# Overview of Undergraduate Programmes in Robotics and Artificial Intelligence in the United Kingdom

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***Abstract*—In both the United Kingdom and abroad, the demand for robotics professionals is increasing rapidly due to the widespread adoption of automation and artificial intelligence technologies. This highlights the critical need for robotics and artificial intelligence professionals to support the advancement of automation technologies while also addressing its potential impact on the workforce. These trends underscore a growing gap between the demand for robotics professionals and the available talent pool, emphasizing the necessity for more specialised education and training programmes. Historically, undergraduate engineering and computer science programmes in British universities have been designed to focus on conventional technological domains, such as mechanical, electrical, and computing engineering. However, careers in robotics require a comprehensive blend of these fields, alongside training in systems engineering and advanced applications. Therefore, there is a clear need for new educational programmes dedicated to robotics and artificial intelligence. Despite some recent progress in introducing specialised robotics and artificial intelligence programmes in the UK, there is limited systematic research on how these programmes should be structured to align with evolving market and societal needs. This paper examines the structure and learning outcomes of robotics and artificial intelligence programmes offered in the UK. The authors evaluate the similarities and differences among these programmes, identify subject-specific learning outcomes, and outline core topic streams in robotics and artificial intelligence. We analysed 12 undergraduate educational programmes currently offered in the UK with titles explicitly including both 'Robotics' and 'Artificial Intelligence'. Our findings revealed that modules in the areas of artificial intelligence and computer science typically account for approximately one-third of the total available credits in these programmes. This proportion is often comparable to the combined share of modules related to electrical, electronic, and general engineering. However, a preliminary analysis of job advertisement keywords for positions in the areas of robotics in AI in the UK posted on LinkedIn in the during the last quarter of 2024 indicates that over 55% of the keywords fall into the AI or computer science categories. This disparity suggests a potential misalignment between the curricula of these educational programmes and the demands of the job market.**

***Index Terms*—robotics, artificial intelligence, education, job market**

## I. Introduction

Robotics and artificial intelligence are among the fastest-growing sectors of the global economy, necessitating a workforce of highly skilled engineering graduates with specialized expertise in robotics, control systems, machine learning, and related engineering domains. To meet the increasing demand for robotics professionals, higher education institutions must develop and introduce new undergraduate programmes in robotics and artificial intelligence. In countries such as Japan, South Korea, and China, dedicated undergraduate programmes in robotics and related fields have already been well established. Similarly, over the past decade, several universities in the United Kingdom have launched undergraduate programmes in robotics and artificial intelligence. These programmes aim to educate professionals with expertise that integrates knowledge from multiple conventional engineering disciplines.

Research in robotics education is extensive [1]–[3], with a substantial body of work emerging since robotic technologies have become more affordable and the demand for systematic teaching and learning methodologies has grown. This section provides a concise overview of efforts to integrate robotics education into traditional engineering and computing curricula, as well as the development of specialised degree programmes in robotics and artificial intelligence. Notably, the latter topic—dedicated robotics and artificial intelligence programmes—remains underexplored and inadequately documented in the academic literature.

Robotic technology has been widely utilised as an effective multidisciplinary tool to enhance the teaching of various engineering disciplines across all levels of education [4]–[8]. Due to its inherently multidisciplinary nature, robotics serves as an exemplary model for curriculum integration. The development of innovative robotics courses and individual taught modules provides educators with numerous opportunities to make their curricula more engaging and stimulating for students [9]–[11]. Research has shown that incorporating robotics topics and specialized courses into existing engineering programmes can enhance their appeal, improve learning outcomes, and increase student motivation [12]–[14].

One significant advantage of teaching robotics within engineering disciplines is the emphasis on hands-on experience with hardware and software systems, which equips students with the practical and applied skills sought by employers in a competitive job market. For example, it has been demonstrated that robotics modules can be seamlessly integrated into undergraduate programmes in electrical and electronic engineering, industrial engineering, and computer science [15]–[17]. Additionally, the inclusion of robotics modules has been shown to foster improved communication skills and experience in cross-disciplinary teamwork among students [18]. Numerous studies also highlight the benefits of incorporating robotics competitions and challenges into educational programmes, which are positively received by students at both undergraduate and postgraduate levels [9], [19], [20].

