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From Excel to Python to AI: A Connectivist Approach to Teaching Coding Concepts in an Introductory Information Systems Course

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Abstract

This study examines the use of connectivist learning principles to teach first-year students about coding with Python in a Fundamentals of information Systems course. The instructional design integrates tools such as Microsoft Excel, Google Colab, and AI chatbots to support conceptual understanding and develop problem solving skills. Students engaged in collaborative coding activities, progressing from designing and sharing solutions with spreadsheets to designing solutions by writing Python code. They then demonstrate their prompt engineering skills. The study also addresses four research questions: (1) To what extent does prior experience with Excel support students' understanding of Python programming concepts? (2) How do digital tools and peer networks support student engagement and learning in coding? (3) How do students perceive the value of learning Python for academic and career development? and (4) To what extent are students motivated to continue learning coding independently? Survey results indicate that students find benefit in using networked collaboration and learning tools, recognize the value in learning Python, and favor further informal study. These findings also support the use of connectivist learning techniques as a valuable framework for presenting coding instruction to first-year information systems students.

Keywords: Python, Coding, Excel, Generative AI, Connectivist Learning.

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1. INTRODUCTION

The ability to code, or at least understand code, has become an essential skill for many 21st century professionals (Kivunja, 2014). Approaches to teaching coding concepts to students in introductory information systems survey courses have varied from teaching the vocabulary of coding (sequence, selection, repetition, input, output, variables, functions, classes, objects, methods) by example (Parsons, 2023) to using visual block-based coding tools to implement basic algorithms and procedures (Andone & Frydenberg, 2021; Bozan & Taslidere, 2024). Emphasis is often on concepts rather than creating actual programs.

This paper presents an innovative approach to introducing first-year students in a Fundamentals of Information Systems course to coding through a three-session module. Building on their prior knowledge and proficiency with Microsoft Excel, students learn the basics of Python programming and then use generative AI to create Python code for more complex tasks such as data visualization.

Guided by principles of connectivist learning, which emphasizes knowledge construction through connections between people, tools, and ideas, this study investigates the following research questions:

- **RQ1.** To what extent does prior experience with Excel support students' understanding of coding concepts?
- **RQ2** How do digital tools and peer networks support student learning and engagement in an introductory information systems course?
-
  RQ3. How do students perceive the value of learning Python for their academic and professional goals?
- **RQ4.** To what extent are students motivated to continue learning coding after the course?

2. THEORETICAL FOUNDATIONS AND RELATED WORK

Connectivist learning theory, as introduced by Siemens and Downes (Downes, 2010; Siemens, 2005, 2014; Siemens & Downes, 2011) emphasizes these core principles:

- Learning happens by making connections, constructing and interacting with both human and technological networks.
- Learning is not only about understanding concepts, but also making connections with individuals, ideas, and technology.
- Learning from peers and being exposed to a variety of perspectives and solutions is central.
- Making decisions is an ongoing process in a rapidly changing world driven by information.
- Learning also relies on the use of technology to store, process, and generate information. Technology is essential to the connectivist classroom, enabling students to access, share, and create knowledge.

Literature suggests a growing interest in applying connectivist learning approaches in business education, with a few studies specifically focusing on learning to code. Connectivist learning empowers students to learn collaboratively, generate knowledge, interact with different tools and connect with different information sources (Gottipati et al., 2023; Utecht & Keller, 2019).

A second-year programming course at the University of Pretoria integrated connectivist strategies with scaffolding interventions from instructors and found that students valued this approach, engaging with online resources and peers, and as a result, felt more confident in taking on complex coding projects (Matthee & van Deventer, 2022).

In a recent Finnish study investigating the impact of a connectivist learning approach on teaching sustainable business in an online context, results showed that peer interactions and digital tools were seen as active nodes of learning, allowing students to make use technology to help strengthen knowledge and learn from different perspectives. (Dziubaniuk et al., 2023) This suggests that a connectivist approach also can be applied to learning to code, especially when learners choose tools and networks that suit their needs and learning styles. While the coding environment (Google Colab) was standardized, students used the AI tools of their own choice refining prompts and debugging code across platforms. This process reflects key connectivist principles: navigating multiple knowledge nodes, applying real-time feedback, and developing personal strategies for problem solving.

Recent research supports a meaningful connection between spreadsheet fluency and learning to code. Lovászová and Hvorecký (2004) describe how spreadsheets can be used to explore foundational algorithmic structures such as sequence, selection, and repetition without writing formal code in a programming language. As they note, "Programming problems can be also solved using spreadsheet calculations. The stage is built around one of the spreadsheet solutions. It is selected and arranged in a way that exhibits and amplifies the considered properties of the algorithm. By experimenting with the spreadsheet solution, the students reveal the properties and extrapolate them to the field of programming" (Lovászová & Hvorecký, 2004, p. 46).

Csernoch and Biró (2019) found that first-year students who approached solving spreadsheet tasks algorithmically demonstrated stronger problem solving and computational thinking skills than those who relied on more basic functions. Finally Sarkar et al. (2020) reported a positive correlation between spreadsheet formula use and experience with traditional programming languages such as Python or Java. From a connectivist perspective, these findings suggest that activating prior spreadsheet knowledge can help students build new conceptual connections when they learn to code.

3. IMPLEMENTATION: FROM EXCEL TO PYTHON TO AI

One of the biggest challenges in learning to code is understanding new syntax and abstract concepts. "The learning of programming is difficult because it involves the simultaneous acquisition of three domains of knowledge: the syntax and semantics of a programming language, the notional machine (an abstract model of the execution process), and problem-solving strategies" (Robins et al., 2003, p. 138).

This study describes a three-session module for teaching coding concepts using familiar examples based on students' prior knowledge of Microsoft Excel in CS 100 ("Solving Business Problems with information Technology"), a systems fundamentals course required of all first-year students at business-focused university in New England. Course topics include intermediate proficiency in Excel along with basic computing concepts (operating systems, organizing files and data, cybersecurity, the Internet and World Wide Web, security and privacy), and emerging technologies such as virtual reality and generative AI.

The course also includes a coding component which historically had three classes on web development. Students learned to create simple web pages by hand-coding basic HTML tags for headers, paragraphs, images, and links, along with simple formatting for fonts and colors. The original intent was that by writing HTML and viewing it in a browser, students would learn about coding. The Python curriculum described here replaces the HTML unit for those sections that adopted it as an alternative.

