

2.9:

- a. For branch, branch_name is the primary key.

For customer, customer_name is the primary key.

For loan, loan_number is the primary key.

For borrower, customer_name and loan_number are the primary key.

For account, account_number is the primary key.

For depositor customer_name and account_number are the primary key.

- b. For loan, branch_name which references branch.

For borrower, customer_name which references customer and loan_number referencing loan.

For account, account_name referencing branch.

For depositor, customer_name referencing customer and account_number referencing account.

2.13:

a. $\Pi_{\text{loan_number}} (\sigma_{\text{amount} > 10000}(\text{loan}))$

b. $\Pi_{\text{customer_name}} (\sigma_{\text{balance} > 6000}(\text{depositor} \bowtie \text{account}))$

c. $\Pi_{\text{customer_name}} (\sigma_{\text{balance} > 6000 \wedge \text{branch_name} = \text{"Uptown"}}(\text{depositor} \bowtie \text{account}))$

6.11

- a. $\Pi_{\text{person_name}} (\sigma_{\text{company_name} = \text{"First Bank Corporation"}}(\text{works}))$
- b. $\Pi_{\text{person_name}, \text{city}} (\sigma_{\text{company_name} = \text{"First Bank Corporation"}}(\text{works} \bowtie \text{employee}))$
- c. $\Pi_{\text{person_name}, \text{street}, \text{city}} (\sigma_{\text{company_name} = \text{"First Bank Corporation"} \wedge \text{salary} > 10000}(\text{works} \bowtie \text{employee}))$
- d. $\Pi_{\text{person_name}} (\sigma_{\text{works} \bowtie \text{company} \bowtie \text{employee}})$
- e. $\Pi_{\text{company_name}} (\text{company} \div \Pi_{\text{city}} (\sigma_{\text{company_name} = \text{"small bank corporation"}})(\text{company}))$

6.13

- a. $r1 \leftarrow \text{company_name} \bowtie_{\text{count-distinct}(\text{person_name})}(\text{works})$
 $\rho_{r2}(\text{company name, num employees})(r1)$
 $r3 \leftarrow \bowtie_{\text{max}(\text{num_employees})} (r2)$
 $\Pi_{\text{company_name}}(r2 \bowtie r3)$
- b. $r1 \leftarrow \text{company name} \bowtie_{\text{sum}(\text{salary})}(\text{works})$
 $r2 \leftarrow \bowtie_{\text{min}(\text{payroll})}(\rho_{r3}(\text{company name payroll})(r1))$
 $\Pi_{\text{company name}} (r3 \bowtie \rho_{r4}(\text{payroll})(r2))$
- c. $r1 \leftarrow \text{company_name} \bowtie_{\text{avg}(\text{salary})}(\text{works})$
 $r2 \leftarrow \sigma_{\text{company_name} = \text{"First Bank Corporation"}}(r1)$
 $\Pi_{\text{company name}} ((\rho_{r3}(\text{company name, avg salary y})(r1)) \bowtie_{\text{company name avg salary} > \text{first_bank_avg_salary}} (\rho_{\text{first bank}(\text{company name_avg_salary})}(r2)))$