

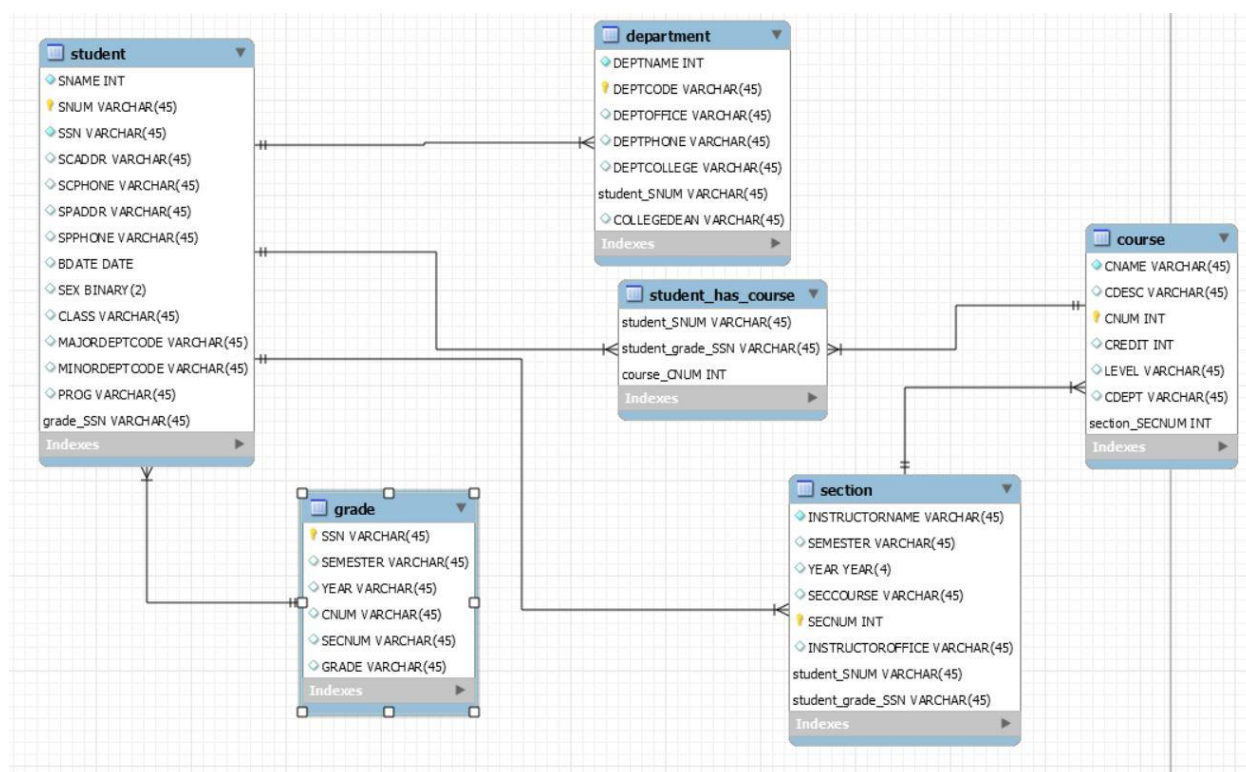
CSCI 4370 Project 4 Report

Team: 2019NationalChamps

Team Members: Alex Kimbrell (ER Diagram), Pravallika Nallamotu (3NF), Obediah Blair (BCNF)

	ER	BCNF	3NF
No. of tables	6	8	6
Lossless	Yes	Yes	Yes
Functional Dependencies Preserved	Yes	Yes	Yes

ER Diagram:



Above is a visual representation of the schema for the university database. The database initially contained 5 tables (student, department, course, section, and grade), but an additional tables was added when forming relationships between tables. The student_has_course table was automatically added by MySQL Workbench since the student table and the course table have a many-to-many relationship (a student can take multiple courses, and a course can have multiple students). Other relationships are also present in the diagram. For instance, student and grade have a one-to-many relationship since a student can have multiple grades, but each grade only corresponds to one student.

BCNF:

- To satisfy BCNF the table:
 - Should be in 3NF
 - And, for any dependency $A \rightarrow B$, A should be a **super key**
- After the 3NF synthesis, I was unable to find any violations for BCNF that would require any further changes to the tables. From checking Piazza, I found that other students had similar issues, so Dr. Arpinar added some new attributes to the description in order to combat them.
- From the Piazza post, I've added the attribute COLLEGEDEAN to the 'department' table and INSTRUCTOROFFICE to the 'section' table in our 3NF synthesized database.
- 'Department table' changes:
 - DEPTCODE, COLLEGEDEAN form a primary key because you can find all the columns in the table with this combination
 - COLLEGEDEAN depends on DEPTCOLLEGE, which is not allowed in BCNF
 - because DEPTCOLLEGE is not a super key in this instance
 - We create new table 'college' in order to satisfy BCNF
- 'Section table' changes:
 - SECNUM, INSTRUCTOROFFICE form a primary key because you can find all the columns in the table with this combination.
 - INSTRUCTOROFFICE depends on INSTNAME, and this is not allowed because INSTNAME is not a super key in this instance
 - We create a new table 'instructor' in order to satisfy BCNF
- New tables 'college' and 'instructor' are in bcnf.sql

