



**Cairo University**  
**Faculty of Computers and Artificial**  
**Intelligence**



**Object Oriented Programming**  
**Sent to: Dr. Mohamed El-Ramly**  
**CS213**

- 
- **Assignment:** A1
  - **Task:** T2 & T3
  - **Section:** S23
  - **Project Name:** Some information about Trainings
  - **Names and IDs:**

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- **Task:** T3.
  - **Name:** Aly El-Deen Yasser Aly.
  - **Project Name:** DEPI.
- 

- What will we talk about?
    - 1- What is DEPI?
    - 2- Who offers it and where is its location?
    - 3- What it offers?
    - 4- When will it open and how long will it take?
    - 5- The conditions for application and acceptance and the fees
    - 6- The different learning tracks.
    - 7- The track I chose for this training
-

- **What is DEPI?**

DEPI, short for *Digital Egypt Projects Initiative*, is a national program to empower Egyptian students with cutting-edge digital skills in different technological fields.

It's all about real-world projects and technical training to prepare students for the future job market, particularly in artificial intelligence, data science, software development, and more.

DEPI's mission is to contribute to Egypt's digital transformation by nurturing local talents.

- **Who offers it and where is its location?**

DEPI is offered by the Ministry of Communications and Information Technology (MCIT) of Egypt in collaboration with major tech companies such as Microsoft, Google, IBM, and other industry leaders. These partnerships ensure that the training provided is aligned with global standards and covers the latest advancements in technology.

Most of the training happens online, making it accessible from anywhere in Egypt. This allows flexibility in learning, so whether you're in Cairo, Alexandria, or any other part of the country, you can participate.

However, there are on-site sessions in tech hubs, universities, or government institutions for hands-on practice and networking events.

- **What it offers?**

DEPI offers a wealth of resources, training opportunities, and experiences that can accelerate your tech career in different fields like Data science, Data analysis, Software engineering, Software Testing, Web Development, Photoshop, and different types of other fields. It includes:

**Training and Courses:** Comprehensive learning programs focused on practical skills. You'll get a mix of video lessons, live sessions, and assignments that challenge you to apply your knowledge.

**Real-World Projects:** It doesn't just teach theory. It involves working on actual projects that are aligned with national or global challenges. This gives you a chance to build solutions that have real societal impacts.

**Mentorship:** Throughout your journey, you'll receive guidance from industry experts. Mentors will help you navigate difficult technical challenges and offer career advice.

Networking Opportunities: DEPI connects you with top professionals in Egypt's tech industry and fellow students, opening doors for future collaborations and job opportunities.

Job and Internship Opportunities: DEPI's connections to companies like Microsoft, IBM, and others mean that high-performing students might receive job offers or internships directly through the program and not only this it will train you freelance till you get 200\$ dollars to succeed in it.

So, It is a great chance for me to be a part of it in this cycle.

- **When will it open and how long will it take?**

DEPI opens for applications in cycles. These cycles are announced on the official website of the Ministry of Communications and Information Technology, and other partner platforms. For instance:

Application Period: Applications are usually open a few months before the start of each cycle. You'll need to keep an eye out for announcements to apply on time.

Duration: Most tracks last anywhere from 3 to 6 months depending on the track and the depth of the content. You'll be expected to spend around 10-15 hours per week on coursework and projects. Some advanced tracks may extend beyond this timeframe for specialized training.

- **Conditions for application and acceptance, and fees**

You need to be an Egyptian citizen and typically be a student or recent graduate (second year or higher in university) and it is completely free, If you don't achieve 70% of attendance you will pay 16000 EGP as fees for the course.

Each track has its requirements. For example, for the Data Science track, having a background in programming (preferably Python) might be necessary.

You'll need to demonstrate a strong interest in technology and possibly pass an entrance exam or technical assessment.

- **The different learning tracks.**

DEPI covers a wide array of technological fields. Here are some key tracks offered:

Artificial Intelligence (AI): In this track, you'll delve into machine learning, natural language processing, and AI development. It's ideal if you're interested in creating intelligent systems and automating decision-making processes.

**Data Science:** This track focuses on making sense of vast amounts of data. You'll learn to collect, clean, analyze, and visualize data. It also covers predictive modeling and machine learning algorithms.

**Internet of Things (IoT):** Learn how to build and connect smart devices that interact with each other, forming intelligent networks that can automate homes, factories, and cities.

**Cybersecurity:** A critical field that teaches you how to protect digital systems from attacks. You'll learn about encryption, threat detection, and creating secure digital infrastructures.

**Software Development:** If you love coding, this track will teach you how to build scalable software solutions. You'll cover topics like app development, web programming, and database management.

**Digital Transformation:** Learn how technology can be leveraged to transform traditional industries and improve operational efficiency in fields like finance, healthcare, and education.