Comparing Excel and coding concepts is an effective way to scaffold student learning (Groner, 2023). "At its heart, connectivism is the thesis that knowledge is distributed across a network of connections, and therefore that learning consists of the ability to construct and traverse those networks" (Downes, 2010). Figure 1 describes a learning network showing the progression implemented in this study encouraging students to learn coding by making and applying connections between spreadsheets, and coding, and using AI to apply knowledge of those concepts.

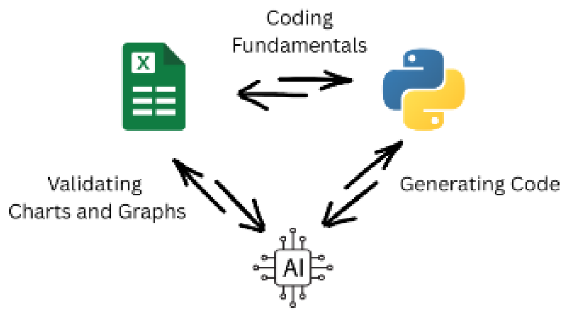
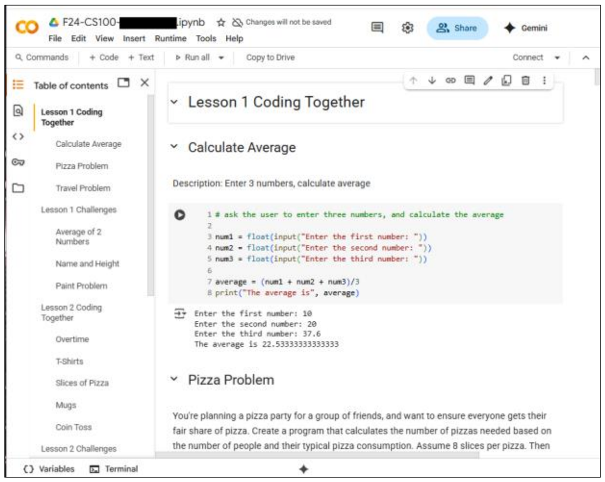


Figure 1. Network showing the knowledge progression and connections from Excel to Python to AI.

Students used the Google Colab environment for developing and submitting their Python programs; after creating their notebooks, they shared a link to it with their instructor who checked it for grading and completion. Figure 2 shows an example of a student's Google Colab notebook. Students add a hierarchy of headings to make their notebooks easy to navigate and are required to show the program output to facilitate grading. Text blocks describe code, and code blocks contain executable Python statements.

Using an online environment eliminates the need to install an IDE and upload solutions to a course learning management system. After creating their notebooks, students share the links with their instructor by completing an online form.



Lesson 1 Coding Together

Calculate Average

Description: Enter 3 numbers, calculate average

```python
# ask the user to enter three numbers, and calculate the average

num1 = float(input("Enter the first number: "))
num2 = float(input("Enter the second number: "))
num3 = float(input("Enter the third number: "))

average = (num1 + num2 + num3)/3
print("The average is", average)
```

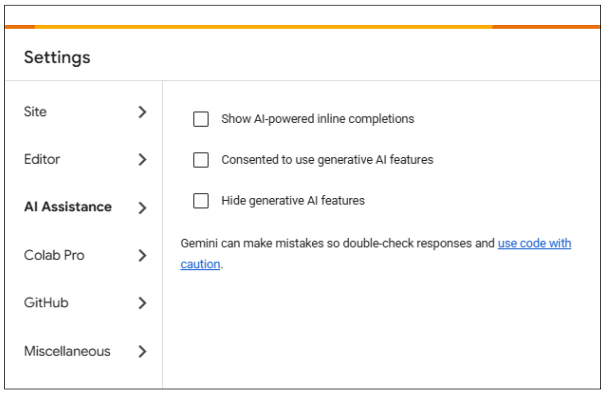
```
Enter the first number: 10
Enter the second number: 20
Enter the third number: 37.6
The average is 22.533333333333333
```

Pizza Problem

You're planning a pizza party for a group of friends, and want to ensure everyone gets their fair share of pizza. Create a program that calculates the number of pizzas needed based on the number of people and their typical pizza consumption. Assume 8 slices per pizza. Then

Figure 2. A Google Colab Notebook.

Google Colab can provide AI-generated code. Students were instructed to modify notebooks' settings to disable this feature for the first two lessons when they are learning coding fundamentals, and then to enable it for the third lesson when they will run and evaluate the results of AI-generated code to create charts and graphs. (See Figure 3)



☐ Show AI-powered inline completions

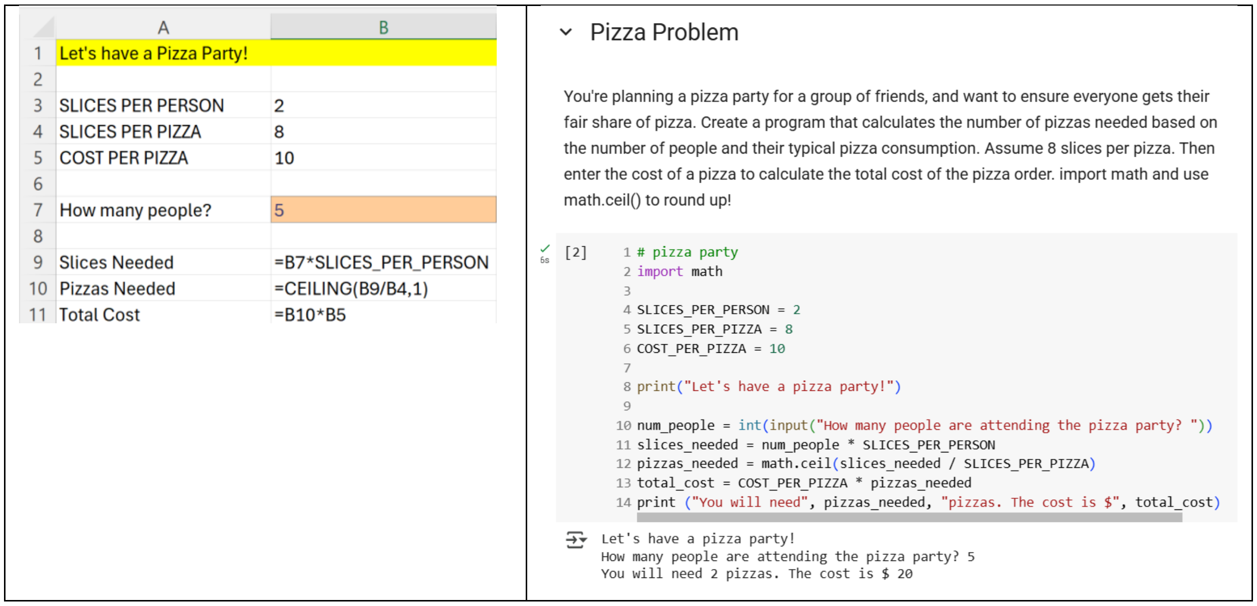
☐ Consented to use generative AI features

☐ Hide generative AI features

Gemini can make mistakes so double-check responses and use code with caution.