Table	Attributes
university	SNAME INT(11), SNUM INT(11), SCADDR VARCHAR(45), SCPHONE VARCHAR(45), CLASS VARCHAR(45), MAJORDEPTCODE INT(11), MINORDEPTCODE INT(11), PROG VARCHAR(45)
student	SSN INT(11), SNAME VARCHAR(45), SPADDR VARCHAR(45), SPHONE VARCHAR(45), BDATE DATETIME, SEX VARCHAR(45)
course	CNUM INT(11), CNAME VARCHAR(45), CDESC VARCHAR(45), CREDIT INT(11), LEVEL INT(11), CDEPT VARCHAR(45)
grade	SSN INT(11), GRADE INT(11), CNUM VARCHAR(45), SECNUM VARCHAR(45)
department	DEPTNAME VARCHAR(45), DEPTPHONE INT(11), DEPTOFFICE VARCHAR(45), DEPTCODE INT(11), INST_ID INT
college	COL_ID INT, DEPTCOLLEGE VARCHAR(45), COLLEGEDEAN VARCHAR(45)
section	SECNUM INT(11), SEM VARCHAR(45), YEAR INT(11), SECCOURSE VARCHAR(45), INST_ID INT
instructor	INST_ID INT, INSTNAME VARCHAR(45), INSTRUCTOROFFICE VARCHAR(45)

3NF:

- The yellow highlighted values are the keys (multiple primary keys make up the Candidate Key)
- There are example records in each table

Comparison Table

- No of Tables: 6
- Lossless: Yes
- FD Preserved: Yes

1NF Synthesis

- To put the tables in 1NF I ensured:
 - Each record is unique
 - Each cell contains a single value
- I had to split up the CNUM,SECNUM column in Grades table into two separate columns because there should only be a single atomic entry

University Table:

SNAME	SNUM	SSN	SCADDR	SCPHONE	SPADDR	SPHONE	BDATE	SEX	CLASS	MAJORDEPTCODE	MINORDEPTCODE	PROG
Patrick	1	7655	Miller st	543546546	Hew Dr	543546546	01.01.1994	M	Soph	321	243	BS
Mary	2	6554	Miller st	5675465434	Block St	5675465434	02.02.1994	F	Junior	243	321	BS
Tim	3	3554	Test Dr	6787654564	Wire St	6787654564	03.03.1994	M	Graduate	245	245	BA

Department Table:

DEPTNAME	DEPTCODE	DEPTPHONE	DEPTOFFICE	DEPTCOLLEGE
Math	321	6789304958	326	College of Arts
English	243	6839485789	265	College of Arts
Biology	245	5792837485	264	College of Science

Course Table:

CNAME	CDESC	CNUM	CREDIT	LEVEL	CDEPT
MATH1113	A beginner course to algebra	352	4	1000	Math
ENGL1102	A class on Edgar Allen Poe works	285	3	1000	English
BIOL1104	Beginner Bio class on Living Organisms	948	4	1000	Biology

Section Table:

INST NAME	SEM	YEAR	SEC COURSE	SEC NUM
Edgar Poe	FALL	2019	ENGL1102	1
Eliza Allen	FALL	2019	BIOL1104	2
Sarah Cooke	SP	2019	MATH1113	3

Grade Table:

SSN	SEMESTER	YEAR	CNUM	SECNUM	GRADE
765	FALL	2019	352	1	B
654	FALL	2019	285	2	B
354	SPRING	2019	948	3	A

2NF Synthesis

- To put the tables in 2NF I ensured:
 - That I removed all partial dependencies – meaning any column not reliant on both columns in the composite key should be separated
 - I separated the University table into two separate tables to avoid trivial functional dependencies
 - I created a new Student table containing all columns relevant to their SSN number (the primary key)

University Table:

SNAME	SNUM	SCADDR	SCPHONE	CLASS	MAJORDEPTCODE	MINORDEPTCODE	PROG
Patrick	1	Miller st	543546546	Soph	321	1A	BS
Mary	2	Miller st	5675465434	Junior	243	NA	BS
Tim	3	Test Dr	6787654564	Graduate	245	3A	BA

Student Table

SNAME	SSN	SPADDR	SPHONE	BDATE	SEX
Patrick	765	Hew Dr	543546546	01.01.1994	M
Mary	654	Block St	5675465434	02.02.1994	F
Tim	354	Wire St	6787654564	03.03.1994	M

Department Table:

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Section Table:

INST NAME	SEM	YEAR	SEC COURSE	SEC NUM
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Eliza Allen	FALL	2019	BIOL1104	2
Sarah Cooke	SP	2019	MATH1113	3

Grade Table:

SSN	SEMESTER	YEAR	CNUM	SECNUM	GRADE
765	FALL	2019	352	1	B
654	FALL	2019	285	2	B
354	SPRING	2019	948	3	A

3NF Synthesis

- To put the tables in 3NF I ensured:
 - All transitive functional dependencies are removed
 - Transitive dependencies are when a non-key attribute is dependent on another non-key attribute
 - The TD in this database are highlighted in green. They are considered redundant and will be removed.

University Table:

SNAME	SNUM	SCADDR	SCPHONE	CLASS	MAJORDEPTCODE	MINORDEPTCODE	PROG
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Comparison of 3 Methods

The ER Diagram, BCNF decomposition, and 3NF synthesis all seek to help a database manager recognize and eliminate redundancy in his/her database design. The reduction of redundancy is critical for the overall performance of querying the database. Insertions, deletions, and updates to tables will be considerably better once a database schema has gone through BCNF or 3NF. In general, 3NF synthesis can typically be obtained without having to sacrifice functional dependencies and is lossless. BCNF decomposition does not necessarily preserve functional dependencies and can often result in lossy decomposition.