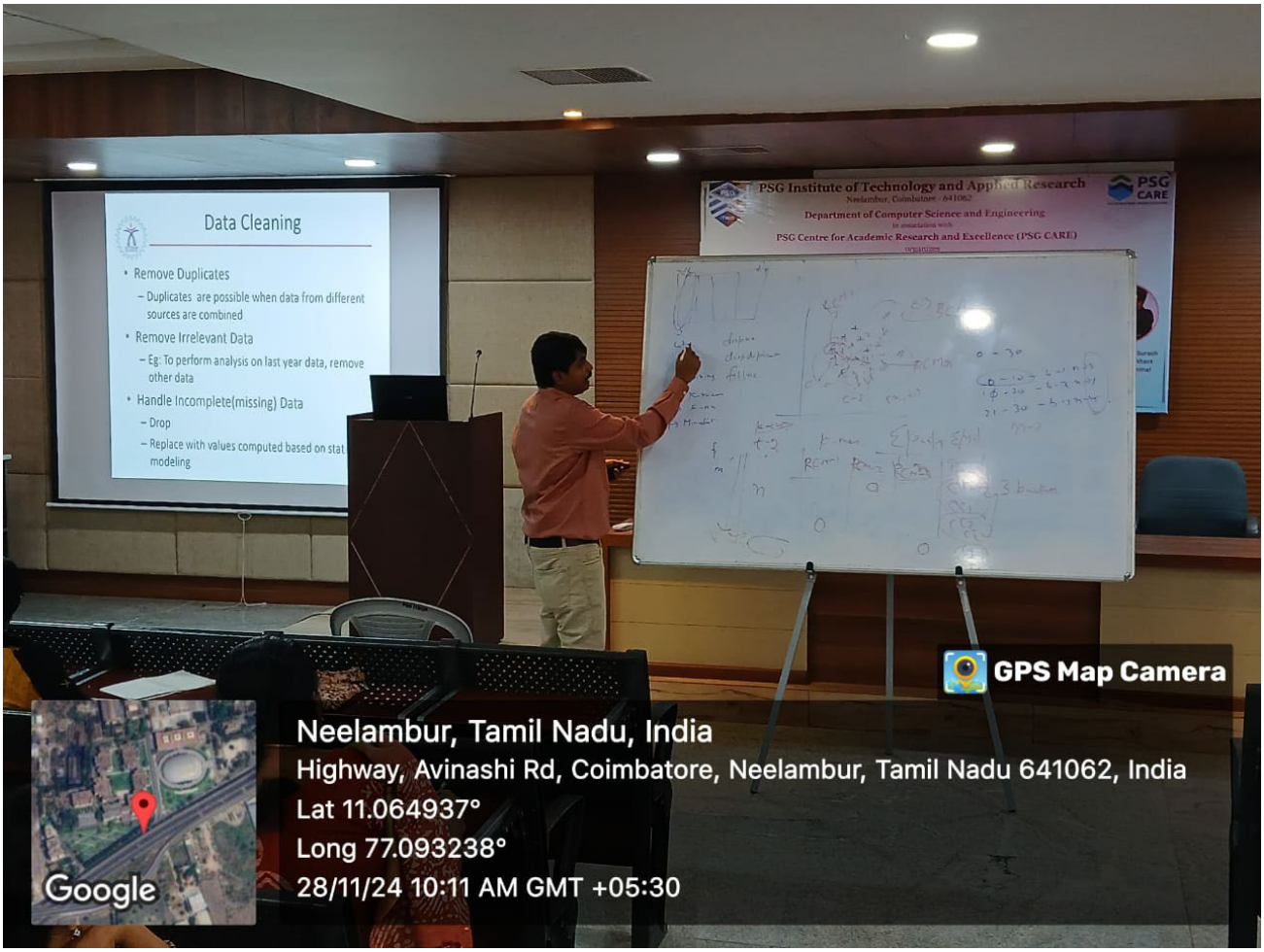
In the first half of the session, the resource person covered the topic **Feature Engineering: Understanding the Data's Potential**. He explained the key algorithms and mathematical techniques used in data preparation. The five steps involved in data preparation were:

1. Data Discretization
2. Data Cleaning
3. Data Integration
4. Data Transformation
5. Data Reduction

The resource person explained the concept of Data Discretization, including techniques like **binning** with equal frequency binning and equal width binning**.** He also discussed clustering**,** which groups unlabelled data into clusters, and introduced the **K-Means Algorithm,** which uses Euclidean distance to

find similarities and organize data into **clusters**. He further talked about improving data quality by removing duplicates, eliminating irrelevant data, and handling missing values. The importance of identifying and managing outliers using the **interquartile range (IQR)** was also emphasized to ensure the dataset is accurate, reliable, and ready for analysis.





