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CS 1555

Homework 8

1. Consider the following set of functional dependencies:
   FD1: ItemId → ItemDescription, ItemPrice, StockQuantity
   FD2: PurchaceId → PurchaceDate, VendorCode
   FD3: VendorCode → VendorName, VendorAddress
   FD4: ItemId, PurchaceId → OrderQuantity

   a. Using universal relational approach (top-down process), construct a set of 3NF/BCNF relations from the above functional dependencies. Indicate the primary keys for the result relations. Please show all steps clearly as mentioned in the lecture slides.

      Key = {ItemId, PurchaseId}
      R = (ItemId, ItemDescription, ItemPrice, StockQuantity, PurchaseId, PurchaseDate, VendorCode, VendorName, VendorAddress, OrderQuantity)

      R Decompisition →
      R_1 = (VendorCode, VendorName, VendorAddress) → FD3
      R_2 = (ItemId, ItemDescription, ItemPrice, StockQuantity, PurchaseId, PurchaseDate, VendorCode, OrderQuantity)

      R_2 → Decompisition
      R_3 = (ItemId, ItemDescription, ItemPrice, StockQuantity) → FD1
      R_4 = (ItemId, PurchaseId, PurchaseDate, VendorCode, OrderQuantity)

      R_4 Decompisition →
      R_5 = (PurchaseId, PurchaseDate, VendorCode) → FD2
      R_6 = (ItemId, PurchaseId, OrderQuantity) → FD4

Final Decompisition:
R_1 = (<u>VendorCode</u>, VendorName, VendorAddress)
R_3 = (<u>ItemId</u>, ItemDescription, ItemPrice, StockQuantity)
R_5 = (<u>PurchaseId</u>, PurchaseDate, VendorCode)
R_6 = (<u>ItemId</u>, <u>PurchaseId</u>, OrderQuantity)

b. Using the table method, check whether the constructed set of relations is lossless or not. Also, state if your decomposition is good, bad or ugly. You must show all steps. Hint: Bad decomposition is a lossy one, while ugly decomposition is lossless but does not preserve some dependencies.

	ItemId	ItemDescription	ItemPrice	StockQuantity	PurchaseId	PurchaseDate	VendorCode	VendorName	VendorAddress	OrderQuantity
R_1	U	U	U	U	U	U	**<u>K</u>**	K	K	U
R_3	**<u>K</u>**	K	K	K	U	U	U	U	U	U
R_5	U	U	U	U	**<u>K</u>**	K	**<u>K</u>**	U → K	U → K	U
R_6	**<u>K</u>**	U → K	U → K	U → K	**<u>K</u>**	U → K	U → K	U	U	K

	ItemId	ItemDescription	ItemPrice	StockQuantity	PurchaseId	PurchaseDate	VendorCode	VendorName	VendorAddress	OrderQuantity
R_1	U	U	U	U	U	U	K	K	K	U
R_3	**<u>K</u>**	**<u>K</u>**	**<u>K</u>**	**<u>K</u>**	U	U	U	U	U	U
R_5	U	U	U	U	**<u>K</u>**	**<u>K</u>**	**<u>K</u>**	K	K	U
R_6	**<u>K</u>**	**<u>K</u>**	**<u>K</u>**	**<u>K</u>**	**<u>K</u>**	**<u>K</u>**	**<u>K</u>**	U → K	U → K	K

	ItemId	ItemDescription	ItemPrice	StockQuantity	PurchaseId	PurchaseDate	VendorCode	VendorName	VendorAddress	OrderQuantity
R_1	U	U	U	U	U	U	K	K	K	U
R_3	K	K	K	K	U	U	U	U	U	U
R_5	U	U	U	U	K	K	K	K	K	U
R_6	**K**	**K**	**K**	**K**	**K**	**K**	**K**	**K**	**K**	**K**

Good Decomposition

2. Consider the following set of functional dependencies:
   A → B,
   B → CD,
   A → D,
   B → C,
   AB → CD,
   A → C,
   E → F

   a. Using synthesis approach (bottom-up process), construct a set of 3NF/BCNF relations from the above functional dependencies. Indicate the primary keys for the result relations and whether or not they are in 3NF or BCNF. Please show all steps clearly as mentioned in the lecture slides.

      A → D, - inferred from (A → B, B → CD) then A → CD then A → C and A → D [Transitive and Decomposition]
      A → C, - inferred from (A → B, B → CD) then A → CD then A → C and A → D [Transitive and Decomposition]
      B → C, - inferred from B → CD then B→ C and B → D [Decomposition]
      AB → CD, - inferred from (A → B, B → CD) [Composition]

      Canonical Cover:
      A → B,
      B → CD,
      E → F
      Key: {A, E}

      R_1: (<u>A</u>, B)
      R_2: (<u>B</u>, C, D)
      R_3: (<u>E</u>, F)
      R_4: (<u>A</u>, E) → added because no other relation contains the key

b. Using the table method, check whether the constructed set of relations is lossless or not. If not, correct them.

	A	B	C	D	E	F
R_1	**K**	**K**	U → K	U → K	U → K	U
R_2	U	**K**	K	K	U	U
R_3	U	U	U	U	**K**	K
R_4	**K**	U	U	U	**K**	U → K

	A	B	C	D	E	F
R_1	K	K	K	K	**K**	U → K
R_2	U	K	K	K	U	U
R_3	U	U	U	U	**K**	K
R_4	K	U	U	U	**K**	K

	A	B	C	D	E	F
R_1	**K**	**K**	**K**	**K**	**K**	**K**
R_2	U	K	K	K	U	U
R_3	U	U	U	U	K	K
R_4	K	U	U	U	K	K

Lossless