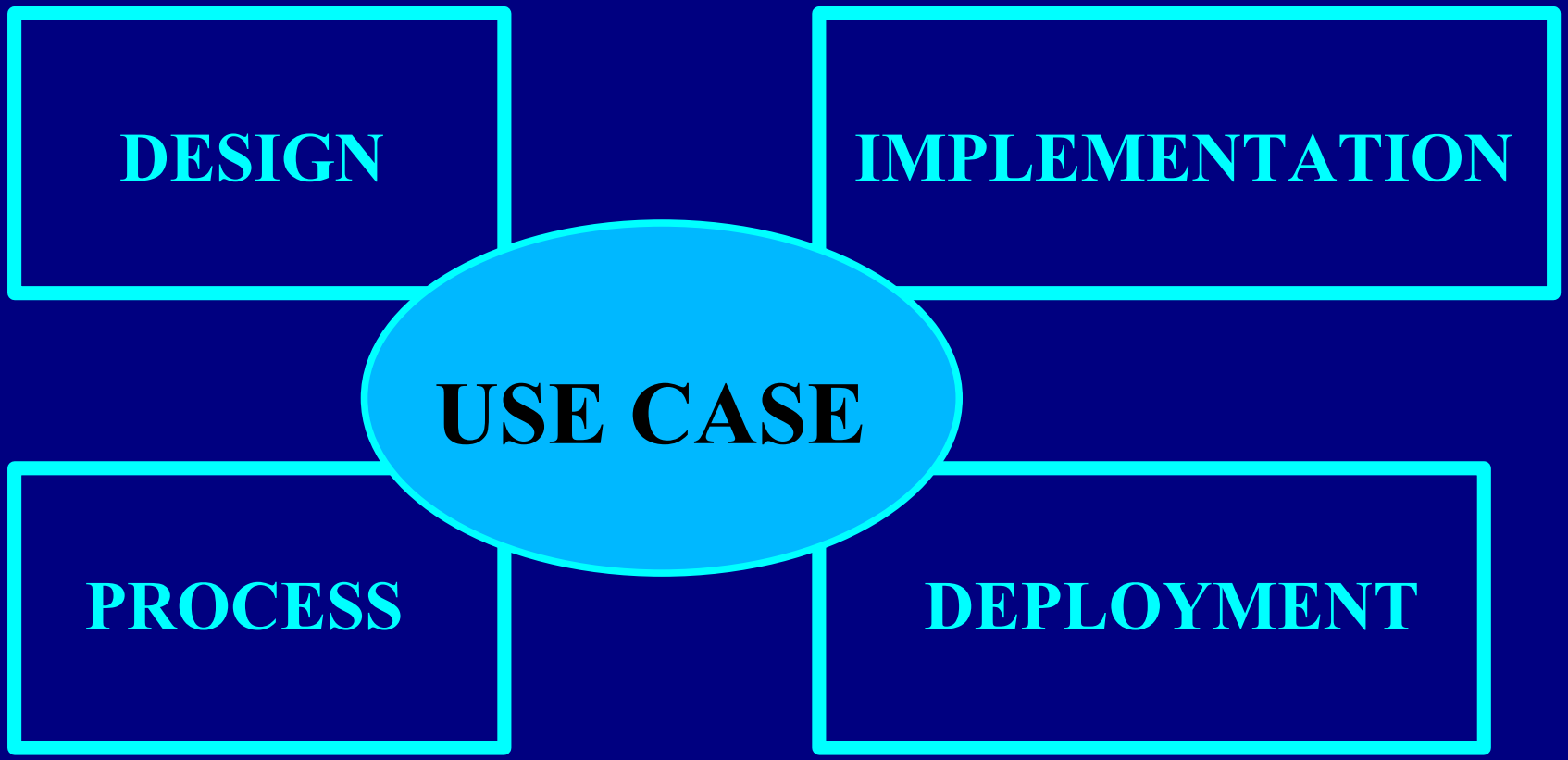
Five UML Views of a System



UML Views of a System

The architecture of a system is the fundamental organization of the system as a whole.

The five UML Views:

- Use Case View: focuses on scenarios
- Design View: focuses on the vocabulary
- Process View: focuses on timing & control
- Implementation View: focuses on physical system
- Deployment View: focuses on geographic distribution.

Unified Process

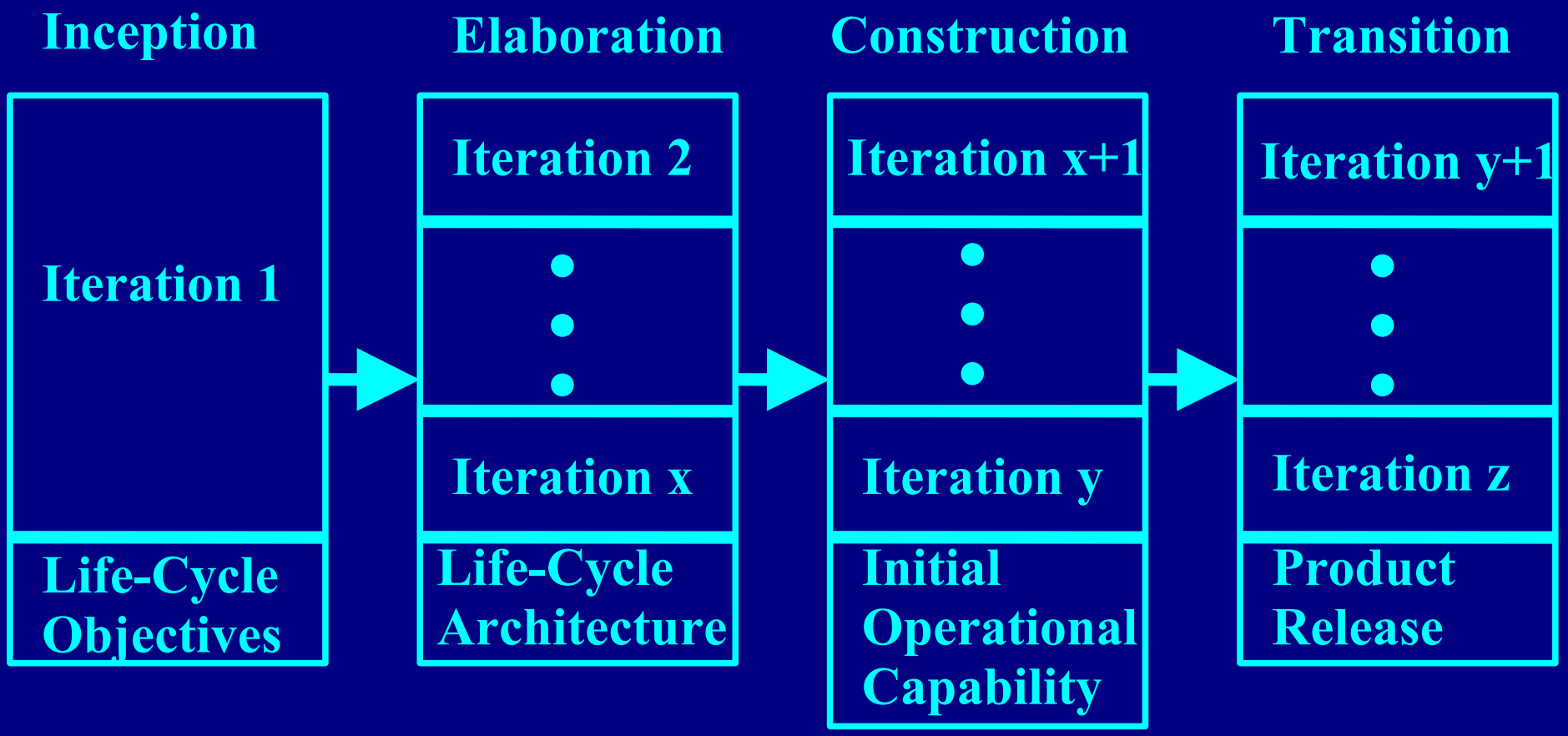
Key Features

- Use Case Driven
- Architecture-centric
- Iterative and Incremental

Four Phases (span between milestones)

- Inception
- Elaboration
- Construction
- Transition

Phases & Major Milestones



Inception

Primary goal is to establish the case for the viability of the proposed system.

