COMP1140: Database and Information Management

Lecture Note – Week 2

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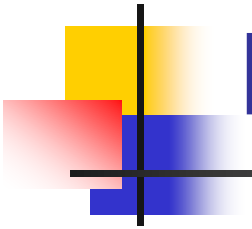
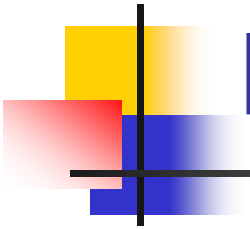


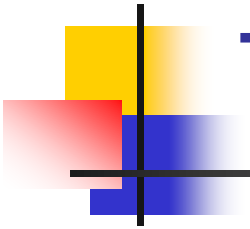
Notice

- Assignment 1 starts now, due 12pm Friday, August 24, 2018
- Discussion forums have been created on BB
- Lab starts this week – SQL server & T-SQL etc.



Last lecture

- Introduction to course
- Introduction to DBMSs
- Databases in Perspective
- Database Design Process
- Requirements Gathering
- Any questions?



This lecture

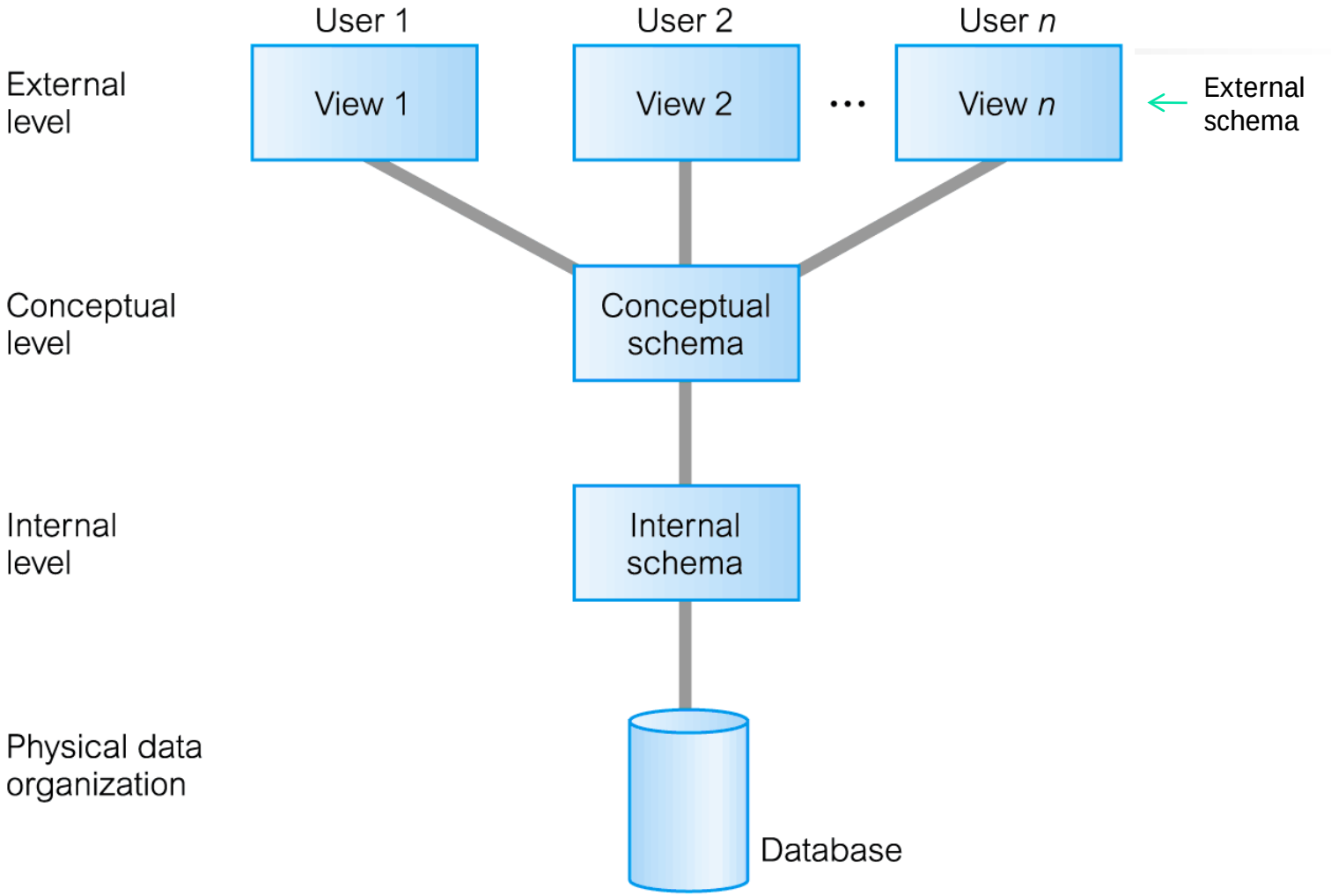
- Database and DBMS architectures
  - **Three-level database architecture**
  - **Multi-User DBMS architectures**
- Assignment discussion:
  - **Clarify any requirements and scope**

- Reference: Chapters 2, 3, 10, 11, Appendices A & B

Three-level database architecture

- **Purpose of three-level database architecture**
  - All users should be able to access same data.
  - A user's view is immune to changes made in other views.
  - Users should not need to know physical DB storage details.
  - DBA should be able to change database storage structures without affecting the users' views.
  - Internal structure of database should be unaffected by changes to physical aspects of storage.
  - DBA should be able to change conceptual structure of database without affecting all users.

