Introduction of Object-Oriented Programming

Chapter 1

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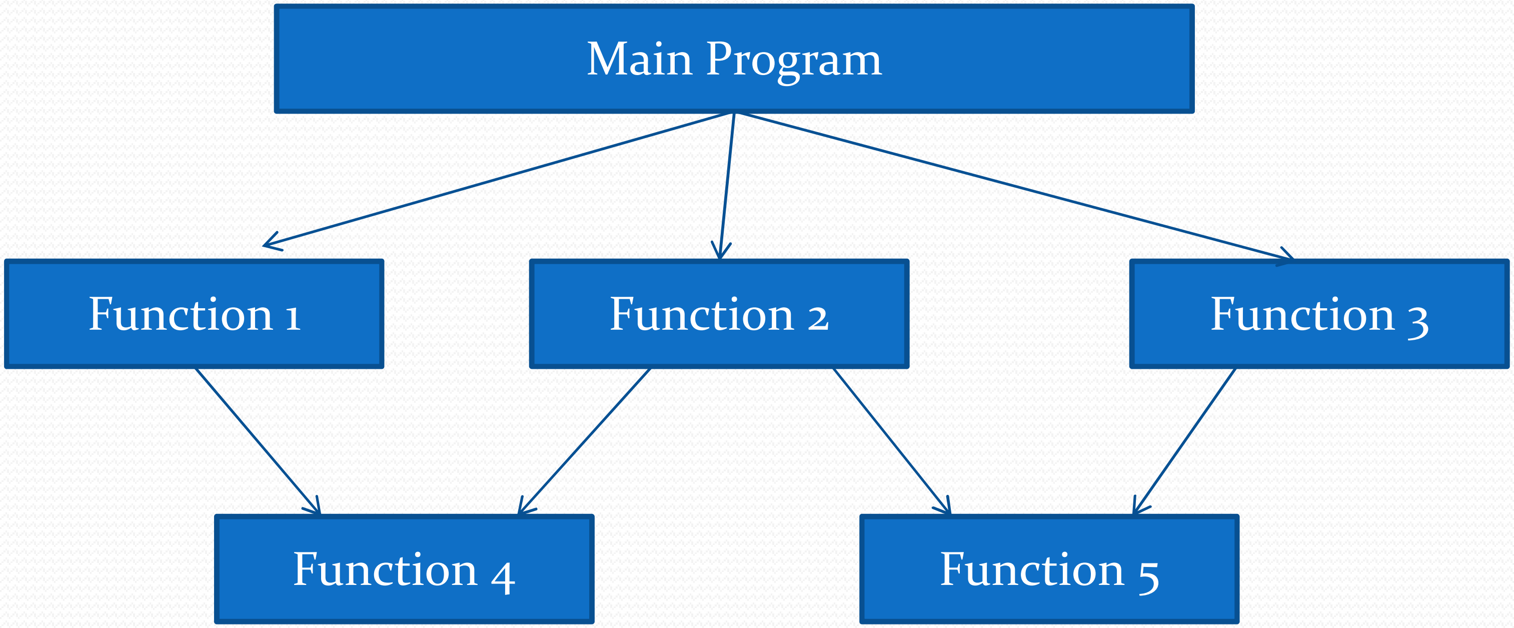
Procedure Oriented Programming (POP)

- Conventional programming using high level languages such as COBOL, FORTRAN and C, is commonly known as procedure-oriented programming (POP).
- In the procedure-oriented approach, the problem is viewed as a sequence of things to be done such as reading, calculating and printing.
- A number of functions are written to accomplish these tasks.
- The primary focus is on functions.

