Recruiting the Next Generation of Information Technology Professionals

Dmitri A. Gusev
dgusev@purdue.edu
(812) 348-2029

Dewey A. Swanson
dswanson@purdue.edu
(812) 348-2039

Melissa R. Casner
casnerm@purdue.edu
(812) 528-1942

Purdue Polytechnic Columbus
4444 Kelly Street
Columbus, IN 47203

Abstract

Recruiting tomorrow's information technology students is getting to be a challenging job even though there are a variety of many good-paying jobs in the field when they graduate. This is not just an issue for our department, Computer and Information Technology (CIT). According to experts, with declining birthrates, students determining there are alternate career paths besides college AND Covid may be an issue for years to come. At Purdue Polytechnic in Columbus, we continue to do the traditional types of recruiting. However, we feel we need to be more creative in an effort to beat our competition. In this paper, we will share some of the strategies and focus on the activities we have developed. We would like a dialogue with our audience, so bring activities that work for you!

INTRODUCTION

College enrollment has been dropping in the recent years. Worsened by the COVID-19 pandemic, college student enrollment dropped by almost 10% from 2012 to 2022 (Zdanowicz, 2022). Smaller private colleges and two-year public colleges have taken the brunt of these losses with average drops in the range of 35-59%, while larger public four-year and more elite institutions have seen increases over that time. In the near future this disparity will only get worse, as a significant drop or "cliff" as it is referred to (Drozdowski, 2023) is expected after 2025 because of the birth rates dropping during the Great Recession of 2007-2009. This will have a negative effect on the enrollment numbers in 2025-2029. Although at Purdue Polytechnic Columbus we are a public four-year university, we have not seen increased enrollment. The numbers at Purdue Polytechnic tend to mirror the trends at the two-year and four-year private colleges.

With these facts in mind, the competition is getting tougher to recruit students unless you are a large public university or an elite university. The prevalent research marketing strategies today place much more emphasis on connecting in a variety of ways, especially via social media. In fact, a recent Niche Senior Survey of over 19,000 seniors found that 28% of the students did not visit any college prior to enrolling (Welding, 2023). Although this may sound alarming for college recruiters, it just emphasizes that students are using a variety of tools to make their college choice. Having said that, 72% of the students visit colleges before they make their choic-

es, and it is important that we use that time to give students a feel for the university and make the best use of those visits. As faculty, we are often called to talk to potential students or come up with activities for students to give them an idea of what our program is like. In this paper, we will review some of the activities we have incorporated over the last few years. They are typically geared towards high-school students; most don't require any prior knowledge to participate and vary in time from 30 minutes to two hours in length with generally minimum software requirements for the activity.

ACTIVITIES USED IN EVENTS ON CAMPUS

SQL Man Activity

SQL Man is an activity from Oracle Academy, the educational arm of Oracle Corporation, that was modified from the original material provided by Oracle Academy. The scenario involves a superhero solving a bank robbery by using SQL. Students are given access to a Criminal database that includes a Suspects table. The activity can be completed in several ways. Students can be given all of the clues at one time and try to beat the other students to solve the crime as a timed competition and when they are finished present their two suspects they feel are guilty of robbing the bank (similar to the Clue game fashion, where if they are wrong they are eliminated) or the way that was used for the College Preview Day that involved a little more role playing by the faculty and volunteers and ended up being a fun activity for the high-school students. Using faculty and college student volunteers to play the role of SQL Man, witnesses and suspects, witnesses would come into the lab at different intervals and provide clues to SQL Man and then the students would use the clues to write SQL (Structured Query Language) code to narrow the list of suspects down until they find the 2 bank robbers. This approach has everyone completing the first several steps at about the same time and then a race to get the two bank robbers.

This activity was used by high-school students from freshman to senior level in a college preview day session. Students completed the activity individually but could work in pairs. No knowledge of SQL was required coming into the event (students were given handouts with the basics of SQL and enough to solve the crime). The time allotted was 60-75 minutes. The first approach played as a contest to see who could finish would probably be quicker than the approach used in the Preview Day. To complete the activity, students need a computer with the Criminal database and Suspects table on the machines (Microsoft Access was used, but the activity was developed with an Oracle database).

Program It – Python racing game

On April 14, 2023, the Boiler Tech Challenge (BTC) event was held at Purdue Polytechnic Columbus. As part of the 6-hour event, the co-authors of this paper developed and conducted the *Program It* challenge for teams of high-school students interested in CIT. The five teams that took on the challenge, listed below in the order of the final ranking (1st to 5th), came from Greenwood Community High School, Columbus Signature Academy (CSA) New Tech High School, Columbus East High School, Columbus North High School, and North Decatur High School. Each team consisted of four student members, except for the Greenwood team that had only two members, albeit exceptionally well-prepared ones, as it turned out.