Figure 3. Disabling or Enabling AI Assistance in Google Colab.

Each day's lesson began with "coding together" problems where students solved a problem in small groups using Microsoft Excel. The instructor then showed them how to translate that solution into a Python program. See Figure 4 for a sample spreadsheet and coding solution for a problem of calculating the number of pizzas required and cost of a pizza party.



	A	B
1	Let's have a Pizza Party!	
2		
3	SLICES PER PERSON	2
4	SLICES PER PIZZA	8
5	COST PER PIZZA	10
6		
7	How many people?	5
8		
9	Slices Needed	=B7*SLICES_PER_PERSON
10	Pizzas Needed	=CEILING(B9/B4,1)
11	Total Cost	=B10*B5

Pizza Problem

You're planning a pizza party for a group of friends, and want to ensure everyone gets their fair share of pizza. Create a program that calculates the number of pizzas needed based on the number of people and their typical pizza consumption. Assume 8 slices per pizza. Then enter the cost of a pizza to calculate the total cost of the pizza order. import math and use math.ceil() to round up!

```python
# pizza party
import math

SLICES_PER_PERSON = 2
SLICES_PER_PIZZA = 8
COST_PER_PIZZA = 10

print("Let's have a pizza party!")

num_people = int(input("How many people are attending the pizza party? "))
slices_needed = num_people * SLICES_PER_PERSON
pizzas_needed = math.ceil(slices_needed / SLICES_PER_PIZZA)
total_cost = COST_PER_PIZZA * pizzas_needed
print ("You will need", pizzas_needed, "pizzas. The cost is $", total_cost)
```

```
Let's have a pizza party!
How many people are attending the pizza party? 5
You will need 2 pizzas. The cost is $ 20
```

Figure 4. From Excel to Python (Spreadsheet and Python solutions).

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Note that the spreadsheet solution uses a named range for cell B3 as an example of how named ranges can be more descriptive than cell names, encouraging the use of descriptive variable names.

Each Coding Together problem had a similar Coding Challenge for students to work on, usually with a partner, for homework. Students presented their coding challenge solutions at the start of the next class.

This structure reflects connectivist learning by applying its core ideas: students learn through peer collaboration, make use of familiar tools and learn to use new ones, and they engage with technology as an active partner in their learning. This approach moves beyond memorizing concepts and typing code without understanding to develop students as networked learners, capable of adapting and learning through their connections with tools, peers, and knowledge systems.

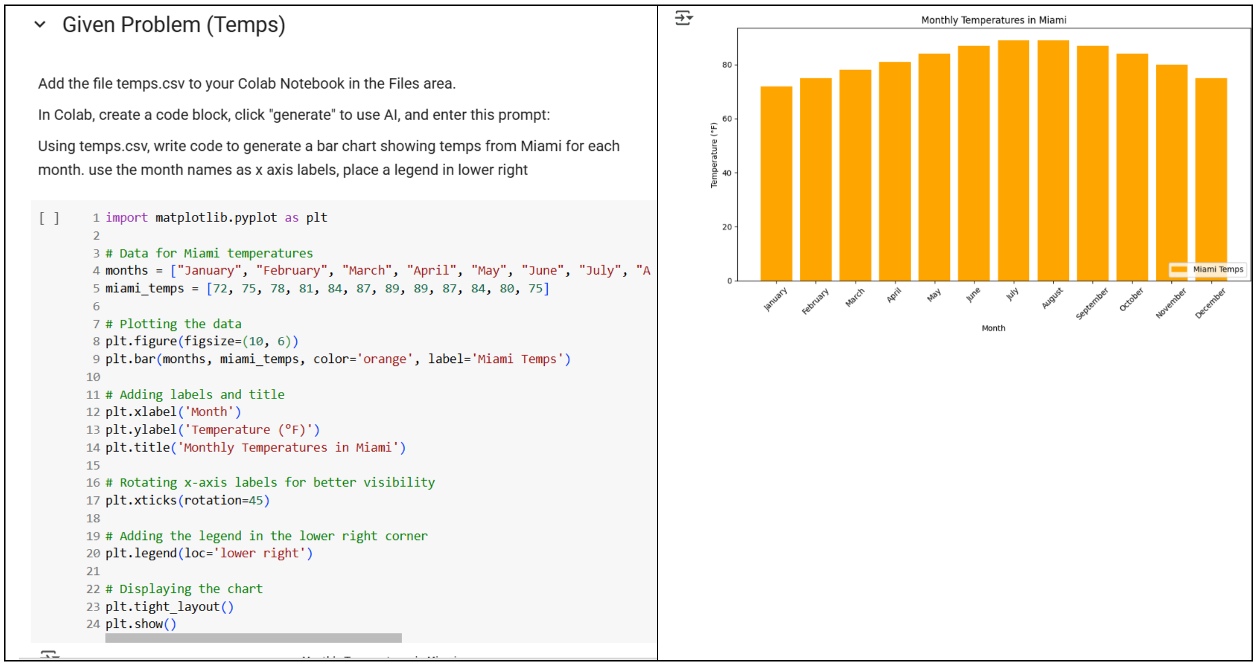
Each day's lesson introduces a coding concept by relating it to a familiar Excel concept. The focus is on what coding can do, as much as it is on writing the code itself. On the third day, by using AI to generate code, students learn that AI can be an effective problem-solving tool, where the solution that AI provides is not the end, but a means to accomplishing a greater task (in this case, visualizing and interpreting data).

