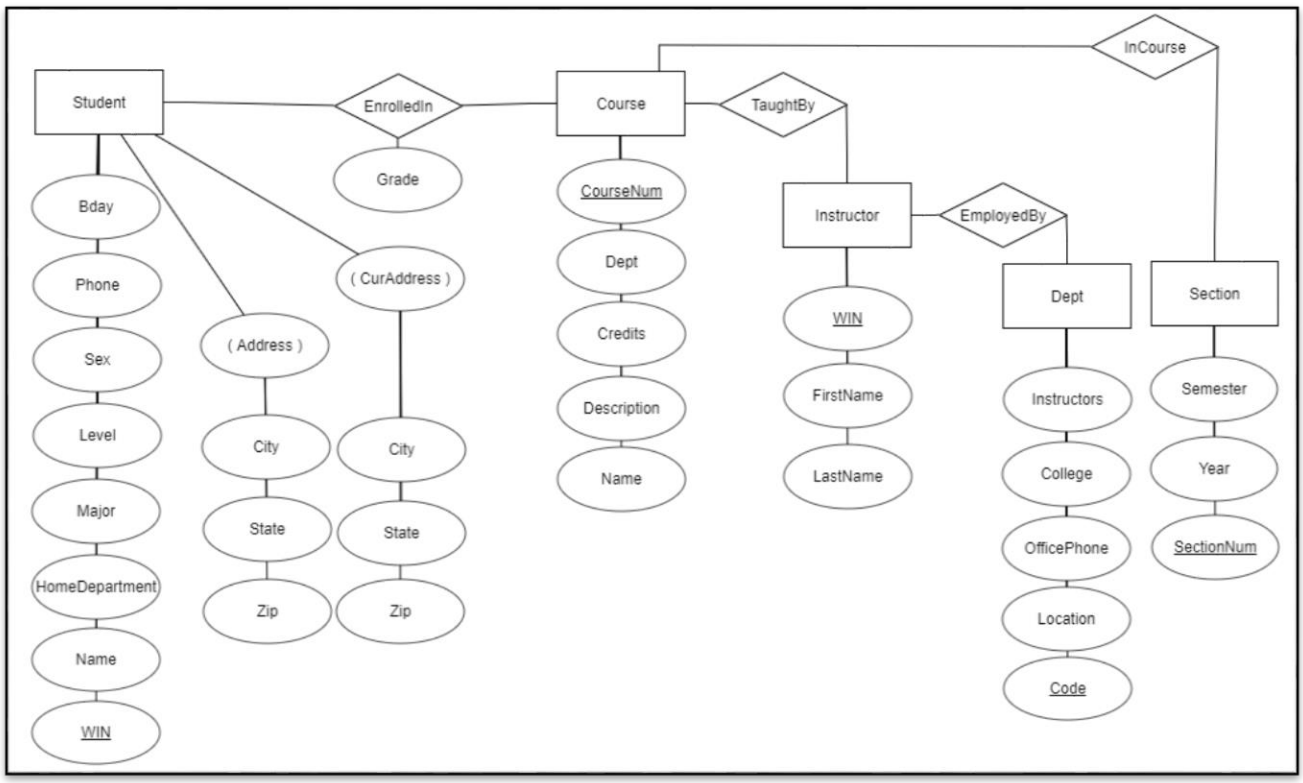
PART I



Converted to Schema

```
CREATE TABLE Student (
    Bday DATE,
    Phone varchar(20),
    Sex varchar(10),
    Level varchar(10),
    Major varchar(20),
    HomeDepartment varchar(20),
    FirstName varchar(20),
    LastName varchar(20),
    PRIMARY KEY WIN int,
    CurCity varchar(40),
    CurState varchar(2)
    CurZip varchar(9),
    City varchar(40),
    State varchar(2),
    Zip varchar(9)
```

```
);
//Previously EnrolledIn, but makes more sense to call it "Grades".
CREATE TABLE Grades (
    FOREIGN KEY (WIN) REFERENCES Student(WIN),
    FOREIGN KEY (CourseNum) REFERENCES Courses(CourseNum),
    Grade varchar(2)
);
CREATE TABLE Course (
        PRIMARY KEY CourseNum int,
        Dept varchar(20),
        Credits int,
        Description varchar(200),
        Name varchar(40),
        FOREIGN KEY (TaughtBy) REFERENCES Instructor(WIN)
);
CREATE TABLE Instructor (
        PRIMARY KEY WIN int,
        FirstName varchar(20),
        LastName varchar(40)
);
CREATE TABLE Dept (
        FOREIGN KEY (Instructor) REFERENCES Instructor(WIN),
        College varchar(40),
        OfficePhone varchar(40),
        Location varchar(40),
        PRIMARY KEY Code varchar(4)
);
CREATE TABLE Section(
        Semester varchar(40),
        Year int,
        PRIMARY KEY SectionNum int,
        FOREIGN KEY (CourseNum) REFERENCES Course(CourseNum)
);
```

Part II

1a. C → D

C → A

B → C

-Which attribute(s) can not be determined?

-Those not on the right side - B.

-The attribute(s) must be present in the candidate key.

-Closure on the set [B]?

-What attributes can be determined from the closure on set B?

-B,C,A,D

ANSWER: We can determine all attributes from closure on set B, so B is the candidate key for the functional dependency expressed.

1b. Prime Attributes - B

Non-Prime Attributes- C,A,D

Are the Non-Prime Attributes functionally dependent upon B?

Yes: Then we know the relation is certainly in 2NF.

ANSWER: This relation contains transitive dependencies (B->C C->A,B->C C->D), so the highest normal form must be 3NF.

2a. B → C

D → A

-Which attribute(s) can not be determined?

-Those not on the right side - B,D.