Each team was given access to two Dell quad PC workstations for two hours (after a 30-minute intro) and instructed to *Program It* in Python 3, a popular coding language taught in many high schools. Each PC workstation had Python 3 and the Wing 101 9 IDE installed, along with the free *codesters* library (Codesters, 2023) converted from Python 2 to Python 3 by Dmitri Gusev. The additional libraries that *codesters* depended upon were installed as well. Each team was provided an 8GB portable USB drive to help facilitate collaboration and the subsequent presentation on the room's teaching station, which had the same software installed on it and was

linked to a projector. All USB drives were collected after the team presentations. The BTC event was car race themed, so the teams were given a starter project called *btc_racing.py* to modify and make the resulting version of the arcade-style game race themed. Three screenshots of the starter game running are shown in Figure 1.

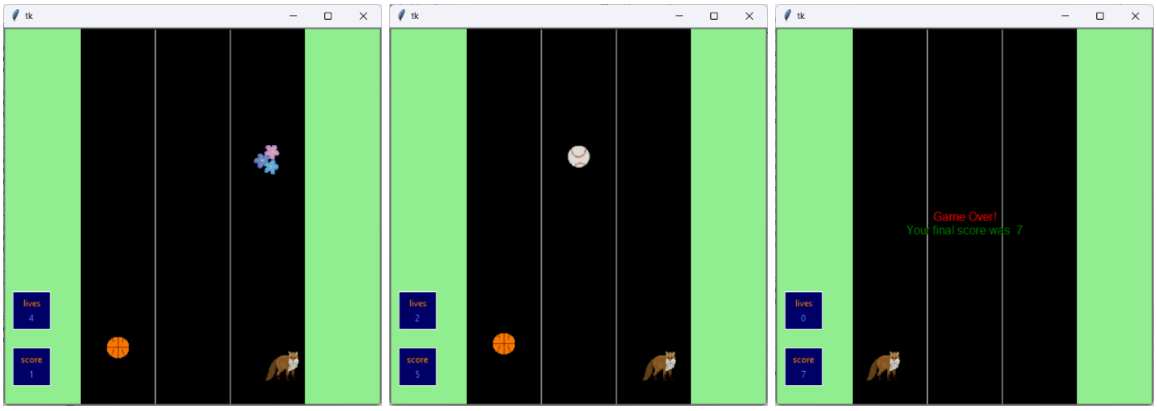

Figure 1. Three screenshots of the original *btc_racing.py* running: The fox moves left and right and catches flowers (loot), while getting hit by baseballs and basketballs (obstacles). The loot and the obstacles always appear in the same fixed lanes.

The students were shown the path to the folder where the sprites were stored. The folder contained several race car sprites (Craig Lowe, 2014), two obstacle sprites called *pothole.gif* and *nails.gif* (Dreamstime, 2023), and a loot sprite named *gas.gif* (Denis Khlebnikov, 2019). A screenshot of the *sprites* folder is shown in Figure 2. The students were permitted to seek and add sprites of their choice to the folder and reference them in their mods.

