Course Title	:	Practical Application of Deep Learning
Course Code	:	CDS525
Recommended Study Year	:	1
No. of Credits/Term	:	3
Mode of Tuition	:	Lectures
Class Contact Hours	:	42 hours (3 to 6 hours per week*)
Category in Major Prog.	:	Required course
Discipline	:	Business
Prerequisite(s)	:	Nil
Co-requisite(s)	:	Nil
Exclusion(s)	:	Nil
Exemption Requirement(s)	:	Nil

Brief Course Description:

Deep learning is one of the bleeding-edge technologies of machine learning. It is a neural network used to establish and simulate the human brain for analytical learning and to interpret data by imitating the mechanism of the human brain. Deep learning is widely used in computer vision, speech recognition, natural language processing, and other fields. This course aims at providing an intensive understanding and hands-on experience of the existing deep learning approaches. The topics will cover how to select deep neural networks, how to design deep neural networks, and how to train and optimize the neural networks for practical applications. The course will cover deep neural network models, including convolutional neural networks, recurrent neural networks, long short-term memory networks, deep residual networks, generative adversarial networks, attention-based models, adversarial learning models, and training techniques including dropout, batch normalization, selection of activation functions and so on. TensorFlow, Pytorch, or other state-of-the-art deep learning tools will be introduced and applied to solve different classes of problems with huge datasets in business domains.

Aims:

This course aims to:

1. Introduce fundamental theories, concepts, and approaches to deep learning.
2. Develop students' ability to use TensorFlow, Pytorch or other state-of-the-art deep learning platforms.
3. Enable students to solve various business problems with huge datasets using deep learning techniques.
4. Equip students communication skills for presenting and delivering their deep learning solutions for business problems to different stakeholders.

Learning Outcomes (LOs):

Upon successful completion of this course, students will be able to:

1. Identify, describe and apply various deep learning models for problem solving;
2. Discriminate and verify the advantages and limitations of various deep learning networks under different business scenarios;
3. Design, implement and deploy deep learning models and systems for solving some real-world business problems;
4. Visualize and present the solutions or findings based on deep learning models for business problems.

Indicative Contents:

1. Neural Networks
   Perceptron, fully connective layer, active function, output layer, loss.

2. Deep Feedforward Networks
   Basic theory: overfitting, overgeneralization, stochastic gradient descent, hidden units, regularization, architecture design
   Classical models: Multilayer perceptron network, Back-propagation network, Radial basis function network and so on.
   Practical Applications- function approximation, drug prediction, badge classification

3. Convolutional Neural Networks
   Basic theory: convolution layers, pooling layers, gradient propagation, batch normalization, transferred learning;
   Classical models: LeNet-5, DRN, ResNet, DensNet, GoogleNet, VGG net, AlexNet;
   Practical Applications- image classification, object recognition, action recognition, pose estimation

4. Recurrent Neural Networks
   Classical models: Recurrent neural networks, bidirectional recurrent neural networks, long-short term memory models;
   Practical Applications- voice recognition, text recognition, action recognition

5. Unsupervised Pre-trained Neural Networks
   Classical models: auto-encoder, deep generative models, Boltzmann machines, restricted Boltzmann machines, deep belief neural networks.
   Practical Applications- Dimension reduction, feature extraction and reconstruction

6. Other Deep Learning Methods

Classical models: Generative adversarial networks, attention-based models, adversarial learning models, deep reinforcement learning,

Practical Applications-image generation, image transformation

Teaching Methods:

There are different teaching and learning activities, including lectures, assignments, and tutorials. The concepts, principles, and categories of deep learning and different will be discussed in lectures. Students will learn how to select deep neural networks, how to design deep neural networks, how to train and optimize the neural networks for practical applications in lectures. The implementations of deep neural networks in TensorFlow, PyTorch, or Keras will be assigned as daily group assignments and projects. Students will learn these two parts by hand-on programming based on some real projects. The edge deep learning technologies and applications will be discussed in tutorials. Students will learn these parts by analyzing some real cases and application examples.

