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Hackathons for experiential learning in IS higher education

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Abstract

Industry has identified the lack of experiential learning in higher education as the leading cause of the current skills gap. Hackathons recently got more attention as an effective experiential learning tool to prepare students for the job market. Hackathon events help students apply their knowledge and skills in real-world settings and develop the required technical and soft skills for industry needs. Furthermore, they help higher education keep up with the pace of technological advancement and close collaboration with industry. This paper outlines the use of hackathons, specifically an RPA hackathon using UiPath, in higher education as a tool for experiential learning to better prepare graduates for the job market. In the RPA hackathon, students participate in a limited-time event, work in teams to identify a real-world problem, design and develop a solution, and present their problem and solution to the industry sponsor. The results show that students leave hackathons excited, motivated, and better prepared for the job market, and they can gain valuable insights for their future careers.

Keywords: hackathon, robotic process automation, higher education, information systems

Introduction

The rapid pace of technology advancement and industry demand for employees with emerging technology skills creates a challenge in higher education. Only 60% of employers believe that recent graduates possess the knowledge and skills needed for success in entry-level positions in their organizations (Finley, 2021). According to the 2021 Association of American Colleges and University survey (AAC&U), employers believe college-educated applicants are not receiving engaging educational practices or being prepared for current job openings.

Being able to learn in real-world settings is a high priority for employers. In fact, only 23% of employers believe that recent college graduates are prepared to apply knowledge and skills in real-world settings, and just 14% of employers report that graduates have the knowledge and skills needed to complete a significant applied learning project (Finley, 2021). AAC&U research found that almost all employers (93%) believe that skills such as problem-solving, critical thinking, and communication skills are more important than the student's major (Hart Research Associates, 2013). Most employers report they are more likely to consider a job candidate for employment if they have participated in a diverse team in a meaningful way, such as a collaborative research project, a field-based project, a senior project, a community-based project, or a community-based project completed an internship. (Finley, 2021).

To meet this need, the Association to Advance Collegiate Schools of Business (AACSB) has updated its business schools standards to reinforce the importance of experiential learning in higher education (AACSB, 2013; Calco & Veeck, 2015). Business schools are redesigning their curricula to include more

experiential learning and prepare their graduates for the required skills by the market. Higher education programs have a lot of oversight and usually require significant time to design, develop, and receive approvals needed for curriculum changes. This structure does not support agility or quick changes to support the rapidly evolving demand for knowledge, skills, and competencies (Happonen et al., 2020). While oversight in higher education is critical and needed to evaluate suggested changes, higher education and specifically Information Systems (IS) programs need to learn how to meet industry needs quicker and better prepare new graduates in their programs.

Engaging and hands-on teaching methods can be used to reinforce experiential learning. Hackathons originally started in the computing industry during the late 1990s at MIT. The term "hackathon" was derived from "hack" and "marathon" (Zukin & Papadantonakis, 2017). Traditionally, hackathons (hacking marathons) were intensive computer-programming limited-time events. During hackathons, programmers and developers collaborate in teams for short periods of time to create software prototypes to solve complex software-related problems or produce innovative technologies (Briscoe & Mulligan, 2014; Maaravi, 2020). In recent years, hackathons have become popular beyond the computing science and technology events and are used as an educational tool in higher education. Hackathons have been utilized as a tool for experiential learning with proven results (Čović & Manojlović, 2019; Maaravi, 2020; Nandi & Mandernach, 2016; Skirpan & Yeh, 2015; Yarmohammadian et al., 2021). In addition to providing an excellent opportunity for experiential learning, one of the most essential benefits of hackathons in higher education is keeping up with the pace of technological advancement and creating a close collaboration with industry. There are a set of skills and key competencies that develop during hackathons that are among the highly regarded skills by employers, such as critical thinking, problem-solving, creativity, collaboration, communication, teamwork, project management, time management, troubleshooting, and presentation skills (Čović & Manojlović, 2019; Porras et al., 2019).