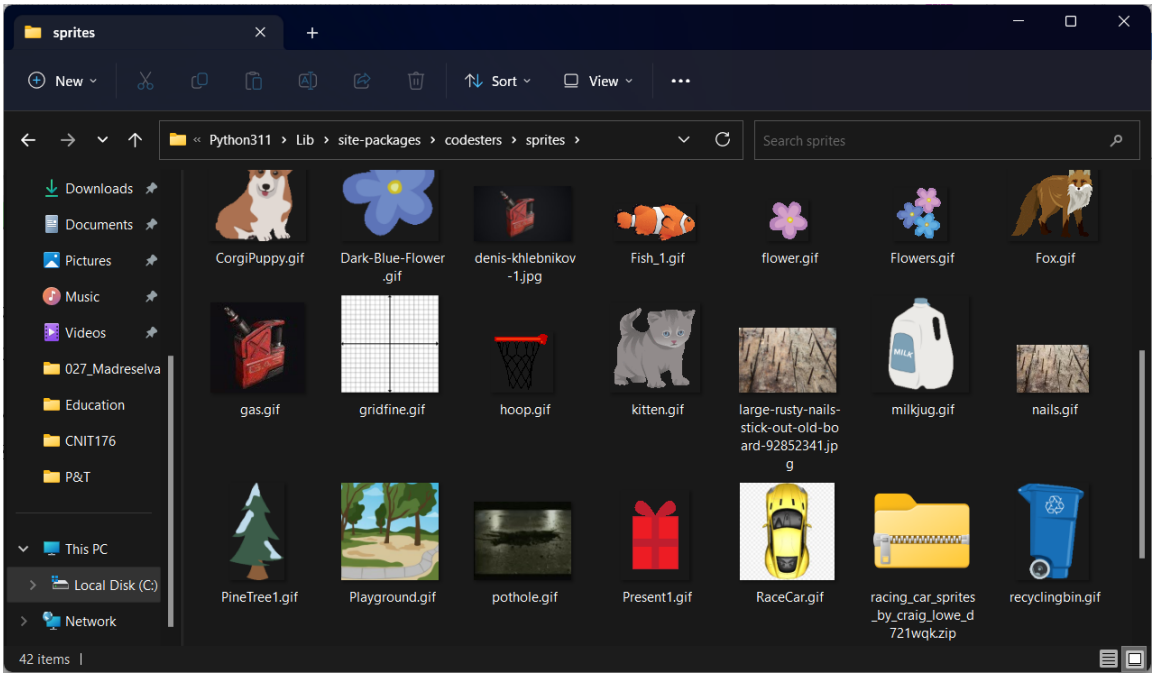

Figure 2. A screenshot of the partial contents of the *sprites* folder.

Our own partial solution to the challenge (*btc_racing_solution.py*) included the opportunity to use the Up and Down arrow keys to speed up and slow down the vertical movement of the loot and obstacles, which were generated in random lanes. The car's movement was constrained to prevent it from leaving the screen on the left or

on the right. Three screenshots of our partial solution running are featured in Figure 3. Our solution was neither given, nor shown to the contest participants and team coaches.

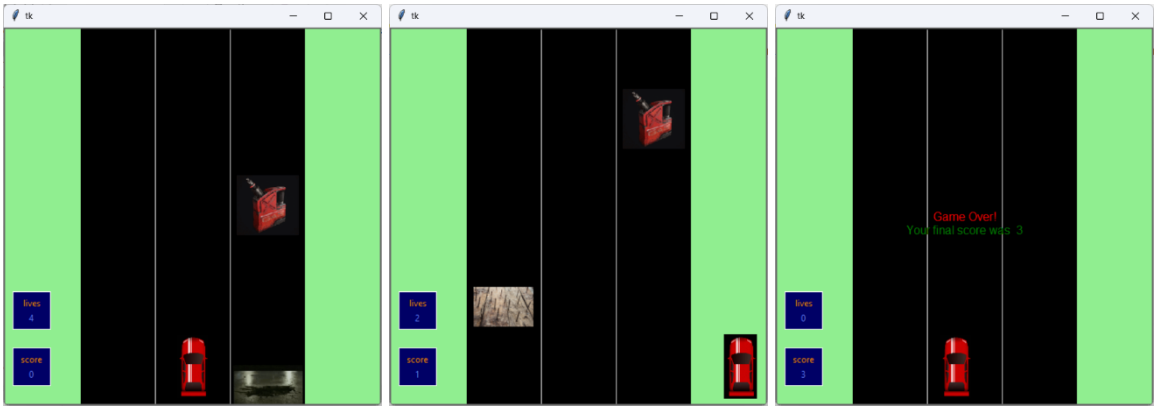

Figure 3. Three screenshots of our *btc_racing_solution.py* running: The car moves left and right without leaving the screen. The lanes where the loot and the obstacles spawn are randomized.

The team submissions were ranked independently by four contest judges based on pseudocode (20%), programming (50%), teamwork (15%), and presentation (15%). Evaluation of programming included the teams' handling of (a) sprites – 10%, (b) lane walls – 8%, (c) loot – 16%, and (d) hazards – 16%. The rankings were totaled up, and the team with the lowest sum of the ranks won. The winning solution is illustrated by three screenshots shown in Figure 4.

