Lesson Plan No. 2	Course Name: Data structures Topic: Asymptotic Notation	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to: a. Understand the Asymptotic notation. b. Articulate that what are the types of Asymptotic notation.
Teaching Aids (if any)	a) PowerPoint Presentation b) Use of Near Pod engagement tool for online quiz c) Pen Tablet for highlighting important points d) Chalk & Talk for offline classes.
Teaching Development	1. **Introduction** (5 minutes) Ask questions - What do you mean by asymptotic notation? - What are the types of asymptotic notation. - What are the applications of asymptotic notation. 2. **Development** (30 minutes) - Definition/Introduction of Asymptotic notation. - Explanation on various type of Asymptotic notation. - Detailed concept about the applications of asymptotic notation . 3. **Exercise** (5 minutes) - Ask students to explain Asymptotic notation and to narrate its different types. Use Nearpod to collect responses and discuss the answers.
Closure	- Summarize the Lesson Learning Outcomes and get affirmation from students on these. Spend **5 minutes** to wrap up and consolidate the learnings Suggested Video Lecture
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Nearpod Quiz on Cloud Computing Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 3	Course Name: Data Structures Topic: Self Referencial structures	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to: a. articulate the concept of cloud computing. b. select the appropriate cloud deployment model for different use-case scenarios. c. illustrate different cloud service models with examples. d. appreciate advantages of cloud computing and its associated challenges
Teaching Aids (if any)	a. Video of Facebook data center b. Use of Nearpod tool for online quiz

Teaching Development	1. **Introduction** (5 minutes)
	- Ask questions.
	  which email service do the students use?
	  where is your email account stored?
	  do you know the location of your email data?
	  Where is your bank data stored?
	- Introduce the concept of cloud. Show Figure on slide.
	- Talk about utilities – water, electricity and build the pay-per-use concept
	- Introduce the formal definition of cloud computing by NIST
	  http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	- Highlight the important characteristics of the cloud – on-demand, pay-per-use, elasticity etc.
	- Highlight the size of the cloud computing marketplace and rapid adoption by businesses globally through some statistics.
	
	2. **Development** (30 minutes)
	  a. Cloud Data Centers
	  - Introduce the concept of data center, server farms etc.
	  - Show video of Facebook Data Center
	    https://www.youtube.com/watch?v=_r97qdyQtIk
	  - Introduce concept of virtualization and improving resource utilization.
	  b. Cloud Service Models
	  - Introduce the concepts of IaaS (hire a barebones server), PaaS (hire a deployment/development ready platform) and SaaS (simply consume a service) with examples.
	  - Show figures to illustrate differences in the models and their ability to cater to different needs of stakeholders in the ecosystem (Cloud Service Provider, Service Provider and End Consumer.)
	  - Give example of a scientist needing large number of servers to run a simulation (gene sequencing), which can be easily

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	provisioned on the cloud in a fraction of the cost without need to buy physical servers.
	
	   c. Major players in cloud computing
	     - Amazon AWS
	     - Microsoft Azure
	     - Google App Engine
	     - Typical VM pricing models
	   d. Advantages of Cloud Computing
	     - Scale
	     - Elasticity
	     - On-demand/pay-per-use
	     - Low cost of ownership
	     - Higher RoI
	     - Give examples to illustrate the advantages from a user-perspective.
	   e. Challenges in Cloud Computing
	     - Security
	     - National Laws on Data Storage
	     - Vendor Lock-in
	     - Energy Efficiency (Give example of energy consumption in large data centers)
	     - Resource Utilization
	
	3. Exercise (5 minutes) –
	Give different use-cases and make students select appropriate cloud deployment models.
	   - National Security Data (Private Cloud)
	   - Health Data of Patients (Hybrid Cloud)
	   - Credit card Details/Bank Details (Private Cloud)
	   - Student Academic Data (Hybrid Cloud)
	   - Learning Resources for Students (Public Cloud)
	
	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
	   - Original NIST Paper on Cloud Computing
	     http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	3. Homework
	   - Create your video log highlighting cloud computing concepts and submit on Google classroom.
	