Students still need to run the AI-generated code and make sure that it produces the desired results (or modify their prompts or possibly the code) if the results are not as expected. Students also learn that when the AI-generated code does not work (and it often may not), they should try a different AI tool to see if it generates different solutions. The exercise becomes a lesson in prompt engineering, as students must apply the vocabulary of charts and graphs (chart types, legends, titles, axis labels, major and minor axis, etc.) to specify the desired appearance of their charts and then verify that the results are correct. Anecdotally, ChatGPT's code seemed more reliable than that generated within Colab for data/charts. Figure 5 shows part of a student's Colab notebook with AI-generated code and the resulting bar chart visualizing temperature data.

Table 1 summarizes the concepts of each lesson. Appendix B shows a summary of the Coding Together and Coding Challenge problems for each lesson.

Lesson	Python Concepts	Excel Concepts	Connections
1	variables, calculations, data types, input and print	Cells, formulas, data types, calculations, entering and displaying values	Calculations are the basic feature of spreadsheets and at the foundation of any algorithm. Topics include data types (int and float), simple math operations (round, ceiling, max, min, average) and their corresponding functions in Excel.
2	if statements, conditions for Loops	=IF(), =AND(), =OR() functions Copying values or formulas down a range of cells	Students are familiar with various forms of the if function in Excel, so writing if statements in Python is a natural extension. The process of copying values down a range of cells in a spreadsheet is similar to iterating over a list of items or values using a for loop.
3	using AI to generate Python code	Charts, graphs	Students are familiar with making pie, bar, line, and other charts in Excel. Coding these in Python by hand is difficult, but an AI tool can often generate the code if given a descriptive prompt.

Table 1. Excel to Python to AI Lesson Topics and Rationale



Given Problem (Temps)

Add the file temps.csv to your Colab Notebook in the Files area.

In Colab, create a code block, click "generate" to use AI, and enter this prompt:

Using temps.csv, write code to generate a bar chart showing temps from Miami for each month. use the month names as x axis labels, place a legend in lower right

```
import matplotlib.pyplot as plt

# Data for Miami temperatures
months = ["January", "February", "March", "April", "May", "June", "July", "A
miami_temps = [72, 75, 78, 81, 84, 87, 89, 89, 87, 84, 80, 75]

# Plotting the data
plt.figure(figsize=(10, 6))
plt.bar(months, miami_temps, color='orange', label='Miami Temps')

# Adding labels and title
plt.xlabel('Month')
plt.ylabel('Temperature (°F)')
plt.title('Monthly Temperatures in Miami')

# Rotating x-axis labels for better visibility
plt.xticks(rotation=45)

# Adding the legend in the lower right corner
plt.legend(loc='lower right')

# Displaying the chart
plt.tight_layout()
plt.show()
```

Figure 5. AI-Generated Code for Charting Weather data, shown in a Colab notebook.

4. METHODOLOGY

The author piloted the three-session during the Spring 2024 semester with one section of 18 honors students. The following Fall, after making it available to other CS 100 instructors, one instructor adopted the lesson in place of HTML/Web Development in Fall 2024 for the two sections of approximately 35 students that he taught, and three instructors (five sections of approximately 35 students each) adopted the module for Spring 2025. All instructors who taught the Python module participated in two training sessions led by the author, who reviewed both the pedagogy and coding principles for these lessons. Students completed a short survey reflecting on their experience learning about coding after completing the last module.

Survey Data

During these three semesters, 217 students (124 males, 92 females, 1 preferred not to say) completed the survey, usually during class time. Given maximum class sizes, at most 299 students would have been enrolled in sections teaching this curriculum, for a response rate of approximately 73%. The majority (60%) had not coded before; 30% had some Java or Python in high school, and the rest had varying degrees of coding experience (self-taught, knew HTML coded in Scratch, did "hour of code"). Most students (86%) were 18 or 19 years old, with 30 students 20 or older. When asked about their intended majors, there were only two that mentioned Computer Information Systems, while the majority were split between Accounting, Finance, and Corporate Finance and Accounting.

The survey includes several questions based on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree), as shown in Appendix A. For clarify of results, the author organized the questions into broad categories:

- Learning and Understanding
- Student Engagement
- Value of Learning Python
- Future Interest

Because the Python curriculum was entirely similar across sections, and because all instructors were trained to follow the pedagogy for this module, the results that follow aggregate all results from all sections over three semesters.

The charts in Figure 6 summarize the averages of all responses for each question in each category.

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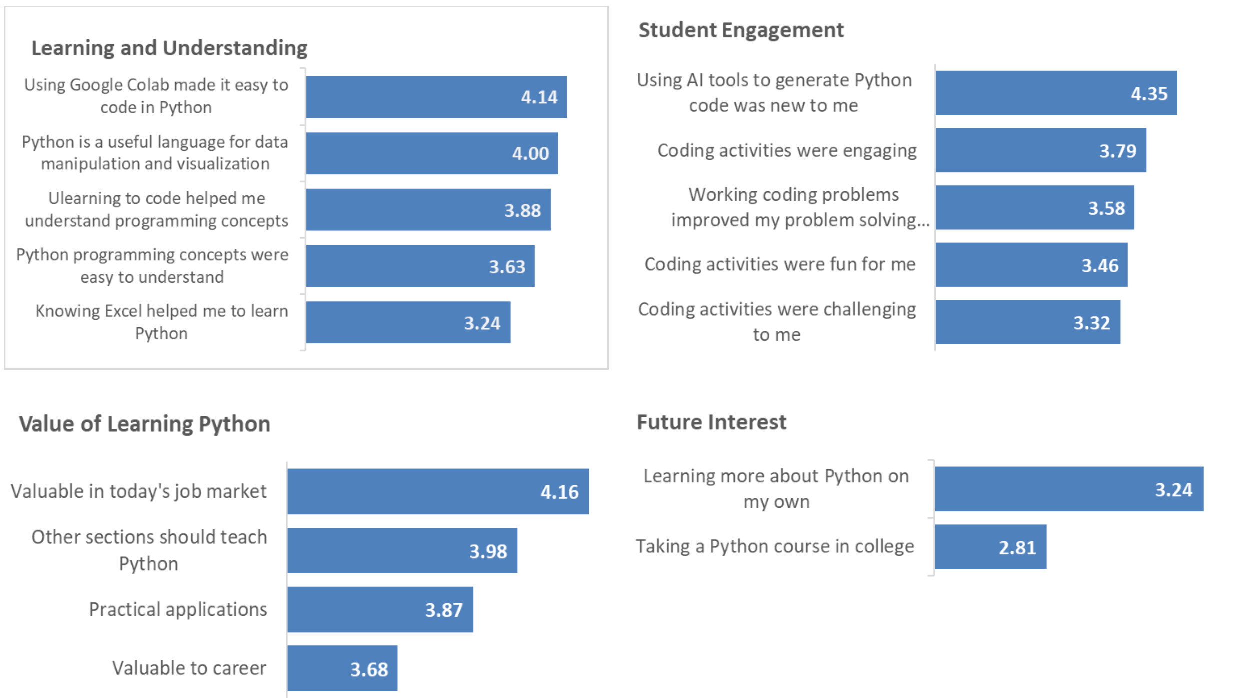