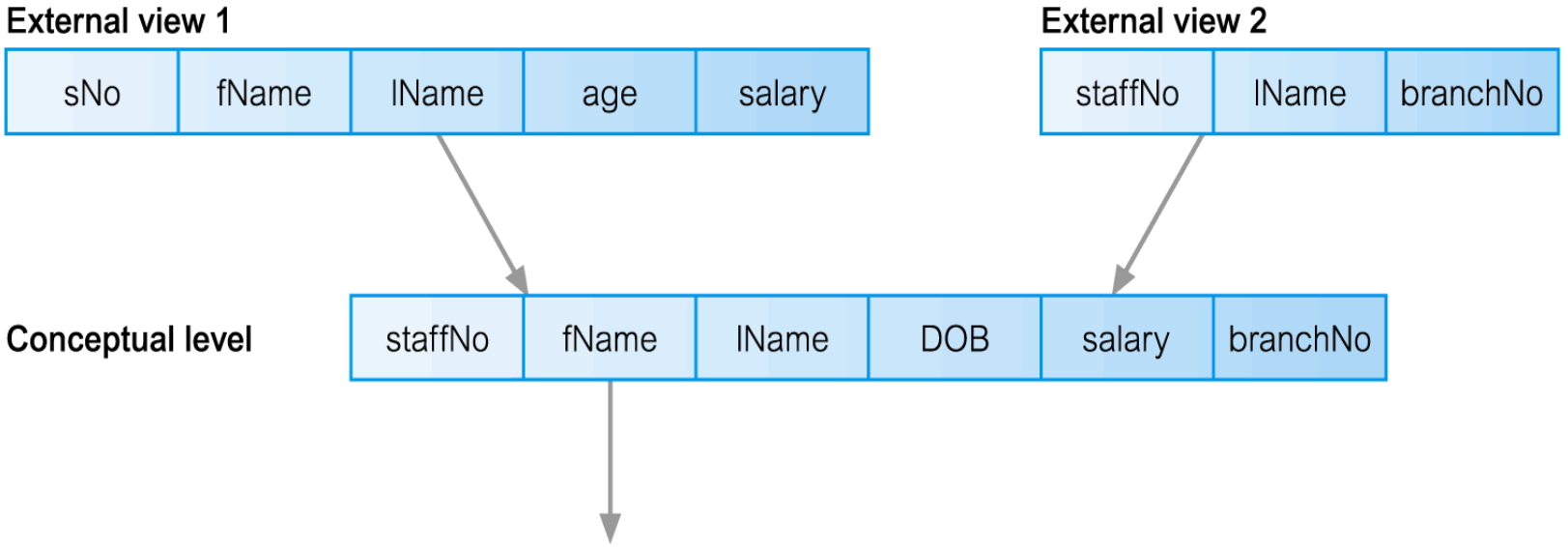
ANSI-SPARC Three-Level Architecture



ANSI-SPARC Three-Level Architecture

- **External Level**
  - **Users' view of the database.**
  - **Describes that part of database that is relevant to a particular user.**
- **Conceptual Level**
  - **Community view of the database.**
  - **Describes what data is stored in database and relationships among the data.**
- **Internal Level**
  - **Physical representation of the database on the computer.**
  - **Describes how the data is stored in the database.**

Differences Among Three Levels of ANSI-SPARC Architecture



Internal level

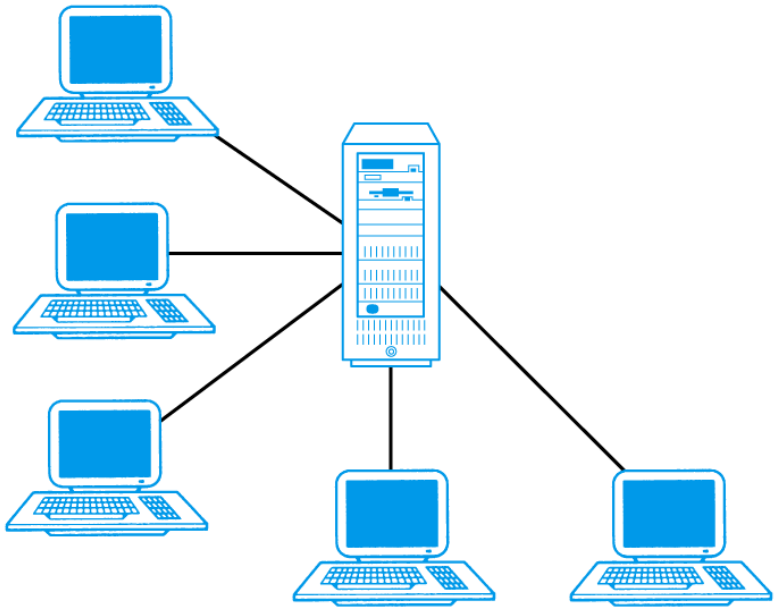
```
struct STAFF {
      int staffNo;
      int branchNo;
      char fName [15];
      char lName [15];
      struct date dateOf Birth;
      float salary;
      struct STAFF *next;                  /* pointer to next Staff record */
};
index staffNo; index branchNo;             /* define indexes for staff */
```

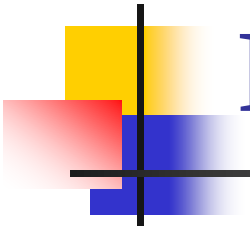
Multi-User DBMS Architectures

- **Teleprocessing**
- **File server**
- **Client-server**

Teleprocessing

- **Traditional architecture.**
- **Single mainframe with a number of terminals attached.**
- **IT trend is now towards downsizing, so leading to following architecture.**