	Spend 5 minutes to wrap up and consolidate the learnings

Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to

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	answer and discuss.
	2. Nearpod Quiz on Cloud Computing
	Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 4	Course Name: Data Structures Topic: Types of Data Structure	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to:
	  a. Understand the Types of data structures
	  b. Understand the various operations performed on data structure

Teaching Aids (if any)	a. Video of Facebook data center b. Use of Nearpod tool for online quiz

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	    - What do you mean by data structure?
	    - What are the types of data structures?
	    - What are the types of operations performed on data structures?
	
	2. **Development** (30 minutes)
	    - Definition/Introduction of data structure.
	    - Explanation on various types of data structures.
	    - Detailed concept about operations performed on data structures.
	3. **Exercise** (5 minutes)
	    - Ask students to explain of data structure and to narrate its different types and application.
	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
	    - Original NIST Paper on Cloud Computing
	     http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	3. Homework
	    - Create your video log highlighting cloud computing concepts and submit on Google classroom.
	
	Spend 5 minutes to wrap up and consolidate the learnings

Evaluation	1. Reflective Questions (What, why, Who?). Allow students to answer and discuss. 2. Responses acquired from Near Pod Quiz on AIS. Spend **5 minutes** to evaluate student assimilation of the lesson contents

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Lesson Plan No. 5	Course Name: Data Structures Topic: Time Space Complexity	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of Time and space complexity of algorithms
Teaching Aids (if any)	a) PowerPoint Presentation b) Use of Near Pod engagement tool for online quiz c) Pen Tablet for highlighting important points d) Chalk & Talk for offline classes

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	    - What do you mean by complexity?
	    - What are the types of complexity.
	    - What do mean by Time and space complexity of algorithms.
	
	2. **Development** (30 minutes)
	    - Definition/Introduction of Time and space complexity.
	    - Explanation on how to calculate the complexity .
	
	3. **Exercise** (5 minutes)
	    - Ask students to find time and space complexity of an algorithm.
	Use Nearpod to collect responses and discuss the answers.

Closure	- Summarize the Lesson Learning Outcomes and get affirmation from students on these. Spend **5 minutes** to wrap up and consolidate the learnings Suggested Video Lecture
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Nearpod Quiz on Time and Space Complexity Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 6	Course Name: Data Structures Topic: Linked List	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to:
	   a. Understand the linked list and its types.
	   b. Articulate various operation perform on linked list.

Teaching Aids (if any)	a) PowerPoint Presentation b) Use of Near Pod engagement tool for online quiz c) Pen Tablet for highlighting important points d) Chalk & Talk for offline classes.

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	    - What do you mean by linked list?
	    - What are the types of linked list.
	    - various operation perform on linked list.
	
	2. **Development** (30 minutes)
	    - Definition/Introduction of linked list.
	    - Explanation on various type of linked list.
	    - Detailed concept about the representation of linked list.
	
	3. **Exercise** (5 minutes)
	    - Ask students to explain linked list and to narrate its different types and uses.
	Use Nearpod to collect responses and discuss the answers.

Closure	a) Summarize the Lesson Learning Outcomes and get affirmation from students on these. b) Spend **5 minutes** to wrap up and consolidate the learnings Suggested Video Lecture c) Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, why, Who?). Allow students to answer and discuss. 2. Responses acquired from Near Pod Quiz on AIS. Spend **5 minutes** to evaluate student assimilation of the lesson contents

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Lesson Plan No.13	Course Name: Data Structures Topic: B + Trees	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to:
	  a. Understand the concept of collision in hashing.
	  b. Articulate Types of Hash Algorithms

Teaching Aids (if any)	a. Video of Facebook data center b. PowerPoint Presentation c. Use of Near Pod engagement tool for online quiz

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	    - What do you mean by hashing?
	    - Explain the concept of collision in hashing
	    - Various types of hashing Algorithms.
	
	2. **Development** (30 minutes)
	    - Definition/Introduction of hashing.
	    - Explanation on collision in hashing.
	    - Explanation on various types of hashing Algorithms
	3. **Exercise** (5 minutes)
	    - Ask students to explain hashing and to narrate collision in hashing .
	Use Nearpod to collect responses and discuss the answers.