And a lot of other different fields that I can't mention them all.

- **The track I chose.**

As a participant in the Data Science track, you're on one of the most exciting paths in tech today. Here are some additional details on what you'll learn:

Core Curriculum:

**Data Collection & Cleaning:** Master techniques for collecting data from various sources, including databases and APIs, and preparing it for analysis.

**Data Visualization:** Learn how to use tools like Matplotlib and Seaborn to create insightful charts and graphs that communicate complex information clearly.

**Exploratory Data Analysis:** Get hands-on experience with Pandas to explore and summarize datasets, discovering patterns and relationships.

**Machine Learning:** Learn supervised and unsupervised learning techniques, including classification, regression, clustering, and dimensionality reduction.

**Statistical Methods:** Understand the foundational statistical concepts like hypothesis testing and probability distributions that are essential for making data-driven decisions.

Tools & Technologies:

You'll be working with Python (a key language for data science) and libraries like Pandas, NumPy, and Scikit-learn.

For database work, you'll gain experience with SQL, and for visualization, you'll use Tableau or Power BI.

### Real-World Projects:

You'll participate in a capstone project, which is a comprehensive, hands-on project where you'll apply your skills to solve a real-world problem using data. This could involve analyzing public health data, customer behavior patterns, or environmental datasets.

### Career Opportunities:

The demand for data scientists is growing rapidly across industries like finance, healthcare, and e-commerce. After completing this track, you'll be equipped with the skills needed to work as a Data Scientist, Data Analyst, or Machine Learning Engineer.

In short, your journey in the Data Science track will be intensive but incredibly rewarding, providing you with both the theoretical knowledge and practical experience needed to excel in this field.

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- **Task : T3**
  - **Name:** Alaa Tarek Mohamed Salah El-Den.
  - **Project Name:** Free Code Camp and LinuxFoundationX.
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### What will we talk about?

1. **Who offers it**
2. **What it offers**
3. **When it opens and how long it is and online or offline**
4. **The conditions for application and acceptance and the fees and conditions if any**
5. **The different learning track**
6. **The track I chose for this training**

- 
- **Who offers it?**

**freeCodeCamp** is offered by the **freeCodeCamp.org non-profit organization**, which was founded in **2014** by **Quincy Larson**. **Quincy Larson** is a former teacher **and** software engineer

who taught himself programming and wanted to help others learn the same skills for free.

**freeCodeCamp** operates as an **open-source, community-driven platform**, relying heavily on volunteers, individual donations, and community contributors to create and maintain its courses.

**Open Source Community:** Developers from around the world contribute to maintaining and improving the curriculum and platform.

**Funding:**

Supported through donations from individuals and companies.

They also run freeCodeCamp **YouTube** and **freeCodeCamp** News (a blog with coding tutorials), offering additional learning resources.

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- **What it offers?**

freeCodeCamp provides a wide variety of coding and technology courses, all free of charge, including:

- **Full Certification Programs:**

1. Responsive Web Design (HTML, CSS, Flexbox, CSS Grid)
2. JavaScript Algorithms and Data Structures
3. Front-End Development Libraries (Bootstrap, React, jQuery)
4. Data Visualization (D3.js)
5. Back End Development and APIs (Node.js, Express.js)
6. Scientific Computing with Python
7. Machine Learning with Python
8. Information Security and Quality Assurance

It is an open source with videos and some code and written content and there is also Github Repository which there is the codes they teach as an open source

Its Github:

<https://github.com/freeCodeCamp>.



- **When it opens and how long it is and online or offline?**

It is available year-round. **Courses are online self-paced** and can be started anytime and there is no offline courses.

It can be accessed from anywhere in the world

Each certification is designed to take **300 hours** of study, but students can learn at their own pace.

Along the way, you'll work on coding challenges and build complete projects to demonstrate your skills.

- **The conditions for application and acceptance and the fees and conditions if any**

There is no conditions or application as it is open source to learn and there is no fees or conditions

You should just be aware of the basic concept of programing to be able to learn by yourself and pave the way for your own self-learning.

- **The different learning track**

### **1. Responsive Web Design**

- **Focus:** HTML, CSS, and web design principles.
- **Projects:** Build portfolio pages, tribute pages, and product landing pages.
- **Certification:** Demonstrates ability to create responsive, accessible websites using modern CSS.

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### **2. JavaScript Algorithms and Data Structures**

- **Focus:** Core JavaScript concepts, algorithms, and data structures.
- **Projects:** Build interactive applications and solve algorithm challenges.
- **Certification:** Proves proficiency in solving algorithmic problems and implementing data structures.

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### **3. Front End Development Libraries**

- **Focus:** React, Redux, Bootstrap, jQuery, and Sass.

