C/S – Basic Concepts

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- Client/Server Balance
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The Gartner Model

- Became de facto reference model
- Recognizes 5 possible modes of distribution:
  - distributed presentation
  - remote presentation
  - distributed logic
  - remote data access
  - distributed database
- Assumes a 2-tier model and allocates functionality to client or server

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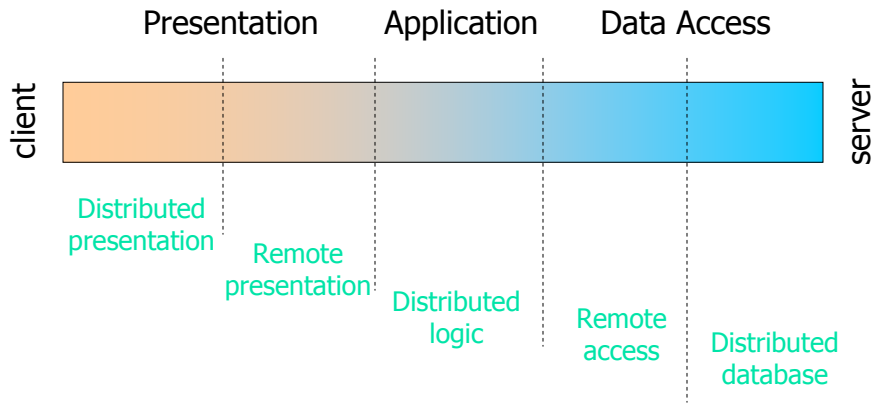
Gartner Group Model



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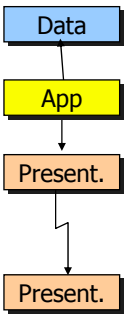
GM: distributed presentation

- Distributed presentation
  - only presentation management function shared between client and server
  - everything else remains on the server
  - screen-scraping (emulation-based) applications
  - GUI placed in front of existing character-based interface
  - first step in migration of legacy applications to a GUI



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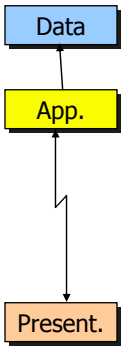
GM: remote presentation

- Remote presentation
  - presentation manager entirely on client
  - presentation logic, data logic and data manager on server
  - X Window System, Web applications where clients are Web browsers



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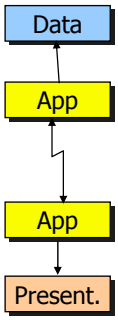
GM: distributed logic

- Distributed logic:
  - application is split into presentation logic and data logic component
  - all presentation management activities on workstation
  - all data management activities on the server



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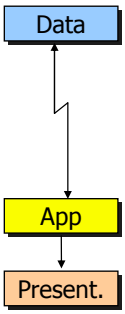
GM: remote data access

- Remote data access
  - database manager resides on server
  - presentation management and data logic reside on client
  - typical of client/server DBMSs (DB2, Oracle, Informix, etc.)



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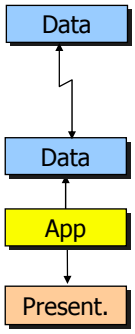
GM: Distributed Database

- Distributed Database
  - portions of the database reside on client
  - portions of the database reside on server
  - DBMS manages communication involved
  - limited implementation of full-fledged DDBMS functionality



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Critique of the Gartner Model

- Distributed processing is not distributed data
  - first 4 levels describe distributed processing
  - fifth level describes distributed data
  - database distribution is orthogonal to processing distribution and is applicable to all 4 layers
  - distributed databases are transparent to the user, the other 4 layers are not

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Winsberg's Model – Func'ty

Functional Area	Layer	Description
User Interface	Presentation Mgmt.	Drives display and graphical layout
	Presentation Logic	Logic for screens, interaction w/users
Application Logic	Application Logic	Business logic and control flow
Data (or Resource) Management	Data Logic	Logical data access, consistency rules
	Database Mgmt.	Storage/retrieval/recovery

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Basic Concepts and Notation

- Client: user or program that wants to perform an operation over the system. To support a client, the system needs to have a presentation layer through which the user can submit operations and obtain a result.
- Application logic: establishes what operations can be performed and how they take place. Enforces business rules and establishes business processes.
- Resource manager: deals with storage, indexing, and retrieval of data necessary to support the application logic.

