

# Skills Demands in the Technology Industry: Perceptions of Students and Graduates in Computing

Rafaela Otemaier<sup>1</sup>, Regina Albuquerque<sup>2</sup>, Vinicius Hernandez<sup>3</sup>, Sheila Reinehr<sup>1</sup>,  
Andreia Malucelli<sup>1</sup>

<sup>1</sup>Graduate Program in Computer Science (PPGIA) – Pontifícia Universidade Católica do Paraná (PUCPR)

<sup>2</sup>Polytechnic School – Pontifícia Universidade Católica do Paraná (PUCPR)

<sup>3</sup>Pontifícia Universidade Católica do Paraná (PUCPR)

{kelly.rafaela, regina.fabia, gustavo.hernandes  
sheila.reinehr, andreia.malucelli@pucpr.br}

**Abstract.** *The growing demand for IT professionals has revealed a gap between the skills acquired by graduates and the needs of the technology industry, especially in terms of soft skills. This study identifies the hard and soft skills most valued by technology companies and explores how students and graduates perceive these demands. A survey with 251 students, 561 graduates, and the analysis of 135 job advertisements were conducted. Results show that companies prioritize analytical skills and English fluency, which students often overlook, while graduates' perceptions align more with industry needs due to their experience. These findings highlight the need for universities to adapt curricula to better prepare graduates and bridge the skills gap, enhancing their employability.*

## 1. Introduction

With society's growing dependence on digital solutions and the emergence of new technologies, the demand for qualified Information Technology (IT) professionals has never been higher [Burbekova 2021]. This is one of the key factors driving Computer Science students to complete their in-person courses [Dantas et al. 2023]. As a result, much has been said about the possible shortage of professionals in the sector, which refers to the scarcity of qualified talent in the area to meet the growing demand for technological services and products [Breaux and Moritz 2021].

However, despite the apparent abundance of job opportunities in this sector, there seems to be a significant gap between the skills of computer graduates and the demands of the industry [Oguz and Oguz 2019]. This gap can be attributed to various factors, with contributions from both industry and universities. Companies advance rapidly and tend to use the latest technologies, which leads them to believe that universities cannot keep up with this rapid evolution. On the other hand, although universities strive to train professionals with a solid theoretical and technical base, they face difficulties in updating their curricula at the same speed as industry's technological evolution [Carvalho et al. 2023].

In addition, employers are increasingly demanding soft skills [Ahmed et al. 2012]. According to the [World Economic Forum 2023], analytical thinking is considered an essential skill in the job industry, followed by creative thinking,



resilience, flexibility and agility. When observing the demands of technology companies, additional needs related to soft skills are identified, such as problem solving, teamwork and communication, with communication being the skill most demanded by the technology industry [Ahmed et al. 2015].

Developing soft skills is one of the main challenges for universities, which have implemented various efforts to improve these skills in students [Marques et al. 2020, Mussa et al. 2021, Alves and Rocha 2021, Oran et al. 2023]. However, students tend to be more familiar with technical work and find it difficult to assimilate concepts related to soft skills. The study of [Rupakheti et al. 2017] points out that although soft skills are essential, they are often neglected in favor of learning hard skills. It is common for students to have a misperception about the skills required by the industry in their field [Inuwa and Varol 2019]. Correcting this perception can help professors to get students more engaged in the aspects that are often neglected.

Understanding the skills valued by companies enables universities to strengthen collaboration with industry and adapt their educational programs to meet evolving professionals demands. Aligning academic training with these needs not only enhances its relevance but also significantly improves graduates' employability. This study contributes to the field of computing education by providing insights that can bridge the gap between academic curricula and industry requirements.

The article is organized as follows. Section 2 presents related work. Section 3 describes the research method. Section 4 presents the results. Section 5 the discussion and Section 6 concludes the paper.

## **2. Related Work**

The literature on employability in Computing consistently highlights the importance of both technical skills (hard skills) and behavioral skills (soft skills) in meeting industry demands. In one of the earliest studies in this field, [Matturro 2013] identified the relevance of oral communication, teamwork, proactivity, analytical thinking, and problem-solving in job advertisements for software positions in Uruguay. Following this trend, [Gurcan and Şevik 2020] analyzed job advertisements in the software development sector, emphasizing communication as a critical element for team collaboration while also highlighting technical skills related to web, mobile, multiplatform, and object-oriented development.

