CS1555 Assignment6

Group 5

Members:

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1. Functional dependencies:

b->de, e->d, c->de, c->f, ab->e, df->a, dc->a, cd->e, ef->d, abe->ed

* 1. Using synthesis approach, construct a set of 3NF/BCNF relationship
  2. canonial form:
     1. b->d,
     2. b->e,
     3. e->d,
     4. c->d,
     5. c->e,
     6. c->f,
     7. ab->e,
     8. df->a,
     9. dc->a,
     10. cd->e,
     11. ef->d,
     12. abe->e,
     13. abe->d
  3. drop extraneous attributes:
     1. remove ab->e due to b->e;
     2. remove cd->e due to c->e;
     3. remove ef->d due to e->d;
     4. remove abe->e due to b->e;
     5. remove abe->d due to e->d;
     6. b->d
     7. b->e
     8. e->d
     9. c->d
     10. c->e
     11. c->f
     12. df->a
     13. dc->a
  4. drop redundant FDs
     1. b->e, e->d implies b->d
     2. c->d, dc->a implies c->a
  5. final FDs
     1. b->e
     2. e->d
     3. c->d
     4. c->e
     5. c->f
     6. df->a
     7. c->a
  6. primary key: bc
     1. bc+: bc->bcd(c->d);
     2. bcd->bcde(b->e);
     3. bcde->bcdef(c->f);
     4. bcdef->abcdef(c->a);
  7. 3NF relationship
     1. b->e
     2. e->d
     3. c->adef
     4. df->a
     5. R1(b, e)
     6. R2(e, d)
     7. R3(c, a, d, e, f)
     8. R4(df, a)
     9. R5(b, c)
  8. BCNF
     1. R(a, b, c, d, e, f)
     2. apply b->e, R1(a, b, c, d, f) in 1NF, R2(b, e) in BCNF
     3. apply e->d, R3(e, d) in BCNF,
     4. apply c->adef, R4(c, a, d, e, f) in BCNF,
     5. apply df->a, R11(b, c) in BCNF, R5(d, f, a) in BCNF
  9. a

b1.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | a | b | c | d | e | f |
| R1(b, e) | u11 | a2 | u13 | u14 | a5 | u16 |
| R2(e, d) | u21 | u22 | u23 | a4 | a5 | u26 |
| R3(c, a, d ,e f) | a1 | u32 | a3 | a4 | a5 | a6 |
| R4(df, a) | a1 | u42 | u43 | a4 | u45 | a6 |
| R5(b, c) | u51 | a2 | a3 | u54 | u55 | u56 |

b2. use b-> e

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | a | b | c | d | e | f |
| R1(b, e) | u11 | a2 | u13 | u14 | a5 | u16 |
| R2(e, d) | u21 | u22 | u23 | a4 | a5 | u26 |
| R3(c, a, d ,e f) | a1 | u32 | a3 | a4 | a5 | a6 |
| R4(df, a) | a1 | u42 | u43 | a4 | u45 | a6 |
| R5(b, c) | u51 | a2 | a3 | u54 | a5 | u56 |

b3. use e->d

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | a | b | c | d | e | f |
| R1(b, e) | u11 | a2 | u13 | a4 | a5 | u16 |
| R2(e, d) | u21 | u22 | u23 | a4 | a5 | u26 |
| R3(c, a, d ,e f) | a1 | u32 | a3 | a4 | a5 | a6 |
| R4(df, a) | a1 | u42 | u43 | a4 | u45 | a6 |
| R5(b, c) | u51 | a2 | a3 | a4 | a5 | u56 |

b4. use c->adef

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | a | b | c | d | e | f |
| R1(b, e) | u11 | a2 | u13 | a4 | a5 | u16 |
| R2(e, d) | u21 | u22 | u23 | a4 | a5 | u26 |
| R3(c, a, d ,e f) | a1 | u32 | a3 | a4 | a5 | a6 |
| R4(df, a) | a1 | u42 | u43 | a4 | u45 | a6 |
| R5(b, c) | a1 | a2 | a3 | a4 | a5 | a6 |

R5 contains all known values, the decomposition is lossless

2.

