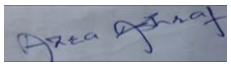
Department of CSE

Details of Lesson Plan

S.No.	Particulars	Details
1.	Course Name	Generative AI
2.	Course Code	COM-801
3.	Academic Year	2024-2025
4.	Semester	8th
5.	Number of Lesson plans	33
6.	Faculty Assigned	Azra Ashraf



Faculty Signature

Lesson Plan No. 1	Course Name: Generative AI Topic: Introduction to Gen AI	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. Understand the basic concepts of Generative AI. b. Explore the applications of Generative AI across various domains such as art, healthcare, finance, and entertainment.
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Show a simple example of a generative model in action (e.g., generating text with GPT). 2. **Development** (30 minutes) Applications of Generative AI in Various Domains - Art and Creativity: AI-generated art, music, and literature. Case study: DALL-E, DeepArt, Jukedeck. Healthcare: Drug discovery, medical imaging. Case study: AI in generating synthetic medical data. Finance: Algorithmic trading, fraud detection. Case study: Generative AI in predictive modeling. Entertainment: AI in video game design, film industry. Case study: AI-generated scripts, character design. 3. Exercise (5 minutes) – - Have students brainstorm and present other potential applications of Generative AI in different industries. Use Nearpod to collect responses and discuss the answers.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://www.techtarget.com/searchenterpriseai/definition/generative-AI 3. Homework -Research Paper Review: Students can choose a recent research paper on a specific Generative AI application and write a short review on its potential impact and ethical considerations. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Quiz on Gen AI 3. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 2	Course Name: Generative AI Topic: Introduction to generative and discriminative models.	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. Understand the fundamental differences between generative and discriminative models in machine learning. basic concepts of Generative AI. b. Explore common examples and applications of generative and discriminative models.
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Introduction to classification and prediction tasks in machine learning. 2. **Development** (30 minutes) - Generative Models: Concepts and Examples Definition and Theory: - What are generative models? - How they model the joint probability distribution P(X,Y) - **Common Generative Models:** - Naive Bayes Classifier. - Gaussian Mixture Models (GMMs). - Hidden Markov Models (HMMs). - Generative Adversarial Networks (GANs). - Comparative Analysis: Generative vs. Discriminative Models - **Key Differences:** - Data Modeling: Joint distribution vs. conditional distribution. - Use Cases: Where each model excels. - Computational Complexity: Pros and cons in terms of training and inference. b. **Advantages and Disadvantages:** - Generative Models: Flexible in dealing with missing data, but often more complex. - Discriminative Models: Typically achieve better classification accuracy with less data, but less flexible. - 3. Exercise (5 minutes) – - Quick poll: Ask students to name any machine learning models they are familiar with and categorize them as either generative or discriminative.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://www.tutorialspoint.com/difference-between-generative-and-discriminative-model 3. Homework -Write a short essay on the role of generative models in modern AI applications, with a focus on emerging trends (e.g., in natural language processing or computer vision). Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Quiz on Gen AI 3. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 3	Course Name: Generative AI Topic:Taxonomy of generative models	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. Understand the categorization and hierarchy of various generative models in machine learning. b. Learn the characteristics and differences between different types of generative models.
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Importance of generative models in AI and machine learning. 2. **Development** (30 minutes) - Introduction to the classification of generative models. - The hierarchy of generative models based on different criteria (e.g., data representation, learning approach). - Explicit Density Models (Parametric Models,Non-Parametric Models) - Implicit Density Models (GANs,Energy based models) - Autoregressive Models (Pixcel CNN) - Latent Variable Models (VAEs) - Illustrate the taxonomy with a diagram showing the hierarchy and relationships between different types of generative models. 3. Exercise (5 minutes) – -Divide the class into groups and assign each group a category of generative models. Each group will present an example and a use case of the assigned category. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://medium.com/@avinashmbhat182/taxonomy-of-generative-model-4c9be2a09748 3. Homework -Select a generative model from one of the categories discussed in class. Write a report detailing its architecture, working mechanism, and applications. Spend 5 minutes to wrap up and consolidate the learnings

Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Quiz on multiple generative models. 3. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 4	Course Name: Generative AI Topic:GenAI modalities mappings.	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of modalities in Generative AI. b. Learn about different types of modalities in Generative AI (e.g., text, image, audio, video). c. Analyze the applications and challenges of cross-modal generation.
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Introduction to Generative AI Modalities. 2. **Development** (30 minutes) - How generative models interact with and process different modalities. - What are modalities in the context of AI? - Examples of common modalities: Text, image, audio, video, 3D models. - Text Generation:GPT,BERT. - Applications: Chatbots, content creation, language translation. - Image Generation: GANs, VAEs . - Applications: Image synthesis, style transfer, art generation. - Audio Generation:WaveNet, MelGAN. - Applications: Speech synthesis, music generation, sound design. - Video Generation:GAN-based models, video prediction models. - Applications: Deepfakes, video inpainting, animation generation. - **3D Model Generation:**3D GANs, (NeRFs). - Applications: Virtual reality, 3D printing, game design. 3. Exercise (5 minutes) – -Show examples of generative outputs for each modality, such as a text-generated story, an AI-generated image,
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading

	https://medium.com/@analyticsinsightsubmissions/deep-dive-into-data-modalities-understanding-generative-ai-inputs-022a845c5e31 Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 5	Course Name: Generative AI Topic: Generative Models: Fundamentals and Techniques.	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. Understand the fundamental concepts of generative models in machine learning. b. Analyze the strengths, weaknesses, and appropriate use cases for different generative techniques.
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Importance of generative models in AI and machine learning. 2. **Development** (30 minutes) - Joint probability distribution P(X,Y)) vs. conditional probability distribution P(Y | X) - The role of generative models in simulating complex data distributions. - Mathematical Foundations-Use of conditional probabilities in generating sequences. - Discuss the trade-offs between different generative models (e.g., VAEs vs. GANs). - Strengths and weaknesses of each technique in terms of quality, training difficulty, and flexibility. 3. Exercise (5 minutes) – - Have students brainstorm and present other potential applications of Generative AI in different industries. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://www.sciencedirect.com/science/article/abs/pii/S0957417423033481 3. Homework -Analyze scenarios where one generative model technique might be preferred over others.Discuss industry applications and research frontiers for each technique. Spend 5 minutes to wrap up and consolidate the learnings

Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 6	Course Name: Generative AI Topic: Introduction to basic generative models (Gaussian Mixture Models (GMMs)	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of generative models and where Gaussian Mixture Models (GMMs) fit within them. b. Learn the mathematical foundation of GMMs. c. Gain insight into how GMMs are used for clustering and density estimation.
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Introduction to Gaussian Mixture Models (GMMs): - Where GMMs fit in the broader category of generative models. - High-level overview of what GMMs do (modeling data as a mixture of multiple Gaussian distributions). 2. **Development** (30 minutes) - **Concept of Gaussian Distributions:** - Concept of univariate and multivariate Gaussian distributions. - Key properties: Mean, covariance, and the Gaussian distribution function. - Introduction to the Expectation-Maximization (EM) algorithm for estimating GMM parameters. **b. Real-World Applications:** - Speech recognition: Modeling the distribution of acoustic features. - Image processing: Background subtraction in video frames. - Financial modeling: Modeling the distribution of asset returns. 3. Exercise (5 minutes) – - Step-by-step walkthrough of how the EM algorithm works, with whiteboard explanations.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://www.geeksforgeeks.org/gaussian-mixture-model/