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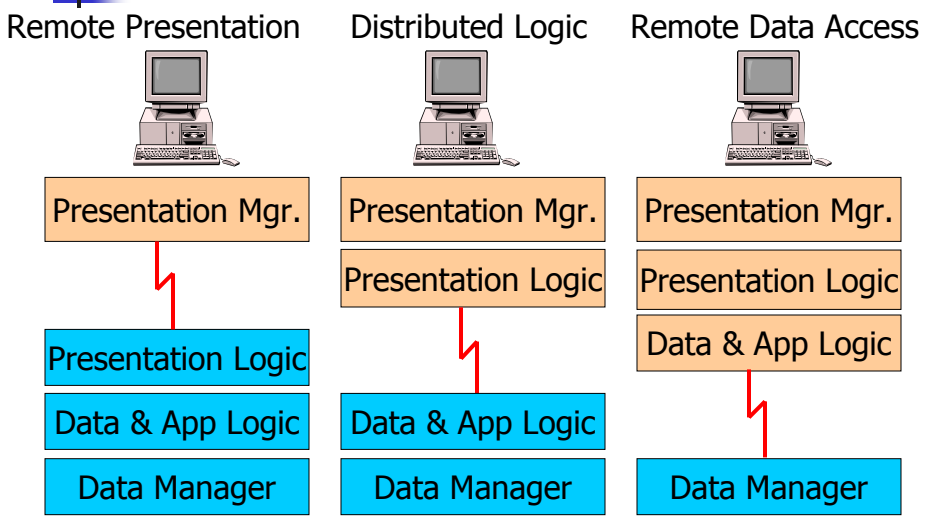
Winsberg's Model



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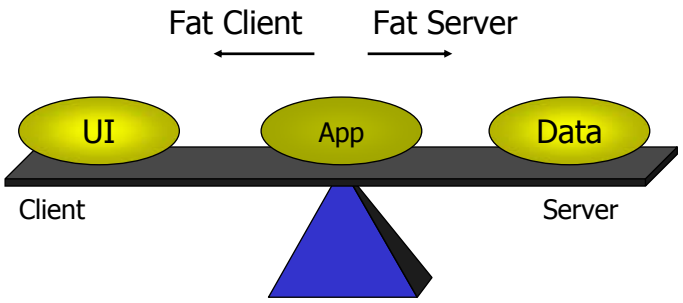
Client/Server Balance



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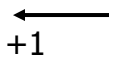
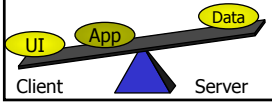
Example - Fat Client

- Integrity and Consistency
  - Data type verification, ranges, etc. – integrity
    - e.g. Date of birth verification
  - Verify existence of data (according to relationships) – referential integrity
    - Department exists (association relationship)
  - Calculate the next employee number [*Autonumber*] (read last; add one; return it)
    - e.g. Employee number (unique)





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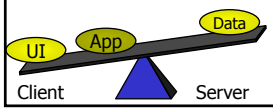
Example - Fat Client

- Business Rules
  - They could be application-specific
  - Business rules scattered in many applications
  - Expressed in form of programming code
- Example:
  - Department Bonus (10% for all programmers)



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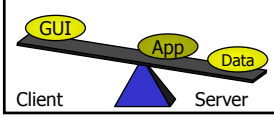
Example - Fat Server

- Integrity and Consistency
  - Based on Stored Procedures
  - A unique version of the verification process is maintained at the server side
  - *Autonumber* is a Stored Procedure that controls uniqueness