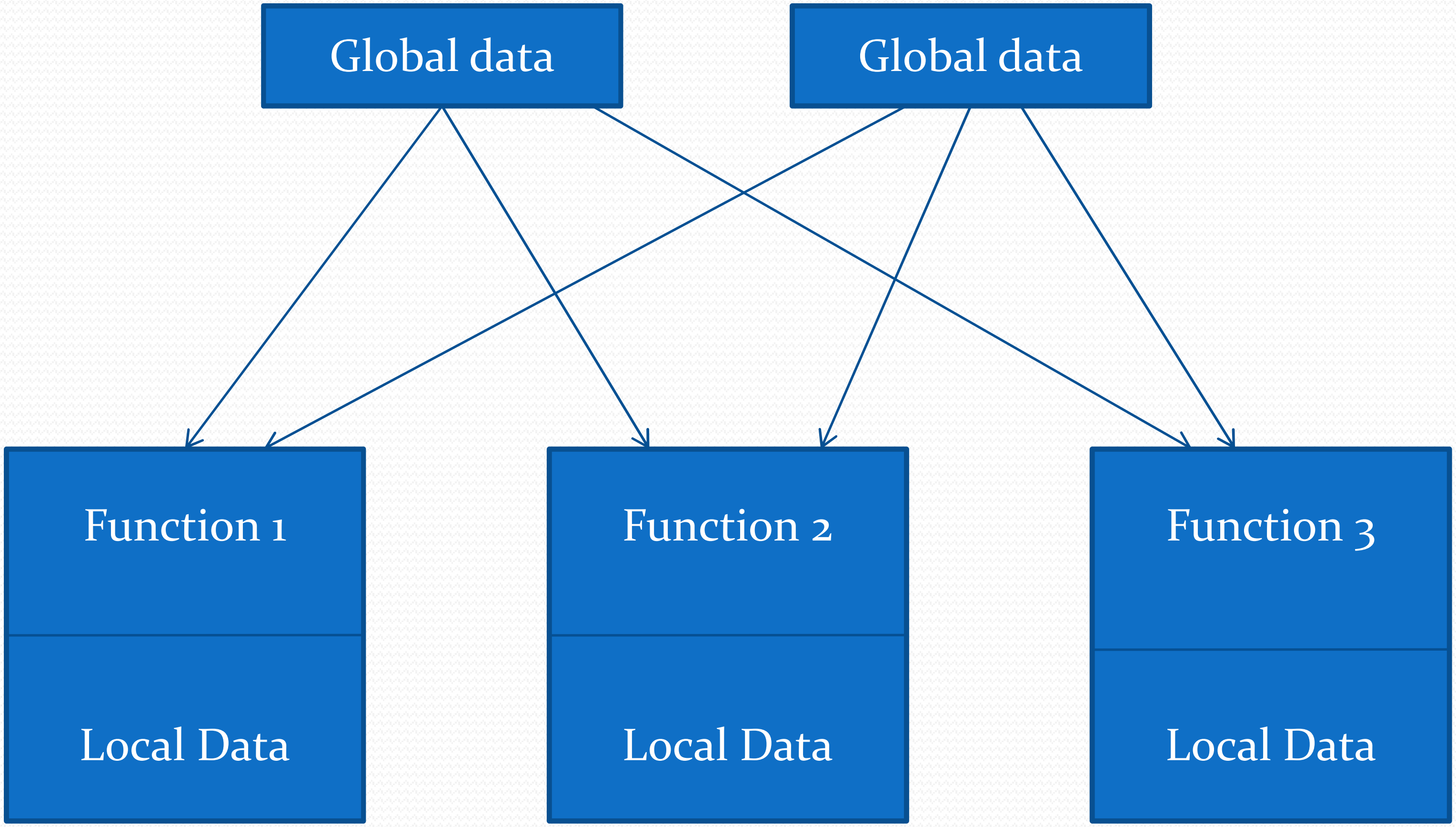
Typical Structure of Procedure-Oriented Programs



Drawbacks

- In multi-function program, many important data items are placed as global so that they can be accessed by all the function.
- Global Data is vulnerable to an inadvertent change by a function.
- Another serious drawback with procedural approach is that it does not model real world problems very well.
- This is because functions are action-oriented and do not correspond to the elements of the problem.

