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

(a) Using synthesis approach, construct a set of 3NF/BCNF relationship

1. 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
2. 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
3. drop redundant FDs
   1. b->e, e->d implies b->d
   2. c->d, dc->a implies c->a
4. final FDs
   1. b->e
   2. e->d
   3. c->d
   4. c->e
   5. c->f
   6. df->a
   7. c->a
5. primary key: bc

1. bc+: bc->bcd(c->d);
2. bcd->bcde(b->e);
3. bcde->bcdef(c->f);
4. bcdef->abcdef(c->a);

6. 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)
7. 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
8.

(b) 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

(c)

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

(a)

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)

(b)
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

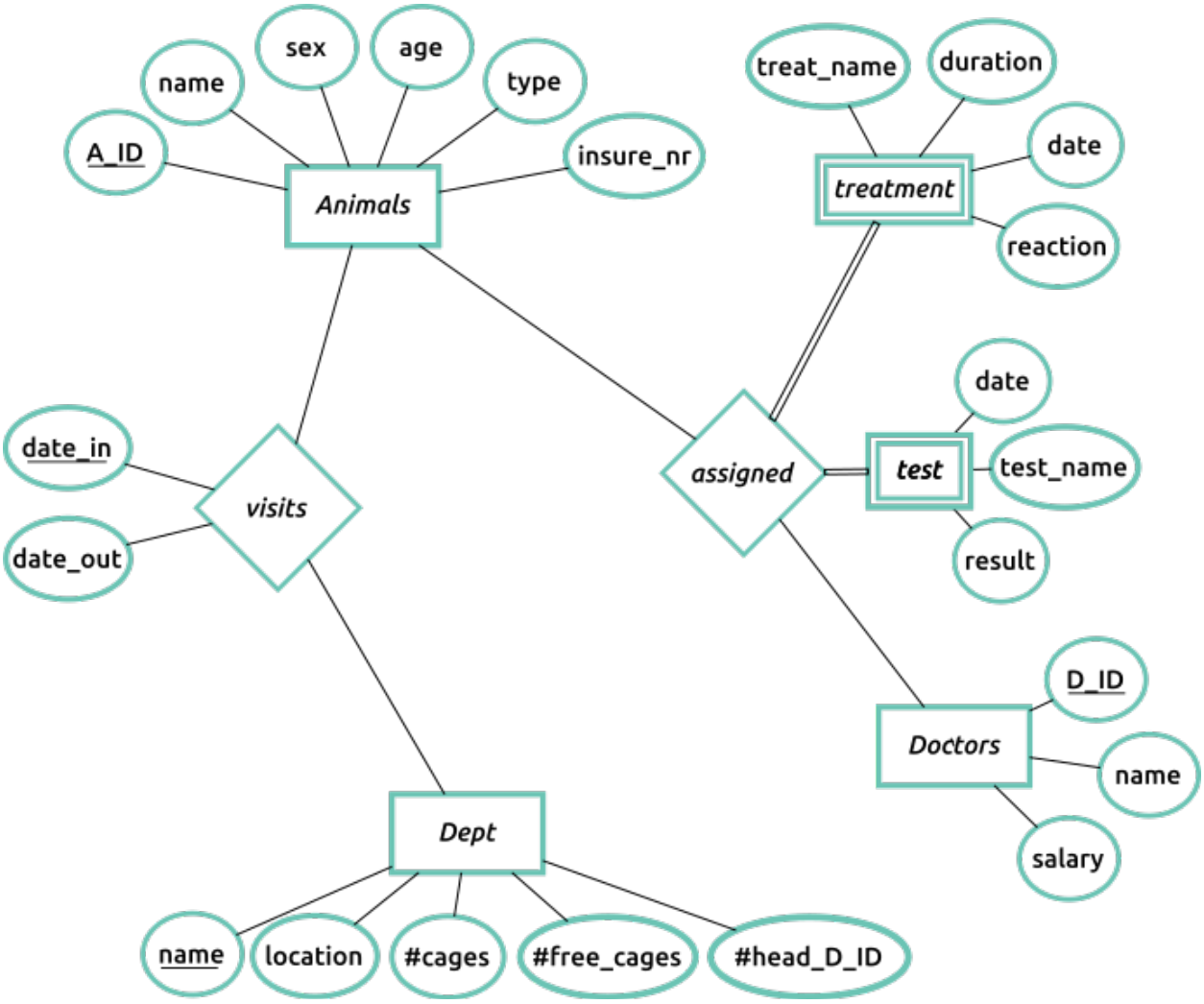
	BookISBN	OrderNumber	Title	PublisherName	Price	QuantityOnHand	OrderDate	SupplierCode	SupplierName	SupplierAddress	QuantityOrdered
R1 (BookISBN, Title, PublisherName, Price, QuantityOnHand)	a1	u12	a3	a4	a5	a6	u17	u18	u19	u	u
R2 (OrderNumber, OrderDate, SupplierCode)	u21	a2	u23	u24	u25	u26	a7	a8	u29	u	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)


sex
age
name
type
A_ID
insure_nr
Animals
treat_name
duration
date
treatment
reaction
date
date_in
visits
assigned
test
test_name
date_out
result
D_ID
Doctors
name
Dept
salary
name
location
#cages
#free_cages
#head_D_ID

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