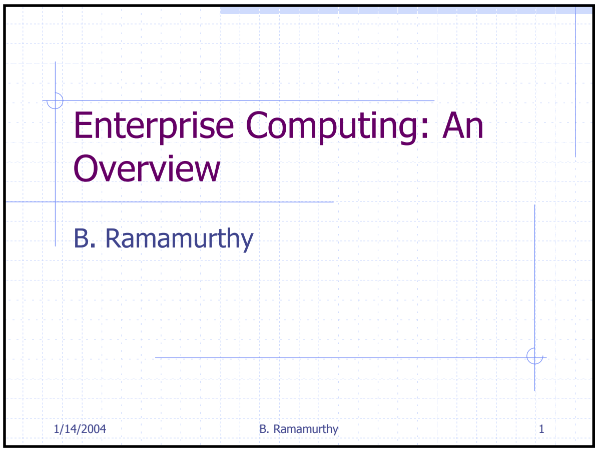
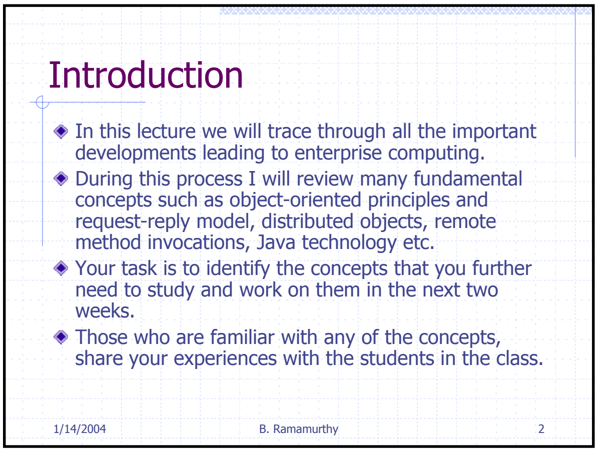


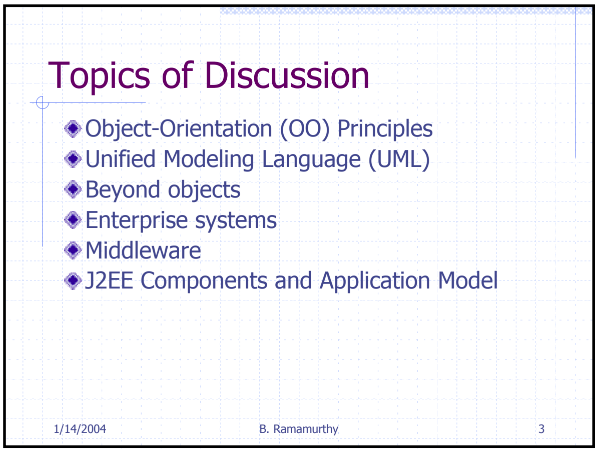
Enterprise Computing: An Overview

B. Ramamurthy



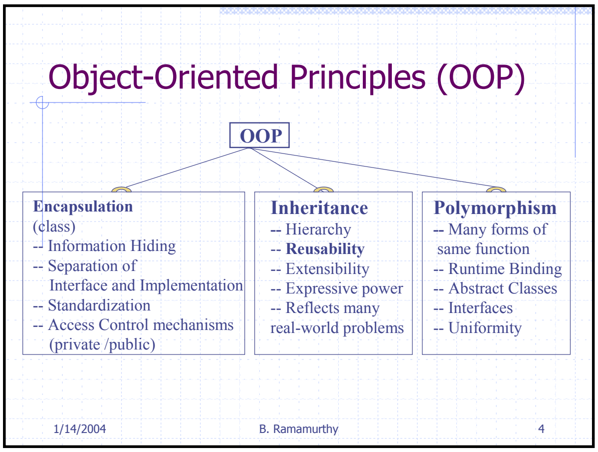
Introduction

- In this lecture we will trace through all the important developments leading to enterprise computing.
- During this process I will review many fundamental concepts such as object-oriented principles and request-reply model, distributed objects, remote method invocations, Java technology etc.
- Your task is to identify the concepts that you further need to study and work on them in the next two weeks.
- Those who are familiar with any of the concepts, share your experiences with the students in the class.