-The attribute(s) must be present in the candidate key.

-Closure on the set [BD]?

-What attributes can be determined from the closure on set [BD]?

-B,C,D,A

ANSWER: We can determine all attributes from set [BD], so [BD] is the candidate key for the functional dependency expressed in question 2.

2b. Prime Attributes - B,D

Non-Prime Attributes- A,C

Are the Non-Prime Attributes functionally dependent upon [BD]?

No: Both C and A are only partially dependent upon [BD].

ANSWER: This relation contains partially dependent attributes, so the highest normal form must be 1NF.

3a. ABC → D

D → A

-Which attribute(s) can not be determined?

- Those not on the right side - B,C.

- The attribute(s) must be present in the candidate key(s).

-Closure on the set [BC]?

- What attributes can be determined from the closure on set [BC]?

- B,C

- So, take combinations of attributes to determine the candidate key(s).

-Closure on [BCA] is B,C,A,D

-Closure on [BCD] is B,C,D,A

ANSWER: We can determine all attributes from closure on set [BCA] and set [BCD], so both are candidate keys for the functional dependency expressed in question 3.

3b.

ANSWER: Non-prime attribute can not be partially dependent on candidate key, so highest normal form must be 1NF.

4a. A → B

BC → D

A → C

-Which attribute(s) can not be determined?

-Those not on the right side - A.

-The attribute(s) must be present in the candidate key.

-Closure on the set [A]?

- What attributes can be determined from the closure on set [A]?

- A,B,C,D

ANSWER: We can determine all attributes from closure on set [A], so [A] is the candidate key for the functional dependency expressed in question 4.

4b. The highest normal form that the relation satisfies is BCNF.

5a. AB → C

AB → D

C → A

D → B

-Which attribute(s) can not be determined?

None

ANSWER: We can determine all attributes from closure on set [AB] and set [CD], so [AB] and [CD] are the candidate keys for the functional dependency expressed in question 5.

5b. Given that there are no partial dependencies in the relation, but the relations do not all map a candidate key to a prime attribute, I am guessing it would be 2NF for the highest normal form.