Databases

Normalisation

Normalization

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Introduction to normalization

- Normalization is the sequence of steps for creating and improving a relational database model

- The steps are called **normal forms**

- Normalization can be seen as a **quality assurance** removing duplication and minimizing redundant chunks of data

- The following slides are based upon **"Beginning database design"**

Types of dependencies

- Normalization is based upon analysing the ***dependencies*** between fields

- The goal of normalization:
  - Remove partial & transitive dependencies, so that all attributes are fully functional dependent on the primary key

- Types of dependencies:
  - ***Functional dependency:*** see example figure 4-3 page 77 "Beginning database design"
    CURRENCY is functionally dependent on FXCODE - FXCODE is the determinant

  - ***Partial dependency:*** a field is dependent on only ***part of*** the composite/compound primary key

  - ***Transitive dependency:*** a field is more dependent on another field than on the primary key

Introduction to normal forms (NF)

- The different steps in the normalization process are called ***normal forms***
-
  NB! Only 3 normal forms are used here

- The purpose of each normal form is:
  - 1st normal form (1NF): eliminate ***repeating groups***
  - 2nd normal form (2NF): eliminate ***partial dependencies*** (apply for composite/compound primary keys)
  - 3rd normal form (3NF): eliminate ***transitive dependencies***

1st normal form (1NF) - examples

- Eliminate **repeating groups**

- Visualization of problem: see figure 4-8 + 4.9 page 84 in **"Beginning database design"**

- Solution: see figure 4-11 + 4-12 page 85+86 in **"Beginning database design"**

2nd normal form (2NF) - examples

- Eliminate *partial dependencies*

- See example in assignment 1

3rd normal form (3NF) - examples

- Eliminate **transitive dependencies**

- See example in assignment 1

Example of using the 3 normal forms: assignment 1 normalization - examples

- Examine the Patient Medication Form for the Wellmeadows Hospital case study shown next slide

- (a) Identify the functional dependencies represented by the attributes shown in the form. State any assumptions you make about the data and the attributes shown in this form

- (b) Describe and illustrate the process of normalizing the attributes shown in the form to produce a set of well-designed 3NF relations

- (c) Identify the primary, and foreign keys in your 3NF relations.

Patient medication form for assignment 1

Wellmeadows Hospital
Patient Medication Form

Patient Number: P10034

Full Name: Robert MacDonald

Ward Number: Ward 11

Bed Number: 84

Ward Name: Orthopaedic

Drug Number	Name	Description	Dosage	Method of Admin	Units per Day	Start Date	Finish Date
10223	Morphine	Pain Killer	10mg/ml	Oral	50	24/03/04	24/04/05
10334	Tetracyclene	Antibiotic	0.5mg/ml	IV	10	24/03/04	17/04/04
10223	Morphine	Pain Killer	10mg/ml	Oral	10	25/04/05	02/05/06

Solution assignment 1 normalization

- A solution showing the steps in the normalization process is shown in the file called **_"Solution assignment 1 normalization.pdf"_**

- Primary key: patientNo, drugNo, startDate

- Partial dependencies:
  - patientNo → fullName
  - drugNo → name, description, dosage, methodOfAdmin

- Transitive dependencies:
  - wardNo → wardName

Assignment 2 normalization

- The table shown next slide lists sample dentist/patient appointment data. A patient is given an appointment at a specific time and date with a dentist located at a particular surgery. On each day of patient appointments, a dentist is allocated to a specific surgery for that day.

- (a) Identify the functional dependencies represented by the attributes shown in the table next slide. State any assumptions you make about the data and the attributes shown in this table

- (b) Describe and illustrate the process of normalizing the table to 3NF relations. Identify the primary and foreign keys in your 3NF relations.

- Upload your solution to the folder "Assignment 2" in the "02 Normalization" folder.

Dentist-patient appointment data for assignment 2

staffNo	dentistName	patNo	patName	appointment date	time	surgeryNo
S1011	Tony Smith	P100	Gillian White	12-Sep-04	10.00	S15
S1011	Tony Smith	P105	Jill Bell	12-Sep-04	12.00	S15
S1024	Helen Pearson	P108	Ian MacKay	12-Sep-04	10.00	S10
S1024	Helen Pearson	P108	Ian MacKay	14-Sep-04	14.00	S10
S1032	Robin Plevin	P105	Jill Bell	14-Sep-04	16.30	S15
S1032	Robin Plevin	P110	John Walker	15-Sep-04	18.00	S13

Additional resources for normalization

- http://holowczak.com/database-normalization/5/

- http://www.slideshare.net/jagaarj/database-design-normalization

- https://www.youtube.com/watch?v=U-F_fRJ_YTQ