In this paper, we provide a promising solution to close this gap in higher education and provide a better understanding of the following:

- How can we design an education hackathon to improve student learning and interest in Management Information Systems (MIS)?
- How effective is a hackathon in helping students develop in-demand soft skills and technology skills?

This paper aims to outline the use of hackathons in higher education as a tool for experiential learning to better prepare graduates for the job market. Specifically, we will outline and discuss an RPA hackathon using UiPath. In the RPA hackathon, students participate in a limited-time event and work in teams to identify a real-world problem and design and develop a solution. Then the teams present their problem and solution to the industry sponsor. To increase student motivation, the top three teams receive a monetary prize.

We argue that hackathons are an effective experiential learning tool for higher education to help develop soft skills and technical skills that can be implemented quickly. In addition, hackathons are an easy and effective way for higher education to evaluate better and support needed curriculum changes. Students can gain valuable hands-on experience and in-demand skill sets essential for employability. They also have the chance to interact with industry partners, increase their professional network, and acquire in-roads for internships and full-time employment. The results show that students leave hackathons excited, motivated, and be better prepared for the job market, and they can gain valuable insights for their future careers.

Hackathons and Experiential Learning

Hackathon is derived from two words, Marathon and Hack. It literally means a group of programmers participate in an activity for a short period of time until they solve the problem. The word "hackathon" was initially used in the 1960s and 1970s when a group of MIT graduate students worked together for a short period of time to solve programming problems (Zukin & Papadantonakis, 2017). Hackathons are organized events in a centralized location where participants collaborate in teams to solve a specific problem in a limited time. All teams present their solutions and are evaluated by the judges, and the winner is announced (Yarmohammadian et al., 2021).

Hackathons have become more prevalent in the last couple of decades in large part to organizations such as Facebook and Google, who internally use hackathons regularly. Hackathons have evolved to include different forms and different event types. They are used in industry and education as innovative problem-solving means with numerous applications. Hackathons have been used on college campuses, with teens, for women-only events, and to brainstorm improvements for social issues with as improving education, increasing clean energy, and reducing water pollution (Calco & Veeck, 2015).

The benefit of a hackathon includes more than just the solutions generated. Students can acquire new knowledge, enhance their hands-on skills, and gain important general skills such as problem-solving, creativity, teamwork, and networking in a social context through strong team dynamics (Byrne et al., 2016). Participants can also gain knowledge and skills from working in a team, and thus is a good tool for higher education to consider using as an educational tool for students.

Pedagogical benefits of hackathons have recently become of interest in educational research (Byrne et al., 2016; Čović & Manojlović, 2019; Maaravi, 2020; Nandi & Mandernach, 2016; Skirpan & Yeh, 2015). Although most of the previous studies are exploratory with limited theoretical background, they all suggest that hackathons are a well-suited educational approach for experiential learning that increases students' knowledge and hands-on skills in the related area.

Experiential Learning Theory (ELT) (Kolb & Kolb, 2005) is a widely accepted pedagogical theory. ELT is based on the purposeful engagement of learners in a direct experience in which learners actively pose questions, investigate, experiment, be curious, solve problems, assume responsibility for the problem, be creative, and construct meaning from the experience (Kolb & Kolb, 2005). Higher Education is starting to consider hackathons as an educational tool for experiential learning or an opportunity for organizations to work with and recruit their students.

Experiential learning is guided by certain principles, including: "promoting hands-on learning, using a problem-solving process, addressing real-world problems, encouraging student interaction with each other and the content, engaging in direct experiences, and using multiple subjects to enhance interdisciplinary learning" (Wurdinger & Carlson, 2009, p. 8). Key benefits of experiential learning are identified as enhancing students' knowledge and abilities (Maaravi, 2020; Wurdinger & Carlson, 2009), raising motivation (Kolb & Kolb, 2005; Maaravi, 2020;), enabling students to experience end-to-end, long, and complex processes (Maaravi, 2020). ELT is based on six propositions to improve learning in higher education (Kolb & Kolb, 2005). The six propositions are listed in Table 1.

