Week 5: Domains of computer science & Grading Policy

Part 1:

1.0 Data Science:

The art of uncovering the insights and trends in data has been around since ancient times. The ancient Egyptians used census data to increase efficiency in tax collection and they accurately predicted the flooding of the Nile river every year. Since then, people working in data science have carved out a unique and distinct field for the work they do. This field is data science.

Data science is the field of study that combines domain expertise, programming skills, and knowledge of mathematics and statistics to extract meaningful insights from data. Data science practitioners apply machine learning algorithms to numbers, text, images, video, audio, and more to produce artificial intelligence (AI) systems to perform tasks that ordinarily require human intelligence. In turn, these systems generate insights which analysts and business users can translate into tangible business value. The field encompasses analysis, preparing data for analysis, and presenting findings to inform high-level decisions in an organization. As such, it incorporates skills from computer science, mathematics, statistics, information visualization, graphic design, and business.

Examples:

- Netflix data mines movie viewing patterns to understand what drives user interest and uses that to make decisions on which Netflix original series to produce.
- Amazon's recommendation engines suggest items for you to buy, determined by their algorithms. Netflix recommends movies to you. Spotify recommends music to you.
- Gmail's spam filter is data product – an algorithm behind the scenes processes incoming mail and determines if a message is junk or not.
- Computer vision used for self-driving cars is also data product – machine learning algorithms are able to recognize traffic lights, other cars on the road, pedestrians, etc.

1.1 Image Processing:

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps:

- Importing the image via image acquisition tools;
- Analysing and manipulating the image;
- Output in which result can be altered image or report that is based on image analysis.

Examples:

- Detecting License Plate
- Scanning Whiteboard Contents
- Detecting Text in Still Images
- Enhancing X-Ray Images
- Extracting Urban Areas in Google Maps Aerial Images
- Extracting Forest Areas in Google Maps Aerial Images
- Extracting Agricultural Fields in Google Maps Aerial Images
- Extracting Serous Cell Nuclei etc

1.2 Machine learning:

Machine-learning algorithms use statistics to find patterns in massive amounts of data. And data, here, encompasses a lot of things—numbers, words, images, clicks, what have you. If it can be digitally stored, it can be fed into a machine-learning algorithm.

Machine learning is the process that powers many of the services we use today—recommendation systems like those on Netflix, YouTube, and Spotify; search engines like Google and Baidu; social-media feeds like Facebook and Twitter; voice assistants like Siri and Alexa. The list goes on.

In all of these instances, each platform is collecting as much data about you as possible—what genres you like watching, what links you are clicking, which statuses you are reacting to—and using machine learning to make a highly educated guess about what you might want next. Or, in the case of a voice assistant, about which words match best with the funny sounds coming out of your mouth.

1.3 Big data handling:

Big Data is a phrase used to mean a massive volume of both structured and unstructured data that is so large it is difficult to process using traditional database and software techniques. In most enterprise scenarios the volume of data is too big or it moves too fast or it exceeds current processing capacity.

Big Data has the potential to help companies improve operations and make faster, more intelligent decisions. The data is collected from a number of sources including emails, mobile devices, applications, databases, servers and other means. This data, when captured, formatted, manipulated, stored and then analyzed, can help a company to gain useful insight to increase revenues, get or retain customers and improve operations.

Example:

An example of big data might be petabytes (1,024 terabytes) or exabytes (1,024 petabytes) of data consisting of billions to trillions of records of millions of people—all from different sources (e.g. Web, sales, customer contact center, social media, mobile data and so on). The data is typically loosely structured data that is often incomplete and inaccessible.

1.4 Artificial Intelligence:

Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. The term may also be applied to any machine that exhibits traits associated with a human mind such as learning and problem-solving.