FD1: BookISBN -> Title, PublisherName, Price, QuantityOnHand

FD2: OrderNumber -> OrderDate, SupplierCode

FD3: SupplierCode -> SupplierName, SupplierAddress

FD4: BookISBN, OrderNumber -> QuantityOrdered



a1. BookISBN and OrderNumber does not appear on the right hand side of Fps

primary key: BookISBN, OrderNumber+:

* + BookISBN, OrderNumber, Title, PublisherName, Price, QuantityOnHand (BookISBN -> Title, PublisherName, Price, QuantityOnHand)
  + BookISBN, OrderNumber, Title, PublisherName, Price, QuantityOnHand, OrderDate, SupplierCode (OrderNumber -> OrderDate, SupplierCode)
  + BookISBN, OrderNumber, Title, PublisherName, Price, QuantityOnHand, OrderDate, SupplierCode, SupplierName, SupplierAddress (SupplierCode -> SupplierName, SupplierAddress)
  + BookISBN, OrderNumber, Title, PublisherName, Price, QuantityOnHand, OrderDate, SupplierCode, SupplierName, SupplierAddress, QuantityOrdered (BookISBN, OrderNumber -> QuantityOrdered)

a2. 3NF:

R1 (BookISBN, Title, PublisherName, Price, QuantityOnHand)

R2 (OrderNumber, OrderDate, SupplierCode)

R3 (SupplierCode, SupplierName, SupplierAddress)

R4 (BookISBN, OrderNumber, QuantityOrdered)

a3. BCNF:

R (BookISBN, OrderNumber, Title, PublisherName, Price, QuantityOnHand, OrderDate, SupplierCode, SupplierName, SupplierAddress, QuantityOrdered)

* apply BookISBN -> Title, PublisherName, Price, QuantityOnHand,
  + R1(BookISBN, OrderNumber, OrderDate, SupplierCode, SupplierName, SupplierAddress, QuantityOrdered) in 1NF;
  + R2(BookISBN, Title, PublisherName, Price, QuantityOnHand) in BCNF
* apply OrderNumber -> OrderDate, SupplierCode
  + R11(BookISBN, OrderNumber,SupplierName, SupplierAddress, QuantityOrdered) in 1NF
  + R3(OrderNumber, OrderDate, SupplierCod) in BCNF
* apply SupplierCode -> SupplierName, SupplierAddress
  + R111(BookISBN, OrderNumber, QuantityOrdered) in BCNF
  + R4(SupplierCode, SupplierName, SupplierAddress)

(part b in the next page)

b1.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | BookISBN | OrderNumber | Title | PublisherName | Price | QuantityOnHand | OrderDate | SupplierCode | SupplierName | SupplierAddress | QuantityOrdered |
| R1 (BookISBN, Title, PublisherName, Price, QuantityOnHand) | a1 | u12 | a3 | a4 | a5 | a6 | u17 | u18 | u19 | u | u |
| R2 (OrderNumber, OrderDate, SupplierCode) | u21 | a2 | u23 | u24 | u25 | u26 | a7 | a8 | u29 | u | u |
| R3 (SupplierCode, SupplierName, SupplierAddress) | u31 | u32 | u33 | u34 | u35 | u36 | u37 | a8 | a9 | a10 | u |
| R4 (BookISBN, OrderNumber, QuantityOrdered) | a1 | a2 | u43 | u44 | u45 | u46 | u47 | u48 | u49 | u | a11 |