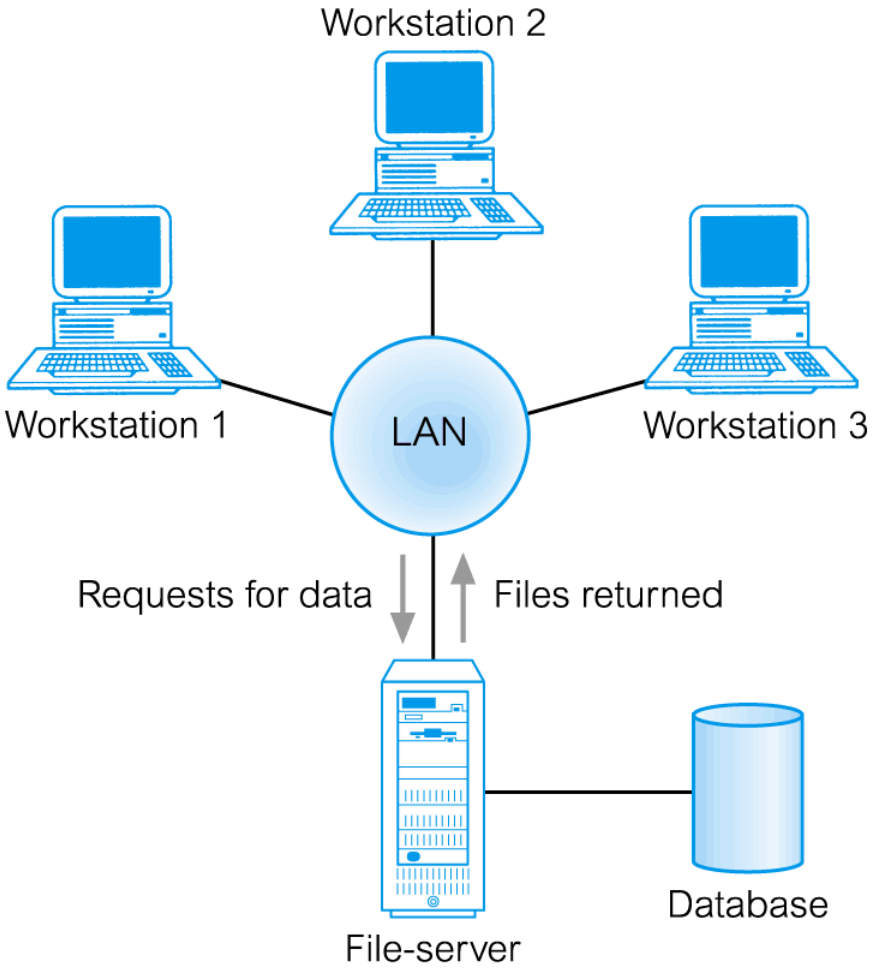


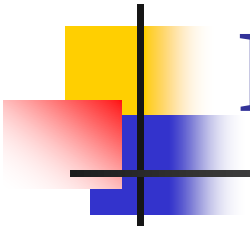


File Server

- **File server is connected to several workstations across a network.**
- **Database resides on file server.**
- **DBMS and applications run on each workstation.**

File Server Architecture





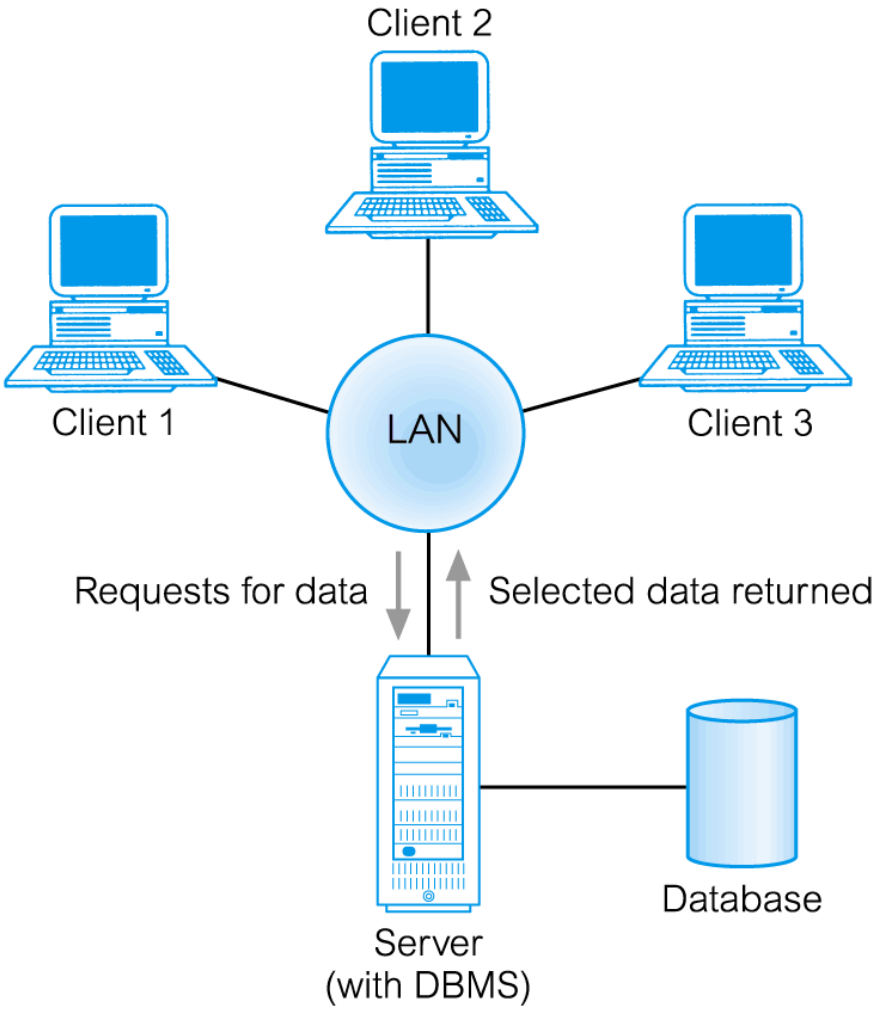
File Server

- **Disadvantages include:**
  - **Significant network traffic.**
  - **Copy of DBMS on each workstation.**
  - **Concurrency, recovery and integrity control more complex.**