- **Define the scope of the system.**
- **Outline a candidate architecture.**
- **Identify critical risks and how to address them.**
- **Start to make the business case that the project is worth doing based on initial estimates of cost, effort, schedule, and product quality.**

Inception Milestones

Life-Cycle Objectives

- The major stakeholders agree on the scope of the proposed system.
- The candidate architecture clearly addresses a set of critical high-level requirements.
- The business case for the project is strong enough to justify a green light for continued development.

Elaboration

Primary goal is to establish the ability to build the new system given the financial constraints, schedule constraints, and other kinds of constraints.

- Capture a healthy majority of the remaining requirements.
- Expand the candidate architecture into a full architectural baseline (internal release of the system focused on describing the architecture).
- Address the risks on an ongoing basis.
- Finalize the business case, prepare a project plan.

Elaboration Milestones

Life-Cycle Architecture

- Most of the functional requirements for the new system have been captured in the use case model
- The architectural baseline is a small, skinny system that will serve as a solid foundation for ongoing development.
- The business case has received a green light, and the project team has an initial project plan that describes how the Construction phase will proceed.

Construction

Primary goal is to build the system that is capable of operating successfully in beta customer environments.

The major milestone is called the Initial Operational Capability. More or less fully operational in beta customer's hands.

Transition

Primary goal is to roll out the fully functional system to customers.

The major milestone is called the Product Release.

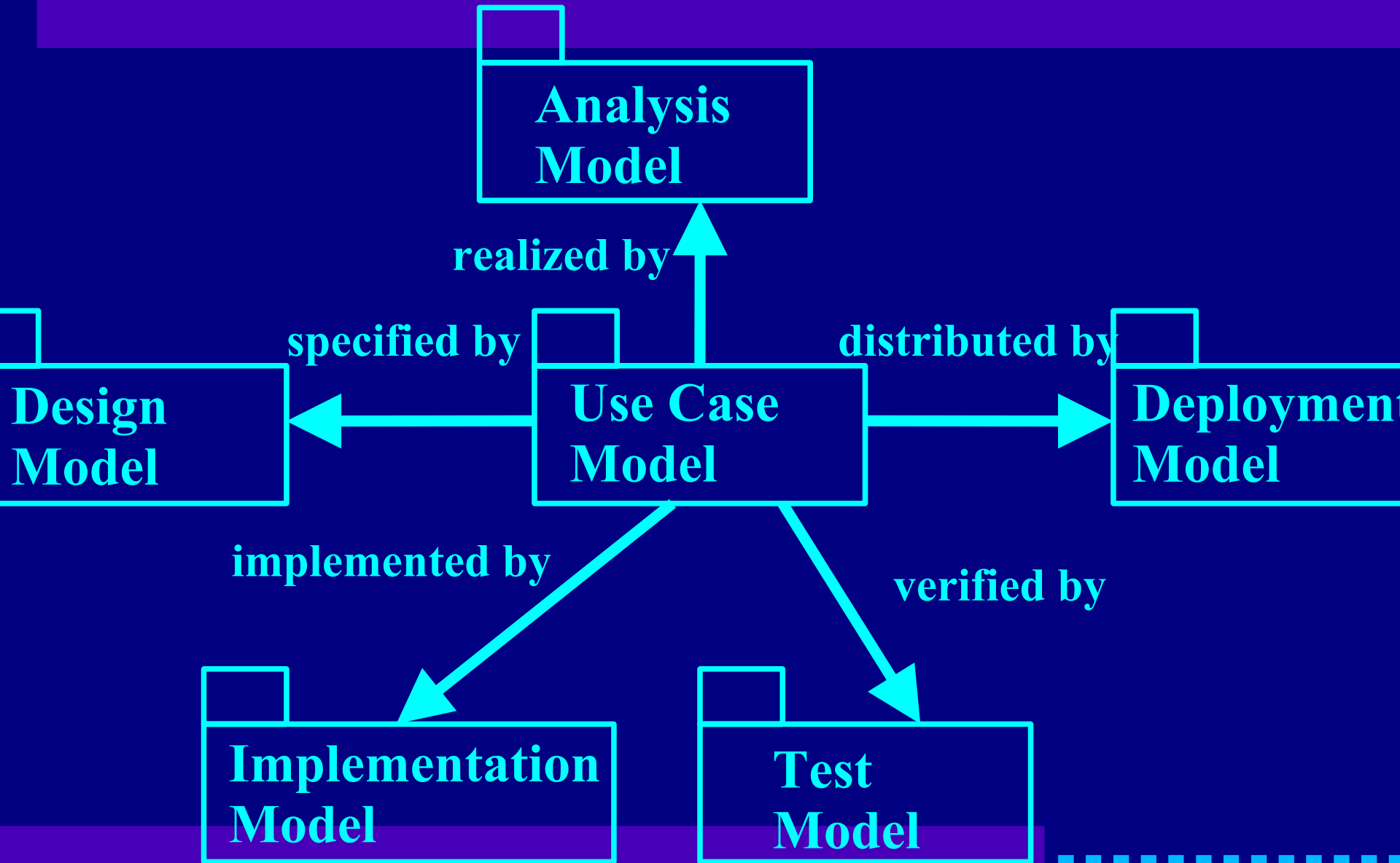
Five Work Flows

Each work flow is a set of activities that various project workers perform.

- **Requirements**
- **Analysis**
- **Design**
- ***Implementation***
- ***Test***

These five work flows are associated with six kinds of UML models.

Six Basic Unified Process Models



Requirements Work Flow

- Aimed at building the Use Case Model.
- Captures the functional requirements of the system being modeled.
- Serves as the foundation for all other development work (see previous slide)
- Prototyping activities are a part of the requirements work flow.

Analysis Work Flow

- Aimed at building the Analysis Model.
- Helps developers refine and structure the functional requirements captured in the use case model.
- Realizations of the use cases that lend themselves better to design and implementation.

Design Work Flow

- Aimed at building the Design Model.
- Describe the physical realizations of the use cases.
- Describe the physical realizations of the contents of the analysis model.
- Serves as an abstraction of the implementation model.
- Also focuses on the Deployment Model which defines the physical organization of the system in terms of computational nodes.