Table 1: ELT Propositions (Principals)

P1	The learning process should focus on engaging students and giving feedback on their efforts' effectiveness.
P2	The learning process should examine, test, and integrate students' beliefs and ideas about a topic into the new and more refined ideas.
P3	The learning process should facilitate conflict, differences, disagreement, opposing models, action, and feelings and thinking.
P4	The learning process should be a holistic process of the integrated functioning of cognition, thinking, feeling, perceiving, and behaving.
P5	The learning should occur through incorporating new experiences into existing concepts and accommodating existing concepts to new experiences.
P6	The learning process should create social knowledge through the personal knowledge of the learner, in contrast to the traditional transmission model in that preexisting fixed ideas are transmitted to the learner.

In experiential learning, students develop life skills such as critical thinking, problem-solving, creativity, communication, collaboration, time management, responsibility, perseverance, work ethic, and self-direction (Wurdinger & Allison, 2017). Furthermore, experiential learning includes a cycle of thinking, planning, testing, and reflecting. Students undergo multiple trial and error attempts and learn from mistakes (Wurdinger & Allison, 2017), precisely as in hackathons. Hackathons offer the same characteristics as identified by Wurdinger and Allison's (2017) experiential learning characteristics, including:

- It is a problem-solving process
- It requires a series of trial-and-error attempts
- Students learn from their mistakes
- It occurs outside the classroom
- Students work on real-world projects
- Its cognitive process is more complex than memorizing information

If thoughtfully designed, a hackathon could support all six of the ETL propositions, could be used to help keep up with the pace of technological advancement, and could help create close industry collaborative relationships. Regular hackathons events could excite students and make them aware of current technical industry needs while providing an experiential learning opportunity that enables students to get involved with organizations and current real-world problems. Since hackathons can be done outside of a specific class, they could provide opportunities for higher education to try out emerging technologies and help provide support to adapt their curriculum quicker to meet evolving industry needs.

We believe a strategically designed hackathon could provide the benefits associated with ELT. Previous research argues that there is correspondence between ELT elements and the benefits of hackathons (Maaravi, 2020; Wurdinger & Carlson, 2010). Furthermore, with constantly evolving industry demands for the knowledge and skills in the field of IS, hackathons could be the right approach for helping higher education adapt to the industry needs. In Table 2, we identify how hackathons' characteristics and capabilities can serve the six principles of experiential learning.

Table 2: ELT Principals Mapped to Hackathon Characteristics

ELT Principal	Hackathon Characteristics & Capabilities
P1, P2, P3, P4, P5	Problem Solving
P1, P2, P4, P5	Critical Thinking
P2, P4, P5	Creativity
P3, P4	Responsibility
P3, P4	Time/Project Management
P3, P4	Communication
P4, P6	Presentation
P3, p4	Teamwork/Collaboration
P1, P2, P4, P5	Trial and Error
P1, P4, P6	Real-World Project
P1, P4	Motivation

The Hackathon Design Model

We utilized the Bridge21 pedagogical activity model (Byrne et al., 2016) to develop our RPA hackathon event. The Bridge21 model was developed based on design thinking elements to allow for a nonlinear approach in which teams can go back and revise previous stages. Design thinking is a method that is incredibly useful for tackling complex, ill-defined problems. At the heart of design thinking is the goal of understanding the human need, ideating numerous possibilities in brainstorming sessions, and by adopting a hands-on approach to prototyping and testing. Since the design thinking process promotes critical thinking, communication, and creativity, it is one of the best roadmaps to design educational hackathons (Meinel & Leifer, 2012). Design thinking allows hackathon participants to understand the problem, develop creative solutions, redesign their solutions, and develop an improved solution through teamwork and collaboration. The Bridge21 model consists of seven stages to develop a comprehensive solution in an experiential learning process.

