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Virtual Residency Week | 27 Sept - 1 Oct 2021



Computer Science: The Super Specializations and more

Dr. Soharab Hossain Shaikh
Ph.D., University of Calcutta
Associate Professor - SoET
Computer Science & Engineering

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Agenda

Why specialization?

What are the super specialization areas in CS?

Technology Overlap

Other Essential Skills

CS Specializations @BMU

Focus of India - are we on the right track?

Q-n-A/Discussion

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Let's participate in a quick survey.

Link: <https://www.menti.com/qpywffam3f>
Code: 6948 4835

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Why specialization?

Focused concentrated studies to develop skills

Employability

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Artificial Intelligence

Artificial intelligence leverages computers and machines to mimic the problem-solving and decision-making capabilities of the human mind.

It is the simulation of human intelligence processes in artificial machines, especially computer systems.

- Machine Learning & Deep Learning (with focus towards Unsupervised and Reinforcement Learning)
- Computer Vision
- Natural Language Processing
- Speech Processing

Job Roles

- ML Engineer
- AI Engineer/Specialist
- Developer Associate in AI/ML

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Data Science and Analytics

Data science is an interdisciplinary field that uses scientific methods, processes, algorithms and systems to uncover meaningful pattern, extract knowledge and insights from noisy, structured and unstructured data and apply knowledge and actionable insights from data across a broad range of application domains.

Applications

- Fraud and Risk Detection
- Healthcare
- Internet Search
- Targeted Advertising
- Product Recommendations
- Airline Route Planning

Job Roles

- Data Scientist
- Data Engineer
- Data Analyst

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Internet of Things (IoT)

The Internet of Things (IoT) describes physical objects, that are embedded with sensors, processing ability, software, and other technologies, and that connect and exchange data with other devices and systems over the Internet or other communications networks.

Smart Cities

Job Roles

- IoT Developer
- IoT Embedded System Designer
- IoT Infra Architecture
- IoT System Admin

Artificial Intelligence of Things (AIoT)

Combination of AI technologies with the IoT infrastructure to achieve more efficient operations, improve human-machine interactions and enhance data management and analytics.

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Cloud Computing

Cloud computing is the on-demand availability of computer system resources, especially data storage and computing power, without direct active management by the user. Large clouds often have functions distributed over multiple locations, each location being a data center.

PRODUCT	aws	Microsoft Azure	Google Cloud
Virtual Servers	Iamroles	Vm instances	VM instances
Platform as a Service	Elastic Beanstalk	Cloud Services	App Engine
Backend Container	Lambda	Auto Functions	Cloud Functions
Container Management	ECS	Container	Container Engine
Kubernetes Management	EKS	Kubernetes Service	Kubernetes Engine
Object Storage	S3	Block Blob	Cloud Storage
Archiving	Amazon S3	Archive Storage	Cloud Archive
File Storage	EPS	Acute File	ZFS / Acute
Global Content Delivery	Cloudfront	Delivery Network	Cloud CDN
Managed Data Warehouse	Redshift	SQL Warehouse	Big Query

Benefits/Different types of service offerings

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Cyber Security

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Cyber Security

Cyber security is the application of technologies, processes and controls to protect systems, networks, programs, devices and data from cyber attacks. It aims to reduce the risk of cyber attacks and protect against the unauthorized exploitation of systems, networks and technologies.

Job Roles:

- Cyber Forensics Solutions architect
- Malware analyst
- Cyber Security architect/administrator
- Information Security Analyst
- Network security analyst

Types of Cybersecurity Threats

	Malware	Phishing
Spear Phishing		
Man in the Middle Attack		
Denial of Service Attack		
SQL injection		
Zero-day Exploit		
Advanced Persistent Threats		
Ransomware		
DNS Attack		

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BIG DATA

Data contains greater variety, arriving in increasing volumes and with more velocity. This is also known as the three Vs.

Big data is larger, more complex data sets, especially from new data sources.

These data sets are so voluminous that traditional data processing software just can't manage them. But these massive volumes of data can be used to address business problems you wouldn't have been able to tackle before.

Job Roles:

- Big Data Architect
- Big Data Manager
- Big Data Specialist
- Big Data Analyst
- Big Data Engineer
- Big Data Developer

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Time for another quick survey.