Figure 6. Survey Results

In the Learning and Understanding category, students overwhelmingly rated Google Colab as an easy-to-use tool for coding in Python (4.14). They found Python to be useful for manipulating ad visualizing data (4.00) and felt it helped them understand programming concepts (3.88), even though students were challenged to understand Python programming concepts (3.63).

Unexpectedly, students rated "knowing Excel helped me to learn Python (3.24)" lowest in this category, suggesting mixed impact of prior Excel experience on learning about coding in Python. Upon sharing this finding with a CIS tutor who helped CS 100 students learning Python, the tutor reflected: "When I would help students in CS 100 with Python, I noticed there was a logic disconnect. Some students struggled with the multi-step process of solving a Python problem, whereas Excel tended to work in smaller, separate chunks." While formulas would often translate similarly, when writing Python programs, students also needed to think about accepting user input, converting values to numeric data types, printing results, adding comments to code, and navigating Python syntax issues (indentation, colons, etc.) not encountered when creating spreadsheets.

Students found Python accessible and helpful to learn coding concepts, especially when using Google Colab. One student commented, "Even though it was very tricky at times; there was always a sense of reward when you finally got the problem right. It sparked an interest in CS I didn't really have before."

Under Student Engagement, using AI tools to generate Python code was new to most students (4.35), suggesting that learning and applying this was engaging. Students moderately agreed that they found the units to be engaging (3.79), fun (3.46), and challenging (3.32). Said one student, "it [writing code] definitely is something that you need to practice at and understand what you're doing, writing code is not always easy and you have to think about every action involved." Another student commented that they could connect learning Python with previous coding experiences: "I had some prior experience with Java so it was nice to learn a new language and apply some of the prior knowledge I had."

Considering the value of learning Python, students overwhelmingly felt it was a valuable skill to have in today's job market (4.16), and that other sections should teach it (3.98). Students saw it as valuable to their career (3.68), suggesting that students recognize the professional and academic relevance of coding.

Finally, students had a moderate interest in learning more about Python independently (3.24), and lower-rated the possibility of taking a college course in Python (2.81). While they see the value in learning Python, fewer are motivated to take a course in it. This is consistent with the selection of majors that students are interested in pursuing, most of which do not require a coding course. One student commented, "I really enjoyed Python, and I think basic coding is an essential skill for extracurricular projects; I have already needed to code for a case competition.

Overall, the data suggests that students found the coding environment and Colab to be helpful; they were engaged with the topic (especially using AI); and they clearly valued the relevance of knowing Python; but they prefer informal over formal instruction for future learning.

Sentiment Analysis
To better understand students' responses to the coding module, this study implemented a sentiment analysis using Python's TextBlob library (Loria, 2018). TextBlob evaluates sentiment along two dimensions: polarity (-1.0 for strongly negative to +1.0 for strongly positive), and subjectivity (0 for objective to 1.0 for highly personal) (Liu & Pang, 2025).

The analysis shown here focuses on polarity, and classifies comments as:

- Positive (polarity > 0.2)
- Neutral (-0.2 <= polarity <= 0.2)
- Negative (polarity < -0.2)

These bounds are based on a commonly used heuristic (Loria, 2018). Although they provide a practical way to filter positive or negative sentiment, they are admittedly not perfect, especially for short comments, and the author acknowledges this as a limitation of this study.

Out of 78 responses, 47 (60%) were positive, 24 (31%) were neutral, and only 7 (9%) were negative. Neutral sentiments were mostly due to blank ("n/a" or "none") responses. Figure 7 displays a word cloud colored by sentiment polarity. Green words indicate positive sentiment, and red words indicate negative sentiment (See Figure 7).

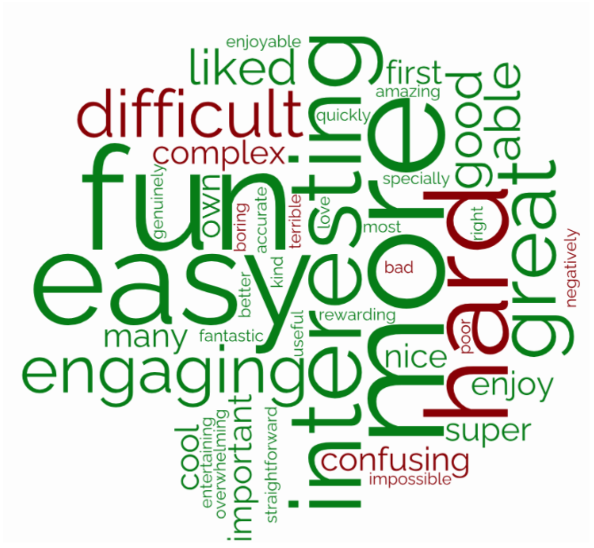

Figure 7. Sentiment Word Cloud (Generated with wordclouds.com).

Positive themes included student enjoyment when learning Python, recognition if its value for future careers or in other courses and appreciating the use of Google Colab and engaging projects. Selected examples are shown in Table 2 to provide additional context.

Comment	Polarity	Sentiment
"Very interesting and enjoyable."	0.58	Positive
"I was never efficient with technological skills so my opinion is biased and against coding however this course was not terrible for someone like myself."	0.50	Positive
"I enjoyed learning about Python and felt that it was an easy concept to understand."	0.47	Positive
"It was a fun and engaging experience. I'm not much for coding, but it was nice to learn some basics nonetheless."	0.30	Positive
"I found the Excel integration a little challenging even though I already kind of know python. I also didn't completely understand its value."	0.25	Neutral
"It was fun but i don't see a ton of practical applications for it in my major."	0.18	Neutral
"At first I didn't understand it completely but by the time we had to do the project I felt ready and it was very simple to do because I knew what I was doing."	0.14	Neutral
"I did not enjoy using AI to code because it gave me error messages and I didn't know how to fix it. Everything else was fun."	0.05	Neutral
"The third python assignment was difficult. Adding the data into the platform didn't work."	-0.25	Negative
"Bad/boring."	-1.00	Negative

Table 2. Comments and Polarity Scores.