Measurement of Learning Outcomes:

Learning Outcome	**Class Attendance and Participation**	**Individual Assign-ments**	**Group Project**	**Group Present-ation**	**Examination**
1. Identify, describe and apply various deep learning models for problem solving	✓	✓	✓	✓	✓
2. Discriminate and verify the advantages and limitations of various deep learning network under different business scenario	✓	✓	✓	✓	✓
3. Design, implement and deploy deep		✓	✓	✓	✓

learning models and systems for solving some real-world business problems					
4. Visualize and present the solutions or findings based on deep learning models for business problems			✓	✓	✓

Assessment:

1. **10% Class Attendance and Participation:** Class attendance and participation evaluate whether students identify and describe various deep learning models, criticize and value various deep learning networks under different scenarios.
2. **20% Individual Assignments:** Assignments require students to criticize and value various deep learning networks under different scenarios, apply deep learning tools to programming deep learning methods.
3. **20% Group Project:** A group project requires students to develop and deploy deep learning systems to solve some sophisticated business problems. They need to analyze and design deep learning models, programming the models to solve practical problems. Meanwhile, students can present their work well.
4. **10% Group Presentation:** Students will form groups present and visualize their ideas about the rationale and procedures for developing deep learning solutions for business problems. This is to verify their communication skills and critical thinking on how to deliver and visualize their deep learning solutions for business problems for different stakeholders with a variety of diverse backgrounds.
5. **40% Examination:** Assess various deep learning models for problems solving, the advantage and limitations of deep neural networks, design of deep learning models for business problems, and deliver and visualize their solutions comprehensively.

Required/Essential Readings:

Goodfellow, Ian, Bengio, Yoshua, and Courville, Aaron (2016). *Deep learning*. MIT press.

Aggarwal, Charu C. (2018). *Neural networks and deep learning*. Springer.

Recommended/Supplementary Readings:

Gilbert Strang (2016). *Introduction to Linear Algebra, Fifth Edition*, Wellesley-Cambridge Press

Francois Chollet (2018). *Deep Learning with Python,* Manning Publications Co.

Rajalingappaa Shanmugamani (2018) *Deep Learning for Computer Vision: Expert techniques to train advanced neural networks using TensorFlow and Keras*, Packt Publishing.

Patterson, Josh, and Gibson, Adam. (2017). *Deep Learning: A Practitioner's Approach*. O'Reilly Media.

Chris Albon (2018). *Machine Learning with Python Cookbook: Practical Solutions from Preprocessing to Deep Learning*, O'Reilly Media.

Maxim Lapan. (2018). *Deep Reinforcement Learning Hands-On: Apply modern RL methods, with deep Q-networks, value iteration, policy gradients, TRPO, AlphaGo Zero and more (English Edition)*. Packt Publishing.

Vihar Kurama. (2020). *Hands-On Neural Networks with PyTorch 1.0: An all-in-one guide to implement deep learning architectures using Python (English Edition)*. Packt Publishing.

Giancarlo Zaccone, Md. Rezaul Karim. (2018). *Deep Learning with TensorFlow: Explore neural networks and build intelligent systems with Python, 2nd Edition (English Edition)*. Packt Publishing.

Rowel Atienza. (2018). *Advanced Deep Learning with Keras: Apply deep learning techniques, autoencoders, GANs, variational autoencoders, deep reinforcement learning, policy gradients, and more (English Edition)*. Packt Publishing.

Yusuke Sugomori,Boštjan Kaluža,Fábio M. Soares,Alan M. F. Souza. (2017). *Deep Learning: Practical Neural Networks with Java*. Packt Publishing.

Important Notes:

(1) Students are expected to spend a total of 9* hours (i.e. 3* hours of class contact and 6* hours of personal study) per week to achieve the course learning outcomes.
(2) Students shall be aware of the University regulations about dishonest practice in course work, tests and examinations, and the possible consequences as stipulated in the Regulations Governing University Examinations and Course Work. In particular, plagiarism, being a kind of dishonest practice, is "the presentation of another person's work without proper acknowledgment of the source, including exact phrases, or summarised ideas, or even footnotes/citations, whether protected by copyright or not, as the student's own work". Students are required to strictly follow university regulations governing academic integrity and honesty.