Closure	- Summarize the Lesson Learning Outcomes and get affirmation from students on these. Spend **5 minutes** to wrap up and consolidate the learnings Suggested Video Lecture
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Nearpod Quiz on Hashing and B+ trees Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No.15	Course Name: Data Structures Topic: B- Trees	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to:
	   a. articulate the concept of B-Trees.
	   b. select the appropriate cloud deployment model for different use-case scenarios.
	   c. illustrate different B - Trees with examples.
	   d. appreciate advantages of B-Trees and its associated challenges

Teaching Aids (if any)	a. Video of Facebook data center b. Use of Nearpod tool for online quiz

Teaching Development	**1. Introduction** (5 minutes)
	Ask questions
	    - What do you mean by B–trees?
	    - How to perform in an B–trees data structure .
	
	2. Development (30 minutes)
	    - Definition/Introduction of in an B–trees.
	    - Explanation on Working of an B–trees.
	    - Perform searching in an B–trees
	3. Exercise (5 minutes)
	    - Ask students to explain B–trees and to narrate its working.
	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
	   - Original NIST Paper on B-Trees
	    http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	3. Homework
	   - Create your video log highlighting c B-Trees loud computing concepts and submit on Google classroom.
	
	Spend 5 minutes to wrap up and consolidate the learnings

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

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Lesson Plan No. 12	Course Name: Data Structures Topic: Binary Search Tree	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to: a. Understand the Binary search trees,. b. Articulate various properties of Binary search trees,.
Teaching Aids (if any)	a. Video of Facebook data center b. PowerPoint Presentation c. Use of Near Pod engagement tool for online quiz

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	   - What do you mean by Binary search trees,?
	   - Representation of Binary search trees,.
	   - properties of Binary search trees.
	
	2. **Development** (30 minutes)
	   - Definition/Introduction of Binary search trees.
	   - Explanation on Representation of Binary search trees.
	   - Detailed concept about the properties of Binary search trees.
	
	3. **Exercise** (5 minutes)
	   - Ask students to explain Binary search trees and to narrate its different properties and uses.
	Use Nearpod to collect responses and discuss the answers..

Closure	- Summarize the Lesson Learning Outcomes and get Affirmation from students on these. Spend **5 minutes** to wrap up and consolidate the learnings Suggested Video Lecture
Evaluation	1. Reflective Questions (What, why, Who?). Allow students to answer and discuss. 2. Responses acquired from Near Pod Quiz on Binary Search Tree. Spend **5 minutes** to evaluate student assimilation of the lesson contents

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Lesson Plan No. 11	Course Name: Data Structures Topic: Binary Trees	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to: a. Understand the binary tree and Traversing binary trees. b. Articulate various types Inorder, Preorder and Postorder.
Teaching Aids (if any)	a. Video of Facebook data center b. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) Ask questions - What do you mean by Traversing binary trees? - Types of traversing binary tree - Explain Inorder, Preorder and Postorder 2. **Development** (30 minutes) - Definition/Introduction of binary tree. - Explanation on Representation Traversing binary trees. - Detailed concept about the types. 3. **Exercise** (5 minutes) - Ask students to explain Traversing binary trees and to narrate its different types and uses. 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 - Original NIST Paper on Binary Trees http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf 3. Homework - Create your video log highlighting Binary Trees concepts and submit on Google classroom. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Nearpod Quiz on Binary Trees. Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 28	Course Name: Data Structures Topic: Bubble Sort	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to:
	   a. articulate the concept of bubble sorting.
	   b. select the appropriate bubble sorting model for different use-case scenarios.
	   c. illustrate different bubble sorting with examples.
	   d. appreciate advantages of bubble sorting and its associated challenges

Teaching Aids (if any)	a. Video of Facebook data center
	   b. PowerPoint Presentation
	   c. Use of Nearpod engagement tool for online quiz
	      Pen Tablet for highlighting important points

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	    - What do you mean by Bubble sort?
	    - Bubble sort complexity
	    - Optimized Bubble sort Algorithm.
	
	2. **Development** (30 minutes)
	    - Definition/Introduction of Bubble sort.
	    - Explanation on Working of Bubble sort Algorithm.
	    - Bubble sort complexity
	3. **Exercise** (5 minutes)
	    - Ask students to explain Bubble sort and to narrate its algorithms and uses.
	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
	    - Original NIST Paper on bubble sorting
	      http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	3. Homework
	    - Create your video log highlighting bubble sorting concepts and submit on Google classroom.
	
