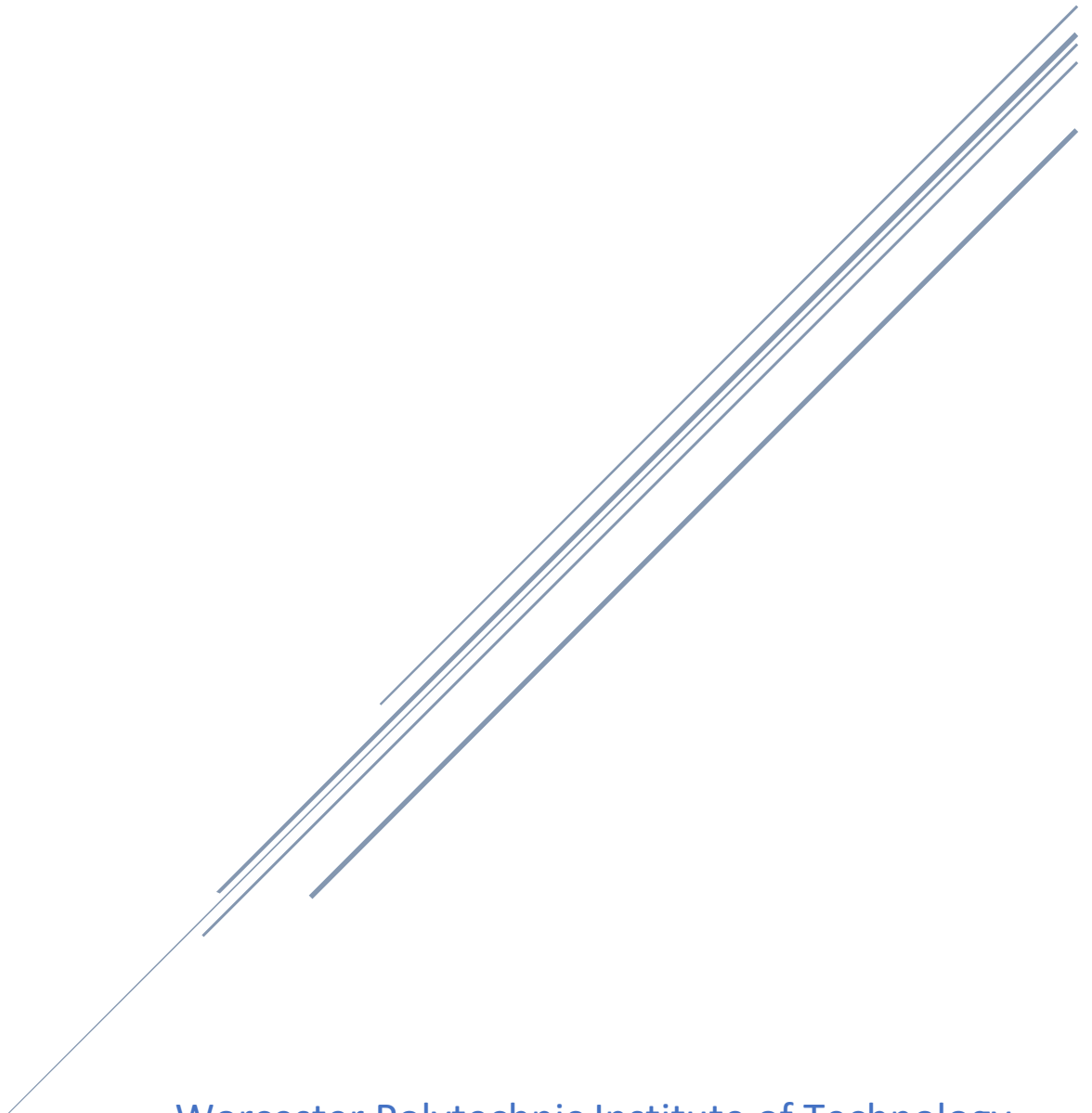


# INTEGRATING ARTIFICIAL INTELLIGENCE TECHNOLOGY INTO COMPUTER SCIENCE COURSES

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Worcester Polytechnic Institute of Technology  
Interactive Qualifying Project

## Integrating Artificial Intelligence Technology into Computer Science Courses

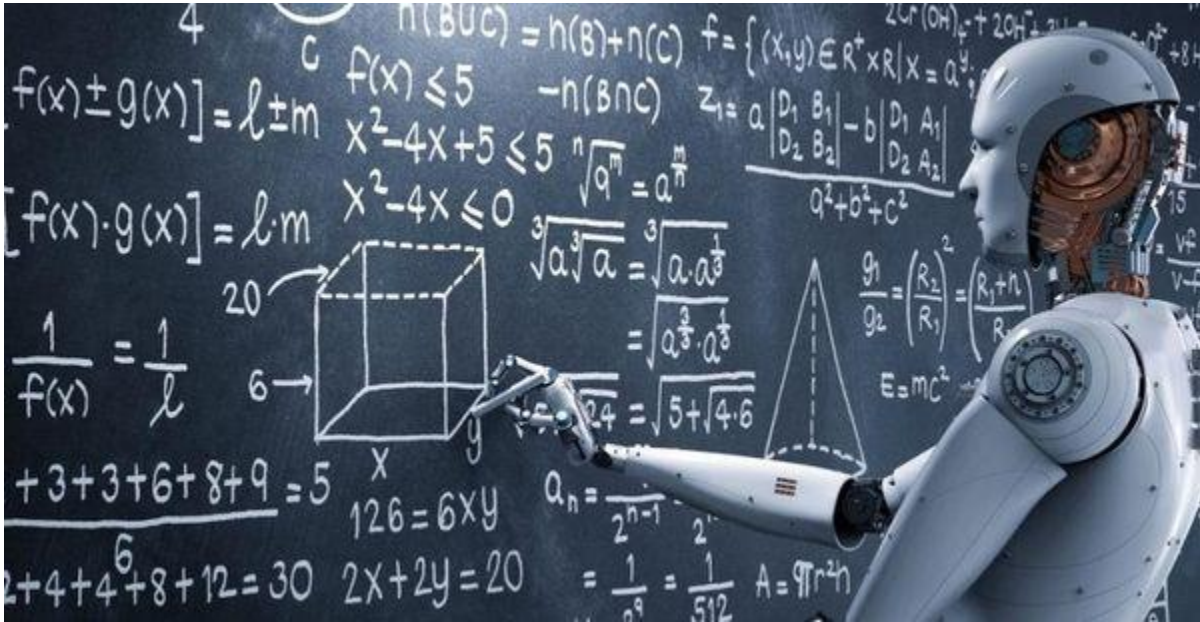


Image obtained from “5 ways AI is Changing the Education Industry” (Johnson, 2021).

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This report represents the work of one or more WPI undergraduate students submitted to the faculty as evidence of completion of a degree requirement. WPI routinely publishes these reports on the web without editorial or peer review.

## **Abstract**

New chatbot technology has the potential to significantly impact various aspects of society, particularly education, prompting our study of its educational benefits. We aim to develop an introductory programming class dedicated to educating and harnessing this technology for constructive purposes. To acquire insights into this emerging topic, we sought the perspectives of the Zurich University of Applied Sciences community, given the limited research available on this subject. Concerns within the community revolve around false information and its impact on learning outcomes when using chatbots. We addressed this by emphasizing that chatbots are not infallible but rather sophisticated search engines that can help mitigate the spread of inaccurate information. Leveraging chatbots as educational tools to empower learning and ensure comprehensive topic understanding, akin to personal teaching assistants, represents an effective use of this technology within an academic environment. By implementing chatbot technology to support educational endeavors, we harness its potential while reducing the risks associated with its uninformed use. This project aligns with academic needs by addressing concerns surrounding chatbots, offering guidance on their responsible use, and promoting their positive role in education within the computer science field.

## **Executive Summary**

Our project endeavors to integrate artificial intelligence (AI) chatbot technology, with a focus on ChatGPT, into an introductory Python computer science (CS) class. This initiative stems from the understanding that AI tools will inevitably find their way into education, and our mission is to ensure their integration enables positive student learning experiences. The goal is supported by three primary objectives.

### **Methodology**

Our first objective was to gain an understanding of the CS classes at Zurich University of Applied Sciences (ZHAW). We began with a thorough examination of the existing computer science courses at ZHAW. Discussions with sponsors, teachers, and a careful analysis of the current introductory programming curriculum provided essential insights into the structure and content of these courses, forming a critical foundation for the integration of chatbots.

Our next objective was researching the effects and opinions on chatbot technologies within education. To collect this information, we conducted surveys and interviews within the ZHAW community. These efforts allowed us to comprehend the diverse perspectives on chatbots which influenced our strategy for effective integration into CS classes.

Our final objective was to synthesize the information gathered in the first two steps to build a functional class syllabus and outline. The goal of our syllabus was to mitigate the drawbacks and highlight the positive views and benefits identified through our research.

Activities and lessons were designed with those views in mind to optimally leverage AI technologies in an educational context.

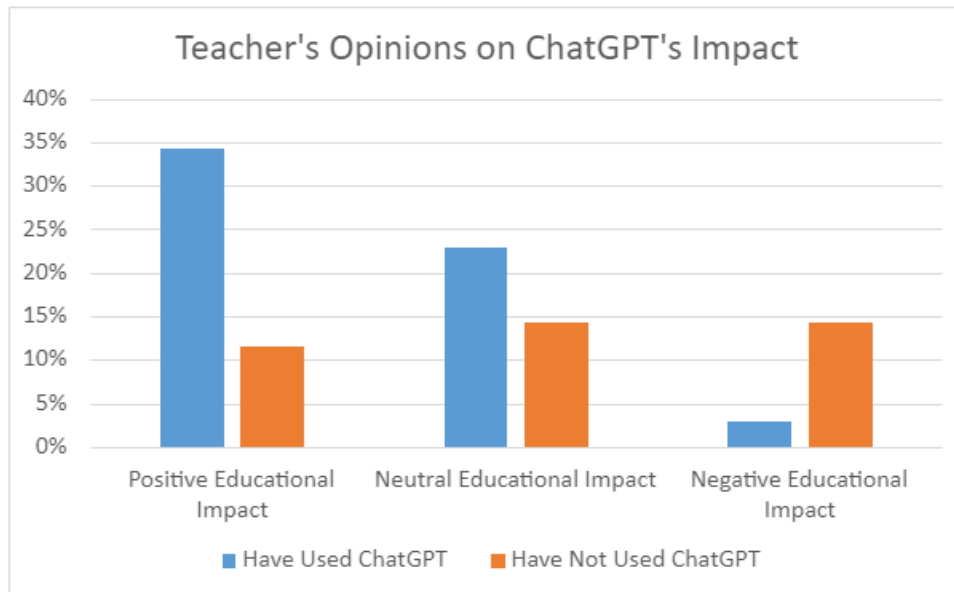
## **Results & Analysis**

### *State of Current CS Classes*

To meet our first objective, we collaborated with ZHAW instructors and students in order to gain insights into existing class structures. Participating in classes allowed us to observe the various teaching approaches present at ZHAW, encouraging us to formulate an original syllabus. We witnessed in-class assignments, which aimed to improve creative thinking and coding skills whilst the teacher offered in-class guidance. These in turn helped inspire our own assignments that we used for the class outline. By sitting in on classes we noted the need for more interactive elements in the curriculum.

### *Opinions on ChatGPT*

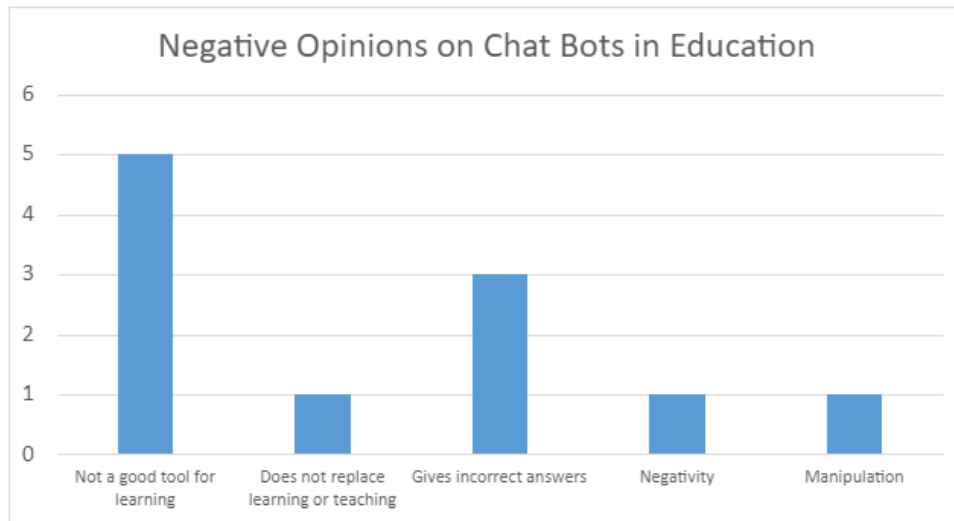
To better understand perspectives on ChatGPT and accomplish our second objective, we conducted surveys and analyzed responses. Many of the respondents expressed positive views or recognized the potential of ChatGPT. Others had some doubts and concerns about the tool, many of these respondents were confused about ChatGPT and its use. There was a trend, shown in the figure below, that teachers with experience using this technology perceived it as a beneficial tool more often, showing that this technology should be taught so more people can understand it and its uses. These insights influenced our approach in crafting a beneficial integration of ChatGPT in education.



**Figure E1 ChatGPT Source Opinions:** This chart shows the percentage of the 35 teachers’ viewpoints on ChatGPT’s effect in the educational system in comparison to having experience using ChatGPT.

### *Negative Viewpoints*

Survey participants expressed varied negative viewpoints regarding ChatGPT. Figure E2 shows the general opinions given in the responses of the surveys. We primarily focused on the “Not a good tool for learning” and “Gives incorrect answers” issues since they were the largest category of concerns. We do not want to replace learning or teaching with chatbots, and the manipulation viewpoint seemed to be talking about media rather than chatbots, so these viewpoints were not relevant for our study.

