DATABASE MANAGEMENT SYSTEM (IT214)

Title: Advanced Crime Examination (ACE)

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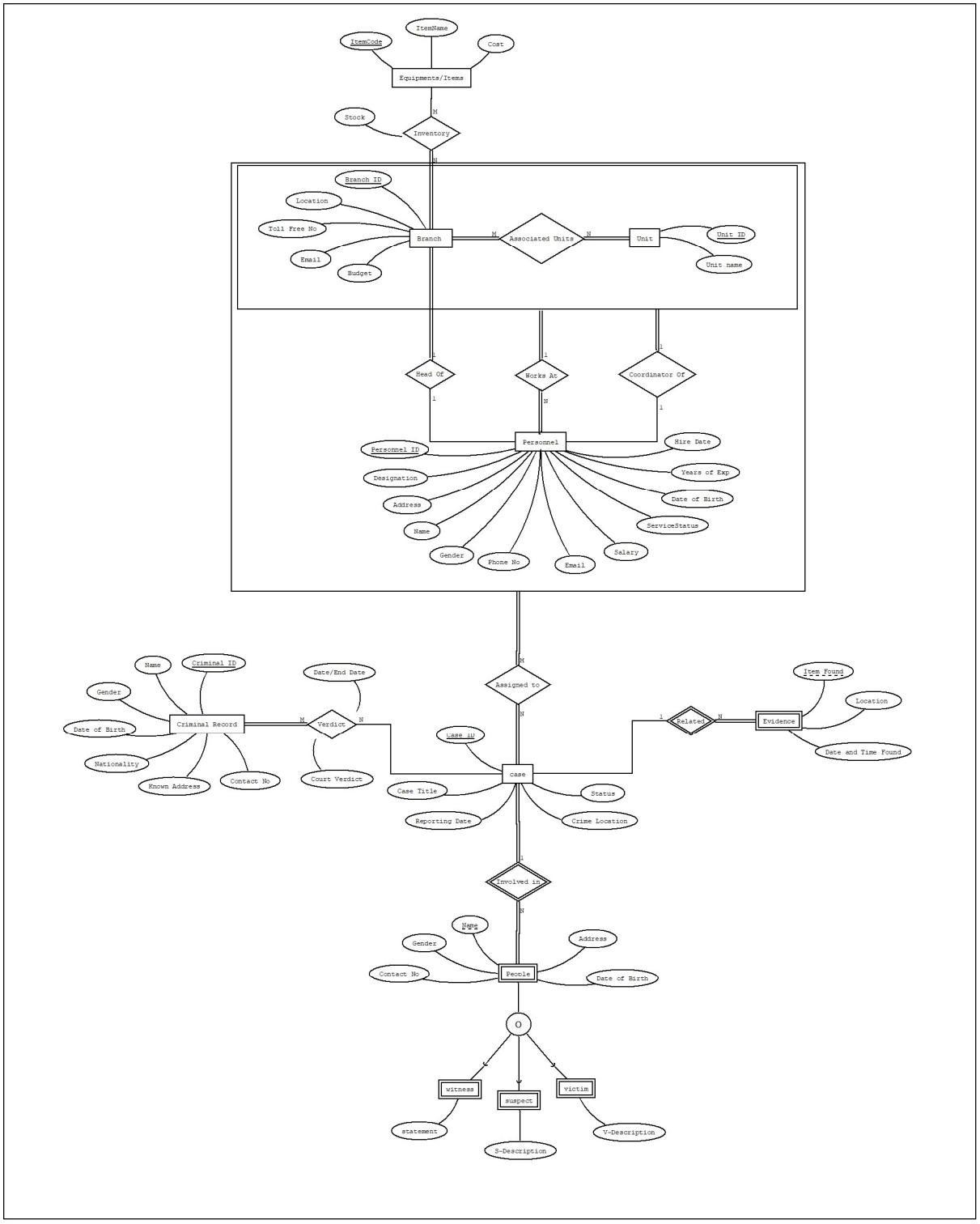
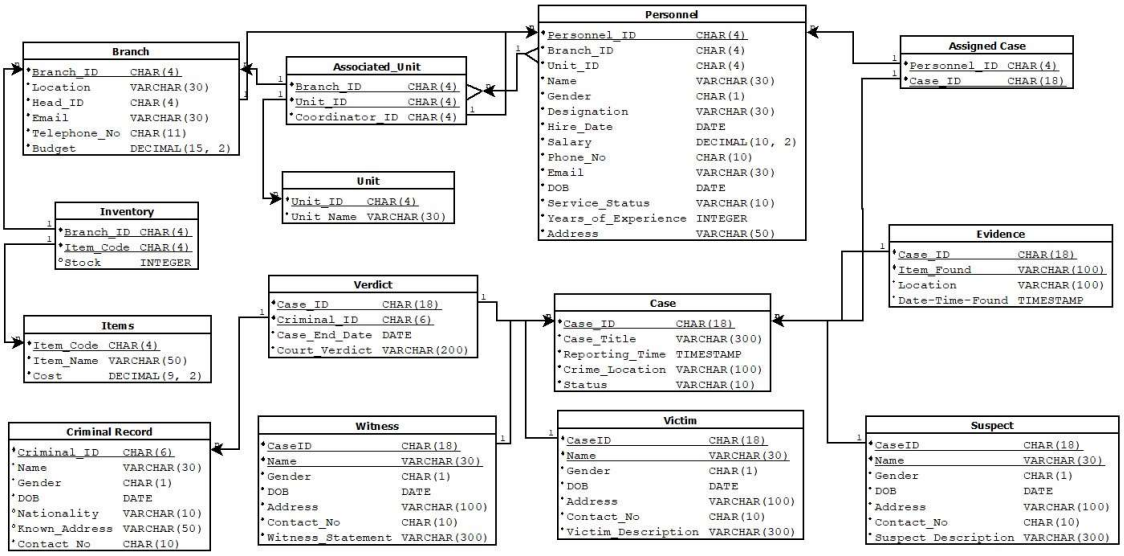
➢ Entity Relationship Diagram:



➢ Relational Schema:

ACE RELATIONAL SCHEMA



➢ Normalization Proofs

- **Branch Relation**
  - **FD Set**
    Branch_ID → {Location, Head_ID, Email, Telephone_No, Budget}
  - **Minimal FD Set**
    Branch_ID → Location
    Branch_ID → Head_ID
    Branch_ID → Email
    Branch_ID → Telephone_No
    Branch_ID → Budget
  - **Key**
    Branch_ID
  - **Normal Form**
    "Branch" Relation's all functional dependencies (FDs) have the key on the left side. Additionally, the right side of each FD is irreducible. Therefore, the "Branch" relation is in BCNF.
- **Unit Relation**
  - **FD Set**
    Unit_ID → Unit_Name
  - **Minimal FD Set**
    Unit_ID → Unit_Name
  - **Key**
    Unit_ID
  - **Normal Form**
    "Unit" relation has only one FD with key having on the left side. Thus, it is in BCNF.
- **Item Relation**
  - **FD Set**
    Item_Code → {Item_Name, Cost}
  - **Minimal FD Set**
    Item_Code → Item_Name
    Item_Code → Cost
  - **Key**
    Item_Code

- **Normal Form**
  "Item" Relation has two functional dependencies (FDs) with key having on the left side. Additionally, the right side of these two FDs is irreducible. Therefore, the "Item" relation is in BCNF.

- ## Inventory Relation
  - **FD Set**
    {Branch_ID, Item_Code} → Stock
  - **Minimal FD Set**
    {Branch_ID, Item_Code} → Stock
  - **Key**
    {Branch_ID, Item_Code}
  - **Normal Form**
    "Inventory" relation has only one FD with key having on the left side. Thus, it is in BCNF.

- ## Associated_Unit Relation
  - **FD Set**
    {Branch_ID, Unit_ID} → Cordinator_ID
  - **Minimal FD Set**
    {Branch_ID, Unit_ID} → Cordinator_ID
  - **Key**
    {Branch_ID, Unit_ID}
  - **Normal Form**
    "Associated Unit" relation has only one FD with key having on the left side. Thus, it is in BCNF.

- ## Personnel Relation
  - **FD Set**
    Personnel_ID → {Branch_ID, Unit_ID, Name, Gender, Designation, Hire_Date, Salary, Phone_No, Email, DOB, Service_Status, Years_of_Experience, Address}
  - **Minimal FD Set**
    Personnel_ID → Branch_ID
    Personnel_ID → Unit_ID
    Personnel_ID → Name
    Personnel_ID → Gender
    Personnel_ID → Designation

Personnel_ID → Hire_Date
Personnel_ID → Salary
Personnel_ID → Phone_No
Personnel_ID → Email
Personnel_ID → DOB
Personnel_ID → Service_Status
Personnel_ID → Years_of_Experience
Personnel_ID → Address

- **Key**
  Personnel_ID

- **Normal Form**
  In the “Personnel” Relation, every functional dependency (FD) has its key on the left side, with the right side being irreducible. Hence, the “Personnel” relation meets the BCNF criteria.