He then explained **Data Normalization**, covering techniques like decimal scaling, min-max normalization, and z-score normalization, which are used to scale data for better analysis. He also discussed the **Central Limit Theorem**, which describes how the distribution of sample means tends to follow a normal distribution as the sample size increases. This explanation falls under the broader topic of visualizing the data, helping us better understand data patterns and distributions.

He also explained **Principal Component Analysis (PCA),** a technique used to reduce the dimensionality of data while preserving its key patterns. Additionally, he discussed **correlation**, which measures the relationship between variables, and covariance, which indicates how two variables change together. These concepts are essential for understanding and simplifying complex datasets in data analysis.

The session covered **Machine Learning Paradigm**, focusing on **classification** and **regression**. The speaker explained **linear** and **logistic regression** and introduced **mutually exclusive** (one outcome) and **mutually exhaustive** (all outcomes) events, key concepts for machine learning.

The forenoon session was concluded with the presentation of a memento to the Resource person **Dr Preeth R** by **Dr A. Sunita Nandhini** Ma'am, as a token of appreciation for sharing their valuable insights and expertise.

The afternoon session on **Data Analytics through Weather Forecasting** was conducted by **Mr. Selva Vignesh**, a Product Strategist from Coimbatore. The session focused on the essential aspects of data analytics, starting with the **types of data—structured, unstructured, and semi structured**. Mr. Vignesh also covered the three key types of **data analysis: descriptive, predictive, and prescriptive**. He explained how each type serves different purposes in understanding and predicting outcomes based on data.

A major portion of the session was hands-on, where participants worked on a **weather forecasting dataset using Google Colab**. Mr. Vignesh guided the participants through several crucial steps in the data analytics process. These included:

- **Data Cleaning:** The participants learned how to clean the data by handling missing values, removing duplicates, and addressing inconsistencies in the dataset.
- **Feature Engineering:** Mr. Vignesh demonstrated how to extract useful features from the weather data, such as creating new columns for year, month, day, and time from the original timestamp.
- **Outlier Detection:** The session also covered identifying and dealing with outliers using the Interquartile Range (IQR) method, ensuring the dataset was accurate and reliable for analysis.

Mr. Vignesh also introduced **machine learning techniques**, specifically **Logistic Regression**, to predict weather conditions. The participants split the dataset into training and testing sets, performed data scaling, and applied the logistic regression model. The performance of the model was evaluated using key metrics like accuracy, precision, recall, and F1-score.

In addition to the hands-on work, Mr. Vignesh explained various techniques in model selection and hyperparameter tuning to optimize the model's performance.

The session concluded with **Dr A. Sunita Nandhini** presenting a memento **to Mr. Selva Vignesh** in appreciation of his insightful session. The participants gained valuable **hands-on experience** in applying data analytics techniques to a real-world problem, and they left the session with a deeper understanding of the practical application of machine learning in forecasting.

Day 5: 29.11.2024

The fifth and final day of the Faculty Development Program featured an action-packed forenoon session conducted by **Mr. Jai Ganesh Suresh**, senior AI Architect, Ericsson. The session delved deep into the captivating topics of Gen AI and GANs. The following points were discussed in detail.

The differences between AI, ML, DL and Gen AI

Mr. Jai Ganesh gave an overview of the differences between the different buzzwords in the industry. The following are the key points touched upon by him.

Artificial Intelligence (AI)

- AI refers to the broad field of computer science focused on creating systems capable of mimicking human intelligence.

Machine Learning (ML)

- ML focuses on systems that learn and improve from data without explicit programming. These algorithms are trained on data to make predictions or decisions.

Deep Learning (DL)

- DL uses neural networks with multiple layers (deep neural networks) to process complex data. Capable of extracting features automatically, unlike ML which often requires feature engineering.