Similarly, [Akdur 2022] and [Anewalt and Polack 2023] focus on the alignment between academia and industry in Software Engineering programs. Their findings indicate the need to enhance academic training beyond programming by incorporating analytical thinking, time management, teamwork, and communication. These authors also stress the importance of practical experience and supporting tools (e.g., GitHub, Slack, Jira) as well as the growing influence of Artificial Intelligence (AI) technologies in software development.

While these studies provide valuable insights, many primarily focus on either market demands (through job advertisements) or the perceptions of professionals already working in the industry (graduates). This study advances the discussion by integrating three distinct perspectives: (i) job advertisement analysis within the IT sector, (ii) the



perceptions of students in training, and (iii) the viewpoints of graduates already active in the job market. By simultaneously considering these three groups, our research provides a more comprehensive analysis of the existing misalignment between what is taught in higher education institutions and what is actually required by companies in terms of both hard and, especially, soft skills. Consequently, the study proposes pathways to bridge the gap between academia and industry, contributing to the development of future professionals with both technical and behavioral competencies that better align with market needs.

### **3. Research Method**

The research questions that guided this research were:

- **RQ1.** What are the hard skills most in demand by technology companies when hiring computer professionals?
- **RQ2.** What are the soft skills most in demand by technology companies when hiring computer professionals?
- **RQ3.** How do students and graduates of computing courses perceive the demands of the industry in terms of hard skills?
- **RQ4.** How do students and graduates of computing courses perceive the demands of the industry in terms of soft skills?

#### **3.1. Job Advertisement Analysis**

To answer RQ1 and RQ2, a dataset of 135 job vacancies published on the internal career portal of the Pontifical Catholic University of Paraná (PUCPR) was used. These vacancies were collected in November 2023 and included both internship and full-time positions. On this portal, companies submit opportunities containing detailed information, such as job title, description, and the required hard and soft skills. All postings are reviewed by the university's career advisors prior to publication to ensure data consistency and reliability.

From each posting, the following fields were extracted: company name, contact e-mail, required hard skills, required soft skills, type of position, and job title. The data were exported in CSV format and subjected to a manual cleaning process to eliminate duplicates and inconsistencies before being imported into Power BI for analysis.

To support the classification of skills, a normalization and grouping process was carried out. A thorough review of all job descriptions and related communications was performed to identify different ways of referring to the same skill. For example, expressions such as "Excel," "Excel spreadsheet," and "VBA" were identified as referring to related competencies and were treated as a single consolidated entry.

Similarly, soft skills such as "commitment," "dedication," and "responsibility" were unified based on contextual meaning. This approach aimed to reduce redundancy, ensure consistency, and improve the reliability of subsequent analyses. The grouping was independently conducted by two researchers and reconciled through discussion to validate the categorization of both hard and soft skills.

#### **3.2. Survey 1 – Students and Graduates**

To answer RQ3 and RQ4, we carried out two descriptive surveys using the script proposed by



### **3.3. Threats to Validity**

Content validity was ensured through a pilot study in which participants provided suggestions to improve the clarity and accuracy of the questionnaire items.

Regarding external validity, a key limitation is that data were collected from a single higher education institution, which may restrict the generalizability of the findings to other academic or regional contexts. Factors such as institutional characteristics, geographical location, and students' socioeconomic backgrounds may influence perceptions of employability and industry expectations.

The sample may also be subject to selection bias, as participation was voluntary and may have attracted individuals with a stronger interest in career development. This could result in an overrepresentation of respondents who are more aware of market demands or actively engaged in employability-related activities, potentially skewing the perception of required skills.

## **4. Results**

This section presents the characterization of the respondents, followed by the results organized according to the research questions.

### **4.1. Characterization of the Respondents**

The survey included 251 students (85% male and 15% female) and 570 graduates. Among the students, 56.16% are employed or interning, with 83.04% working in their field of study. Among the graduates, 91.96% are employed, and 78.22% are working in their training area. These findings indicate a strong professional placement in the IT field. The 40 most required skills were identified, divided into 20 hard skills and 20 soft skills. The period considered includes vacancies from 01/01/2023 to 31/12/2023.