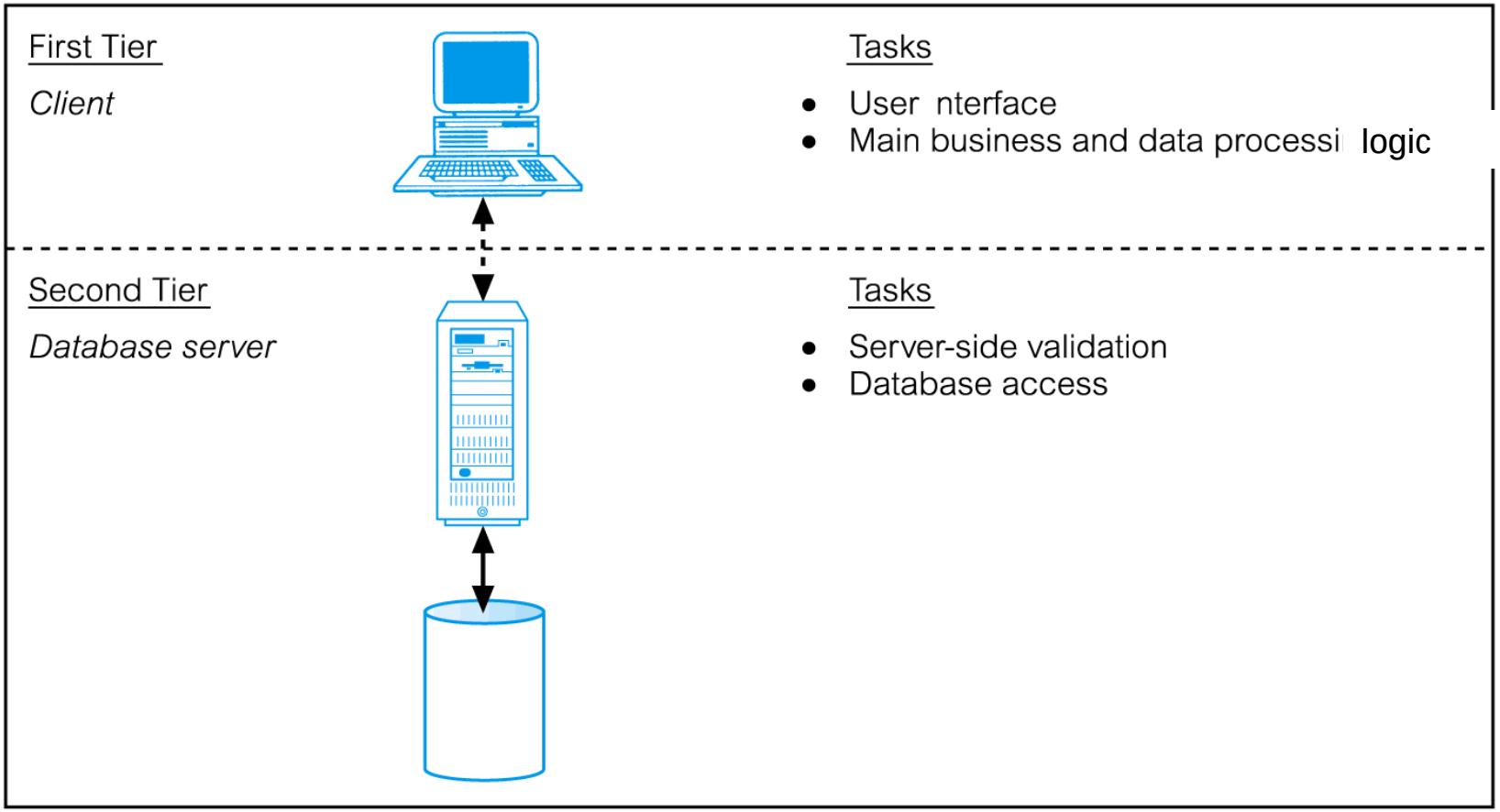
Traditional Two-Tier Client-Server

- **Client (tier 1) manages user interface and runs applications.**
- **Server (tier 2) holds database and DBMS.**

Traditional Two-Tier Client-Server



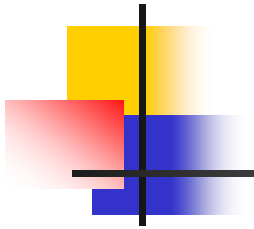
Traditional Two-Tier Client-Server