Generative AI (GenAI)

- Specialized AI Approach: A subset of AI focused on generating new content, ideas, or outputs similar to input data using advanced ML/DL models.

Large Language Models

The resource person also delved into the topic of Large Language models and illustrated how they differed from the usual machine learning models.

LLMs (Large Language Models) are advanced artificial intelligence models designed to process, understand, and generate human-like text. They are a specific type of deep learning model, typically built using transformer architectures, and are trained on massive datasets of text.

Deep fakes:

Deep fakes, created using advanced AI technologies like **Generative Adversarial Networks (GANs)**, can produce highly realistic fake content, such as altered videos, images, or audio. While they have innovative applications, they also raise significant ethical, societal, and security concerns.

Advantages:

- **Film and TV**: Used for CGI effects, recreating actors in scenes, or resurrecting deceased actors.
- **Gaming**: Enhancing realism in character design and virtual reality.
- **Historical Reconstructions**: Recreating historical figures for documentaries, museums, or educational tools.
- Assisting people with disabilities by creating synthetic voices or lip-synced videos for better communication.

Disadvantages:

- Deepfakes can be used to create fake news, propaganda, or altered political statements, misleading the public. For instance, videos of public figures making counterfeitannouncements.
- Impersonating individuals to gain unauthorised access to sensitive information.
- Undermines trust in digital media as people may doubt the authenticity of even legitimate content.
- Misuse in geopolitical conflicts to spread disinformation or provoke tensions.

Generative Adversarial Networks (GANs)

They are designed to generate new, synthetic data that is indistinguishable from real data.

GANs are composed of two competing neural networks: a generator and a discriminator, which are trained simultaneously through a minimax game.

GENERATOR:Generate realistic data**.**

DISCRIMINATOR: Distinguish between real data and fake (generated) data.

Common GAN Variants

1. DCGAN (Deep Convolutional GAN):
    - Uses convolutional layers instead of fully connected layers for image generation.
    - Better for high-dimensional data (e.g., images).
2. Conditional GAN (cGAN):
    - Allows conditioning on additional information (e.g., class labels, text).
    - Example: Generating specific types of objects or styles.

TRANSFORMERS are a type of neural network architecture designed for processing sequential data, like text, but with a focus on parallelization. They use mechanisms like **self-attention** to weigh the importance of each word in a sequence, enabling them to handle long-range dependencies efficiently. Transformers power state-of-the-art models in NLP, such as BERT and GPT.

A hands-on session was conducted on a transformer-based model design. The resource person Mr. Jai Ganesh Suresh went into the step-by-step process of training a GAN and cleared any doubts the participants could have along the way.

The FDP session on Gen-**AI and GAN Architecture** provided an insightful overview of the transformative potential of Generative AI and the innovative capabilities of Generative Adversarial Networks. Participants gained a comprehensive understanding of AI's foundational concepts, real-world applications, and the intricate workings of GANs, including their adversarial training process, Generator-Discriminator dynamics, and real-world use cases like image synthesis, data augmentation, and creative content generation.

The session also highlighted the strengths and limitations of GANs, emphasizing their potential for innovation alongside ethical considerations and technical challenges. By bridging theoretical concepts with practical examples, the session empowered participants with valuable knowledge to explore AI-driven solutions and foster research and development in this rapidly evolving field.
Overall, the FDP successfully laid a strong foundation for participants to engage with AI and GANs, inspiring further exploration and application in academic and professional domains.

The Valedictory Function of the five-day Faculty Development Program took place on 29th November 2024 at 3:30 PM. The program was marked with the Welcome address, given by Dr. R. Manimegalai, HoD/CSE. The Presidential Address was delivered by Dr. R. Rudhramoorthy, Director of PSG CARE, who emphasised the significance of the event and its outcomes.Following this, the Valedictory Address was delivered by Mr. Jai Ganesh Suresh, Senior AI Architect, who shared valuable insights and inspiring thoughts, leaving the participants motivated and reflective. Next the certificates were distributed to participants, recognizing their engagement and contributions. Feedback from attendees was then collected, highlighting the positive impact of the event and the scope for improvement.

The program concluded with a heartfelt Vote of Thanks by Dr. B. Gomathy, Professor at PSG iTech, at 4:30 PM, marking the successful conclusion of the event.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in association with
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