The ideal characteristic of artificial intelligence is its ability to rationalize and take actions that have the best chance of achieving a specific goal. Artificial intelligence is based on the principle that human intelligence can be defined in a way that a machine can easily mimic it and execute tasks, from the most simple to those that are even more complex. The goals of artificial intelligence include learning, reasoning, and perception.

Applications of Artificial Intelligence

The applications for artificial intelligence are endless. The technology can be applied to many different sectors and industries. AI is being tested and used in the healthcare industry for dosing drugs and different treatment in patients, and for surgical procedures in the operating room.

Other examples of machines with artificial intelligence include computers that play chess and self-driving cars. Each of these machines must weigh the consequences of any action they take, as each action will impact the end result. In chess, the end result is winning the game. For self-driving cars, the computer system must account for all external data and compute it to act in a way that prevents a collision.

Artificial intelligence also has applications in the financial industry, where it is used to detect and flag activity in banking and finance such as unusual debit card usage and large account deposits—all of which help a bank's fraud department. Applications for AI are also being used to help streamline and make trading easier. This is done by making supply, demand, and pricing of securities easier to estimate.

1.5 Deep Learning

Deep learning is a machine learning technique that teaches computers to do what comes naturally to humans: learn by example. Deep learning is a key technology behind driverless cars, enabling them to recognize a stop sign, or to distinguish a pedestrian from a lamppost. It is the key to voice control in consumer devices like phones, tablets, TVs, and hands-free speakers. Deep learning is getting lots of attention lately and for good reason. It’s achieving results that were not possible before.

In deep learning, a computer model learns to perform classification tasks directly from images, text, or sound. Deep learning models can achieve state-of-the-art accuracy, sometimes exceeding human-level performance. Models are trained by using a large set of labeled data and neural network architectures that contain many layers.

Examples:

Deep learning applications are used in industries from automated driving to medical devices.

- **Automated Driving:** Automotive researchers are using deep learning to automatically detect objects such as stop signs and traffic lights. In addition, deep learning is used to detect pedestrians, which helps decrease accidents.
- **Aerospace and Defense:** Deep learning is used to identify objects from satellites that locate areas of interest, and identify safe or unsafe zones for troops.
- Medical Research: Cancer researchers are using deep learning to automatically detect cancer cells. Teams at UCLA built an advanced microscope that yields a high-dimensional data set used to train a deep learning application to accurately identify cancer cells.
- **Industrial Automation:** Deep learning is helping to improve worker safety around heavy machinery by automatically detecting when people or objects are within an unsafe distance of machines.
- **Electronics:** Deep learning is being used in automated hearing and speech translation. For example, home assistance devices that respond to your voice and know your preferences are powered by deep learning applications.

1.6 Data mining

Data mining is a process used by companies to turn raw data into useful information. By using software to look for patterns in large batches of data, businesses can learn more about their customers to develop more effective marketing strategies, increase sales and decrease costs. Data mining depends on effective data collection, warehousing, and computer processing.

Example:

Grocery stores are well-known users of data mining techniques. Many supermarkets offer free loyalty cards to customers that give them access to reduced prices not available to non-members. The cards make it easy for stores to track who is buying what, when they are buying it and at what price. After analyzing the data, stores can then use this data to offer customers coupons targeted to their buying habits and decide when to put items on sale or when to sell them at full price.

1.7 Bio informatics:

The explosion of data from high throughput biological experiments like sequencing and micro-arrays has led to the science called Bioinformatics. Bioinformatics is the interdisciplinary science which is similar to Data Science for solving biological problems.

It is an interdisciplinary field that develops and applies computational methods to analyse large collections of biological data, such as genetic sequences, cell populations or protein samples, to make new predictions or discover new biology. The computational methods used include analytical methods, mathematical modelling and simulation.

Example:

- Bridging among protein, DNA, and RNA sequences
- Searching for related sequences in other organisms
- Searching for functional patterns in proteins and nucleic acids etc

2.0 High Performance Computing

2.1 Distributed Computing

A distributed system, also known as distributed computing, is a system with multiple components located on different machines that communicate and coordinate actions in order to appear as a single coherent system to the end-user.

