Career opportunities and essential skills for CSE graduates in a changing tech landscape

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Abstract

Example abstract for the Physics Open journal. Here you provide a brief summary of the research and the results.

Keywords: keyword 1, keyword 2, keyword 3, keyword 4

1. Introduction

1.1. Background

Industries have evolved because of rapid technological advances, which has created demand for skilled CSE professionals. Because technologies like cloud computing, big data analytics, artificial intelligence, and the Internet of Things today support daily living and manufacturing processes, modern technological skills is necessary. Industry 4.0 and the digital economy are compelling higher education institutions to revise their academic programs to equip graduates with the competencies needed in evolving workplaces [1] . In addition to fundamental programming skills, data analytics, machine learning, and cybersecurity competencies are now essential for CSE professions. New graduates need to continue learning to remain relevant due to the fact that technology is changing so rapidly [2] . In addition to technical skills, employers also highly regard soft skills such as teamwork, communication, problem-solving, and adaptability. These skills are presently viewed as key drivers of career success on par with the level of sector-specific knowledge for most employers [3] . Even amid strong demand in fields such as Bangladesh's IT sector, where job placement for CSE graduates reaches as much as 77 percent, a gap in skills between education by schools and industry remains. Most graduates do not possess up-to-date, industry-relevant skills or in-job experience that restricts their own likelihood of direct employability without additional training [4] . New global career paths are being opened to individuals who acquire proficiency in emerging fields such as data science and artificial intelligence. As CSE graduates drive innovation and digital transformation in every sector of the global economy, it is crucial to solve these problems [5] .

1.2. Motivation

In light of IR 4.0, Malaysian researcher Poh Kiong Tee [6] provides an essential perspective on the digital skills required and the talent deficits.The results of the investigation refuted the notion that eagerness to pay for microcredentials has a modulating impact on employability. The present study verified how well microcredentialing fills digital skill gaps; future research will concentrate on other digital skill domains that affect graduate employability. This research confirms how entry-level graduate employees' employability is impacted by microcredentials and digital skills.These findings suggest that educational programs should put development of these competencies first so as to better get pupils ready for the workplace.Employers could also profit from recognizing the need of microcredentials in assessing prospective candidates. Mehrdad Maghsoudi [7], Four different skill groups were found inside the network: Generalist, Infrastructure and Security, Software Development, and Embedded Systems.Generally, the research offers insightful information on the present condition of the computer science job market and can help individuals and companies make wise decisions regarding skills development and Professionals looking for employment or career growth in the computer science field should consider acquiring these highly sought-after skills to boost their employability and job prospects.For the CSE Department students looking for jobs, this paper is so good; but, this work can be more grand since the CSE industry is not constrained by these four clearly defined abilities. Cheng Peiwen [8] conducted a research where he write AI affects several sectors quite differently, though lowskilled jobs are fast being replaced, the demand for highskilled ones and fresh roles is growing, therefore changing the job market toward a more intelligent one with advanced countries and hightech sectors adjusting fast to this change while less developed areas and conventional industries are under more pressure to transform. The dynamic and complex link between artificial intelligence and employment requires multiple studies to guarantee that technical developments improve the job market.Future studies could assist to assess the efficacy of current rules and to measure the effects of artificial intelligence on the job market in several sectors and locations using empirical analysis.In many ways, artificial intelligence and employment are related; thus, in several methods, these links have to be investigated to guarantee that technological advancements support the job market. Lately, as we wrap up our computer science degree, we've been struck by how quickly the world of work is changing. It feels like every few months there's a new tool or framework, and our classes can't always keep up. Researchers say the digital revolution and Industry 4.0 have turned the job market on its head; employers now want people who can juggle information, collaborate online, design digital content, safeguard data and solve problems [9]. Sadly, many graduates still fall short on these basics and critics warn that universities are lagging [9]. We see why: a lot of syllabuses still focus on classic theory while exciting fields like data analysis, AI and simulation barely get airtime. Some academics argue for a broader approach to digital literacy that blends technical skills with critical thinking, teamwork, ethics and creativity. Others admit they don't feel ready to teach these emerging topics or to collaborate across departments [10]. No wonder reviewers note that graduates often lack both technical and soft digital skills because it's hard to predict exactly what industry will need next [9]. Reports from the labour market back this up: a World Bank brief states the digital economy is growing six times faster than the rest and could soon represent a quarter of global GDP [11]. The same brief suggests that 83 million jobs might vanish by 2025 while 69 million new ones emerge, with almost half of all workers needing to update their skills [11]. It also mentions that digital literacy is basically mandatory now; more than ninety per cent of US job ads ask for it and employers especially value people who can think analytically, dream up new ideas and keep learning. Meanwhile, the International Labour Organization finds that about a quarter of jobs worldwide now involve generative AI in some way, yet it reassures us that most occupations will evolve rather than disappear [12]. We're also seeing whole sectors blossom: healthcare, finance, manufacturing, retail and entertainment are all investing heavily in AI [13]. Freelancing platforms report a boom in technical gigs like AI modelling and data annotation, but also in people-centric roles such as coaching and training; specialists with deep AI expertise are commanding higher fees [14]. As for us, we've mastered C, C++, Java, data structures and some GUI work, yet we've had little chance to tackle interdisciplinary or AI projects, so we know we'll need to build soft skills and get hands-on experience. Picking languages wisely matters too; surveys put Python at the top for its data and machine-learning libraries. Java still holds its own thanks to its stability in big companies, and JavaScript runs much of the web. There's still room for C++ and C# in high-performance and enterprise systems; TypeScript is catching up as a scalable alternative; and SQL remains indispensable for managing data in the age of AI [15]. All these threads point to one conclusion: the future will favour people who combine cutting-edge technical know-how with timeless human qualities like communication, flexibility and ethics. Jobs will morph rather than vanish, so we need to stay curious and push for classes that reflect where technology is going. Our hope with this paper is to spark a conversation about how universities, companies and policymakers can work together to equip computer science graduates for a labour market transformed by AI.

