

# Abstract Class

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## Problem 1: Payment System – “Polymorphic Transactions”

In modern e-commerce platforms, payments can come from multiple sources. Design an **abstract class** `Payment` with a pure virtual function `processPayment()` that represents a general payment transaction.

- **Derived classes:**
  - `CreditCardPayment`: Should simulate entering card details and print a confirmation of processing via a bank gateway.
  - `PayPalPayment`: Should simulate logging into PayPal and confirming the transaction.
  - `BankTransferPayment`: Should simulate direct bank transfer details and verification.

The program should allow the user to choose a payment method dynamically at runtime and then process the payment accordingly, ensuring **runtime polymorphism**.

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## Problem 2: Shape Drawing Application – “Geometric Designer”

Imagine developing a **geometry design tool** for an educational app. Create an abstract class `Shape` with the following **pure virtual functions**:

- `draw()`: Prints how the shape would be drawn.
- `area()`: Calculates and returns the area of the shape.
- **Derived classes:**
  - `Circle`: Uses  $\pi r^2$  to compute area.
  - `Rectangle`: Uses  $l \times w$ .
  - `Triangle`: Uses  $\frac{1}{2} \times \text{base} \times \text{height}$ .

The program should maintain a **collection of shapes** (using pointers or references) and demonstrate polymorphism by iterating through them to **draw each shape** and **calculate its area**.

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## Problem 3: Vehicle Rental System – “Polymorphic Rentals”

You are tasked with creating a vehicle rental system for a transportation company. Define an abstract class `Vehicle` with the following **pure virtual functions**:

- `getRentalRate()`: Returns cost per day.
- `displayDetails()`: Displays type-specific details.
- **Derived classes:**
  - `Car`: With attributes like model and daily rental rate.
  - `Bike`: With attributes like type (sports/commuter) and rate.

- **Truck**: With attributes like load capacity and rate.

The system should allow a customer to rent multiple vehicles, calculate the **total rental cost for a given number of days**, and display a detailed receipt.

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## Problem 4: Online Learning Platform – “Abstract Courses”

A university wants to simulate an online learning platform where students can enroll in different types of courses. Define an abstract class **Course** with **pure virtual functions**:

- **getCourseContent()**: Returns a summary of the syllabus.
- **getDuration()**: Returns duration in weeks.
- **Derived classes**:
  - **ProgrammingCourse**: Covers coding fundamentals with a duration of 12 weeks.
  - **MathCourse**: Covers algebra, calculus, and statistics with a duration of 10 weeks.
  - **HistoryCourse**: Covers world history with a duration of 8 weeks.

The program should allow students to **enroll in multiple courses**, and then display their **learning dashboard** with the course list, duration, and content.

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## Problem 5: File Compression Tool – “Virtual Compressors”

A software company wants to build a tool that supports different compression formats. Create an abstract class **Compressor** with **pure virtual functions**:

- **compress()**: Simulates file compression.
- **decompress()**: Simulates file extraction.
- **Derived classes**:
  - **ZipCompressor**: Should simulate **.zip** format compression.
  - **RarCompressor**: Should simulate **.rar** format compression.
  - **TarCompressor**: Should simulate **.tar** format compression.

The system should allow users to **choose a format** dynamically, and then perform both compression and decompression on a file name entered by the user. This ensures flexibility and demonstrates polymorphism in action.

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