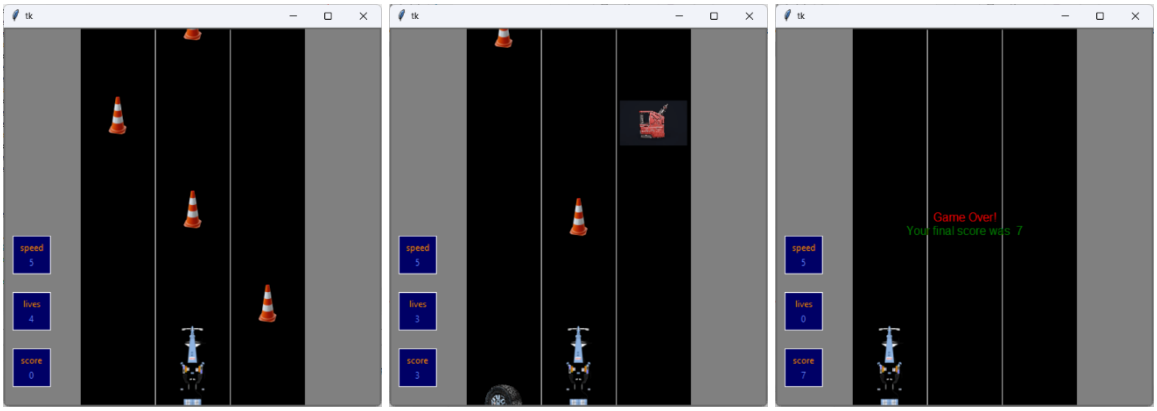

Figure 4. Three screenshots of the winning solution running. Speed is displayed (and controlled cleverly). A sprite of an Indy car is used. The car is not allowed to leave the track. The loot consists of gas and tires, the barrier cones serve as obstacles.

ESCAPE Encounter

At Purdue Polytechnic Columbus on Friday, November 18, 2022, for 45 minutes, local high school juniors and seniors supported by their parents applied a multitude of technology skills and applications to several new and not so new snags to locate a missing pieces of computer code and solve the encounter with computer information technology in a timed environment aka a timed "ESCAPE Encounter." The structure of the challenge is shown in Table 1.

Table 1. Structure of the CIT ESCAPE Encounter

★	**ESCAPE Encounter: Computer and Information Technology**
E	**Encrypted** – Decryption & Caesar Cipher Info
S	**SQL** – Find the KEY to the Caesar Cipher Encrypted file from a database using SQL
C	**Cybersecurity** – Caesar cipher decoder to find the commands to find a file
A	**Authentication** – Find the text file with missing lines of code in a folder you have access to
P	**Programming** – A program with a missing piece of code found in a secured folder on a virtual machine
E	**Encounter** – Complete the Interactive Lab

Not all students finished the encounter in the allotted time, so each student's completion time was documented to give out 1st, 2nd, and 3rd place certificates.

The students needed to be able to search the Internet and use the basics of a computer. There were 4 parts to the challenge. Each part dealt with a specific aspect of computer information technology.
In the first part, it was explained to them in a handout how to use Microsoft Access. They accessed a database that had multiple tables and thousands of records in several of the tables. They were shown how to do an introductory SQL SELECT statement using a generic example and a more specific example. They were shown how to execute SQL statements. Then, they were given clues to help them narrow the tables and records down to a manageable subset.

In part two, it was explained to them about encoding/encryption and decoding/decryption. They were given an example of the oldest and simplest cipher. It is called the Caesar Cipher. It is a substitution cipher, in which each letter is shifted by a certain number of places down the alphabet. So, if encrypting the word 'CRACKING' with a +22 shift, the letter C would become the letter Y, the letter R would become the letter N, and so on for each letter of the message being encrypted. The resulting encrypted word would read YNWYGEJC. This word could then be decrypted by anyone who knew the original encryption method of a +22 Caesar Cipher. They could reverse the cipher by translating all letters back: Y to C, N to R, and so on. Once the concept was explained, we also linked the participants to an online decoder tool.

In part three, the students were instructed to find the missing code hidden on a Linux virtual machine (VM). Linux was installed as a simplistic Ubuntu Linux VM on Oracle's VM VirtualBox Manager. The participants were given clues to help them identify the folders where the missing code was located. They were also given a simple handout of basic commands they would need and some that were just nice to know. Table 2 lists these commands.

Table 2. Basic LINUX commands for Part 3 of the ESCAPE EncounterLINK Excel.Sheet.12 https://purdue0-my.sharepoint.com/personal/casnerm_purdue_edu/Documents/Documents/CollegePreviewDay/Records%20for%20Access%20Database.xlsx Sheet1!R2C6:R10C7 \a \f 5 \h * MERGEFORMATX-

Command	**Description**
ls -l	Shows file type and access permission
cat jsyrhmx.22	Displays the file content of a particular file i.e. “jsyrhmx.22”
CTRL +P	Go to the previous commands in the command history
ESC	Terminate insert mode (this is the key on the keyboard)
:q!	Quit vi editior and do not save changes to file
cd 'Escape Encounter'	To change to a par-

	ticular directory
cd ..	Move one directory level up
vi jsyrhmx.22	Opens the file content of a particular file in the vi editor i.e. "jsyrhmx .22"

Lastly, the students were given instructions on how to open, edit, compile, and run a C# calculator application using Windows Forms on a Windows PC that was missing the code that they found on the Linux VM. They were given a list of basic coding techniques including the information about comments used as placeholders. Then, they were given clues to help them find the comment placeholder where the missing code belonged. If the repaired application worked correctly under Visual Studio, we determined that they had mastered the ESCAPE Encounter for the event.