Link: <https://www.menti.com/46tua6g6ab>
Code: 4325 5739

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DevOps

DevOps is a combination of new age philosophies, best practices, tools and techniques required for an organization to deliver software products at a much faster pace than traditional software development process.

Job Roles:

- DevOps Engineer
- DevOps Architect
- DevOps Consultant
- DevOps Manager
- DevOps System Admin

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AR and VR

Augmented reality (AR) and Virtual Reality (VR) bridge the digital and physical worlds.

They allow users to take in information and content visually, in the same way you take in the world.

AR dramatically expands the ways our devices can help with everyday activities like searching for information, shopping and expressing yourself.

VR lets you experience what it's like to go anywhere — from the front row of a concert to distant planets in outer space.

Job Roles:

- AR/VR Developer
- AR/VR Researcher
- AR/VR Maintenance Support
- Gameplay and Tools Engineer

<https://www.medicalaugmentedreality.org/>

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Quantum Computing

Quantum computing is the amalgam of Physics, Mathematics, and Quantum Mechanics that exploits the collective properties of quantum states, such as superposition, interference, and entanglement, to perform computation.

Qiskit
Qiskit accelerates the development of quantum applications by providing the complete set of tools needed for interacting with quantum systems and simulators.

Quantum Cryptography

<https://www.ibm.com/quantum-computing/>
<https://qiskit.org/>

IBM Quantum Computer

Mercedes Benz used IBM quantum computers to simulate the chemical reactions at the molecular levels inside a lithium-ion battery to make more efficient battery and beyond. (*future of the Electric Vehicles*).

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Blockchain Technology

Distributed ledger of immutable transactions. Replicated across different nodes in a P2P distributed network.

Supply chain, Health-care, Identity management, Record-keeping, Media/Entertainment/IP, Registry/Notary, Cryptocurrency.

Job Roles:

- Blockchain Developer
- Ethereum Developer
- Hyperledger Developer
- Solidity Developer
- Blockchain Architect
- Blockchain Consultant
- Blockchain Manager

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Cryptocurrency & DeFi

Decentralized Finance is a blockchain-based form of finance that does not rely on central financial intermediaries such as brokerages, exchanges, or banks to offer traditional financial instruments, and instead utilizes smart contracts on blockchains, the most common being *Ethereum*.

Financial services

Industry	Percentage
Financial services	46%
Industrial products and manufacturing	12%
Energy and utilities	11%
Healthcare	4%
Government	1%
Retail and consumer	1%
Entertainment and media	1%

Job Roles:

- Blockchain Developer
- Ethereum Developer
- Hyperledger Developer
- Solidity Developer
- Blockchain Architect
- Blockchain Consultant
- Blockchain Manager

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Source: The Global Blockchain Employment Report, 2021. <http://theblockchainacademy.com/wp-content/uploads/2021/04/2021-Global-Blockchain-Employment-report.pdf> [Issue Note]

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Human Computer Interaction

HCI is the study of designing computers and machines so that they best serve their users (i.e. humans). Deals with the construction and implementation of interfaces and tool-building technologies that would adapt seamlessly to people's needs. Focuses on creating simplified interfaces to achieve the best satisfaction for various types of users. HCI is the study of how computers and machines can serve us better.

Source: Get-Smarter, Sixteen-Nine

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Embedded Computer Vision

Embedded vision is the integration of computer vision in machines that use algorithms to decode meaning from observing (image & video).

Compact vision systems (on the basis of adapted camera modules) are integrated directly into machines or devices.

Jetson TX2, Jetson TX1, Raspberry-Pi, Camera module

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Bioinformatics

Bioinformatics is defined as the application of tools of computation and analysis to the capture and interpretation of biological data. It is an interdisciplinary field, which harnesses computer science, mathematics, physics, and biology. It is essential for management of data in modern biology and medicine. It is being used to interpret biological data and to further understanding of disease. The potential clinical applications of these data is in drug discovery and development.

<http://pages.gersteinlab.org/e-print/whatis-imia/>

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Full Stack Development

A full stack developer is a person who is comfortable working in the front-end and back-end side of web development. A Full Stack Developer works with the Back End — or server side — of the application as well as the Front End, or client side.

Full Stack Developers have to have some skills in a wide variety of coding niches, from databases to graphic design and UI/UX management in order to do their job well.