- **Projects:** Develop web apps using front-end frameworks and tools.
  - **Certification:** Shows ability to use popular libraries to create functional, dynamic user interfaces.
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#### 4. Data Visualization

- **Focus:** D3.js, JSON APIs, and charts.
  - **Projects:** Create data visualizations and work with APIs.
  - **Certification:** Demonstrates skills in visualizing data effectively using D3 and JavaScript.
- 

#### 5. Back End Development and APIs

- **Focus:** Node.js, Express, and MongoDB.
  - **Projects:** Build APIs and web apps that connect with databases.
  - **Certification:** Validates skills in creating and deploying back-end services.
- 

#### 6. Information Security and Quality Assurance

- **Focus:** Security best practices, Chai, and testing frameworks.
  - **Projects:** Develop secure applications and write unit/integration tests.
  - **Certification:** Demonstrates knowledge in secure coding practices and testing software for quality.
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#### 7. Scientific Computing with Python

- **Focus:** Python fundamentals, libraries (NumPy, Pandas).
  - **Projects:** Build automation scripts and small tools.
  - **Certification:** Validates ability to solve problems using Python.
- 

#### 8. Data Analysis with Python

- **Focus:** Data wrangling, visualization, and statistical analysis.
  - **Projects:** Work with real datasets to create meaningful insights.
  - **Certification:** Proves competence in data analysis and visualization using Python.
-

## 9. Machine Learning with Python

- **Focus:** Machine learning libraries (TensorFlow, Scikit-learn).
  - **Projects:** Build models for predictions and data classification.
  - **Certification:** Shows skills in applying machine learning algorithms and concepts.
- 

## 10. Coding Interview Prep (Additional Track)

- **Focus:** Advanced algorithms and problem-solving skills.
  - **Content:** 3,000+ coding challenges designed to prepare students for technical interviews.
- 

Each track is **self-paced and project-based**, offering practical, real-world experience. Learners earn certificates by completing all the challenges and projects within a track. These tracks are entirely **online and free** with no prerequisites, making them accessible to anyone interested in technology

- **The track I chose for this training**

As a computer science student, I would choose the **Back End Development and APIs** track on freeCodeCamp. Here's why it aligns perfectly with my interests and goals, based on the structure and content available in the freeCodeCamp curriculum:

### **Why This Track?**

#### **Interest in Logic and Systems**

I've always enjoyed tackling logic-heavy problems and designing efficient systems that manage data seamlessly. Backend development emphasizes the internal workings of applications, enabling me to focus on writing algorithms, managing databases, and building reliable APIs. This focus allows me to deepen my understanding of how applications operate behind the scenes.

These technologies are widely adopted in the industry, and becoming proficient in them will give me a competitive edge during internships and job interviews.

#### **Benefits of Learning Backend Development**

- **Portfolio Projects:** I'll have the opportunity to develop practical projects, such as a URL shortener or a message board, to showcase my skills to potential employers.
- **Understanding Full Stack Development:** With a strong foundation in backend technologies, I can later explore frontend tools, paving the way to become a full-stack developer, which is highly sought after in the job market.
- **Deploying Real-World Apps:** The course includes guidance on deploying applications to the cloud, allowing me to see my projects live and accessible to users.

#### **Challenges I Anticipate**

Backend development can present challenges, requiring knowledge of network protocols, database queries, and asynchronous programming. However, I am confident that this track will provide ample hands-on experience to help me navigate these challenges and prepare for real-world software development.

# LinuxFoundationX:

## 1. Who Offers It and Where It Is Offered

The Linux Foundation, a prominent nonprofit organization dedicated to fostering open-source software development, offers these free courses through its **training portal**. Accessible online, these courses can be taken from anywhere, making them ideal for learners globally, including those in Egypt.

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## 2. What It Offers

The free courses cover a range of topics relevant to open-source software and technology, including:

- **Introduction to Linux:** A beginner-friendly course covering the basics of Linux, including file management, command-line usage, and system navigation.
- **Blockchain for Business:** An overview of blockchain technology, its applications, and how it can transform business practices.
- **Open Source Software Development Methods:** A course that explores the principles of open-source software development, including collaboration and community involvement.
- **Kubernetes Fundamentals:** An introductory course on Kubernetes, focusing on its architecture and core concepts.
- **Linux Security Basics:** This course provides foundational knowledge about securing Linux systems and best practices.

These courses aim to equip students with essential skills and knowledge, encouraging them to explore further into specialized areas.

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## 3. When It Opens, Its Duration, and Nature of Delivery

- **Open Enrollment:** Free courses are available for enrollment at any time, allowing students to start learning whenever they choose but there are some courses open on October 14<sup>th</sup> and lasts 14 weeks & it is held online also.
  - **Duration:** Most courses can be completed within a few hours to a couple of weeks, depending on the student's pace and commitment.
  - **Mode:** All courses are delivered **online** and are **self-paced**, enabling flexibility for learners to manage their schedules effectively.
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## 4. Prerequisites

- **Basic Computer Skills:** While many of the courses are designed for beginners, a general familiarity with computers and technology is beneficial.

