Database Design (IS414)
Lecture 1- Course Overview

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References

Books:

- El Masri, Navathe, "Fundamentals of Database Systems"

- C. J. Date, "An Introduction to Database Systems"

- "Next Generation Databases: NoSQL, NewSQL, and Big Data" By Guy Harrison - 2015

Websites:
Websites references will be attached to each lecture

Goal of the Course

- To have the knowledge and skills needed to design relational database schemas (conceptual, logical and physical design).

- Design issues related to new database models are also considered.

Overview of Database Design

- Usually many designs are possible
- Some are (much) better than others!
- How do we choose?
- There are some design traps which should be avoided in any database design.
- There are some design issues do not appear in the conceptual design and appear in the physical design.

DB Design Example

- **Example: Student enrolled in courses per semester.**
  - Students enroll in courses.
  - Courses offered in semesters.
  - Students are assigned to courses per semester.

DB Design Example

- Student(sID, sName, cID, cName, semId, SemesterName)

  Is this a good Design??!!! Why?!!!

DB Design Example

123 Ahmed Ali IS414 Database Design Sem-1 Fall.

123 Ahmed Ali IS214 *Database II Sem-1 Fall2020.*

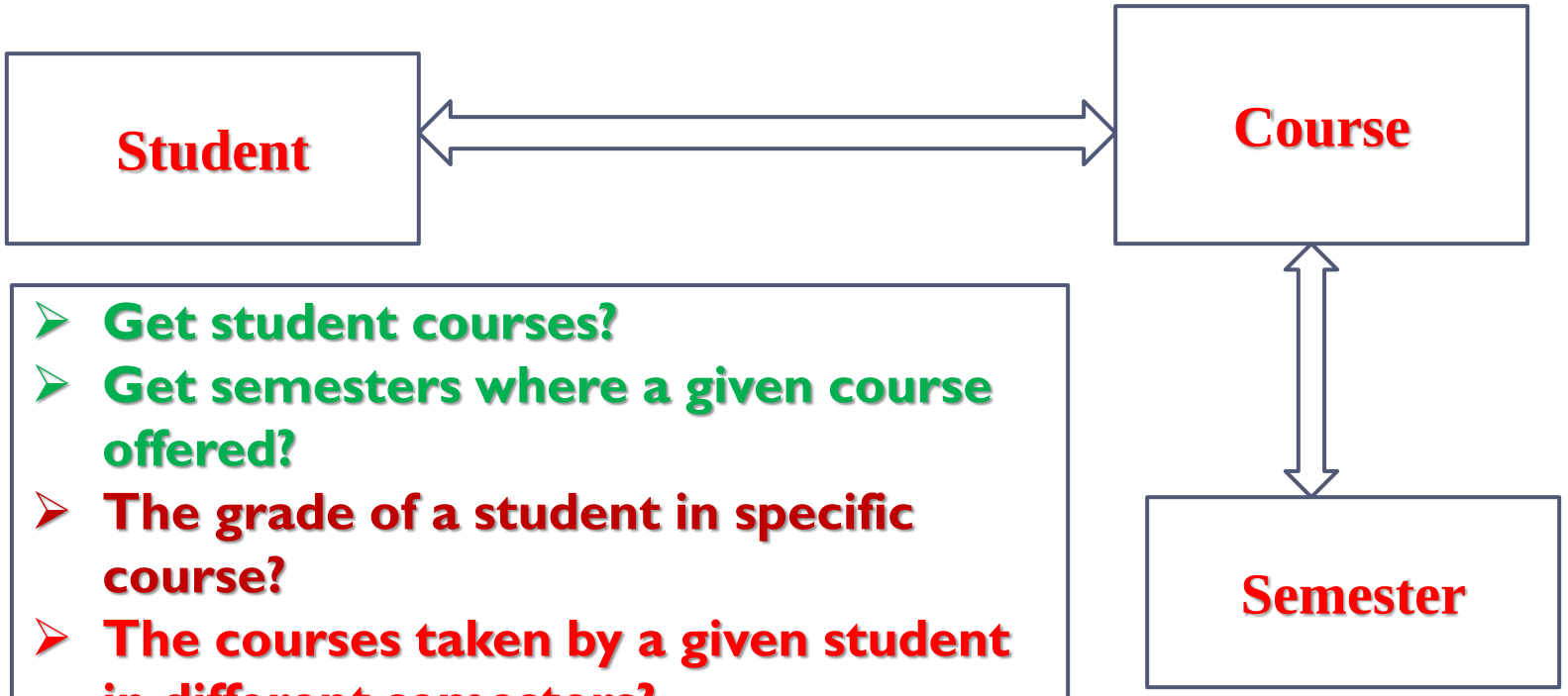
123 Yassin Ali IS414 Database Design Course Sem-1 Fall2020.