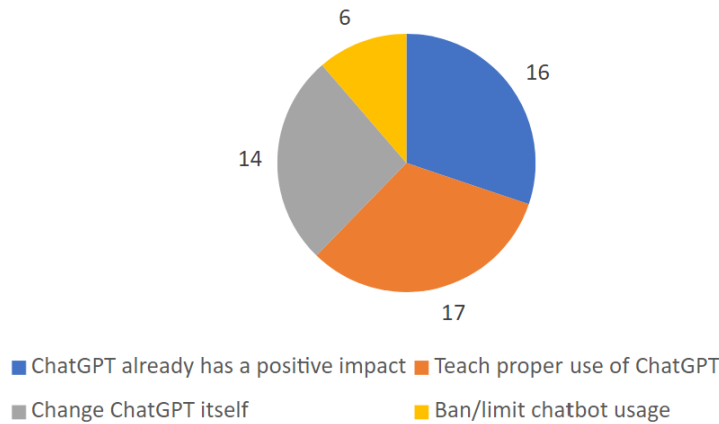


**Figure E2 Negative Opinions on Chatbots in Education:** This is a summary of the 11 negative responses we got in response to question 4 in Appendix A.

### *Integrating ChatGPT into Curriculum*

Respondents were asked what potential changes could be made for them to view ChatGPT positively. Many of these viewpoints were centered on teaching students how to use the tool productively. This resonates with our approach of instructing students on effective ChatGPT usage, preventing reliance and promoting active learning. Additionally, suggestions for changes to ChatGPT itself, like source citation and improved accuracy, were noted. We found that Bing Chat cites sources making it a possible alternative to ChatGPT for those concerned about source material.

What would make you see ChatGPT as having a positive impact on education or industry?



**Figure E3 What would make you see ChatGPT or other chatbots as a positive impact on education:** This is a summary of the answers from all respondents given to question 6 above from the survey in appendix A

### *Teaching How to Effectively Use ChatGPT*

Teaching students how to effectively prompt ChatGPT is a pivotal aspect in integrating this AI tool into educational settings. Our surveys and interviews highlighted a consensus that, while ChatGPT offers significant potential for productivity in classrooms, teacher guidance and instruction remain necessary. There were two primary reasons found within the surveys for emphasizing proper education on the use of ChatGPT. The first was to ensure that students do not rely on the tool to produce answers but engage with it to enhance their understanding, learning process, and professional communication skills. The second was to equip students with the skills required to utilize chatbots for more complicated tasks which in turn prepares them for the world beyond academia.



Addressing these concerns is at the core of our project's goals, aiming to prevent plagiarism and promoting learning. Teaching students how to construct prompts for ChatGPT is key in achieving this, enabling them to solicit the necessary information without receiving incorrect or misleading responses.

ZHAW professor Daniel Bajka's approach of treating ChatGPT like a teaching assistant underscores the effectiveness of having students write specific, clear prompts. This interaction allows for a deeper exploration of topics as students engage in a conversation-like exchange with the chatbot. The ability to ask personalized follow-up questions enhances comprehension and helps avoid students presenting ChatGPT's answers as their own.

In the CS curriculum, interactive elements during class time often do not convey information effectively. This leads to a heavy reliance on lecture-based teaching, causing students to finish learning the topics outside of class through homework assignments and projects. ChatGPT, used productively, introduces an interactive component that can significantly strengthen overall student comprehension both inside and outside the classroom.

An essential aspect of teaching effective prompting is imparting the skill to discern the accuracy of information provided by ChatGPT. To promote this, we created activities in our course which presented students with erroneous or misleading information generated by ChatGPT, challenging them to identify and correct mistakes. This hands-on approach is integral to teaching students how to use ChatGPT productively and critically.

### ***Limitations to our data***

We accept the inherent limitations and challenges associated with granting students the ability to use chatbots for assignments. Students who heavily rely on chatbots can be less likely to retain information long term. While chatbots can offer swift assistance in completing tasks, it may inadvertently hinder the development of crucial cognitive skills and deeper understanding of the subject matter. The balance between leveraging AI tools for support and ensuring genuine comprehension is a critical aspect that we have addressed in our curriculum design.

### **Conclusion**

Our group determined that the most effective approach to incorporating the use of chatbots in CS courses involved utilizing them as comprehensive studying tools and teaching assistant. We created a syllabus that includes a timeline of the topics that will be taught and several different assignments for the students to aid learning. We designed the syllabus assuming a 14-week semester with two classes a week. It can also be used as a template as we understand that teachers may prefer different teaching styles or class setups. The amount of information that will be taught during the class can be adjusted depending on the desired schedule. Our recommendations are meant to ensure that students learn the necessary programming skills while learning how to use chatbots to improve their learning process and have an advantage when going into the work force.

## **Recommendations – Next Steps**

### ***ChatGPT weekly assignment***

In our syllabus we included a weekly homework assignment found in Appendix C. This homework assignment teaches students how ChatGPT can be used in a beneficial way as a studying tool by having them enter a dialogue with the chatbot. This includes the students asking it multiple questions about relevant subjects, then asking it to create a study guide for them.

### ***Use of ChatGPT during Quizzes and Exams***

We recommend a locked down browser during exams and significant quizzes to prevent students using chatbots or other online resources. However, since chatbots are an integral part of the course, we decided that using ChatGPT should be an option. This choice may entail stricter grading due to the wider range of accessible information, ensuring a fair grading process for everyone. Students who chose this option will have to submit any conversations they had with the chatbot during the assessment.

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## **Authorship**

Miles, Luis, Matthew, and Joseph all made equal contributions to composing the Findings and Results, Methodology, as well as the additions to the Introduction and Background sections of the paper. Joseph dedicated a significant effort to revising and editing the essential components of the final paper, including the methodology, introduction, background, and findings. He also took charge of drafting, proofreading, and reviewing the entire executive summary. Matthew provided valuable and thorough proofreading for each section of the paper and appendix, wrote the abstract, and wrote the AI homework script seen in Appendix C. He also formatted the entire paper, creating the table of contents, cover page, page numbers and ensuring sections had the correct heading and style. Miles and Luis primarily engaged in reviewing and providing feedback on all sections, in addition to collaborating on the conclusion and recommendation section. In addition, they primarily helped with the writing of the syllabus, class schedule, and some example assignments seen in appendix D. Joseph came up with the solution to integrate ChatGPT in a final project and developed the web scrapping assignment seen in appendix E. All of us actively participated in refining, organizing, and structuring of the final paper. The entire group read over every single section at least once to ensure accuracy and quality.

This work is original to the project authors and study participants and was not generated or assisted using ChatGPT or any other AI tools.



## Meet the Team

Matthew Crane (WPI):



Hello, my name is Matthew Crane. I am from Groton Massachusetts and came to WPI to pursue a double major in Astronautical Aerospace Engineering and Computer Science. This project interested me due

to my interest in artificial intelligence technology and its application in the world. I enjoyed this project since it explored both the positives and negatives of implementing this new technology into the world, while trying to create the best possible outcome. I believe that this project is pivotal in the world and could be built upon for other implementations of artificial intelligence technology throughout education. Switzerland was an amazing country to visit and allowed me to visit many other countries as well as enjoy the natural beauty that you can find in the Swiss mountains and cities.

Luis Garcia (WPI):



Hello, my name is Luis Garcia. I'm originally from Caracas, Venezuela and then moved to Santo Domingo, Dominican Republic in 2017. I'm currently a junior studying Computer Science and Robotics Engineering. I have enjoyed working on this experience a lot. Being able to research and work on

artificial intelligence has been a great opportunity. I loved living in this city, and it has given me so many experiences and memories that I didn't think I would be able to experience and that I'll forever cherish. I'm so grateful to have learned so much about the cultures and people's thoughts about our topic.

Joeseph Thesmar (WPI):



My name is Joseph Thesmar, and I am from Versailles France. As of now, I am a junior and currently majoring in Computer Science. The chance to live and work abroad, fully immersed in Swiss German culture, was undeniably enlightening. Moreover, delving into an emerging and controversial topic during this project was profoundly thought-provoking.

Miles Williams (WPI):



Hi, I'm Miles Williams. I'm a Biology/Biotech and Bioinformatics double major from Framingham Massachusetts. Participating in an IQP in Zurich Switzerland has been a great experience, I've particularly enjoyed experiencing all the different cultures that make up Switzerland. I'm glad I got to work on such an interesting and relevant project as this one, since AI is something that has a large effect on our current education. Overall, I've thoroughly enjoyed working on this project and I'll treasure the experiences and memories I've gained while here.



Our team with one of our sponsors, Dr. Vorburger.

## **Acknowledgements**

- ◆ Dr. Martin Schüle - Zurich University of Applied Sciences (ZHAW)
- ◆ Dr. Robert Vorburger - Zurich University of Applied Sciences (ZHAW)
- ◆ Professor Christian Glahn - Zurich University of Applied Sciences (ZHAW)
- ◆ Professor Daniel Bajka - Zurich University of Applied Sciences (ZHAW)
- ◆ Dr. Beatrice Kulli Honauer - ZHAW School of Life Sciences and Facility Management
- ◆ Dr. Evelyn Wolfram - ZHAW School of Life Sciences and Facility Management
- ◆ Eric Gericke - Zurich University of Applied Sciences (ZHAW)
- ◆ Stefanie Schürch - ZHAW School of Life Sciences and Facility Management
- ◆ Our Advisors Uma Kumar and Leonard Polizzotto
- ◆ Professor Nancy A. Burnham - WPI's Switzerland Project Center Director

## Chapter 1: Introduction

Since the release of ChatGPT there have been many questions about its effect on our educational system. Some professors believe that ChatGPT has a negative impact on academia, while others view it as a beneficial tool. A common negative perspective regarding ChatGPT is its potential to significantly facilitate academic dishonesty, allowing students to cheat or plagiarize while evading detection (Weissman, 2023). Nevertheless, our team and our esteemed sponsors at Zurich University of Applied Sciences (ZHAW) share the collective belief that ChatGPT holds the potential to be a pioneering tool for advancing the educational system. We are committed to the integration of ChatGPT into assignments and teaching methodologies, allowing students to utilize the chatbot as an innovative learning approach.

ChatGPT is a type of artificial intelligence (AI) known as a chatbot. This type of AI technology functions through a mechanism called large language processing, which allows for programs to process regular text or speech (Ina, 2022). These chatbots are trained on massive amounts of data which can be used to predict patterns and connections between words and phrases, enabling them to emulate human language and speech patterns. In essence, when you ask ChatGPT a question, it leverages its data to determine the statistically anticipated response, resembling a sophisticated iteration of the autofill feature on smartphones. Utilization of this technology can allow students to generate answers to their homework and assignment questions with almost no knowledge on how to use chatbots (Mallow, 2023). They don't merely echo the answer; rather, they provide detailed responses regarding the thought process and the underlying knowledge needed to provide the answer. This feature can greatly support studying and understanding unfamiliar concepts.

Our sponsors at ZHAW think the integration of ChatGPT in classroom settings can help students learn the fundamentals of coding in a more effective manner, enabling them to utilize extra allotted time for extra practice or to cover additional topics (M. Schüle, personal communication, April 14, 2023). For this project it was our goal to research and determine how ChatGPT can be used in this way while trying to alleviate the concerns of individuals against ChatGPT's use in the computer science (CS) field.

This proposal encompasses both a background chapter on ChatGPT and an analysis of introductory CS courses. The significance of evaluating these introductory courses stems from the necessity of this information for devising a functional syllabus for an introductory class integrating ChatGPT. We will also discuss why Python was chosen over different programming languages for this class, due to its simpler and more beginner friendly design. Following that is a methodology chapter that discusses the research methods we will use to reach our project goal and objectives. Next, our findings chapter covers the results of our research, by analyzing the responses to our surveys and interviews. Our conclusion and recommendations chapters discuss the syllabus we developed and the potential next steps of this project. Finally, we will discuss how our research aligns with sustainable development goal of quality education (United Nations, n.d.), and how our work can help further that objective.

## **Chapter 2: Background**

The field of education is constantly changing along with rapid technological advances. Chatbots are the newest form of technology that has had a significant affect the educational world. This chapter supplies background information on artificial intelligence (AI) technology, chatbots, Zurich University of Applied Sciences, and computer science courses.

### **2.1 - The Challenge of Using AI Technology in Computer Science Courses**

In 2020, the chatbot GPT-3 was released by developer OpenAI, this release caused a massive controversy across the field of computer science. Some teachers believe that chatbots can be used as a learning tool rather than an avenue for plagiarism (Abramson, 2023). For example, some teachers in the New York City department of education are teaching students to use critical thinking when using ChatGPT. They also emphasize that analyzing computer algorithms is as important as knowing how to program computers. Across the US, many educators are encouraging their students to question the excitement around rapidly evolving AI tools and consider the technologies' potential side effects. Many of these educators focus on understanding how their user activity is being used to train these tools (Singer, 2023).

AI offers an innovative way of teaching students computer science; it also equips students with the ability to become efficient at using modern technology as a learning tool. Chatbots like ChatGPT offer 24/7 access to automated support, personalized questions, recommendations, quick and accurate answers, and access to an extensive dataset, tools that professional programmers are already taking advantage of in the workplace. ChatGPT could help

students who are struggling academically by improving their access to information and finding new methods of learning. It can also reduce the stress put on students by creating a faster inlet for studying and realizing solutions to assignments (Mallow, 2023).