The machines that are a part of a distributed system may be computers, physical servers, virtual machines, containers, or any other node that can connect to the network, have local memory, and communicate by passing messages.

There are two general ways that distributed systems function:

1. Each machine works toward a common goal and the end-user views results as one cohesive unit.
2. Each machine has its own end-user and the distributed system facilitates sharing resources or communication services.

Examples:

Distributed systems have endless use cases, a few being electronic banking systems, massive multiplayer online games, and sensor networks.

- Telecommunication networks: Telephone networks and Cellular networks.
- Network of branch office computers -Information system to handle automatic processing of orders
- Real-time process control: Aircraft control systems
- Electronic banking
- Airline reservation systems

2.2 Cloud Computing:

Cloud computing is the on-demand delivery of IT resources over the Internet with pay-as-you-go pricing. Instead of buying, owning, and maintaining physical data centers and servers, you can access technology services, such as computing power, storage, and databases, on an as-needed basis from a cloud provider like Amazon Web Services (AWS), microsoft azure etc

Example:

- Consumer services like Gmail or the cloud back-up of the photos on your smartphone, though to the services which allow large enterprises to host all their data and run all of their applications in the cloud.
- Netflix relies on cloud computing services to run its its video streaming service and its other business systems too and have a number of other organisations.

2.3 Parallel Computing

Parallel computing is a type of computing architecture in which several processors execute or process an application or computation simultaneously. Parallel computing helps in performing large computations by dividing the workload between more than one processor, all of which work through the computation at the same time. Most supercomputers employ parallel computing principles to operate.

Parallel computing is also known as parallel processing.

Example:

- Climate modeling,
- Agriculture estimates,
- Financial risk management,
- Video color correction,
- Computational fluid dynamics,
- Medical imaging and drug discovery.

3.0 Computer Networks

3.1 Web development:

Web development broadly refers to the tasks associated with developing websites for hosting via intranet or internet. The web development process includes web design, web content development, client-side/server-side scripting and network security configuration, among other tasks.

Web development is also known as website development. Web development ranges from creating plain text pages to complex web-based applications, social network applications and electronic business applications.

The web development hierarchy is as follows:

- Client-side coding
- Server-side coding
- Database technology

3.2 IoT

The Internet of Things, or IoT, refers to the billions of physical devices around the world that are now connected to the internet, all collecting and sharing data. Thanks to the arrival of super-cheap computer chips and the ubiquity of wireless networks, it's possible to turn anything, from something as small as a pill to something as big as an aeroplane, into a part of the IoT. Connecting up all these different objects and adding sensors to them adds a level of digital intelligence to devices that would be otherwise dumb, enabling them to communicate real-time data without involving a human being. The Internet of Things is making the fabric of the world around us more smarter and more responsive, merging the digital and physical universes.

Example:

Pretty much any physical object can be transformed into an IoT device if it can be connected to the internet to be controlled or communicate information:

- A lightbulb that can be switched on using a smartphone app is an IoT device, as is a motion sensor or a smart thermostat in your office or a connected streetlight.
- An IoT device could be as fluffy as a child's toy or as serious as a driverless truck.
- Some larger objects may themselves be filled with many smaller IoT components, such as a jet engine that's now filled with thousands of sensors collecting and transmitting data back to make sure it is operating efficiently.
- At an even bigger scale, smart cities projects are filling entire regions with sensors to help us understand and control the environment.

3.3 Security

Computer security deals with the protection of computer systems and information from harm, theft, and unauthorized use. The main reason users get attacked frequently is that they lack adequate defences to keep out intruders, and cybercriminals are quick to exploit such weaknesses. Computer security ensures the confidentiality, integrity, and availability of your computers and their stored data.