Topics of Discussion

- Object-Orientation (OO) Principles
- Unified Modeling Language (UML)
- Beyond objects
- Enterprise systems
- Middleware
- J2EE Components and Application Model



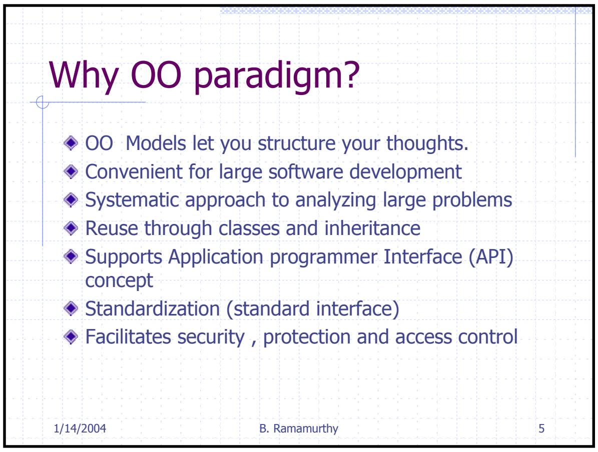
Object-Oriented Principles (OOP)

OOP

Encapsulation
(class)
-- Information Hiding
-- Separation of
Interface and Implementation
-- Standardization
-- Access Control mechanisms
(private /public)

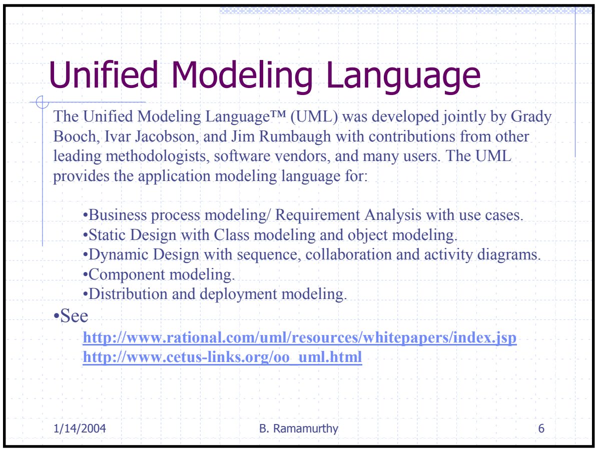
Inheritance
-- Hierarchy
-- **Reusability**
-- Extensibility
-- Expressive power
-- Reflects many
real-world problems

Polymorphism
-- Many forms of
same function
-- Runtime Binding
-- Abstract Classes
-- Interfaces
-- Uniformity



Why OO paradigm?

- OO Models let you structure your thoughts.
- Convenient for large software development
- Systematic approach to analyzing large problems
- Reuse through classes and inheritance
- Supports Application programmer Interface (API) concept
- Standardization (standard interface)
- Facilitates security , protection and access control



Unified Modeling Language

The Unified Modeling Language™ (UML) was developed jointly by Grady Booch, Ivar Jacobson, and Jim Rumbaugh with contributions from other leading methodologists, software vendors, and many users. The UML provides the application modeling language for:

- •Business process modeling/ Requirement Analysis with use cases.
- •Static Design with Class modeling and object modeling.
- •Dynamic Design with sequence, collaboration and activity diagrams.
- •Component modeling.
- •Distribution and deployment modeling.

•See

http://www.rational.com/uml/resources/whitepapers/index.jsp
http://www.cetus-links.org/oo_uml.html

Phases of System Development

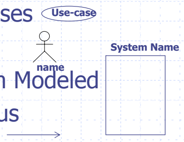
- Requirement Analysis
  - Functionality users require from the system
  - Use case model
- OO Analysis
  - Discovering classes and relationships
  - UML class diagram
- OO Design
  - Result of Analysis expanded into technical solution
  - Sequence diagram, state diagram, etc.
  - Results in detailed specs for the coding phase
- Implementation (Programming/coding)
  - Models are converted into code
- Testing
  - Unit tests, integration tests, system tests and acceptance tests.

Use-Case Modeling

- In use-case modeling, the system is looked upon as a black box whose boundaries are defined by its functionality to external stimulus.
- The actual description of the use-case is usually given in plain text. A popular notation promoted by UML is the stick figure notation.
- We will look into the details of text representation later. Both visual and text representation are needed for a complete view.
- A use-case model represents the use-case view of the system. A use-case view of a system may consist of many use case diagrams.
- An use-case diagram shows (the system), the actors, the use-cases and the relationship among them.

Components of Use Case Model

- The components of a use case model are:
  - Use cases
  - Actors
  - System Modeled
  - Stimulus



System

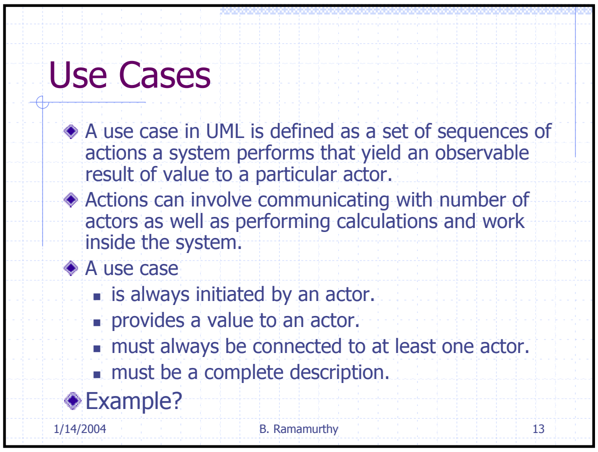
- As a part of the use-case modeling, the boundaries of the system are developed.
- System in the use-case diagram is a box with the name appearing on the top.
- Defining a system is an attempt to define the catalog of terms and definitions at an early stage of the development of a business model.