- **Interest in Open Source:** A genuine curiosity about open-source technology will enhance the learning experience.
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## 5. Application Conditions and Fees

- **Open Access:** There are no formal application conditions; anyone can enroll in the free courses directly on the Linux Foundation's training site.
  - **Fees:** All listed courses are free of charge, allowing students to learn without financial constraints.
- 

## 6. The Learning Track I Would Choose

I would choose the **Introduction to Linux** course as my initial learning track. Given that Linux is a foundational technology in many IT environments, understanding its basics will provide me with a solid grounding for further exploration into system administration, cloud computing, and software development.

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## 7. Why I Picked It

The **Introduction to Linux** course is particularly appealing due to its relevance across multiple domains in technology. Gaining proficiency in Linux will enhance my problem-solving skills and prepare me for more advanced courses and certifications. Furthermore, since it's free, it offers a low-risk opportunity to develop crucial skills that are highly valued in the job market.

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- **Task :** T3
  - **Name:** Fatema El-Zhraa Ahmed Mohamed El-fiky
  - **Project Name:** ITI
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- **What will we talk about?**

- 1-What is ITI?
  - 2-Who offers it and where is its location?
  - 3-What it offers?
  - 4-When will it open and how long will it take?
  - 5-The conditions for application and acceptance and the fees
  - 6-The different learning tracks.
  - 7-The track I chose for this training
- 

- **What is ITI?**

ITI is for information technology institutes. It helps the university students and fresh-graduated students also to have great and valuable courses. It gives the opportunity for the students to be well-qualified for work through a lot of tasks and projects to be implemented by the students.

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- **Who offers it and where is its location?**

The Ministry of Communications and Information Technology offers that trainings . Most of the study is online . Their locations in many governments

in Egypt as Alexandria , Smart village , Assiut ,... ,So it is easy to be available from any place.

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- **What it offers?**

It offers a lot of great opportunities for learning technologies and how to get in deep with them and also opportunities for the real practical life too . It also offers a variety of technologies. As for any student needs that to facilitate the learning process . That opportunities as:

. Trainings and The courses : they provide you a good content that prepare you very well for the technology and through direct applying by assigning tasks , assignments and projects .

. The Mentorship : there are mentors that are available for helping you to understand the missing parts and guide you.

. Roadmap : they provide you a roadmap to go with , this map will make you be able to determine and know what is the next steps to develop more that technology or that filed .

. Connections opportunities : it offers you a good connection with qualified instructors who could help you further more as connections is important .

. Job opportunities: it qualifies you for working in a multinational companies as Microsoft , Google ,Oracle ,.... .

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- **When will it open and how long will it take?**

The ITI opens the registration starting from May. There are two choices. The first choice is to have 9 months training and the second choice is to have 4~3 months training. The first one the acceptance is very narrow but the 4~3 months one has a high possibility of acceptance. There are some constraints will talk about it in the conditions of applications part. The 4~3 months is more condensed than the 9 months as the 9 months concentrate on qualifying the student to be able to work in multinational company.

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- **The conditions for application and acceptance and the fees**

The training conditions :

1. The GPA should be good for all the fields except (3D art-motion graphics-Game Development- Game Art )
2. The students who graduated for the last 5 years .
3. He is prohibited from joining the military service .
4. The student should be Egyptian.

The requirements to apply for the trainings and steps are taken to apply:

1. You start to apply for the training from that link <https://iti.gov.eg/iti/programs/details/9M> .When registration is started.
2. You should upload some papers as personal identification , personal photo, some military papers and the academic qualification.
3. You will choose the place that you will be examined at.
4. You choose at most two technologies as a desire.
5. You will be informed when the exam will be done.

6. You will be informed for the interview in case of success in the exam.
7. Then you will be informed which technology you will take .

The trainings are free scholarship from the ministry of communications and information technology.

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- **The different learning tracks**

The Trainings offers a good variety of different tracks to choose from. As the following :

### **1.Cybersecurity :**

This track focuses on teaching participants the principles of securing digital systems and networks from cyber threats. It covers topics such as network security, cryptography, ethical hacking, incident response, and risk management. Participants will gain hands-on experience in identifying vulnerabilities, implementing security measures, and mitigating risks. The track emphasizes best practices for protecting data, ensuring privacy, and maintaining the integrity of information systems.

### **2. Artificial intelligence:**

The AI and Machine Learning track provides a comprehensive understanding of AI and its applications. It covers concepts like supervised/unsupervised learning, neural networks, deep learning, and natural language processing. Practical aspects include data preprocessing, model evaluation, and optimization. Participants gain hands-on experience and a solid foundation in AI principles. Prerequisites: basic programming, statistics, and linear algebra.