b2. apply BookISBN -> Title, PublisherName, Price, QuantityOnHand

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | BookISBN | OrderNumber | Title | PublisherName | Price | QuantityOnHand | OrderDate | SupplierCode | SupplierName | SupplierAddress | QuantityOrdered |
| R1 (BookISBN, Title, PublisherName, Price, QuantityOnHand) | a1 | u12 | a3 | a4 | a5 | a6 | u17 | u18 | u19 | u | u |
| R2 (OrderNumber, OrderDate, SupplierCode) | u21 | a2 | u23 | u24 | u25 | u26 | a7 | a8 | u29 | u | u |
| R3 (SupplierCode, SupplierName, SupplierAddress) | u31 | u32 | u33 | u34 | u35 | u36 | u37 | a8 | a9 | a10 | u |
| R4 (BookISBN, OrderNumber, QuantityOrdered) | a1 | a2 | a3 | a4 | a5 | a6 | u47 | u48 | u49 | u | a11 |

b3. apply OrderNumber -> OrderDate, SupplierCode

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | BookISBN | OrderNumber | Title | PublisherName | Price | QuantityOnHand | OrderDate | SupplierCode | SupplierName | SupplierAddress | QuantityOrdered |
| R1 (BookISBN, Title, PublisherName, Price, QuantityOnHand) | a1 | u12 | a3 | a4 | a5 | a6 | u17 | u18 | u19 | u | u |
| R2 (OrderNumber, OrderDate, SupplierCode) | u21 | a2 | u23 | u24 | u25 | u26 | a7 | a8 | u29 | u | u |
| R3 (SupplierCode, SupplierName, SupplierAddress) | u31 | u32 | u33 | u34 | u35 | u36 | u37 | a8 | a9 | a10 | u |
| R4 (BookISBN, OrderNumber, QuantityOrdered) | a1 | a2 | a3 | a4 | a5 | a6 | a7 | a8 | u49 | u | a11 |

b4. apply SupplierCode -> SupplierName, SupplierAddress

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | BookISBN | OrderNumber | Title | PublisherName | Price | QuantityOnHand | OrderDate | SupplierCode | SupplierName | SupplierAddress | QuantityOrdered |
| R1 (BookISBN, Title, PublisherName, Price, QuantityOnHand) | a1 | u12 | a3 | a4 | a5 | a6 | u17 | u18 | u19 | u | u |
| R2 (OrderNumber, OrderDate, SupplierCode) | u21 | a2 | u23 | u24 | u25 | u26 | a7 | a8 | u29 | u | u |
| R3 (SupplierCode, SupplierName, SupplierAddress) | u31 | u32 | u33 | u34 | u35 | u36 | u37 | a8 | a9 | a10 | u |
| R4 (BookISBN, OrderNumber, QuantityOrdered) | a1 | a2 | a3 | a4 | a5 | a6 | a7 | a8 | a9 | a10 | a11 |

R4 contains all known values, it is lossless and is a good one

3.

a)

b) (Note\* part b and part a for question 3 are done by different members with different opinions, treat them separately if you can)

Animals(A\_ID, name, sex, age, type, insure\_nr)

PK(A\_ID)

Visits(A\_ID, date\_in, date\_out)

PK(A\_ID)

FK(A\_ID) -> Animals(A\_ID)

Department(name, location, cages, free\_cages, head\_Doc\_ID)

PK(name)

FK(head\_Doc\_ID) -> Doctors(Doc\_ID)

Treatments(A\_ID, name, duration, reaction, authorized\_by)

PK(A\_ID, name)

FK(A\_ID) -> Animals(A\_ID)

FK(authorized\_by) -> Doctors(Doc\_ID)

Tests(A\_ID, name, result, authorized\_by)

PK(A\_ID, name)

FK(A\_ID) -> Animals(A\_ID)

FK(authorized\_by) -> Doctors(Doc\_ID)

Doctors(Doc\_ID, name, Department)

PK(Doc\_ID)

FK(Department) -> Department(name)

Assumptions:

1. Each department has a head doctor
2. The same animal can be admitted or discharged multiple times in the same day