Implementation Work Flow

- *Aimed at building the Implementation Model.*
- *Describes how the elements of the design model are packaged into software components.*
  - **source code files**
  - **dynamic link libraries (dlls)**
  - **enterprise Java Beans (ejbs)**

Test Work Flow

- Aimed at building the Test Model
- Describes how integration and system tests will exercise executable components from the implementation model.
- Describes how the team will perform tests.

The test model contains test cases often derived directly from the use cases.

Identifying Relevant Real-World Things

An *object is simply a real-world thing or concept.*

- *An object has identity. Generally takes the form of a human-readable name.*
- *An object has state. The various properties that describe the object (attributes) and the values of those attributes at some point in time.*
- *An object has behavior. Represented by functions (methods) that use or change attributes.*

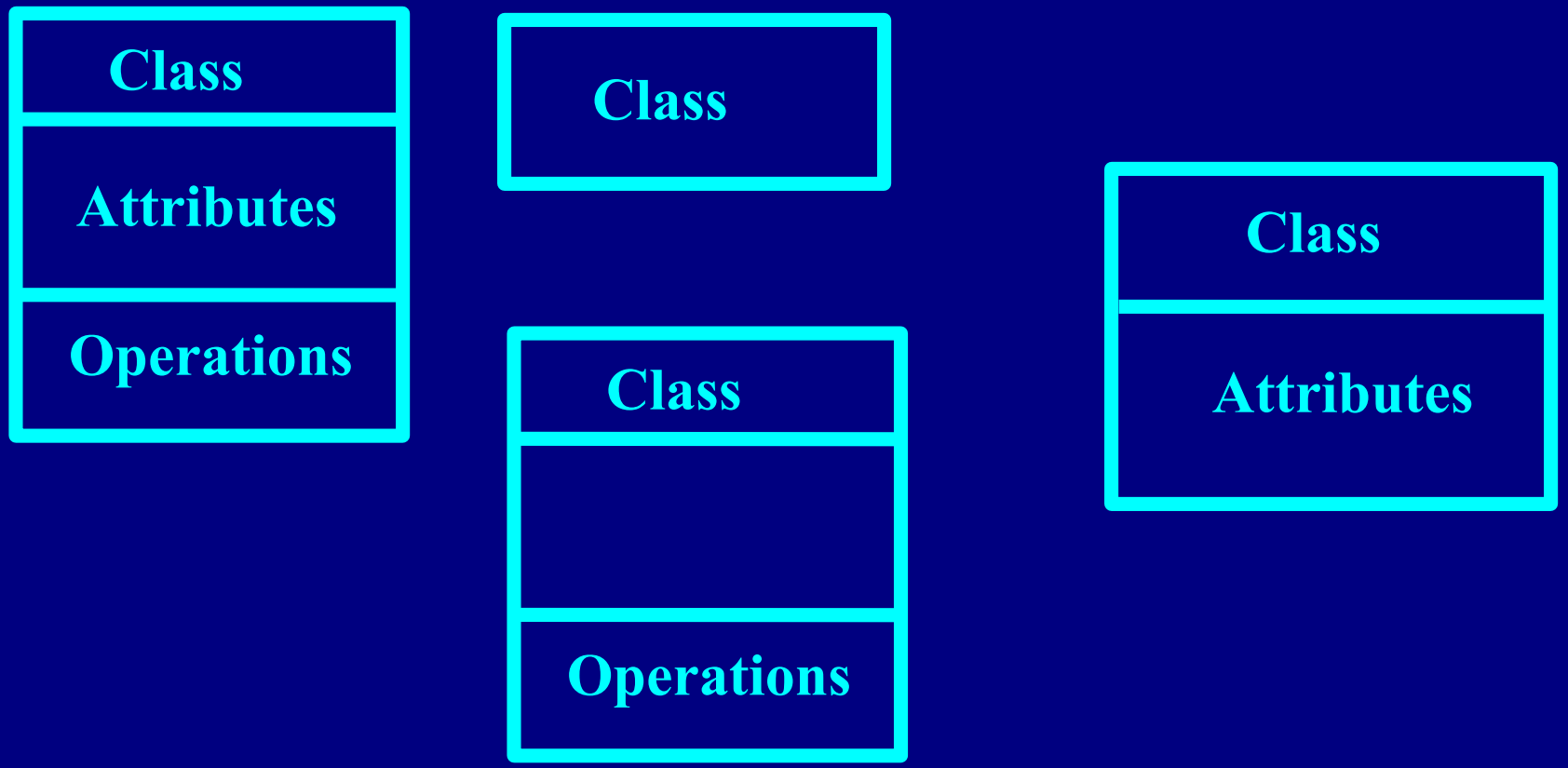
Classes

A class is a collection of objects that have the same characteristics.

An object that belongs to a particular class is often referred to as an instance of that class.

UML's standard notation is a box with three parts (seen before).

UML Class Notations



Class Relationships

Associations

- Structural connection between classes.
- Shown as a line between classes.
- If no arrow, then the association is bidirectional.
- Can have adornments
  - Name: indicating nature of relationship.
  - Roles: the faces that classes present to other classes.
  - Multiplicity: How many objects associated with each class can be present within the association.

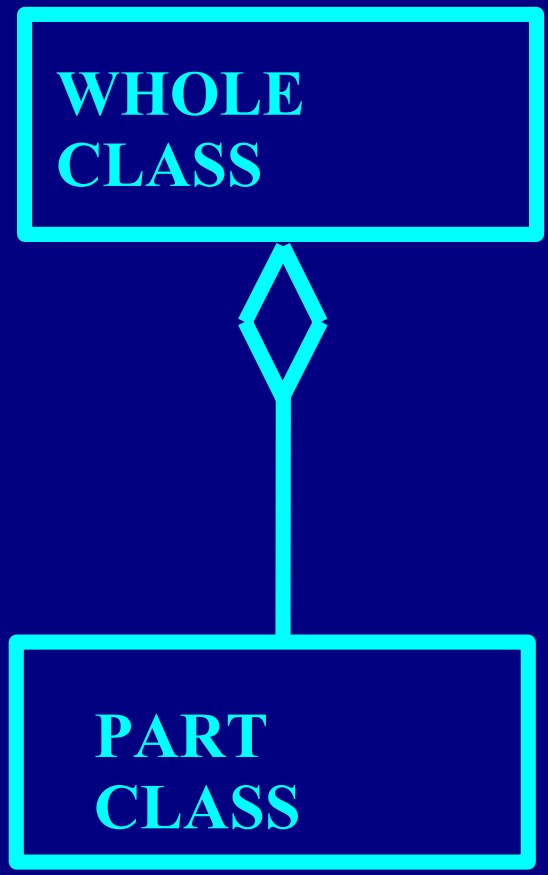
Fixed Value (1 or 3)	Range of values (3..*)
Many (*)	Set of values (2,4,6,8)

Aggregation

An *aggregation is a special kind of association – a "whole/part" relationship within which one or smaller clases are "parts" or a larger "whole".*

UML notation for an aggregation is an open diamond at one end of the line connecting the classes. The class next to the diamond is the "whole" class. The class at the other end is the "part" class.

AGGREGATION



Generalization

Generalization refers to a relationship between a general class (the superclass or parent) and a more specific version of that class (the subclass or child).

The subclass is a kind of the superclass.