Actors

- An actor is something or someone that interacts with the system.
- Actor communicates with the system by sending and receiving messages.
- An actor provides the stimulus to activate an use case.
- Message sent by an actor may result in more messages to actors and to use cases.
- Actors can be ranked: primary and secondary; passive and active.
- Actor is a role not an individual instance.

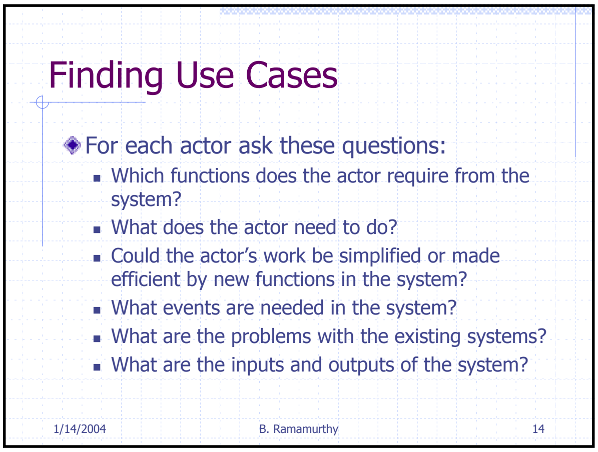
Finding Actors

- The actors of a system can be identified by answering a number of questions:
  - Who will use the functionality of the system?
  - Who will maintain the system?
  - What devices does the system need to handle?
  - What other system does this system need to interact?
  - Who or what has interest in the results of this system?



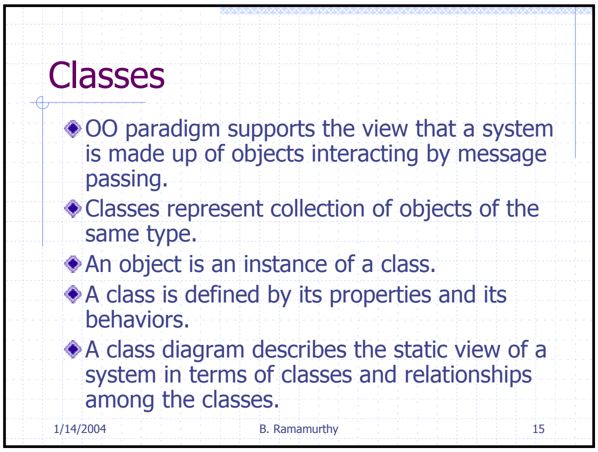
Use Cases

- A use case in UML is defined as a set of sequences of actions a system performs that yield an observable result of value to a particular actor.
- Actions can involve communicating with number of actors as well as performing calculations and work inside the system.
- A use case
  - is always initiated by an actor.
  - provides a value to an actor.
  - must always be connected to at least one actor.
  - must be a complete description.
- Example?



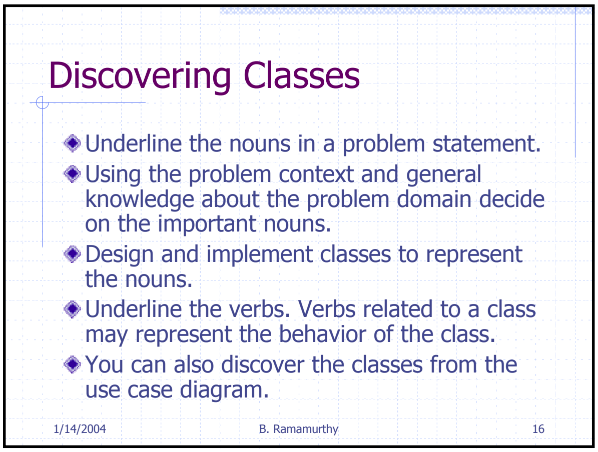
Finding Use Cases

- For each actor ask these questions:
  - Which functions does the actor require from the system?
  - What does the actor need to do?
  - Could the actor’s work be simplified or made efficient by new functions in the system?
  - What events are needed in the system?
  - What are the problems with the existing systems?
  - What are the inputs and outputs of the system?