A survey conducted among faculty teaching robotics [21] revealed that, despite the apparent growth in robotics degree programmes, the majority of robotics courses continue to be offered within traditional disciplines such as computer science (predominantly), mechanical engineering, and electrical engineering. One of the most significant challenges identified was defining the set of topic areas to be covered for students across various programmes [22]. Other studies have emphasized that the primary competency students should acquire from robotics courses is a multidisciplinary, systems-level perspective on engineering problem-solving.

To address the need for a comprehensive educational foundation in robotics and artificial intelligence, the creation of specialized degree programmes has been proposed and explored in several works [23]–[25]. These studies suggest that robotics engineering and artificial intelligence could be effectively promoted as standalone undergraduate engineering programmes, providing students with a focused and robust education in these fields.

In this study, we present a novel analysis of undergraduate programmes in robotics and artificial intelligence offered at universities across the United Kingdom. The structure of these programmes is examined with a focus on the engineering areas and topics covered, including the number of core robotics modules. The identified areas are subsequently aligned with market demands, determined through an analysis of job advertisements in the fields of robotics and artificial intelligence. The key findings reveal significant discrepancies between the content of the taught programmes and the skills sought by employers. To the best of our knowledge, this is the first study to provide a formal comparison of market needs and the curricular structures of undergraduate programmes in robotics and artificial intelligence within the UK.

## II. State of Robotics and AI Education in the UK

### A. *Undergraduate Programmes in Robotics and AI*

As of late 2024, the Universities and Colleges Admissions Service (UCAS) website lists 44 universities across the United Kingdom offering full-time undergraduate programmes whose title contains the term ‘robotics’. Additionally, at least 18 more universities provide programmes in various engineering disciplines—such as mechanical, mechatronics, electrical, aeronautical, and computer science—that include individual modules focused on robotics as part of their curricula. In our analysis, we use the terminology accepted in the UK Higher Education system[1] (the terms may have a slightly different meanings in other countries). Many of these programmes are well-established and encompass a broad spectrum of specialisations, ranging from traditional robotics engineering to application-driven fields (e.g., biomedical robotics) and creative robotics technologies. Concurrently, there are over 100 providers of full-time undergraduate programmes in artificial intelligence (AI). The disciplines underpinning modern AI, including machine learning, decision-making, and computer vision, are increasingly integral to contemporary robotics systems, which must process large volumes of unstructured sensor data, make autonomous decisions in complex environments, and demonstrate adaptive performance improvement. The growing demand from industry for specialists at the intersection of robotics and AI has prompted many UK universities to develop and offer dedicated undergraduate programmes, with new courses being introduced annually.

This study examines the curricula of all undergraduate programmes offered by UK universities with the terms ‘robotics’ and ‘artificial intelligence’ explicitly included in their titles. A total of 13 such programmes were initially identified; however, one was excluded due to the lack of publicly available detailed information on its modules and content. Of the remaining 12 programmes, nine have a duration of three years of taught study (often with the option of a foundation year or an industrial placement year—commonly referred to as a “sandwich year”—following the second year). Two programmes (offered by Kingston University and the University of Glasgow) allow students to choose between three-year and four-year options (BEng or MEng), while one programme (at University College London) is exclusively a four-year offering.

The names of the programmes evaluated, along with their corresponding universities, core module counts, and optional module counts, are summarized in Table I. The degree abbreviations used include BSc (Bachelor of Science), BEng (Bachelor of Engineering), and MEng (Master of Engineering). The designation “B/MEng” indicates that both BEng and MEng options are available. Furthermore, in the program title column, “AI” and “R” abbreviate artificial intelligence and robotics, respectively, while “R. Eng” denotes Robotics Engineering. In cases where essential information was unavailable on official university pages, “N/A” is used.

The following quick observations can be made:

- The most common module counts (mode) across the first, second, and third years of study within the analysed programmes were six, six, and five modules, respectively.
- Each module is assigned a specific number of credits, with the total credits for all modules in the same academic year typically amounting to 120. However, there is considerable variation in credit allocation across programmes. Some programmes distribute credits evenly across modules within a year (e.g., six or eight modules,

[1]Programme or Course - programme of study (i.e. BEng/MEng). Module or class - a specific topic that forms the structure of the programme (i.e. ‘Robot kinematics’).