## **2.2 - Integrating AI Technology into Computer Science Courses Stakeholders**

Integrating AI technology into computer science courses has the potential to impact a wide range of stakeholders. For CS teachers, this could mean more effective classroom instruction due to having access to a tool that can provide immediate and accurate answers to student's simpler questions. ChatGPT can also provide more detailed and useful feedback on student papers in a fraction of the time it takes for a teacher to do it (Roose, 2023). This would help alleviate some of the burden of answering repetitive questions and allow teachers to focus on more complex issues and individual students. Instead of banning the tool schools could embrace it as a teaching aid, since it could improve students' creativity, offer personalized tutoring, and better prepare students to work alongside AI systems as adults (Roose, 2023).

For computer science students, the use of ChatGPT would offer a unique and engaging learning experience. ChatGPT can allow CS students to help in numerous ways, such as explaining coding concepts, generating code snippets, creating coding challenges, improving their understanding of specific concepts or algorithms, getting inspiration for their coding projects, and receiving feedback and suggestions from the chatbot. However, it is important to note that ChatGPT is not a substitute for hands-on practice and in-depth learning. Students should use ChatGPT as a supplement to their learning and always test and debug the code before using it in an assignment (Coin telegraph, 2023).



Universities with computer science programs can benefit from incorporating ChatGPT technology into their curriculum. It can improve their educational offerings, attracting more students and providing them with valuable skills needed for the workforce. ChatGPT can be used to help software development and computer science majors in several ways. Firstly, it can be used as a tool to write code for simple programs. Students and developers can also use it to write segments of an application to make their work more efficient. However, the code will still need to be reviewed by knowledgeable humans to identify and correct errors as ChatGPT is not perfect and can produce non-functional but good-looking code. Secondly, software developers can integrate ChatGPT into new coding projects they develop, making it easier for anyone to use apps using common language. Next, communities can also benefit from the integration of AI technology in computer science courses, as the development of these courses can foster innovation and create a more tech-savvy population, driving economic growth and promoting progress in various fields. By staying ahead of the curve and offering courses that incorporate modern technologies, universities can distinguish themselves from competitors.

### **2.3 - Sites and Sponsors**

The site where we will research and test our work is the Zurich University of Applied Sciences (ZHAW). We will work with the Institute of Computational Life Sciences from ZHAW to develop a course that uses AI technology to aid in classroom learning. Our sponsors are Doctor Robert Vorburger and Doctor Martin Schüle from ZHAW. Doctor Schüle is the head of research in the Cognitive Computing in Life Sciences Team, with a focus area in the digital environment. He is experienced in AI and has worked on many projects that focus on chatbots.

Doctor Vorburger is the department head of research in Team Digital Labs & Production. His specialty is databases and processing data and information about certain topics (Zurich University of Applied Sciences, n.d.). Both Doctors' fields will play a significant role in our project, both in developing and monitoring its success.

ZHAW's mission statement is to create a university that keeps up with current societal trends and professional practices (Zurich University of Applied Sciences, n.d.). After meeting our sponsors at ZHAW, it was clear that they have recognized an influx of ChatGPT usage and the educational controversies surrounding it. They have also noticed that ChatGPT is used in professional settings of software development (M. Schüle, personal communication, April 14, 2023). The professors have emphasized that the current computer science classes at ZHAW, that have a 1:1 ratio of lecture to hands on project learning, are not as effective as they should be. They hope that ChatGPT will be able to aid in the teaching of fundamental programming concepts which will reduce the time allotted to lectures, in favor of more application-based teaching.

## **2.4 - Artificial Intelligence Technology**

Artificial intelligence (AI) is the simulation of human intelligence processes by machines. It involves creating computer programs that can perform tasks that typically require human-like understanding, such as visual perception, speech recognition, decision-making, or language translation. For decades, artificial intelligence has played a pivotal role in a diverse range of fields, including military defense, financial security, capital market operations, asset insurance, advertising, and search engine functionality. What is called artificial intelligence nowadays has

had different names in the past, engineers often talked about similar tools and called them generalized linear models, generalized boosted models, or decision trees (Mims, 2023).

AI, especially newly founded controversial and popular chatbots that generate responses to any questions, has startled many educators, students, and professional programmers around the world (Markoff, 2011). Chatbots are computer programs designed to simulate conversation with human users over the internet or through other communication channels. They use natural language processing, a subcategory of AI that allows machines to understand plain language, and other artificial intelligence technologies to understand and respond to user inputs in a human-like manner (Robinson, 2018). In 2011, Stanford launched a free virtual course about AI, which attracted over 58,000 students around the globe. Dr. Sebastian Thrun, one of the leading AI experts in the world, believes “the vision is: change the world by bringing education to places that can’t be reached today” (Markoff, 2011). In 2011, the sudden emergence of AI caused a lot of questioning among students and Stanford professors. They were aware that this newfangled technology could potentially have a huge effect on education once it was fully implemented.

The history of chatbots began in 1966 with Joseph Weizenbaum’s creation of ELIZA, which used pattern matching and substitution methodology to simulate conversation to mimic human conversation. In the decades that followed, chatbot creators built upon Weizenbaum’s model to strive for more human-like interactions, with passing the Turing test, a common assessment to see if AI can exhibit human-like intelligence, as a common goal. Since then, many notable chatbots have risen, including PARRY, Jabberwacky, Dr. Sbaitso, ALICE, SmarterChild, and Siri. ChatGPT, a large language model trained by OpenAI, is the latest and most advanced chatbot that uses a deep learning algorithm to understand natural language and provide relevant responses (Ina, 2022).

The influential chatbot ChatGPT is an all-accessible AI website that can answer a wide variety of questions (Browne, 2023). The incorporation of OpenAI's ChatGPT into computer science classes has raised hope with its possibilities to improve the students' learning experiences and knowledge of the growing field of AI. In a recent study, students showed a diversity of opinions regarding the use of ChatGPT in education. Shekina and Kaden found ChatGPT to be a powerful and useful tool that can assist them in their assignments. Will, on the other hand, found that ChatGPT lacks the level of knowledge required to write a paper on a certain topic. Bozhidar suggested that ChatGPT could be used as an inspiration tool or to teach the proper essay structure to students. Henry and Tim believe that ChatGPT can rob students of their motivation to do their work and affect students who do not use AI as lessons will be based on what ChatGPT or another AI does (Network, 2023). There are both advantages and disadvantages to the use of ChatGPT in education, and schools should find ways to use it ethically and responsibly.

## **2.5 - Impacts of AI, Chatbots, and ChatGPT**

Over the last year a variety of large language model-based tools have become available and free for public use (McMurtrie, 2023). This has had a significant impact on many areas of computer science both professionally and academically, as many of these chatbots can write functional code when given precise prompts. While sources such as ChatGPT can produce errors when creating more complicated programs, they have a high success rate when writing the type of simple code that students might be asked to work on for homework or tests. Additionally, while prompts for more complicated programming can require some engineering, getting

ChatGPT to write code for the type of assignments typically used for introductory courses requires no knowledge about the system or prompt engineering (Tili, 2023). This has led to students worldwide in various classes using these AI coding tools to write their assignments for them (Abdullah, 2022). Students using AI to do their homework represents a problem to many teachers who see this as cheating as the students are not writing the code for their assignments themselves (McMurtrie, 2023). This is not a problem unique to computer science as many humanities teachers have expressed concerns over students writing papers using ChatGPT. However, due to the scope of this project we will be focusing only on its uses in programming.

Students cheating on their homework assignments is nothing new, but it represents a greater problem in programming classes. For these classes, the students are expected to learn many topics primarily through homework assignments. Additionally, research has found that interactive elements in computer science courses improve comprehension and confidence in the topic more than interactive elements improve comprehension in other subjects, such as math or English (Packard, 2020). Since homework is the most prevalent interactive element in lecture-based classes, students who are not participating actively in the homework assignments would have a significantly worse understanding of computer science than comparable students who do participate in the homework.

Outside of academic use, ChatGPT and similar tools have also seen significant usage for professional programming, where it is seen more as an assisted programming tool like Stack Overflow. Proponents of using AI professionally have cited improvements in productivity caused by the chatbot. Notably many programmers have also mentioned an increase in their understanding of their work while using ChatGPT (Skjuve, 2023). For example, when ChatGPT writes code it also adds an explanation for the distinct parts of the program it created. This can be

useful for someone who asks the AI for code because they did not fully understand how to code something themselves.

Despite their many uses, large language models like ChatGPT still have their limitations. For example, when generating more complex or unique programs it has a high chance of error (Skjuve, 2023). This is due to chatbots' nature, they function by predicting what words or phrases will come next based on millions of complex data points. So, if you ask it to code something that it does not have a reference for, it can generate something based on how it thinks the code should look, instead of how it should function (Loaiza, 2019). However, this does not pose a problem for this specific project, since the type of assignments introductory students will be working on are simple enough for ChatGPT to solve consistently as any chatbot will have many reference points for simple coding concepts and puzzles (Skjuve, 2023). Additionally, all AI models currently require internet access, which may be a problem for some students if their use becomes widely adopted. However, ChatGPT does not have access to the entire internet, instead it is fed a curated information database to help prevent misinformation. This may present a problem in the future if chatbots are introduced with full internet access which could provide students with incorrect information, but it is not currently a problem (Journal of International Affairs Editorial Board 2022).

The main reason ChatGPT represents a significant opportunity for improved learning and comprehension in CS classes is its capability as an interactive teaching tool. Because of its functions as a chatbot, these tools can instantly and seamlessly explain complicated programming topics to a user and show them how they might be implemented in code. As seen in Figure 1, when asked to code a simple game in Python, ChatGPT provided the requested code and an explanation for how each part of the code functions. This can benefit students, as when they ask

ChatGPT for help coding they receive the code they need, and that code explained to them. Additionally, students would be able to discuss their own code with the AI which could find errors or optimizations in the program. In this way, AI tools can fill the roles of both a code database and a code critique, both of which are often used in modern computer science courses. As such, AI chatbots can be used without plagiarism when the students are not simply copying and pasting answers written by the AI, instead they can use AI to help improve their understanding of programming topics and to help improve the code they have already written (Qadir, 2022).

Outside of homework, AI chatbots can also be used during classes as an interactive learning tool for class activities. This could be useful for providing explanations or visualization of more theoretical programming concepts that students have a tough time understanding. ChatGPT's use as an interactive medium cannot be overstated, as the AI generated nature of its responses allows it to interact with a student like how a teacher or teaching assistant might (Abdullah, 2022). The strength of AI chatbots such as ChatGPT for teaching is their ability to interact with the students on an individual level, and to explain and assist with confusing computer science topics that students are struggling with.

In this program, we start by importing the `random` module which allows us to generate a random choice for the computer's move. We then define a `play_game()` function that handles the game logic.

Within the `play_game()` function, we define a list of options ('rock', 'paper', 'scissors') and then use the `random.choice()` method to select a random move for the computer.

The player is then prompted to input their choice, which is converted to lowercase and checked to ensure it is a valid option.

Next, the program compares the player's choice to the computer's choice and determines the winner based on the game's rules.

Finally, the player is asked if they want to play again. If they do, the function calls itself recursively. If not, the function ends and the program exits.

I hope this helps!

**Figure 1 Example of an explanation ChatGPT provides when being asked to write a program:** When prompted to program rock paper scissors in Python, ChatGPT responded with a functional Python program along with the above explanation. Created by Miles Williams on April 10th, 2023, by asking ChatGPT the prompt “show me how to program rock paper scissors in Python?”.

## 2.6 - Case Studies

We reviewed three case studies to gain a better understanding of ChatGPT, the most well-known chatbot currently available, introductory programming classes, and programming languages. The first case study involves a session where several CS staff from different universities express their opinions on how and why Python is the best language for introductory CS classes. The second case study focuses more on the impacts of ChatGPT in coding practices



and software development. The last case study reviews how using Python as an introductory programming language affects the education system.

### ***2.6.1 Successful Approaches to Teaching Introductory Computer Science Courses with Python***

The paper, “Successful Approaches to Teaching Introductory Computer Science Courses with Python” (Ranum et al, 2006), explains how Python is the superior language when teaching introductory computer science (CS) classes, due to its simplicity and overall preference by CS students when they are just starting to learn to program. It shows how Python was more effective for the students and helped create a better transition to higher programming languages, such as C++ and Java.

The paper provides several cases where Python was the language used for the introductory CS class, and in some cases, that class was compared to another one where another programming language, such as Java, was being taught. However, it was found that “Python students can be doing interesting things sooner because of the less complex syntax of Python.” (Ranum, 2006, p. 397). It is explained how the main objective of these Python classes is to teach the students to basic problem-solving approaches, and, in some cases, instead of switching to higher level programming language, continue with Python in the next introductory classes, as the feedback from the first class with Python was met with nothing but positive reviews. (Ranum, 2006, p. 397).

## ***2.6.2 ChatGPT Prompt Patterns for Improving Code Quality, Refactoring, Requirements Elicitation, and Software Design***

“ChatGPT Prompt Patterns for Improving Code Quality, Refactoring, Requirements Elicitation, and Software Design” (White et al, 2023), describes many ways that AI can be used to develop code. The authors emphasize the importance of prompts, explaining how changing prompt patterns, rules and dictation could change the results you get from ChatGPT and GitHub Copilot. These prompt classifications and abilities can be seen below in Table 1.

**Table 1***Prompt classification patterns.*

<b>Requirements Elicitation</b>	Requirements Simulator Specification Disambiguation Change Request Simulation
<b>System Design and Simulation</b>	API Generator API Simulator Few-shot Example Generator Domain-Specific Language Creation Architectural Possibilities
<b>Code Quality</b>	Code Clustering Intermediate Abstraction Principled Code Hidden Assumptions
<b>Refactoring</b>	Pseudo-code Refactoring Data-guided Refactoring

*Note.* This table was taken from the article “ChatGPT Prompt Patterns for Improving Code Quality, Refactoring, Requirements Elicitation, and Software Design” (White et al, 2023, p. 2).

