# Normalization Proofs

- Login_info (<u>username</u>, password, mpin, UUID)
  - FD = {username → {password, mpin, UUID},
    UUID → username}
  - Candidate key can be username or UUID.
  - Hence, Login_info is in BCNF because the determining attributes are key.

- Customer (<u>UUID</u>, fname, lname, location, PIN, mobile_no, email, DOB)
  - FD = {UUID → {fname, lname, location, PIN, mobile_no, email, DOB}}
  - Candidate key can be UUID or mobile_no or email.
  - Hence, Customer is in BCNF because the determining attributes are key.

- Document (<u>UUID, document</u>)
  - Trivial FD only.
  - Candidate key can be {UUID, document}.
  - Hence, Document is in BCNF because the determining attributes are key.

- Pincodes (<u>PIN</u>, city, district, state)
  - FD = {PIN → {city, district, state}}
  - Candidate key can be PIN.
  - Hence, Pincodes is in BCNF because the determining attributes are key.

- Account (account_no, available_balance, branch_code, UUID, acc_type)

    - FD = {account_no → {available_balance, branch_code, UUID, acc_type}}
    - Candidate key is account_no.
    - Hence, Account is in BCNF because the determining attributes are key.

- Acc_type (type_name, interest_rate)
    - FD = {type_name → {interest_rate}}
    - Candidate key is type_name.
    - Hence, Acc_type is in BCNF because the determining attributes are key.

- Loan_application (loan_app_no, chosen_term, loan_amt, status, closed_date, approved_date, applied_date, account_no, loan_ID)
    - FD = {loan_app_no → {chosen_term, loan_amt, status, closed_date, approved_date, applied_date, account_no, loan_ID}}
    - Candidate key is loan_app_no.
    - Hence, Loan_application is in BCNF because the determining attributes are key.

- Loan_info (loan_ID, min_term, max_term, delay_penalty, loan_type, min_amt, max_amt, interest_rate, eligibility_criteria)
    - FD = {loan_ID → {min_term, max_term, delay_penalty, loan_type, min_amt, max_amt, interest_rate, eligibility_criteria}}
    - Candidate key is loan_ID.
    - Hence, Loan_info is in BCNF because the determining attributes are key.

- Loan_repayment (<u>loan_app_no, loan_installment_no</u>, due_date, due_amt, settlement_date)
    - FD = {{loan_app_no, loan_installment_no} → {due_date, due_amt, settlement_date}}
    - Candidate key is {loan_app_no, loan_installment_no}.
    - Hence, Loan_repayment is in BCNF because the determining attributes are key.

- Investment_application (<u>inv_app_no</u>, annual_duration, inv_amt, status, approved_date, profit, account_no, inv_ID)
    - FD = {inv_app_no → {annual_duration, inv_amt, status, approved_date, profit, account_no, inv_ID}}
    - Candidate key is inv_app_no.
    - Hence, Investment_application is in because the determining attributes are key.

- Investment_info (<u>inv_ID</u>, inv_type, delay_penalty)
    - FD = {inv_ID → {inv_type, delay_penalty}
      inv_type → {inv_ID}}
    - Candidate key is inv_ID or inv_type.
    - Hence, Investment_info is in BCNF because the determining attributes are key.

- Investment_payment (<u>inv_app_no, inv_installment_no</u>, due_date, due_amt, settlement_date)
    - FD = {{inv_app_no, inv_installment_no} → {due_date, due_amt, settlement_date}}
    - Candidate key is {inv_app_no, inv_installment_no}.
    - Hence, Investment_payment is in BCNF because the determining attributes are key.

- Insurance_application (<u>ins_app_no</u>, chosen_premium_amt, status, approved_date, end_date, ins_ID, account_no)

- FD = {ins_app_no → {chosen_premium_amt, status, approved_date, end_date, ins_ID, account_no}}
- Candidate key is ins_app_no.
- Hence, Insurance_application is in BCNF because the determining attributes are key.

- Insurance_info (ins_ID, annual_pay_period, ins_type, delay_penalty, ins_term, coverage_amt, premium_amt, eligibility_criteria)
  - FD = {ins_ID → {annual_pay_period, ins_type, delay_penalty, ins_term, coverage_amt, premium_amt, eligibility_criteria }}
  - Candidate key is ins_ID.
  - Hence, Insurance_info is in BCNF because the determining attributes are key.

- Insurance_record (ins_app_no, ins_installment_no, due_date, due_amt, settlement_date)
  - FD = {{ins_app_no, ins_installment_no} → {due_date, due_amt, settlement_date}}
  - Candidate key is {ins_app_no, ins_installment_no}.
  - Hence, Insurance_Record is in BCNF because the determining attributes are key.

- Service (service_ID, service_name)
  - FD = {service_ID → service_name
    service_name → service_ID}
  - Candidate key is service_ID or service_name.
  - Hence, Service is in BCNF because the determining attributes are key.

- Service_request (req_ID, req_date, status, additional_notes, account_no, service_ID)
  - FD = {req_ID → {req_date, status, additional_notes, account_no, service_ID}}

- Candidate key is req_ID.
- Hence, Service_request is in BCNF because the determining attributes are key.

- FD_info (FD_ID, interest_rate, tenure_yrs, min_amt, description)
  - FD = {FD_ID → {interest_rate, tenure_yrs, min_amt, description}
    interest_rate → FD_ID, tenure_yrs → FD_ID}
  - Candidate key is FD_ID or interest_rate or tenure_yrs.
  - Hence, FD_info is in BCNF because the determining attributes are key.

- Fixed_deposit (FD_no, dep_amt, maturity_date, maturity_amt, opened_date, account_no, FD_ID)
  - FD = {FD_no → {dep_amt, maturity_date, maturity_amt, opened_date, account_no, FD_ID}}
  - Candidate key is FD_no.
  - Hence, Fixed_deposit is in BCNF because the determining attributes are key.

- Transaction (transaction_ID, amount, transaction_type, date, mode, receiver_acc_no, payer_acc_no)
  - FD= {transaction_ID → {amount, transaction_type, date, mode, receiver_acc_no, payer_acc_no}}
  - Candidate key is transaction_ID.
  - Hence, Transaction is in BCNF because the determining attributes are key.

- Branch (branch_code, branch_name, location, PIN)
  - FD = {branch_code → {branch_name, location, PIN}}
  - Candidate key is branch_code.
  - Hence, Branch is in BCNF because the determining attributes are key.

- Employee (emp_ID, emp_password, fname, lname, join_date, salary, email, mobile_no, dep_no, branch_code)
  - FD = {emp_ID → {emp_password, fname, lname, join_date, salary, email, mobile_no, dep_no, branch_code}}
  - Candidate key is emp_ID.
  - Hence, Employee is in BCNF because the determining attributes are key.

- Department (dep_no, dep_name)
  - FD = {dep_no → dep_name, dep_name → dep_no}
  - Candidate key is dep_no.
  - Hence, Department is in BCNF because the determining attributes are key.

- Operates_in (branch_code, dep_no, mgr_ID)
  - FD = {{branch_code, dep_no} → mgr_ID}
  - Candidate key is {branch_code, dep_no}.
  - Hence, Operates_in is in BCNF because the determining attributes are key.