(3) Students are required to submit writing assignment(s) using Turnitin.
(4) To enhance students' understanding of plagiarism, a mini-course "Online Tutorial on Plagiarism Awareness" is available on https://pla.ln.edu.hk/.

** Numbers of hours per week are subject to different modes of teaching.*

Course Title	:	Big Data Analytics
Course Code	:	CDS527
Recommended Study Year	:	1
No. of Credits/Term	:	3
Mode of Tuition	:	Lectures
Class Contact Hours	:	42 hours (3 to 6 hours per week*)
Category in Major Prog.	:	Elective course
Discipline	:	Business
Prerequisite(s)	:	Nil
Co-requisite(s)	:	Nil
Exclusion(s)	:	Nil
Exemption Requirement(s)	:	Nil

Brief Course Description:

This course provides an understanding of the concept and challenge of big data. The focus is on the data analytic techniques to tackle the V's (volume, velocity, variety, veracity, valence, and value) in big data and how these impacts data collection, monitoring, storage, analysis and reporting. The following topics across the big data domain will be introduced: distributed file systems; big data analysis techniques; high-performance processing algorithms for big data; big data search and query technologies. An example (Apache Spark) of big data management system to manage and process large-scale data is introduced in the course. Big data analytics applications in business will also be elaborated. Students will actively participate in the delivery of this course through assignments, portfolio development, and projects.

Aims:

This course aims to:

1. Understand the fundamental platforms, such as Spark, Hadoop, and other tools.
2. Develop students' hands-on experience of construction of big data analysis using professional software packages.
3. Identify the challenges and constraints associated with scaling big data algorithms.
4. Enhance students' reasoning and problem-solving abilities, particularly in dealing with big data analytics solution in real applications.

Learning Outcomes (LOs):

Upon completion of this course, students will be able to:

1. Explain the concepts and components of fundamental platforms supporting big data applications.
2. Evaluate the efficiency and effectiveness of big analytical data management systems in business areas.
3. Apply and implement the tools and techniques of big data analytics using pySpark.

4. Construct a big analytical data management system and decision support system using professional software.
5. Deliver the system and demonstrate communication strategies with different stakeholders with various backgrounds.

Indicative Contents:

1. An Introduction to Spark with Python
    a. Components
    b. How Spark Works
    c. Configuration Running Platform
2. Programming with Resilient Distributed Dataset (RDD)
    a. Create RDD
    b. Spark Operations
3. Statistics and Linear Algebra Preliminaries
    a. Linear Algebra Preliminaries
    b. Measurement Formula
    c. Confusion Matrix
4. Data Exploration, Manipulation and Feature Extraction for Big Data
    a. Univariate Analysis
    b. Multivariate Analysis
    c. Data Manipulation
    d. Feature Transform
    e. Feature Selection
5. Regression, Classification and Clustering Solution for Big Data
    a. Linear Regression
    b. Generalized Linear Regression
    c. Binomial Logistic Regression
    d. Multinomial logistic regression
    e. Decision Tree Regression and Classification
    f. Random Forest Regression and Classification
    g. Gradient-boosted Tree Regression and Classification
    h. Naive Bayes Classification
    i. K-Means Clustering
6. Text Mining Solution
    a. Text collection
    b. Text Preprocessing
    c. Text Classification
    d. Sentiment analysis
    e. N-grams and Correlations
7. Wrap PySpark Package

a. Package Wrapper
b. Package Publishing on PyPI
c. Install from Repo
d. Auditing on Big Dataset
e. PySpark API

8. Real world Business Application Practice

Teaching Method:

There are different teaching and learning activities, including lectures, assignments, project and tutorials. The basic concepts and components of fundamental platforms supporting big data applications will be explained in lectures (LO1). Students will also learn various data exploration, manipulation and feature extraction, regression, classification and clustering solutions, and text mining in lectures (LO3). The implementations of some solutions in PySpark platforms and tools will be assigned as group projects (LO3-5). The detailed efficiency and effectiveness of different solutions will be discussed in tutorials (LO2).

