

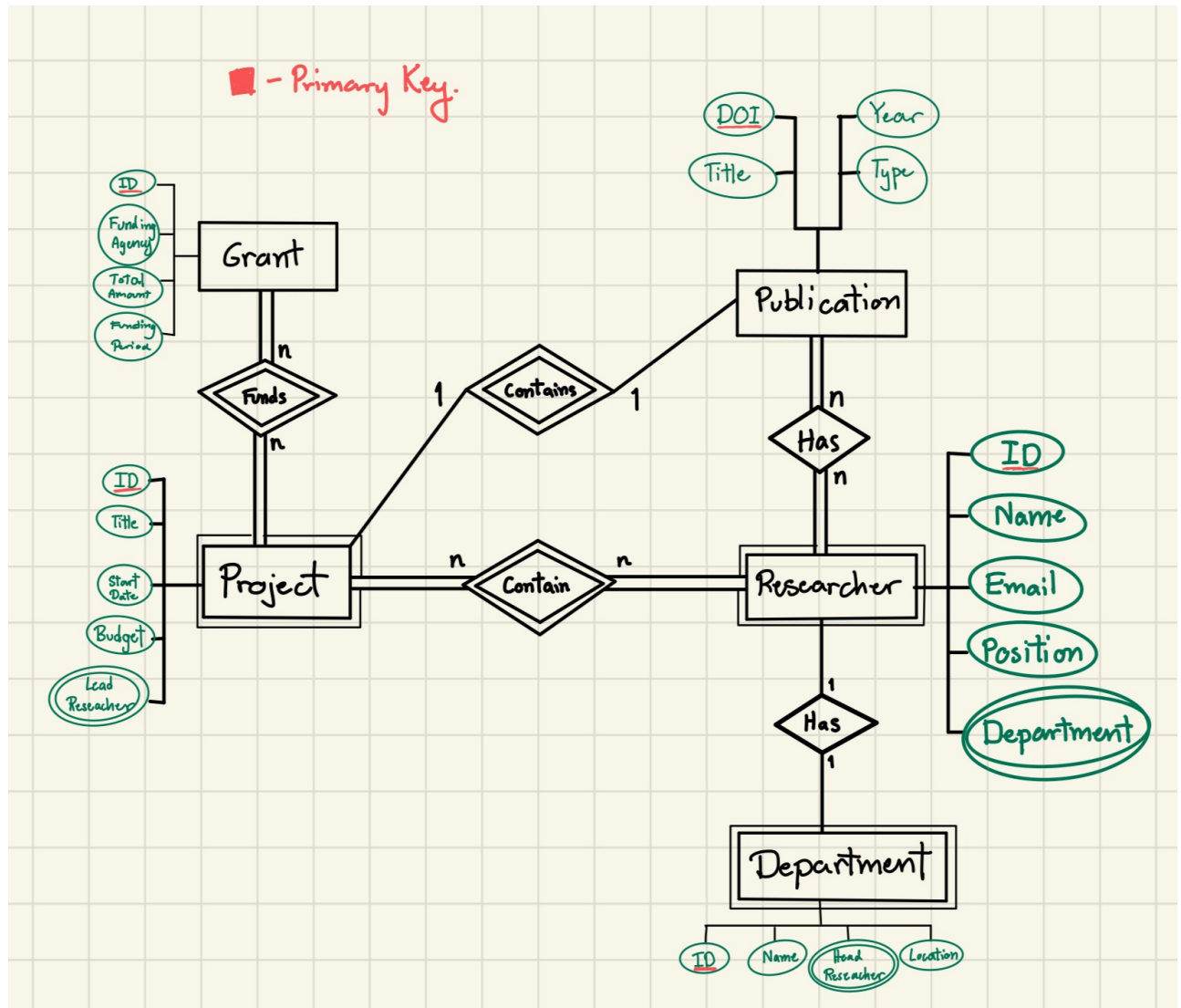
SEN-209: Designing And Implementing Databases
Midterm Exam