Bridge21 Activity Model (Byrne et al., 2016) steps:

1- Set up
2- Warm-up (divergent thinking)
3- Investigate (define the problem, research, convergent thinking)
4- Plan (tasks, roles, schedule)
5- Create (create, review, reflect)
6- Present
7- Reflect

The RPA Hackathon Event with UiPath

Robotic Process Automation (RPA) is software that can be programmed to operate in the way a human would (Van der Aalst et al., 2018). RPA creates software programs or bots that perform high-volume and repetitive transactional tasks such as entering data, running queries, updating records, filling out forms, and producing reports (Tucci, 2021). RPA aims to automate manual and tedious processes, thus creating organizational value and cost savings.

RPA has proven to be a technology that helps organizations by increasing accuracy, efficiency, and productivity, improving customer service, reducing cost, and improving compliance with standards and regulations (Lawton, 2021). RPA is used in all industries such as banking, insurance, government,

healthcare, manufacturing, retail, and utilities, and all business functions such as accounting, finance, logistics, customer service, human resource, and IT management (Tucci, 2021).

The global RPA market worth has grown enormously during the past few years, from $271 million in 2016 to over US$1 billion in 2018 and $2,5 billion in 2020 (Everest Group, 2019; Impact, 2021). North America continues to lead most of the market share, followed by the Asia Pacific with the highest growth of RPA (Everest Group, 2019). RPA is currently the fastest-growing enterprise software; however, there is a shortage of professionals who have the necessary knowledge and the skills required to meet the demand for RPA, and UiPath is an industry leader in the RPA industry.

A significant advantage of UiPath RPA that makes it suitable for business school students is that it is a low-code or no-code programing language. This design means that students can easily pick up on programming in UiPAth. The RPA hackathon was designed in collaboration with a large manufacturing organization to promote the Management Information Systems major/minor and for the organization to identify good interns and new hires.

Our hackathon was designed as a one-day event in which students solve a problem, and at the end of the day, students present their solution. The presentations are judges, and the top three winners are awarded a cash prize. Students can network and be mentored by some of the organization's RPA employees throughout the day.

RPA hackathon agenda:

1- Welcome
2- Introduction to RPA with UiPath by Industry Partner
3- The Hackathon Project Released (divergent thinking)
4- Students Form Teams (tasks, roles, schedule)
5- Students Investigate Solutions (define problem, research, convergent thinking)
6- Students Create a Solution (create, review, reflect)
7- Student Presentations
8- Wrap-Up and Reflection

The hackathon project is open-ended. The decision to make it open-ended was intentional. Meaning students are instructed to identify their problem and create a UiPath bot to solve it. By making the project open-ended, the students can identify their own problems to solve. This design allows the students to fully use and showcase their creativity and practice collaboration and teamwork. It enables them to create their own stories to persuade the judges in their project presentations.

Discussion

The students have thoroughly enjoyed the RPA hackathons. The hackathon outcomes have included students switching their major to MIS or deciding to minor in MIS. Each semester multiple internships were offered to the standout students. At the end of each hackathon, students were engaged and excited about future careers involving RPA and MIS.

A follow-up email was sent to the students the day after the hackathon. The questions asked were all open-ended. Our goal was to find out with as much detail as possible the students' perceptions of attending the hackathon and how we could improve future hackathons.

1. How did the hackathon help you develop critical thinking, problem-solving, or creativity skills?
2. How did the hackathon help you develop time/project management skills?
3. How did the hackathon help you develop soft skills such as - collaborative group work, how to plan and execute teamwork in a collaborative environment, communication, ability to present ideas in a clear and concise manner, self-direction, and curiosity?
4. Did the hackathon help prepare you for real-world project experience or working with real-world technology? If so, how?
5. What was your biggest learning from the hackathon?
6. What would you have liked more of?
7. What would you have liked less of?
8. What could have been done better?