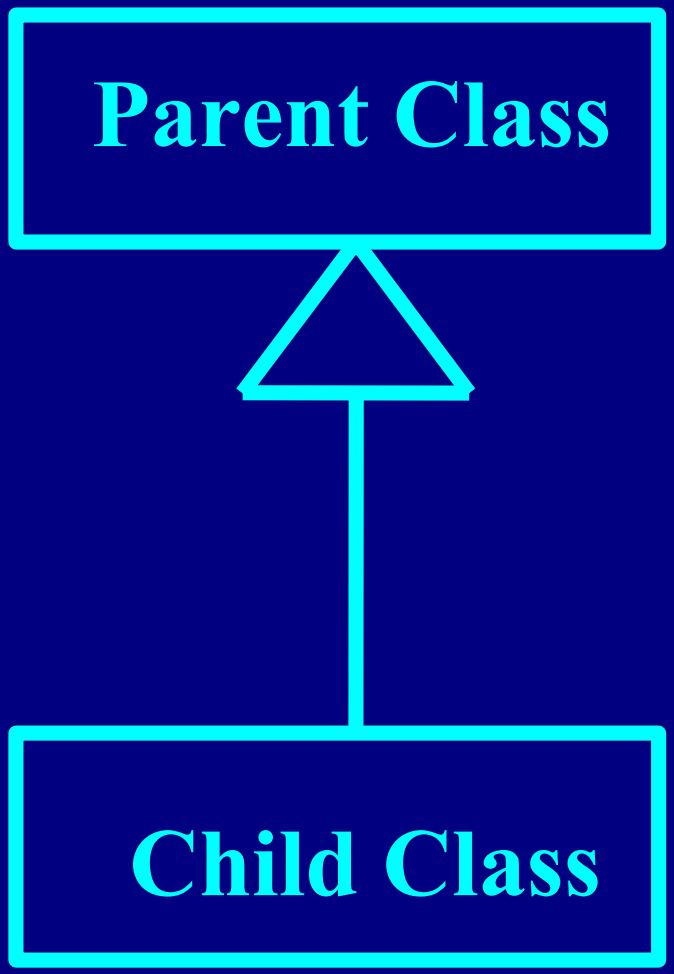
A subclass inherits the attributes and operations from one super class (single inheritance) or from more than one (multiple inheritance).

Generalization (cont.)

Two important principles of generalization:

- **Substitutability states that an object of a subclass may be substituted anywhere an object of an associated superclass is used.**
- **Polymorphism states that an object of a subclass can redefine any of the operations it inherits from its superclass(es).**

UML Generalization Notation

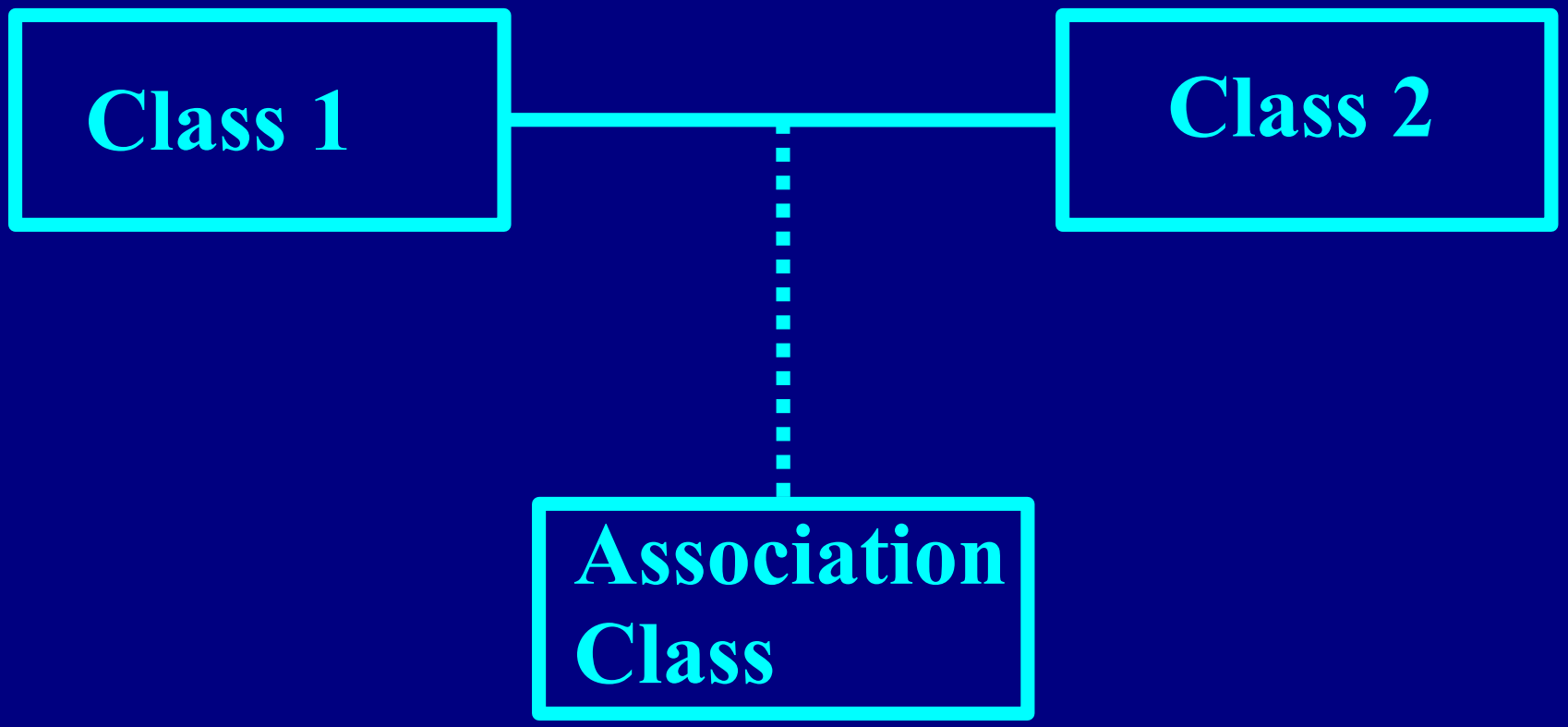


Association Classes

An association class is a cross between an association and a class. You use it to model an association that has interesting characteristics of its own outside the classes it connects.