The computer labs were set up with temporary student accounts and we made sure Microsoft Access was installed. The temporary student accounts had access to the specially configured Ubuntu Linux server locally via Oracle's Virtual Box where the directories of possible locations for the file and the actual file were located. Finally, Microsoft's Visual Studio was preinstalled to run the completed C# calculator application.

Game Night, Open House, and Day in College

At Purdue Polytechnic Columbus, we held three game night and open house events on Oct. 14, 2021, Jan. 26, 2022, and Apr. 27, 2022. We also held a Day in College event on Nov. 18, 2022. During these recruitment events for prospective CIT students, the attendees (high-school students and their parents) learned about our program, talked to the current students and faculty, and played the video and mobile games developed by our CIT students for their classes. The demonstrated student games included *Showdown at the Fair* (Fig. 5), *Super Scary Speed Run* (Fig. 6), *Runaway Robot* (Fig. 7), and *Dante* (Fig. 8). The former two games were developed using Unity, whereas *Runaway Robot* employed Unreal Engine 4, and *Dante* was developed using Android Studio and Kotlin.

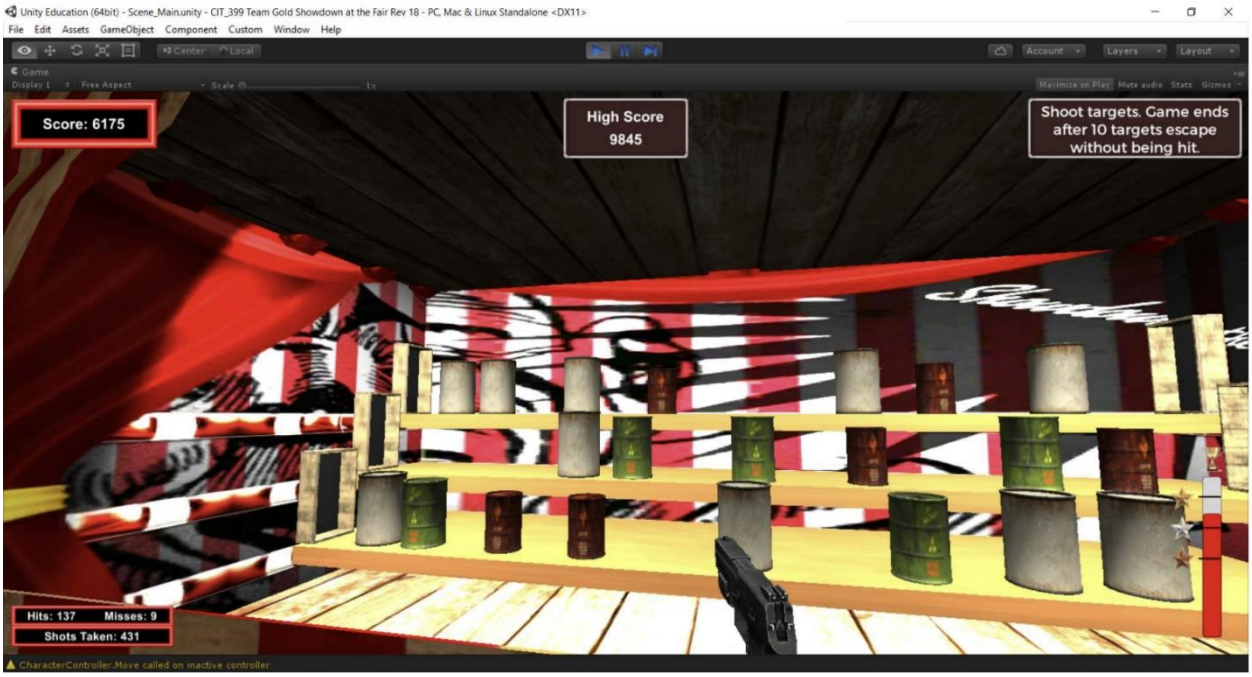

Figure 5. *Showdown at The Fair*: Level 1 (the Classic level), a screenshot of the video game for PC developed by three undergraduate students for their Spring 2015 team project in CNIT 399 Introduction to Game Development (Gusev & Swanson, 2017).

