

IBM Skills Build: Build, Learn, and Earn - A free Certificate Program for K-20 students and faculty in Cybersecurity, AI, and Others

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Abstract

Cyberattacks on critical infrastructures on the US and around the globe are rising at an alarming rate, and cybercriminals are using new and robust tools to hack, attack, and breach data. Therefore, traditional security methods alone are not adequate to prevent cyberattacks, and the researchers have started incorporating Artificial Intelligence (AI) technologies into cyberspace to construct smart models for defending systems from cyberattacks. Our graduates must be trained in the use of AI and other technologies to protect our cyberspace, and there is an urgent need for the development and implementation of awareness-raising campaigns targeted at the safe and responsible use of AI and other technologies. The theoretical knowledge gained from the course work must be enhanced with real-world experience in collaboration with government and industry.

Tech industries like Amazon, Google, and International Business Machines (IBM) offer many freely available short courses in Cybersecurity, Artificial Intelligence (AI), and others. In our computing curriculum we have infused a few short courses from IBM in cybersecurity and AI. The objective of this paper is to provide a brief overview of these short courses, the challenges to infusing these short courses into existing courses, and the faculty and student experiences with these short courses. The findings presented in this paper may be used by interested parties in cybersecurity curriculum and course development.

Introduction

With the advancement in information and communication technologies, cyberspace has become an indispensable part of today's society. There has been significant growth in the online activities of individual users, government, and industry. The abundance of data and resources on cyberspace makes it a lucrative battlefield for hackers to carry out malicious acts such as phishing, identity thefts, denial-of-service, and ransomware. More importantly, complex and sophisticated cyberattacks such as advanced persistent threats pose serious risks to critical infrastructures such as energy, transportation, financial services, agriculture, healthcare and public health.

Recent attacks such as the ransomware attack against the Colonial Pipeline showed the need for stronger cybersecurity measures to avert future threats and prevent disruptions in the operations of critical infrastructures [1]. Advanced Persistent threat is another attack that can cause severe damage to critical infrastructure due to its stealthy, dynamic, and adaptive nature [2]. Data breaches have been on the rise for several years, and sadly, this trend isn't slowing down. Data breaches have affected companies and organizations of all shapes, sizes, and sectors such as

Apple, Meta, Twitter, T-Mobile, Colonial Pipeline, and they are costing US businesses millions in damages [3], According to Cybersecurity Ventures, the global annual cost of cybercrime is predicted to reach \$9.5 trillion USD in 2024. Compounding this is the rising cost of damages resulting from cybercrime, which is expected to reach \$10.5 trillion by 2025 [4]. On one hand, when cybercrimes are rapidly evolving, there are not enough security professionals to protect systems, data, and networks. Currently, there are 469,930 cybersecurity job openings in the U.S. and the employed cybersecurity workforce consists of 1,239,018 individuals [5].

According to Ismail, et al., different cybersecurity courses are introduced at the high school level, undergraduate computer science and information systems programs, and even at the government level. Due to the peculiar nature of cybersecurity, educational institutions face many issues when designing a curriculum or cybersecurity activities [6]. Rahman, et al. explored why it is so critical that modern learners are educated about the risks associated with being active in cyberspace and the strategies that stakeholders can use to promote cyber security education in schools [7]. Mishra discussed curriculum overcrowding, the digital divide, and varying levels of cybersecurity awareness among educators and students. He also explored the resistance to change within educational institutions and the lack of standardized guidelines for cybersecurity education [8]. Ofusori, et al. conducted a comprehensive review of use of AI in cybersecurity and offered insights into the effectiveness, challenges, and emerging trends in utilizing AI for cybersecurity purposes [9]. Ari et al. studied Integrating Artificial Intelligence into Cybersecurity Curriculum and concluded that AI and ML techniques should be considered for future integration into cybersecurity curriculum to better align with advancements in the field [10].