Relationship between data and functions in procedural programming



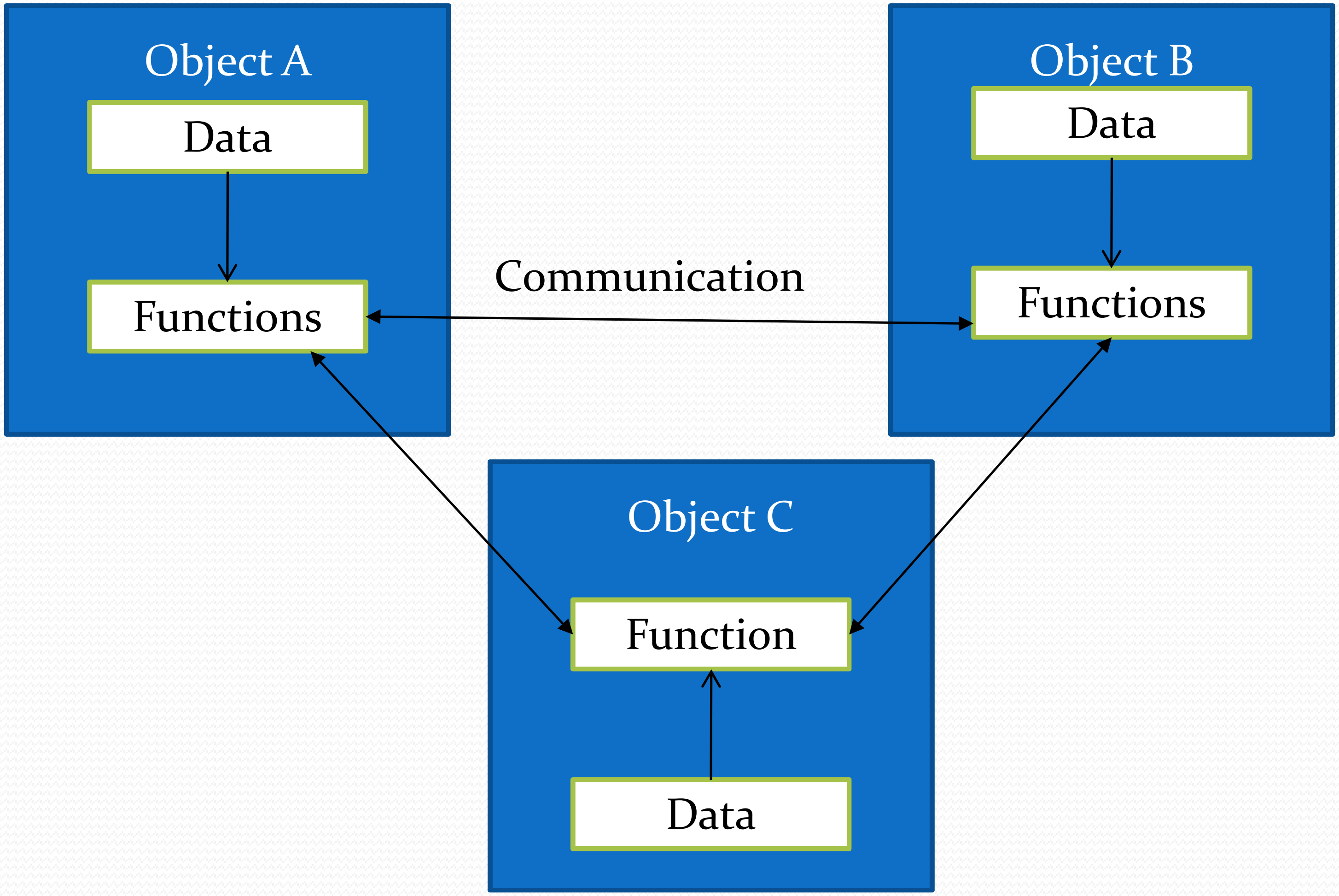
Characteristics of POP

- Emphasis is on doing things (algorithms).
- Large programs are divided into smaller programs known as functions
- Most of the functions share global data
- Data moves openly around the system from function to function
- Functions transform data from one function to another.
- Employs top-down approach in program design.