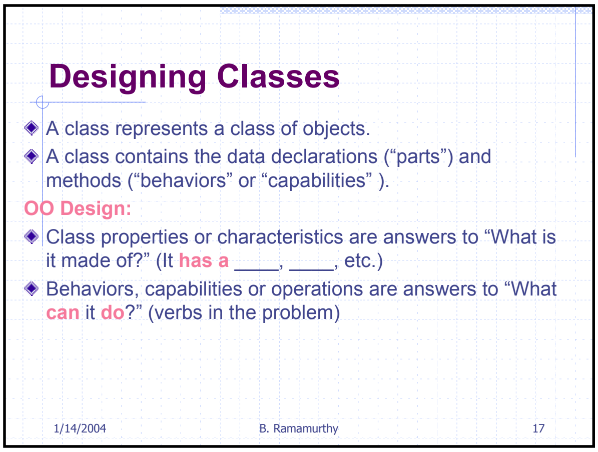
Classes

- OO paradigm supports the view that a system is made up of objects interacting by message passing.
- Classes represent collection of objects of the same type.
- An object is an instance of a class.
- A class is defined by its properties and its behaviors.
- A class diagram describes the static view of a system in terms of classes and relationships among the classes.



Discovering Classes

- Underline the nouns in a problem statement.
- Using the problem context and general knowledge about the problem domain decide on the important nouns.
- Design and implement classes to represent the nouns.
- Underline the verbs. Verbs related to a class may represent the behavior of the class.
- You can also discover the classes from the use case diagram.

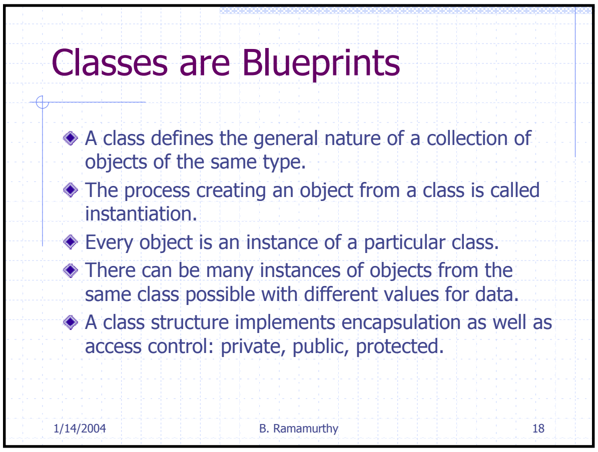


Designing Classes

- A class represents a class of objects.
- A class contains the data declarations (“parts”) and methods (“behaviors” or “capabilities”).

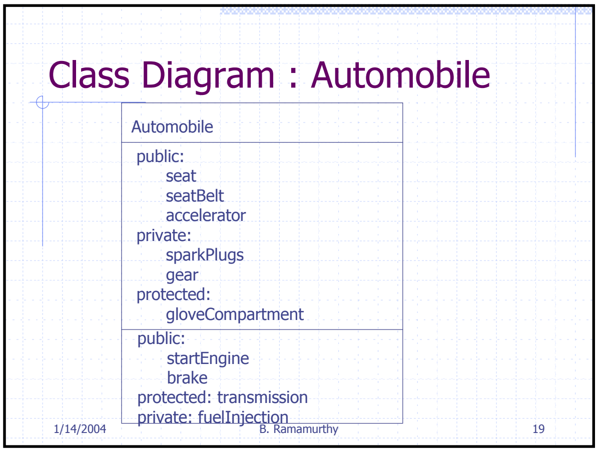
OO Design:

- Class properties or characteristics are answers to “What is it made of?” (It **has a** _____, _____, etc.)
- Behaviors, capabilities or operations are answers to “What **can** it **do**?” (verbs in the problem)



Classes are Blueprints

- A class defines the general nature of a collection of objects of the same type.
- The process creating an object from a class is called instantiation.
- Every object is an instance of a particular class.
- There can be many instances of objects from the same class possible with different values for data.
- A class structure implements encapsulation as well as access control: private, public, protected.

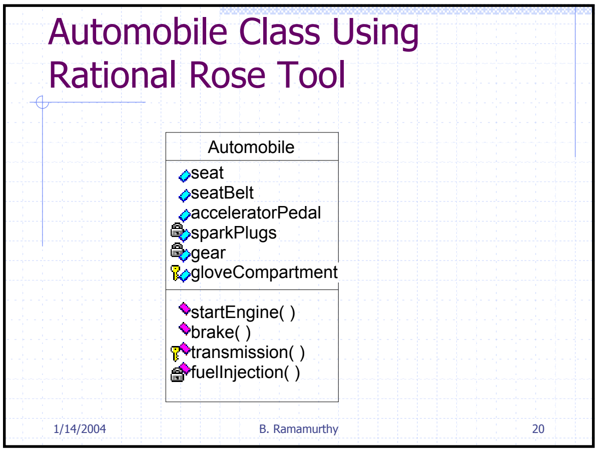


Class Diagram : Automobile

Automobile

public:
  seat
  seatBelt
  accelerator
private:
  sparkPlugs
  gear
protected:
  gloveCompartment