2. Literature review

To help CSE students toward futureproof careers in 2025 and beyond, this table offers a rolewise evidence matrix synthesizing literature, industry practice, and open standards.Every line profiles a high-demand job and covers the main growth factors supporting hiring across industries including finance, healthcare, logistics, and consumer software.Along with the usual toolchains applicants will come across in production scenarios, the table identifies vital skills for each role that turns coursework into job-ready ability.A committed Methods column clarifies the dominant technological approaches, patterns, and evaluation practices expected in real projects, hence assisting readers to bridge theory with implementation discipline.The Datasets column spotlights freely accessible corpora and traces usable to practice techniques or replicate results; the Representative datasets or benchmarks field points to canonical tasks employed by the community to gauge progress. Qualitatively on a Low to High scale, AI replaceability risk reflects the degree to which automation may affect entry-level activities versus higherorder design, integration, and safety work.Taken together, these areas help to turn the table into both a practical planning tool for curriculum, internships, and portfolio assignments as well as a literature map.Roles encompass software, data, artificial intelligence, cloud, security, mobile, blockchain, IoT, XR, testing, and GenAI application engineering to capture the breadth of opportunities available to CSE graduates. Skills emphasize fundamentals such as algorithms, systems, SQL, Python or TypeScript, and testing, then extend to domainspecific capabilities like streaming pipelines, causal inference, SRE practices, contract security, and retrievalaugmented generation. Methods foreground reproducibility, scalability, observability, governance, and ethics so that students can design solutions that are reliable and responsible.Selected to be publicly accessible, frequently quoted, and appropriate for capstonegrade research or mini studies are datasets and benchmarks.Readers can choose portfolio projects that correspond with market demand, identify skill gaps, and frame research contributions aiming at quantifiable gaps including robustness, data quality, cost control, and safety using the matrix.

3. Title 2

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Table 1: Role wise evidence table