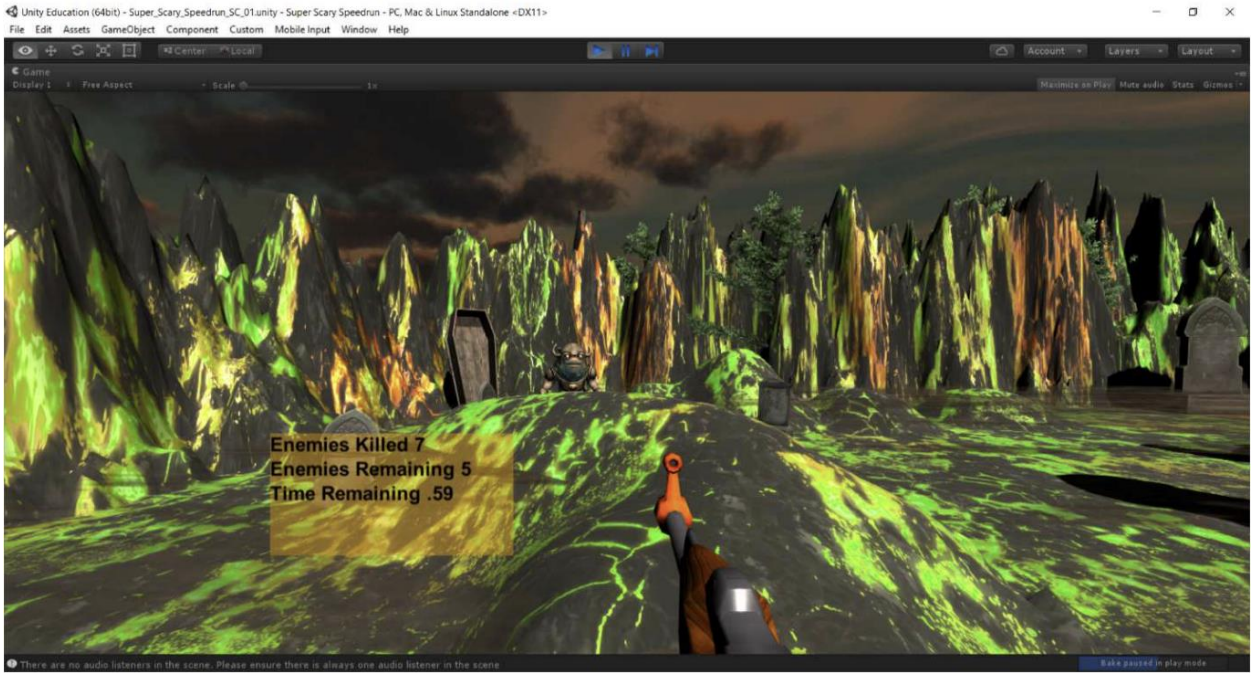

Figure 6. *Super Scary Speed Run*, a screenshot of the game demo developed by three undergraduate students for their Fall 2015 team project in CNIT 355 Software Development for Mobile Computers (Gusev & Swanson, 2017).

