Technological and Higher Education Institute of Hong Kong
Department of Construction, Environment and Engineering

Programme Title:	BEng (Hons) in Building Services Engineering
Programme Code:	ST125103/ST145103
Academic Year:	AY2024/25
Semester:	1
Module Code and Title:	SBS4115 Fundamentals of AI & Data Analytics
Module Convenor:	Roger NG
Module Lecturer(s):	Kelvin SIU
Moderator:	Roger NG

Question No.		Solutions	Marks
Q.1	(i)	Gather a large, diverse dataset of images relevant to the recognition task. Ensure images cover various angles, lighting conditions, and scenarios to improve model robustness. Data Preprocessing	2
		Resizing and normalization: Convert images to a uniform size (e.g., 224×224) and normalize pixel values so the model can learn efficiently. Image augmentation (optional): Randomly flip, rotate, or crop images to increase dataset variety and reduce overfitting.	2
		Commonly use Convolutional Neural Networks (CNNs) for image tasks. During training, the CNN learns feature maps (edges, textures) that help classify or detect objects. Model Evaluation	2
		Split data into training and test (and possibly validation) sets to measure performance on unseen images. Key metrics include accuracy, precision, recall, and F1-score. Evaluation highlights strengths and weaknesses, guiding any necessary refinements to the model.	2
	(ii)	Systems identify unique facial landmarks (e.g., distance between eyes, nose shape, jawline). Features are converted into a digital facial “template” for matching.	3
		Airports and border checkpoints use face recognition to verify passenger identities quickly. Smartphones unlock via face ID, providing a convenient and secure authentication method. Cameras at checkpoints scan passengers’ faces, instantly matching them against passport or ID photos in a secure database.	3

		Benefits: Improved Accuracy: AI can handle large passenger volumes, reducing human error. Operational Efficiency: Faster throughput and shorter queues. Enhanced Security: Rapid detection of unauthorized individuals. Advantages of AI in Facial Recognition	3
	(iii)	Rule-Based NLP Central Idea: Uses a set of handcrafted linguistic rules, grammar structures, and pattern-matching. Techniques/Models: Syntax analysis, parsing rules, lexicons. Machine Learning–Based NLP Central Idea: Trains algorithms on labeled textual data to recognize language patterns (e.g., spam detection). Techniques/Models: Logistic regression, Naive Bayes, Support Vector Machines (SVMs). Sentiment Analysis in social media monitoring: classifying user comments or tweets as positive, negative, or neutral to gauge public opinion. Deep Learning–Based NLP Central Idea: Leverages neural network architectures (e.g., RNNs, LSTMs, Transformers) to learn contextual language representations from large datasets. Techniques/Models: CNNs or Transformer-based models like BERT, GPT.	2 2 2 2

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Question No.		Solutions	Marks
Q.2	(i)	In domains like healthcare, AI systems often require access to highly personal data (medical histories, genetic information).	2
		Risks: Data breaches, unauthorized access, or misuse can compromise patient confidentiality. Trust erosion and legal ramifications arise if sensitive data is mishandled. Accountability of AI Decisions	2
		In law enforcement or healthcare, AI may recommend arrests or medical treatments that can have life-altering impacts.	2
		Challenges: Determining who is responsible (developers, users, or the AI itself) when errors lead to wrongful arrests or misdiagnoses.	2
		Ensuring clear oversight and liability frameworks is crucial to uphold justice and patient safety.	2
	(ii)	Bias can stem from historical inequalities, incomplete datasets, or skewed labeling. Results in discriminatory outcomes, reinforcing societal stereotypes or excluding certain groups. Real Example: Recruitment Tool Bias	3
		Amazon’s AI-based hiring tool was found to favor male candidates for technical roles because it learned from a dataset of mostly male applicants’ resumes.	3
		Algorithmic bias can undermine trust in AI, hamper diversity, and exacerbate inequalities. Ensuring equitable representation in training data and monitoring AI decisions are essential for mitigating discriminatory effects.	3