public:
  startEngine
  brake
protected: transmission
private: fuelInjection

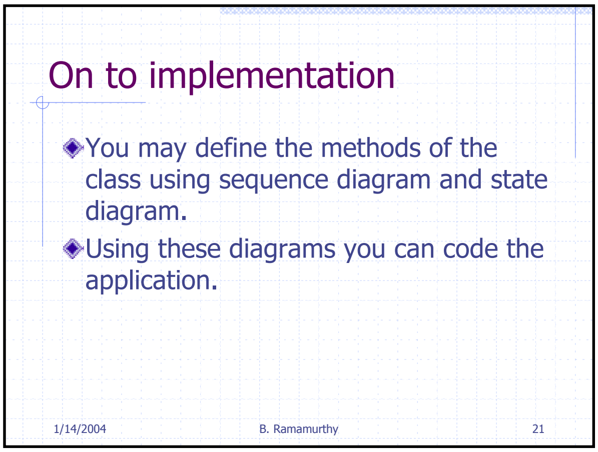


Automobile Class Using Rational Rose Tool

Automobile

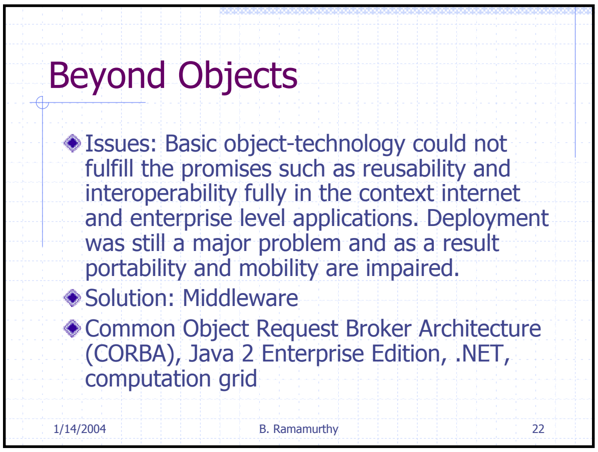
seat
seatBelt
acceleratorPedal
sparkPlugs
gear
gloveCompartment

startEngine( )
brake( )
transmission( )
fuelInjection( )



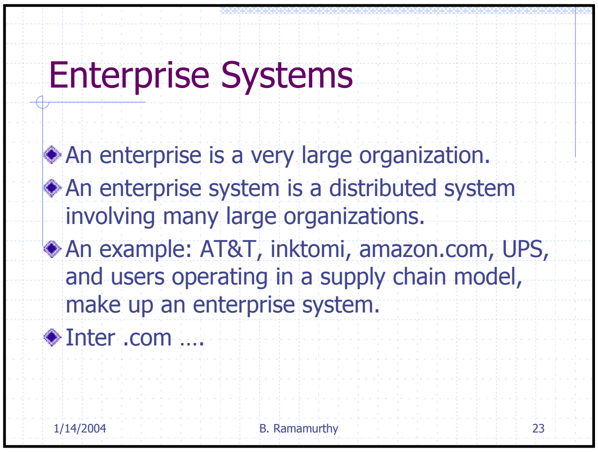
On to implementation

- You may define the methods of the class using sequence diagram and state diagram.
- Using these diagrams you can code the application.



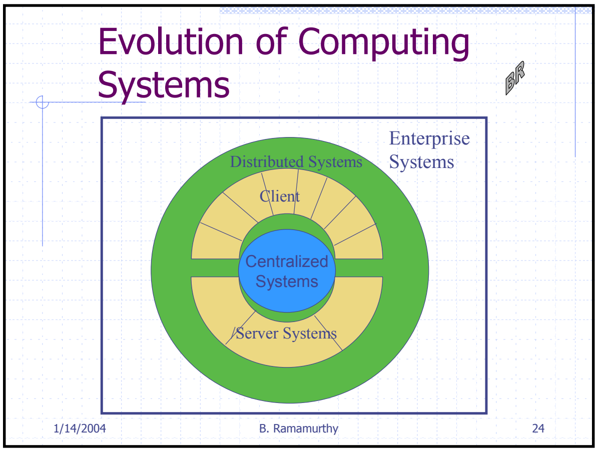
Beyond Objects

- Issues: Basic object-technology could not fulfill the promises such as reusability and interoperability fully in the context internet and enterprise level applications. Deployment was still a major problem and as a result portability and mobility are impaired.
- Solution: Middleware
- Common Object Request Broker Architecture (CORBA), Java 2 Enterprise Edition, .NET, computation grid