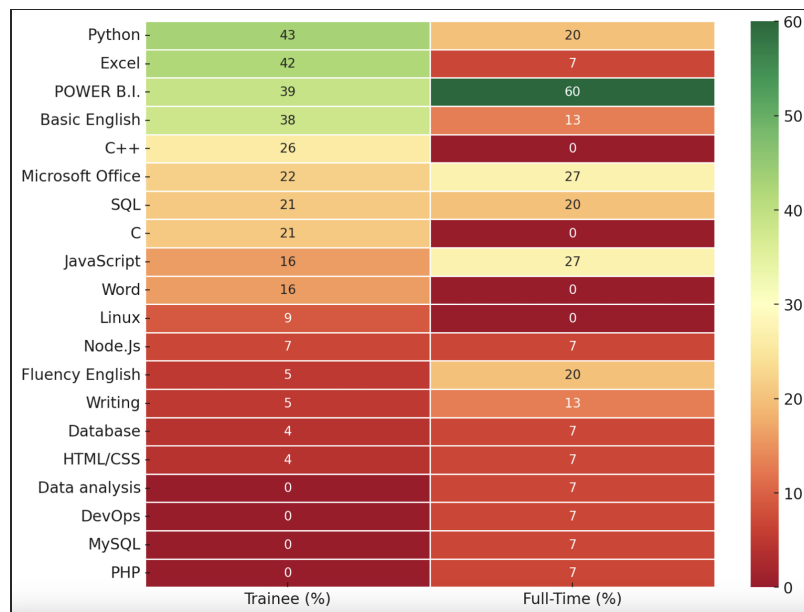
### **4.2. RQ1. What are the hard skills most in demand by technology companies when hiring computer professionals?**

The analysis of Figure 1, which presents the hard skills required for trainee and full-time positions, reveals key differences in industry expectations for early-career professionals and full-time hires.

An analysis of 135 job postings on the PUCPR internal portal, spanning both trainee and full-time (CLT) positions, revealed notable differences in the hard skills required. For trainee openings, Python (43%), Excel (42%), and Power BI (39%) stand out, along with Basic English (38%), underscoring the importance of basic programming and data analysis tools at the entry level [Matturro 2013, Gurcan and Şevik 2020]. The emphasis on Power BI reflects a growing market need for data reporting and visualization skills, likely driven by the broader adoption of Business Intelligence across multiple sectors [Oguz and Oguz 2019].

In contrast, full-time roles show continued prominence of Power BI (60%), followed by Microsoft Office (27%), JavaScript (27%), SQL (20%), and Python (20%). The increased demand for Fluent English (20%) is the most significant difference compared to trainee positions, suggesting that mid- and senior-level professionals often collaborate with international teams and advanced documentation [Ahmed et al. 2015]. Unlike





**Figure 1. Hard Skills most in demand by technology companies**

[Matturro 2013], who emphasized programming and communication, our findings highlight a stronger focus on data-driven solutions, exemplified by data analysis tools such as Power BI and SQL.

#### **4.3. RQ2. What are the soft skills most in demand by technology companies when hiring computer professionals?**

Figure 2 provides a comparative view of the soft skills required for trainee vs. full-time positions in the IT sector. A striking observation is the consistency of certain competencies across both categories, with Communication and Organization remaining vital. This aligns with the conclusions of [Matturro 2013] and [Gurcan and Şevik 2020], who pinpoint these skills as essential to team cohesion and project management.

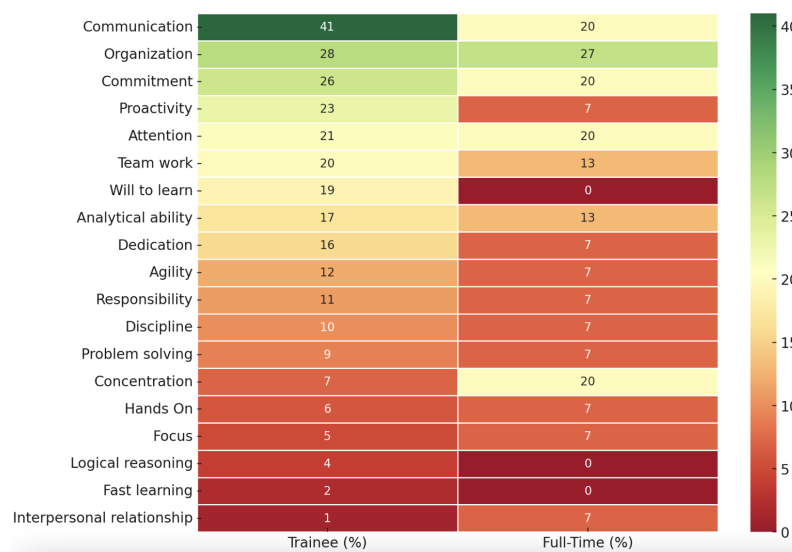
Interestingly, Commitment and a Willingness to Learn (19%) gain prominence for early-career roles, reflecting the industry's preference for adaptable newcomers prepared to grow within an organization [Rupakheti et al. 2017]. On the other hand, experienced roles place a stronger emphasis on Concentration (20%) and Analytical Ability (13%), suggesting that deeper cognitive engagement becomes increasingly relevant at advanced professional levels [Akdur 2022].