TABLE I
THE NUMBER OF CORE AND OPTIONAL MODULES ON DIFFERENT ROBOTICS AND AI PROGRAMMES IN THE UK

| No. | University name | Programme title | Duration (years) | Core modules count | | | | Option modules |
|---|---|---|---|---|---|---|---|---|
| | | | | Year 1 | Year 2 | Year 3 | Year 4 | |
| 1 | Aberystwyth U. | BSc AI&R | 3 | 7 | 6 | 6 | | 0 |
| 2 | Aston U. | BSc AI&R | 3 | 8 | 6 | 2 | | 4 |
| 3 | Edge Hill U. | BSc R&AI | 3 | 6 | 6 | 5 | | 0 |
| 4 | Kingston U. | B/MEng R. Eng.&AI | 3 or 4 | 6 | 6 | 6 | 6 | 0 |
| 5 | Sheffield Hallam U. | BSc AI&R | 3 | 4 | 4 | 3 | | 1 |
| 6 | U. College London | MEng R&AI | 4 | 8 | 8 | 7 | 6 | 1 |
| 7 | U. of Bedfordshire | BSc AI&R | 3 | 4 | 4 | 4 | | 0 |
| 8 | U. of Exeter | BEng R&AI | 3 | 6 | 7 | 5 | | 1 |
| 9 | U. of Glasgow | B/MEng R&AI | 3 or 4 | 8 | 11 | 5 | N/A | N/A |
| 10 | U. of Hertfordshire | BEng R&AI | 3 | 8 | 8 | 7 | | 0 |
| 11 | U. of Hull | BSc R&AI | 3 | 6 | 5 | 3 | | 3 |
| 12 | U. of Portsmouth | BEng R&AI | 3 | 6 | 6 | 4 | | 1 |

each bearing 20 or 15 credits, respectively), while others allocate credits unevenly (e.g., one module worth 40 credits, another worth 20 credits, and six more worth 10 credits each). These variations suggest that credit distribution should be considered when conducting any qualitative comparisons of program specialisation.

- Five of the programmes do not include optional (elective) modules, while only two programmes (offered by Aston University and the University of Hull) provide more than one elective option. Elective modules, where available, are typically offered during the final year of study.

### *B. Comparison of Programmes' Offerings*

To facilitate quantitative comparisons between the programmes, we analysed the syllabi and intended learning outcomes (ILOs) of over 220 modules across the 12 selected programmes. Our analysis focused on the modules to be offered during the 2025–26 academic year. We limited the study to only core (compulsory) modules, for two main reasons: (1) the range of elective modules is highly diverse, and detailed information about them—often limited to their titles—is frequently sparse or unavailable online; and (2) elective modules are subject to year-on-year variation, whereas core modules constitute the stable component of a program's curriculum.

The core modules were categorized into seven broad thematic areas to enable a structured analysis:

- **Artificial Intelligence** (encoded as '**AI**'): This category encompassed modules covering topics such as machine learning, artificial intelligence, deep learning, reinforcement learning, and intelligent systems.
- **Computer science (CS)**: This included modules related to programming, algorithms, data structures and software engineering. Additional topics in this category included modelling and simulation, computer systems architecture, networks, smart devices, real-time operating systems, and similar areas.
- **General (G)**: Modules aimed at developing transferable skills and professional knowledge were grouped under this category. Examples included problem-solving, study skills, communication, professional practice, equality, diversity and inclusion, economics, entrepreneurship, and project management.
- **Projects (P)**: This category included all project-based activities, typically involving team and individual projects in the final years of study.
- **Electronics and Electrical Engineering (EEE)**: In addition to traditional electronics and electrical engineering modules, this category included digital signal processing, embedded systems and microcontrollers, sensors and signal conditioning, filtering and sensor fusion.
- **Robotics (R)**: This category included modules such as robot kinematics, robotic systems, mobile robots and drones, behaviour and social robotics, human-robot interaction, and related topics.
- **Engineering (Eng)**: Modules that serve as a foundation to the topics in robotics and AI were included here. Examples included mathematics, computational methods, numerical analysis, industrial automation, knowledge representation, mechatronics, materials science, and manufacturing. Modules on control systems were also grouped under this category following deliberation.

These categorizations provide a structured framework for comparing the core curricula across the analysed programmes.