These results and findings on how prompt patterns and classifications can aid your coding process are essential to learning how ChatGPT can be used for educational purposes. The different forms of prompt patterns, rules, and classifications of both could be an essential part of the course learning objectives in teaching students to use chatbots effectively. Some assignments

could involve prompts for a specific algorithm or process that they want coded, and the students will need to decipher and effectively prompt ChatGPT for full marks.

### ***2.6.3 Impact of using Python as an Introductory Programming Language***

The article “Investigating the impact of adopting Python and C languages for introductory engineering programming courses” (Balreira et al, 2022) presents a study about students learning programming in CS classes in two different languages, Python and C++. It explains the complete process, including the time schedule showing the amount of time spent on lectures, labs, and discussions, as well as the number of presentations and slides and the time needed to watch all the lectures. The study's methodology is also shown, explaining the students' performance and feelings and opinions about each programming language. Finally, the article shows the results, proving how Python was the superior learning language for CS students.

The process used for both classes is fundamental when creating new CS classes. The amount of time spent on each class shows a great way to present it, while still engaging by introducing labs and discussions where students can focus on their work and get the help needed. The types of questions are also very essential, as they use both multiple choice and complex problems, making it less likely that students will use advance tools, such as ChatGPT, for cheating. At the end of the courses, results show how Python was the more favorable language, showing how students were more engaged and learned more with the problems and presentations presented in this class than in the C++ class.

## 2.7 - Summary

The literature review examines the impact of integrating AI technology, specifically ChatGPT, into computer science courses, highlighting its potential benefits for the many stakeholders: teachers, students, universities, and communities. The review also discusses the impacts of AI, chatbots, and ChatGPT on computer science, both academically and professionally. While these tools have the potential to improve learning outcomes, concerns about cheating have been raised, particularly in programming classes where homework is a crucial learning element. Developing and coming up with the right technique of using ChatGPT to teach while avoiding plagiarism will pose a great challenge. Nonetheless, integrating AI into computer science courses can foster innovation, drive economic growth, and promote progress in various fields.

## **Chapter 3: Methodology**

Our team's goal was to implement artificial intelligence (AI) technology, specifically chatbots like ChatGPT, into an introductory Python computer science (CS) class. For this project, we worked under the assumption that the use of AI tools in CS classes by students is inevitable, our aim is to control that use in a way that positively impacts student learning. We achieved our goal through three objectives:

- understanding the basic concept of computer science (CS) classes at Zurich University for Applied Sciences (ZHAW);
- researching how AI assisted programming affects coding both professionally and academically; and
- developing methods for how we would integrate AI into the Python introductory class.

As the goal of this project was to develop an introductory programming class using AI tools, our final product was a syllabus and a sample class outline.

### **3.1 - Gain an understanding of the basic CS classes that exist at ZHAW**

When we began work at the project center in Zurich Switzerland, we first assessed the current CS courses of our sponsor, Dr. Robert Vorburger, at ZHAW. As the Swiss school year started two weeks after our arrival, we took time to discuss the current curriculum for introductory programming courses with our sponsors, and other teachers. We contacted local professors specializing in computer science, using a list of classes provided by our sponsors.

Subsequently, we conducted interviews with each instructor, then asked permission to observe their respective introductory classes. Our interviews featured open-ended questions about their opinions on the current CS courses at ZHAW, and on AI tools, specifically ChatGPT, more information is provided in the interview guide in Appendix B. We conducted these interviews using a semi-structured approach, initially presenting our questions to the interviewees and then following up to delve deeper into the discussed topics (Cannell, 1981). Furthermore, the interviewees also posed their own follow-up questions to us, which we addressed and documented along with the other gathered information. We interviewed five professors this way. This feedback was useful for designing the class as teachers are one of our most important stakeholders, and we needed their cooperation and advice for this project to be successful.

After the interviews, we attended classes of the teachers that we interviewed. These sessions offered us valuable insights into the dynamics and structure of a typical class at ZHAW. We took notes about what the syllabi and class outlines contained, which proved crucial in developing a template for our deliverables. These notes encompassed the speed of the classes, general concepts taught, methods of testing and assessment, methods of teaching, and in-class interactive elements. This allowed us to align our approach with the typical structure of an introductory class at ZHAW, noting the differences from our experiences in introductory classes at Worcester Polytechnic Institute (WPI).

We employed coding for open-ended responses, a method that categorizes responses by color into positive, neutral, and negative sentiments (Saldana, 2023), then structured the data using graphs. Subsequently, we further categorized and condensed the information based on the main theme of their perspectives. For the multiple-choice responses, we applied statistical

analysis to identify trends within the data. Our team stored data collection and analysis securely in a Microsoft One Drive that only we could access.

During our data collection process, we prioritized participant anonymity if desired. While interviewing, we obtained verbal consent, as outlined in Appendix I, enabling us to quote or paraphrase them directly in the paper. In the surveys, we included sections for personal identification of the respondents, such as name, phone number, or email. Participants opting for interviews, or the gift card raffle could provide their preferred contact method and name, providing a way to reach back to them.

### **3.2 - Research assisted programming's effects and the opinions on the subject**

Our second objective was to understand students, teachers, and administrators' academic and professional opinions on AI and ChatGPT and to determine the social implications that these technologies present within the field of CS. We achieved this objective within the initial four weeks.

We conducted additional surveys, and both in-person and remote interviews to gather a diverse range of opinions about chatbots; survey questions can be found in Appendix A and interview guides can be found in Appendix B. We believe it is vital to gather insights from as many ZHAW individuals as possible regarding ChatGPT to tailor its implementation in an academic setting, considering its potential impact. Once again, we obtained permission to interview them and include their answers in this report, following the consent script in Appendix I.



We used purposive sampling for the interviews and surveys, which means we had a specific target population in mind that we wanted to respond (Frost, 2022). The desired populations included our stakeholders, both teachers and students in the CS field, along with some administrators that joined during project work. We chose to include these individuals because they are the ones most impacted by our project. We gained access to this population by asking our sponsors to use ZHAW's email database to send out our surveys. However, since we lacked access to ZHAW emails, our sponsors helped us by sending these surveys using the school's database to both students and teachers, ensuring broader outreach.

For the surveys we asked a few questions to get a general idea of the population's opinion on ChatGPT and how they use it, the questions are available in Appendix A. The survey was created using Microsoft Forms and responses were stored in excel spreadsheets in a folder that only our team - Matthew Crane, Miles Williams, Joseph Thesmar and Luis Garcia, have access to. We analyzed data to understand ChatGPT usage, gather opinions, and address concerns of those with negative views. Coding methods, detailed in 'An Introduction to Coding' (Saldana, 2023), were used to categorize opinions. This analysis informed our project solutions for a better AI-assisted learning approach.

Next, we conducted targeted interviews with individuals who responded that they were willing to participate in an interview. We used semi-structured interviewing for those interviews (Cannell, 1981). Everyone not interviewing the individual took notes, and each note document was put into a shared secure file that only our group can access. The goal for these interviews was to determine what individuals think of integrating AI tools into CS classes and if they had concerns or suggestions for us, the interview guide is available in Appendix B. We examined

interview data to ensure we didn't miss any perspectives or uses of ChatGPT, positive or negative, and incorporated these insights into our project.

### **3.3 - Methods and Solutions to Integrate AI in a Curriculum**

We utilized the gathered data to construct a functional syllabus, sample assignments, and outline of the class structure. To achieve this, we began formulating potential solutions by integrating the insights from Sections 3.1 and 3.2, which are further discussed in Chapter 4: Findings, to develop a comprehensive working solution.

From the findings in 3.1 we determined the basic structure of the syllabus and class outline. The data we gathered helped show what the most common topics and class structure was within the CS classes at ZHAW. This includes the types of assignments, teaching styles, assessments, topic progressions and speed of the class. We also gained helpful information regarding the most effective methods for student learning and what to anticipate for their approach to classes. This data was used to determine what CS topics our class syllabus would cover and outline a potential schedule for the class.

The data in 3.2 informed the use of AI technologies and ChatGPT in the deliverables. Based on our data analysis, we identified and incorporated numerous positive perspectives and benefits suggested by individuals and implemented many ways to highlight these benefits. We used neutral viewpoints to minimize the potential concerns they had with ChatGPT while emphasizing the potential benefits they suggested. With this knowledge, we edited the current syllabus and outline to meet the criteria that would satisfy both viewpoints. Lastly, we analyzed why people foster negative views on these innovative technologies, and if their worries could be

alleviated in an academic setting. We addressed these concerns in the syllabus and class outline to create a final product that would help individuals understand the correct use and potential benefits of these newly adopted technologies.

## Chapter 4 Findings

This chapter describes the results and data collected from our work towards creating a computer science (CS) course that implements artificial intelligence (AI) tools. This data was collected in multiple ways to ensure a diversity of information and viewpoints. Firstly, we distributed surveys to both teachers and students at Zurich University of Applied Science (ZHAW) to gather their insights and perspectives on chatbots and their applications in both professional and academic settings. We received fifty-five responses from students and teachers. In the surveys, we asked the respondents to participate in an interview to further discuss the topic, we conducted 5 interviews this way. Lastly, we attended multiple CS classes at ZHAW to gain a concrete understanding of the structure of their current classes. The end goal was to develop a syllabus that fits with the school's teaching dynamics. The importance of this data lies in assessing the viewpoint of both teachers and students on how ChatGPT might best be integrated into an academic environment to assist students' learning and comprehension.

### 4.1 State of current CS classes

Based on our project's objectives, we aim to develop an introductory class syllabus encompassing comprehensive coding materials utilizing ChatGPT suitable for beginners. This initiative's main objective is to foster collaboration between students, teachers, and ChatGPT in learning. We will generate a comprehensive syllabus, comprising lectures' subjects, assignments, homework, and examinations, all organized within a structured timetable. So far, through insightful discussions with four professors and a student, we have gained a deeper understanding

of the existing class structures at ZHAW. We've observed a variety of teaching approaches, encompassing interactive formats and traditional lectures, with students encouraged to practice outside the classroom. It's apparent that each professor employs a unique teaching methodology. Consequently, we aim to formulate our own original syllabus, and draw inspiration from our mentors and various sources.

#### ***4.1.1 Syllabus***

We gathered insights from ZHAW higher education instructors and a student to understand their teaching methods. Professor Christian Glahn, who teaches Digitization and Data Science, provided details on his syllabus structure. In the first week, he focuses on class introduction and ice breakers to smoothly integrate students. He highlighted the Swiss school system's variability, and the choice students make between university preparation and practical skills for specific professions after lower secondary education. This diverse background of students entering university influences Glahn's approach to introduce them smoothly to tertiary education.

On the other hand, Professor Vorburger adopts a different approach, immediately diving into teaching with a structured curriculum, covering basics to advanced Python libraries throughout the semester. Both approaches aim for a continuous and effective flow of information.

Eric, a graduate student, emphasized the need for more interactive teaching methods at ZHAW, suggesting it enhances student engagement and information retention—a valuable consideration for shaping our own syllabus. In addition to these insights, Stefanie, another

student, expressed a positive view on utilizing ChatGPT for various purposes in her daily work, finding it helpful for email checking, improving writing, and structuring presentation topics.

Stefanie admires the academia potential, suggesting how people can use it for crafting thesis introductions and obtaining overviews on specific topics. However, she mentioned using ChatGPT for major tasks like writing an entire thesis is a risky possibility. Furthermore, our discussion leaned towards controlled integration of ChatGPT into classes. She believes that for functions such as debugging code and structuring academic content, as long as it remains non-disruptive and is not employed during exams, we should allow it.

Professor Daniel Bajak, who teaches data science at ZHAW, emphasized the importance of formulating questions, a critical aspect even in coding, encouraging understanding by questioning the 'why' and 'how'. Daniel highlighted that this interactive engagement with ChatGPT facilitates accelerated learning and better communication through meaningful dialogues, enabling the explanation of code and enhancing comprehension. Moreover, he highlighted the evolving capabilities of GPT models with larger datasets and advocated for teaching students “powerful tools like this now and accelerate society as a whole”.

Beatrice, a teacher with 15 years of experience at ZHAW's Institute of Natural Resource Management teaching social science, shared her perspective on chatbots. She views chatbots as a promising tool that people can utilize, but she emphasized the importance of knowing how to use them effectively. Beatrice has observed instances where coworkers used chatbots for writing, resulting in overall poorer quality. While she hasn't used ChatGPT professionally, she plans to incorporate it into an exam format, having it generate an answer for students to analyze for mistakes. She's had students use chatbots for smaller tasks within projects and remains open to

her students using them for classes. Beatrice does caution that people tend to overestimate ChatGPT's capabilities and intelligence. However, she sees the potential for ChatGPT to enhance efficiency in work, provided individuals learn how to use it effectively.

#### ***4.1.2 HW assignments***

Homework assignments here in ZHAW encompass a wide range of original algorithms and real-life application examples. For instance, Professor Vorburger likes to initiate his semester with a foundational assignment, tasking students with creating a simple BMI calculator. This project involves allowing users to input their data via the command prompt and receive the results within the same interface. To properly integrate ChatGPT in the classroom we needed to improvise and come up with our own assignments which will require and improve critical creative thinking. For example, students could create an RMR calculator, a pace calculator, web scraping from a specific website and organize data, there are no limitations.

#### ***4.1.3 Sitting in on classes***

Classes at ZHAW for undergraduate and master students began in mid-September, aligning with the Swiss academic system's delayed start compared to the United States. During our time, we were part of sessions for two weeks, guided by two professors: Dr. Vorburger, one of the sponsors, and Professor Christian Glahn. The initial weeks involved administrative

activities and introductory icebreakers in the introduction to computer science classes. However, by the second week, we delved into the learning materials.