As a result, cybersecurity and AI education and training are extremely important to safeguard data, systems, and networks and protect the critical infrastructure against malicious attacks and intrusions. There is an urgent need for the development and implementation of awareness-raising campaigns targeted at the safe and responsible use of cybersecurity and AI. Several academic institutions offer cybersecurity programs classified as minors, concentrations, certificates, and degrees programs with varying amounts of course credits, but despite our best efforts, the cyberattacks on our infrastructure are on the rise, and course work alone is not going to solve this severe shortage of cybersecurity skilled workers, and the theoretical knowledge gained from the course work must be enhanced with real-world experience through hands-on skills in collaboration with government and industry.

There are many industries such as Amazon, Google, and International Business Machines (IBM) with freely available short courses in Cybersecurity, Artificial Intelligence (AI), and others but IBM offers approximately 1000 courses in 20 languages for adult learners, high school and university students and faculty through their IBM Skillsbuild program [11]. IBM has designated our institution as a cybersecurity leadership center, and our institution is a member of the IBM SkillBuild program. We are thankful to IBM for providing us with this opportunity.

IBM SkillsBuild Program

IBM SkillsBuild is a free education program focused on underrepresented communities in tech, that helps adult learners and high school and university students and faculty, develop valuable new skills and access career opportunities. The program includes an online platform that is

complemented by customized practical learning experiences delivered in collaboration with a global network of partners.

The open version of IBM SkillsBuild is an online platform which offers over 1,000 courses in 20 languages on artificial intelligence, cybersecurity, data analysis, cloud computing and many other technical disciplines — as well as in workplace skills such as Design Thinking. Most important, participants can earn IBM-branded digital credentials that are recognized by the market.

The resources in IBM SkillsBuild are divided into the following four categories:

- Learners
- Educators
- Organizations
- Events

The Learners Category (<https://skillsbuild.org/students>) provides free courses and resources to build career in technology. It provides learning pathways for High School Students, College Students, and Adult Learners to explore new technology, build foundational skills for the workplace and earn digital credentials. The course catalog in the category includes short courses on the following topics:

- **Artificial intelligence** – 4 short courses in English (Getting Started with Artificial Intelligence (A 3hr Digital Badge Course); AI Foundations: A Collaboration of ISTE and IBM; Artificial Intelligence Fundamentals; and Build Your Own Chatbots)
- **Blockchain** – 2 short courses (Blockchain: Getting Started and Blockchain Explained)
- **Cloud computing** – 4 short courses (Cloud Computing Fundamentals; Introduction to Cloud; IBM Cloud Essentials; and Hybrid Cloud: Getting Started)
- **Cybersecurity** – 3 short courses (Cybersecurity: Getting Started; Cybersecurity Fundamentals; and Getting Started with Threat Intelligence and Hunting (A 5 hr Digital Badge Course))
- **Data** – Getting Started with Data (A 3 hr Digital Badge Course)
- **Information technology** – Information Technology Fundamentals (A Digital Badge Course)
- **IT project management** – Project Management Fundamentals (A 3.5 hr Digital Badge Course)
- **User experience design** – User experience Design Fundamentals (A Digital Badge Course)
- **Web development** – Web Development Fundamentals (A Digital Badge Course)

The Educator Category (<https://skillsbuild.org/college-educators>) provides educators with course and other learning resources access to help the students meet the demands of the workforce of the future.

The Organizations Category (<https://skillsbuild.org/organizations-supporting-adult-learners>) provides client access to digital training, project-based learning, and professional credentials, designed to help them gain the skills they need and land an entry-level tech job. All at no cost.

The Events Category (<https://skillsbuild.org/events>) connect with the SkillsBuild community and gain firsthand experience with the latest technology, whether in-person or from your home.

Since the focus of this paper is on Cybersecurity and Artificial Intelligence, here is a brief description of these two courses.

Getting Started with Artificial Intelligence - This credential earner demonstrates a foundational understanding of Artificial Intelligence concepts and processes, including common applications of AI, and generative AI. The individual has worked with generative AI tools to refine and create prompts. Duration 3 hours.

Getting Started with Threat Intelligence and Hunting - This badge earner has completed all the learning activities included in this online learning experience, including hands-on experience, concepts, methods and tools related to the threat intelligence and hunting domain. The individual has demonstrated domain knowledge and understanding in adopting practices, methods and tools that relate to the activities performed in cyber threat hunting. Duration 5 hours.

