

# Advanced Data Modeling

Summer Semester 2008

- Exercises I -

- 1) Model the following scenario using the relational data model. List all relation schemata, including domains of the attributes.

*Scenario: Planning of teaching at a university.*

There are different types of events: lectures, tutorials and seminars. Every event takes place in a certain room and has a start, an end time and a title. An event may have other events as prerequisites. Professors, students and research assistants are persons. Every person has a name and an e-mail address. Additionally, every professor has a working group and every research assistant works in a working group. Events are given by professors or research assistants. Every tutorial belongs to a lecture. Students attend events.

Event(ID:EventID, title:String, from:time, to:time, room:RoomNo, givenBy: Person)

Lecture(ID:EventID)

Seminar(ID:EventID)

Tutorial(ID:EventID, Lecture:EventID)

Person(ID:PersonID, name:String, eMail:string)

Professor(ID:PersonID, Group: GID)

ResearchAssistant(ID:PersonID, Group:GID)

Student(ID:PersonID)

Attends(Person:PersonID, Event:EventID)

Prerequisite(Event:EventID, PrereqFor: EventID)

2) Create an instance of your database schema, modeling the following world knowledge:

Prof. Herbrand leads the working group of computational logic. Prof. Tarski leads the AI group. Mr Lloyd and Mr. Topor are Research Assistants of Prof. Herbrand. Prof. Herbrand gives the lecture on Advanced Data Modeling and Mr Lloyd gives the corresponding tutorial. There is a seminar about Datalog given by Mr. Topor. Joe attends the Advanced Data modeling lecture and tutorial. Jane attends the tutorial and the seminar. Jim attends a seminar called “Non-monotonic reasoning” by Prof. Tarski. Databases I is a prerequisite for Advanced Data Modeling. The Advanced Data Modeling tutorial is a prerequisite for doing the lecture and vice versa.

Event					
ID:EventID	title:String	from:time	to:time	room:RoomNo	givenBy:Person
ADML	Advanced Data Modeling	10:15	11:45	1	Herbrand
ADMT	Advanced Data Modeling	08:00	10:00	2	Lloyd
DLS	Datalog	07:00	08:00	3	Topor
NMRS	Non-monotonic Reasoning	15:00	17:00	2	Tarski
DBIL	Databases I	13:00	00:00	4	Herbrand

Lecture	Seminar	Tutorial	
ID:EventID	ID:EventID	ID:EventID	Lecture:EventID
ADML	DLS	ADMT	ADML
DBIL	NMRS		

Person	Professor	ResearchAssistant	Student
ID:PersonID	ID:PersonID	ID:PersonID	ID:PersonID
Herbrand	Herbrand	Lloyd	Joe
Tarski	Tarski	Topor	Jane
Lloyd			Jim
Topor			
Joe			
Jane			
Jim			

Attends		Prereq	
Person:PersonID	Event:EventID	Event:EventID	PrereqFor:EventID
Joe	ADML	DBIL	ADML
Jane	ADMT	ADML	ADMT
Jim	NMRS	ADMT	ADML
Joe	ADMT		
Jane	DLS		

- 3) Formulate the following queries using relational algebra. Is it possible to model the queries using relational algebra? If not, why? If yes, list the results.
- List all rooms for events, which are not tutorials.
  - List all students of professor Herbrand (attending events offered by the professor's working group).
  - List **all** prerequisites for the lecture on Advanced Data Modeling. Please note that a prerequisite course may in turn again have prerequisites.
  - List all courses without any prerequisites.

- $\pi_{\text{Event.room}}(\sigma_{\text{Event.ID=tutorial.ID}}(\text{Tutorial} \times \text{Event}))$
- $\sigma_{\text{Attends.Event=Event.ID, Event.givenBy=Person.ID}}(\text{Attends} \times \text{Event} \times (\pi_{\text{Person.ID}}(\sigma_{\text{Professor.Group=Assistant.Group, Person.ID=Assistant.ID}}(\text{Person} \times \text{Assistant} \times (\sigma_{\text{Professor.ID=Herbrand}}(\text{Professor}))) \cup (\pi_{\text{Person.ID}} \sigma_{\text{Person.ID=Herbrand, Person.ID=Professor.ID}}(\text{Professor} \times \text{Person}))))))$
- Not possible, as this requires computing the transitive closure of the Prerequisite relation, which can not be formulate in relational algebra.
- $\text{Course} - (\sigma_{\text{Course.ID=Prerequisite.Event, CourseID=Prerequisite.PrereqFor}}(\text{Course} \times \text{Prerequisite}))$

- 4) How would you model the following integrity constraints (using first order logic, or using relational algebra queries, which select invalid entries)? List all tuples violating the constraints.
- No Person is a Professor and a Research Assistant.
  - Every student attends at least two events.
  - No course has itself as a prerequisite.

- $\text{Person} \triangleright \triangleleft_{\text{Person.ID=Professor.ID}} \text{Professor} \triangleright \triangleleft_{\text{Person.ID=Assistant.ID}} \text{Assistant}$
- $\forall X : \text{Student}(X) \exists Y, Z : \text{Attends}(X, Y) \wedge \text{Attends}(X, Z) \wedge \neg(Y=Z)$
- $\sigma_{\text{Course.ID=Event.ID, Course.ID=Prerequisite.Event, CourseID=Prerequisite.PrereqFor}}(\text{Course} \times \text{Event} \times \text{Prerequisite})$

- 5) Add a new event type Group Project to your schema. Formulate a new constraint that no event is a Lecture and a Group Work.

Group Project
ID:EventID

$$\neg \exists X : \text{Event}(X) \wedge \text{Lecture}(X) \wedge \text{GroupProject}(X)$$