Design Anomalies

- Redundancy
  - Capturing info multiple times
  - Wrong statistics and aggregates
- Update Anomaly
  - Update facts differently
- Deletion Anomaly
  - Complete Deletion of an instance

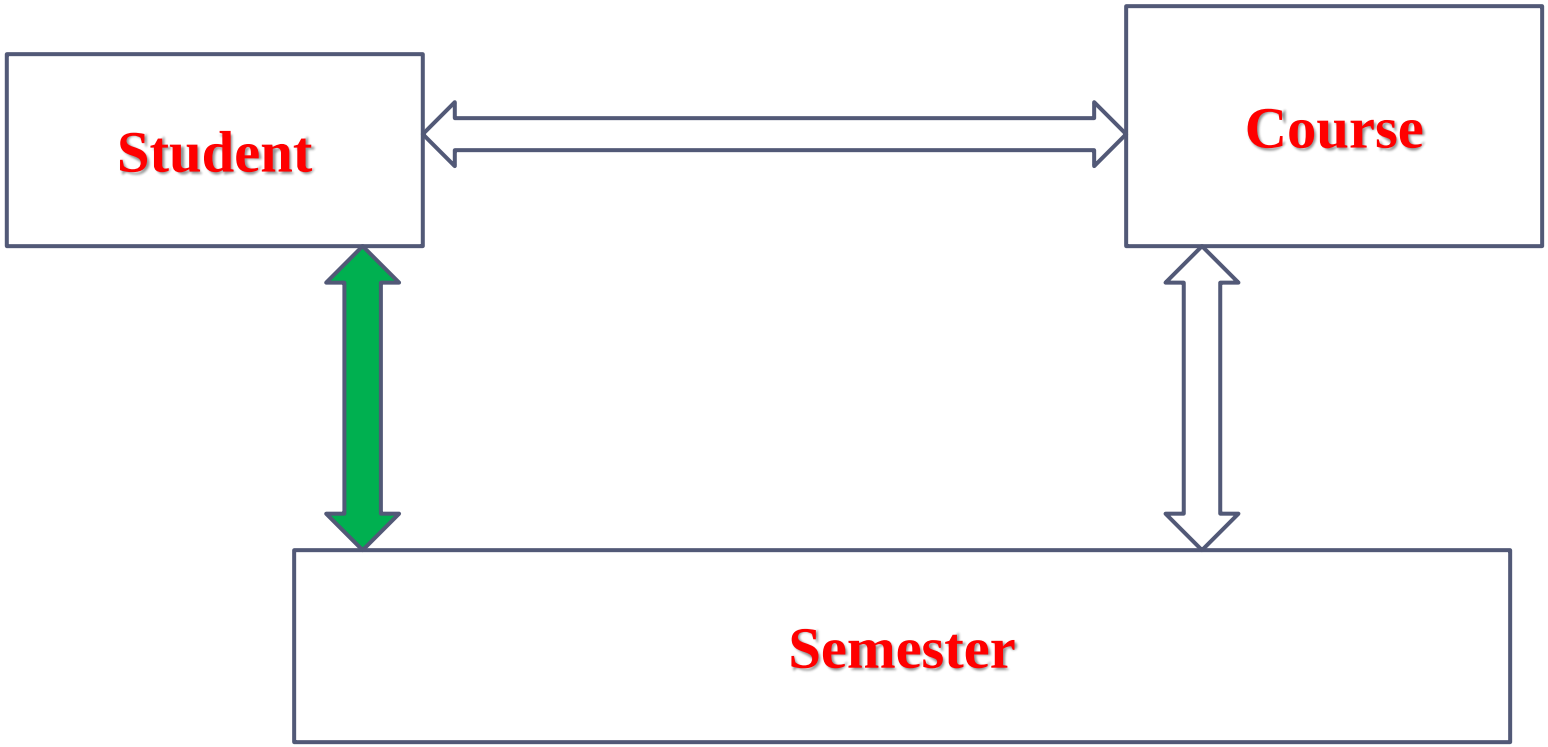
DB Design Example

- What about this design?