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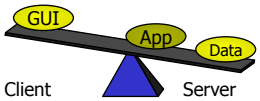
Example - Fat Server

- Business Rules
  - Stored Procedures & Triggers
  - Business rules are located in one place (the server)
  - Example:
    - Department Bonus (10% for all programmers)
    - Employee table (column dept) has a trigger that is executed on update or on insert. The trigger in fact executes a store procedure



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2-tier, 3-tier, and Multi-tier

- Two-tier architectures are typical of
  - environments with few clients
  - homogeneous environments
  - closed environments (e.g. DBMS)
- Three-tier architectures are required for
  - scalability to thousands of clients
  - access to heterogeneous data sources
  - maintainability (update software on few app. servers instead of thousands of clients)

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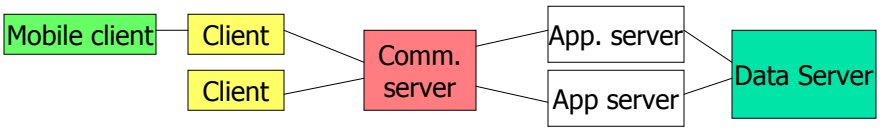
2-tier, 3-tier, and Multi-tier



- Multi-tier architectures result when
  - functionality is delegated to specialized servers (communication-, web-, application-, data-server)
  - mobile clients are considered (desktop client could act as server to mobile client)
  - considering distributed object systems in which every server can act as client to another server

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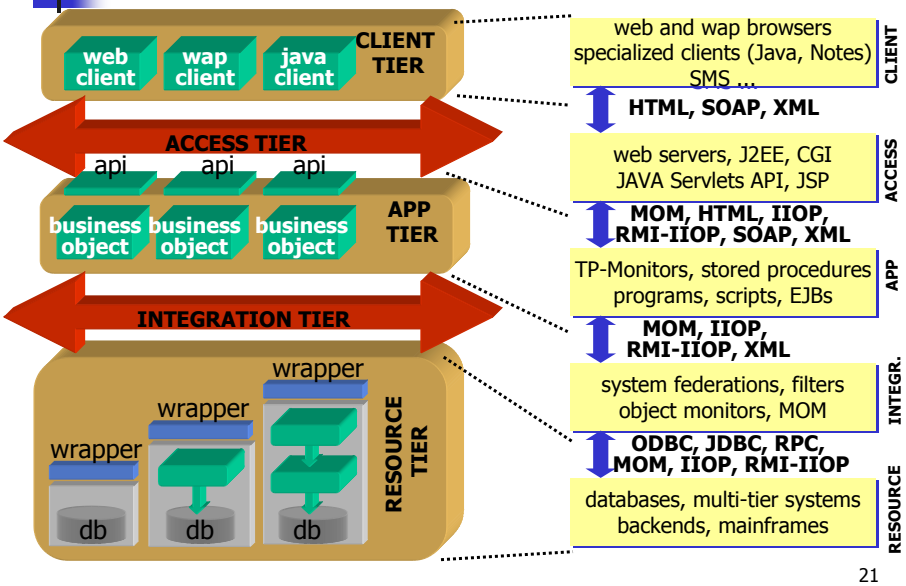
Multi-tier: What is Involved?



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The Problem Space of C/S

- Three axes:
  - two-tier vs. three-tier vs. n-tier
  - transactional vs. informational
  - relational vs. object-oriented vs. semi-structured