Measurement of Learning Outcomes:

Learning Outcomes	**Attendance and In-class Participation**	**Individual Assignments**	**Group Project**	**Group Presentation**
Explain the concepts and components of fundamental platforms supporting Big Data applications.	✓	✓	✓	✓
Evaluate the efficiency and effectiveness of big analytical data management systems in business areas.	✓	✓	✓	✓
Apply and implement the tools and techniques of big data analytics using pySpark.		✓	✓	✓
Construct a big analytical data management system and decision support system using professional software.			✓	✓
Deliver the system and demonstrate communication strategies with different stakeholders with various backgrounds.			✓	✓

Assessment:

1. **10% Attendance and In-class Participation:** In class, students need to understand the concepts and components of fundamental platforms for big data analytics. Furthermore, they need to learn how to evaluate the efficiency and effectiveness of big analytical data management systems in business areas. Attendance will be taken in each lecture and grade also depends on whether a student actively participates in discussion and offers constructive views.

2. **30% Individual Assignments**: Students will individually work on several after-class assignments. These assignments will test whether students are able to understand the basic concept of components of fundamental platforms for big data analytics, evaluate the efficiency and effectiveness of big analytical data management systems in business areas.

3. **40% Group Project**: Students will work as groups. The Project will test whether students are able to work as a team to solve the real world problem by using professional software.

4. **20% Group Presentation:** Students will form groups and present their ideas about the rationale and procedures for developing a big analytical data management system and decision support system for business problems. This is to verify their communication skills and critical thinking on how to deliver their system for business problems for the users with different backgrounds.

Required/Essential Readings:

N/A

Recommended/ Supplementary Readings:

1. Wenqiang Feng: *Learning Apache Spark with Python*, 2020. [Online]: https://runawayhorse001.github.io/LearningApacheSpark/pyspark.pdf
2. EMC Education Services: *Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data*, 2015.ISBN: 9781118876138.
3. Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia: *Learning Spark: Lightning-Fast Big Data Analysis 1st Edition*, ISBN: 1449358624.
4. Rajkumar Buyya Rodrigo Calheiros Amir Vahid Dastjerdi: *Big Data: Principles and Paradigms, 1st Edition*, 2016, ISBN: 9780128093467.
5. Venkat Ankam: *Big Data Analytics*, 2016, ISBN: 9781785884696.

Important Notes:

(1) Students are expected to spend a total of 9* hours (i.e. 3* hours of class contact and 6* hours of personal study) per week to achieve the course learning outcomes.
(2) Students shall be aware of the University regulations about dishonest practice in course work, tests and examinations, and the possible consequences as stipulated in the Regulations Governing University Examinations and Course Work. In particular, plagiarism, being a kind of dishonest practice, is "the presentation of another person's work without proper acknowledgement of the source, including exact phrases, or summarised ideas, or even footnotes/citations, whether protected by copyright or not, as the student's own work". Students are required to strictly follow university regulations governing academic integrity and honesty.
(3) Students are required to submit writing assignment(s) using Turnitin.
(4) To enhance students' understanding of plagiarism, a mini-course "Online Tutorial on Plagiarism Awareness" is available on https://pla.ln.edu.hk/.

** Numbers of hours per week are subject to different modes of teaching.*

Course Title	**:** Blockchain
Course Code	**:** CDS528
Recommended Study Year	**:** 1
No. of Credits/Term	**:** 3
Mode of Tuition	**:** Lectures
Class Contact Hours	**:** 42 hours (3 to 6 hours per week*)
Category	**:** Elective course
Discipline	**:** Business
Prerequisite(s)	**:** Nil
Co-requisite(s)	**:** Nil
Exclusion(s)	**:** Nil
Exemption Requirement(s)	**:** Nil

Brief Course Description:

Blockchain, as a decentralized open ledger, has proven to be a phenomenal success. This ground-breaking technique holds a huge promise in various fields, digital identification, data marketing, cryptocurrencies like bitcoin, etc. This course introduces students the fundamentals of blockchain, distributed ledger technology, alternative consensus, smart contracts and security, and cryptocurrencies. Case studies of cryptocurrencies and examples of application (e.g., Bitcoin) will be also elaborated. Students will understand the impact of blockchain technologies on financial services and other industries through assignments and projects.