We acknowledge that this classification approach is subject to debate. Firstly, the choice of categories is inherently subjective, and alternative schemes with either fewer or more categories could have been employed. We emphasize that no offence was intended toward mathematicians or control engineers by grouping related modules under the broad 'Engineering' category. To maintain balance, modules related to computer vision were categorized under 'Computer Science', as these typically require a strong foundation in data structures, algorithms for data representation, numerical methods, and image processing techniques for visualisation—areas more closely aligned with computer science than with mathematics or artificial intelligence. Our aim was to create a classification system that minimized the number of categories while ensuring that each remained sufficiently distinct to facilitate meaningful comparison across programmes. Additionally, we

TABLE II
PERCENTAGE OF MODULES ON A PROGRAMME BY CATEGORY

| University | AI | CS | EEE | Eng | G | P | R |
|---|---|---|---|---|---|---|---|
| Aberystwyth | 14.3 | 45.7 | - | - | 17.1 | 11.4 | 11.4 |
| Aston | 16.7 | 16.7 | - | 16.7 | 11.1 | 27.8 | 11.1 |
| Edge Hill | 16.7 | 27.8 | 5.6 | 22.2 | 11.1 | 11.1 | 5.6 |
| Kingston | 9.1 | 6.1 | 18.2 | 9.1 | 9.1 | 24.2 | 24.2 |
| Sheff. Hallam | 11.8 | 23.5 | 11.8 | 11.8 | 5.9 | 23.5 | 11.8 |
| UCL | 9.7 | 12.9 | 16.1 | 22.6 | 3.2 | 16.1 | 19.4 |
| Bedfordshire | 8.3 | 25.0 | - | 25.0 | 16.7 | 8.3 | 16.7 |
| Exeter | 4.3 | 17.4 | 13.0 | 34.8 | 4.3 | 26.1 | - |
| Glasgow | 5.9 | 26.5 | 26.5 | 35.3 | 2.9 | 2.9 | - |
| Hertfordshire | 8.3 | 20.8 | 16.7 | 8.3 | 4.2 | 25.0 | 16.7 |
| Hull | 6.7 | 40.0 | 20.0 | - | 6.7 | - | 26.7 |
| Portsmouth | 6.2 | 6.2 | 43.8 | 12.5 | 6.2 | 12.5 | 12.5 |
| **Median values** | 8.7 | 22.2 | 14.6 | 14.6 | 6.5 | 14.3 | 12.2 |

introduced a dedicated ‘Projects’ category to reflect the significant role of project-based learning in most programmes, with such activities (e.g., final-year projects or group projects) often being extensive and integrative of knowledge across multiple domains.

Another reason the proposed module classification may be contested is that many modules inherently cover topics spanning multiple categories, making their assignment to a single category somewhat speculative. For instance, modules such as ‘Decision Making and Robot Kinematics’ span both Artificial Intelligence (AI) and robotics (R), ‘Modeling and Simulation in Soft Robotics’ intersects computer science (CS) and robotics (R), and ‘Fundamentals of Control and Instrumentation’ bridges engineering (Eng) and electronics and electrical engineering (EEE). In such cases, we examined the module syllabi in detail and used our best judgment to assign each module to the category most representative of the predominant topics listed.

Figure 1 and Table II provide a summary of the distribution of module credits by category across the 12 programmes analysed. The data reveals substantial variation between programmes. For example, a specific module category may be entirely absent in one program while accounting for over 30% of the total credit allocation in another. Notably, the Electronics and Electrical Engineering (EEE) and Engineering (Eng) categories are absent from the curricula of three and two universities, respectively, yet constitute as much as 43.8% and 34.8% of the credit allocation in the programmes offered by the University of Portsmouth and the University of Glasgow, respectively. Among the seven identified module categories, only three (Artificial Intelligence (AI), Computer Science (CS), and General) are present across all 12 programmes. Even within these categories, there is significant variation: credits allocated to AI range from 4.3% to 16.7%, credits for CS vary from 6.1% to an exceptionally high 45.7%, and credits for the ‘General’ category range from 2.9% to 17.1%.

It is important to note that the data presented in Table II is based on a relatively coarse classification of modules into the categories of interest. A more precise and objective method for assessing the specialization of each programme would involve analysing the weekly topics covered within individual modules and assigning these topics to the respective categories. However, while such an approach is theoretically feasible for the 223 modules examined, the publicly available data lacks the required granularity regarding the specific topics covered within each module. Consequently, the current analysis relies on module syllabi and intended learning outcomes (ILOs), which may not fully capture the nuances of each programme’s content.