Object Oriented Programming (OOP) Paradigm

- *Object Oriented Programming is an approach that provides a way of modularizing programs by creating partitioned memory are for both data and functions that can be used as templates for creating copies of such modules on demand.*

Organization of data and functions in OOP



Striking features of OOP

- Emphasis is on data rather than procedure
- Programs are divided into what are known as objects.
- Data structures are designed such that they characterize the objects.
- Functions that operate on the data of an object are tied together in the data structure.
- Data is hidden and cannot be accessed by external functions
- Objects may communicate with each other through functions.
- New data and functions can be easily added whenever necessary.
- Follows bottom up approach in program design

Basic Concepts of OOP

- It is necessary to understand some of the concepts used extensively in object oriented programming. These include:
  - Object
  - Class
  - Data abstraction and encapsulation
  - Inheritance
  - Polymorphism
  - Dynamic binding
  - Message Passing

Objects

- Objects are the basic runtime entities in an object oriented system.
- They may represent a person, a place , a bank account, a table of data or any item that the program has to handle. They may also represent user defined data such as vectors, time and lists.
- Programming problems is analyzed in terms of objects and the nature of communication between them.
- Program objects should be chosen such that they match closely with the real world objects.

Object

- When a program is executed the objects interact by sending messages to one another.
- For example, if " customer" and "account" are two objects in a program, then the customer object may send a message to the account object requesting for the bank balance.
- Objects interact without having to know details of each other's data or code.

Classes

- We mentioned that objects contain data and code to manipulate that data.
- The entire set of data and code of an object can be made a user defined data type with the help of a class.
- Objects are variables of the type class.
- Once class has been defined we can create any number of objects belonging to that class.
- Class is collection of objects of similar types.

Data Abstraction and Encapsulation

- The wrapping up of data and functions into a single unit (called class) is known as encapsulation.
- Data encapsulation is most striking feature of a class. The data is not accessed to the outside world and only those functions which are wrapped in the class can access it.
- The insulation of data from direct access by the program is called data hiding or information hiding.

Data Abstraction and Encapsulation

- Abstraction refers to the act of representing essential features without including the background details or explanations
- Since classes use the concept of data abstraction, they are known as Abstract Data Types (ADT).

Inheritance

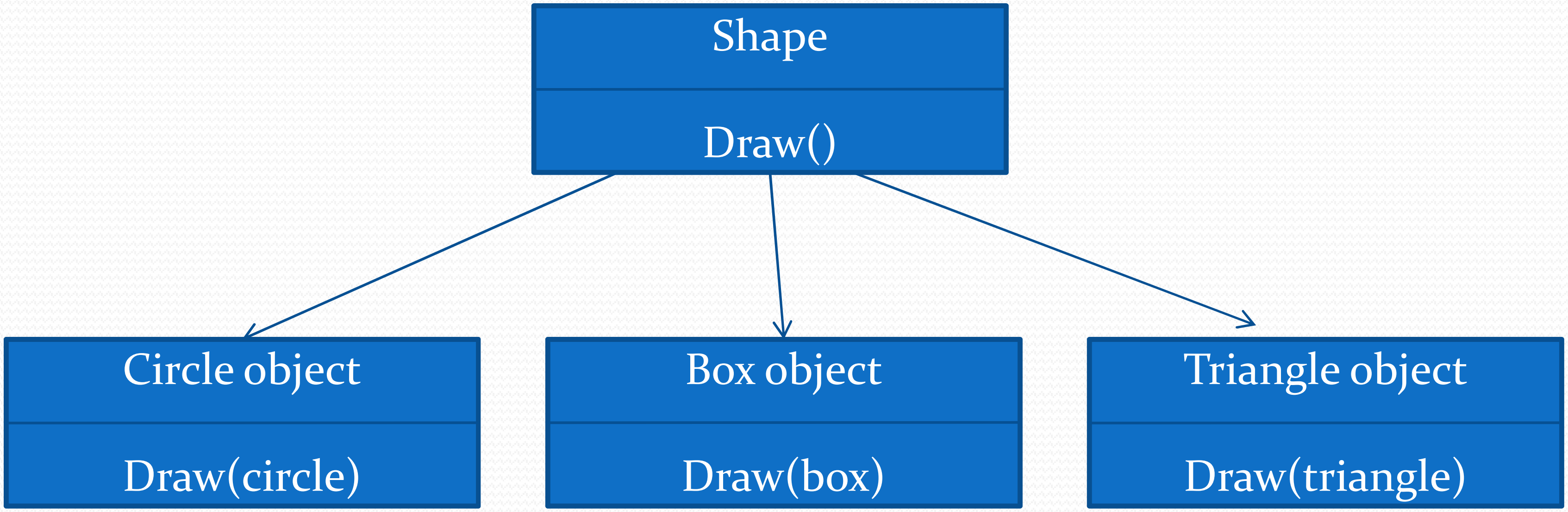
- Inheritance is a process by which object a of one class acquire the properties of objects of another class.
- It supports the concept of hierarchical classification.
- For example the bird robin is a part of class flying bird which is again a part of the class bird.
- The principal behind inheritance is that each derived class shares common characteristics with the class from which it is derived.
- Inheritance provides the idea of reusability.
- It is the process of adding new features to the existing cless without modifying it.