	3. Homework -Write a report on a real-world application of GMMs in a specific domain (e.g., finance, healthcare).Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 7	Course Name: Generative AI Topic: Hidden Markov Models (HMMs).	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. Understand the fundamental concepts of Hidden Markov Models (HMMs). b. Learn the structure and components of HMMs, including states, observations, and transition probabilities. c. Gain insight into the mathematical foundations of HMMs, including the Forward-Backward algorithm
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Introduction to Markov processes and Markov Chains - Basic concepts: States, transitions, and the Markov property -Difference between Markov Models and Hidden Markov Models. 2. **Development** (30 minutes) - **Key Components of an HMM:** - States,Observations,Transition Probabilities,Emission Probabilities,Initial State Distribution Graphical Representation of HMMs - Visualizing HMMs: State transition diagrams and trellis diagrams. - Explain how the state transitions and emissions create the observation sequence. - **Applications of Hidden Markov Models:** Bioinformatics,NLP etc 3. Exercise (5 minutes) – - Provide students with a simple example (e.g., weather prediction) and have them draw the state transition diagram and describe the components.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://www.javatpoint.com/hidden-markov-model-in-machine-learning 3. Homework -Write a report on the use of HMMs in a specific domain (e.g., speech recognition or bioinformatics), focusing on how the model is applied and its effectiveness.

Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 8	Course Name: Generative AI Topic: Latent Variable Models.	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of latent variables and their role in probabilistic models. b. Learn about different types of latent variable models and their applications. c. Explore the mathematical foundations of latent variable models.
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Definition of latent variables - Examples of latent variables in different domains(e.g.intelligence, market sentiment, topics in documents). 2. **Development** (30 minutes) -Principal Component Analysis (PCA):Dimensionality reduction by identifying the principal components (latent variables). - Key Concepts: Eigenvalues, eigenvectors, and covariance matrix. - Applications: Data compression, noise reduction, visualization. - Factor Analysis: - Key Concepts: Factor loadings, uniqueness, and communalities. - Applications: Psychometrics, social sciences, market research. - Variational Autoencoders (VAEs): - Key Concepts: Encoder, decoder, latent space, reparameterization trick -Applications: Image generation, anomaly detection, semi-supervised learning. 3. Exercise (5 minutes) – - Divide students into groups and assign each group a type of latent variable model. Each group will research their model and present a brief explanation, including an example application.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://en.wikipedia.org/wiki/Latent_variable_model
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 9	Course Name: Generative AI Topic: Statistical Language Models (SLM)	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. Understand the basic concepts of Statistical Language Models (SLMs) b. Learn about different types of SLMs, including n-gram models, smoothing techniques, and more advanced models like Hidden Markov Models (HMMs).
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Definition of Statistical Language Models - Brief history: Evolution from simple models like n-grams to more sophisticated models (e.g., HMMs, neural language models). 2. **Development** (30 minutes) - **N-gram Models:** - Definition. - Examples: Unigram, bigram, trigram models. - Mathematical Foundation: Probability estimation using frequency counts. - Limitations: Sparsity, inability to capture long-range dependencies. 3. Exercise (5 minutes) – - Ask students to think about how a computer might predict the next word in a sentence and discuss their ideas.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://medium.com/@redbeet1007/nlp-statistical-language-model-bca51c21d934
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 10	Course Name: Generative AI Topic: Role of encoder and decoder networks.	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. Understand the roles and functions of encoder and decoder networks in machine learning models. b. Learn how these networks are used in sequence-to-sequence tasks and other applications. c. Gain insight into the architecture and working of encoder-decoder systems, including their variations like Transformers.
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Definition of Encoder and Decoder networks. - Role in processing and generating sequences. 2. **Development** (30 minutes) - Architecture and Functionality - Encoder Networks - Basics of RNNs, LSTMs, and GRUs as encoders. - Attention Mechanisms - Decoder Networks - Sequence-to-Sequence Models (Seq2Seq) 3. Exercise (5 minutes) – - Have students draw and label the architecture of a basic encoder-decoder model, including the components and connections.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://medium.com/analytics-vidhya/encoders-decoders-sequence-to-sequence-architecture-5644efbb3392
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 11	Course Name: Generative AI Topic: Introduction to GANs and the GAN framework.	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. Understand the fundamental concepts of Generative Adversarial Networks (GANs). b. Learn about the GAN framework, including its components and how they interact. c. Explore the mathematical foundations and training dynamics of GANs.
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Definition of GANs. 2. **Development** (30 minutes) - Components of GANs:Generator NetworkDiscriminator Network:Adversarial Training: - Explanation of the minimax game between the generator and discriminator. - Loss Functions: Binary Cross-Entropy loss used in the GAN framework. - Iterative training 3. Exercise (5 minutes) – - Work through a simple example calculation of GAN training dynamics. Discuss how the loss functions guide the learning process.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://www.geeksforgeeks.org/generative-adversarial-network-gan/ 3. Homework -Write a report on a specific application or variant of GANs, including its implementation details and real-world impact. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Quiz on Gen AI 3. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 12	Course Name: Generative AI Topic: Generator-discriminator adversarial training process.	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. Understand the adversarial training process in Generative Adversarial Networks (GANs). b. Learn the roles of the generator and discriminator in the training process. c. Gain insight into the optimization and convergence challenges associated with GAN training.
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Definition of adversarial training in GANs 2. **Development** (30 minutes) - Adversarial Objective Function - **Formulation:** Minimax game defined by the objective function minGmaxDV(D,G)=Ex~pdata(x)[logD(x)]+Ez~pz(z)[log(1−D(G(z)))] - **Interpretation:** The generator seeks to minimize this value, while the discriminator seeks to maximize it. - 3. Exercise (5 minutes) – - Ask students to consider why training two models in opposition might lead to better results compared to training a single model.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://www.javatpoint.com/generative-adversarial-network 3. Homework -Write a report on a specific application or variant of GANs, including its implementation details and real-world impact. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 13	Course Name: Generative AI Topic: Variants of GANs.	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. By the end of the lesson, students should be able to understand the concepts behind Conditional GANs and Wasserstein GANs, their differences from standard GANs, and their applications.
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Explain why variants of GANs are developed (to address issues like training stability, control over generated data, etc.). 2. **Development** (30 minutes) - Concept and Motivation - Mathematical Formulation - Objective Function: Explain the modified objective function of cGANs where both the Generator and Discriminator are conditioned on extra information. - Formulation: - Generator $G(z \mid y)$ and Discriminator $D(x \mid y)$, where y is the conditional input. - Objective: Maximize $E_{x,y}[\log D(x\|y)]+E_{z,y}[\log(1-D(G(z\|y)\|y)]$ - Applications and Examples:Image-to-Image Translation,Text-to-Image Generation etc
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://ieeexplore.ieee.org/document/10160093 3. Homework -Provide a list of key research papers and articles on cGANs and WGANs.
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Compare and contrast cGANs and WGANs with standard GANs. 3. Discuss the scenarios where each variant might be preferable. 4. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 14	Course Name: Generative AI Topic: Autoregressive Models (PixelCNN and PixelRNN architectures for image generation).	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. By the end of the lesson, students should be able to understand the principles behind autoregressive models for image generation, focusing on PixelCNN and PixelRNN architectures. They should be able to discuss their architectures, training processes, and applications.
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Introduce PixelCNN as an autoregressive model that uses convolutional layers to model pixel dependencies. 2. **Development** (30 minutes) **Architecture Details** - **PixelCNN Layers:** - **Masked Convolutions:** Explain how masks are used to ensure that predictions are made in a left-to-right and top-to-bottom order. - **Convolutional Layers:** Discuss the use of standard and dilated convolutions to capture different levels of spatial context. - **Conditional PixelCNN:** Introduce the concept of conditioning on additional information (e.g., class labels). - **Applications and Examples** - Image Generation - Inpainting and Super-Resolution - Complex Pattern Modeling 3. Exercise: - Compare and contrast PixelCNN and PixelRNN in terms of architecture and performance.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://medium.com/game-of-bits/image-synthesis-using-pixel-cnn-based-autoregressive-generative-model-05179bf662ff