Traditional Two-Tier Client-Server

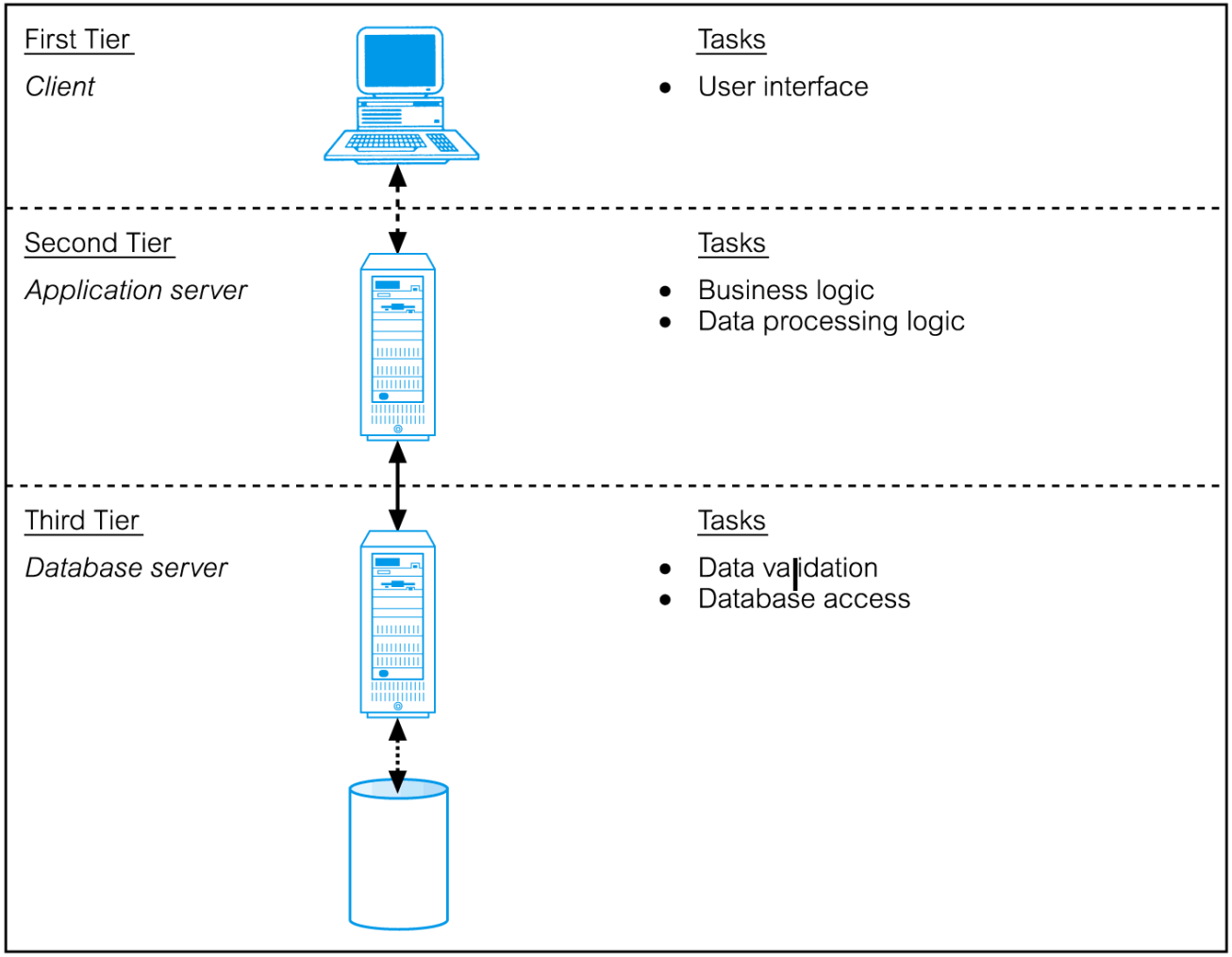
- **Advantages include:**
  - **wider access to existing databases;**
  - **increased performance;**
  - **possible reduction in hardware costs;**
  - **reduction in communication costs;**
  - **increased consistency.**