Infusing IBM cybersecurity and AI modules to selected courses at our institution

At our institution, all non-CS majors are required to take CS 150. Computer Technology, and all CS majors are required to take CS 151 Introduction to Computer Science during their freshman year to satisfy their degree requirements. These courses are part of the general education program: a planned sequence of courses that include critical and practical knowledge gained from studies in communications, mathematics, computer technology, science, history, philosophy, literature, and the arts. The course introduces students to computers and selected popular applications and their uses in society. We also encourage students in our CS curriculum to complete the IBM Cybersecurity and AI modules in other CS courses. For this paper, we will focus on the CS 150 course.

Catalog Description of CS 150 Computer Technology Course at our institution:

CS 150 Computer Technology. 3(1, 2). This course is for undergraduates from all disciplines, which explores the nature and history of computers, their impact on society, networks, cybersecurity, and their use in various disciplines and careers. This course involves one hour of lecture and two hours of structured laboratory each week. The lab segment introduces students to selected popular applications such as spreadsheets and web page development software and cybersecurity hands on exercises.

Prerequisite: None.

The Cybersecurity and AI modules are offered as part of the CS150 course. The title of the IBM Cybersecurity module is Getting Started with Threat Intelligence and Hunting (Introduction to

Cybersecurity), and the title of the AI module is Getting Started with Artificial Intelligence (Introduction to Artificial Intelligence).

They are self-paced learning modules with assistance from the instructor. Upon the completion of these modules, students will get a badge for Getting Started with Threat Intelligence and Hunting and a credential for Getting Started with Artificial Intelligence (which has three courses: Introduction to Artificial Intelligence, Introduction to Large Language Models, and Mastering the Art of Prompting).

20 out of 100 points are applied to students' final grades when IBM issues the badge or credential to them. Each module lasts about six weeks.

Course structure:

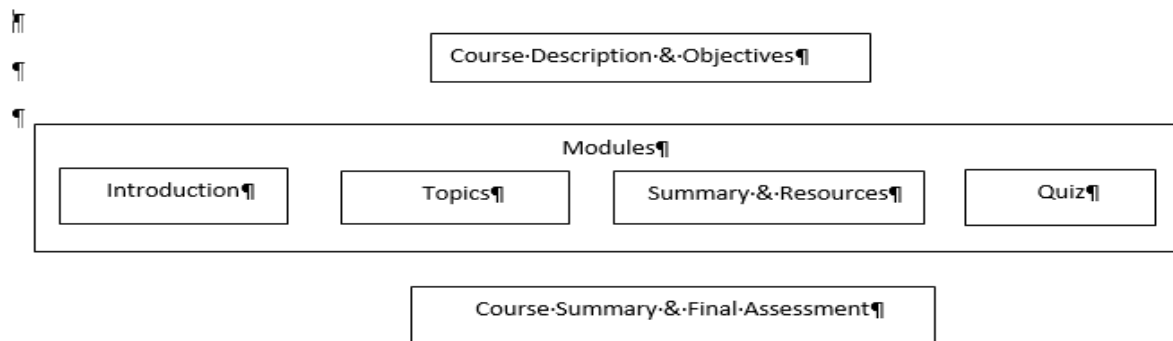


Figure 1 – General Structure of IBM Short Courses

A. Cybersecurity

IBM Learning Module I: Getting Started with Threat Intelligence and Hunting (Badge)

Course Description:

This course is intended to assist individuals with an active interest in understanding the concepts related to the adoption of cybersecurity hardening practices within the enterprise, the course provides an inside view of the roles, technologies, and processes security teams adopt to tackle real-world cyber-attacks and insider threats affecting companies in all major industries across the globe today.

About This Course:

Understand the impact of cybersecurity threats on industries and society.

1. Why study cybersecurity?
2. Cybersecurity impact in the job market

Course Objectives:

- Understand the taxonomy of cybersecurity attacks
- Analyze top targeted industries and security trends
- Determine what steps you can take to protect your organization against these threats.