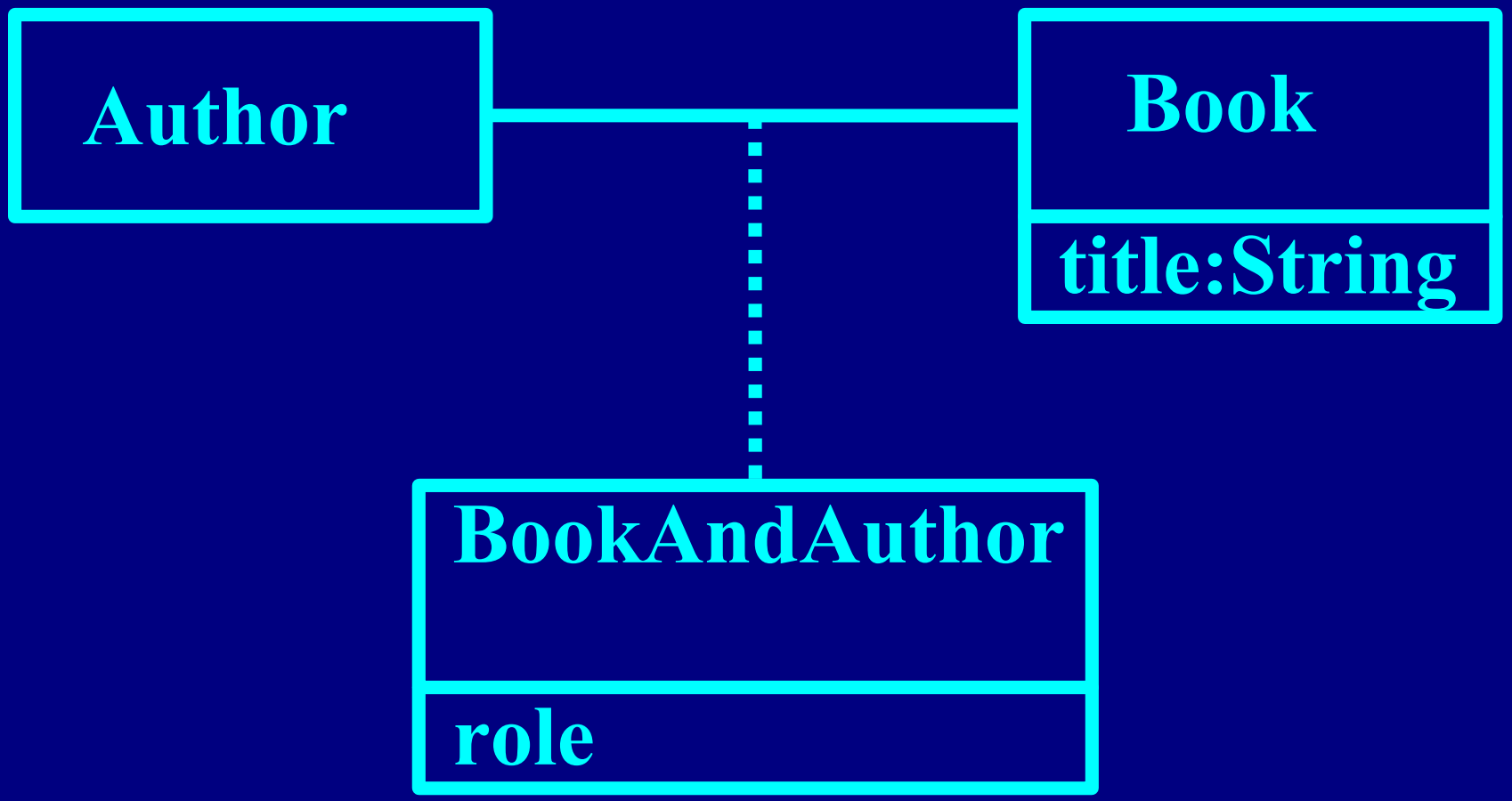
It is handy to break a many-to-many relationship into a set of one-to-many relationships.

UML Association Class Notation



Association Class Example

Online Bookstore



Example notes

- Normally there would be a many-many relationship between Author and Book.
  - An Author may have written more than one Book.
  - A Book may have one or more Authors.
- The presence of the BookAndAuthor association class allows us to pair one Author with one Book. The *role attribute gives us the option of stating whether the Author was the primary or supporting author or something else (editor).*

UML Class Diagram

A class diagram shows classes and the various relationships in which they are involved.

Class diagrams are the primary means by which you show the structure of a system being developed.

Class Diagram Example

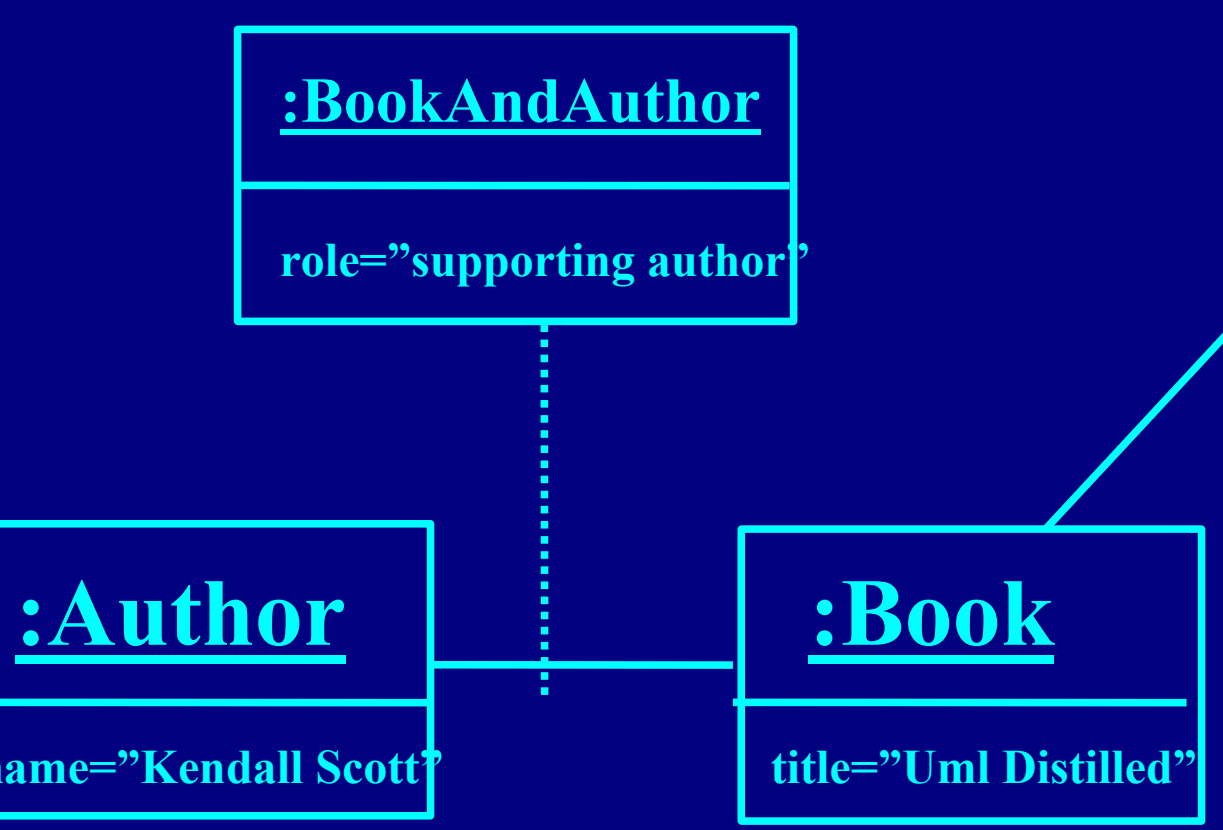
Online Bookstore

Object Diagrams

Similar to Class diagram with name of the class to which object belongs after a colon and contents of top box underlined.