One noteworthy nuance involves the decline in Proactivity at more senior roles (7%), hinting that higher-level professionals are already expected to operate with autonomy and initiative [Anewalt and Polack 2023]. Collectively, these findings underscore the multifaceted nature of soft skills, where early focus on learning and commitment transitions into a demand for analytical and self-guided performance.

#### **4.4. RQ3. How do students and graduates of computing courses perceive the demands of the industry in terms of hard skills?**

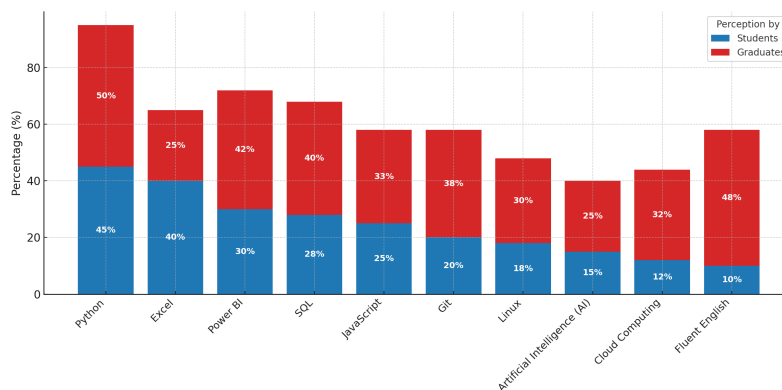
Students and graduates present points of convergence and differences regarding the hard skills they consider most important (Figure 3). The common ground lies in the emphasis





**Figure 2. Soft skills most in demand by technology companies**

on programming languages and data analysis tools (e.g., Python, Excel, Power BI, SQL), aligning with traditional Computer Science curricula [Rupakheta et al. 2017].



**Figure 3. Hard skills as perceived by students and graduates**

However, the importance assigned to market-oriented skills differs between the two groups. Students often underestimate the relevance of Git, Cloud Computing, and Fluent English, highlighting a disconnect between academic preparation and professional expectations [Anewalt and Polack 2023]. In contrast, graduates adopt a more pragmatic stance, placing high importance on Fluent English (48%), essential for accessing technical documentation and collaborating with global teams [Ahmed et al. 2015], as well as Git (38%) and Cloud Computing (32%), foundational to agile, scalable development in corporate settings [Oguz and Oguz 2019].

Moreover, the growing recognition of AI among graduates underscores that emerging technologies are now considered a baseline requirement for competitive performance in diverse computing domains [Carvalho et al. 2023]. These findings underscore the pivotal role of real-world experience, through internships, employment, or applied research, in shaping a more accurate and strategic understanding of the technical



skillsets demanded by industry. It is crucial for academic programs to broaden their scope beyond conventional subjects, incorporating version control, cloud infrastructure, English proficiency, and AI applications to keep pace with rapid technological evolution [Rupakheti et al. 2017].

#### 4.5. RQ4. How do students and graduates of computing courses perceive the demands of the industry in terms of soft skills?

The contrast in soft skills valuation between students and graduates, illustrated in Figure 4, provides insights into how practical experience modifies one’s appreciation of interpersonal and cognitive abilities. While both groups agree on the general relevance of interpersonal abilities, like Creativity and Relationship-Building, graduates exhibit a stronger inclination toward Problem Solving, Decision Making, and Time Management. The marked difference in these areas (e.g., 34.6% vs. 18.3% for Problem Solving) suggests that firsthand exposure to workplace challenges fosters a deeper recognition of these competencies [?].