Job Roles
- Full Stack Developer

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Source: Hackernoon, Codingtojo

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Technology Overlap - Application Demand

Blockchain provides an immutable record that can be shared across multiple parties.

IoT technology uses sensors to sense events and send data.

AI and machine learning data analyzes, learns, recognizes patterns, makes decisions, and automate actions.

RELATIONSHIP BENEFITS: **Iot + Blockchain** Registering device interactions creates a secure environment, increases security, and builds accountability and trust.

RELATIONSHIP BENEFITS: **IoT + AI** AI hardware and software support improved processing power and interfaces, while improving IoT data processing.

RELATIONSHIP BENEFITS: **AI + Blockchain** Blockchain supports security and integrity of data transmission through its authentication and ability to render data immutable.

Technologies that facilitate human-computer interaction

- Eye-tracking
- Speech
- IoT
- Cloud Computing
- AR/VR

Source: <https://www.allin.com/blog/how-human-computer-interaction-increases-worker-productivity>
<https://internethingsagenda.techtarget.com/his/AI-blockchain-and-IoT-convergence-improves-daily-applications>

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Other Essential Skills

- Logical Thinking and Problem Solving abilities.

Programming Languages

- Procedural Programming
- Object Oriented Programming
- Functional Programming

Hardware Programming

- System/Kernel Programming
- Network Programming
- Parallel Programming (GPU)

- Continuous Learning - new technologies/tools, Learn, Unlearn and Relearn.

Image source: <http://codingalphabetsforkids.brakesoft.com/>

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CS Specializations @BMU

- Data Science and Artificial Intelligence
- IoT
- Cyber Security

Traditional way of specialization:

- Projects
- Core Elective courses (offered in the final year)

@BMU:

- Revamped the curriculum
- Courses offered all through 4-years of studies
- Multiple Projects (*experiential learning*)

For more information please visit: www.bmu.edu.in

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Focus of India?

National Education Policy (NEP), 2020.

- Major change in the pedagogical structure introducing more flexibility and choices for the students.
- Importance on skill development not just having a good academic report card.

Under Graduation will be of either 3 or 4 years with multiple entry and exit option

1 Year Certificate	2 Years Associate Diploma	4 Years Bachelor's Degree
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Information source: MHRD and NEP, 2020 policy document and other sources.

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Focus of India?

Digital India
– Vision and Vision Areas

Ministry of Electronics & Information Technology
Government of India
National Mission for Education through Technology
Technology Development for Indian Languages (TDIL)

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Vision Areas of Digital India

The Digital India programme is centred on three key vision areas:

- Digital Infrastructure as a Core Pillar for Every Citizen**
 - Availability of high speed internet as a core pillar for every citizen.
 - Creating a digital delivery model that is unique, lifelong, online and authentic accessible to every citizen.
 - Mobile broadband connectivity enabling citizens participation in digital economy and access to e-governance services.
 - Free access to e-governance Service Centres.
 - Universal access to digital infrastructure.
- Governance & Services on Demand**
 - Seamless, integrated services delivery irrespective of jurisdiction.
 - From a single point of contact.
 - All citizens accessible to all services.
 - Digital delivery services for increasing level of digitization.
 - Moving financial transactions directly from bank to bank.
 - Leveraging Geospatial Information Systems (GIS) for improving system & development.
- Digital Empowerment of Citizens**
 - Enhanced digital literacy.
 - Universal digital access.
 - Universal digital connectivity.
 - Collaborative digital platforms for participatory governance.
 - Universal access to digital media.

Source: <https://www.digitalindia.gov.in/content/vision-and-vision-areas>
<https://www.mca.gov.in/content/technology-development-indian-languages-tdil>

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Focus of India?

Digital India - National Program for ResponsibleAI for Youth

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Powered by intel

CREATE FOR INDIA

RESPONSIBLE AI FOR YOUTH
A National Program For Government Schools

LAUNCH VIDEO
PROGRAM OVERVIEW VIDEO

Source: <https://responsibleaiforyouth.negd.in/home>

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Q&A

Questions?



soharab.hossain@bmu.edu.in

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Resources


Sohrab
Software Engineer
Associate Professor
CS Dept, IIT-BHU Varanasi

soharabhossain / CS-Super-Specialization
<https://github.com/soharabhossain/CS-Super-Specialization>

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