Professor Christian Glahn's course, "Daten und Informationen," emphasized data collection and the fundamental principles of data aggregation, transformation, and management. Professor Glahn produced an effort and conducted the class in English on the second week, allowing our participation. This language adaptation led the Swiss German students to seek clarification or express themselves in German if needed. Our team was pleasantly impressed by the students' communication in English. In Professor Glahn's class, interaction was at its peak. He adeptly engaged everyone in discussions, encouraging a dynamic learning environment. He would move around the classroom, offering comments, compliments, and critiques to each student individually. A unique hands-on activity involved distributing bags of Lego pieces to alternate students. Professor Glahn instructed the teams of pair students to categorize the diverse cube and rectangular Legos within five minutes and create a descriptive Lego inventory. In a classroom discussion, we actively participated in compiling a list of Lego characteristics, with Glahn demonstrating the correlations among various data attributes.

Professor Robert Vorburger's course, "Programmieren," centered on introducing students to programming. His strategy to progressively increase the workload in each class appeared seamless, offering timely objectives to propel students forward. Despite being taught in German, which posed a language barrier for us, Vorburger's approach of encouraging students to learn through tutorials, grapple with problems, and seek assistance seemed effective to us. The students displayed focus on their tasks, and the professor showed accessibility for questions by actively constantly providing support to the scholars.



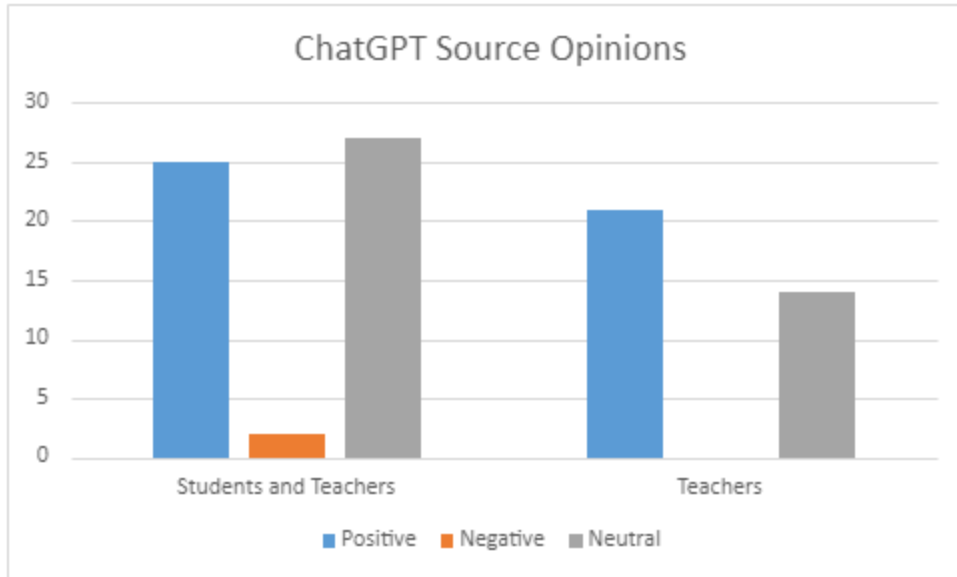
## **4.2 Opinions on ChatGPT**

We examined the general ideas and opinions on ChatGPT as a whole using our data collections. The responses, encompassing a broader range of ideas than our team's perspective, aided us in understanding the effectiveness of ChatGPT and understanding varying opinions on the topic. We then discussed and drew conclusions that guided us in the creation of a well-rounded syllabus and class outline.

### ***4.2.1 Statistics of opinions***

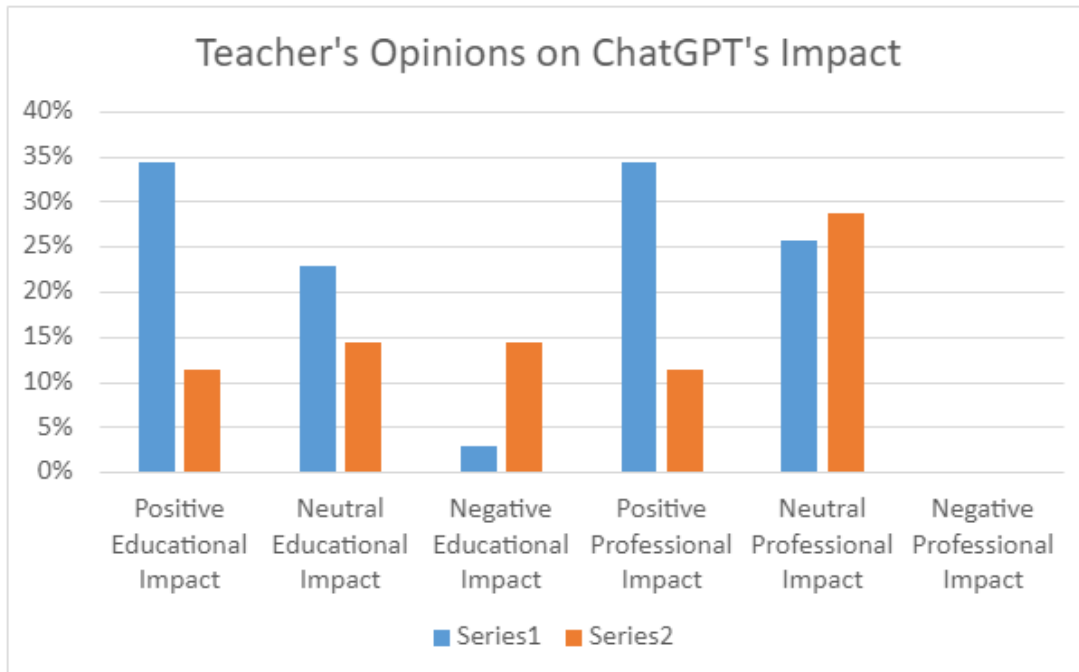
The general results of the survey showed that most respondents carried positive views on the topic or saw positive potential in ChatGPT. After reviewing the 'Neutral' responses, we noted that these participants were not impartial or indecisive. Instead, they identified both positive and negative aspects of the topic. The disparity between public opinion and perspectives presented by the sources they relied upon is intriguing. As shown in Figure 1, "General Opinion of Chat Bot Sources," we observe that the sources people were exposed to were primarily positive or neutral. Therefore, we need to exercise caution regarding the rising trend of negative views.

Our group received student responses. However as there were only nine responses that were from students, we could not justify using that small response population to generalize a full student body. For that reason, we did not analyze the student data, instead we analyzed the total data and teacher data.



**Figure 2 ChatGPT Source Opinions:** This is a bar chart of all the responses in our survey questions found in Appendix A question 4 as well as if said they were teaching at ZHAW in question 1.

Figure 2 shows that the sources accessed by both teachers had similar viewpoints and trends compared to the total population. This is a good thing as it shows there is little statistical bias in where the separate populations are getting their information on ChatGPT from. This alignment is positive because it indicates that these academic groups tend to perceive chatbot information similarly. However, when interpreting the information from these sources alongside their unique experiences, differences in deductions between the two groups become clear.



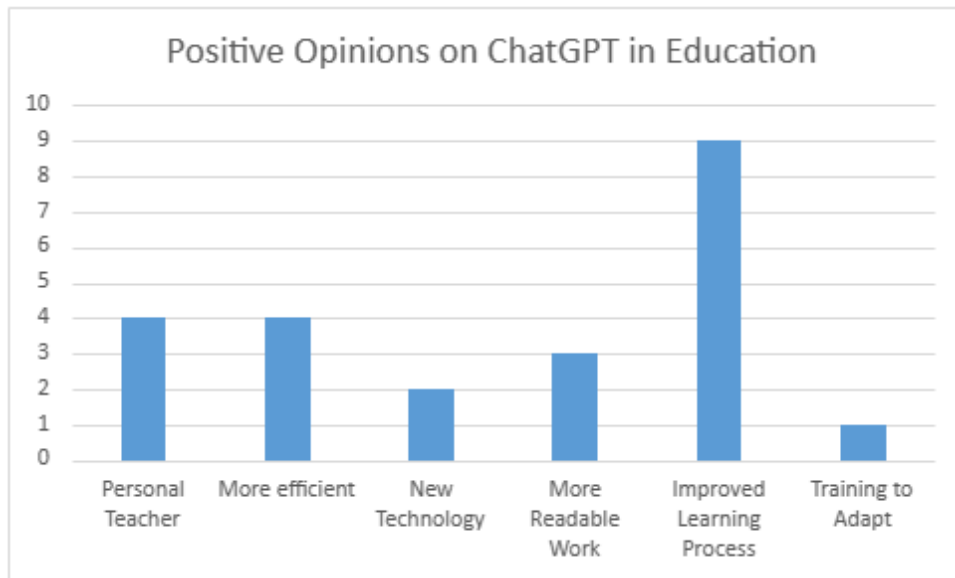
**Figure 3 Teacher's Opinions on ChatGPT's Impact:** This bar chart encompasses the opinions on ChatGPT's impact compared to if they've had previous experience with ChatGPT.

Figure 3 highlights that the impact of ChatGPT in the professional field is generally thought of as more positive than its impact in the academic field. Therefore, our group started to focus on the difference between the two areas, and why this disparity exists within the two settings. Learning was significant because it allowed us to take the best aspects of both fields and use them to create our class outline and syllabus that fully maximizes the utility of ChatGPT.

Teachers were shown to have a more neutral or negative viewpoint on chatbots impacting the education system. There could be distinct reasons for this, ranging from the fear of cheating and plagiarism to concerns about students not adequately understanding the information. This information will be further discussed and analyzed in section 4.1.4 Negative viewpoints, where we individually discuss each viewpoint and problem that survey respondents brought up about the use of ChatGPT.

Lastly it is shown that both groups tend to favor the idea of ChatGPT being used in a professional setting versus being used in an educational setting. Due to this our group determined that the focus should be on educating students on how to use the tool and why it would be important. This is because people would be more accepting of its implementation in a classroom if the focus is on preparing students to take on professional jobs and being ahead of their colleagues in the newest form of assisted coding.

#### 4.2.2 Positive viewpoints



**Figure 4 Positive Opinion on ChatGPT in Education:** This is a summary of the 23 positive responses we got in response to question 7 in Appendix A.

From the data in figures 1 and 2, we observe that 45 percent of all the survey responders have a positive view of ChatGPT in both the educational and professional fields. Our group reviewed all responses to comprehend the real incentive behind the participants' positive views

in order to implement this crucial knowledge into our introductory class. In Figure 2, we see that the list of positive aspects we created using the responders' main ideas matches our project's goals and reasons.

All around, the respondents have a positive view on ChatGPT. They appreciate that ChatGPT can function as both a teacher and a tool to improve their learning process. Survey Participant 3 says that “It's a great opportunity to have topics explained again on different levels of abstraction” and Participant 18 explains how the AI can be used to focus more on the high-end, complex problems instead of the smaller details that can be solved quicker. ChatGPT plays a key role in answering students’ queries when students are not getting enough information from teachers or do not fully retain the facts during class time. Students use the chatbot tool to go over topics and expand their understanding of class materials whenever necessary. Survey Participant 7 mentions how “It will be like having a personalized teacher for every student that has an incredible general knowledge which a lot of human teachers lack. It also has near perfect grammar so you can learn how to write in some general sense as well.” Using ChatGPT enhances knowledge by promoting active learning through typing, reading, and the limitless opportunity to ask and learn from an endless array of questions. In conclusion, ChatGPT can act as an all-day support system and for a better understanding.

#### ***4.2.3 Neutral viewpoints***

More than 50 percent of the participants have a neutral opinion on ChatGPT and other chatbots in the academic and professional sector. They find the concept of integrating chatbots across various fields intriguing and are generally supportive of their implementation, although

they do have some concerns. Our plan is to address these concerns and try to implement their suggestions into the class and show them how useful ChatGPT can be for the future.

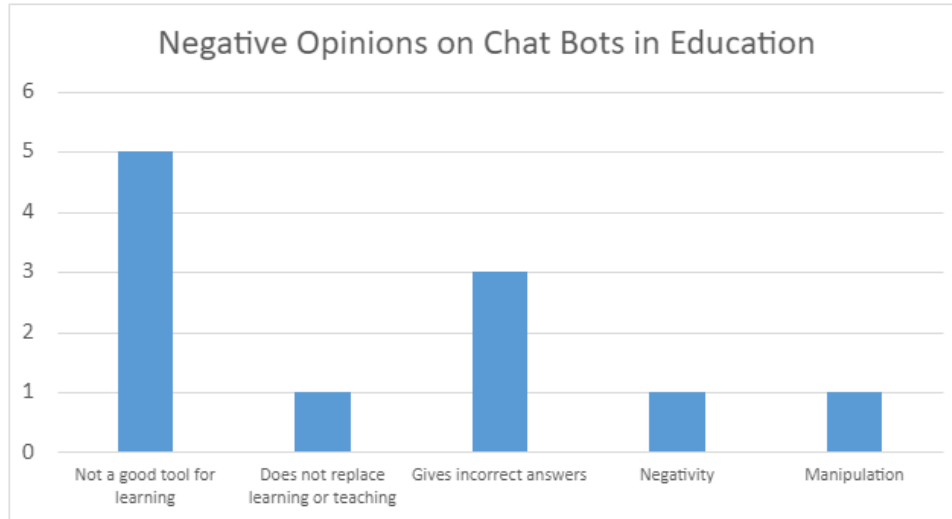
Teachers and students have multiple different concerns on the impact of ChatGPT and AI on academics and professionalism. From the minimal student responses that we got, it seems that students are concerned about how those modern technologies affect human creativity and how they output responses that are sometimes incorrect. Participant 8 emerged with an interesting idea on how we could implement technology in education. They describe how “Information can be quickly summarized and displayed. However, this can also promote bulimia learning.” In a way, they agree that it’s an important and useful tool, but to not let it be the only way to acquire information. Instead of letting students ask for everything, teach them the skills they need and how to ask the correct questions to ChatGPT. This way, it can be used when one doesn’t understand questions and phrases, or when one needs quick and small information to continue with their assignment. Participant 16 is concerned about both issues, saying that “Depending on what you use it for, it can make work and learning more efficient. However, you should know the respective limits in order not to use or learn misinformation - or not to learn certain things yourself and leave the work to the AI. The boundaries are constantly shifting. I see great potential if we learn to use ChatGPT properly.” Although it’s true that chatbots can produce incorrect information at times, it shouldn’t be a reason to shy away from it. That misinformation can be used for students to correctly identify where the AI went wrong and correct it, providing additional and improved learning skills. At the same time, it can be taught how to correctly ask questions so that one doesn’t receive constant misinformation.