	(iii)	Include data across various demographics to minimize skew and reflect real-world diversity. Regular Auditing and Testing for Bias. Conduct periodic reviews of AI outputs. When biases are found, retrain or adjust the model accordingly.	2
		Build interpretable AI systems that allow stakeholders to understand how decisions are reached.Clearly document the model's decision-making criteria and model architecture.	2
		Establish clear governance: Identify who is responsible for AI outcomes.Define ethical standards (e.g., fairness metrics) and monitor compliance to protect stakeholders.	2
Question No.		**Solutions**	**Marks**
Q.3	(a)(i)	AI-driven systems (e.g., in Los Angeles) analyze real-time traffic data to adjust traffic signals, reducing congestion and commute times. Benefits include lower fuel consumption and reduced emissions.	2
		Smart grids use AI to monitor energy usage patterns, optimizing supply. This reduces wastage, lowers energy costs, and improves grid reliability.	2
		Automated Waste Management. Sensors in smart bins or on garbage trucks detect fill levels to optimize collection routes.	2
		AI tracks city services (e.g., lighting, heating in public buildings) and dynamically adjusts usage to reduce consumption.	2

	(a)(ii)	AI-Assisted Medical Imaging. AI algorithms detect anomalies in X-rays, MRIs, and CT scans that can be overlooked by human interpretation. Improves early detection of conditions such as cancer or fractures. Systems like IBM Watson Health utilize vast datasets to recommend treatments, supporting personalized care. Faster and more accurate diagnosis aids timely interventions. Early, accurate detection enables targeted treatments, potentially improving survival rates (e.g., lung cancer). Reduces unnecessary biopsies and lowers healthcare costs. AI highlights suspicious areas for radiologists, reducing false negatives and helping medical staff focus on critical cases.	2 2 2 2
	(b)	Predictive analytics forecast material needs, schedules, and costs, drawing on historical data to flag potential delays or overruns. More accurate resource allocation avoids budget inflation and rework. AI optimizes energy usage by monitoring heating, cooling, and lighting in buildings, leading to significant savings. Automating repetitive tasks (e.g., ordering materials) cuts labor costs and reduces human error. Predictive Maintenance AI systems analyze equipment usage patterns, detecting maintenance needs before breakdowns. Minimizes downtime and expensive emergency repairs. Computer vision monitors construction sites, checking for protective gear compliance.	3 3 3

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Question No.		Solutions	Marks
Q.4	(i)	Supervised Learning. Trains on labeled datasets (input-output pairs). Learns to map inputs (e.g., images) to known targets (e.g., class labels). Use Cases: Predictive modeling (forecasting sales), image classification (cat vs. dog).	2
		Unsupervised Learning. Works on unlabeled data to identify hidden patterns or groupings. Use Cases: Clustering (customer segmentation), anomaly detection, dimensionality reduction.	2
		Key Differences: Data Requirement: Supervised needs labeled data; unsupervised does not. Output Specificity: Supervised provides more precise predictions; unsupervised offers insights about structure without predefined labels.	2
	(ii)	Narrow AI (Weak AI). Focused on one specific task (e.g., language translation, image recognition). Examples: Apple's Siri, Google Translate. Excels in specialized areas but lacks adaptability outside its trained domain.	3
		Artificial General Intelligence (Strong AI). A hypothetical system with human-like adaptability and understanding, capable of performing any intellectual task. Not yet realized in practice but envisioned to handle reasoning, creativity, and learning in diverse fields.	3
		Key Contrasts. Scope: Narrow AI is domain-specific, while AGI aims for cross-domain competence. Practical Status: Narrow AI is widely used today; AGI remains a research goal.	3

	(iii)	Narrow AI automates repetitive tasks (e.g., data entry), increasing speed and reducing errors. AGI could adapt to multiple domains simultaneously, coordinating complex tasks with minimal human intervention.	2
		Narrow AI: Self-driving vehicles with specialized obstacle detection reduce accidents. AGI: Would manage unexpected scenarios and make context-aware decisions, potentially enhancing safety in healthcare, defense, and beyond.	2
		Narrow AI fosters innovation in focused applications (e.g., personalized medicine, robotics).	2
		AGI (if achieved) might revolutionize all aspects of science, industry, and daily life, driving cross-disciplinary breakthroughs. Conclusion	2
		Narrow AI already transforms industries through task-specific automation. AGI's future potential could disrupt conventional workflows, demanding ethical oversight and robust regulatory frameworks.	2

MLO	Question 1	Question 2	Question 3	Question 4
1				V
2	V			
3			V	
4		V		

MLO1: Understand fundamentals concepts of AI and data analytics;

MLO2: Acquire the basic skills in using AI and data analytics technologies and applications;

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MLO3: Articulate examples of how the adoption of AI and data analytics enhances the engineering industries; and

MLO4: Demonstrate awareness of ethical issues and the impact of the applications of AI and data analytics in daily life.