- Leverage high-end security enterprise solutions in high demand such as IBM Cloud X-Force Exchange

Course Content:

Module 1 – Threat intelligence

Reasons Behind Cyber Attacks; Global Threat Trends; Threat Assessment by Industry and Geography; Enterprise Security Domains

Module 2 – Threat hunting

Cyber Resilience; Why Threat Hunting; Threat Hunting Methodology

Module 3 – Threat map worldwide view with IBM X-Force Exchange

Analyzing Botnet Global Threat Reports; Visualizing the Cyber Threat Activity Map

B. Artificial Intelligence

IBM Learning Module II: Getting Started with Artificial Intelligence (Credential)

Number of Courses: 3

- Introduction to Artificial Intelligence
- Introduction to Large Language Models
- Mastering the Art of Prompting

Description:

Does artificial intelligence spark your interest? Embark on a journey into the world of artificial intelligence with this course designed for beginners. Gain foundational knowledge in artificial intelligence systems, common industry applications, and a look into the innovative realm of generative AI. This learning module offers the perfect starting point for anyone who wants to understand and use the transformative power of AI technology.

Learning Module Objectives:

After completing *Getting Started with AI*, you should be able to:

- Describe the history of AI development
- Define and describe structured, unstructured, and semi-structured data, machine learning, and ways that AI makes predictions from data
- Describe three ways that AI analyzes data
- Define large language models (LLMs)
- Identify key LLM concepts such as transformers
- Describe some common applications of large language models
- Explain generative AI and the impact in today's world
- Identify the rules to follow to write effective prompts to generate focused and accurate results from an AI language model
- Create a playlist using a generative AI model

Learning Module Content:

Module 1: What is artificial intelligence?

What is AI; What is the difference between AI and augmented intelligence; What does AI do; What predictions can AI make; How is AI evolving

Module 2: What are the three eras of computing?

The Era of Tabulation; The Era of Programming; The Era of AI

Module 3: Structured, semi-structured, and unstructured data

A look at the types of data; Analyzing unstructured data

Module 4: Is machine learning the answer to the unstructured data problem?

How does machine learning approach a problem; Machine learning uses probabilistic calculation

Module 5: Three common methods of machine learning

Supervised learning; Unsupervised learning; Reinforcement learning

Module 6: How will machine learning transform human life?

Take another look at the three levels of artificial intelligence

Module 7: Large Language Model Basics




What are large language models; How large language models work

Module 8: How to write prompts in LLMs (ChatGPT, Bard and Hugging Face)

These modules include lecture notes, practice problems, and quizzes. The learners can complete these modules at their own pace. The course instructor acts as the facilitator and provides help as needed.

The modules can be accessed at <https://skills.yourlearning.ibm.com/>. Students need to create accounts to log in and sign up a module to see the module content. The login screen is shown in Figure 2:

Hi there! How would you like to log in to IBM SkillsBuild?

	Log in with Google
	Log in with Email
	Log in with LinkedIn
	Log in with IBM ID

Don't have an account with IBM SkillsBuild? [Sign up](#)

Figure 2 – Log in options

Analysis of Course Survey Results

Student Surveys

A. Cybersecurity (Fall 2024, Sample Size N = 88)

The Cybersecurity module was infused to six sections of CS 150 course during Fall 2024 semester. The total enrollment in these sections was 185 students. A survey was conducted among course participants to gauge their satisfaction with various course activities. Questions 1 through 3 of the survey included Likert scale responses in the scale of 1 to 5 with 1 representing "not satisfied" and 5 representing "very satisfied". Question 4 of the survey included Likert scale responses in the scale of 1 to 3 with 1 representing "not relevant" and 3 representing "very relevant". Approximately 47% (88) students returned the survey. A brief analysis of the student responses to survey questions is shown below.

Question 1: How satisfied were you with this Cybersecurity Module from IBM?

Analysis: Approximately 96% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the IBM Cybersecurity course module.

Question 2: How relevant and helpful do you think this AI topic and activities were to career goals/objectives?

Analysis: Approximately 94% of the survey respondents thought (satisfied to very satisfied) that the IBM AI topics and activities were relevant to their career goals/objectives.

Question 3: How satisfied were you with the various contents of this Module as shown below?