	Spend 5 minutes to wrap up and consolidate the learnings

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

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Lesson Plan No. 20	Course Name: Data Structures	Course No.: PSCSATC 221
	Topic: Collision in Hashing	

Objectives	At the end of the lesson the student shall be able to: a. articulate the concept of Hashing. b. select the appropriate Hashing model for different use-case scenarios. c. illustrate different hashing models with examples. d. appreciate advantages of Hashing and its associated challenges
Teaching Aids (if any)	a. Video of Facebook data center b. PowerPoint Presentation c. Use of Nearpod engagement tool for online quiz d. Pen Tablet for highlighting important points
Teaching Development	1. **Introduction** (5 minutes) Ask questions - What do you mean by hashing? - Explain the concept of collision in hashing - Various types of hashing Algorithms. 2. **Development** (30 minutes) - Definition/Introduction of hashing. - Explanation on collision in hashing. - Explanation on various types of hashing Algorithms 3. **Exercise** (5 minutes) - Ask students to explain hashing and to narrate collision in hashing . 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 - Original NIST Paper on hashing and Collision in Hashing. - http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf 3. Homework - Create your video log highlighting hashing and Collision in Hashing concepts and submit on Google classroom. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Nearpod Quiz on hashing and Collision in Hashing Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 21	Course Name: Data Structures Topic: Collision	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to: a. articulate the concept of collision. b. select the appropriate collision for different use-case scenarios. c. illustrate different collision with examples. d. appreciate advantages of collision and its associated challenges
Teaching Aids (if any)	a. Video of Facebook data center b. PowerPoint Presentation c. Use of Nearpod engagement tool for online quiz d. Pen Tablet for highlighting important points

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	    - What do you mean by hashing?
	    - Explain the concept of collision resolution
	    - Various types of hashing Algorithms.
	
	2. **Development** (30 minutes)
	    - Definition/Introduction of hashing.
	    - Explanation on collision resolution.
	    - Explanation on various types of hashing Algorithms
	3. **Exercise** (5 minutes)
	    - Ask students to explain hashing and to narrate collision resolution .
	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
	    - Original NIST Paper on Collision
	    - http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	3. Homework
	    - Create your video log highlighting Collision concepts and submit on Google classroom.
	
	Spend 5 minutes to wrap up and consolidate the learnings

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

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Lesson Plan No. 17	Course Name: Data Structures Topic: Graphs	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to: a. articulate the concept of Graphs. b. select the appropriate Graphs model for different use-case scenarios. c. illustrate different Graphs models with examples. d. appreciate advantages of Graphs and its associated challenges
Teaching Aids (if any)	a. Video of Facebook data center b. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) Ask questions - What do you mean by Graph? - Representation of Graph. - various types and some basic Graph Terminology. 2. **Development** (30 minutes) - Definition/Introduction of Graph data structure. - Explanation on Representation of Graphs. - Detailed concept about the Graph Terminology. 3. **Exercise** (5 minutes) - Ask students to explain graphs and to narrate its Terminology. 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 - Original NIST Paper on Graphs http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf 3. Homework - Create your video log highlighting Graphs concepts and submit on Google classroom. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Nearpod Quiz on Graphs Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 16	Course Name: Data Structures Topic: Heap	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to:
	   a. articulate the concept of heap.
	   b. select the appropriate Heap for different use-case scenarios.
	   c. illustrate different Heap with examples.
	   d. appreciate advantages of Heap and its associated challenges

Teaching Aids (if any)	a. Video of Facebook data center b. Use of Nearpod tool for online quiz

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	     - What do you mean by Heap data structure.
	     - Representation of Heap data structure.
	     - Various operation performed on heap.
	2. **Development** (30 minutes)
	     - Definition/Introduction of Heap data structure.
	     - Explanation on Representation of Heap data structure. Detailed concept about various operation performed on heap
	3. **Exercise** (5 minutes)
	     - Ask students to explain Heap data structure and to narrate its operations .
	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
	    - Original NIST Paper on Heap
	      http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	3. Homework
	    - Create your video log highlighting Heap concepts and submit on Google classroom.
	