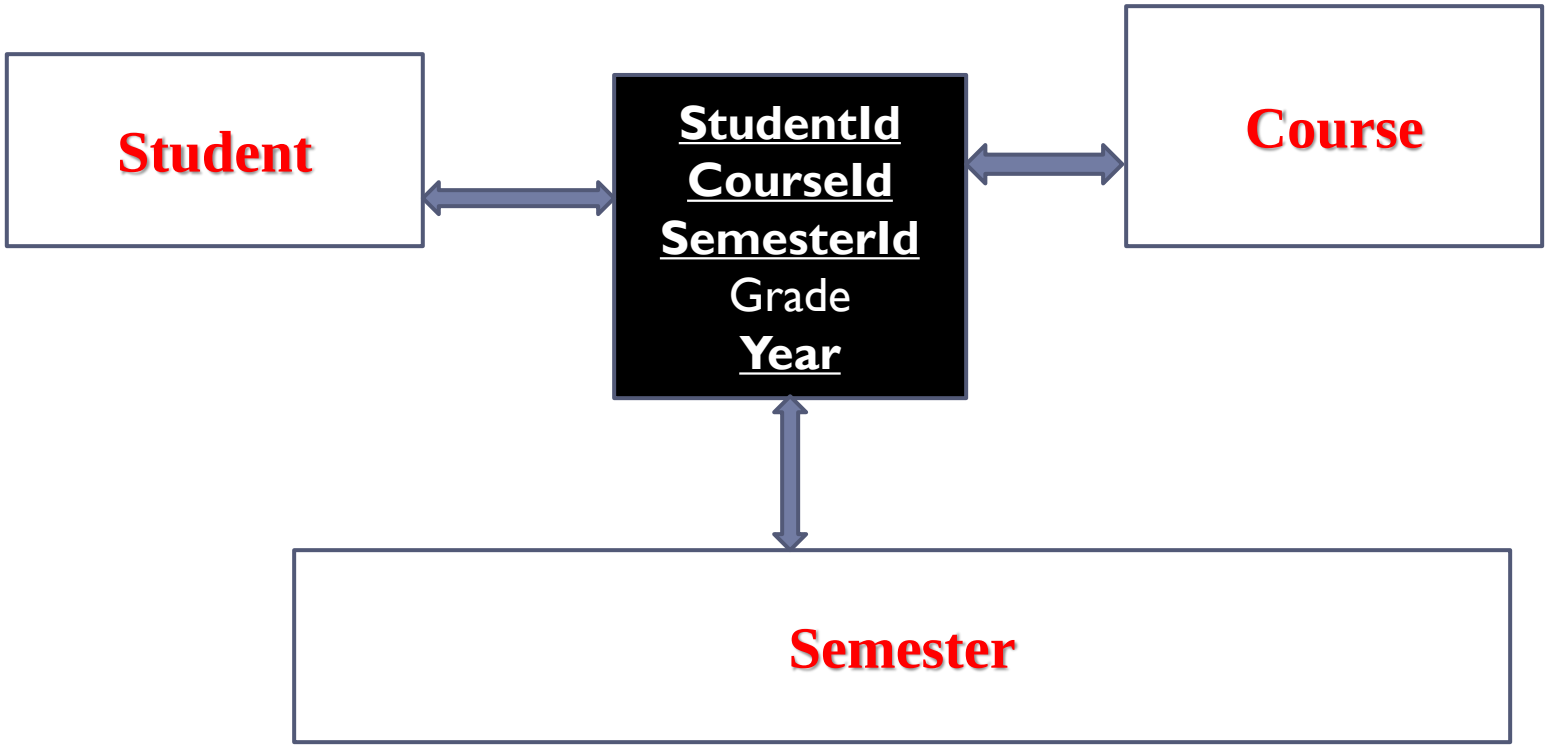
DB Design Example

A suggested solution is:



DB Design Example

- A better design according to real world requirements:



Another Example

- **Example: College application info.**
  - ID and name
  - Colleges applying to
  - High schools attended (with city)
  - Hobbies

Another Example

- Apply(ID, sName, cName, HS, HScity, hobby)

  Is this a good Design??!!! Why?!!!

DB Design Example

- Apply(ID, sName, cName, HS, HScity, hobby)

123 Mostafa Tantawy from OrmanHS(Giza) and ElGalaaHS(Haram) plays tennis and violin and applied to Cairo Univ., GUC, and AUC.

Design Anomalies

- Redundancy
  - Capturing info multiple times
- Update Anomaly
  - Update facts differently
- Deletion Anomaly
  - Complete Deletion of an instance

DB Design Example

- What about this design?
  - Student(stud_ID, sName)
  - Apply(stud_ID, cName)
  - HighSchool(stud_ID, HS)
  - Located(stud_ID, HScity)
  - Hobbies(stud_ID, hobby)

DB Design Example

- What if the HS name is not a key for the high school and we need to have both high school and city to identify it. What can we change in the following design?

  - Student(Stud_ID, sName)
  - Apply(Stud_ID, cName)
  - HighSchool(Stud_ID, HS)
  - Located(HS, HScity)
  - Hobbies(Stud_ID, hobby)

DB Design Example

- A better design according to real word requirements:
  - Student(Stud_ID, sName)
  - Apply(Stud_ID, cName)
  - HighSchool(Stud_ID, HS, HScity)
  - ~~Located(HS, HScity)~~
  - Hobbies(Stud_ID, hobby)

DB Design Example

- What about if the student doesn't want to reveal all the hobbies to all colleges?! .. Only one hobby for each college application..

  - Student(Stud_ID, sName)
  - Apply(Stud_ID, cName)
  - HighSchool(Stud_ID, HS, HScity)
  - Hobbies(Stud_ID, hobby)