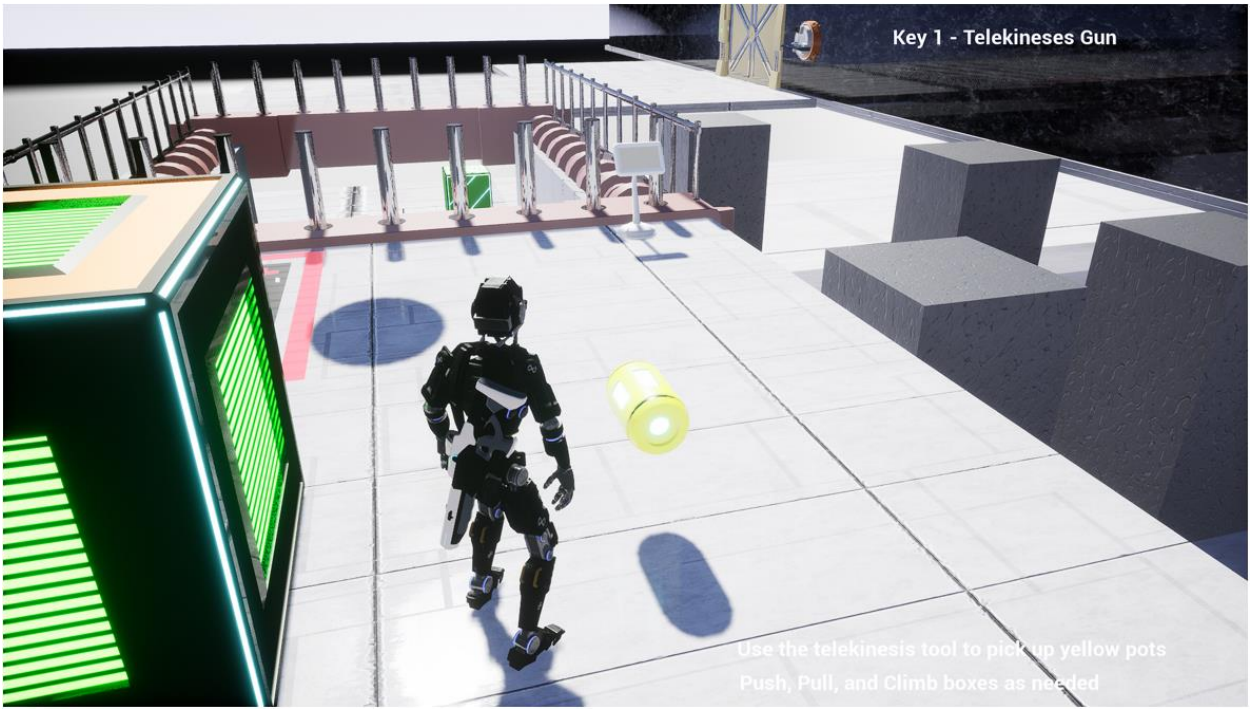

Figure 7. *Runaway Robot*, a screenshot of the video game for PC developed by five undergraduate students for their Spring 2021 team project in CNIT 381 Introduction to Game Development Technology, our pilot course that succeeded CNIT 399 Introduction to Game Development (Swanson & Gusev, 2022).

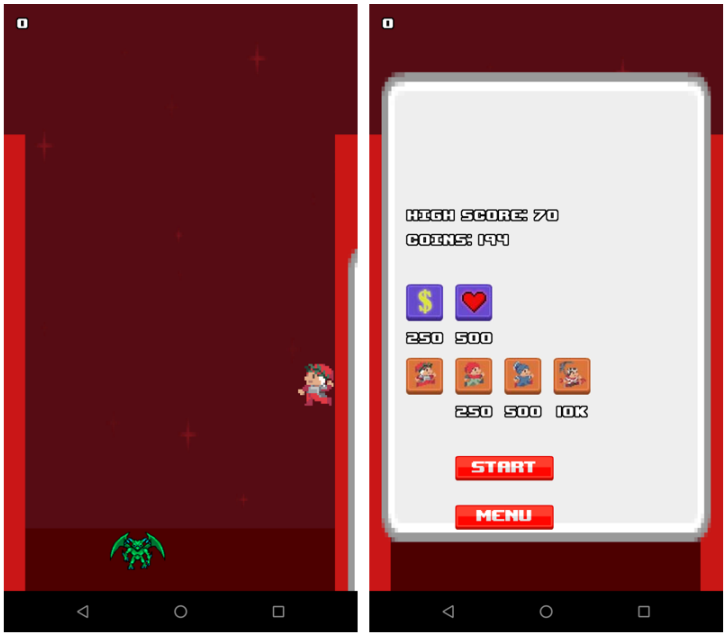

Figure 8. *Dante*, two screenshots of the arcade-style mobile game for Android developed by undergraduate students for their Fall 2021 team project in CNIT 355 Software Development for Mobile Computers (Swanson & Gusev, 2022).

Evacuate It Challenge

Evacuate It is an activity using Alice software to create a Public Service Announcement (PSA) for an approaching tornado. Tornado or any kind of disaster can be used. In the scenario, students are asked to create a PSA that will be displayed at local movie theater among movie trailers, with the goal to raise awareness and, in an entertaining manner, show the public what to do if a tornado is approaching. Students work in teams of 3-4 for this activity. In this situation, the activity was used as a formal competition with presentations and a winner but would not need to be completed as a competition. This would save time. Following are the criteria given for each team:

Create the animation using Alice with associated activities (each animation should be 60-90 seconds in length):
Start by displaying the title
Go through the scenarios in different scenes for
In home
In car
On foot
In mobile home
Add objects in the scene to make each scene (activity) distinguishable. These objects do not have to have any actions associated with them.