However, teachers are more worried about how it can be used for assignments and exams and how it can negatively affect students' critical thinking skills. They’re concerned about

students using the tool to fully write essays and assignments, instead of working on them themselves and improving their knowledge. As explained by Survey Participant 11, “ChatGPT is for text like the calculator in mathematics. A lot of things are getting easier, but you still have to be able to calculate. There is more time for review and creativity” and we agree with this statement. Our group doesn’t want ChatGPT to completely substitute the basic knowledge and skills that one would learn in introductory classes. Just as the participant suggested, it’s just an aid to making things more efficient when one has already learned those skills and to aid in learning the skills. Just as websites like Stack Overflow have been helpful for programmers in some special cases, we want AI to be that useful tool that can be used when aid is needed in assignments. Survey Participant 10 had similar views, while still approving of ChatGPT, they mention how “It is an additional way to get information but does not replace learning or teaching. Media literacy will have to grow again on the part of lecturers and students”. By having students use ChatGPT as one would get quick information from the internet when they need it, we can have students use these tools and still learn.

#### ***4.2.4 Negative viewpoints***

Our group thoroughly analyzed the negative viewpoints of our survey participants since these would be the concerns that we need to address the most to ensure that ChatGPT is integrated in a way that boosts learning. In Figure 5 it shows the 11 viewpoints that have been generalized into their basic theme to have a better understanding of why or what the problem with ChatGPT is according to them.



**Figure 5 Negative Opinions on Chatbots in Education:** This is a summary of the 11 negative responses we got in response to question 7 in Appendix A. There are 11 data values as one viewpoint contained two different base ideas.

Addressing each one of these main ideas is one of our goals in the project in order to show how ChatGPT, and other chatbots, are a beneficial tool that will set the stage for the future. To begin addressing each base idea we began by focusing on the ones that had one response each. The “Hate” viewpoint was generalized as the response given by Survey Participant 31 who said “These chatbots have catastrophic effects on ‘education’, you certainly don’t have to justify that” and as there was no real justification for their opinion being negative sadly there was no real way to classify this statement besides “Negativity”. The “Manipulation” comments were interesting ones, but not ones that really pertained towards our study. Survey participant 46 stated “the manipulation of people is taking on an even greater scale than is already being done by the media, etc.; Children, adolescents, students think, reflect, learn even less and the dumbing down is increasing rapidly. A development that has already been proven by brain researchers based on excessive smartphone consumption.” Since this does not mention artificial intelligence,



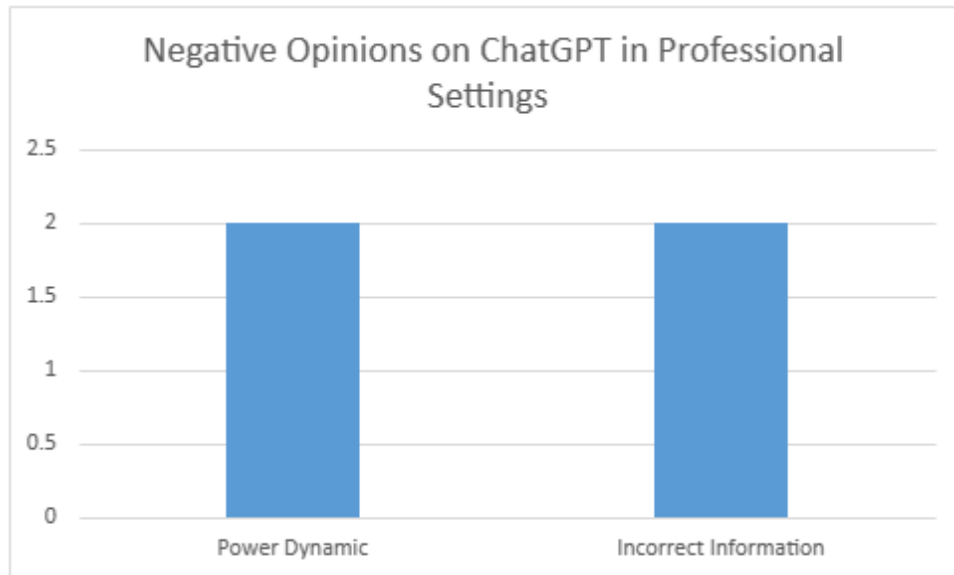
it is not effective towards our study. However, if the individual was trying to say that chatbots are another form of manipulation posed on us by society there are countermeasures in place to ensure this does not happen. Artificial intelligence systems are built to create as little bias as possible due to safe AI procedures implemented by AI engineers. Any other form of manipulation or decrease in intelligence is unknown to our group as we do not have access to the study the participant mentions. Lastly, a concern from Survey Participant 10 said “It is an additional way to get information but does not replace learning or teaching.” which our group agrees completely on. Our goal is not to replace teachers or learning with ChatGPT, but to use it as a tool to aid students' learning capabilities and increase their productivity and knowledge within computer science.

The second largest group of answers raised the concern that ChatGPT gives false, misleading or incorrect information. While this is a problem with the current systems of GPT-3.5 we believe that this is why it should be used as a tool, and not be the end all be all of education. However, before making specific recommendations the individual responses should be addressed. Survey Participant 28 stated that “If a statement appears often enough on the net, ChatGPT will believe it to be true and incorporate it into its texts.” While this could be true if ChatGPT had internet access it currently does not. As of now, the data ChatGPT is trained on is a static dataset containing information before September 2021. ChatGPT has no internet access whatsoever and the dataset is validated by the engineers working on the AI system prior to being implemented to remove the false information that could occur within the web. Chatbots like Bing Chat or Google Chat can experience these issues; however, they do site the sources they got the information on for people to check the data. If students were to not check their information prior to using it, this would be marked against them regardless of the whether they used a chat bot or

just clicked the first website given to them from a simple internet search. Next, Survey Participant 20 stated “Wrong / thrown together answers are presented as correct in a very convincing way.” Survey Participant 38 had a similar notion as 20 stating, “ChatGPT does not cite sources and does not provide reproducible answers.” This is a real issue with ChatGPT, for example if you were to put a compressible fluid problem into ChatGPT you could get three different answers with three different methods of solving it and none could be correct. Due to this we planned to stress the fact that ChatGPT is not a perfect source of knowledge, it is subject to criticism and validation always. We also plan to make exercises that involve finding ways in which ChatGPT is incorrect in its understanding and talking about how or why this occurred. This boosts the learning of the students as they start to question answers deemed as “correct”.

Survey Participant 38 also stated “The danger is that students think they don't need to know anything anymore because ChatGPT can provide you with the answers. Critical thinking is more likely to be undermined if the topic is not consciously treated critically.” Participant 12 and Participant 44 both had similar responses to 38. In this case, as stated previously, we want to develop the class to build around questioning ChatGPT and making sure that it is exactly what you want it to be, not some random answer that has no value to your current issue. This will be explored throughout the class we help develop at ZHAW. The last two participants had similar views on why ChatGPT is not proper learning, Participant 36 worded it well by saying “Education can only happen ‘in’ the brain of the learner - but for this to happen, the brain has to do something ‘actively’”. In response to this statement, we say that to actively learn is to actively question your surroundings and what you are doing, this is especially true of CS classes where the majority of learning is done through interactive elements. If you do not have the ability to develop questions you will never create breakthroughs in your workplace. Teaching students to

develop proper questions to ask ChatGPT or question the responses they get from it will cause them to actively learn. Certainly, adopting a "copy question, paste answer" approach would hinder learning. However, it would also be detrimental to actively restrict students from utilizing the most up-to-date technology prevalent in the computer science industry.



**Figure 6 Negative Opinions on Chatbots in Education:** This is a summary of the 4 negative responses we got in response to question 7 in Appendix A.

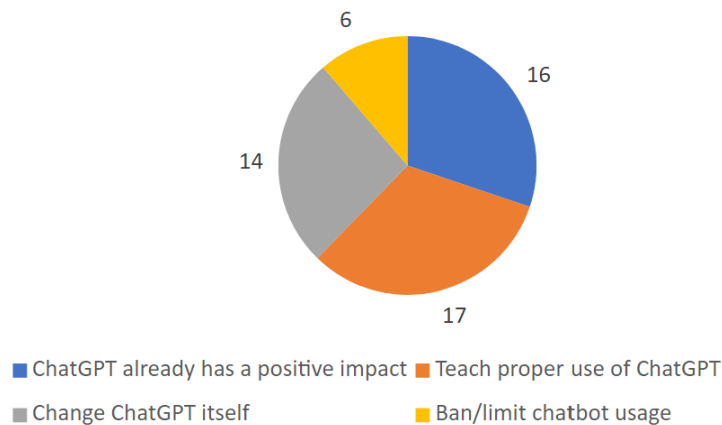
The negative opinions of ChatGPT in a professional setting have some overlap with the issues with using them in an educational setting. Since not much differed from the incorrect information responses to the professional setting compared to the educational setting, the solution remains the same.

The “Power Dynamic” issue is an interesting concept to discuss. Survey participant 25 stated “However, I think that humans as beings or individuals will sooner or later also use ChatGPT to gain power/money/...” While this is true as any individual will eventually use tools

to gain power and money, individuals will also use tools to advance technology in the future. The difference between it being a capitalistic tool for self-benefit and a beneficial tool for humankind is the education on such topics. If everyone is educated on the topic of chatbots and how to use them properly the ability for individuals to spearhead their own personal growth diminishes since it is not a unique skill it would be like the ability to use a power tool over a screwdriver. This is why we need to stress the importance of learning such a new and crucial tool for society. Without proper education about it the tool will become an instrument for those in positions of power to benefit at the cost of their employees through increasing automation.

### 4.3 Changes to Curriculum or ChatGPT

What would make you see ChatGPT as having a positive impact on education or industry?



**Figure 7** What would make you see ChatGPT or other chatbots as a positive impact on education: This is a summary of the answers from all respondents given to the question above from the survey in appendix A

The focus of the surveys and interviews we conducted was the respondent's opinions on the use of chatbots in professional and academic settings, and how that opinion might be improved. In the surveys sent to teachers and students we asked the question "What would make you see ChatGPT or other chatbots as a positive effect in either education or the professional industry?". We used this question to assess what changes to coursework or ChatGPT itself would make people more open to its use. After collecting this data, we organized the responses into four broad categories based on their opinions. The first category of response was those saying they believed ChatGPT already has a positive effect on education. The second was those who believed that students must be taught how to use ChatGPT productively to encourage learning. The third type of response was those who said that changes to ChatGPT itself are necessary to make it a productive learning tool. The final category of response was those stating that it cannot be used productively in academia and instead must be banned or limited in its use. The first three categories had a similar number of responses as seen in figure 4, while only a few people responded that ChatGPT use must be banned or extremely limited in an academic setting.

#### ***4.3.1 Teaching how to use ChatGPT***

The most common response from both our surveys and interviews was that ChatGPT can be used in a productive manner in classes, however, its proper use must be taught to the students first. This is often mentioned for two reasons, the first is so students are still able to learn while using the tool and not just copying answers, the second is so students are equipped to use chatbots for more complex tasks in a professional setting. These issues reflect the two major problems this project seeks to solve, how to moderate students' use of AI tools in a way that is

not plagiarism while still allowing learning, and how to teach students how to write prompts for ChatGPT optimally in a way that gives them the necessary information and does not present incorrect or misleading answers. Because this category of response was so common in our data, we placed a heavy emphasis on teaching students how to use ChatGPT productively in our syllabus, using activity's that show students how to create prompts correctly and how to verify information provided by ChatGPT.

Professor Daniel uses ChatGPT to teach his students by having them work with the chatbot like they might work with a teaching assistant. By having students write specific prompts and use direct and clear questions, they enter into a conversation about the topic with the chatbot. This can deepen their understanding of the subject as the repetition and explanations provided by ChatGPT help them comprehend difficult topics. Additionally, it is possible for the students to ask personalized follow-up questions to ChatGPT in a way that is not always feasible for something like a prerecorded video explaining the topic. In this way the professor has his students use ChatGPT to deepen their understanding of the topics instead of relying on it and presenting its answers as their own. When discussing the current CS classes at ZHAW, graduate student Eric Gericke mentioned a lack of interactive elements during class time, saying that they were almost entirely lecture-based. ChatGPT, when used in a productive manner, can provide an interactive element that could be lacking otherwise which could strengthen overall student comprehension.

In the survey responses that fall into this category, there is a heavy emphasis on teaching students how to discern if information provided by ChatGPT is accurate or not. Professor Kulli Beatrice at ZHAW worries that students can overestimate the capabilities and intelligence of ChatGPT, and not understand its capacity as a chatbot. This can lead to issues as ChatGPT is still

capable of providing incorrect or incomplete information, and if students do not understand this, they can instill inaccurate information unknowingly. We plan to address this concern in our course by having activities in class where students are presented with wrong or misleading information provided by ChatGPT and they must figure out the mistakes themselves. This works towards the goal of teaching students how to use ChatGPT in a productive way.

#### ***4.3.2 Changes to ChatGPT itself***

Many respondents to the survey believed that, for it to be properly integrated into a school environment, ChatGPT itself would have to change. The most common changes that were recommended were to have it cite the sources that it used to produce an answer, to have more curated sources, and generally to be less likely to produce incorrect information. Notably these issues all pertain to what sources are used, and how accurately the source's information is conveyed. These issues are important because, when asked a complex or multilayered question, ChatGPT can produce incorrect information. However, this would likely not be a problem for students in our class since it is an introductory programming course, and ChatGPT is incredibly adept at solving the simple problems common for that type of class.

