

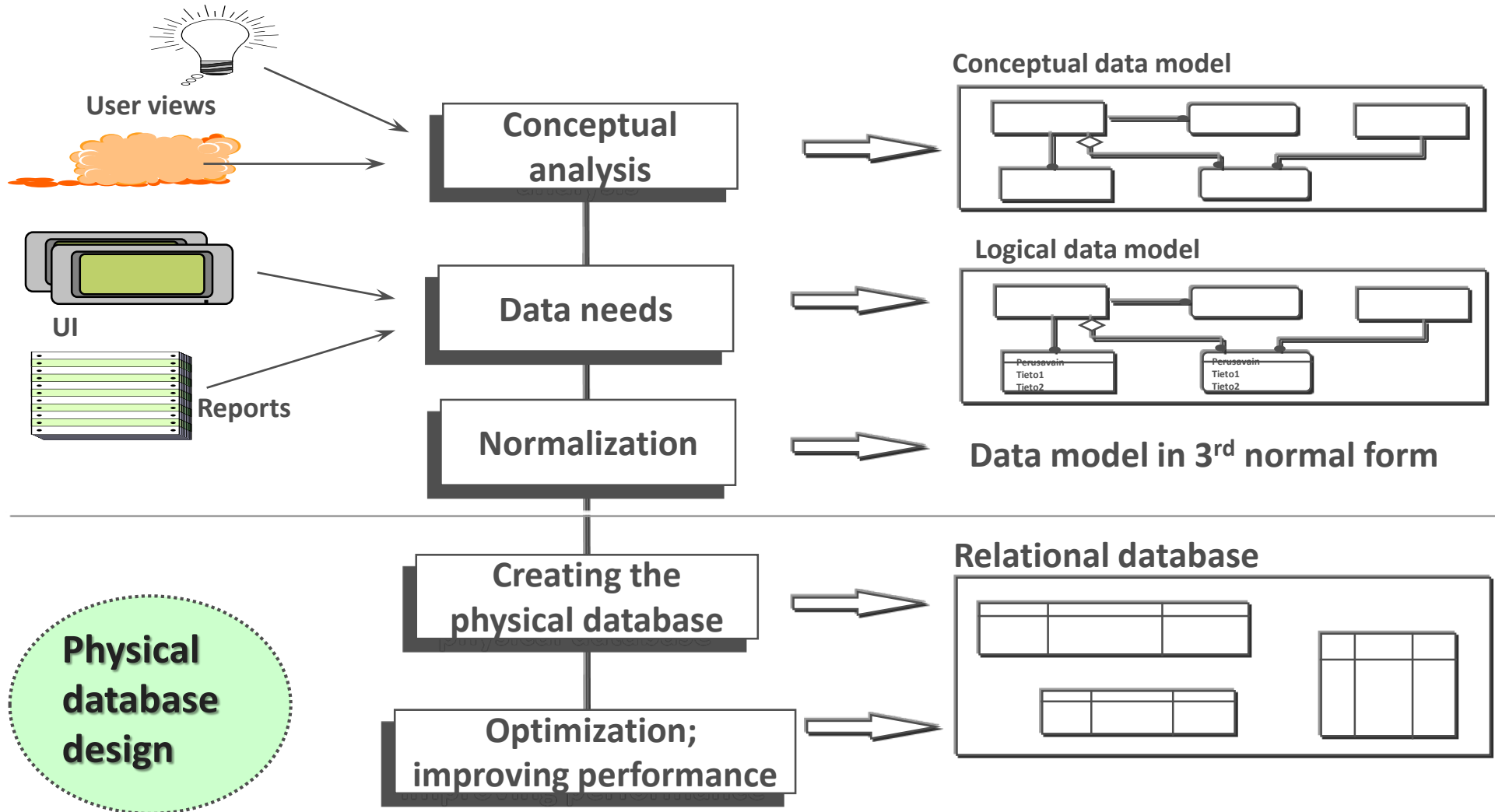
# TTOW0110 ADVANCED DATABASES

## **PHYSICAL DATABASE DESIGN**

BASED ON THE BOOK HOVI, HUOTARI, LAHDENMÄKI:  
TIETOKANTOJEN SUUNNITTELU & INDEKSOINTI,  
DOCENDO (2003, 2005), CHAPTER 9