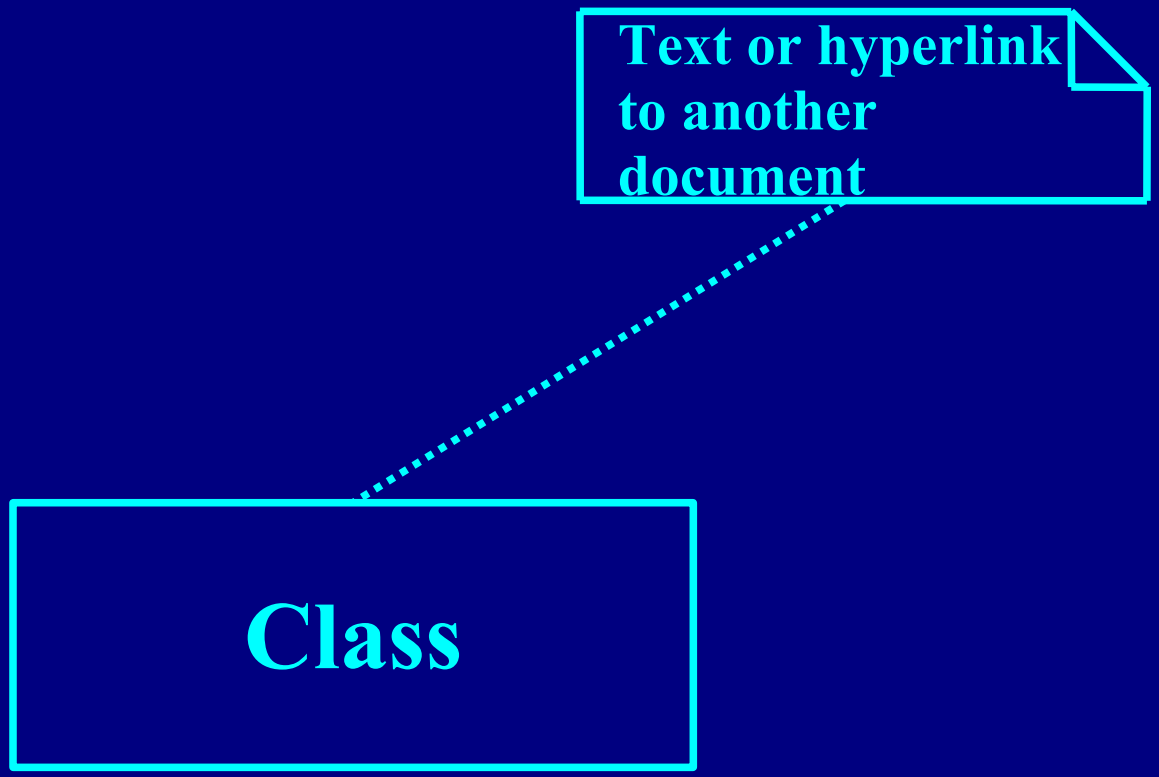
Sample Object Diagram

Online Bookstore

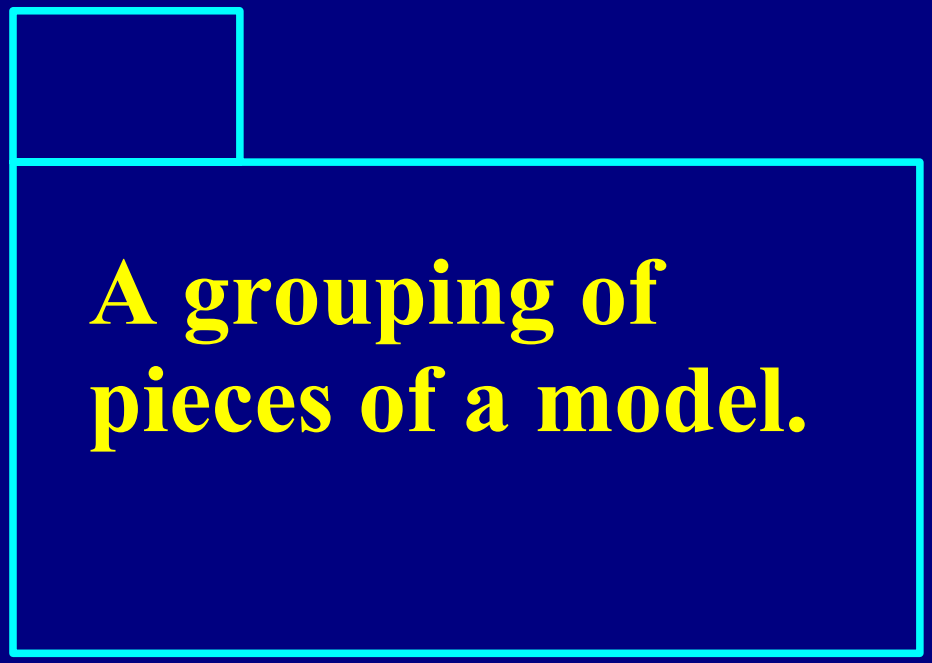


Only 1 of the four objects has a name. The others are anonymous.

UML Notes



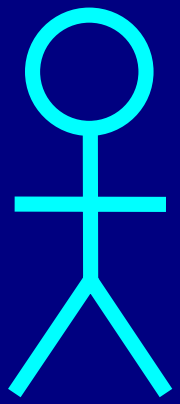
UML Packages



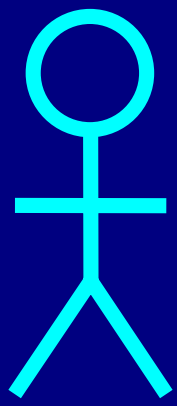
Capturing Requirements

ACTORS AND USE CASES. An actor represenents one of two things:

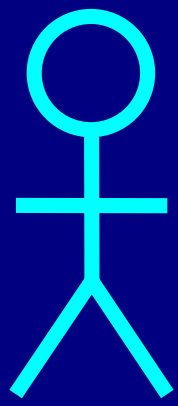
- **A role that a user can play with regard to the system.**
- **An entity, such as another system or a database, that resides outside the system.**



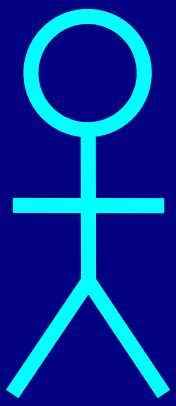
Sample Actors



Customer



Shipping System



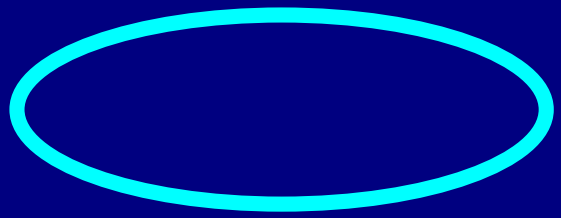
Accountant

Use Cases

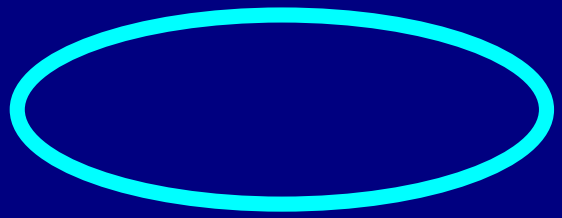
A use case is a sequence of actions that an actor performs within a system to achieve a particular goal.