Based on a summary of received responses, most of the students believed that the hackathon event helped them develop critical thinking, problem-solving, creativity, and time/project management skills. Furthermore, most students confirmed that the hackathon event helped them to develop soft skills such as collaborative group work, teamwork in a collaborative environment, communication, the ability to present ideas in a clear and concise manner, self-direction, and curiosity. And most students believed that the hackathon event helped them to prepare for real-world project experience or working with real-world technology.

Some of the students' direct responses are presented in the following:

How did the hackathon help you develop critical thinking, problem-solving, or creativity skills?

"It forced me to take things one step at a time."

"It helped me to think logically and analytically through a problem and how to solve the problem."

How did the hackathon help you develop time/project management skills?

"It made me think ahead and plan how much time each step would need."

"The pressure of having only one day to identify a problem and create a solution scared me at first. However, once our team identified our problem, we made a plan and worked through it logically. That made all the difference in meeting the time deadline."

How did the hackathon help you develop soft skills such as collaborative group work, planning and executing teamwork in a collaborative environment, communication, the ability to present ideas clearly and concisely, and self-direction curiosity?

"It helped me collaborate with new people, find common ground, and helped me to communicate effectively."

"I did not know my teammates before today. I learned that I am good at leading a project team. I presented my idea and persuaded the team to choose my idea to create a solution for."

Did the hackathon help prepare you for the real-world, real-world project experience or working with real-world technology?

"Yes, in the real world, I'll be working with a team and have a deadline to meet. This hackathon let me experience this firsthand."

"I had so much fun learning about RPA. I have no programming experience, and I have gained confidence that I could pursue a more technical career."

What was your biggest learning from the hackathon?

"The RPA/UIpath software. It was my first time using it."

"The hackathon made me excited for the future that I did not know existed. It opened my eyes to new possible jobs."

"Participating in the hackathon makes me think I should change my major from management to management information systems."

A Winning RPA Bot Example

The first winning example is a grocery list RPA bot. The problem identified by this student team centered on creating a grocery shopping list from a recipe website. When a person uses a recipe website, they search for specific recipes, open each recipe, and then go through all of the needed ingredients one recipe at a time. The person must manually write down all of the ingredients required and ensure they are no duplicates on the created list. This team created an RPA bot that can search for recipes based on the holiday, type of recipe, or a specific ingredient. The bot pulls the ingredients from the desired recipes, creates a grocery shopping list, and checks/eliminates duplicate ingredients. Figures 1 and 2 are screenshots of this RPA bot.