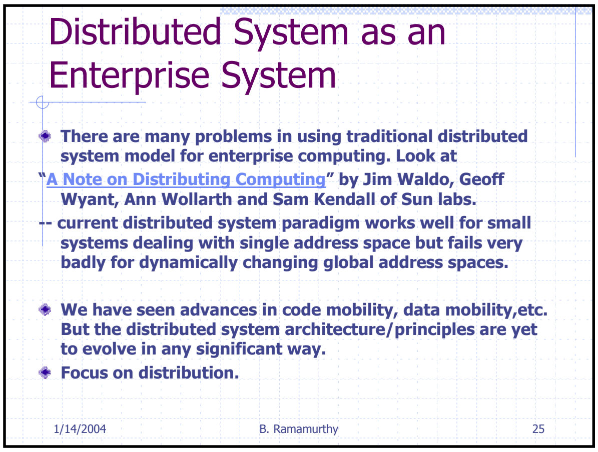
Enterprise Systems

- An enterprise is a very large organization.
- An enterprise system is a distributed system involving many large organizations.
- An example: AT&T, inktomi, amazon.com, UPS, and users operating in a supply chain model, make up an enterprise system.
- Inter .com ….



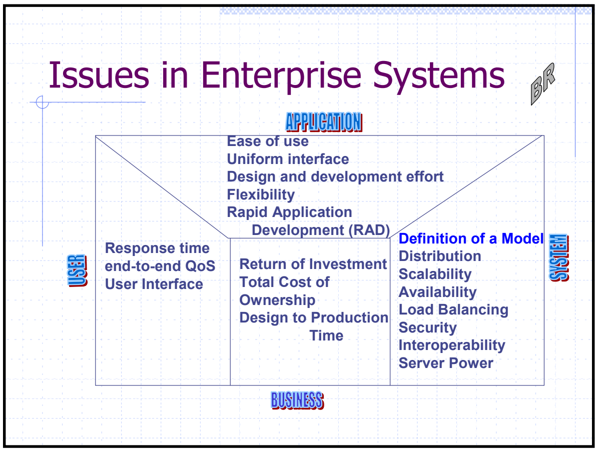
Evolution of Computing Systems

Enterprise Systems
Distributed Systems
Client
Centralized Systems
Server Systems



Distributed System as an Enterprise System

- There are many problems in using traditional distributed system model for enterprise computing. Look at "A Note on Distributing Computing" by Jim Waldo, Geoff Wyant, Ann Wollarth and Sam Kendall of Sun labs.
-- current distributed system paradigm works well for small systems dealing with single address space but fails very badly for dynamically changing global address spaces.
- We have seen advances in code mobility, data mobility,etc. But the distributed system architecture/principles are yet to evolve in any significant way.
- Focus on distribution.



Issues in Enterprise Systems

APPLICATION

Ease of use
Uniform interface
Design and development effort
Flexibility
Rapid Application Development (RAD)

USER

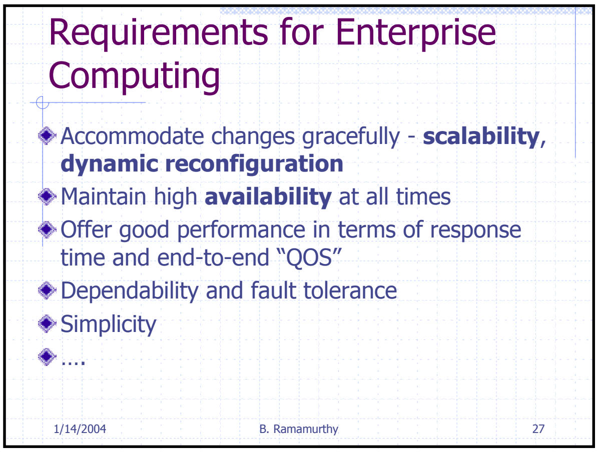
Response time
end-to-end QoS
User Interface

Return of Investment
Total Cost of Ownership
Design to Production Time

SYSTEM

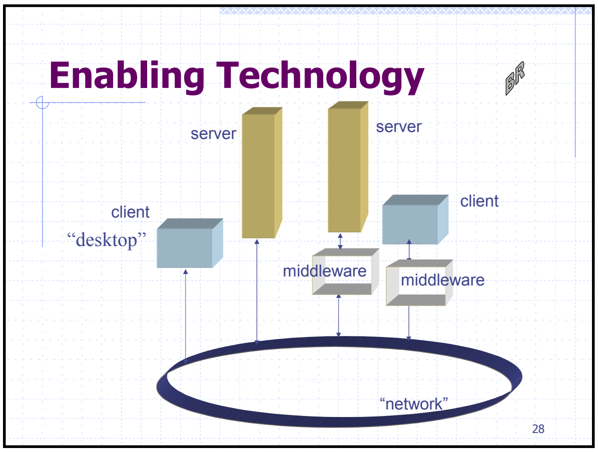
Definition of a Model
Distribution
Scalability
Availability
Load Balancing
Security
Interoperability
Server Power