While it is unlikely that OpenAI, the company that created ChatGPT, would alter their product based on the suggestions of this project, these suggestions would broadly increase the general confidence of the public in the information provided by the chatbot. ChatGPT citing the sources it uses for responses would allow people to check the sources provided to make sure the response is factually correct. Additionally, having a more curated set of sources would allow for

greater trust that the information provided did not contain misinformation. Our survey results show that currently, a large amount of the resistance against using ChatGPT comes from its potential to produce incorrect information, and these proposed changes would mitigate that risk. Despite the benefits these changes could provide, there are possible downsides to them as well. The most notable downside is that ChatGPT was trained on about 570 GB worth of sources. If it were to cite all of its sources for any given answer the amount of data might overwhelm new or unexperienced users. Additionally, if ChatGPT was only trained on a smaller data set of more curated sources, it might be more accurate with specific topics but could become worse at answering more niche topics as it would have less information overall.

#### ***4.3.3 Banning ChatGPT use in classrooms***

The least common category of responses was those stating that ChatGPT cannot be effectively utilized in a learning environment, instead its use should be severely limited or banned entirely. The strongest argument for this viewpoint is that AI tools are inherently harmful to student learning. These respondents believed that there is no way to integrate ChatGPT in such a way that stops students from simply getting it to solve their assignments for them. Survey participant 46, who thought that ChatGPT had a negative impact on both academia and industry, responded when asked what could make them more positive about its integration that there should be “Bans/regulations in society in general, educating the teachers in education”, implying that students be banned from using it and teachers should be trained to recognize its use by students.



The main counterargument against this claim is logistical; it simply not possible to prevent students from using ChatGPT outside of school. During interviews multiple teachers at ZHAW claimed that 50-60% of their students already use ChatGPT for schoolwork, and this percentage will only grow as the technology advances and becomes more widespread. You can train teachers to detect ChatGPT usage but that is time-consuming and will still inevitably miss many instances of its use. Additionally, these tools are constantly gaining prominence in the professional industry, so a school that bans their use leaves its students increasingly unprepared to use them in the workforce.

It is also worth mentioning that ChatGPT is not dissimilar from existing assisted programming tools and is in many ways a more interactive version of code repositories or tutorials found on websites such as GitHub or Stack Overflow. Even if ChatGPT was permanently banned from schools, students would still be able to look up assignments on these code repositories. Additionally, ChatGPT has the upside of being able to provide an in-depth explanation of any code it generates, which is not possible for prewritten code found on these sites. However, it is important to integrate and acknowledge these respondent's arguments instead of simply dismissing them. To that end, we designed some class activities and assignments that ChatGPT is prohibited from, by using in-class activities with locked browsers or pen-and-paper assignments to limit their access to the chatbot.

#### **4.4 Limitations to the data**

Surveys, interviews, and class observations are powerful tools, but they have their fair share of limitations. Surveys can be inaccurate if not enough diverse people participate or if

some don't respond. People also sometimes change their answers to match what they think the surveyor wants. Interviews, while great for understanding people, can be influenced by the interviewer's style or the way questions are asked. Also, people might not always remember things accurately or might hold back sensitive info. When observing classes, just having someone watch can change how the class behaves, giving a skewed view. In addition, we can't really dive deep into what each student is truly experiencing because most of the classes are taught in German. Being aware of these limitations is key as we learn to navigate research in our computer science journey. ChatGPT is also fresh in tech. When we try talking to people about this technology, we often run into a problem—most folks aren't familiar enough with it to give helpful thoughts. So, when we reach out to teachers and students for their thoughts on using chatbots in education, we might face a bit of a knowledge gap, or some might just give the same answer.

#### ***4.4.1 Survey Limitations***

In our surveys, we gathered opinions on ChatGPT from both students and professors. The questions were straightforward, aiming to weigh perceptions and potential utility of ChatGPT. However, a limitation rose from the fact that most respondents were from tech-related fields, which skewed the results towards a more favorable view of chatbots. We suspect this limited perspective might have caused us to miss out on a more diverse range of opinions.

#### ***4.4.2 Interview Limitations***

Conducting interviews, a critical part of our research, also presents its own limitations. Unfortunately, due to resource constraints, most interviews have had to be conducted via Zoom. The time constraints imposed by the free version of Zoom allow only 40-minute discussions which we believe limited the depth of our conversations and the richness of the knowledge exchanged. Additionally, some professors, such as Beatrice from ZHAW's Institute of Natural Resource Management, expressed skepticism about ChatGPT's potential, potentially influencing the interview outcomes.

#### ***4.4.3 Class Viewing Limitations***

While observing classes provides valuable information about teaching methods and class dynamics, there are inherent limitations. Language proves to be a barrier, as most classes are conducted in German, hindering our comprehensive understanding. Moreover, we recognize that being external observers without active participation means we lack immersive experience of in-class assignments, grading, and exams. This absence of involvement constrains our analysis of teaching methodologies and the true dynamics within the classroom. Additionally, due to the short length of the IQP we were only able to sit in on a few weeks of classes, meaning we only saw the beginning of these courses. Because of this, we missed the more advanced topics that would be covered later in the classes, as well as their midterms and finals which are important aspects of a class.

## Chapter 5: Conclusions & Recommendations

### 5.1 Conclusion

Our group concluded that the best way to teach CS courses with the use of ChatGPT was by using it as a comprehensive tool for studying and as a teaching assistant. In our syllabus we included a weekly homework assignment found in Appendix C; this is an altered version of a template used by Professor Daniel Bajka for his own classes. This homework assignment teaches students how ChatGPT can be used in a beneficial way as a study tool by having them enter a dialogue with the chatbot. This includes the students asking it multiple questions about relevant subjects, then asking it to create a study guide for them.

Our syllabus, found in Appendix D, contains the main information for how the class will be taught and operated. As it is an introductory class, we worked with the assumption that the students have little to no programming experience, hence there are no prerequisites to enroll in this class. The course objectives are to teach students how to use chatbots to boost their education and critical thinking abilities while teaching them introductory Python and data science concepts. The course outcomes fully encompass what the class will provide for students. Lastly the syllabus ends with an outline of the course from week one to the final week. This schedule contains example assignments that could be used in class or as homework. The suggestions for the exams are that the students should take the tests on a lockdown browser, to prevent them from using ChatGPT or other online resources. There is also an option for teachers who allow students to use ChatGPT for tests. If the students choose to use ChatGPT they must

provide their chat history at the end of each question or at the end of the exam, this is up to the teacher's discretion.

Finally in Appendix E there is an example final project that would take approximately two weeks. It is meant to teach students a variety of useful, slightly more advanced, tools in the CS and data science world. The project uses the information taught throughout the class about the ability to use, insert, manipulate, and analyze data and combines it with the real-world applications of web scraping. Web scraping is a common and useful tool for data science where substantial amounts of data are gathered from a web page or database using an automated process. We believe that having the student create their own web scraping project may be beyond their current capabilities, so we suggested that the students be provided with a source code that uses HTTP requests to be able to web scrape data from a website of the students choosing. The students must learn how to use this code and are heavily encouraged to use ChatGPT as part of this project. They then must create a basic predictive function that utilizes the data they obtained from the web scraping.

## **5.2 Recommendations**

The recommendations provided in our syllabus are aimed at current CS teachers, as ChatGPT is an increasingly influential part of programming. We anticipate that many aspects of this syllabus, such as homework assignments and the material covered during the class, will be changed by teachers who implement it, as different teaching styles and schedules will require different class structures. The key aspect of our curriculum is that students should use ChatGPT

as an interactive teaching assistant and studying tool. This reflects the idea that students must be taught how to use ChatGPT properly, which was a common claim in our surveys and interviews.

We believe that this class is the first step towards a future in which students' learning capabilities are increased due to advances in modern technology. The ideal next step for this project is the actual implementation of this course at ZHAW. By having this class be integrated, we can gain information on whether our proposed teaching and studying methods are effective, and the class can be changed based on student feedback. Through this project, this course can be continually updated and improved to better teach students necessary programming skills and how to use ChatGPT. We hope other fields of study can take on aspects of this project and implement it into their own classrooms to fully utilize the modern advancements in the world.

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## Appendices

### Appendix A: Survey Questionnaire on ChatGPT and AI Technology

**Goal:** Record opinion on ChatGPT and AI technology

**Type of sampling:** Purposive sampling – members within the CS industry or educational systems

1. What do you currently do/study?
  - a. Short response answer on their current profession/educational pursuit
2. Have you heard of ChatGPT or chatbots?
  - a. Yes/No
    - i. If not, that is all the data we need on them, this ends the questionnaire for them.
3. Where did you hear about ChatGPT or chatbots?
4. What type of opinion did the source have on the topic?
  - a. Positive
  - b. Neutral
  - c. Negative
5. Have you used this type of technology?
  - a. Yes/No
    - i. What did you use them for and why?
6. What impact do you think ChatGPT or other chatbots will have on education?
  - a. Positive
  - b. Neutral
  - c. Negative
7. Why do you think this?
8. What impact do you think ChatGPT or other chatbots will have in the professional world?
  - a. Positive
  - b. Neutral
  - c. Negative
9. Why do you think it will have that impact?

10. What would make you see ChatGPT or other chatbots as a positive effect in either education or the professional industry?
11. Would you be willing to be interviewed to better understand your views on ChatGPT and its impact within society? We would contact you to get a time that works best for you and conduct an interview that will last a maximum of 20 minutes.
  - a. Yes
    - i. Provide contact information.
  - b. No

## **Appendix B: Interview Guide**

**Goal:** Determine the opinion of ChatGPT and CS classes from different perspectives of the CS world

**Type of sampling:** Purposive sampling – members within the CS industry or educational systems

1. What is your current role?
  - a. Student
  - b. Teacher
  - c. Administrator
  - d. CS industry position
2. If you are a student or teacher, what subjects do you study/teach?
3. What are your opinions on ChatGPT?
  - a. Why do you think that?
    - i. If negative, how could we ease your concerns on the subject?
4. Do you think ChatGPT could be used beneficially for educational purposes?
  - a. Yes/No
    - i. Elaborate
  - b. Would it be this way only within your field or other fields?
5. Do you think ChatGPT is beneficial for coding in the professional world?
  - a. How and why is it beneficial?
6. Would you (have been) open to learning/teaching a ChatGPT assisted class?
  - a. Why?
7. What is your opinion on the current CS classes at ZHAW?
  - a. What do you think could be improved?
  - b. What parts of these classes worked the best?
8. What is your opinion on the overall goals of this project, do you believe it is possible/beneficial to integrate AI tools into CS classes?
9. Do you have any more questions or concerns for us?

## Appendix C: ChatGPT Assignment

**ChatGPT Weekly Assignment:** students are expected to go through this script weekly asking about a subject they are confused about or interested in from that week's topics.

1. Given a generic script or topic by the professor.
2. Prompt ChatGPT to explain or summarize the given text.
3. Have a conversation with ChatGPT on the summarization or any other prompts students want to use.
4. Prompt ChatGPT to generate 8 flashcards on the conversation had, memorize them.
5. Prompt ChatGPT to write 10 multiple choice questions on the conversation without giving the answers to them.
6. Send ChatGPT your answers and read its response.
7. Share the conversation with the teacher.

## Appendix D: Class Syllabus

Introduction to Python Data Processing using AI Technology

**Prerequisites:** None

**Course Objective:** This computer science course aims to equip students with fundamental Python skills and a solid grasp of its core concepts, primarily focusing on data science and analytic applications. It also introduces students to practical problem-solving techniques through programming. The course mainly utilizes ChatGPT for both in-class and out-of-class assignments to enhance learning and prepare students for an AI-driven computer science industry.

**Course Outcomes:** Upon completion of this course, the student will be able to:

- **Develop problem-solving skills:** Analyze complex problems and develop effective coding solutions.
- **Master Python basics:** Understand and apply fundamental syntax and mechanics of the Python programming language.
- **Work with variables and data types:** Manipulate variables and utilize different data types in Python.
- **Debug broken code:** Interpret Python errors and debug faulty code.
- **Manage data structures:** Create, access, and modify lists and dictionaries in Python.
- **Work with SDKs:** Download and utilize online SDKs in code.
- **Implement control flow:** Utilize loops, conditional statements, and Boolean logic for efficient program execution.



- **Create and use functions:** Modularize code by creating functions, passing arguments, and handling return values.
- **Handle files and datasheets:** Access, edit, manage, and analyze various types of data files and datasheets.
- **Utilize ChatGPT:** Prompt ChatGPT accurately to enhance learning, improve skills, and solve programming challenges effectively.

### **Chatbot Options:**

- **ChatGPT:** Allows a conversation about the data. Will explain the information provided in depth. Less credible information does not cite sources. Inaccuracies will need to be understood by the user.
- **Bing Chat:** Provides sources of information. Acts as a comprehensive internet search. Easier to validate information present. Cannot converse about the data present. Will not explain the data given to you in depth.

**Web Scraping Project:** students select a data source for web scraping, analyze the retrieved data, and develop a predictive program based on their dataset.