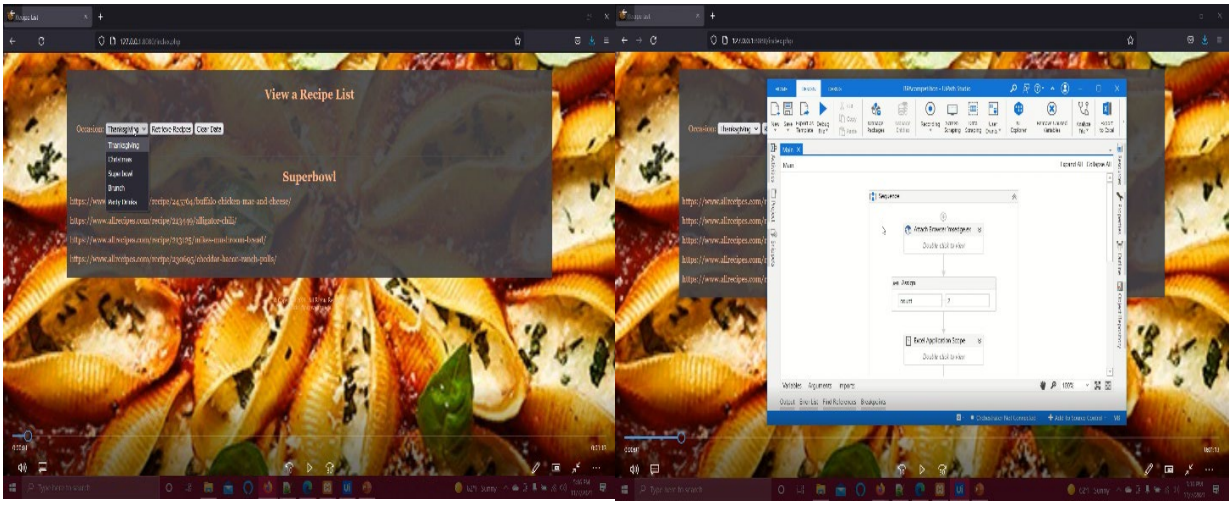

Figure 1: Interface and Bot for an RPA Shopping Lister Generator

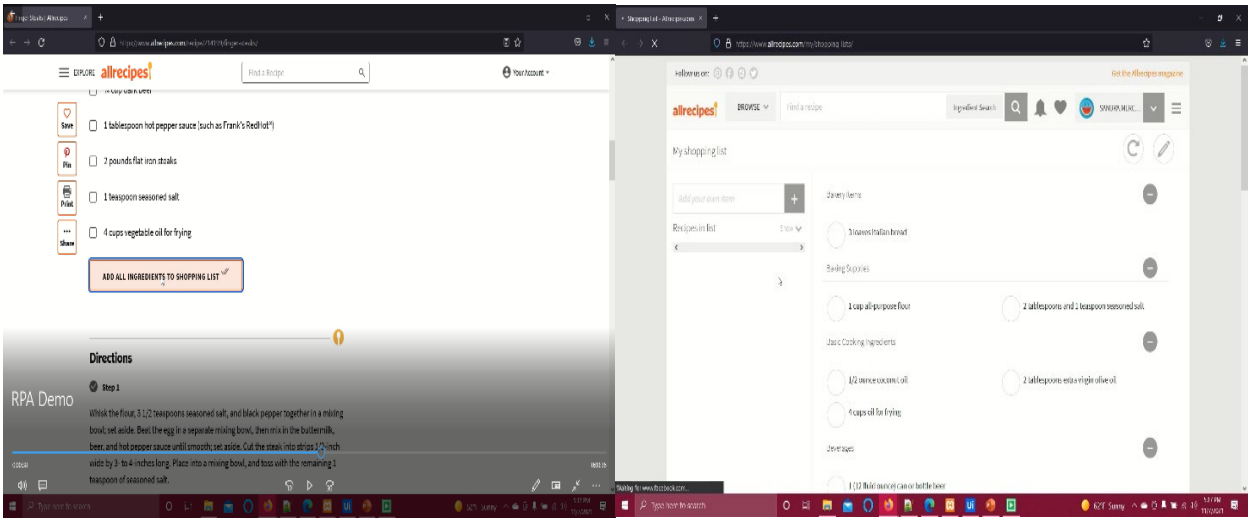

Figure 2: Scraping the Website for Ingredients and Shopping List Generated

A Winning RPA Bot Example

The second winning example is a house buying RPA bot. The problem identified by this team was buying a house, especially during a tight housing market. Houses are currently selling as fast as they come on the market. The bot is designed to allow users to enter their desired home requirements (number of bedrooms, number of bathrooms, and square footage). The bot was programmed to run automation every hour to search for homes listed on Zillow based on the users' requirements. Figures 3 and 4 are displays of the project user interface, the project presentation description, and a screenshot of the RPA bot code.