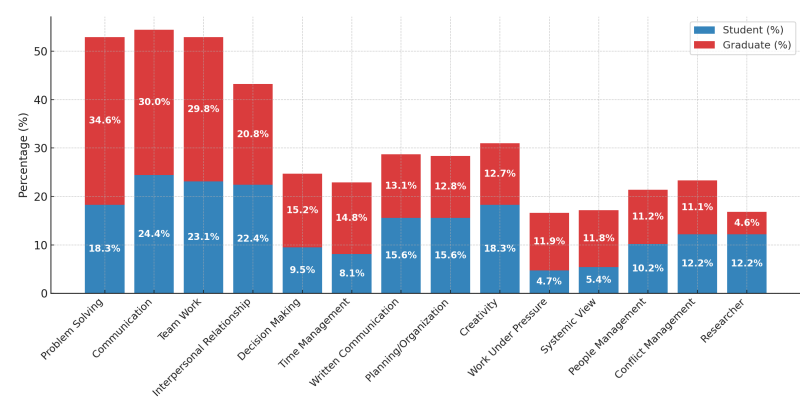


Figure 4. Soft skills as perceived by students and graduates

In addition, graduates place heightened value on Analytical Ability, Conflict Management, and People Management, reflecting real-world demands for leadership and collaboration under time constraints or project complexity (Ahmed et al. 2015). This pattern indicates a shift from theoretical awareness, common among students, to practical application and adaptation in professional contexts.

In summary, while the IT job market highlights analytical skills and English proficiency (RQ1 and RQ2), students (RQ3) often underestimate these essentials, especially on the soft skills side, until they face real organizational demands. Graduates stand closer to the industry’s expectations, having honed their soft skills through authentic project experiences and international collaboration. These outcomes underscore the need for academic institutions to integrate active learning strategies, team-based projects, and soft skill development modules early in the curriculum, bridging the gap between academic preparation and professional success [Marques et al. 2020].

## 5. Discussion

The findings highlight, on one hand, the relevance of hard skills such as Git, Cloud Computing, and AI to meet the growing demands of the job market (RQ1 and RQ3), and on the



other hand, the importance of soft skills (e.g., communication, organization, and problem-solving) in the daily activities of IT professionals (RQ2 and RQ4). The perceived gap between students' prioritized competencies and the actual demands of the industry suggests the need for more consistent pedagogical strategies to foster these skills from the early semesters, as well as for structured partnerships with the productive sector.

One way to intensify the early development of communication and problem-solving skills is through the adoption of active learning methodologies, such as Project-Based Learning, where students face real or simulated scenarios that require planning, argumentation, deadline negotiation, and task distribution. In this context, activities such as case studies, corporate situation simulations, and teamwork offer genuine opportunities to practice interpersonal interaction, conflict management, and decision-making, making soft skills as tangible as traditional technical skills.

Furthermore, promoting university-industry partnerships can accelerate the alignment between the academic environment and market demands. IT companies can contribute with guest lectures, workshops, and real-world challenges in which students develop solutions to concrete problems under the guidance of experienced mentors. At the same time, continuous feedback from industry professionals enables curriculum adjustments, ensuring that topics such as Git, Cloud Computing, and AI are timely incorporated or updated. This strong interaction fosters a more comprehensive education, in which students not only understand the value of technology but also the necessity of communicating effectively within multidisciplinary teams and fast-paced environments.

In summary, the integration of innovative pedagogical strategies with strong partnerships with the business sector supports both the strengthening of hard skills and the consolidation of essential soft skills. As a result, graduates from Computer Science programs are not only proficient in current tools and programming languages but are also prepared to solve complex problems, address communication challenges, and exercise leadership in diverse IT market contexts.

## **6. Conclusion**

The findings of this study reveal a clear gap between the technical and behavioral competencies required by the IT industry and those perceived by students during their initial academic training. While data analysis tools such as Python, Power BI, and SQL, as well as English fluency, are frequently emphasized in job postings and well understood by graduates, students tend to underestimate the importance of some of these skills, particularly advanced English proficiency and the use of collaborative tools like Git.

Moreover, the soft skills most valued by the industry, such as critical thinking, effective communication, and proactivity, often receive insufficient attention from students, even though they are readily acknowledged by graduates who are already active in the professional sphere.

As a practical implication, this calls for curricular adaptations that foster the integrated development of both technical and behavioral skills, as well as stronger collaboration between academia and industry to ensure that educational programs remain aligned with the fast-paced evolution of the technology sector. Initiatives such as interdisciplinary coursework, real-world projects in partnership with companies, and a stronger emphasis



on English language training may help bridge the gap between market expectations and the skill set of future computing professionals.