## III. JOB MARKET NEEDS IN ROBOTICS AND AI

### A. Search Methods

We conducted a review of approximately 100 job advertisements from the “Jobs” section of LinkedIn using the keyword “robotics.” The search was restricted to positions located within the United Kingdom. While the initial query returned over 17,000 results, we refined our focus to jobs posted within the preceding two months (October–November 2024). Academic positions, such as university teaching or research roles, were excluded, along with advertisements lacking detailed descriptions or identified as duplicates. Each advertisement was manually reviewed by the authors to confirm its relevance to the field of robotics. The job descriptions, including information on roles, responsibilities, and required skills or expertise, were collected and saved for further analysis.

To identify patterns, a Python script was utilized to extract and count recurring two-word combinations from job descriptions. The resulting list was manually reviewed to exclude common phrases containing articles, prepositions, or terms that were either overly general (e.g., '*innovative solutions*', '*foundation models*') or vague (e.g., '*design implementation*', '*protection systems*'). We chose not to analyse three-word combinations, as they typically provided limited actionable insights into the specific skills and knowledge demanded within the robotics sector.

The identified word combinations were subsequently mapped to the same seven categories used for classifying academic modules, as described in the previous section. However, isolating and classifying project-based outcomes posed notable challenges. For example, while students working on group projects undoubtedly gain project management experience, we categorized modules related to project management under the General category. Similarly, students can develop communication skills through various activities, many of which may be project-based (e.g., delivering design iteration presentations) or general (e.g., participating in modules on effective communication). Ultimately, teamwork-related skills were assigned to the ‘Projects’ category, while communication-related skills were placed under the ‘General’ category. A comprehensive list of keywords extracted from the job advertisements can be found in Appendix, Table III.

### B. Results

The analysis of keywords extracted from job advertisements revealed the following distribution across identified skill areas:

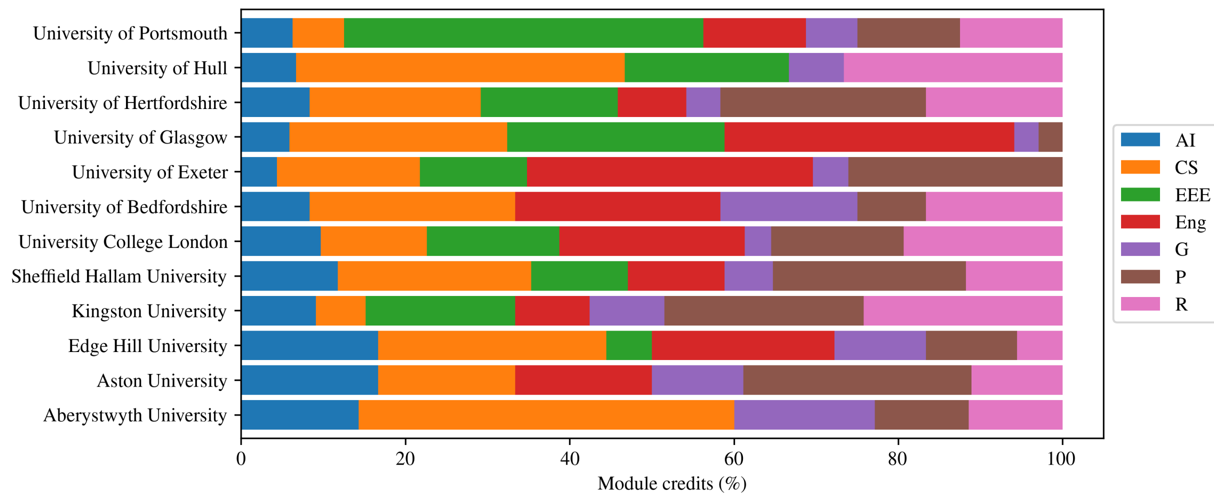


Fig. 1. Module credit composition of each UG programme in robotics and AI by category: AI, computer science (CS), electrical and electronics engineering (EEE), general engineering (Eng), general (transferable) skills (G), project-based modules (P) and robotics (R)

- Artificial intelligence (29% of all combinations): he most frequent keyword pairs included machine learning, deep learning, '*AI safety*', '*generative AI*', '*autonomous systems*'.
- Computer science (26.6%): CS, computer vision, software development and engineering.
- General (16.1%): communication skills, project management.
- Project work (12.23%): team work (particularly in cross-functional teams), hands-on experience.
- Engineering (11.4%): control systems.