While the results from the survey's Likert scale responses show that students valued the experience overall, this sentiment analysis confirms engagement and enjoyment, even among students who found coding difficult, and suggests their emotions (frustration, reward, curiosity) while completing the module.

6. CONCLUSIONS

This study explored how students engaged with a connectivist approach, that integrated networked tools, peer collaboration and real-world applications to learning about coding,

Limitations and Future Research
This study combines data from eight sections taught by five different instructors during a three-semester span. For all except the original instructor, none had taught this material before. Teaching Excel concepts knowing what the upcoming Python content would be, or having more familiarity with it, might also influence student perception of the value of knowing Excel prior to learning basic Python skills.

Future research could include a larger sample size, introducing this curriculum in a similar course at another university, or examining results based on instructor or students' anticipated majors or minors to discover learning trends or biases.

Research Questions
Returning to the research questions:

RQ1. To what extent does prior experience with Excel support students' understanding of coding concepts?

While the curriculum aimed to build on students' prior experience with Excel, the impact of that prior knowledge on learning Python was less significant than expected. The survey results suggest this connection was moderate. Students gave lower ratings to the statement "Applying my Excel knowledge to Python made it easier…" (mean = 3.24), indicating mixed perceptions about the strength of that knowledge transfer. From a connectivist learning perspective, not all students were able to make those connections effectively without additional guidance. While the instructor designed the module to create the bridge between Excel and Python, it may require additional scaffolding to make those connections clearer to more students.

RQ2. How do digital tools and peer networks support student learning and engagement in an introductory information systems course, through a connectivist lens?

Web-based tools such as Google Colab assist with student learning, but surprisingly, prior Excel knowledge was less of a benefit in learning Python than expected. Students made connections between spreadsheet and Python concepts, but found the coding exercises to be more challenging, and using AI to generate complex Python code to be most interesting.

RQ3. How do students perceive the value of learning Python for their academic and professional goals?

Students' high ratings of Python's usefulness and relevance suggest that they clearly see the benefit of learning about coding for both academic projects and future employment.

RQ4. To what extent are students motivated to continue learning coding after the course?

Students recognized the value of learning Python, particularly in their continued studies and in their careers. Their interest in pursuing future course work, however, was less than expected. This aligns with connectivist principles, however, which stresses learning as a self-directed process. One student noted "I really enjoyed Python, and I think basic coding is an essential skill for extracurricular projects; I have already needed to code for a case competition."

These results collectively support the use of connectivist learning as a lens through which to evaluate this instructional approach. Students engaged meaningfully with tools such as Google Colab, Excel, and AI chatbots, while also learning through interactions and collaborative problem solving with their peers. Sharing solutions in class reinforced social learning, and using technology tools enabled students to draw connections between familiar and new concepts. Overall, the findings suggest that coding education grounded in connectivist principles can result in greater engagement and deepen understanding in learning environments that thrive on technology, collaboration, and real-world applications.

7. REFERENCES

Andone, D., & Frydenberg, M. (2021). Co-creating with TalkTech: Developing Attributes through International Digital Collaborative Projects. *2021 IEEE Global Engineering Education Conference (EDUCON)*, 1073–1077. https://doi.org/10.1109/EDUCON46332.2021.9454119

Bozan, I., & Taslidere, E. (2024). The Effect of Digital Game Design-Supported Coding Education on Gifted Students' Scratch Achievement and Self-Efficacy. *International Journal of Contemporary Educational Research*, *11*(1), 20–28. https://doi.org/10.52380/ijcer.2024.11.1.531

Csernoch, M., & Biró, P. (2019). *Are digital natives spreadsheet natives?* (arXiv:1909.00865). arXiv. https://doi.org/10.48550/arXiv.1909.00865

Downes, S. (2010). New Technology Supporting Informal Learning. *Journal of Emerging Technologies in Web Intelligence*, *2*(1). https://doi.org/10.4304/jetwi.2.1.27-33

Dziubaniuk, O., Ivanova-Gongne, M., & Nyholm, M. (2023). Learning and teaching sustainable business in the digital era: A connectivism theory approach. *International Journal of Educational Technology in Higher Education*, *20*(1), 20. https://doi.org/10.1186/s41239-023-00390-w

Groner, D. (2023). *Python for Data Analytics: A Business Oriented Approach*. Prospect Press. https://www.prospectpressvt.com/textbooks/groner-python

Kivunja, C. (2014). Do You Want Your Students to Be Job-Ready with 21st Century Skills? Change Pedagogies: A Pedagogical Paradigm Shift from Vygotskyian Social Constructivism to Critical Thinking, Problem Solving and Siemens' Digital Connectivism. *International Journal of Higher Education*, *3*(3), 81–91. http://dx.doi.org/10.5430/ijhe.v3n3p81

Liu, C., & Pang, S. (2025). *Empty Vessels Make the Most Noise: Analyst Self-Promotion Behavior and Market Outcomes* (SSRN Scholarly Paper 5292117). Social Science Research Network. https://doi.org/10.2139/ssrn.5292117

Loria, S. (2018). *TextBlob: Simplified Text Processing—TextBlob 0.19.0 documentation*. https://textblob.readthedocs.io/en/dev/

Lovászová, G., & Hvorecký, J. (2004). On Programming and Spreadsheet Calculations. *Spreadsheets in Education*, *1*(1). https://sie.scholasticahq.com/article/4510-on-programming-and-spreadsheet-calculations, https://sie.scholasticahq.com/article/4510-on-programming-and-spreadsheet-calculations

Matthee, M., & van Deventer, P. (2022). Preparing IS Programming Students for Work by Enhancing a Connectivist Teaching Approach by Scaffolding Practices. *Proceedings of the 2022 AIS SIGED International Conference on Information Systems Education and Research*. https://aisel.aisnet.org/siged2022/11

Parsons, J. (2023). Coding with Python. In *New Perspectives Concepts 2021 and Microsoft Office 2021* (21st ed.). Cengage.