	Spend 5 minutes to wrap up and consolidate the learnings

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

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Lesson Plan No.23	Course Name: Data Structures Topic: Insertion sort	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to: 　a. articulate the concept of insertion sort. 　b. select the appropriate insertion sort model for different use-case scenarios. 　c. illustrate different insertion sort with examples. 　d. appreciate advantages of insertion sort and its associated challenges
Teaching Aids (if any)	a. Video of Facebook data center 　b. Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (5 minutes) Ask questions 　　　- What do you mean by Insertion sort? 　　　- Insertion sort complexity 　　　- Optimized Insertion sort Algorithm. 　2. **Development** (30 minutes) 　　　- Definition/Introduction of Insertion sort. 　　　- Explanation on Working of Insertion sort Algorithm. 　　　- Insertion sort complexity 　3. **Exercise** (5 minutes) 　　　- Ask students to explain Insertion sort and to narrate its algorithms and uses. 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 　　- Original NIST Paper on insertion sort 　　http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf 　3. Homework 　　- Create your video log highlighting insertion sort concepts and submit on Google classroom. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 　2. Nearpod Quiz on insertion sort Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 25	Course Name: Data Structures Topic: Internal External Sorting	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to: a. articulate the concept of internal external sorting . b. select the appropriate internal external sorting for different use-case scenarios. c. illustrate different internal external sorting with examples. d. appreciate advantages of internal external sorting and its associated challenges
Teaching Aids (if any)	a. Video of Facebook data center b. PowerPoint Presentation c. Use of Nearpod engagement tool for online quiz d. Pen Tablet for highlighting important points

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	   - What do you mean by Sorting Algorithm?
	   - Different Sorting Categories like Internal sorting and External sorting.
	   - Types of Sorting in Data Structure.
	
	2. **Development** (30 minutes)
	   - Definition/Introduction of Sorting Algorithm.
	   - Explanation on Different Sorting Categories like Internal sorting and External sorting.
	   - Types of Sorting in Data Structure **.**
	3. **Exercise** (5 minutes)
	   - Ask students to explain Sorting Algorithm and to narrate its Categories and types.
	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
	   - Original NIST Paper on internal external sorting
	    http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	3. Homework
	   - Create your video log highlighting internal external sorting concepts and submit on Google classroom.
	
	Spend 5 minutes to wrap up and consolidate the learnings

Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Nearpod Quiz on internal external sorting

	Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 27	Course Name: Data Structures Topic: Merge Sort	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to:
	   a. articulate the concept of merge sorting.
	   b. select the appropriate merge sorting for different use-case scenarios.
	   c. illustrate different merge sorting with examples.
	   d. appreciate advantages of merge sorting and its associated challenges

Teaching Aids (if any)	a. Video of Facebook data center
	   b. PowerPoint Presentation
	   c. Use of Nearpod engagement tool for online quiz
	   d. Pen Tablet for highlighting important points

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	    - What do you mean by Merge sort?
	    - Merge sort complexity
	    - Optimized Merge sort Algorithm.
	
	2. **Development** (30 minutes)
	    - Definition/Introduction of Merge sort.
	    - Explanation on Working of Merge sort Algorithm.
	    - Merge sort complexity
	3. **Exercise** (5 minutes)
	    - Ask students to explain Merge sort and to narrate its algorithms and uses.
	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
	    - Original NIST Paper on merge sorting
	     http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	3. Homework
	    - Create your video log highlighting merge sorting concepts and submit on Google classroom.
	
	Spend 5 minutes to wrap up and consolidate the learnings

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

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Lesson Plan No. 10	Course Name: Data Structures Topic: m-way Trees	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to:
	  a. Understand the m-way trees.
	  b. Articulate searching in an m-way trees.

Teaching Aids (if any)	a) PowerPoint Presentation b) Use of Near Pod engagement tool for online quiz c) Pen Tablet for highlighting important points.

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	  - What do you mean by m-way trees?
	  - How to perform in an m-way trees data structure .
	
	2. **Development** (30 minutes)
	  - Definition/Introduction of in an m-way trees.
	  - Explanation on Working of an m-way trees.
	  - Perform searching in an m-way trees
	3. **Exercise** (5 minutes)
	  - Ask students to explain m-way trees and to narrate its working.
	Use Nearpod to collect responses and discuss the answers.