Analysis:

Course Instructor – Approximately 94% of the survey respondents showed their satisfaction (satisfied to very satisfied) with their course instructor.

Practice Activities – Approximately 95% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the Practice Activities.

Project Activities – Approximately 90% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the Project Activities.

IBM Badge Examination – Approximately 93% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the Practice Activities.

Question 4: Which activities did you find most relevant?

Analysis:

Practice Activities – Approximately 92% of the survey respondents felt that the practice activities were between Relevant to Very Relevant.

Project Activities – Approximately 94% of the survey respondents felt that the project activities were between Relevant to Very Relevant.

IBM Badge Examination – Approximately 97% of the survey respondents ranked the IBM Badge Examination between Relevant to Very Relevant.

Question 5: Did you take the IBM Badge Examination?

Question 6: Did you pass the IBM badge examination?

***Analysis:** The two questions on the IBM Badge exam are not clear since we used a Likert scale for this question. We know that approx. 30% of students passed the IBM Badge Examination. We will rephrase these questions with two answer options – Yes/No.*

B. Artificial Intelligence (Fall 2023 and Fall 2024)

The Artificial module was infused to CS 150 course sections from Fall 2023 semester. During Fall 2023 semester, the total enrollment in CS 150 was approximately 700 students, and during Fall 2024 semester, the total enrollment was approximately 400 students. A survey was conducted among course participants to gauge their satisfaction with various course activities. Questions 1 through 3 of the survey included Likert scale responses on the scale of 1 to 5 with 1 representing "not satisfied" and 5 representing "very satisfied". Question 4 of the survey included Likert scale responses in the scale of 1 to 3 with 1 representing "not relevant" and 3 representing "very relevant". Approximately 36% (251) students responded to the survey during Fall 2023, and approximately 33% (131) students responded to the survey during Fall 2024. A brief analysis of the student responses to survey questions is shown below.

<i>Survey Questions</i>	<i>Survey Response Analysis</i>	
	<i>Fall 2023 (N = 251)</i>	<i>Fall 2024 (N = 131)</i>
1. How satisfied were you with the AI Module from IBM?	<i>92% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the IBM AI course module.</i>	<i>93% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the IBM AI course module.</i>
2. How relevant and helpful do you think this AI topic and activities were to career goals/objectives?	<i>91% of the survey respondents thought (satisfied to very satisfied) that the IBM AI topics and activities were relevant to their career goals/objectives.</i>	<i>95% of the survey respondents thought (satisfied to very satisfied) that the IBM AI topics and activities were relevant to their career goals/objectives.</i>

3. How satisfied were you with various contents of this Module as shown below?	<p>Course Instructor - 89% of the survey respondents showed their satisfaction (satisfied to very satisfied) with their course instructor.</p> <p>Practice Activities - 91% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the Practice Activities.</p> <p>Project Activities - 90% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the Project Activities.</p> <p>IBM Badge Examination - 86% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the Practice Activities.</p>	<p>Course Instructor - 95% of the survey respondents showed their satisfaction (satisfied to very satisfied) with their course instructor.</p> <p>Practice Activities - 95% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the Practice Activities.</p> <p>Project Activities - 93% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the Project Activities.</p> <p>IBM Badge Examination - 92% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the Practice Activities.</p>
4. Which activities did you find most relevant?	<p>Practice Activities - 91% of the survey respondents felt that the practice activities were between Relevant to Very Relevant.</p> <p>Project Activities - 91% of the survey respondents felt that the project activities were between Relevant to Very Relevant.</p> <p>IBM Badge Examination - 87% of the survey respondents ranked the IBM Badge Examination between Relevant to Very Relevant.</p>	<p>Practice Activities - 97% of the survey respondents felt that the practice activities were between Relevant to Very Relevant.</p> <p>Project Activities - 97% of the survey respondents felt that the project activities were between Relevant to Very Relevant.</p> <p>IBM Badge Examination - 95% of the survey respondents ranked the IBM Badge Examination between Relevant to Very Relevant.</p>
5: Did you take the IBM Badge Examination?	<p>We know that approx. 180 out of 700 (25%) students passed the IBM Badge Examination. We will rephrase these questions with two answer options – Yes/No.</p>	<p>Approx. 30% of students passed the IBM Badge Examination.</p>
6: Did you pass the IBM badge examination?		