Aims:

This course aims to:

1. Demonstrate a blockchain system's fundamental components, how they fit together and examine a modular blockchain system in more detail.
2. Understand private and public keys as well as addresses and how exactly they are constructed and used.
3. Provide a thorough understanding of cryptocurrency, smart contracts, their technical capabilities, practical applications, limitations and security constraints they operate within.
4. Enhance students' reasoning, problem-solving and modeling abilities, particularly in dealing with blockchain solution in real applications.

Learning Outcomes (LOs):

Upon successful completion of this course, students will be able to:

1. Explain the concepts and components of blockchain, cryptocurrency, and distributed ledger technologies;
2. Evaluate security issues relating to blockchain and cryptocurrency;
3. Analyze the application and impact of blockchain technology in the business areas; and
4. Design solution by using blockchain technologies in other markets.

Indicative Contents:

1. Introduction
2. Cryptography and Security
    a. Asymmetrical Cryptography
    b. Public key and Private key
3. Blockchain Fundamental Technologies
    a. Distributed System
    b. Hash Function
    c. Digital Signature
    d. Alternative Consensus
    e. Smart Contract
    f. P2P Network
    g. Classification
4. Bitcoin
    a. Bitcoin Network
    b. Bitcoin clients and APIs
    c. Transaction and Payments
    d. Bitcoin Mining
5. Other Classical Blockchain Systems
    a. Hyperledger
    b. Ethereum

Teaching Method:

There are different teaching and learning activities, including lectures, assignments, projects, and tutorials. The concepts of cryptography and security, data models, blockchain fundamental technologies, and bitcoin technologies will be discussed in lectures (LO1, LO3). The instructor will provide in-class examples while students need to work on in-class exercises. Students will also learn classical blockchain systems in real world. The implementations of blockchain fundamental technologies and classical systems will be assigned as group projects (LO4). The security evaluation, impact analysis and solution design will be discussed in tutorials (LO2).

Measurement of Learning Outcomes:

Learning Outcomes	Attendance and In-class Participation	Assignments	Project	Examination
Understand the concepts and components of blockchain, cryptocurrency, and distributed ledger technologies.	✓	✓	✓	✓
Evaluate security issues relating to blockchain and cryptocurrency.	✓	✓	✓	✓
Analyze the application and impact of blockchain technology in the business areas.		✓	✓	✓
Design solution by using blockchain technologies in other markets.		✓	✓	✓

Assessment:

1. **10% Attendance and In-class Participation**: In class, students need to understand various knowledge of blockchain, cryptocurrency, and distributed ledger technologies. Furthermore, they need to learn security issues relating to blockchain and cryptocurrency. Attendance will be taken in each lecture and grade also depends on whether a student actively participates in discussion and offers constructive views.

2. **20% Assignments**: Students will individually work on several after-class assignments. These assignments will test whether students are able to understand the basic concept of blockchain, cryptocurrency and distributed ledger technologies. apply blockchain methodologies to formulate the problem and whether they are able to comprehensively solve the problem.

3. **40% Project**: Students will work as groups. The Project will test whether students are able to work as a team to solve the real world problem by using blockchain.

4. **30% Examinations**: Exam will include basic concept of blockchain, cryptocurrency, and distributed ledger technologies. Each problem requires students to formulate problem and convey ideas and solutions, and apply appropriate analytics techniques.