### **3. Game Programming :**

The Game Programming track trains individuals in game development, starting with basic common concepts and advancing to state-of-the-art engines. It covers not just mobile, console, and PC, but also extended reality (VR/AR). Graduates can apply their skills to simulations, architecture, education, and more. The track includes learning advanced game engines (Unity, Unreal) and programming languages (C++ and C#), equipping graduates with versatile capabilities beyond traditional gaming.

#### **4. Software Testing & Quality Assurance :**

This program delves into the core of software testing and QA, empowering you to become a versatile professional. Master various testing roles, from functional testers ensuring software behaves as intended, to automation testers streamlining processes with code. Identify bugs like a pro, guarantee functionality, and champion user satisfaction. Become a key player in building high-quality software and shaping exceptional user experiences

#### **5. Data Science :**

This track focuses on teaching the fundamental concepts of data science. It covers topics such as data exploration, data preprocessing, statistical analysis, machine learning, and data visualization. Participants will gain hands-on experience with popular tools and languages used in data science. The track emphasizes practical application of data science techniques in solving real-world problems, extracting insights from data, and making data-driven decisions.

#### **6. ERP consulting:**

The ERP Consulting track involves providing expertise and guidance in implementing and improving Enterprise Resource Planning (ERP) systems in organizations. It includes assessing enterprise needs, analyzing processes, and recommending suitable ERP system implementation and configuration. The track encompasses user training, documentation development, project monitoring, and change management. It requires deep technical knowledge of popular ERP systems.

## **7. Cloud Architecture :**

This track focuses on teaching participants the principles and practices of designing and implementing cloud-based architecture. It covers topics such as cloud computing models, scalability, security, and cost optimization. Participants will gain hands-on experience with cloud platforms and services, enabling them to design and deploy scalable and resilient cloud solutions. The track also emphasizes best practices for managing and optimizing cloud infrastructure to meet business objectives.

These are some of them not all of them that the scholarship offers . and small brief about the tracks .

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- **The track I chose for this training :**

I choose the ERP consulting track . It goes deep more in organizing complicated systems and Esystems . Moreover , it delves into how to manage the payroll , .. etc. You can manage for some companies as coca-cola , Vodafone, Facebook,.... etc. All of that famous companies their success

depends on the ERP consultants . The famous Erp systems are SAP and Odoo. Odoo is more general for all companies , but SAP is ERP system for Orcale.

To conclude , I am particularly interested in ERP because it combines both technology and business, and I enjoy solving problems that have real-world applications. This track also gives me the opportunity to develop technical skills like database management and business skills like process optimization . ERP is a growing field with constant advancements, offering opportunities for professional development

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- **The AI report :**

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## **Introduction :**

The report is made to compare between 2 AI tools in implementing the polynomial class and its functions which are some constructors (empty, parameterized and copy constructors) and doing some operations on them as we overloaded plus , minus and multiplication . Also , as doing derivatives , evaluating ,doing some integrations and definite integrals, composing polynomials by compose function and get roots for the polynomial functions too . Every AI tool gave a code through different responses different efficiency ,different correctness and also other things that will be discussed in the report.

This report will help us to determine well which AI tool will help and give higher accuracy and of course in shorter time .As we know that we are in the AI era which means that we need some help of the AI as implementing simple things and save our time , so it is important to make that report to decide which one will be able and better to help us.

The report explains the two codes which are generated by the two AI tools . Then we describe the response of each tool from giving the code correct or not and other measures are mentioned in the description. Then there is analysis and comparison between the two AI tools measured according to some standards are mentioned too . Then test analysis to show the codes passed and failed in which cases . Then there is Evaluation for the two AI tools and at the end giving a final thought . at the end in the appendix there will be a link for a drive contains the test case , 2 AI codes and the test code .

## **Used AI Tools :**

We used **Chat GPT** and **Gemini** for implementing the code and everyone has their own response and will be discussed in the description .

## Chat GPT Code Description:

- **Constructors :**

He implemented the empty , parameterized and copy constructors very well .

In the empty initialize the vector with zero values . in the parameterized constructor , he take the vector and give the private vector the passed values by the initializer list . in the copy constructor same way by initializer list he gives the private vector values by passing a polynomial.

- **Assignment operator :**

First , he checks weather both polynomials are not equal , then assign vector of that in that one .

- **Addition operator :**

He loops on the greater index and check if one of them is out of range or not to not access it . and all that in vector and return a polynomial that has that vector .

- **Subtraction operator :**

same way as the addition works , but it subtracts after adding the calling object and subtracts which is passed to the minus operator .

- **Multiplication operator :**

it works with nested loop and the size of the new vector is about the first vector and the second vector minus one .