In summary, the results underscore that soft skills development must be addressed continuously and transversally alongside the acquisition of hard skills, in order to enhance employability and better prepare both students and graduates to meet the demands of an increasingly dynamic and competitive job market.

## References

- Ahmed, F., Capretz, L. F., Bouktif, S., and Campbell, P. (2015). Soft skills and software development: A reflection from the software industry. *International Journal of Information Processing and Management*, 4(3):171–191.
- Ahmed, F., Capretz, L. F., and Campbell, P. (2012). Evaluating the demand for soft skills in software development. *IT Professional*, 14(1):44–49.
- Akdur, D. (2022). Analysis of software engineering skills gap in the industry. *ACM Transactions on Computing Education*, 23(1):1–28.
- Alves, I. and Rocha, C. (2021). Qualifying software engineers undergraduates in devops: Challenges of introducing technical and non-technical concepts in a project-oriented course. In *Proc. 2021 IEEE/ACM Int. Conf. Softw. Eng. Educ. Train. (ICSE-SEET)*, pages 144–153.
- Anewalt, K. and Polack, J. (2023). Industry trends in software engineering: Alumni perspectives. *Journal of Computer Science in Colleges*, 39(3):159–170.
- Breaux, T. D. and Moritz, J. (2021). The 2021 software developer shortage is coming. *Communications of the ACM*, 64(7):39–41.
- Burbekova, S. (2021). Soft skills as the most in-demand skills of future it specialists. In *2021 IEEE Int. Conf. Smart Information Systems and Technologies (SIST)*, pages 1–5.
- Carvalho, F. P. d., Santos, R. C. d., Nascimento, S. M., Coutinho, J. C. d. S., and Sousa, R. R. d. (2023). Investigating the relationship between academia and the information technology industry: A systematic literature review. *Concilium*, 23(21):11–35.
- Dantas, A. A., Rebouças, A. D., and Lopes, R. V. (2023). Compreendendo os fatores que influenciam positivamente na conclusão de cursos presenciais de computação: Um levantamento de dados com egressos formados. In *Workshop sobre Educação em Computação (WEI)*.
- Gurcan, F. and Şevik, S. (2020). Expertise roles and skills required by the software development industry. In *Proc. 2019 IEEE/ACM Int. Conf. Software Engineering (ICSE)*, pages 1–10.
- Inuwa, M. and Varol, A. (2019). Intensity of misconception in software engineering. In *Proc. 2019 IEEE/ACM Int. Conf. Software Engineering (ICSE)*, pages 1–6.
- Marques, A. B., Ferreira, B., Lopes, A., and Silva, W. (2020). Stimulating the development of soft skills in software engineering education through design thinking. In *Proc. XXXIV Brazilian Symposium on Software Engineering (SBES)*, pages 690–699.



- Matturro, G. (2013). Soft skills in software engineering: A study of its demand by software companies in uruguay. In *Proc. 2013 6th Int. Workshop on Cooperative and Human Aspects of Software Engineering (CHASE)*, pages 133–136. IEEE.
- Mussa, A. A. Y., Sunderraman, R., Metzler, M., and Bourgeois, A. G. (2021). Developing parallel programming and soft skills: A project-based learning approach. *Journal of Parallel and Distributed Computing*, 158:151–163.
- Oguz, D. and Oguz, K. (2019). Perspectives on the gap between the software industry and the software engineering education. *IEEE Access*, pages 1–1.
- Oran, A., Lima, R., Gadelha, B., Maia, N., Silva, W., and Rivero, L. (2023). Empowering technical skills and soft skills in software engineering students through problem-based learning. In *Proc. 2023 IEEE/ACM Int. Conf. Software Engineering (ICSE)*, pages 348–357. ACM.
- Rupakheti, C. R., Hays, M., Mohan, S., Chenoweth, S., and Stouder, A. (2017). On a pursuit for perfecting an undergraduate requirements engineering course. In *Proc. 2017 IEEE 30th Conf. Software Engineering Education and Training (CSEET)*, pages 97–106. IEEE.
- World Economic Forum (2023). The future of jobs report 2023. Technical report, World Economic Forum, Geneva. [Accessed: 09 May 2024].