Required/Essential Readings:

N/A

Recommended/ Supplementary Readings:

1. William Mougayar. The Buisness Blockchain: Promise, Practice, and Application of the Next Internet Technology. Wiley; 1st edition (May 9, 2016), ISBN: 9781119300311.
2. Daniel Drescher. Blockchain Basics: A Non-Technical Introduction in 25 Steps. 1st edition, ISBN: 1484226038.
3. Melanie Swan. Blockchain: Blueprint for a New Economy. ISBN: 9781491920497.
4. Imran Bashir. Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained, 2nd Edition, ISBN: 1788839048.
5. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction. Princeton University Press (July 19, 2016), ISBN: 0691171696.
6. Nakamoto S. Bitcoin: A peer-to-peer electronic cash system[J]. 2008.

Important Notes:

(1) Students are expected to spend a total of 9* hours (i.e. 3* hours of class contact and 6* hours of personal study) per week to achieve the course learning outcomes.

(2) Students shall be aware of the University regulations about dishonest practice in course work, tests and examinations, and the possible consequences as stipulated in the Regulations Governing University Examinations and Course Work. In particular, plagiarism, being a kind of dishonest practice, is "the presentation of another person's work without proper acknowledgement of the source, including exact phrases, or summarised ideas, or even footnotes/citations, whether protected by copyright or not, as the student's own work". Students are required to strictly follow university regulations governing academic integrity and honesty.

(3) Students are required to submit writing assignment(s) using Turnitin.

(4) To enhance students' understanding of plagiarism, a mini-course "Online Tutorial on Plagiarism Awareness" is available on https://pla.ln.edu.hk/.

** Numbers of hours per week are subject to different modes of teaching.*

Course Title	: Healthcare Analytics
Course Code	: CDS530
Recommended Study Year	: Any
No. of Credits/Term	: 3
Mode of Tuition	: Sectional Approach
Class Contact Hours	: 42 hours (3 to 6 hours per week*)
Category	: Elective course
Discipline	: -
Prerequisite(s)	: Nil
Co-requisite(s)	: Nil
Exclusion(s)	: Nil
Exemption Requirement(s)	: Nil

Brief Course Description:

Healthcare analytics transform the traditional medical system in an all-round way, making healthcare more efficient, more convenient, and more personalized. This course will introduce student the key technologies that support smart healthcare. It explains how to build the surveillance infrastructure and how the data is collected and transmitted back from various wearable sensors of multiple sources, by using the technologies of Internet of Things (IoT): MAC protocols, routing protocols. This course will also describe data fusion of health and healthcare data, data models, data management, machine learning algorithms, and analytics techniques and tools for health risk prediction. Case studies and examples of application will be elaborated in this course.

Aims:

This course aims to:

1. Demonstrate knowledge of how data are gathered, transmitted, managed, and analyzed for healthcare data analytics.
2. Demonstrate knowledge of the principles undergirding the tools of big data analysis in health care.
3. Provide a comprehensive foundation to apply machine learning algorithms, analytics techniques in solving problems in healthcare.
4. Enhance students' reasoning, problem-solving and modeling abilities, particularly in dealing with healthcare data problems.

Learning Outcomes (LOs):

On completion of this course, students will be able to:

1. Demonstrate a comprehension of understanding of how data are gathered, stored, managed, and analyzed for healthcare data analytics.

2. Apply tools and techniques in the analysis of real world healthcare data effectively.
3. Formulate problems and convey solutions in healthcare analytics.
4. Evaluate and validate the discovered knowledge.

Indicative Contents:

1. Data Sensing
    a. Surveillance Infrastructure based on Internet of Things (IoT)
    b. Introduction to Sensing Devices
2. Data Collection
    a. Data Transmission
        i. Mac Protocol
        ii. Routing protocol
    b. Data Fusion
3. Data Analytics Tools and Techniques
    a. Data Model and Management
    b. Statistical Prediction Models
    c. Clinical Prediction Models
        i. Cost Sensitive Learning
        ii. Multiple Instance Learning
        iii. Reinforcement Learning
        iv. Sparse Methods
        v. Kernel Methods
    d. Survival Models
    e. Temporal Data Mining for Healthcare Data
    f. Dimensionality Reduction
    g. Health Risk Prediction
4. Case Study
    a. Real World Healthcare Problem

Teaching Method:

There are different teaching and learning activities, including lectures, assignments, project and tutorials. The concepts of data gathering, data models, data management and data prediction models will be discussed in lectures (LO1). The instructor will provide in-class examples while students need to work on in-class exercises (LO3). Students will also learn various prediction models and survival models in lectures based on real word scenarios (LO1, LO3). The implementations of some data models and prediction models will be assigned as

group projects (LO2). The problem formulation, solution evaluation and knowledge discovery will be discussed in tutorials (LO3-4).