## **Class breakdown – 14-week semester, 2 classes a week**

- Week One
  - Course overview and expectations
  - Installing IDE
  - Introduction to Python as a programming language
    - Hello World
  - Introduce what a chatbot is
- Week Two
  - Commenting
  - Data types, defining variables
  - Basic math operators
  - Print and input functions
    - Individual assignment for this week can be creating a simple calculator using variables based on user input
  - Basic introduction to ChatGPT, simple prompt examples
    - An example would be prompting “How would you describe a variable in Python code” to show in-depth description of simple topics
    - Introduce ChatGPT Weekly Assignment here for asking follow-up questions about errors
- Week Three
  - Lists & Dictionaries
  - Debugging
  - Suggested assignment:
    - Given a program, without optimizing it, to debug, do it personally. Then put it into ChatGPT to see if it catches the same number of errors.
- Week Four
  - Boolean Logic
  - If / Else statements
  - Suggested assignment:

- Sort a large list of multiple variable types into lists of variable types, order them alphabetically or numerically
- Week Five
  - For & While loops
  - Suggested assignment:
    - Receive a long unoptimized code that has too many if / else statements and students are asked to use Boolean operators to shorten the code
    - Ask ChatGPT for a code that should have too many if / else statements and see where it went wrong and/or how to shorten the code
- Week Six
  - Functions (defining, calling)
  - Functions (parameters and return values)
    - Wrap back into loops for this section
  - Suggested assignment:
    - Have several lists with different elements
    - If they contain certain values call a function that correlates with that value
- Week Seven
  - Review of the topics to far
  - Midterm
    - Locked Browser
    - Optional: Allow use of ChatGPT but they must share the chat history with teach
      - Graded harsher than locked browser.
      - Must send the ChatGPT conversation(s) in at the end.
- Week Eight
  - Objects and Classes
    - Attributes, methods, and inheritance
  - Suggested assignment:
    - Brainstorm attributes that a class describing students at ZHAW would need to include

- After students get their list of ideas prompt ChatGPT to ask it the same question and see how the results differ
    - Write a program that automatically adds all students of a certain major into the student list attribute of this class
- Week Nine
  - File Handling
    - Downloading libraries
  - File Types
    - CSV, XML
  - Arrays
  - How to edit file types
  - Suggested assignment:
    - Input data into the file types
- Week Ten
  - SDK's
    - NumPy, Matplotlib, csv, XML
  - Suggested assignment:
    - Create a picture using matplotlib
- Week Eleven
  - Using SDKs to find statistics of data files
  - Suggested assignment:
    - Take a given datafile and find trends within the data
      - Discuss with classmates trends they found and methods they used
- Week Twelve & Thirteen
  - Project
- Week Fourteen
  - Review
  - Final Exam
    - Locked Browser
    - Optional: Allow use of ChatGPT
      - Graded harsher than locked browser

- Must send the ChatGPT conversation(s) in at the end.

## **Appendix E: Final Project**

Project: Introduction to Web Scraping and Data Export

**Objective:** This assignment aims to guide students in comprehending web scraping concepts and data export to a chosen data file type, with the assistance of chatbots. Students will then proceed to analyze the acquired data. The primary objective is to empower students to effectively prompt chatbots, use the guidance provided, and master the process of web scraping from a website of their choosing.

### **Instructions: (Students are recommended to use ChatGPT for complete guidance)**

1. **Introduction to Web Scraping:** Briefly introduce web scraping, emphasizing its purpose and diverse potential applications.
2. **Selecting a website:** Instruct students to choose a website (e.g., news site, product listings, stock listings) from which they want to scrape data.
3. **Understanding HTML Structure:** Explain the fundamental concepts of HTML and how to inspect webpage structure using browser developer tools.
4. **Web Scraping Process:** Describe the step-by-step process of web scraping, covering using HTTP requests, parsing HTML, and extracting desired data. Provide them with code for the HTTP requests and have them learn how to use it. Have ChatGPT explain concepts of the code given.
5. **Web Scraping Guidance:** Instruct students to engage with ChatGPT to discuss their chosen website, its HTML structure, and potential methods for scraping data.
6. **Data Export:** Guide students to prompt ChatGPT for instructions on saving the scraped data into a data file of their choice (e.g., JSON, CSV) taught in class.
7. **Implementation:** Direct students to implement the web scraping process and data export to their chosen data file based on the guidance from ChatGPT.

8. **Testing and Validation:** Instruct students to test the implemented code to ensure successful data scraping and export to the specified data file type.
9. **Data Analysis and Identifying Trends:** Encourage students to analyze the scraped data independently and identify trends or patterns that intrigue them within the dataset.
10. **Documentation:** Emphasize the importance of documenting the entire process, including code snippets, for future reference and understanding.

### **The deliverables for this assignment:**

**Shared Discussion with ChatGPT:** Students should share their interaction with ChatGPT during the web scraping process. This interaction should showcase the questions asked, guidance received, and any clarifications sought from ChatGPT regarding the web scraping and data export process. **Code Implementation:** Students should submit the code they implemented for web scraping, data export, and data analysis. This should include relevant comments explaining the code and the choice of data file format for export (e.g., JSON, CSV).

**Data File with Scraped Data:** Students should submit the data file that contains the scraped data from their chosen website, exported using the techniques discussed with ChatGPT. **Data Analysis Report:** Students should provide a report summarizing their data analysis process. This report should detail how they analyzed the data, any trends or patterns identified, and the insights gained.

**Documentation:** Students should submit a comprehensive document that includes the entire process of web scraping and data export, along with code snippets and comments. This will serve as a reference for future use and understanding.

## Appendix F: ChatGPT Topic Summarization Example

**User:** Could you summarize how Boolean logic and If/Else statements in python for me?

**ChatGPT:** Certainly! Boolean logic and if/else statements are fundamental concepts in Python and many other programming languages. Here's a summary of how they work in Python:

### Boolean Logic:

Boolean logic deals with values that can be either `True` or `False`, and it's essential for making decisions and controlling the flow of your program. In Python, you primarily work with Boolean values and use logical operators to manipulate them. The key logical operators in Python are:

1. `and`: Returns `True` if both operands are `True`.
2. `or`: Returns `True` if at least one operand is `True`.
3. `not`: Returns the opposite Boolean value of the operand.

Here are some examples:

```
python 📄 Copy code  
  
a = True  
b = False  
  
result1 = a and b # result1 is False  
result2 = a or b  # result2 is True  
result3 = not a   # result3 is False
```

**if/else Statements:** `if` and `else` statements are used for conditional execution of code. They allow you to perform different actions based on whether a certain condition is `True` or `False`.

The basic structure of an `if` statement in Python is as follows:

```
python Copy code  
  
if condition:  
    # Code to execute if the condition is True  
else:  
    # Code to execute if the condition is False
```

Here's an example:

```
python Copy code  
  
age = 18  
  
if age >= 18:  
    print("You are an adult.")  
else:  
    print("You are not yet an adult.")
```

In this example, if the `age` is greater than or equal to 18, it will print "You are an adult." Otherwise, it will print "You are not yet an adult."

You can also have multiple conditions using `elif` (short for "else if"):

```
python Copy code  
  
grade = 85  
  
if grade >= 90:  
    print("A")  
elif grade >= 80:  
    print("B")  
elif grade >= 70:  
    print("C")  
else:  
    print("F")
```



In this example, it checks the grade and prints the corresponding letter grade based on the conditions.

These are the basics of Boolean logic and if/else statements in Python. They are fundamental for controlling the flow of your program and making decisions based on conditions.

**User:** This is still a bit unclear to me, could you write a python function that uses If else statements to help explain?

**ChatGPT:** Of course! Here's an example of a Python function that uses `if` and `else` statements to determine whether a given number is even or odd:

```
python Copy code  
  
def check_even_or_odd(number):  
    if number % 2 == 0:  
        print(f"{number} is even.")  
    else:  
        print(f"{number} is odd.")  
  
# Example usage:  
check_even_or_odd(4) # Output: "4 is even."  
check_even_or_odd(7) # Output: "7 is odd."
```

In this example, we define a function called `check\_even\_or\_odd` that takes one argument `number`. Inside the function, we use an `if` statement to check if `number` is even or odd. The condition `number % 2 == 0` checks if the remainder of dividing `number` by 2 is equal to 0. If it's true, we print that the number is even; otherwise, we print that it's odd.

When we call the function with different values, it will provide the appropriate output based on whether the input number is even or odd.

## Appendix G: ChatGPT Flashcards Example

**User:** Could you write me 8 flashcards to study about the topic of IfElse statements and Boolean logic in Python?

**ChatGPT:** Certainly! Here are 8 flashcards to help you study the topic of Boolean logic and if/else statements in Python:

### Flashcard 1

Front: What are Boolean values in Python?

Back: Boolean values in Python can be either ``True`` or ``False`` and are used to represent truth or falsehood in logical expressions.

### Flashcard 2

Front: What are the three main logical operators in Python?

Back: The three main logical operators in Python are ``and``, ``or``, and ``not``.

### Flashcard 3

Front: How does the ``and`` operator work in Python?

Back: The ``and`` operator returns ``True`` only if both of its operands are ``True``. Otherwise, it returns ``False``.

### Flashcard 4

Front: How does the ``or`` operator work in Python?

Back: The ``or`` operator returns ``True`` if at least one of its operands is ``True``. It returns ``False`` if both operands are ``False``.

### Flashcard 5

Front: What does the ``not`` operator do in Python?

Back: The ``not`` operator returns the opposite Boolean value of its operand. If the operand is ``True``, it returns ``False``, and vice versa.

### **Flashcard 6**

Front: How is an ``if`` statement structured in Python?

Back: An ``if`` statement in Python is structured with the keyword ``if``, followed by a condition to be evaluated, a colon ``:``, and indented code to be executed if the condition is ``True``.

### **Flashcard 7**

Front: What is the purpose of the ``else`` statement in Python?

Back: The ``else`` statement is used to specify a block of code to be executed when the ``if`` condition is ``False``.

### **Flashcard 8**

Front: When might you use an ``elif`` statement in Python?

Back: You use the ``elif`` (short for "else if") statement when you want to specify multiple conditions to be checked sequentially after an ``if`` condition. The code block associated with the first ``True`` condition is executed, and subsequent conditions are not checked.

Feel free to use these flashcards for studying and testing your knowledge of Boolean logic and `if/else` statements in Python!

## Appendix H: ChatGPT Multiple Choice Example

**User:** Could you write me 10 example multiple choice questions about IfElse statements and booleans for studying?

**ChatGPT:** Certainly! Here are 10 multiple-choice questions to help you study Boolean logic and if/else statements in Python:

### Question 1:

What are the possible values of Boolean variables in Python?

- A) 0 and 1
- B) True and False
- C) Yes and No
- D) Positive and Negative

### Question 2:

Which logical operator returns `True` only if both operands are `True`?

- A) and
- B) or
- C) not
- D) xor

### Question 3:

Which logical operator returns `True` if at least one of its operands is `True`?

- A) and
- B) or
- C) not
- D) xor

**Question 4:**

What does the `not` operator do in Python?

- A) Returns the opposite Boolean value of its operand.
- B) Returns `True` if both operands are `True`.
- C) Returns `True` if at least one operand is `True`.
- D) Returns `False` if both operands are `False`.

**Question 5:**

How is an `if` statement typically structured in Python?

- A) `condition:`
- B) `if condition:`
- C) `if condition then:`
- D) `if then condition:`

**Question 6:**

What is the purpose of the `else` statement in Python?

- A) To specify a condition.
- B) To specify a block of code to be executed when the `if` condition is `True`.
- C) To specify a block of code to be executed when the `if` condition is `False`.
- D) To specify a block of code to be executed regardless of the `if` condition.

**Question 7:**

When might you use an `elif` statement in Python?

- A) When you want to specify a block of code to be executed when the `if` condition is `True`.
- B) When you want to specify a block of code to be executed when the `if` condition is `False`.
- C) When you want to specify multiple conditions to be checked sequentially after an `if` condition.
- D) When you want to specify a condition inside a loop.

### Question 8:

What is the output of the following code?

```
python Copy code  
  
x = 10  
if x > 5:  
    print("x is greater than 5")  
else:  
    print("x is not greater than 5")
```

- A) "x is greater than 5"
- B) "x is not greater than 5"
- C) No output
- D) Error

### Question 9:

What is the output of the following code?

```
python Copy code  
  
y = 20  
if y < 10:  
    print("y is less than 10")  
elif y < 30:  
    print("y is less than 30 but not less than 10")  
else:  
    print("y is greater than or equal to 30")
```

- A) "y is less than 10"
- B) "y is less than 30 but not less than 10"
- C) "y is greater than or equal to 30"
- D) No output

**Question 10:**

Which of the following is not a logical operator in Python?

- A) and
- B) or
- C) if
- D) not

**Answers:**

1. B) True and False
2. A) and
3. B) or
4. A) Returns the opposite Boolean value of its operand.
5. B) `if condition:`
6. C) To specify a block of code to be executed when the `if` condition is `False`.
7. C) When you want to specify multiple conditions to be checked sequentially after an `if` condition.
8. A) "x is greater than 5"
9. B) "y is less than 30 but not less than 10"
10. C) if

## **Appendix I: Verbal Interview Consent Script**

As a group of students from Worcester Polytechnic Institute (WPI) in Massachusetts, United States, we would like to invite you to participate in an interview for our research to learn more about integrating AI into CS classes. The purpose of our research is to understand your viewpoints of ChatGPT. The kind of information that we aim to get from the interview is opinionated views on ChatGPT. We anticipate that the interview should take about 20 minutes.

This is a collaborative project between the Zurich University of Life Science and WPI, and your participation is greatly appreciated. Information from our project will be published in a publicly available academic document at the end of our term and we can share a copy of our results if you are interested. No names or identifying information will appear in any of the project reports or publications unless you give us consent to do so.

Your participation in this interview is completely voluntary and you may withdraw at any time. This also means that you can skip any questions that you want. Do you have any questions for us about this interview? Would you be willing to let us quote your responses in our paper at a later date?

For more information about this research and the rights of research participants, you may contact us by email [gr-aizurich@wpi.edu](mailto:gr-aizurich@wpi.edu) or the Institutional Review Board (IRB) Manager (Ruth McKeogh, Tel. 508-831-6699, Email: [irb@wpi.edu](mailto:irb@wpi.edu)) or Human Protection Administrator (Gabriel Johnson, Tel. 508-831-4989, Email: [gjohnson@wpi.edu](mailto:gjohnson@wpi.edu)). Thank you very much!