Database Systems

A 3NF Database with Transitive Dependencies

or

"How I learned to stop denormalizing and love BCNF"

Take small 3NF database…

```
Create Table Rooms (
      room     char(10) not null,
      roomsize int      not null,
Primary Key (room)
)
```

```
Create Table Enroll (
      Student char(20) not null,
      Course  char(10) not null,
      Section char(5)  not null,
      grade   char(2)  not null,
Primary Key (student, course)
)
```

```
Create Table Classes (
      Course    char(10) not null,
      section   char(5)  not null,
      room      char(10) not null,
      startTime datetime,
Primary Key (course, section )
)
```

…and look at the functional dependencies

Rooms: room → roomsize
Classes: course, section → room, startTime
Classes: room, startTime → course, section (This is a transitive dependency.)
Enroll: student, course → section, grade

Why is (room, startTime → course, section) a transitive dependency in the Classes table?

Transitive dependencies are of the form A → B, B→ C, therefore A → C.
A: course, section → room, startTime
B: room, startTime → course, section
Which shows that course, section → course, section. Silly, you ask? No, because any change in a room or startTime might require a change in the primary key (course, section) in order for the database to stay consistent and prevent anomalies. But this is not enforced because (room, startTtime) is not the primary key. This is not so in tables that area BCNF, which is 3NF and no transitive dependencies.

alan@3NFconsulting.com
www.3NFconsulting.com

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Does this violate 3NF?

No, room and StartTime are fully determined by the primary key of (course, section). Plus, (room, startTime) is a candidate key, so we fit the definition of 3NF.

What can go wrong?

Several courses can be assigned to the same room at the same time.

```
insert into Classes( course, section, room, startTime )
values ('Database1', 'A', 'Room 101', '10-08-2003 6:30 PM')

insert into Classes( course, section, room, startTime )
values ('Database2', 'A', 'Room 101', '10-08-2003 6:30 PM')

insert into Classes( course, section, room, startTime )
values ('Compilers1', 'C', 'Room 101', '10-08-2003 6:30 PM')

course     section room       startTime
---------- ------- ---------- -----------------------
Compilers1 C       Room 101   2003-10-08 18:30:00.000
Database1  A       Room 101   2003-10-08 18:30:00.000
Database2  A       Room 101   2003-10-08 18:30:00.000

(3 row(s) affected)
```

How do we fix it?

Add a unique constraint to (room, startTime).

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