Role	Future-Proof Growth Factors	Essential Skills for This Role	Typical tools	AI replaceability risk
Backend Software Engineer	Every product needs secure and scalable APIs, payments, and integrations across sectors like fintech, health, and logistics.	System design; OOP; data structures; SQL and NoSQL; REST and GraphQL; caching; message queues; testing.	Node.js; Express; Java Spring Boot; Python FastAPI or Django; Go; PostgreSQL; MySQL; MongoDB; Redis; Kafka; Docker; Kubernetes.	Medium
Frontend Engineer	Web remains the main user interface for consumer and enterprise apps. Accessibility and performance are critical.	TypeScript; accessibility; performance budgets; state management; testing; design systems.	React or Vue or Angular; Next.js; Tailwind; Vite; Vitest; Playwright; Web Vitals.	Medium to High
Mobile App Developer	Continuous growth of mobile usage, super apps, fintech, and on device AI features.	Kotlin or Swift; Flutter or React Native; offline first sync; app architecture; performance; security.	Android Studio; Xcode; Flutter; Firebase; Realm; SQLite.	Medium
Data Engineer	Data pipelines are the foundation for BI and AI. Companies move to lakehouse and streaming.	Advanced SQL; Python; data modeling; ETL and ELT; streaming; orchestration; data quality.	Airflow; dbt; Spark; Kafka; Flink; Snowflake; BigQuery; Delta Lake; Great Expectations.	Low to Medium
Machine Learning Engineer	AI features are moving from demo to production across many industries.	Python; classic ML; deep learning; feature engineering; evaluation; deployment; vector search.	scikit learn; PyTorch; TensorFlow; Hugging Face; ONNX; MLflow; Weights and Biases.	Low to Medium
MLOps Engineer	Organizations need reliable training, deployment, and monitoring of models at scale.	CI/CD for models; feature stores; data and model versioning; monitoring; drift detection.	MLflow; DVC; Feast; Kubeflow; Seldon; Vertex AI; Docker; Kubernetes.	Low
Data Scientist	Product analytics and experimentation drive growth and decisions.	Statistics; causal inference; A/B testing; SQL; Python; visualization; storytelling.	pandas; NumPy; SciPy; scikit learn; Jupyter; Tableau or Power BI.	Medium
Cybersecurity Analyst or Engineer	Rising threats, compliance rules, and AI powered attacks increase demand.	Threat modeling; secure coding; network analysis; incident response; red and blue teaming.	Wireshark; Zeek; Suricata; SIEM like Splunk; Burp Suite; Metasploit; OSINT tools.	Low
Cloud and DevOps Engineer	Cloud adoption continues with cost and reliability focus.	Infrastructure as code; CI/CD; container orchestration; observability; FinOps.	AWS or Azure or GCP; Terraform; Ansible; Docker; Kubernetes; Prometheus; Grafana.	Low to Medium
Site Reliability Engineer	Always on digital services need reliability and fast incident response.	SLI and SLO design; error budgets; incident management; capacity planning; observability.	Prometheus; Grafana; OpenTelemetry; Sentry; PagerDuty; Chaos tools.	Low
Blockchain or Smart Contract Engineer	Enterprise tokenization, DeFi, and digital identity remain active niches.	Solidity or Rust; contract security; cryptography basics; formal verification.	Hardhat; Foundry; OpenZeppelin; Substrate; Ethers.js; Web3.js.	Low
AR or VR or XR Developer	Enterprise training, retail try ons, education, and gaming push immersive tech.	Unity or Unreal; C#; 3D math; shaders; interaction design; performance.	Unity; Unreal; Blender; ARKit; ARCore; OpenXR.	Medium
IoT Systems Engineer	Smart industry, agriculture, and cities need secure low power devices and edge AI.	Embedded C or C++; microcontrollers; RTOS; MQTT; edge inference; OTA updates.	ESP32; Arduino; Zephyr; FreeRTOS; AWS IoT; Azure IoT; Node RED.	Low
QA Automation Engineer	Faster release cycles need strong automated testing and quality gates.	Test strategy; e2e and unit tests; property based tests; performance and security testing.	Selenium; Playwright; Cypress; JUnit; PyTest; Postman; JMeter; k6.	Medium to High
GenAI Application Engineer	Teams add language model features for search, support, and automation.	LLM prompt design; RAG; evaluation; vector search; security; cost control.	OpenAI or local LLMs; Hugging Face; LangChain or LlamaIndex; FAISS or Pinecone or Weaviate; Guardrails.	Medium

Source	RA (J2000) [h,m,s]	DEC (J2000) [o,',"]	$V_{\rm sys}$ km s^{-1}
NGC 253	00:47:33.120	-25:17:17.59	235 ± 1
M 82	09:55:52.725,	+69:40:45.78	269 ± 2

Table 2: Random table with galaxies coordinates and velocities, Number the tables consecutively in accordance with their appearance in the text and place any table notes below the table body. Please avoid using vertical rules and shading in table cells.

3.1. Subsection title

A random equation, the Toomre stability criterion:

$$Q = \frac{\sigma_v \times \kappa}{\pi \times G \times \Sigma} \tag{1}$$

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5. Discussion

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6. Summary and conclusions

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Acknowledgements

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Appendix A. Appendix title 1

Appendix B. Appendix title 2

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