- ## Case Relation
  - **FD Set**
    Case_ID → {Case_Title, Reporting_Time, Crime_Location, Status}

  - **Minimal FD Set**
    Case_ID → Case_Title
    Case_ID → Reporting_Time
    Case_ID → Crime_Location
    Case_ID → Status

  - **Key**
    Case_ID

  - **Normal Form**
    All FDs in the “Case” Relation have their key on the left side and an irreducible right side, which places “Case” relation BCNF.

- ## Assigned_Case Relation
  - **Key**
    {Personnel_ID, Case_ID}

  - **Normal Form**
    “Assigned Case” relation has no FD and thus nothing on right side. Thus, it is in BCNF.

- ## Evidence Relation
  - **FD Set**
    {Case_ID, Item_Found} → {Location, Date_Time_Found}

- **Minimal FD Set**
  {Case_ID, Item_Found} → Location
  {Case_ID, Item_Found} → Date_Time_Found

- **Key**
  {Case_ID, Item_Found}

- **Normal Form**
  "Evidence" Relation has two functional dependencies (FDs) with key having on the left side. Additionally, the right side of these two FDs is irreducible. Therefore, the "Evidence" relation is in BCNF.

Criminal_Record Relation

- **FD Set**
  Criminal_ID → {C_Name, Gender, DOB, Nationality, Contact_No, Known_Address}

- **Minimal FD Set**
  Criminal_ID → C_Name
  Criminal_ID → Gender
  Criminal_ID → DOB
  Criminal_ID → Nationality
  Criminal_ID → Contact_No
  Criminal_ID → Known_Address

- **Key**
  Criminal_ID

- **Normal Form**
  "Criminal_Record" Relation's all functional dependencies (FDs) have the key on the left side. Additionally, the right side of each FD is irreducible. Therefore, the "Criminal" relation is in BCNF.

Verdict Relation

- **FD Set**
  {Criminal_ID, Case_ID} → {Case_End_Date, Court_Verdict}

- **Minimal FD Set**
  {Criminal_ID, Case_ID} → Case_End_Date
  {Criminal_ID, Case_ID} → Court_Verdict

- **Key**
  {Criminal_ID, Case_ID}

- **Normal Form**

"Verdict" Relation has two functional dependencies (FDs) with key having on the left side. Additionally, the right side of these two FDs is irreducible. Therefore, the "Verdict" relation is in BCNF.

- **Suspect Relation**
  - **FD Set**
    {Case_ID, S_Name} → {Gender, DOB, Contact_No, Address, Suspect_Description}
  - **Minimal FD Set**
    {Case_ID, S_Name} → Gender
    {Case_ID, S_Name} → DOB
    {Case_ID, S_Name} → Contact_No
    {Case_ID, S_Name} → Address
    {Case_ID, S_Name} → Suspect_Description
  - **Key**
    {Case_ID, S_Name}
  - **Normal Form**
    "Suspect" Relation's all functional dependencies (FDs) have the key on the left side. Additionally, the right side of each FD is irreducible. Therefore, the "Suspect" relation is in BCNF.
- **Witness Relation**
  - **FD Set**
    {Case_ID, W_Name} → {Gender, DOB, Contact_No, Address, Witness_Statement}
  - **Minimal FD Set**
    {Case_ID, W_Name} → Gender
    {Case_ID, W_Name} → DOB
    {Case_ID, W_Name} → Contact_No
    {Case_ID, W_Name} → Address
    {Case_ID, W_Name} → Witness_Statement
  - **Key**
    {Case_ID, W_Name}
  - **Normal Form**
    "Witness" Relation's all functional dependencies (FDs) have the key on the left side. Additionally, the right side of each FD is irreducible. Therefore, the "Witness" relation is in BCNF.
- **Victim Relation**
  - **FD Set**
    {Case_ID, V_Name} → {Gender, DOB, Contact_No, Address, Victim_Description}

- **Minimal FD Set**
  {Case_ID, V_Name} → Gender
  {Case_ID, V_Name} → DOB
  {Case_ID, V_Name} → Contact_No
  {Case_ID, V_Name} → Address
  {Case_ID, V_Name} → Victim_Description

- **Key**
  {Case_ID, V_Name}

- **Normal Form**
  “Victim” Relation’s all functional dependencies (FDs) have the key on the left side. Additionally, the right side of each FD is irreducible. Therefore, the “Victim” relation is in BCNF.