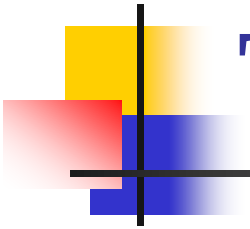
Three-Tier Client-Server



- In 2-tier, client side presented two problems preventing true scalability:
  - 'Fat' client, requiring considerable resources on client's computer to run effectively.
  - Significant client side administration overhead.
- By 1995, three layers were proposed, each potentially running on a different platform.

Three-Tier Client-Server



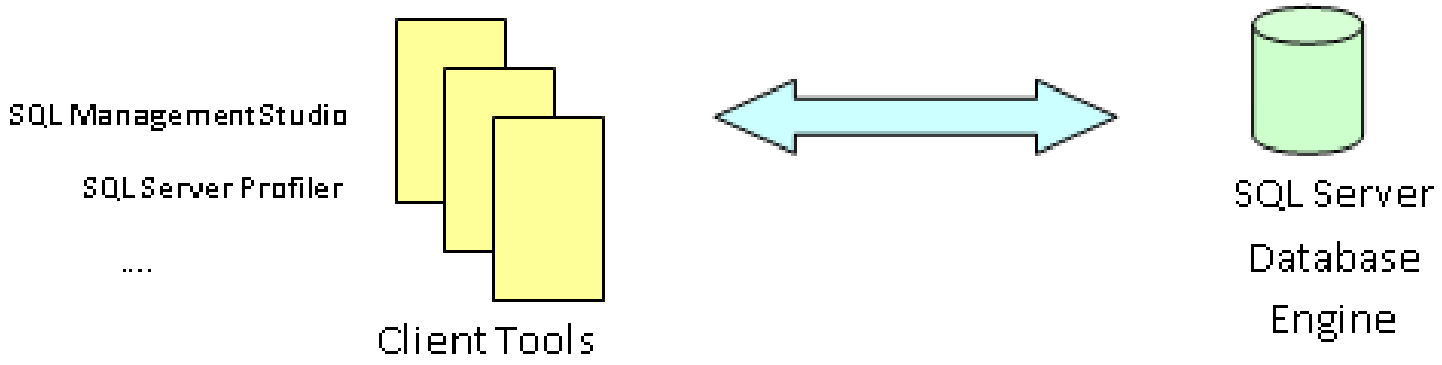


Three-Tier Client-Server

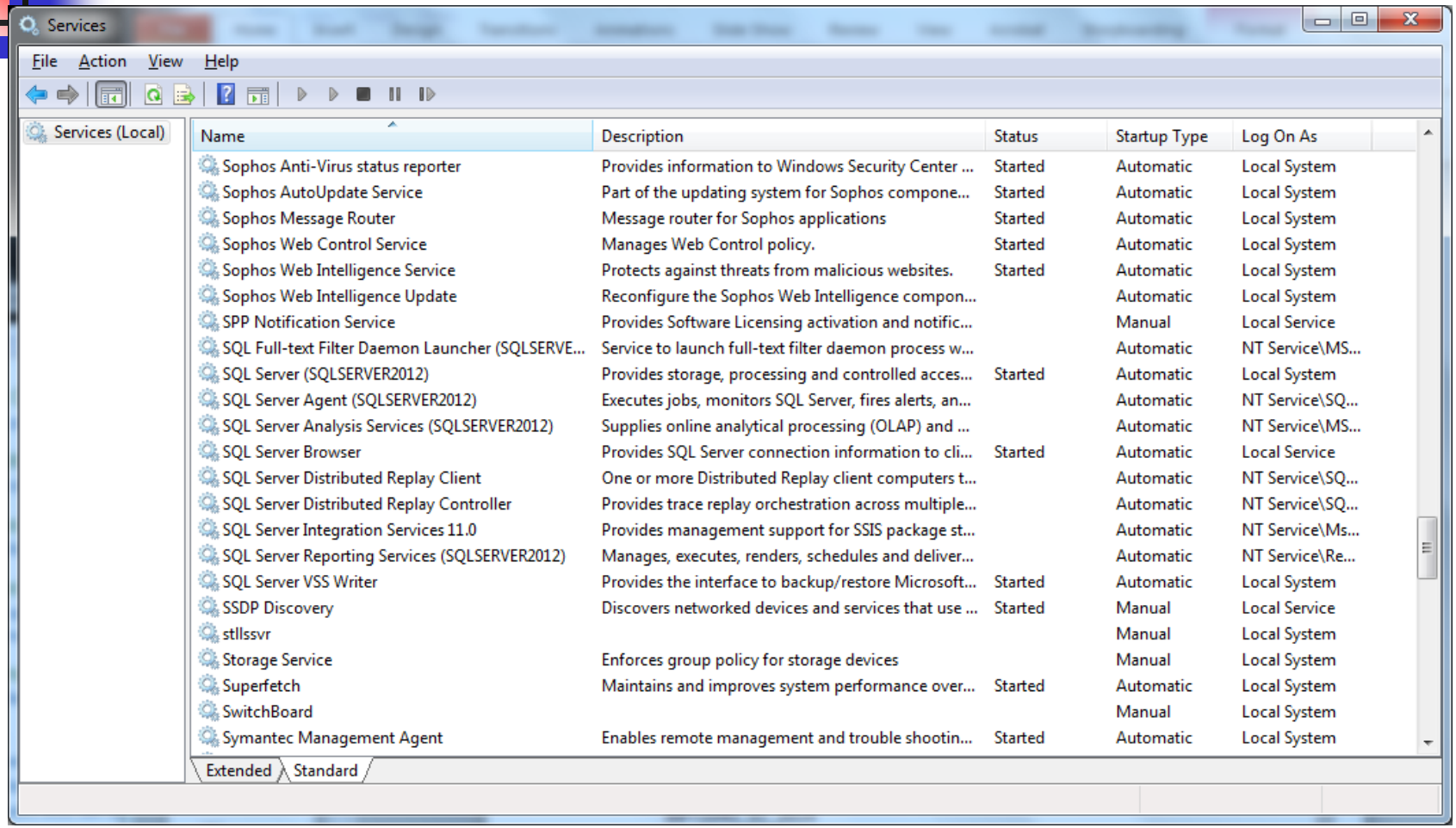
- **Advantages:**
  - ‘Thin’ client, requiring less expensive hardware.
  - Application maintenance centralized.
  - Easier to modify or replace one tier without affecting others.
  - Separating business logic from database functions makes it easier to implement load balancing.
  - Maps quite naturally to Web environment.
  - Makes new technology possible. E.g., cloud computing

Our lab's Client-Server

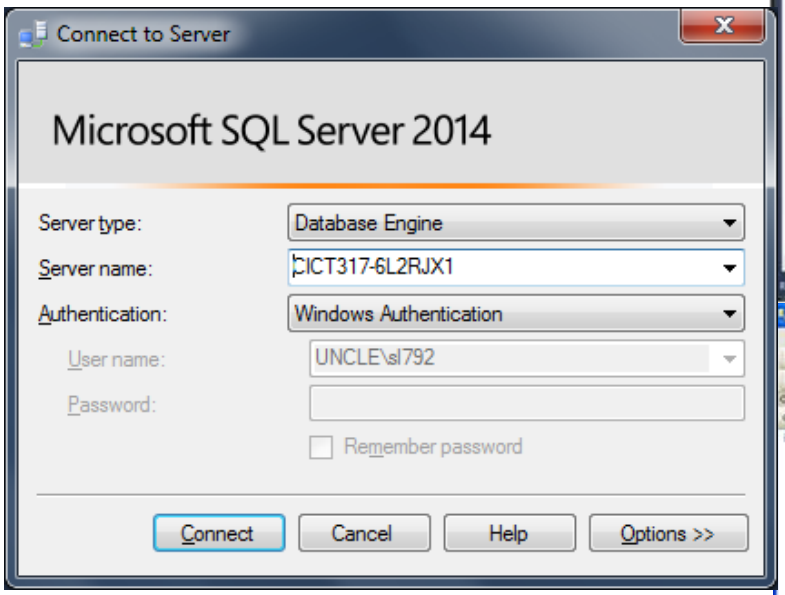
- You'll work with MS SQL Server in a client-server environment