Closure	- Summarize the Lesson Learning Outcomes and get affirmation from students on these. Spend **5 minutes** to wrap up and consolidate the learnings Suggested Video Lecture
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Nearpod Quiz on m-way trees. Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 8	Course Name: Data Structures Topic: Operations on Queues	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to:
	   a. Understand the Queues and its types.
	   b. Articulate various operation perform on Queues.

Teaching Aids (if any)	a. Video of Facebook data center b. Use of Nearpod tool for online quiz

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	     - What do you mean by Queues?
	     - Representation of Queues.
	     - various operation perform on Queues.
	
	2. **Development** (30 minutes)
	     - Definition/Introduction of Queues.
	     - Explanation on Representation of Queues.
	     - Detailed concept about the representation of Queues.
	
	3. **Exercise** (5 minutes)
	     - Ask students to explain data and to narrate its different types and uses.
	   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
	   - Original NIST Paper on Cloud Computing
	    http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	3. Homework
	   - Create your video log highlighting Various different Operations on Queues concepts and submit on Google classroom.
	
	Spend 5 minutes to wrap up and consolidate the learnings

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

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Lesson Plan No.18	Course Name: Data Structures	Course No.: PSCSATC 221
	Topic: Primitive and Composite data	

Objectives	At the end of the lesson the student shall be able to: a. Understand the Fundamental Notations b. Articulate that what are the types of data
Teaching Aids (if any)	a) PowerPoint Presentation b) Use of Near Pod engagement tool for online quiz c) Pen Tablet for highlighting important points

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	    - What do you mean by data and information?
	    - What are the types of data.
	    - What do mean by Primitive and composite data.
	2. **Development** (30 minutes)
	    - Definition/Introduction of data and information.
	    - Explanation on various type of data.
	    - Detailed concept about the Primitive and composite data.
	    - Description on types of data.
	3. **Exercise** (5 minutes)
	    - Ask students to explain data and to narrate its different types and uses.
	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
	    - Original NIST Paper on Primitive and composite data.
	    - http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	3. Homework
	    - Create your video log highlighting Primitive and composite data concepts and submit on Google classroom.
	
	Spend 5 minutes to wrap up and consolidate the learnings

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

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Lesson Plan No. 7	Course Name: Data Structures Topic: Queues	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to: a. Understand the Queues and its types. b. Articulate various operation perform on Queues.
Teaching Aids (if any)	a) PowerPoint Presentation b) Use of Near Pod engagement tool for online quiz c) Pen Tablet for highlighting important points d) Chalk & Talk for offline classes.

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	    - What do you mean by Queues?
	    - Representation of Queues.
	    - various operation perform on Queues.
	
	2. **Development** (30 minutes)
	    - Definition/Introduction of Queues.
	    - Explanation on Representation of Queues.
	    - Detailed concept about the representation of Queues.
	
	3. **Exercise** (5 minutes)
	    - Ask students to explain data and to narrate its different types and uses.
	Use Nearpod to collect responses and discuss the answers.

Closure	- Summarize the Lesson Learning Outcomes and get affirmation from students on these. Spend **5 minutes** to wrap up and consolidate the learnings Suggested NEPTEL Video Lecture
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Nearpod Quiz on Queues Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 22	Course Name: Data Structures Topic: Quick Sort	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to:
	  a. articulate the concept of quick sort.
	  b. select the appropriate quick sort for different use-case scenarios.
	  c. illustrate different quick sort with examples.
	  d. appreciate advantages of quick sort and its associated challenges

Teaching Aids (if any)	a. Video of Facebook data center
	  b. PowerPoint Presentation
	  c. Use of Nearpod engagement tool for online quiz
	  d. Pen Tablet for highlighting important points

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	  - What do you mean by Quick sort?
	  - Quick sort complexity
	  - Optimized Quick sort Algorithm.
	
	2. **Development** (30 minutes)
	  - Definition/Introduction of Quick sort.
	  - Explanation on Working of Quick sort Algorithm.
	  - Quick sort complexity
	3. **Exercise** (5 minutes)
	  - Ask students to explain Quick sort and to narrate its algorithms and uses.
	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
	  - Original NIST Paper on quick sort
	    http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	3. Homework
	  - Create your video log highlighting quick sort concepts and submit on Google classroom.
	