Measurement of Learning Outcomes:

Learning Outcomes	Class Attendance and Participation	Assignments	Project	Examination
Demonstrate a comprehension of understanding of how data are gathered, stored, managed, and analyzed for healthcare data analytics.	✓	✓	✓	✓
Apply tools and techniques in the analysis of real world healthcare data effectively.	✓		✓	✓
Formulate problems and convey solutions in healthcare analytics.		✓	✓	✓
Evaluate and validate the discovered knowledge.		✓	✓	✓

Assessment:

1. **10% Class Attendance and Participation:** In class, students need to understand various knowledge of data sensing and data collection. Furthermore, they need to learn the data analytics tools and techniques. Attendance will be taken in each lecture and grade also depends on whether a student actively participates in discussion and offers constructive views.

2. **20% Assignments**: Students will individually work on several after-class assignments. These assignments will test whether students are able to apply data analytics tools and methodologies to formulate the problem and whether they are able to comprehensively solve the problem.

3. **40% Project**: Students will work as groups. The Project will test whether students are able to work as a team to solve the real world healthcare problem.

4. **30% Examination:** Exam will include basic concept of data sensing and data collection, data analytics tools and techniques. Each problem requires students to formulate problem and convey ideas and solutions, and apply appropriate analytics techniques.

Required/Essential Readings:

N/A

Recommended/ Supplementary Readings:

1. Zhou, Zhi-hua, *Machine Learning, 1st Edition*, Springer Singapore (2020), ISBN: 978-981-15-1966-6
2. Yunhao Liu, *Introduction to IoT*, (2013), ISBN: 978-7-03-037257-4
3. Chandan K. Reddy, *Healthcare Data Analytics*, ISBN: 978-1482232110

Important Notes:

(1) Students are expected to spend a total of 9* hours (i.e. 3* hours of class contact and 6* hours of personal study) per week to achieve the course learning outcomes.

(2) Students shall be aware of the University regulations about dishonest practice in course work, tests and examinations, and the possible consequences as stipulated in the Regulations Governing University Examinations and Course Work. In particular, plagiarism, being a kind of dishonest practice, is "the presentation of another person's work without proper acknowledgement of the source, including exact phrases, or summarised ideas, or even footnotes/citations, whether protected by copyright or not, as the student's own work". Students are required to strictly follow university regulations governing academic integrity and honesty.

(3) Students are required to submit writing assignment(s) using Turnitin.

(4) To enhance students' understanding of plagiarism, a mini-course "Online Tutorial on Plagiarism Awareness" is available on https://pla.ln.edu.hk/.

** Numbers of hours per week are subject to different modes of teaching.*

Course Title	:	Computer Vision
Course Code	:	CDS540
Recommended Study Year	:	1
No. of Credits/Term	:	3
Mode of Tuition	:	Sectional Approach
Class Contact Hours	:	42 hours (3 to 6 hours per week*)
Category	:	Elective course
Discipline	:	-
Prerequisite(s)	:	Nil
Co-requisite(s)	:	Nil
Exclusion(s)	:	Nil
Exemption Requirement(s)	:	Nil

Brief Course Description:

This course will introduce the techniques for visual data processing and analysis. Topics include image processing and analysis in spatial and frequency domains, image restoration and compression, image segmentation and registration, morphological image processing, representation and description, feature description, face recognition, iris recognition, fingerprint recognition, image analysis topics, such as medical image analysis.

Aims:

This course aims to:

1. introduce concepts, techniques and potential applications of computer vision.
2. provide students a comprehensive understanding of the development of computer vision.
3. equip students with hands-on experience in implementing computer vision applications.
4. enable students to apply appropriate computer vision models to solve real world problems.