BUSINESS

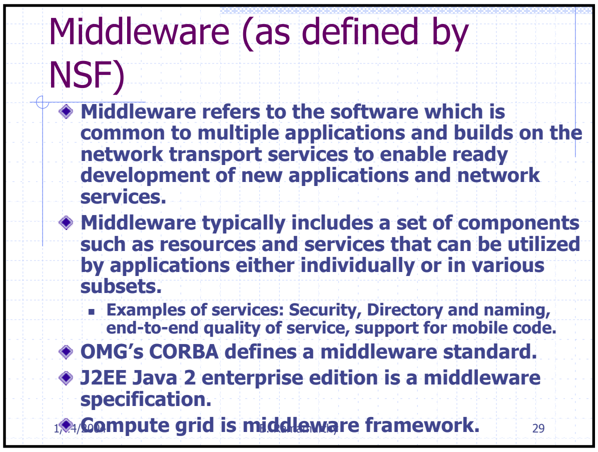


Requirements for Enterprise Computing

- Accommodate changes gracefully - **scalability, dynamic reconfiguration**
- Maintain high **availability** at all times
- Offer good performance in terms of response time and end-to-end "QOS"
- Dependability and fault tolerance
- Simplicity
- ….

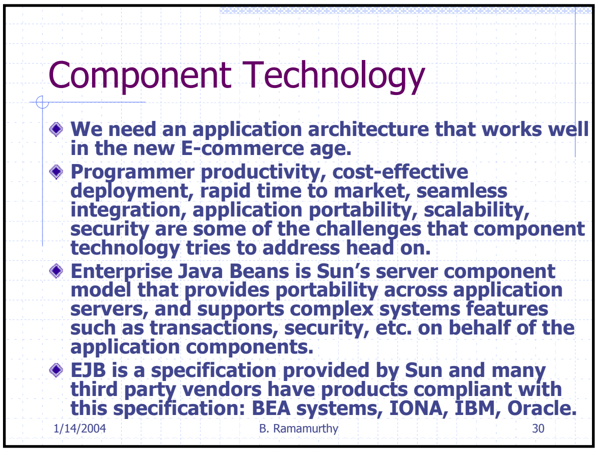


Enabling Technology



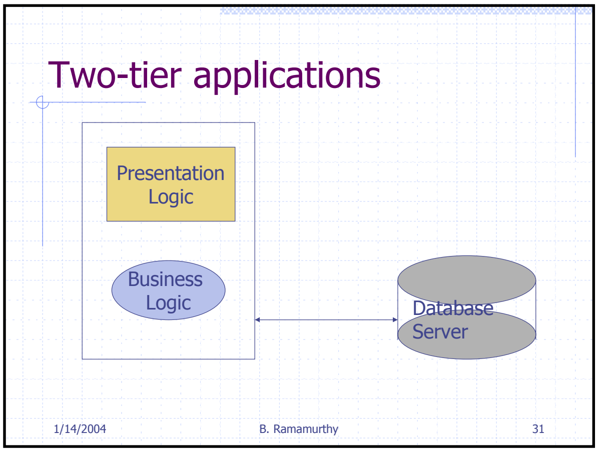
Middleware (as defined by NSF)

- Middleware refers to the software which is common to multiple applications and builds on the network transport services to enable ready development of new applications and network services.
- Middleware typically includes a set of components such as resources and services that can be utilized by applications either individually or in various subsets.
  - Examples of services: Security, Directory and naming, end-to-end quality of service, support for mobile code.
- OMG's CORBA defines a middleware standard.
- J2EE Java 2 enterprise edition is a middleware specification.
- Compute grid is middleware framework.



Component Technology

- We need an application architecture that works well in the new E-commerce age.
- Programmer productivity, cost-effective deployment, rapid time to market, seamless integration, application portability, scalability, security are some of the challenges that component technology tries to address head on.
- Enterprise Java Beans is Sun's server component model that provides portability across application servers, and supports complex systems features such as transactions, security, etc. on behalf of the application components.
- EJB is a specification provided by Sun and many third party vendors have products compliant with this specification: BEA systems, IONA, IBM, Oracle.

