

Database Hw2

Q1

(a)

```
# game in Exploration
cate_game1 = select_{category=="Exploration"}
#game in Adventure
cate_game2 = select_{category=="Adventure"}
#game in either, excluding games in both
cate_game = (cate_game1 Union cate_game2) - (cate_game1 intersect cate_game2)

result(gameid, name, designername) = cate_game * games * gamedesigners
```

(b)

```
g1(siteid1, gameid1) = gamesonsite
g2(siteid2, gameid2) = gamesonsite
g3(siteid3, gameid3) = gamesonsite

# get games appear in 2 or 2 more sites
g2ormore = g1 join_{gameid1==gameid2 AND siteid1<>siteid2} g2

# get games appear in 3 or 3 more sites
g3ormore = g2ormore join_{gameid1==gameid2==gameid3 AND siteid1<>siteid2<>siteid3} g3

# diff
g2exactly = project_{gameid}g2ormore - project_{gameid}g3ormore
result(gameid, name) = g2exactly * games
```

Q2

A	B	C	D	E	F	G	H
a	b1	c	d	e	f1	g1	h1
a	b	c	d2	e2	f2	g2	h2
a	b	c3	d3	e3	f	g	h

Apply $AB \rightarrow CD$

A	B	C	D	E	F	G	H
a	b1	c	d	e	f1	g1	h1
a	b	c	d2	e2	f2	g2	h2
a	b	c	d2	e3	f	g	h

Apply $AC \rightarrow DE$

A	B	C	D	E	F	G	H
a	b1	c	d	e	f1	g1	h1
a	b	c	d	e	f2	g2	h2
a	b	c	d	e	f	g	h

Not lossless.

Q3

Projection into $R1(A,C,D,E)$: $\{AC \twoheadrightarrow DE\}$

Projection into $R2(A,B,C)$: $\{AB \twoheadrightarrow C\}$

Projection into $R3(A,B,F,G,H)$: $\{AB \twoheadrightarrow C, ABF \twoheadrightarrow G\}$

Check dependency preserving:

Given $AC \twoheadrightarrow DE$, $AB \twoheadrightarrow C$, $F \twoheadrightarrow G$,

with $AB \twoheadrightarrow C$ and $AC \twoheadrightarrow DE$, we can get $AB \twoheadrightarrow CD$, and $AB \twoheadrightarrow CDE$

$AC \twoheadrightarrow DE$, we get $AC \twoheadrightarrow E$,

Also, $ABF \twoheadrightarrow G$, and $AB \twoheadrightarrow CDE$ ($AB \twoheadrightarrow E$), we can get $EF \twoheadrightarrow AG$

By now, we get $AB \twoheadrightarrow CD$, $AC \twoheadrightarrow DE$, $EF \twoheadrightarrow AG$, so it is dependency preserving.

Q4

key for F: ABFH, BEFH

using $AC \twoheadrightarrow DE$ to BCNF decompose

R1: A,C,D,E AC \rightarrow DE key:AC

R2: A,B,C,F,G,H AB \rightarrow C, ABF \rightarrow G, key:ABFH, not in BCNF

Use AB \rightarrow C,

R1: ABC AB \rightarrow C key: AB

R2: ABFGH ABF \rightarrow G key:ABFH, not in BCNF

Use ABF \rightarrow G,

R1: ABFG ABF \rightarrow G key: ABF

R2: ABFH {empty} key: {empty}

both are in BCNF

Q5

1.

```
F = {  
  restaurant_name,state -> URL  
  URL -> restaurant_name,state  
  state,street,city,zip -> latitude,longitude  
  latitude,longitude -> state,street,city,zip  
  review_id -> review_text  
  URL,latitude,longitude -> review_id  
}
```

2.

```
4 keys:  
restaurant_name,state,latitude,longitude,cuisine_type  
URL,latitude,longitude,cuisine_type  
restaurant_name,state,street,city,zip,cuisine_type  
URL,street,city,zip,cuisine_type
```

3.

Not in 3NF or BCNF

4.

3NF Decomposition:

```
restaurant_name,state,URL
  fd: restaurant_name,state -> URL
  key: restaurant_name,state
  in BCNF: yes
state,street,city,zip,latitude,longitude
  fd: state,street,city,zip -> latitude,longitude
  key: state,street,city,zip
  in BCNF: yes
review_id,review_text
  fd: review_id -> review_text
  key: review_id
  in BCNF: yes
URL,latitude,longitude,review_id
  fd: URL,latitude,longitude -> review_id
  key: URL,latitude,longitude
  in BCNF: yes
URL,street,city,zip,cuisine_type
  fd: {}
  key: URL,street,city,zip,cuisine_type
  in BCNF: yes
```

5.

They're all in 4NF.

Firstly, they are all in BCNF.

Secondly, according to the fds, there are no multi-valued dependencies here.