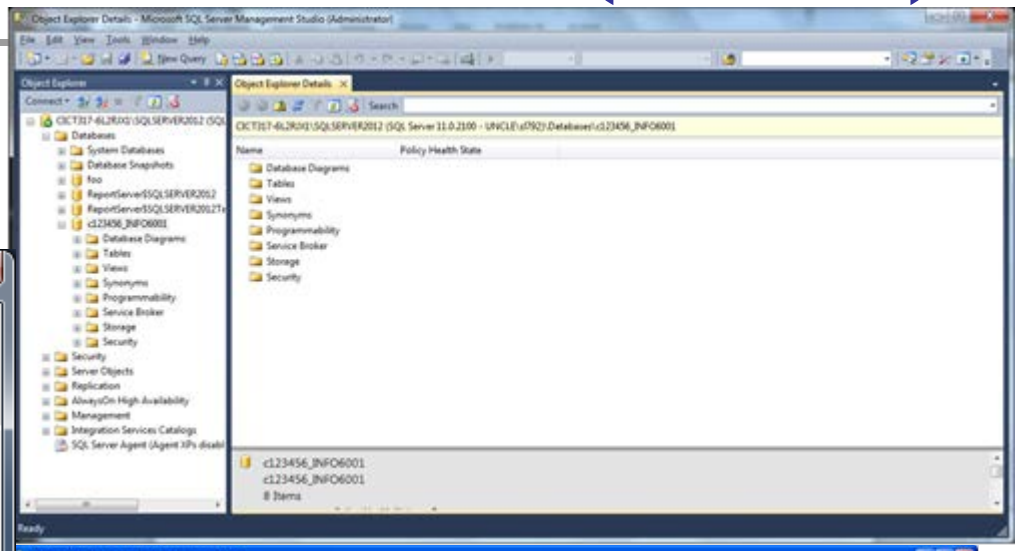


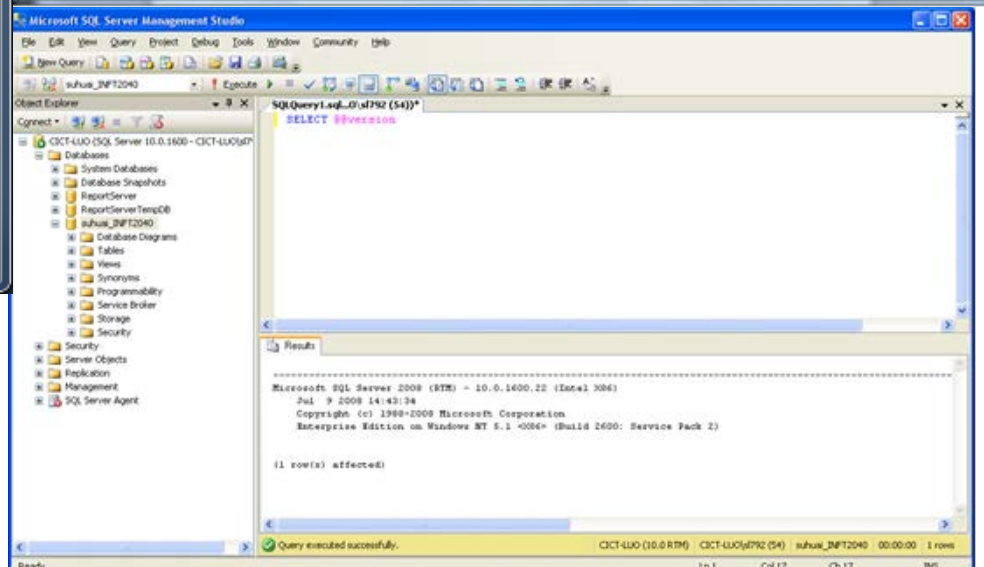
Control panel ->All Control Panel Items -> Administrative Tools -> Services

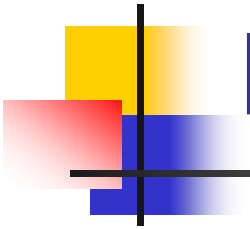


Our lab's Client-Server (cont'd)









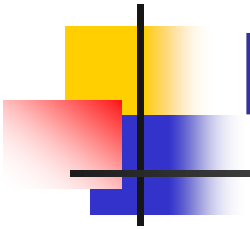
Database Design Process

- Database design process consists of the following main steps:
  - Requirements Analysis
  - Conceptual Database Design
  - Logical Database Design
  - Physical Database Design

Requirements Analysis Background

- Requirements Analysis is the start of any information system.
- It is based on Mission Statement for the DB which has many objectives
- Gathering data requirements is an important process.
- Need to understand the organisation, its operation, processes, procedures and people, and then extract DATA and TRANSACTION requirements. ->

Background (contd.)



- The result of this process is a requirements document outlining
  - What data to store in the database?
  - What are the frequent operations (i.e. transactions)?
  - Identified business rules

A Sample Format

Data Requirements

- **Book:** Information on books maintained by the library include authors (principle author and other authors if any), title of the book, publisher information, edition, physical description (which include number of pages, size, etc.), notes of the book, ...

....

Transaction Requirements

- **Data Manipulation Operations**

Insert/update/delete a book in the library

....

- **Queries**

Search a book based on call number, keyword, author, title, subject and journal title

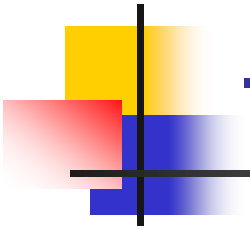
....

Business rules

- A member can have up to 10 holds at any one time

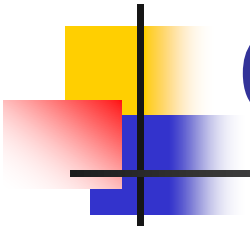
* Sample Requirements Specifications exists in Appendices A & B of text

SEEC Resource Access Project - Requirements/Main Features



- Catalogue Service
- Loan Service
- Acquisition Service
- Reservation Service

- A1 Specification



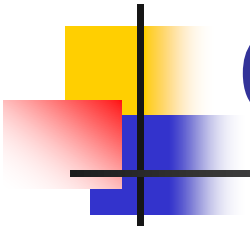
Catalogue

- Resources
  - Movable
    - E.g. camera's, microphones, etc.
  - Immovable
    - E.g. lab rooms, classrooms, studios, etc.

- Every resource has
  - resource id (unique),
  - description
  - present status ('In Use', 'Maintenance', 'Available' 'Borrowed', 'Lost', 'Damaged', etc.).

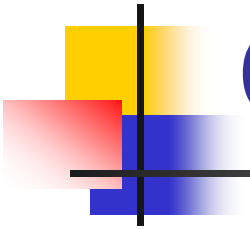
Catalogue (contd.)

- Movable Resource (e.g. camera)
  - name
  - make
  - manufacturer
  - model
  - year
  - asset value



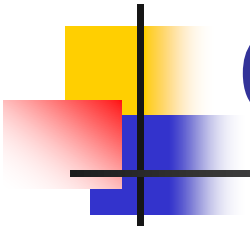
Catalogue (contd.)

- Immovable resource (e.g. classroom)
  - Capacity – maximum number of persons that can be accommodated



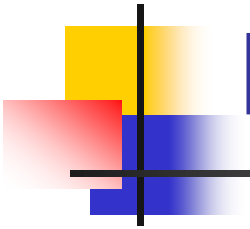
Catalogue (contd.)

- Each resource is categorised to a category
  - E.g. All microphones, all speakers, etc.
- Each category has a unique code, name, description, and max time allowed to borrow/book (in days and/or hours)



Catalogue (contd.)