Examples:

- Encrypting data in storage, transit and use
- Securely identifying people and digital entities
- Defining and implementing privileges for computing resources
- Securing networks with techniques such as network perimeter
- Anti-virus
- Firewalls
- Encryption programs etc

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Part 2:

AIUB grading Structure and calculation

Academic performance in a given course is based on continuous assessment. There are two major examinations, which are written: mid-semester examination and the final examination. In between there are sets of quizzes, in-class evaluation, assignments, case studies, etc. Laboratory classes also follow the same evaluation but have practical examinations instead of the written examinations. Each course has a certain number of credit hours. A letter grade with a specified number of grade points will be given to students. A minimum grade point average (GPA) is to be maintained or satisfactory progress. Also, the minimum number of units earned must be acquired and a CGPA of 2.50 (effective from 17th Convocation held in February 2017) or better in order to qualify for graduation.

Letter grades indicating the quality of coursework completed with their corresponding grade points are shown below:

Grading Policy		
Numerical%	Letter Grade	Grade Point
94-100	A+	4
90-93.99	A	3.75
86-89.99	A-	3.5
82-85.99	B+	3.25
78-81.99	B	3
74-77.99	B-	2.75
70-73.99	C+	2.5
66-69.99	C	2.25
62-65.99	C-	2
58-61.99	D+	1.75
54-57.99	D	1.5
50-53.99	D-	1
<50	F	0
Incomplete	I	
Withdrawal	W	
Unofficial withdrawal	UW	

GPA and CGPA calculation:

Below is an example of how CGPA is computed.

For example, following are the course and result related information of first semester student,

Courses	Grade	Credit	Points
Introduction to Business	A+	3	4.00 x 3 = 12.00
English Reading Skills & Public Speaking	A-	3	3.50 x 3 = 10.50
Business Mathematics - 1	A	3	3.75 x 3 = 11.25
Financial Accounting	A+	3	4.00 x 3 = 12.00
Computer Fundamentals	A	3	3.75 x 3 = 11.25
Total		15	57.00

Therefore the GPA in the first semester of the student (57.00/15) = 3.80

Then again consider the following information are the next or second semester's result of the same student,

Courses	Grade	Credit	Points
Principles of Management	A	3	3.75 x 3 = 11.25
Micro Economics	B+	3	3.25 x 3 = 9.75
English Writing Skills & Communication	A+	3	4.00 x 3 = 12.00
Business Mathematics - 2	A-	3	3.50 x 3 = 10.50
Basics in Social Science	C	3	2.25 x 3 = 6.75
Total		**15**	**50.25**

Therefore, the GPA in the second semester of the student (50.25/15) = 3.35

Accordingly, the CGPA of the student at the end of the second semester (57.00 + 50.25) / (15 +15) = 3.58. For the consecutive semesters, the CGPA will be calculated following the above technique.

Exam Permit Policy

- A student will not be allowed to seat in the examination without the permit
- A student will only get his/her permit if all the things(payment, required attendance, etc.) are cleared against the student.
- Student must collect the permit from the VUES.
- Student need to bring the permit in every exam. In lost or any other case student can collect temporary permit from the VUES. But in that case condition should be meet up for the eligibility.

Examination Guidelines

- Wear your ID properly.
- Bring your examination permit. A student shall not be allowed to seat in the examination without a permit.
- Be sure that the proctor or invigilator signs the permit during the examination period.
- Place all things except permitted materials and examination document in front of the room Latecomers may be allowed to take the examination provided they will not extend the examination time limit.
- Honesty is the best policy; Cheating shall be punished with a grade of zero percent in the said examination.
- Leaving the room during examination is not allowed. Attend to your personal needs before the start of the examination.
- Ensure that you sign the attendance sheet for each examination taken.
- All mobile phones should be switched off during the examination.
- Digital diary or programmable calculators are not allowed in the examination hall.
- Examination rooms are assigned by the Registrar's Office.

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