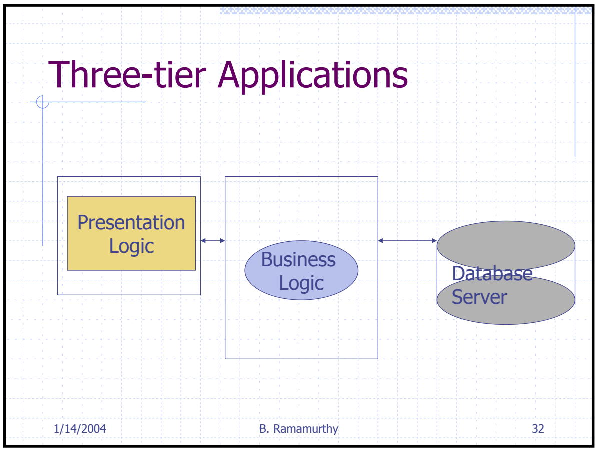


Two-tier applications

Presentation Logic

Business Logic

Database Server

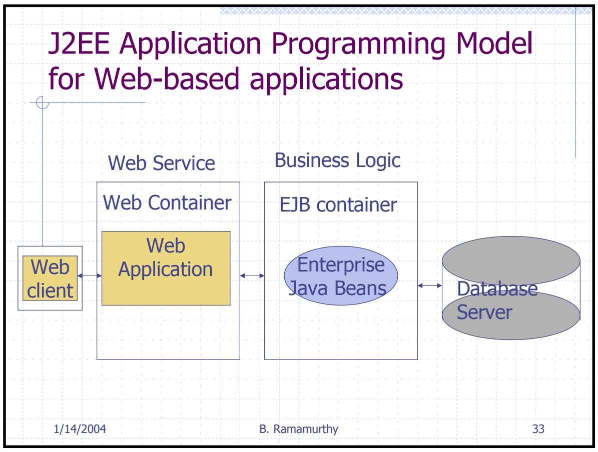


Three-tier Applications

Presentation Logic

Business Logic

Database Server



J2EE Application Programming Model for Web-based applications

Web Service

Business Logic

Web Container

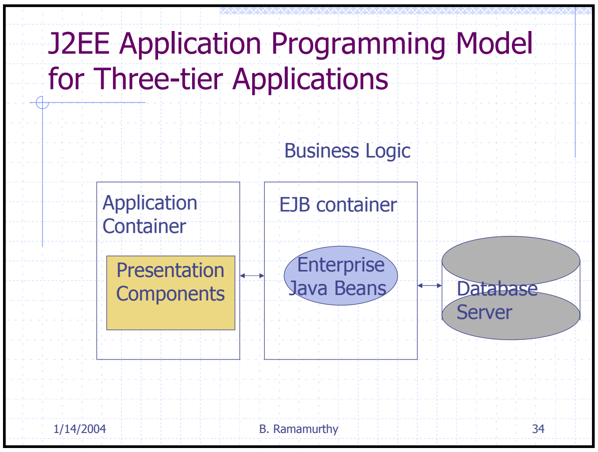
EJB container

Web client

Web Application

Enterprise Java Beans

Database Server



J2EE Application Programming Model for Three-tier Applications

Business Logic

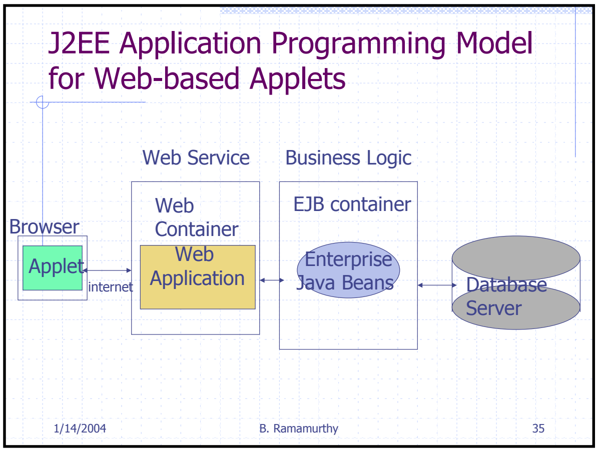
Application Container

EJB container

Presentation Components

Enterprise Java Beans

Database Server



J2EE Application Programming Model for Web-based Applets

Web Service

Business Logic

Browser

Applet

internet

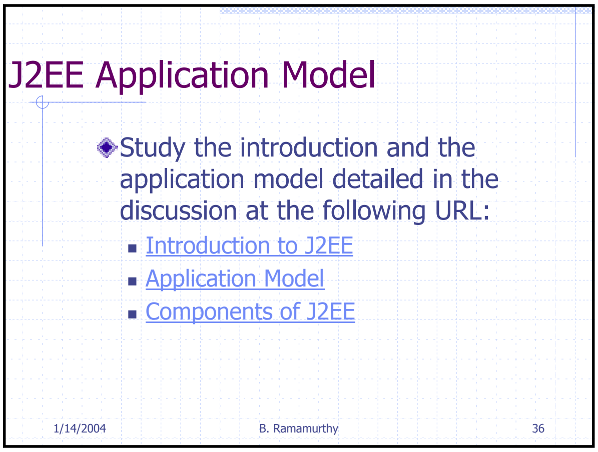
Web Container

Web Application

EJB container

Enterprise Java Beans

Database Server



J2EE Application Model

- Study the introduction and the application model detailed in the discussion at the following URL:
  - Introduction to J2EE
  - Application Model
  - Components of J2EE