The timeline given to the students for the Evacuate It activity was as follows.
10 minutes — Introduction
30 minutes — Go through the 4 tutorials on Alice programming language at www.alice.org
30 minutes — Research on the internet and outline points to cover for tornado and develop sketch out storyboards for each scenario
50 minutes — Develop the animation using Alice
40 minutes — Present
20 minutes — Judges' decision

Using this timeline, it will take students 3 hours as a competition. However, if it is not completed as a competition and the design portion with the storyboards is eliminated the activity can easily be completed in 2 hours or less. The activity was completed by high-school students with no knowledge of Alice. Alice is a block-based drag-and-drop programming environment that makes it easy to create animations, build interactive narratives, or program simple games in 3D. It was created at Carnegie Mellon University and is free to use and easy to install on a computer. The graphics are basic, so it does not require any special memory or storage requirements.

Big Data - Election Day

Big Data Election Day is an activity creating basic SQL code using a Microsoft Access database. The activity can be fun around election time when television viewers are inundated with political ads. The scenario is students are working for an IT company that is hired by a possible candidate to find out information about a potential run for the United States Congress. Students work in teams for this activity. Students are given three questions to answer to prepare for the meeting with the candidate. The following questions are coded by the students using SQL and the Access database.

> Who are the other potential candidates for the district 9 house seat, what city do they live in and what party do they represent?

The candidate would like to know individuals living in Indiana that contribute to campaigns and would like to see the individual contributors name, city, they are from, and the amount contributed and sorted in descending order by amount contributed.

The candidate would like to know who individuals contributed to and show the city they are from, the candidate they contributed to, the party of the candidate, and the amount contributed and sort in descending order by amount.

This activity was used with high-school students from freshman to senior level in a college preview day session. No knowledge of SQL was required coming into the event (students were given handouts with the basics of SQL and enough to solve the crime). The time allotted was 60-75 minutes. To complete the activity, students need a computer with the Election database and 3 tables: committee master, candidate master and individual contributions. The data used was real data from the Federal Election Commission (FEC) and contained several tables with a large number of records – close to 750,000 records, so it is large enough that students can't just open the database and find the answer. The data from FEC is rather cryptic and was reworked slightly so the table names and field names were easier to use and understand. Students were given a handout with basic SQL commands required to get the answers along with information about the election tables. Microsoft Access was used for the activity, but the activity could be used on an Oracle database.

CONCLUSIONS

We have presented strategies for recruitment of new Computer and Information Technology students and illustrated them by detailed descriptions of our recruitment activities covering the full spectrum of the CIT discipline to give high-school students a taste of what it's like to be trained to become a next-generation information technology professional.

REFERENCES

Zdanowicz, Christina (2022). *College enrollment has been dropping. The pandemic has made it worse*. Accessed online at https://www.wlfi.com/news/national/college-enrollment-has-been-dropping-the-pandemic-has-made-it-worse/article_84d2355c-1871-5f29-87cc-c482d98898ee.html.

Drozdowski, M. J. (2023). *Looming Enrollment Cliff Poses Serious Threat to Colleges.* Accessed online at https://www.bestcolleges.com/news/analysis/looming-enrollment-cliff-poses-serious-threat-to-colleges/.

Welding, Lyss (2023). *U.S. College Enrollment Decline*. Accessed online at https://www.bestcolleges.com/research/college-enrollment-decline/.

Caesar Cipher Decoder (2023). Accessed online at https://www.thewordfinder.com/caesar-cipher-solver.

Codesters (2023). Accessed online at https://www.codesters.com/.

Lowe, Craig (2014). *Racing Car Sprites*. Accessed online at https://www.deviantart.com/craig-lowe/art/Racing-Car-Sprites-426711548.

Dreamstime (2023). *41 Board Nails Out Sticking Stock Photos, Images & Pictures*. Accessed online at https://www.dreamstime.com/photos-images/board-nails-out-sticking.html.

Denis Khlebnikov (2019). *Gas Can*. Accessed online at https://www.artstation.com/artwork/Ya4lqY.

Gusev, D. A., & Swanson, D. A. (2017). Transitioning to the Polytechnic: The Game Development Aspect. *The 50th ASCUE Annual Conference,* June 11-15, 2017 (pp. 35-47). Myrtle Beach, SC: The Association Supporting Computer Users in Education (ASCUE).

Swanson, D. A., & Gusev, D. A. (2022). *Tools to Use in an Information Technology Class – and Best of All They Are FREE, version 2! The 54th ASCUE Annual Conference,* June 12-16, 2022 (pp. 98-110). Myrtle Beach, SC: The Association Supporting Computer Users in Education (ASCUE).