- **Equality operator :**

it is overloaded through checking equality of the two vectors of the two polynomials .

- **Degree function :**

it returns the degree of the polynomial by returning size of vector minus one .

- **Evaluate function :**

it substitute in the polynomial function by looping from the end of the vector and there is a variable stores the updated value by multiplying the passed value number of the times of the power and that implemented by the line of changing the result value each iteration.

- **Compose function :**

same way of the evaluate function but idea differs as that not value , it is a polynomial function but the same idea .

- **Derivative function :**

it checks weather it is one element or not as to return zero. It loops from the index one as this derivative will have value and the zero indexed will be equal to zero and then multiplies the coefficients by their powers and put them in index less than the iterative index by one only as derivative decreases the power by one . then return a polynomial of that vector .

- **Integral function :**

it loops from the first element and implement the idea of the integration and it puts the values in (i+1) as the index is increased by one and add one to the vector size as all the indexes will increase by one so we will take an extra place

- **Integral function :**

this one is for definite integration takes the limits and have the integration in a polynomial object and then evaluates that objects and return their subtraction .

- **getroot function :**

this one follows newton's method . it gets the derivative of the function . then it iterates and evaluates every time the derivative and the function too. It checks weather the derivative is so small approaches to the zero or not as we divide on that value . then if it is greater than the value (tolerance) , it creates new value to test with it through that equation( $\text{next\_x} = \text{x} - \text{f\_x} / \text{f\_prime\_x}$ ). if the difference between the new x and the old x approaches to zero then it terminates else it continues.



- **Setters :**

it sets the values of the coefficients .

- **Getters :**

it gets the value of certain index of the coefficients but after checking is in the range or not

- **Operator output :**

it counts the polynomial as Xs in their powers and handle some cases as empty vector .

## **Gemini Code Description:**

- **Constructors :**

He implemented the empty , parameterized and copy constructors very well .

In the empty initialize the vector with zero values . in the parameterized constructor , he takes the vector and gives the private vector the passed values by the initializer list . in the copy constructor same way by initializer list he gives the private vector values by passing a polynomial. Same as Chat GPT .

- **Assignment operator :**

He assigns vector of that in that one directly without checking as Chat GPT did.

- **Addition operator :**

He loops on the first vector of the object who called the function and adds in the vector result. then iterates on the other vector of the other polynomial and adds to the vector result. Then it returns a polynomial of that vector.

- **Subtraction operator :**

same way as the addition works , but it adds first in a loop in the result vector ,then it subtracts from the result vector the passed polynomial or vector in another loop . then it returns a polynomial of that vector .

- **Multiplication operator :**

it works with nested loop and the size of the new vector is about the degree of the first polynomial plus the degree of the second polynomial plus one as if there is a constant term .

- **Equality operator :**

it is overloaded through checking equality of the two vectors of the two polynomials as Chat GPT.

- **Degree function :**

it returns the degree of the polynomial by returning size of vector minus one as Chat GPT.

- **Evaluate function :**

It does not that function as direct implementation as he iterates over the vector of the polynomial and add to a variable the coefficient of the function and the power of the passed value that we substitute with.

- **Compose function :**

Th compose function works wrongly at all and it did not give any good response to fix that all was the same meaning and no real difference . he iterates as nested loops as coefficient of first is multiplied by the coefficient of the second and add that to the index of multiplication .Even indexing is wrong it should be plus as if he deals as the function is multiplied and does not have any higher index at all and of course because of the power or the index , it will make the function work wrongly .

So the simple description of the implementation of the code that it multiplies the coefficient of the main polynomial which called the function by the coefficients of the passed polynomial and putting them in index (i\*j).

- **Derivative function :**

It checks weather it is one sized or not as to know to return zero or not . if It is not it continues and makes a vector to put in it the coefficients and return polynomial of that vector. It loops from the first element and multiplies the index by the coefficient and put them in index less than the iterative index by one as the derivative decreases the power.

- **Integral function :**

it loops from the first element and implement the idea of the integration and it puts the values in (i+1) as the index is increased by one ,so it adds two to the degree to be the vector size as all the indexes will increase by one so we will take an extra place. As the degree is the size of vector minus one .and starts loop from index =1 as that will be stored in the result vector and the coefficients will be divided by index but coefficient minus one as we start from index equal one . he made the first element which is indexed by zero to be equal to zero as the new polynomial will not have any constants . I think it is real extra step which is really not important as the vector is initialized by zero.

- **Integral function :**

this one is for definite integration takes the limits. It returns the integral function and evaluated minus the same integral function and evaluated but by the other value .