Polymorphism

- Polymorphism is another important OOP concept.
- Poly in Greek , means many and morph means forms. Polymorphism means the ability to take more than one form.
- For example + operator is used for addition of two numbers, also the same operator is used for concatenation of two strings.
- Polymorphism plays an important role in allowing objects having different internal structures to share the same external interface.

Polymorphism

- In polymorphism general class operations may be accessed in the same manner even though specific actions associated with each operations may differ. Polymorphism is used in implementing inheritance.



Dynamic Binding

- Binding refers to the linking of procedure call to the code to be executed in response to the call.
- Dynamic binding (also known as late binding) means that the code associated with a given procedure call is not known until the time of the call at runtime.
- It is associated with polymorphism and inheritance.

Message Passing

- An object-oriented program consists of objects that communicate with each other.
- The process of programming in an object-oriented language , therefore involves the following basic steps:
  - Creating classes that define objects and their behaviors
  - Creating objects from class definitions and
  - Establishing communication among objects.

Benefits of OOP

- Through inheritance we can eliminate redundant code and extend the use of existing classes
- The principle of data hiding helps programmers to build secure code that cannot be accessed by other parts of program.
- It is possible to map object in the problem domain to those in the program
- Object oriented systems can easily upgrade from small to large systems.
- Software complexity can be easily managed.

Object Oriented Languages

Characteristics	Simula	Small talk	Objective C	C++	Ada	Object Pascal	Turbo Pascal	Eiffel	Java
Binding	Both	Late	Both	Both	Early	Late	Early	Early	Both
Polymorphism	✓	✓	✓	✓	✓	✓	✓	✓	✓
Data Hiding	✓	✓	✓	✓	✓	✓	✓	✓	✓
Concurrency	✓	Poor	Poor	Poor	Difficult	No	No	Promised	✓
Inheritance	✓	✓	✓	✓	No	✓	✓	✓	✓
Multiple Inheritance	No	✓	✓	✓	No	---	---	✓	No
Garbage Collection	✓	✓	✓	✓	No	✓	✓	✓	✓
Persistence	No	Promised	No	No	Like 3GL	No	No	Some Support	✓
Genericity	No	No	No	✓	✓	No	No	✓	No

Applications Of OOP

- Real-time System
- Simulation and modeling
- Object-Oriented databases
- Hypertext, hypermedia and expertext
- AI and expert systems
- Neural Networks and Parallel programming
- Decision support and office automation systems
- CIM/CAM/CAD systems