	Spend 5 minutes to wrap up and consolidate the learnings

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

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Lesson Plan No. 26	Course Name: Data Structures Topic: Radix Sort	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to:
	  a. articulate the concept of radix sort.
	  b. select the appropriate radix sort for different use-case scenarios.
	  c. illustrate different radix sort with examples.
	  d. appreciate advantages of radix sort and its associated challenges

Teaching Aids (if any)	a. Video of Facebook data center b. PowerPoint Presentation c. Use of Nearpod engagement tool for online quiz d. Pen Tablet for highlighting important points

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	   - What do you mean by Radix sort?
	   - Radix sort complexity
	   - Optimized Radix sort Algorithm.
	
	2. **Development** (30 minutes)
	   - Definition/Introduction of Radix sort.
	   - Explanation on Working of Radix sort Algorithm.
	   - Radix sort complexity
	3. **Exercise** (5 minutes)
	   - Ask students to explain Radix sort and to narrate its algorithms and uses.
	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
	   - Original NIST Paper on radix sort
	     http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	3. Homework
	   - Create your video log highlighting radix sort concepts and submit on Google classroom.
	
	Spend 5 minutes to wrap up and consolidate the learnings

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

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Lesson Plan No.24	Course Name: Data Structures Topic: Selection Sort	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to:
	   a. articulate the concept of selection sort.
	   b. select the appropriate selection sort for different use-case scenarios.
	   c. illustrate different selection sort with examples.
	   d. appreciate advantages of selection sort and its associated challenges

Teaching Aids (if any)	a. Video of Facebook data center
	   b. PowerPoint Presentation
	   c. Use of Near Pod engagement tool for online quiz
	   d. Pen Tablet for highlighting important points

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	    - What do you mean by Selection sort?
	    - Selection sort complexity
	    - Optimized Selection sort Algorithm.
	
	2. **Development** (30 minutes)
	    - Definition/Introduction of Selection sort.
	    - Explanation on Working of Selection sort,Algorithm.
	    - Selection sort complexity
	3. **Exercise** (5 minutes)
	    - Ask students to explain Selection sort and to narrate its algorithms uses.
	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
	    - Original NIST Paper on selection sort
	      http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	3. Homework
	    - Create your video log highlighting selection sort concepts and submit on Google classroom.
	
	Spend 5 minutes to wrap up and consolidate the learnings

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

Lesson Plan No. 29	Course Name: Data Structures Topic: shell sort	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to:
	   a. articulate the concept of shell sorting.
	   b. select the appropriate shell sorting for different use-case scenarios.
	   c. illustrate different shell sorting with examples.
	   d. appreciate advantages of shell sorting and its associated challenges

Teaching Aids (if any)	a. Video of Facebook data center
	   b. PowerPoint Presentation
	   c. Use of Nearpod engagement tool for online quiz
	   d. Pen Tablet for highlighting important points

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	   - What do you mean by Shell sort?
	   - Shell sort complexity
	   - Optimized Shell sort Algorithm.
	
	2. **Development** (30 minutes)
	   - Definition/Introduction of Shell sort.
	   - Explanation on Working of Shell sort Algorithm.
	   - Shell sort complexity
	3. **Exercise** (5 minutes)
	   - Ask students to explain Shell sort and to narrate its algorithms and uses.
	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
	   - Original NIST Paper on shell sorting
	     http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	3. Homework
	   - Create your video log highlighting shell sorting concepts and submit on Google classroom.
	
	Spend 5 minutes to wrap up and consolidate the learnings

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

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Lesson Plan No. 14	Course Name: Data Structures Topic: Threaded Binary Tree	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to: a. Understand the Threaded Binary Tree. b. Articulate various types of Threaded Binary Tree .
Teaching Aids (if any)	a) PowerPoint Presentation b) Use of Near Pod engagement tool for online quiz c) Pen Tablet for highlighting important points

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	    - What do you mean by Threaded Binary Tree?
	    - Representation of Threaded Binary Tree.
	    - Various types of Threaded Binary Tree.
	