	3. Homework -Task students with experimenting with variations of PixelCNN and PixelRNN on different image datasets and analyzing the results.
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Discuss scenarios where one model might be preferred over the other. 3. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 15	Course Name: Generative AI Topic: Sequence Generation and Transformers	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. By the end of the lesson, students should understand the principles of sequence generation, the architecture of Transformers, and their applications in tasks like text generation and machine translation.
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Explain sequence generation as the task of generating a sequence of items (e.g., words, characters) based on a given input sequence. 2. **Development** (30 minutes) - Introduce Transformers as a model architecture designed to handle sequence-to-sequence tasks more efficiently than RNNs and LSTMs. - Self-Attention Mechanism - Positional Encoding - Encoder and Decoder Structure - Real world Examples (OpenAI's GPT-3 and GPT-4,Chatbots,DeepL Translator,YouTube and Netflix,DeepMind's AlphaFold). 3. Exercise (5 minutes) – - Explore scenarios where Transformers offer significant advantages.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://odr.chalmers.se/server/api/core/bitstreams/f2e4092e-c45f-4168-bbdc-ae5d8de7a501/content 3. Homework Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 16	Course Name: Generative AI Topic: Recurrent Neural Networks (RNNs)	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. By the end of the lesson, students should understand the principles of Recurrent Neural Networks, their architecture, and how they are applied to sequence data.
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Introduction to RNNs as a type of neural networks. - Explain why RNNs are suited for tasks involving sequences, such as text generation or time-series forecasting. 2. **Development** (30 minutes) - **Basic Architecture:** - Describe the basic architecture of an RNN, including input, hidden, and output layers. - Explain the key equations: - Hidden State Update:ht=activation(Whht−1+Wxxt+b) - Output: yt=Wyht+by - **Variants and Improvements** - Explain the issues of vanishing and exploding gradients that affect RNN training. - Provide examples of how these issues manifest and their impact on training. 3. Exercise (5 minutes) – - Illustrate how RNNs are applied to predict future values in time series data, such as stock prices or weather forecasting.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://odr.chalmers.se/server/api/core/bitstreams/f2e4092e-c45f-4168-bbdc-ae5d8de7a501/content 3. Homework - Task students with applying RNNs, LSTMs, and GRUs to a new sequence prediction problem and analyzing the results. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Compare and contrast RNNs, LSTMs, and GRUs in terms of their strengths and weaknesses.

	3. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 17	Course Name: Generative AI Topic: Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) cells	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. By the end of the lesson, students should understand the architecture and functionality of LSTM and GRU cells, their advantages over standard RNNs.
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Discuss the motivation for developing LSTMs and GRUs, focusing on their ability to handle long-range dependencies and mitigate gradient issues. 2. **Development** (30 minutes) - Introduction to LSTMs. - Discuss the use of gates and cell state to maintain and update information over time. - LSTM Architecture - Components:Forget GateInput GateCell State UpdateOutput Gate - Use cases such as time series forecasting, machine translation, and text generation. - 3. Exercise (5 minutes) – - Address any questions about the differences and use cases of LSTMs and GRUs. - Explore additional considerations when choosing between LSTM and GRU for specific tasks.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://www.geeksforgeeks.org/deep-learning-introduction-to-long-short-term-memory/ 3. Homework - Task students with applying RNNs, LSTMs, and GRUs to a new sequence prediction problem and analyzing the results. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.

	2. Compare and contrast RNNs, LSTMs, and GRUs in terms of their strengths and weaknesses. 3. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 18	Course Name: Generative AI Topic: Introduction to Transformers	Course No.: COM-801

Objectives	At the end of the lesson the student shall be able to: a. By the end of the lesson, students should understand the architecture and components of Transformer models, their advantages over traditional sequence models, and their applications in various tasks.
Teaching Aids (if any)	a. Powerpoint Presentation b. Chalk & Talk
Teaching Development	1. **Introduction** (5 minutes) - Introduction to the Transformer model 2. **Development** (30 minutes) - Self-Attention Mechanism - Positional Encoding - Explain how Transformers have improved translation quality and efficiency - Examples(Google Translate). 3. Exercise (5 minutes) – - Address any questions or points of confusion regarding Transformer architecture and applications
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Suggested Reading https://arxiv.org/pdf/2304.10557 3. Homework - https://arxiv.org/pdf/2304.10557 - Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Compare and contrast RNNs, LSTMs, and GRUs in terms of their strengths and weaknesses. 3. Spend 5 minutes to evaluate student assimilation of the lesson contents