The remaining keywords, accounting for less than 5%, were evenly distributed between robotics ('*humanoid robots*') and EEE ('*sensor fusion*').

These findings underscore the significant emphasis employers place on computer science competencies among modern graduates. The successful implementation and integration of advanced AI concepts often require strong programming and software engineering skills. Notably, soft skills such as communication and project management also emerged as important, accounting for 16% of identified keywords. The relatively high frequency of terms related to control systems was somewhat unexpected, whereas the limited demand for robotics applications and EEE skills was apparent during the specific time frame of the analysed job postings.

### *C. Matching Learning Outcomes and Market Needs*

A comparison of the job market keywords with the module compositions of the reviewed educational programmes (Table II and Figure 1) suggests that the skills demanded in the UK robotics job market may not fully align with those emphasized in academic curricula. Specifically, during the analysed period and location (UK), the demand for general computer science and AI skills surpassed that for specialized robotics applications and EEE. However, it is important to acknowledge that the methodology used—based on keyword frequency analysis—and the limited time frame of job postings constrain the reliability and generalisability of these conclusions.

The UK robotics and AI labour market often prioritizes roles focused on the integration of pre-existing systems and the implementation of higher-level AI, software engineering, and data processing concepts. This is reflected in the statistics presented in Table II. In contrast, opportunities in hardware and manufacturing are more limited, explaining the lower representation of robotics and EEE-related keywords. Globally, however, these two areas are more prominent in regions with manufacturing hubs.

It is also important to consider the diverse composition of student bodies in UK universities, which often include a significant proportion of international students. Many of these students return to their countries of origin after graduation, seeking employment in contexts that may differ substantially from the UK labour market. Consequently, it is unrealistic to expect that the module composition of UK educational programmes should align perfectly with the demands of the UK job market, irrespective of the specific time frame analysed.

## IV. Conclusion

This study examines the structure and content of undergraduate robotics and artificial intelligence programmes offered in the United Kingdom, highlighting the varied approaches universities take in course design. Among the 12 programmes analysed, none align within 35% of a "median" module distribution when mapped across the seven identified areas: artificial intelligence, computer science, electronics and electrical engineering, general engineering, projects, general/transferable skills, and robotics. Notably, some categories are entirely absent from the offerings of certain programmes, with only three areas (artificial intelligence, computer science, and general/transferable skills) consistently present across all 12 programmes.

A comparison of the module compositions with a keyword analysis of robotics-related job advertisements on LinkedIn over a two-month period revealed significant discrepancies between the skills emphasized in educational offerings and those sought by employers. These differences can be attributed in part to the unique characteristics of the UK robotics job market and in part potentially to the disciplinary backgrounds of the departments offering these programmes. Additionally, UK universities, as institutions catering to a substantial population of international students, may prioritize aligning with global trends rather than closely mirroring the specific demands of the domestic job market.

There are some limitations to our study, primarily due to the relatively small number of job advertisements analyzed, which could introduce bias and reduce overall confidence in the findings. Our focus was on exploring robotics and artificial intelligence programmes and the job market within the United Kingdom. However, a broader study could provide more valuable insights by including other related programmes, such as mechatronics, and considering global markets. Additionally, we did not examine taught postgraduate programmes, which may be important, as many undergraduate students choose to pursue Master's-level courses that are often more specialised in robotics and artificial intelligence. These limitations could be addressed in future research.

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## APPENDIX

TABLE III
RESULTS OF KEYWORD EXTRACTIONS FROM JOB ADVERTISEMENTS

| keywords | counts | category |
|---|---|---|
| machine learning | 56 | AI |
| computer science | 34 | CS |
| control systems | 31 | Eng |
| computer vision | 30 | CS |
| software development | 29 | CS |
| communication skills | 28 | G |
| deep learning | 27 | AI |
| crossfunctional teams | 24 | P |
| control system | 22 | Eng |
| project management | 21 | G |
| software engineering | 20 | CS |
| engineering team | 17 | P |
| hands-on experience | 16 | P |
| excellent communication | 15 | G |
| artificial intelligence | 14 | AI |
| ai safety | 13 | AI |
| generative ai | 13 | AI |
| autonomous systems | 12 | AI |
| humanoid robots | 12 | R |
| programming skills | 11 | CS |
| product development | 11 | G |
| sensor fusion | 10 | EEE |
| Total count | 466 | |

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