Robins, A., Rountree, J., & Rountree, N. (2003). Learning and Teaching Programming: A Review and Discussion. *Computer Science Education*, *13*(2), 137–172. https://doi.org/10.1076/csed.13.2.137.14200

Sarkar, A., Borghouts, J. W., Iyer, A., Khullar, S., Canton, C., Hermans, F., Gordon, A. D., & Williams, J. (2020). Spreadsheet Use and Programming Experience: An Exploratory Survey. *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–9. https://doi.org/10.1145/3334480.3382807

Siemens, G. (2005). Connectivism: A Learning Theory for the Digital Age. *International Journal of Instructional Technology and Distance Learning*, *2*(1), 3–10.

Siemens, G. (2014). *Connectivism: A Learning Theory for the Digital Age*. http://er.dut.ac.za/handle/123456789/69

Siemens, G., & Downes, S. (2011). *Connectivism and Connective Knowledge 2011*. https://cck11.mooc.ca/

APPENDIX A

Survey Questions

Demographics
- Your age
- Gender
- Have you decided what you might major in? If so, what?
- Which section of CS 100 are you in?
- Prior to learning Python in CS 100, what was your coding experience?

Learning and Understanding*
- The Python programming concepts introduced were easy to understand
- Applying my Excel knowledge to Python concepts made it easier when learning to code in Python
- Learning to code in Python helped me understand fundamental programming principles
- Python is a useful language for data manipulation and visualization
- Using Google Colab environment made it easy to code in Python

Student Engagement*
- I found the activities we completed using Python to be engaging
- I found the activities we completed using Python to be fun
- I found the activities we completed using Python to be challenging
- Using AI tools to generate Python code was new to me
- Working on Python problems improved my problem-solving skills

Value of Learning Python*
- Knowing some coding will be a valuable skill in my career
- Having some coding skills are valuable in today's job market
- I can see practical applications for Python beyond this course
- I would recommend that other sections of CS 100 incorporate learning Python as we did

Future Interest*
- After completing the Python programming activities in CS 100, I am interested in learning more about Python on my own
- After completing the Python programming activities in CS 100, I am interested in taking a Python course in college

Open-Ended Feedback
- Other comments about your experience learning Python in CS 100?

***Likert Scale (1 = Strongly Disagree, 5 = Strongly Agree)**

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APPENDIX B.

Lessons and Activities

Lesson 1: Calculations and Data Types

Coding Together

- Write a program to calculate and print the sum and product of two numbers that the user enters.
- You're planning a pizza party for a group of friends and want to ensure everyone gets their fair share of pizza. Create a program that calculates the number of pizzas needed based on the number of people and their typical pizza consumption. Assume 8 slices per pizza. Then enter the cost of a pizza to calculate the total cost of the pizza order. import math and use math.ceil() to round up!
- You're going on a road trip and want to figure out the cost of travel based on user inputs. Write a program to ask the user for the total distance of the trip in miles, the average miles per gallon (MPG) of the vehicle you're driving, the expected price of gasoline per gallon, and the expected average speed of the trip in miles per hour (MPH). Your program should calculate the total amount of fuel needed for the trip, the total cost of fuel, and the estimated travel time. Finally, it should output the total cost of the road trip.

Challenges

- Write a program that takes three numbers as input from the user, calculates their average, and prints the result.
- Write a program to ask the user to enter their name and their height in inches. Print their name followed by their height in feet and inches. Hint: use the // operator for integer division and the % operator for remainder.
- You want to paint four walls in a rectangular room (don't worry about doors and windows!) Assume a gallon of paint covers 350 square feet, and a painter can paint 150 square feet in an hour. Ask the user to enter the length, height, and width of the room in feet. Also enter the painter's hourly rate, and the cost per gallon of paint. Calculate the number of gallons you'll need, the total square feet needed for coverage, the cost of paint, the cost of labor, and the total cost to paint the room.
  Run your program for a 9 x 12 room with 8-foot ceilings, and a painter who makes $50/hour. Paint costs $25/gallon.

Lesson 2. If Statements and For Loops

Coding Together

- Enter an employee's name and the number of hours worked. Assume an hourly rate of $15, with time and a half for all hours over 40.
- A store sells a case of 6 books at a time. Each book costs $10. Write a program to calculate the cost of 6, 12, ..., 48 books.
- A user enters their t-shirt size (S/M/L) and the program converts that size to words (small, medium, large).
- Write a program to simulate flipping 100 coins, count the number of heads and tails. Use these statements to generate random numbers.

```
import random
number = random.randint(0,1) # 0 for heads, 1 for tails
```

Challenges

- A user enters an integer, the program determines whether the number is odd or even. Hint: If number % 2 is 0, the number is even. Otherwise it's odd.
- Print a table of Fahrenheit to Celsius temperature conversions for C values between 0 and 100 in multiples of 10 (0, 10, 20, ... 100). Use the formula F = (C * 9/5) + 32 to convert from C to F.

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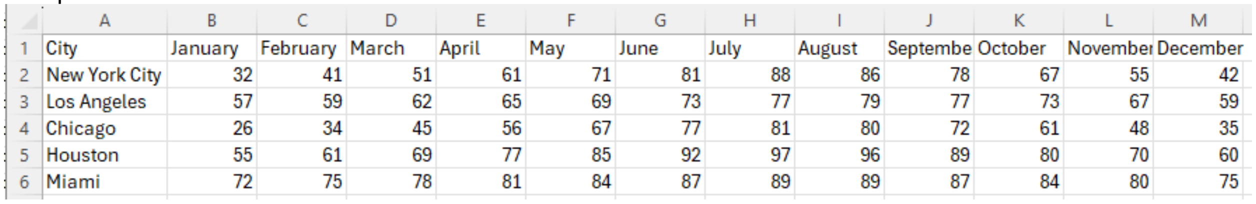
- Write a program of your own choosing that shows your understanding of several concepts from today's lesson. Be sure to include a comment at the top of your program that describes what your program is trying to compute.

Lesson 3. Charts, Graphs, and Coding with AI

Coding Together
Add the file temps.csv to your Colab Notebook in the Files area.