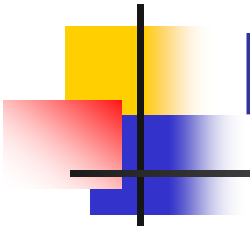
- All resources have a location where they are located
- These locations have a unique id, a room, building and campus



Loan

- School of SEEC's staff and students (i.e. students who enrol in courses offered by SEEC) have lending and reservation rights to School's resources

- They are also known as "members" in the system

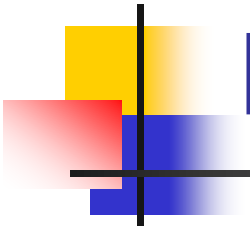


Loan (contd.)

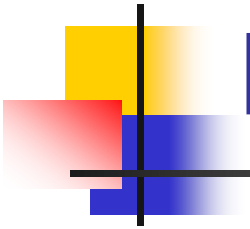
- Members have a unique id, name, address, phone, email, status (‘disabled’, ‘active’) and a comments field

- There are two types of members: staff and students (degree enrolled)

Loan (contd.)



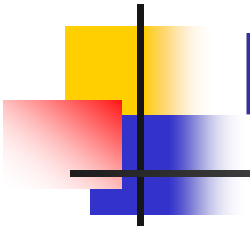
- Student members enrol in courses offered by the School
- Course information about course offerings and student enrolments are maintained
- A course offering has a offering id (unique), course id, name, semester offered, year offered, date the course begins and date course ends



Loan (contd.)

- Staff members can borrow/reserve resources.
- There are no limits on the number of resources used by staff.
- Student members are granted privileges based on the courses they are enrolled in

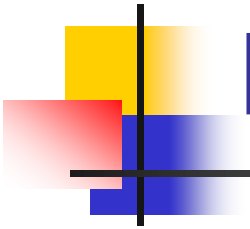
Loan (contd.)



- A course is assigned privileges to different categories of resources

- Each privilege has
  - name
  - description
  - a category to which the privilege is granted for,
  - maximum number of resources that can be borrowed or booked at any given time from the category

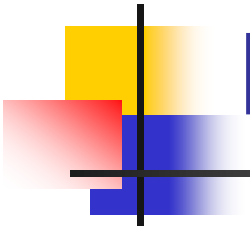
Loan (contd.)



- A member can loan movable resources allowed by his/her privileges
- Information about the resource loaned, member lending the resource, date and time loaned, due date and time, and date and time returned are maintained.

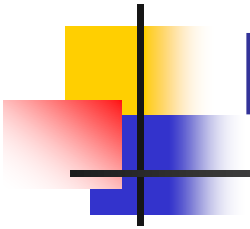
New acquisitions

- A member can request new acquisitions to the School.
- An acquisition contains person requesting acquisition, item name, make, manufacturer, model, year, a description of the required item and its urgency
- The administrator of the system assigns a status (“acquired”, “pending”, etc.), a fund code, vendor code, price and any other notes pertaining to the request.



Reservations

- Members can reserve resources that their privileges allow them to borrow/book.
- Once a reservation is made the resource will be booked for pickup/use by the member on the requested date and time.
- Reservations have the date and time the item is required and a due date & time.
- No two reservations should conflict!



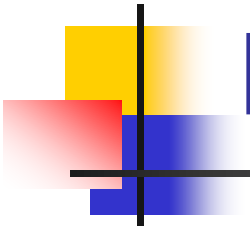
Business rules

- **Expiration of student member access**
  - A student's borrowing privileges are automatically taken away when the current date is later than end date of all his/her enrolled course offerings
  - The status of student member is set to "disabled"

Business rules (contd.)

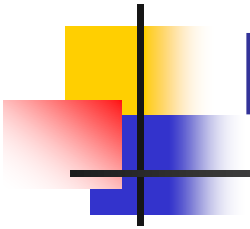
- **Maximum items loaned or reserved at any one time**

  A member cannot borrow or reserve more than the maximum number of items specified in his/her privileges at any given time.



Business rules (contd.)

- **Penalty for late returns by students**
  - Each student member has a default set of points earned (12 at the beginning)
  - A penalty of 3 points is incurred for each overdue day.
  - When the point is reduced to 0, member status is disabled, disallowing borrowing/reservation privileges.
  - The administrator has rights to reset/amend points

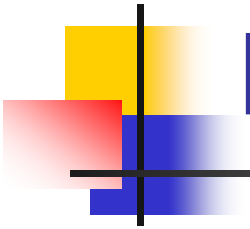


Business rules (contd.)

- **Cancellation of Reservations**
  - A reserved item is cancelled if it is not picked up after a day of the required date or due date (whichever is earlier)
  - Non cancellation of reservation by member, then 1 demerit point
  - Also, the administrator holds the right to cancel any reservation.

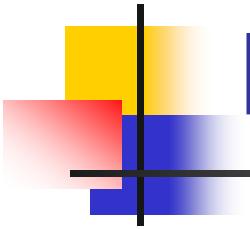
Business rules (contd.)

- **Borrowing / Reservation Periods**
  - The duration of borrowing/reservation periods (either number of days or hours) are determined by the category to which the item belongs
    - For example:
      - Cameras have a duration of 2 days
      - Microphones - 2 hours



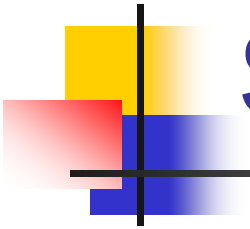
Points to note...

- You may extend requirements that you may consider appropriate for the system
- Points mentioned today should be included in the requirements document
- State any assumptions
- Q?



Lab This Week

- Get familiar with Microsoft's SQL Server 2014, and practice on T-SQL
  - SQL Server 2014 Enterprise Edition
  - Client Server Environment
  - SQL Server Management Studio
  - Transact SQL (T-SQL)



Summary Qs

- Q: what are the four main steps of database design process?
- Q: what are the three-level database architecture specified in the ANSI-SPARC model?
- Q: what are the three Multi-User DBMS Architectures?