- Search by Author
- Produce Shipping Manifest
- Pring GL Report

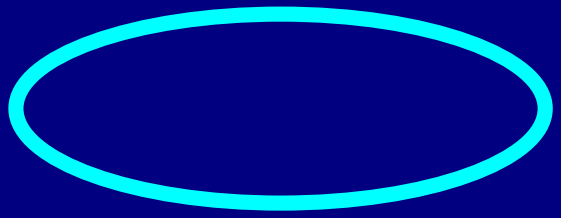
Sample Use Cases



Search By Author



Print GL Report



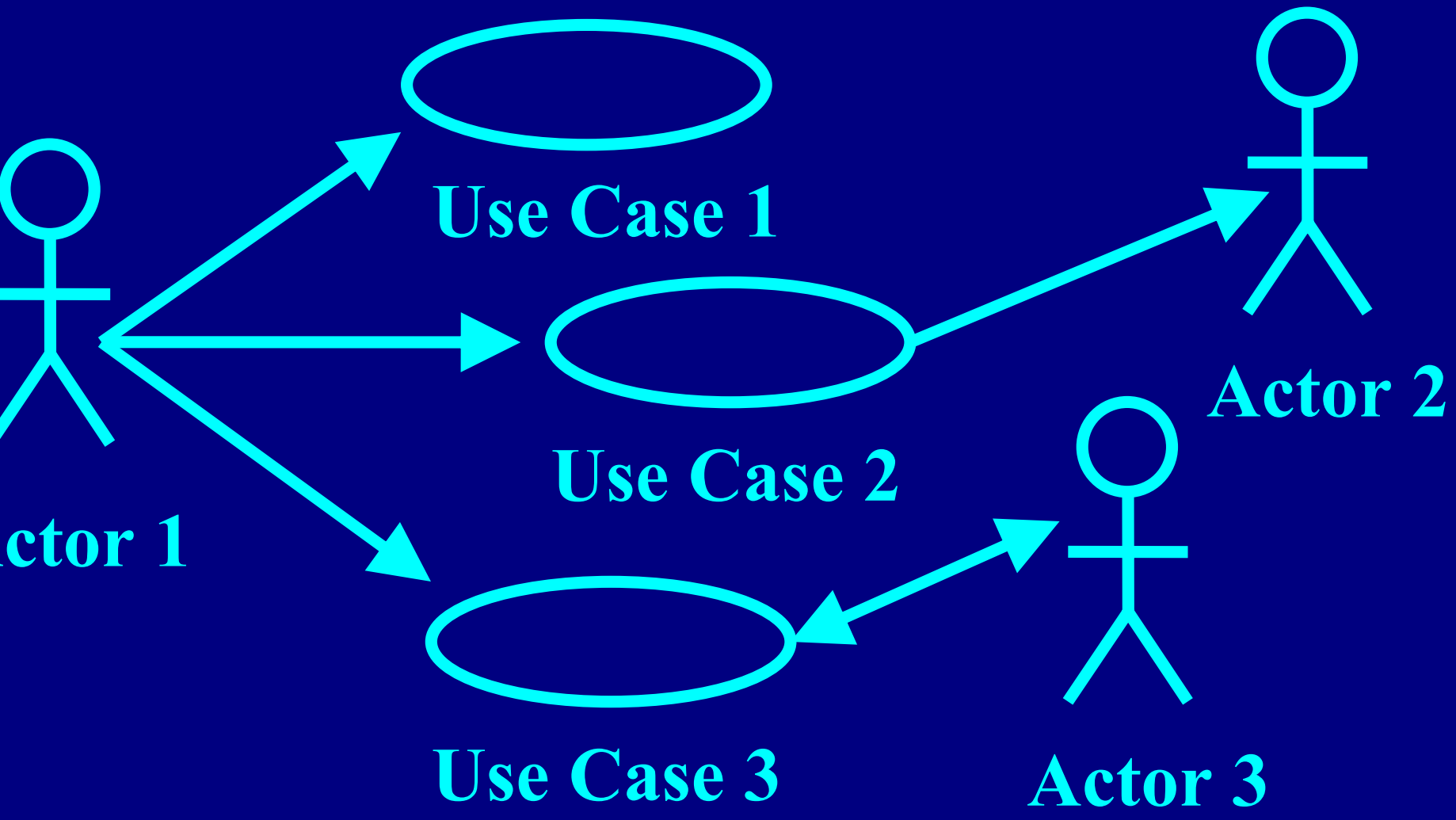
Produce Shipping Manifest

UML Use Case Diagrams

Putting actors together with use cases produces a use case diagram.

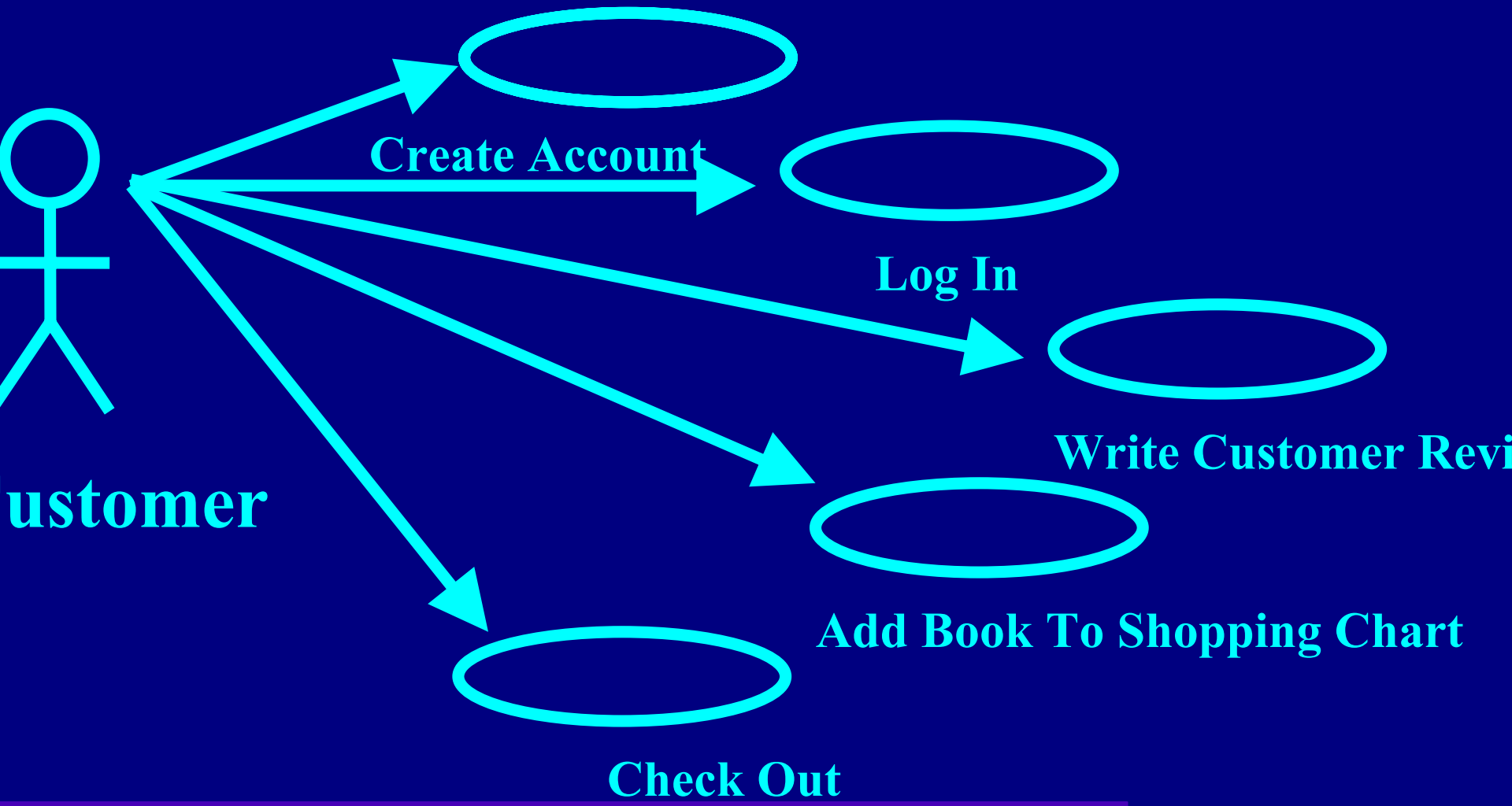
- The actor that executes a given use case usually appears on the lef-hand side.
- The use cases appear in the center.
- Any other actors that are involved in the given use cases tend to appear on the right-hand side.
- Arrows show which actors are involved in which use cases.