	2. **Development** (30 minutes)
	    - Definition/Introduction of Threaded Binary Tree.
	    - Explanation on Representation of Threaded Binary Tree.
	    - Detailed concept about the types of Threaded Binary Tree
	
	3. **Exercise** (5 minutes)
	    - Ask students to explain Threaded Binary Tree and to narrate its different types and uses.
	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
	    - Original NIST Paper on Threaded Binary Trees
	      http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	3. Homework
	    - Create your video log highlighting Threaded Binary Trees concepts and submit on Google classroom.
	
	Spend 5 minutes to wrap up and consolidate the learnings

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

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Lesson Plan No. 19	Course Name: Data Structures Topic: Traversing Graphs	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to:
	   a. Understand the Traversing graphs.
	   b. Articulate various algorithms for Traversing graphs.
	   c. illustrate different Traversing graphs techniques with examples.
	   d. appreciate advantages of traversing graphs and its associated challenges

Teaching Aids (if any)	a. Video of Facebook data center b. Use of Nearpod tool for online quiz

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	    - What do you mean by Traversing graphs?
	    - various algorithms for Traversing graphs.
	
	2. **Development** (30 minutes)
	    - Definition/Introduction of Traversing graphs.
	    - Explanation on various algorithms for Traversing graphs.
	
	3. **Exercise** (5 minutes)
	    - Ask students to explain graphs and to narrate algorithms for Traversing graphs
	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
	   - Original NIST Paper on Traversing graphs techniques
	    http://faculty.winthrop.edu/domanm/csci411/Handouts/NIST.pdf
	3. Homework
	   - Create your video log highlighting cloud computing concepts and submit on traversing Graphs.
	
	Spend 5 minutes to wrap up and consolidate the learnings

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

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Lesson Plan No. 9	Course Name: Data Structures Topic: Trees	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to:
	   a. Understand the Trees and its types.
	   b. Articulate various **Basic Terminology In Tree Data Structure.**

Teaching Aids (if any)	a) PowerPoint Presentation b) Use of Near Pod engagement tool for online quiz c) Pen Tablet for highlighting important points d) Chalk & Talk for offline classes.

Teaching Development	1. **Introduction** (5 minutes)
	Ask questions
	   - What do you mean by **Tree Data Structure**?
	   - What are various **Basic Terminology In Tree Data Structure**.
	   - Different type of tree data structure.
	2. **Development** (30 minutes)
	   - Definition/Introduction of **Tree Data Structure**.
	   - Explanation on **Basic Terminology In Tree Data Structure**..
	   - Detailed concept about the types .
	
	3. **Exercise** (5 minutes)
	   - Ask students to explain trees and to narrate its different types and uses.
	Use Nearpod to collect responses and discuss the answers.

Closure	- Summarize the Lesson Learning Outcomes and get affirmation from students on these. Spend **5 minutes** to wrap up and consolidate the learnings Suggested Video Lecture
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Nearpod Quiz on Trees. Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 1	Course Name: Data Structures Topic: Introduction to Arrays	Course No.: PSCSATC 221

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of arrays their representation . b. Understand various operations performed on arrays.
Teaching Aids (if any)	a) PowerPoint Presentation b) Use of Near Pod engagement tool for online quiz c) Pen Tablet for highlighting important points d) Chalk & Talk for offline classes.Use of Nearpod tool for online quiz
Teaching Development	1. **Introduction** (10 minutes) Ask questions - What do you mean by Array? - Representation of Array. - What are the operations performed on Array . 2. **Development** (30 minutes) - Definition/Introduction of Array. - Explanation on various type of Array. - Detailed concept of various operations performed on arrays. 3. **Exercise** (5 minutes) - Ask students to explain array and to narrate its different types and operations performed on it.. Use Nearpod to collect responses and discuss the answers..
Closure	- Summarize the Lesson Learning Outcomes and get affirmation from students on these. Spend **5 minutes** to wrap up and consolidate the learnings Suggested Video Lecture
Evaluation	1. Reflective Questions (What, why, Who?). Allow students to answer and discuss. 2. Responses acquired from Near Pod Quiz on AIS. 3. Spend 5 minutes to evaluate student assimilation of the lesson contents

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