Faculty Survey (Spring 2024)

N = 4

<i>Survey Questions</i>	<i>Survey Response Analysis</i>
1. How satisfied were you with the AI and Cybersecurity Module from IBM?	<i>100% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the IBM AI course module.</i>
2. How relevant and helpful do you think the IBM AI and Cybersecurity topics and activities for student career goals/objectives?	<i>100% of the survey respondents thought (satisfied to very satisfied) that the IBM AI and cybersecurity topics and activities were relevant to student career goals/objectives.</i>
3 How satisfied were you with student understanding of various contents of the AI and Cybersecurity Modules as shown below?	<p>Course Instructor – There were 3 responses and 100% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the student satisfaction with the course instructor.</p> <p>Practice Activities - There were 3 responses and 100% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the Practice Activities.</p> <p>Project Activities - There were 3 responses and 100% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the Project Activities.</p> <p>IBM Badge Examination – 100% of the survey respondents showed their satisfaction (satisfied to very satisfied) with the Practice Activities.</p>
4. Which activities did you find most relevant?	<p>Practice Activities -100% of the survey respondents felt that the practice activities were Very Relevant.</p> <p>Project Activities - 100% of the survey respondents felt that the project activities were between Relevant to Very Relevant.</p> <p>IBM Badge Examination – 3 out of 4 responded to this question. 100% of the survey respondents ranked the IBM Badge Examination Very Relevant.</p>

5. Do you see a need for improving any of the following activities for AI modules?	<p>Practice Activities - 3 out of 4 responded to this question. 67% felt that there is a need for improving the practice activities.</p> <p>Project Activities - 33% felt that there is a need for improving the project activities.</p> <p>IBM Badge Examination – 3 out of 4 responded to this question. 100% of the survey respondents felt that there is no need to improve the IBM Badge Examination.</p>
6. Do you see a need for improving any of the following activities for Cybersecurity modules?	<p>Practice Activities - 3 out of 4 responded to this question. 67% felt that there is a need for improving the practice activities.</p> <p>Project Activities - 33% felt that there is a need for improving the project activities.</p> <p>IBM Badge Examination – 3 out of 4 responded to this question. 100% of the survey respondents felt that there is no need to improve the IBM Badge Examination.</p>
7. Did IBM Badge Examination enhance student learning?	100% of the respondents felt that IBM Badge Examination enhanced student learning.
8. Do you think IBM AI and Cybersecurity Modules are suitable for all students at an Institution?	<p>AI - 75% of the survey respondents felt that the IBM AI modules are suitable for all students at an institution.</p> <p>Cybersecurity - 100% of the survey respondents felt that the IBM cybersecurity modules are suitable for all students at an institution.</p>
9. Are you planning/currently using IBM AI and/or Cybersecurity modules in one or more of your existing courses?	<p>AI - 60% of the survey respondents are planning to use the IBM AI modules in other courses, and 40% are currently using the IBM AI modules in other courses.</p> <p>Cybersecurity - 80% of the survey respondents are planning to use the IBM cybersecurity modules in other courses, and 20% are currently using the IBM cybersecurity modules in other courses.</p>

Summary and Conclusion

AI and cybersecurity courses offered from IBM Skillsbuild program, provided all majors at our institution with a mix of theoretical knowledge and practical skills, making these courses a

fantastic initiative to infuse to our curriculum. This initiative has enabled our students to complete certificates in AI and cybersecurity. Also, many of our students obtained few micro internships related to AI and cybersecurity, making them earn while learning. The faculty were able to broaden their knowledge base and receive IBM \Digital Badges. The survey results for the Cybersecurity and AI modules from IBM clearly show the success of this initiative at our institution, and we plan to continue offering these IBM short courses/modules to all majors at institution in coming semesters.

IBM has designated our institution as a cybersecurity leadership center, and our institution is a member of the IBM SkillBuild program. We are thankful to IBM for providing us with this opportunity.

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