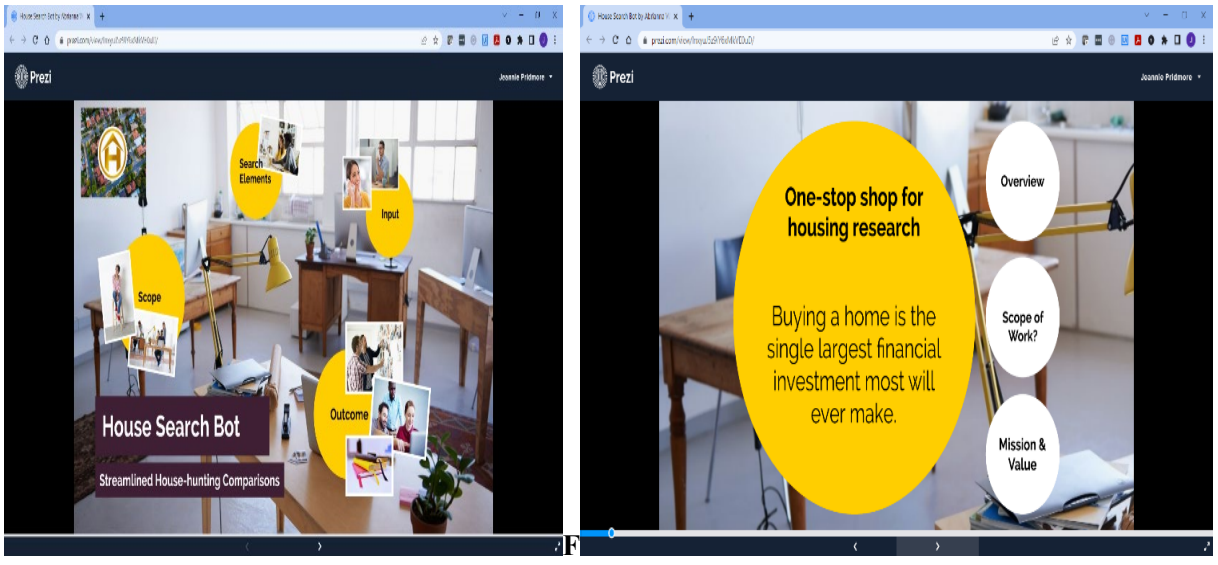

Figure 3: House Bot Search Interface and Project Description

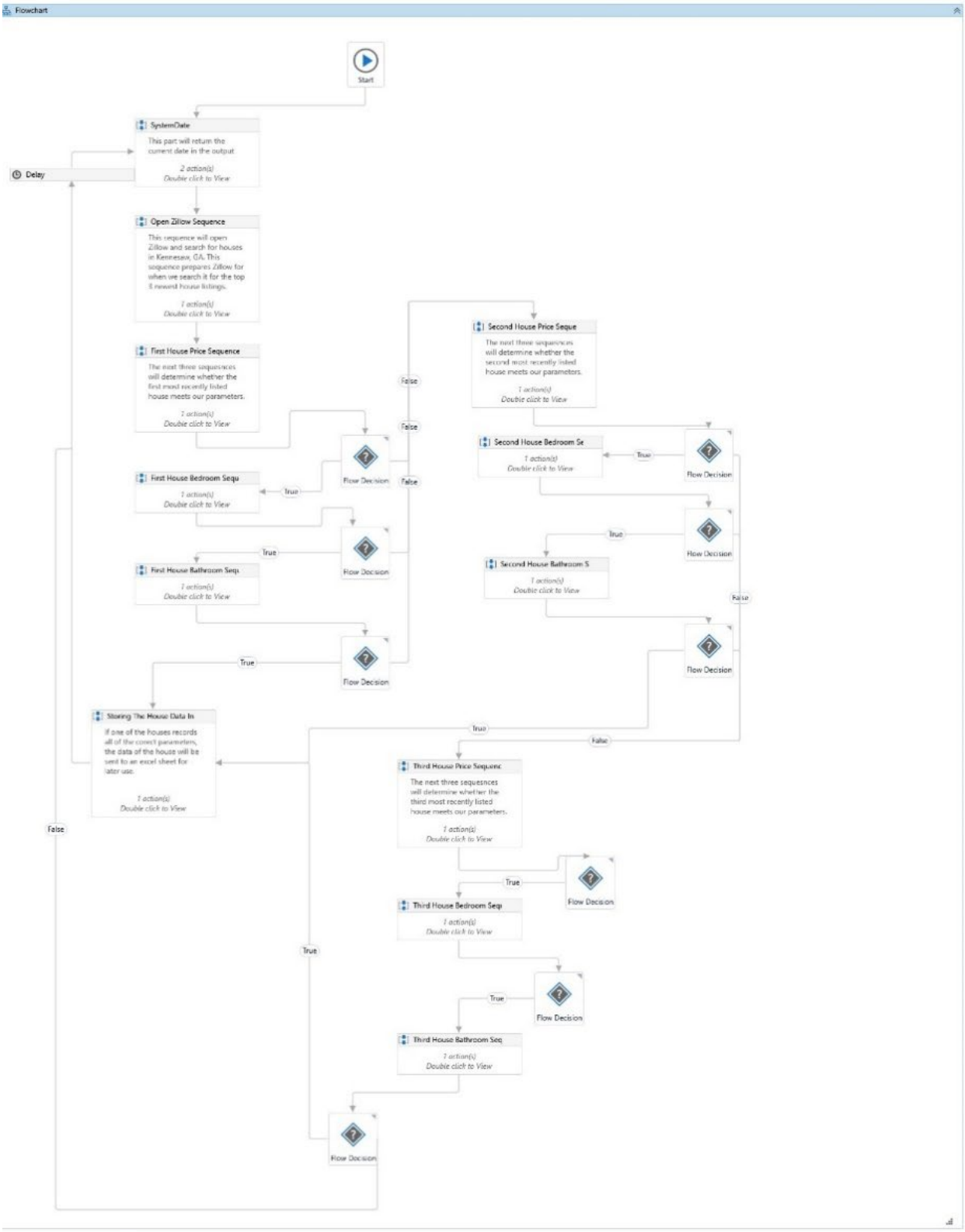

Figure 4: RPA Project Code

Conclusions

This study proposes a solution for the existing gap between higher education graduates' skills and current industry needs. Lack of experiential learning has been identified as one of the main reasons graduates are not prepared for the job market. Hackathons prove to be very effective in enhancing experiential learning and connecting higher education to industry, by supporting all six propositions of experiential learning. During hackathon events, students acquire new knowledge and improve hands-on technical skills, problem-solving, critical thinking, creativity, teamwork, and networking in a social context through strong team dynamics.

We specifically designed, performed, and studied an education RPA hackathon to improve student learning and develop in-demand soft skills and technology skills for MIS students in Business Schools. The proposed RPA hackathon model is designed based on the Bridge21 pedagogical activity model and can be applied in any IS higher education with promising results. Specifically, MIS students in Business schools can benefit the most as RPA continues to be one of the highly used technologies in organizations across all industries and business functions. The results show that the RPA hackathon has been a huge success. The students have enjoyed the experience and the opportunity to network with industry professionals on campus. They gained hands-on experience with emerging RPA technology and had a chance to work on a real-life project in a diverse team.

There are still factors that can be studied in future works. Design factors such as the size of the teams, event duration, and post-hackathon activities can be analyzed to improve the results. For example, giving the students a chance to be familiar with their team members before the day of the event can significantly affect their performance. Or if having a possible extension for the event duration can improve the final proposed solution, as the hackathons events are usually one-day events. Furthermore, post-hackathon activities can be added to expand the networking opportunity for students after the event. Post-hackathon surveys can be performed to collect industry sponsors' insights to keep up with industry needs.

For more insights, other types of hackathons other than RPA, and other pedagogical design methodologies other than the Bridge21 model, can be designed, performed, and compared to find the most suitable solution for the market demands. To increase student motivation, other incentives can be replaced the monetary prize, such as a chance for an immediate internship. Finally, the demographical characteristics of students and their undergraduate/graduate level can be studied to design the most suitable event for specific demography and level of students.

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