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& TAPIO LAHDENMÄKI

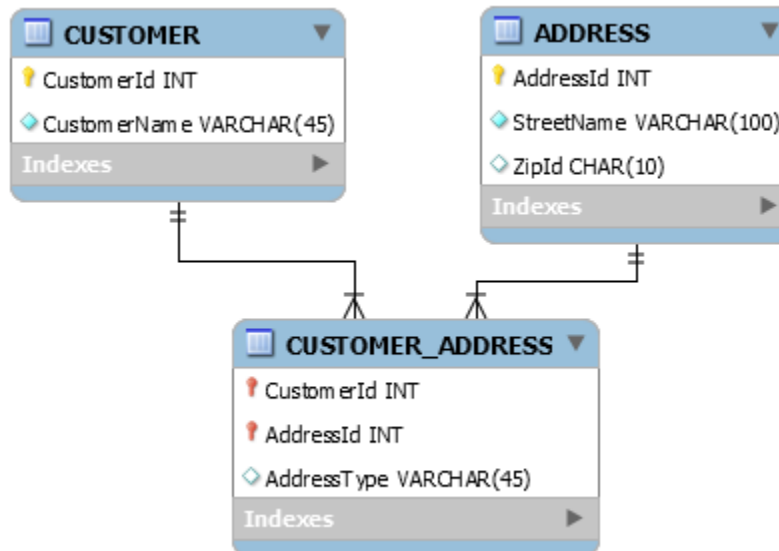
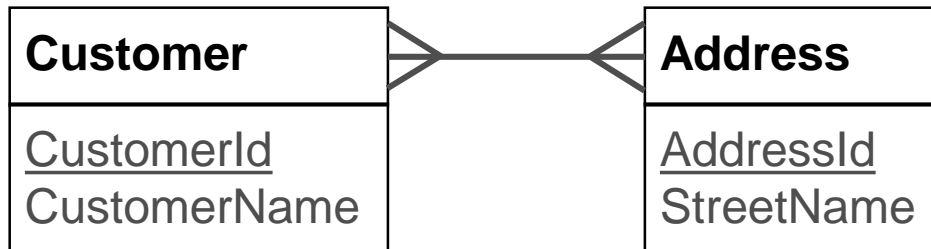
# DATABASE DESIGN PROCESS



# PHYSICAL DATA MODEL (PDM)

- Internal schema of the database
- Physical model depicts:
  - Data tables; their types (e.g. “engine” used)
  - Columns and their data types, are they required (not null) etc.
  - Relationships (primary and foreign keys; identifying/non-identifying)
- PDM should also reflect database naming standards

# Example: from conceptual / logical model to physical data model



# TYPICAL TASKS FOR DB PHYSICAL DESIGN

- Designing and implementing indexes
- Defining the page size (e.g. 4k, 8k, 32k)
- Planning extents and free space
- Partitioning of the tables and indexes
- Planning the use of disks (e.g. hot tables)
- Transaction analysis
- Optimizing the hardware use; how much RAM for data buffers etc.

# EXTENT AND FREE SPACE EXAMPLE: ORACLE

The screenshot displays the Oracle Enterprise Manager Console interface. On the left, a tree view shows the database structure, with the SCOTT user selected and expanded to show the DEPT table. The right pane shows the configuration for the DEPT table, with the 'Storage' tab active. The 'Extents' section is configured with the following values:

- Initial Size: 64 K Bytes
- Next Size: 0 K Bytes
- Increase Size by: 10 %
- Minimum Number: 1
- Maximum Number: Value 2147483645

The 'Space Usage' section shows the following values:

- Percentage free space reserved for updates: 10
- Percentage used space threshold for row insertion candidacy: 40

The 'Number of Transactions' section shows the following values:

- Initial: 1
- Maximum: 255

# DEFINING FREE SPACE

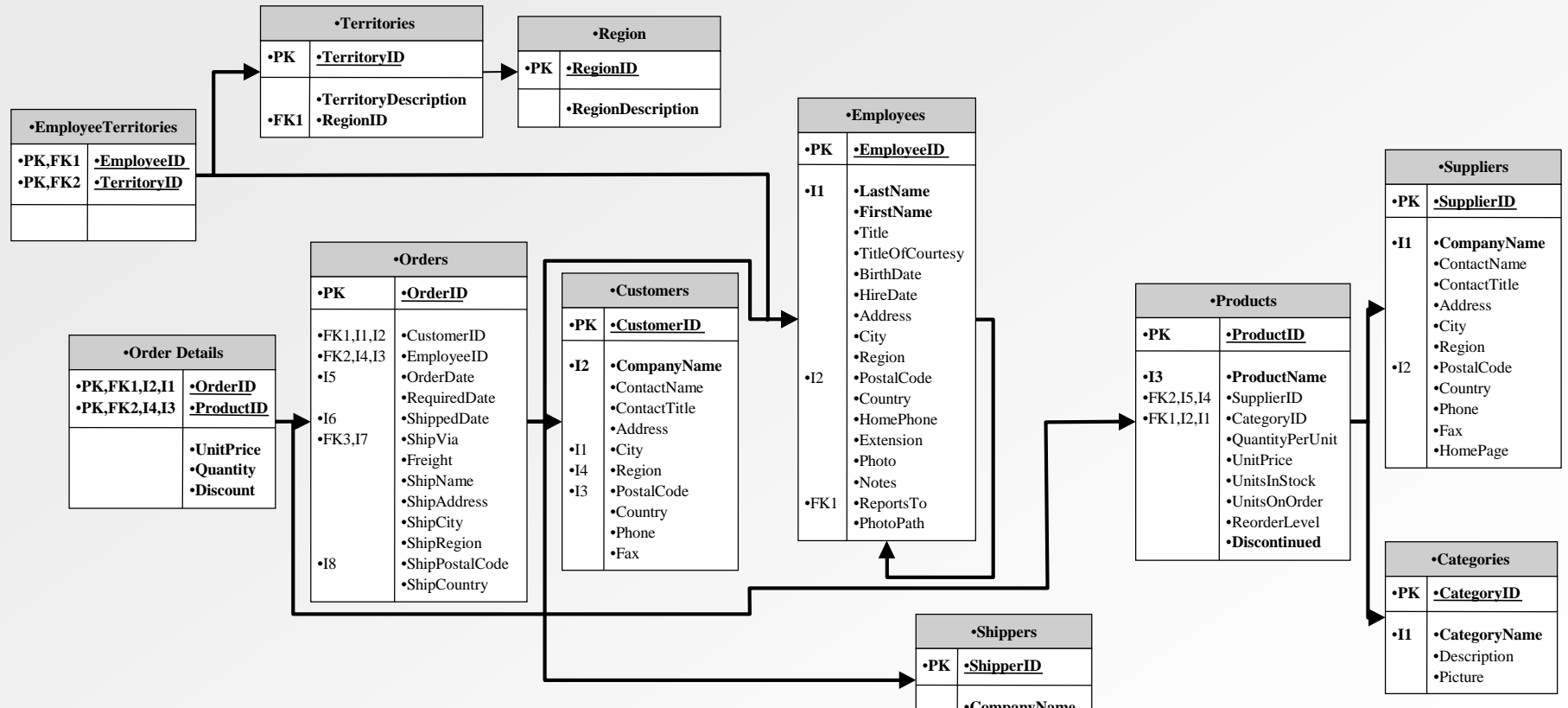
- How much space you need for inserts (PCTFREE, FILLFACTOR) and empty pages (FREEPAGE)
- Rough estimate for calculating disk space

*Space needed = net size of the big tables x 5*

(net size = nr of rows x average length of rows)

# LAYOUT BASICS: ADDING SOME COLOR TO DATA

## Updating Northwind ...



**Static**

**Near Static**

**Dynamic**

**Hot**

almost never

hardly ever

time to time

pretty often



# RAID

- Redundant Arrays of Inexpensive Disks
- RAID 1: mirroring
- RAID 5: at least 3 disks from which one for parity checking
- Elmasri/Navathe, Fundamentals of Database Systems, Fourth Edition, chapter 13



Non-Redundant (RAID Level 0)



Mirrored (RAID Level 1)



Memory-Style ECC (RAID Level 2)



Bit-Interleaved Parity (RAID Level 3)



Block-Interleaved Parity (RAID Level 4)



Block-Interleaved Distribution-Parity (RAID Level 5)



P+Q Redundancy (RAID Level 6)