DB Design Example

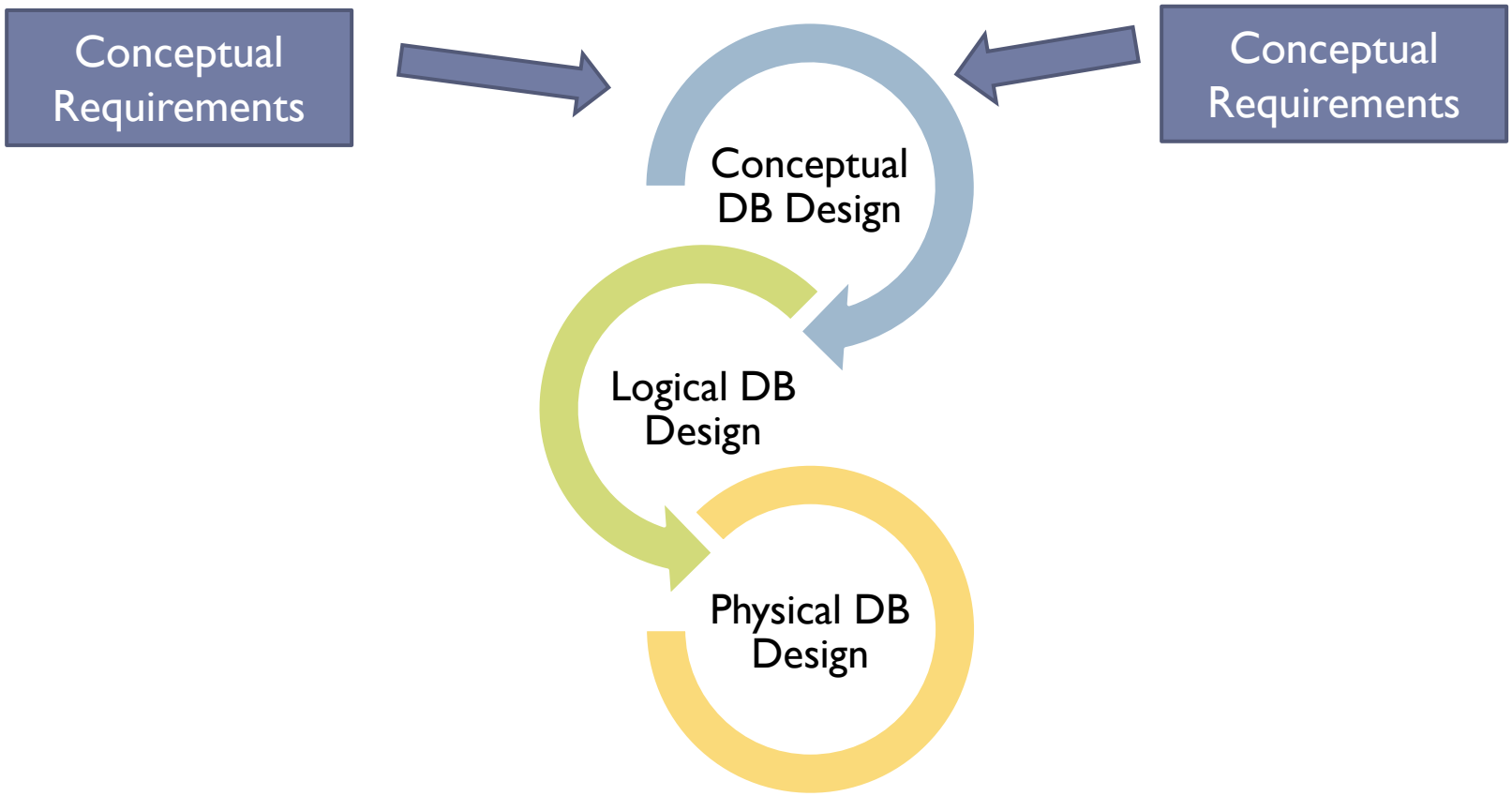
- A better design according to real word requirements:
  - Student(Stud_ID, sName)
  - Apply(Stud_ID, cName, hobby)
  - HighSchool(Stud_ID, HS, HScity)
  - ~~Hobbies(Stud_ID, hobby)~~

DB Design Overview

- **Design by decomposition**
  - Start with "mega" relations containing everything
  - Decompose into smaller, better relations with same info.
  - Can we do this decomposition automatically?

- Automatic decomposition
  - "Mega" relations + *properties of the data*
  - System decomposes based on properties
  - Final set of relations satisfies *normal form*
    - *– No anomalies, no lost information*

Database Design process



Conceptual Database Design

- Review Entity Relationship Diagram
- ERD Design in Depth

Logical Database Design

- Codd's Rules for Relational Database Design
- Conversion into Relational Model
- Normalization
- Virtual & Materialized Views
- Relational Design Practice
- DB Design Case Studies

Physical Database Design

- Introduction to Physical Database Design
- Index Types
- Database Tuning

Course Outline