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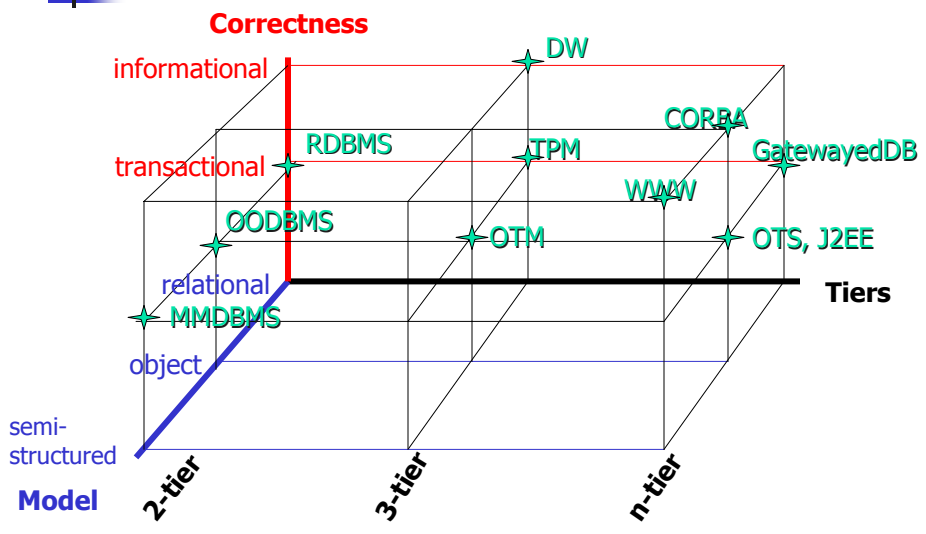
The Problem Space of C/S



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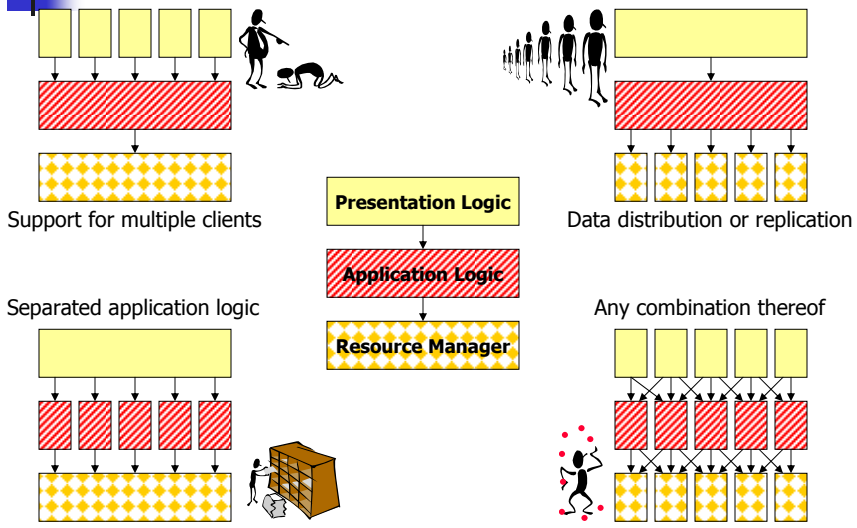
Distribution at the different layers



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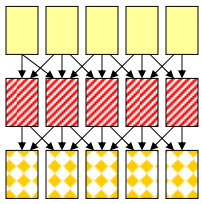
A game of boxes and arrows



There is no problem in system design that cannot be solved by adding a level of indirection.
There is no performance problem that cannot be solved by removing a level of indirection.

- Each box represents a part of the system.
- Each arrow represents a connection between two parts of the system.
- The more boxes, the more modular the system: more opportunities for distribution and parallelism. This allows encapsulation, component based design, reuse.
- The more boxes, the more arrows: more sessions (connections) need to be maintained, more coordination is necessary. The system becomes more complex to monitor and manage.
- The more boxes, the greater the number of context switches and intermediate steps to go through before one gets to the data. Performance suffers considerably.
- System designers try to balance the capacity of the computers involved and the advantages and disadvantages of multiple layers.

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Client/Server Balance

- Separation between client and application server is never clean-cut
  - There's NO recipe … BUT experiences!
- All depends on the kind of application
- It also depends on the hardware (client and server)
- Cached data are needed when part of the application logic is located on the client
  - checking of consistency constraints on client side at data entry time
- Depends on the kind of interaction

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