- **getroot function :**

this one follows newton's method. it iterates and it gets the derivative of the function and evaluates every time the derivative and the function too in every iteration . It checks weather the derivative is so small approaches to the zero or not as we divide on that value . then if it is greater than the value (tolerance) , it creates new value to test with it through that equation( $\text{next\_x} = x - f\_x / f\_prime\_x$ ). if the difference between the new x and the old x approaches to zero then it terminates else it continues.

- **Setters :**

it sets the values of the coefficients .

- **Getters :**

it gets the value of certain index of the coefficients but after checking is in the range or not .

- **Operator output :**

it counts the polynomial as Xs in their powers and handle some cases as empty vector as chat gpt.

## **Description of the Chat GPT Response :**

Chat GPT gave great response . I send a prompt saying to implement that header file , he gave me A full implementation for the code from the first time of response . But he did not handle some case as if the Polynomial is empty . he did not handle that from the first time , so I told him that case , then he gave me an overloading function to print but he added a function to the header file then I asked him to make it in one function. That one that he passed was really not efficient as it was possible to do that by minus one for the loop instead of putting function that check index is included or not. Then when I asked him to implement in one function , he did really that . In the getroot function he failed to get the complex solutions after many responses , but gave only real solution. Then in the degree function he implemented it but it does not handle some cases as if we have vector of coefficients of zeros . it will give unexpected work but after many trials of messaging it did not give any sufficient response.

## **Description of the Gemini Response :**

Gemini needed many responses to implement the whole code . First problem was wrong syntax . it implemented a wrong minus operator overloading . I told him there is a compilation error in that many times . After several responses and messaging him , it fixed the error. Then after that the sent code was not implemented fully, there was missing parts. So, I sent a prompt to complete the missing parts. He did that . The missing parts was the compose function and getroot function. He send the getroot function correct from that response . But after several responses to tell him that the compose function is implemented wrong , He did not give any correct response to that and gave me wrong code also .Also, a problem appeared in the parameterized constructor as , he gave me the parameterized constructor and he removes the leading zeros and that makes the code easier to fall in case of the user wanted to enter for example x power 2 so he will enter two zeros and then the coefficient of the x power of two .

But as a result of removing the leading zeros this will lead to unexpected values. After giving several times Gemini that case will fall , he gave a sufficient response and removed that part of code explaining some cases that will fall . But he failed in getroot to get the complex solutions , it gives only real solution .

Then in the degree function he implemented it but it does not handle some cases as if we have vector of coefficients of zeros . it will give unexpected work but after many trials of messaging it did not give any sufficient response.

There were a problem with the operator of output too but after telling him that will fall at some case, he fixed it .

## **Analysis and Comparison for the two AI Tools of their codes :**

### **Response times :**

Chat GPT has great response , it gave the whole implemented code from the first response while Gemini to give me the whole implementation , it took several responses to give me the whole implementation .Furthermore, it gave me wrong syntax in the code . When there is some case the code fall in chat gives a great response and good solution for that case while Gemini sometimes gives the fixed solution for the case , but many times gives solutions do not fix that at all. Of course Chat GPT too did not give good response for the idea of complex of the getroot and the degree function too as Gemini , but the rest to be comparable Chat GPT had better response in the rest .

### **Efficiency and time of code:**

Chat GPT gave efficient solutions than Gemini. For Example, in the operator of addition and subtraction chat implemented that by one loop with two conditions , Gemini implemented that correctly but in two parallel loops , which differs in constant time. As in Gemini, the constant time will be  $O(2n)$  while in Chat GPT will be  $O(n)$ .

Also, In the getroot function both made the same idea of newton's method . But, as we need the derivative of the function that we gets the root to it . Chat GPT do the derivative before the loop starts and every iteration , it evaluates in the derivative . But Gemini , made for every iteration the derivative and that takes time as now Gemini makes at least hundred iterations if there is no passed value to the parameters of the max iterations and inside the loop we make derivative loop

and evaluate loop , but Chat GPT make the max iteration and inside the loop makes the evaluation loop only .So there is a difference in constant time .

### **Space :**

Chat GPT made an object of polynomial in the function of definite integral to store in it the integration of the polynomial and then returned the evaluation while Gemini did not use an object of polynomial but it called the integration and evaluation twice . in that point they have equal point as one used extra space and one made more time as constant time only , so there is no difference.

### **Correctness :**

Both of the two codes were not able to implement the getroot to get the complex solution but they made the function to get a real solution . Gemini insisted that there is part of code to remove the leading zeros and that will be not correct as if we wanted to write that function equals to  $x^2$  and so the vector will contains two zeros then one , so it will remove so the function become constant function and that is not required.

Also both of them did not implement code of the degree correctly . After many trials , they did not give sufficient response as if there is a passed vector with zeros only , so the degree is zero but as they returns the size they will return the size and say that is the degree ,so they do not handle that case .

