

CZ2007 LAB 3

INTRODUCTION TO DATABASE

Zou Zeren U2022422H
Zeng Xunyi U2022509A
Tan Pei Lun U2022841A
Bryan Chatsirichai U2022154D
Mulder Choo U2022324D

1. CREDIT_CARD (card_num, bank, date_valid_to, date_valid_from, customer_id)

Keys: card_num

Primary Key: card_num

FDs: $\text{card_num} \rightarrow \text{bank, date_valid_to, date_valid_from, customer_id}$

All the attributes are functionally dependent on solely the Primary Key (card_num)

\therefore The relation is in 3NF

2. CUSTOMER (customer_id, username, email, password, full_name, address, phone_num)

Keys: customer_id, username, email

Primary Key: customer_id

FDs:

$\text{customer_id} \rightarrow \text{username, email, password, full_name, address, phone_num}$

$\text{username} \rightarrow \text{customer_id, email, password, full_name, address, phone_num}$

$\text{email} \rightarrow \text{username, customer_id, password, full_name, address, phone_num}$

$\text{phone_num} \rightarrow \text{full_name, address}$

\therefore The relation is **not** in 3NF

3NF Procedures:

Minimal Basis for R:

CUSTOMER (customer_id(A), username(B), email(C), password(D), full_name(E),
address(F), phone_num(G))

= CUSTOMER(A,B,C,D,E,F,G)

KEYS: A,B,C

FDS: $A \rightarrow BCDEFG$, $B \rightarrow ACDEFG$, $C \rightarrow BADEFG$,
 $G \rightarrow EF$

STEP 1:

$A \rightarrow B, A \rightarrow C, A \rightarrow D, A \rightarrow E, A \rightarrow F, A \rightarrow G$

$B \rightarrow A, B \rightarrow C, B \rightarrow D, B \rightarrow E, B \rightarrow F, B \rightarrow G$

$C \rightarrow A, C \rightarrow B, C \rightarrow D, C \rightarrow E, C \rightarrow F, C \rightarrow G$

$G \rightarrow E, G \rightarrow F$

STEP 2:

we remove

$B \rightarrow A, B \rightarrow C, B \rightarrow D, B \rightarrow E, B \rightarrow F, B \rightarrow G$

$C \rightarrow A, C \rightarrow B, C \rightarrow D, C \rightarrow E, C \rightarrow F, C \rightarrow G$

$A \rightarrow E, A \rightarrow F$

$\{A\}^+ = \{ABCDEFGG\}$

$A \rightarrow B, A \rightarrow C, A \rightarrow D, A \rightarrow G, G \rightarrow E, G \rightarrow F$

$\therefore B \rightarrow A, B \rightarrow C, B \rightarrow D, B \rightarrow E, B \rightarrow F, B \rightarrow G$

$C \rightarrow A, C \rightarrow B, C \rightarrow D, C \rightarrow E, C \rightarrow F, C \rightarrow G$

$A \rightarrow E, A \rightarrow F$ is redundant

STEP 3: No FD have redundant attributes on LHS

$A \rightarrow B, A \rightarrow C, A \rightarrow D, A \rightarrow G$

$G \rightarrow E, G \rightarrow F$

3NF:

$A \rightarrow BCDG \quad G \rightarrow EF$

$R_1(ABCDG) = R_1(\text{customer_id}, \text{username}, \text{email}, \text{password}, \text{phone_num})$

$R_2(GEF) = R_2(\text{phone_num}, \text{full_name}, \text{address})$

\therefore The relation is in 3NF

3. ORDER (order_id, date, status, customer_id)

Keys: order_id

Primary Key: order_id

FDs: order_id \rightarrow date, status, customer_id

All the attributes are functionally dependent on solely the Primary Key (order_id)

\therefore The relation is in 3NF

4. ORDER_ITEM (sequence_num(A), order_id(B), product_unit_price(C), quantity(D), status(E), product_id(F), shipment_id(G))

Keys: {sequence_num(A), order_id(B)}

Primary Key: {sequence_num(A), order_id(B)}

FDs: $AB \rightarrow CDEFG$ $F \rightarrow C$

$F \rightarrow D$ violates 3NF (F is not a)

5. ORDER_ITEM (sequence_num, order_id , product_unit_price, quantity, status, order_price, product_id, shipment_id)

Keys: {sequence_num, order_id}

Primary Key: {sequence_num, order_id}

FDs:

sequence_num, order_id \rightarrow product_unit_price, quantity, status, order_price,
product_id, shipment_id

product_id \rightarrow product_unit_price

product_unit_price, quantity \rightarrow order_price

conclusion

product_id, { product_unit_price, quantity} is not a superkey of the relation

product_unit_price and order_price are not contained in a key

\therefore The relation is **not** in 3NF

3NF Procedures:

ORDER_ITEM (sequence_num(A), order_id(B) , product_id(C), shipment_id(D),
product_unit_price(E), quantity(F), status(G), order_price(H))

= ORDER_ITEM(A,B,C,D,E,F,G,H)

KEYS: AB

FDS: $AB \rightarrow CDEFGH$, $C \rightarrow E$, $EF \rightarrow H$

STEP 1(Minimal Basis for R):

STEP 1.1(For all FD, RHS must have only one attribute):

$AB \rightarrow C$, $AB \rightarrow D$, $AB \rightarrow E$, $AB \rightarrow F$, $AB \rightarrow G$, $AB \rightarrow H$, $C \rightarrow E$, $EF \rightarrow H$

STEP 1.2(Remove redundant FDs):

we remove $AB \rightarrow E$

$\{AB\}^+ = \{ABCDEFGH\}$

$AB \rightarrow C$, $C \rightarrow E$, $AB \rightarrow E$

$\therefore AB \rightarrow E$ is redundant

we remove $AB \rightarrow H$

$\{AB\}^+ = \{ABCDEFGH\}$

$AB \rightarrow C, C \rightarrow E, AB \rightarrow F, EF \rightarrow H$

$\therefore AB \rightarrow H$ is redundant

STEP 1.3(For all FDs, LHS must have no redundant attributes):

$AB \rightarrow C, AB \rightarrow D, AB \rightarrow F, AB \rightarrow G, AB \rightarrow H, C \rightarrow E, EF \rightarrow H$

STEP 2(Combine all FDs with common LHS):

$AB \rightarrow CDFG, C \rightarrow E, EF \rightarrow H$

STEP 3(Create table for each FD):

$R_1(ABCDGF) = R_1((\text{sequence_num, order_id}), \text{product_id, shipment_id, quantity, status})$

$R_2(CE) = R_2(\text{product_id, product_unit_price})$

$R_3(EFH) = R_3(\text{product_unit_price, quantity, order_price})$

All the attributes are functionally dependent on solely their Primary Keys

\therefore The relation is in 3NF

6. PRODUCT_TYPE (product_type_id, description, parent_product_type_id)

Keys: product_type_id

Primary Key: product_type_id

FDs: product_type_id \rightarrow description, parent_product_type_id

All the attributes are functionally dependent on solely its Primary Key(product_type_id)

\therefore The relation is in 3NF

7. RESTRICTED_TO (shop_id, product_type_id)

Keys: {shop_id, product_type_id}

Primary Key: {shop_id, product_type_id}

FDs: shop_id, product_type_id \rightarrow shop_id, product_type_id

Only trivial FD exists in the relation

\therefore The relation is in 3NF

8. SHIPMENT (shipment_id, tracking_num, date, invoice_number)

Keys: shipment_id, tracking_num

Primary Key: shipment_id

FDs: shipment_id \rightarrow tracking_num, date, invoice_number

All the attributes are functionally dependent on solely its Primary Key(shipment_id)

∴The relation is in 3NF

9. INVOICE(invoice_number,date,status,order_id)

Keys: invoice_number

Primary Key: invoice_number

FDs: invoice_number \rightarrow date,status,order_id

All the attributes are functionally dependent on solely its Primary Key(invoice_number)

∴The relation is in 3NF

10. PAYMENT (payment_id, amount, card_num,invoice_number)

Keys: payment_id

Primary Key: payment_id

FDs: payment_id \rightarrow amount,card_num,invoice_number

All the attributes are functionally dependent on solely its Primary Key(payment_id)

∴The relation is in 3NF

11. PRODUCT(product_id,name,colour,price,size,description,shop_id,product_type_id)

Keys: product_id

Primary Key: product_id

FDs: product_id \rightarrow name,colour,price,size,description,shop_id,product_type_id

All the attributes are functionally dependent on solely its Primary Key(payment_id)

∴The relation is in 3NF

12. PRODUCT_PHOTO(photo_sequence,product_id,pic)

Keys: {photo_sequence, product_id}

Primary Key: {photo_sequence,product_id}

FDs: photo_sequence,product_id \rightarrow pic

All the attributes are functionally dependent on solely its
Primary Key (photo_sequence,product_id)

∴The relation is in 3NF

13. SHOP (shop_id, shop_name)

Keys: shop_id

Primary Key: shop_id

FDs: shop_id \rightarrow shop_name

All the attributes are functionally dependent on solely its
Primary Key (shop_id)

∴The relation is in 3NF