Learning Outcomes:

On completion of the course, student will be able to:

1. demonstrate command of theories and techniques in computer vision and pattern recognition
2. describe and apply advanced computer vision algorithms for real-world visual tasks (e.g., image classification and generation)
3. identify and evaluate various approaches of computer vision and pattern recognition
4. present and deliver their computer vision solutions to different stakeholders.

Indication Contents:

1. Introduction to Computer Vision
2. Image Processing Fundamentals
3. Image Features and Descriptors
4. Image Classification and Object Recognition
5. Object Detection and Localization
6. Image Segmentation
7. Deep Learning for Computer Vision
8. Video Analysis and Tracking
9. Advanced Topics in Computer Vision

Teaching Method:

The course will be delivered through lectures, lab exercises, assignments and group projects. The fundamental concepts, techniques, and applications of computer vision, software packages, such as OpenCV, will be covered in lectures. Students are required to apply the concepts and principles covered in this course to analyze the real-world problem(s) and formulate them as visual problem(s) in their assignments. Students perform a group project and develop computer vision system(s) to solve real-world problem(s) (e.g., image classifcation). Moreover, computer vision applications, algorithms for image processing, analyzing visual models and design of vision systems will be learnt by students through project-based learning, case studies, and interactive exercises. In the end of the project, they are required to present their proposed viusal systems, with analysis, formulations and evaluation.

Measurement of Learning Outcomes:

Learning Outcome	Class Attendance and Participation	Individual Assignments	Group Project
1. Demonstrate command of theories and techniques in computer vision and pattern recognition	✓	✓	✓
2. Describe and apply advanced computer vision algorithms for real-world visual task	✓	✓	✓
3. Identify and evaluate various approaches of computer vision and pattern recognition		✓	✓
4. Present and deliver their computer vision solutions to different stakeholders			✓

Assessment:

1. **10% Class Attendance and Participation:** There are a number of classroom activities such as lab exercise, question answering and group discussion to consolidate students' knowledge and develop their skills in computer vision.
2. **40% Individual Assignments (about 1000-2000 words):** Assignments require students to obtain a critical awareness of the characteristics and effectiveness of computer vision algorithms
3. **50% Group Project (about 5-6 students):** A Group Project requires students to develop computer vision systems to solve some complex real-world problems under different scenarios. It assesses student's overall understanding in the computer vision concepts, and their ability to compare and evaluate the effectiveness of different computer vision solutions, as well as deliver the key findings to stakeholders through report (about 2000-2500 words) and presentation.

Required/Essential Readings:

1. Klette, Reinhard, Concise computer vision - An introduction into theory and algorithm, Springer, 2014.
2. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2010
3. Goodfellow, Bengio, and Courville, Deep Learning, MIT Press, 2016.
4. IEEE Transactions on Image Processing.
5. Journal of Pattern Recognition.
6. IEEE Transactions on Pattern Analysis and Machine Intelligence.
7. International Journal on Computer Vision.

Recommended/Supplementary Readings:

N/A

Important Notes:

(1) Students are expected to spend a total of 9* hours (i.e. 3* hours of class contact and 6* hours of personal study) per week to achieve the course learning outcomes.

(2) Students shall be aware of the University regulations about dishonest practice in course work, tests and examinations, and the possible consequences as stipulated in the Regulations Governing University Examinations and Course Work. In particular, plagiarism, being a kind of dishonest practice, is "the presentation of another person's work without proper acknowledgement of the source, including exact phrases, or summarised ideas, or even footnotes/citations, whether protected by copyright or not, as the student's own work". Students are required to strictly follow university regulations governing academic integrity and honesty.

(3) Students are required to submit writing assignment(s) using Turnitin.

(4) To enhance students' understanding of plagiarism, a mini-course "Online Tutorial on Plagiarism Awareness" is available on https://pla.ln.edu.hk/.

** Numbers of hours per week are subject to different modes of teaching*