Temps.csv



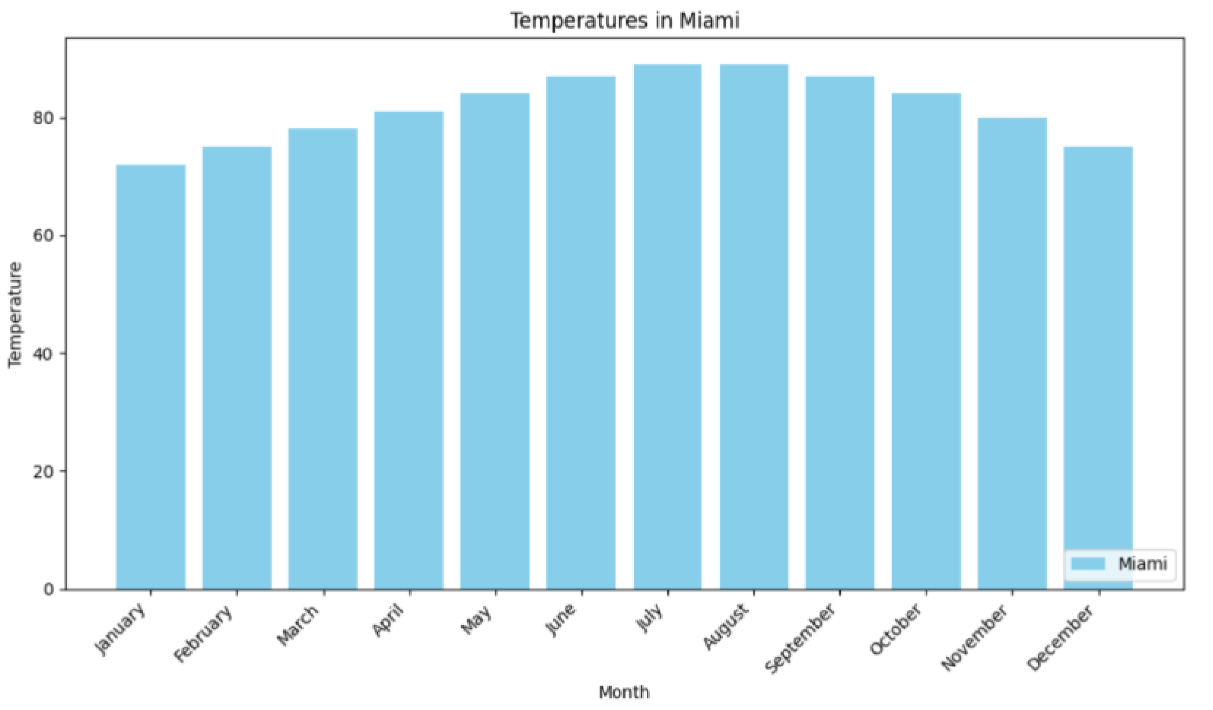
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	City	January	February	March	April	May	June	July	August	Septembe	October	November	December
2	New York City	32	41	51	61	71	81	88	86	78	67	55	42
3	Los Angeles	57	59	62	65	69	73	77	79	77	73	67	59
4	Chicago	26	34	45	56	67	77	81	80	72	61	48	35
5	Houston	55	61	69	77	85	92	97	96	89	80	70	60
6	Miami	72	75	78	81	84	87	89	89	87	84	80	75

```
City,January,February,March,April,May,June,July,August,September,October,November,December
New York City,32,41,51,61,71,81,88,86,78,67,55,42
Los Angeles,57,59,62,65,69,73,77,79,77,73,67,59
Chicago,26,34,45,56,67,77,81,80,72,61,48,35
Houston,55,61,69,77,85,92,97,96,89,80,70,60
Miami,72,75,78,81,84,87,89,89,87,84,80,75
```

In Colab, create a code block, click "generate" to use AI, and enter this prompt:

Using temps.csv, write code to generate a bar chart showing temps from Miami for each month. use the month names as x axis labels, place a legend in lower right

You should see a chart that looks like this when you run the Python code:



Now, create a new text block and this time use the prompt:

Using temps.csv generate a bar chart showing average temperature for each city make each bar a different color

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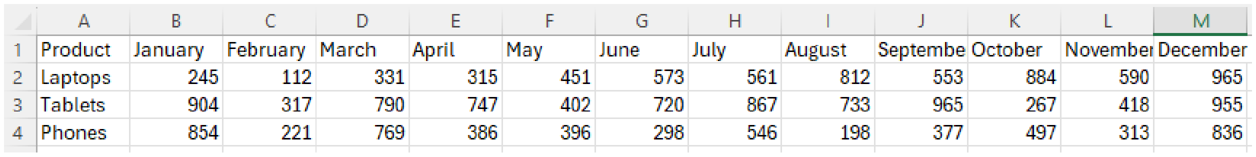
Run the code. If you get an error, it may be because Colab is assuming what the data looks like. In fact there is no "AvgTemperature" column in the data. Try to refine the prompt to give Colab more information about the data:

Challenges
Download the data file: sales.csv



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Product	January	February	March	April	May	June	July	August	Septembe	October	November	December
2	Laptops	245	112	331	315	451	573	561	812	553	884	590	965
3	Tablets	904	317	790	747	402	720	867	733	965	267	418	955
4	Phones	854	221	769	386	396	298	546	198	377	497	313	836

```
Product,January,February,March,April,May,June,July,August,September,October,November,December
Laptops,245,112,331,315,451,573,561,812,553,884,590,965
Tablets,904,317,790,747,402,720,867,733,965,267,418,955
Phones,854,221,769,386,396,298,546,198,377,497,313,836
```

Your challenge is to ask Colab (or ChatGPT, Gemini, CoPilot, or another tool) to create four charts that you design, that show many different features of charts that you learned about in Excel. Try making pie charts, bar charts, horizontal bar charts, or line charts. Use what you know about Charts in Excel to make your prompts as detailed as possible.

If the code that Colab generates doesn't work (as sometimes happened for me), you'll see some Python code with error messages. When that happens, try another tool. Upload the data file, and re-enter your prompt. If that tool doesn't run the code, copy and paste it back into a code block in Google Colab and run it there. See if the results are any better. You may need to edit the line of code df = pd.read_csv('temps.csv') to use the name of your data file if that line shows a different file name other than the one you are using.

Ask Colab, CoPilot, Gemini, or ChatGPT to generate code to display this data as a line chart, pie chart or bar chart. If the chart does not appear when you run the code in Colab, you may need to add a line such as chart.show() at the bottom of the code to instruct Python to display the chart.

How specific do your prompts have to be to get the charts you desire? Some AI tools work better than others with this data when generating code, so if you get error messages with one tool, try using a different one. What problems do you encounter?