Name: Thanawin Pattanaphol

ID: 01324096

Question 1

a) ER Diagram

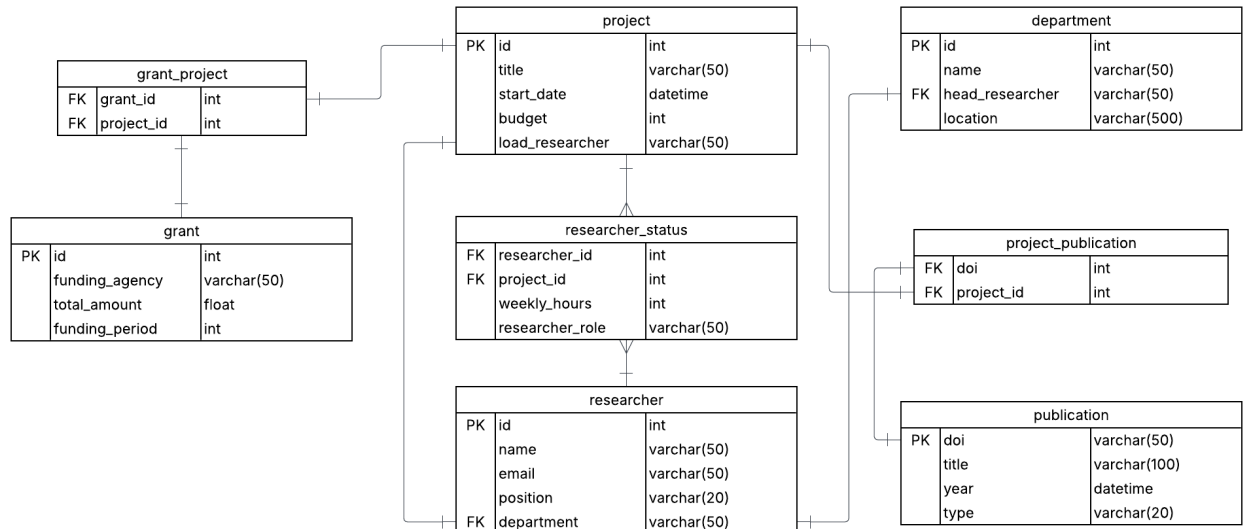


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b) Relationship Schema



- c) This schema enforces referential integrity through the usage of several elements, such as, primary keys to keep rows in tables unique; no duplicate entries allowed, foreign keys to organize the relationships between tables in the database.

Question 2

A. Functional Dependencies (FDs)

6 functional dependencies

- I. ProjectID
- II. ResearcherID
- III. DepartmentName
- IV. GrantID
- V. PublicationDOI
- VI. ProjectID & ResearcherID

B. 1NF → 2NF → 3NF Normalization

- I. 1NF (Remove repeating groups)
 - a. Project: ProjectID, ProjectTitle
 - b. Researcher: ResearcherID, ResearcherName, ResearcherEmail, DepartmentName
 - c. Department: DepartmentName, DepartmentHead
 - d. Grant: GrantID, GrantAgency, GrantAmount
 - e. Publication: PublicationDOI, PublicationTable, PubYear
 - f. Project_Researcher: ResearcherID, Project ID, Researcher_Role, HoursPerWeek

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- g. Proj_Grant: ProjectID, GrantID
- h. Proj_Publication: ProjectID, PublicationDOI

II. 2NF (All data must depend on the Primary key)

Since the table is already in 1NF along with the attributes are partially dependent on a key, the table is indeed in 2NF.

III. 3NF (Remove transitive dependencies)

Here, we would need to separate Departments since there is a transitive dependency of ResearcherID $\rightarrow$ DepartmentName $\rightarrow$ DepartmentHead, therefore we must separate them. However, that is already done in 1NF so these tables are in 3NF.

C. Final Normalized Schema

The finalized schema would be the following:

- I. Projects
 - a. ProjectID (PK)
 - b. ProjectTitle
- II. Researchers
 - a. ResearcherID (PK)
 - b. ResearcherName
 - c. ResearcherEmail
 - d. DepartmentName (FK)
- III. Departments
 - a. DepartmentName (PK)
 - b. DepartmentHead (FK to ResearcherID)
- IV. Grants
 - a. GrantID (PK)
 - b. GrantAgency
 - c. GrantAmount
- V. Publications
 - a. PublicationDOI (PK)
 - b. PublicationTitle
 - c. PubYear
- VI. Project_Researcher
 - a. ProjectID, ResearcherID (Composite PK)
 - b. ResearcherRole
 - c. HoursPerWeek
- VII. Proj_Grant
 - a. ProjectID, GrantID (Composition PK)
- VIII. Proj_Publication

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a. ProjectID, PublicationDOI (Composite PK)

D. SQL Implementation

```
CREATE TABLE Projects(  
    ProjectID INT PRIMARY KEY,  
    ProjectTitle VARCHAR(200) NOT NULL  
);
```

```
CREATE TABLE Researcher (  
    ResearcherID INT PRIMARY KEY,  
    ResearcherName VARCHAR(200) NOT NULL,  
    ResearcherEmail VARCHAR(200) UNIQUE NOT NULL,  
    DepartmentName VARCHAR(100) NOT NULL,  
  
    FOREIGN KEY (DepartmentName) REFERENCES  
    Department(DepartmentName)  
);
```

```
CREATE TABLE Department (  
    DepartmentName VARCHAR(100) PRIMARY KEY,  
    DepartmentHead INT NOT NULL,  
  
    FOREIGN KEY (DepartmentHead) REFERENCES Researcher(ResearcherID)  
);
```

```
CREATE TABLE Grant (  
    GrantID INT PRIMARY KEY,  
    GrantAgency VARCHAR(200) NOT NULL,  
    GrantAmount FLOAT  
);
```

```
CREATE TABLE Publication (  
    PublicationDOI VARCHAR(100) PRIMARY KEY,  
    PublicationTitle VARCHAR(200) NOT NULL,  
    PubYear INT  
);
```

```
CREATE TABLE Project_Researcher (  
    ProjectID INT,  
    ResearcherID INT,  
    ResearcherRole VARCHAR(100) NOT NULL,  
    HoursPerWeek INT,  
    PRIMARY KEY (ProjectID, ResearcherID),
```

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```
        FOREIGN KEY (ProjectID) REFERENCES Project(ProjectID),
        FOREIGN KEY (ResearcherID) REFERENCES Researcher(ResearcherID)
    );
CREATE TABLE Proj_Grant (
    ProjectID INT,
    GrantID INT,
    PRIMARY KEY (ProjectID, GrantID),
    FOREIGN KEY (ProjectID) REFERENCES Project(ProjectID),
    FOREIGN KEY (GrantID) REFERENCES Grant(GrantID)
);

CREATE TABLE Proj_Publication (
    ProjectID INT,
    PublicationDOI VARCHAR(100),
    PRIMARY KEY (ProjectID, PublicationDOI),
    FOREIGN KEY (ProjectID) REFERENCES Projects(ProjectID),
    FOREIGN KEY (PublicationDOI) REFERENCES
Publications(PublicationDOI)
);
```