Also, In compose function Gemini implemented it wrong . he deals with it as normal coefficients are multiplied and there is power first that we need to decompose that term and then multiply the new coefficients with the coefficients of the main function . it deals as first degree only and multiplies not higher degrees. He did not give sufficient response to fix . on the other hand , Chat GPT gave correct code of compose function

### **Good practice that is followed :**

Chat GPT in the assignment overloaded operator , he put a condition to protect from self assignment as in that case will not affect but it is important as if same data and you assign same data and that was pointer , you could delete what the pointer points to and the passed pointer points to same data which is deleted , so it will make a problem . while Gemini did not followed that practice . But in that case it is correct of course in both of codes .

## **Test Analysis :**

### **Test analysis (from 1 to 50):**

- **Chat GPT test case that it falls at:**

#### **Tests 15, 48, and 16: Root Calculation Failure**

In these tests, ChatGPT failed to calculate the correct roots. The function that was supposed to compute the roots did not provide any output, leading to a failure in solving these equations.

#### **Test 28: Integration Coefficient Printing Error**

In this test, ChatGPT incorrectly printed the coefficient of the term '1' during integration. This is not the expected behavior, as the term '1' should be integrated into the constant term, without explicitly printing the coefficient.

- **Gemini test case that it falls at:**

#### **Test 6: Incorrect Root Calculation**

Gemini incorrectly calculated the root as 1, despite the equation having no solution. This was a clear error in solving the equation.

#### **Test 6: Unexplained Multiplication**

In the same test, Gemini multiplied -11 by 6 without any logical reason, introducing an unjustified step into the calculations.

#### **Test 12: Integration Coefficient Printing Error**

During integration, Gemini printed the coefficient of the term '1' unnecessarily, which should have been simplified into the constant of integration.

#### **Tests 15, 48, and 16: Root Calculation Failure**

Similar to ChatGPT, Gemini also failed to calculate the correct roots in these tests. The function did not produce any valid results.

#### **Test 28: Integration Coefficient Printing Error**

Gemini incorrectly printed the coefficient of the term '1' during integration, repeating the error seen in Test 12.



## Test analysis (from 51 to 100):

### In the Tests (53,55,63,64,66,71,72,78,81 and 84) :

function get root failed In both AI code but the rest of functions are correct as output if we put the function code as a comment

The rest of the tests passed.

### The reasons of the failed test:

- In test 53, 55, 64, 66, 72 and 84:

Polynomial 1 = constant, so there is no variable to get its roots.

- In test 63:

Polynomial 1 =  $-10x^{10} + x^9 - 10x^8 + 9x^7 + x^6 - 3x^5 + 12x^4 - 9x^3 + x^2 - 5x - 13$

Have 6 complex roots so the function failed.

- In test 71:

Polynomial 1 =  $6x^4 - x^3 + 4x^2 - 5x + 7$

Have 2 complex roots and 2-real roots so the function of get roots failed.

- In test 78:

Polynomial 1 =  $-7x^{10} + 5x^9 + x^8 - 6x^7 + 6x^6 - 3x^5 - 9x^4 + 12x^3 + 5x^2 - 2x - 8$

Have 4 real roots and 6 complex roots so the function failed

- In test 81:

Polynomial 1 =  $2x^4 + 2x^3 + 3x^2 - 13x + 13$

Have 2 complex roots and 2-real roots so the function of get roots failed.

## **Evaluation of the two AI tools :**

### **Chat GPT :**

It took to one and half hour to implement the code after trials to get that final code and that final code .of course it falls in some cases for sure but according to time to implement is good . the clean of the code was code . it was readable . according to efficiency , it was so observed in the code in some functions .

According to the fails and the passed tests and the trials it gives 85 % of accuracy and correctness .

### **Gemini :**

It took five hours and half to implement the code after trials to get that final code . it falls of course in cases . but relatively to Chat GPT it falls more in cases and more operations are wrong as the compose function . the code was clean and readable .

According to the fails and the passed test cases and the trials it gives 70 % of accuracy and correctness.

### **Final thought :**

We see that Chat GPT is better than Gemini with a big difference . according to time there is a ratio of one to five which really differs. According to efficiency and best practice Chat also wins in that point . According to the correctness of the code , the most important part , Chat had less mistakes than Gemini and it also took more time and more chance than Chat GPT . but both have same points according to the clean code . Gemini fell more than Chat GPT in the testcases as appeared in the test analysis .

In my opinion , Chat is better than Gemini . Moreover, for personal use Chat is more practical than Gemini .

## Appendix :

Here is the ai codes and the test cases and the test code in that drive link

[https://drive.google.com/drive/folders/1t4tm6\\_BSYLpN5nid6ItXHmkGEnrbdE0X?usp=sharing](https://drive.google.com/drive/folders/1t4tm6_BSYLpN5nid6ItXHmkGEnrbdE0X?usp=sharing)