Use Case Diagram



Sample Use Case Diagram

Online Bookstore



Flow Of Events

The text of a use case describes possible paths through the use case.

- Main Flow Of Events
- Exceptional Flow Of Events (Alternate Course Of Action)

Sample Flow Of Events

Online Bookstore

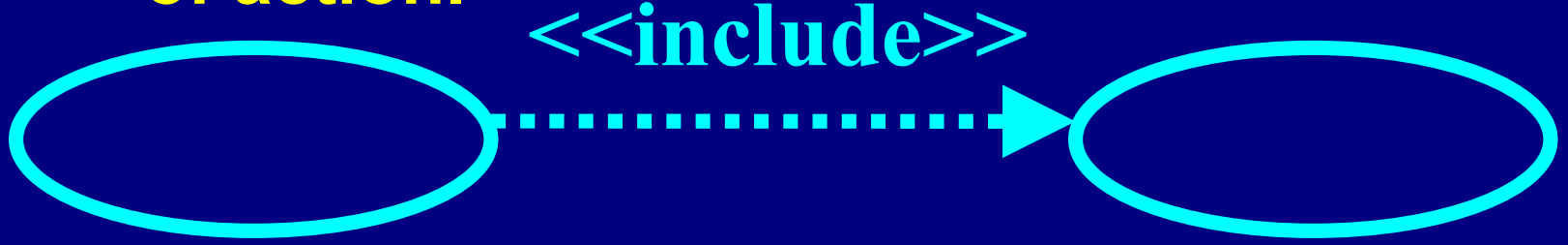
Log In

The Customer clicks the Login button on the Home page. The system displays the Login page. The customer enters his or her user ID and password, and then clicks the OK button. The system validates the login information against the persistent Account data, and then returns the Customer to the Home Page.

Organizing Use Cases

Include

Within an include relationship, one use case explicitly includes the behavior of another use case at a specified point within a course of action.

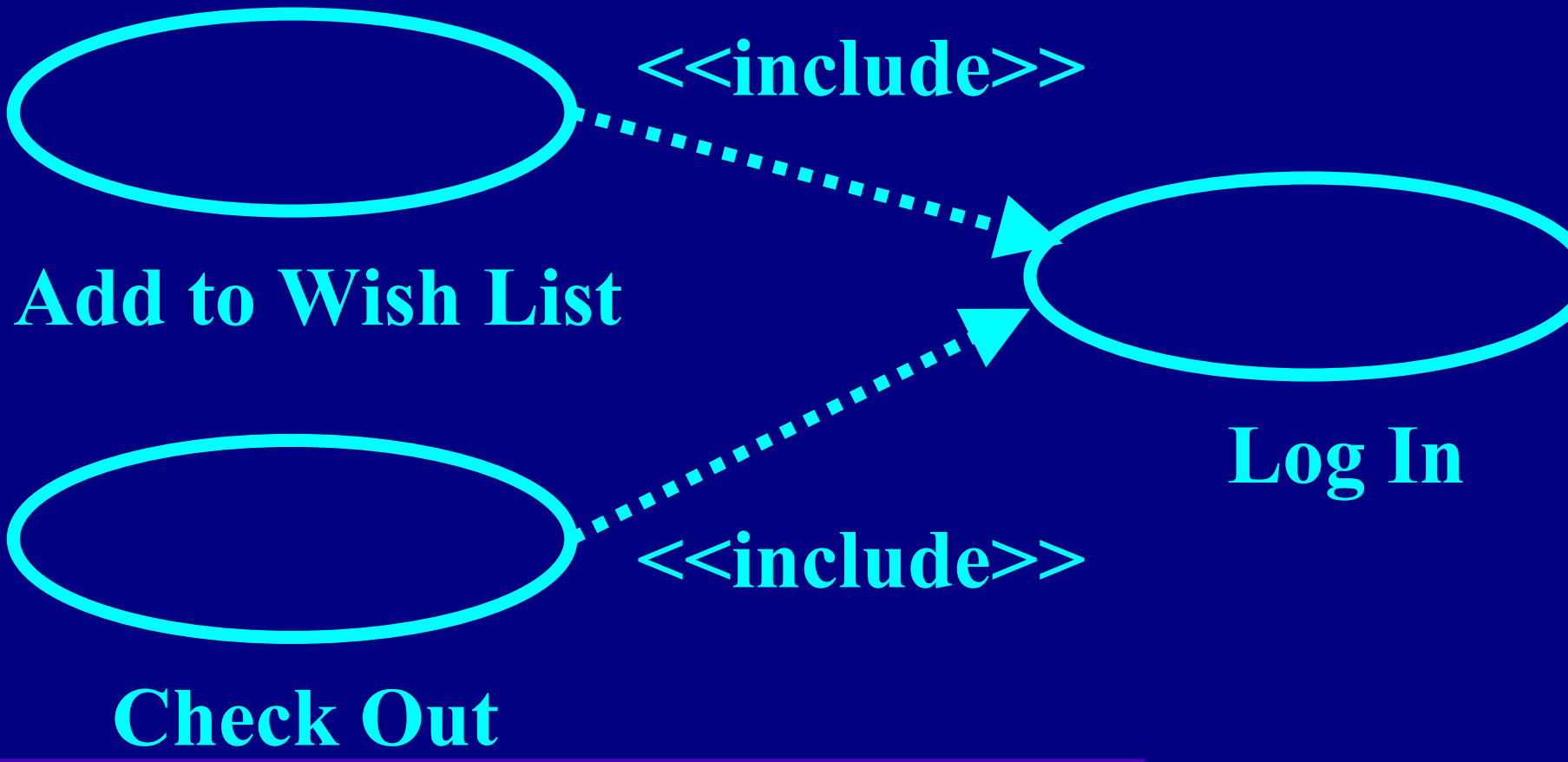


Base Use Case **Included Use Case**

The included use case doesn't stand alone.

Sample Include Relationship

Online Bookstore



Organizing Use Cases (cont.)

Extend

Within an extend relationship, a base use case Implicitly includes the behavior of another use case at one or more specified points. The points are called extension points.

You generally use this construct to factor out behavior that's optional or that occurs only under certain conditions.

Sample Extend Relationship

Online Bookstore

<<extend>>
(order ID)

heck Order Status
extension points
order ID

Cancel Orde

Customer has the option of cancelling an order in conjunction with checking status of that order

Read More

Project-Based Software Engineering by Evelyn Stiller and Cathie LeBlanc

Advanced Use Case Modeling, Software Systems by Frank Armour and Granville Miller