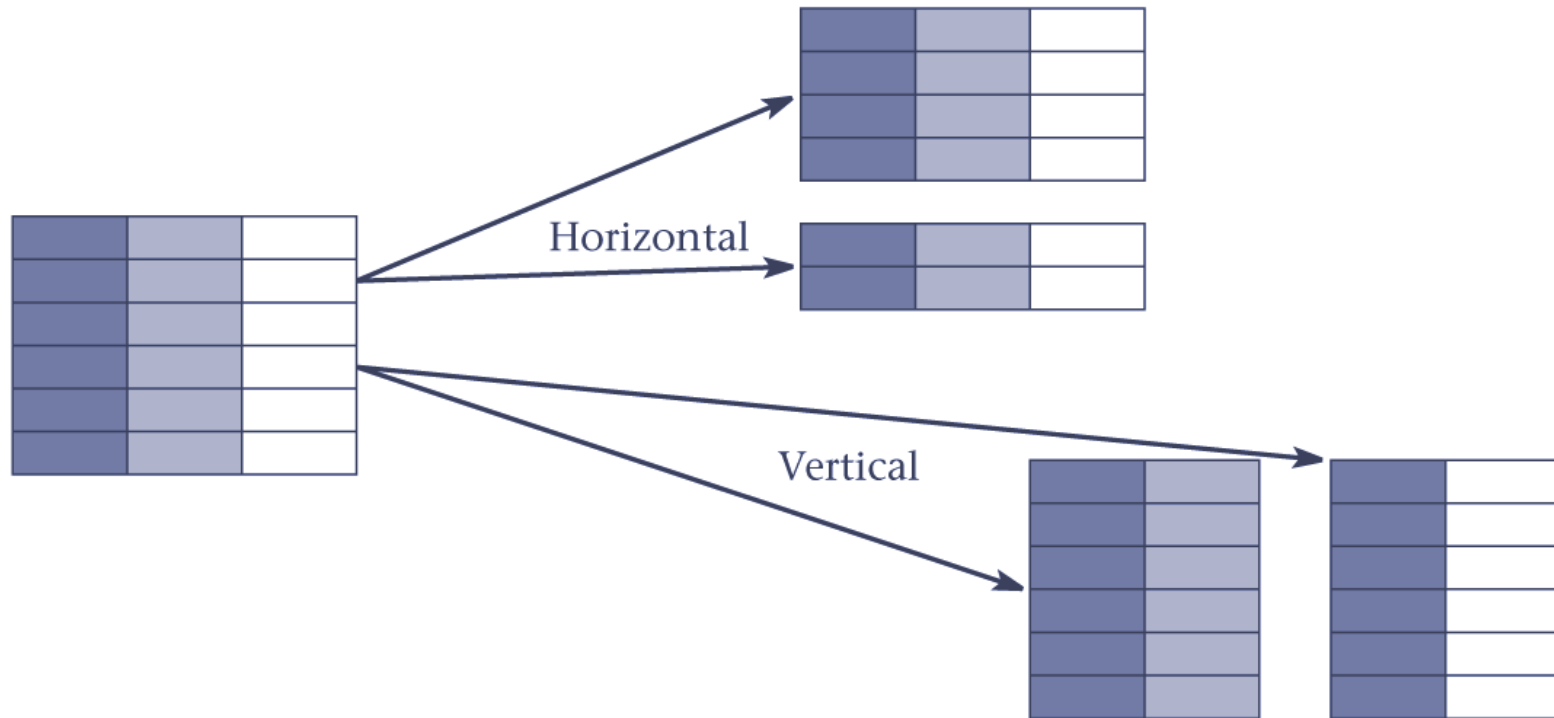
<https://www.cloudwards.net/what-is-raid/>

# PARTITIONING TABLES

- Rather than combining tables, could decompose a table into a smaller number of partitions.
- Horizontal partition: distribute records across a number of (smaller) tables.
- Vertical partition: distribute columns across a number of (smaller) tables. PK duplicated to allow reconstruction.
- Partitions useful for applications that store and analyse large amounts of data.

<https://stackoverflow.com/questions/20771435/database-sharding-vs-partitioning>

# PARTITIONING TABLES



# ASSIGNMENT

Write a database management plan which includes physical design about (but not limited to):

- Creating backups (how, when, where, by whom)
- Partitioning, disk usage
- DB optimization (creating indexes etc.)
- Maintenance of database
- Users, user roles and their rights
- Other database administrator (DBA) tasks/duties