University of London International Academy
MSc/PG Dip in Information Security
Lead College – Royal Holloway

Database Security IYM009 (Optional)

Aims

This module covers several aspects of database security and the related subject of concurrency control in distributed databases. We will discuss methods for concurrency control and failure recovery in distributed databases and the interaction between those methods and security requirements. We will also examine how access control policies can be adapted to relational and object-oriented databases

Pre-requisites

- None

Essential Reading

- None

Assessment

This module is assessed by a two hour unseen written examination.

Learning Outcomes

At the end of the module the student should

- Understand how multi-level security can be preserved within a database whilst still permitting the concurrent execution of transactions.
- Understand why confidentiality is so difficult to achieve within a statistical database.
- Understand the implications that security and its administration have in the context of commercial databases such as Informix and Oracle.

Syllabus

Part 1: Integrity

Unit 1 - Transaction Processing

In this first unit we have a look at several problems that can occur when users are given unrestricted simultaneous access to a database. We will also be introducing concepts and notations that will allow us to examine interleaved transactions and determine their correctness (or otherwise). By doing this unit we will have discovered that the best way to solve these problems is to ensure that they never occur in the first place!

Unit 2 - Serializability Theory

In this unit we are going to focus on the concept of a history, in order to determine if a particular ordering of database operations is a "good" ordering that preserves the integrity of a database.

Unit 3 - Two Phase Locking Schedulers

In this unit we study practical schedulers by looking at two phase locking schedulers, the most popular type in commercial products. For most of this unit, we focus on locking in centralized DBSs, using the models we have already presented. At the end, we show how locking schedulers can be adapted to a distributed system environment.

Unit 4 - Centralized Recovery

A good system must be capable of recovering from the most common types of failures without human intervention. In this unit, we turn to the question of how to process transactions in a fault-tolerant manner.

Unit 5 - Distributed Transactions and Recovery

In this unit, we discuss the reliability and integrity issues that arise when transactions are processed in a distributed database system. We are going to focus on a distributed transaction and see how the involved sites communicate with each other in order to achieve atomic commitment (even in the presence of failures)

Part 2: Security

Unit 6 - Data Security, BLP, and Relational Database Security

In this unit we are going to firstly revisit some of the general aspects of data security together with a slightly simplified version of the Bell LaPadula security model. We will then move on to relational databases and their facilities/functions that can be used to provide data security.

Unit 7 - Access Control in SeaViews and Sword

In this unit we are going to focus primarily on the SeaViews approach to multi-level secure relational database and have a much briefer look at SWORD.

Unit 8 - Statistical Database Security

In this unit we will restrict our attention totally to statistical databases where individual data items are sensitive, but statistical queries (such as SUM, COUNT) are permitted. The areas we will examine include Aggregation and Inference, Direct Attacks, Indirect and Tracker Attacks, Control Mechanisms.

Unit 9 - Concurrency Control and Multi-Level Security

In this unit we return to the topic of concurrency control and discuss, how security requirements may interfere with the concurrency control algorithms described earlier in this module. In particular the unit examines Optimistic Concurrency Control and also Multiversion Time Stamp Ordering.

Unit 10 - Oracle Security

In this final unit we relate some of the previously examined material to the security aspects of Oracle (a widely used commercial relational database). This unit consists of a recorded lecture delivered by Duncan Harris, Chief Security Architect at Oracle.