Database Design

CS 327E
Feb 12, 2018

1) How does the text suggest mapping the 1:1 relationship `Manages` between `Employee` and `Department` which says that every department has a manager?

a) Create a `Manages` relation whose primary key is the combination of `{emp_ssn, dept_number}`
b) Add `dept_number` to `Employee` as a foreign key
c) Add `mng_ssn` to `Department` as a foreign key
d) None of the above

2) How does the text suggest mapping the *m:n* relationship between `Employee` and `Project` which says that employees work on projects?

a) Create a `Works_On` relation whose primary key is the combination of `{emp_ssn, proj_number}`
b) Add the `emp_ssn` to `Project` as a foreign key
c) Add the `proj_number` to `Employee` as a foreign key
d) None of the above

3) How does the text suggest mapping the multivalued attribute `dept_locations`, which represents the different locations of a department?

a) Create *n* fields in `Department`, one for each location
b) Create a relation `Dept_Locations` whose primary key is the combination of {`dep_number`, `location`}
c) Create *n* fields in `Locations`, one for each department
d) None of the above

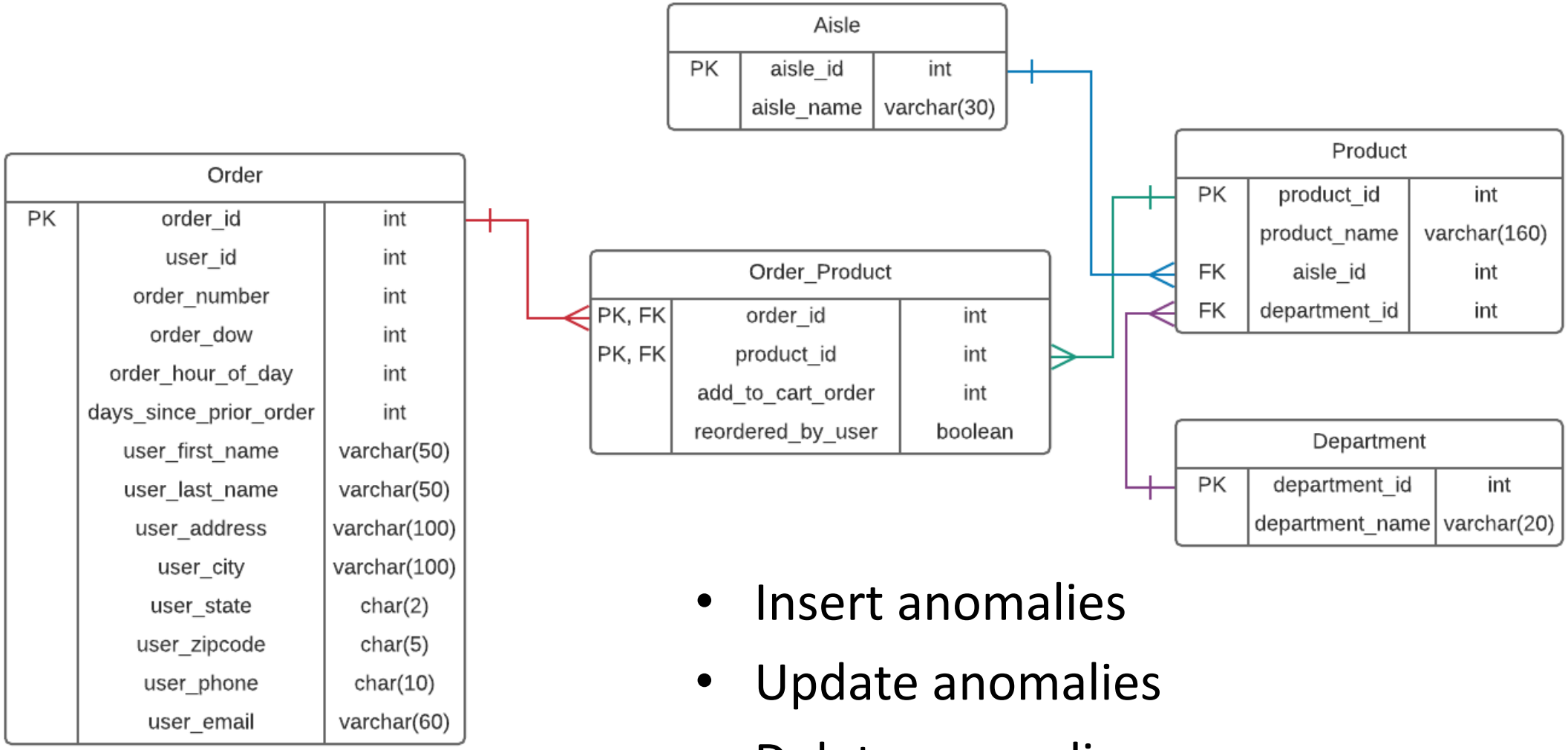
4) Which statement is **true** about mapping a superclass and its subclasses to multiple relations?

a) The subclasses inherit all the attributes from the superclass.
b) The superclass contains a `type` attribute that indicates which subclass a record belongs to.
c) Only the subclasses become relations.
d) None of the above.

5) The higher the normal form, the fewer the number of tables in a database.

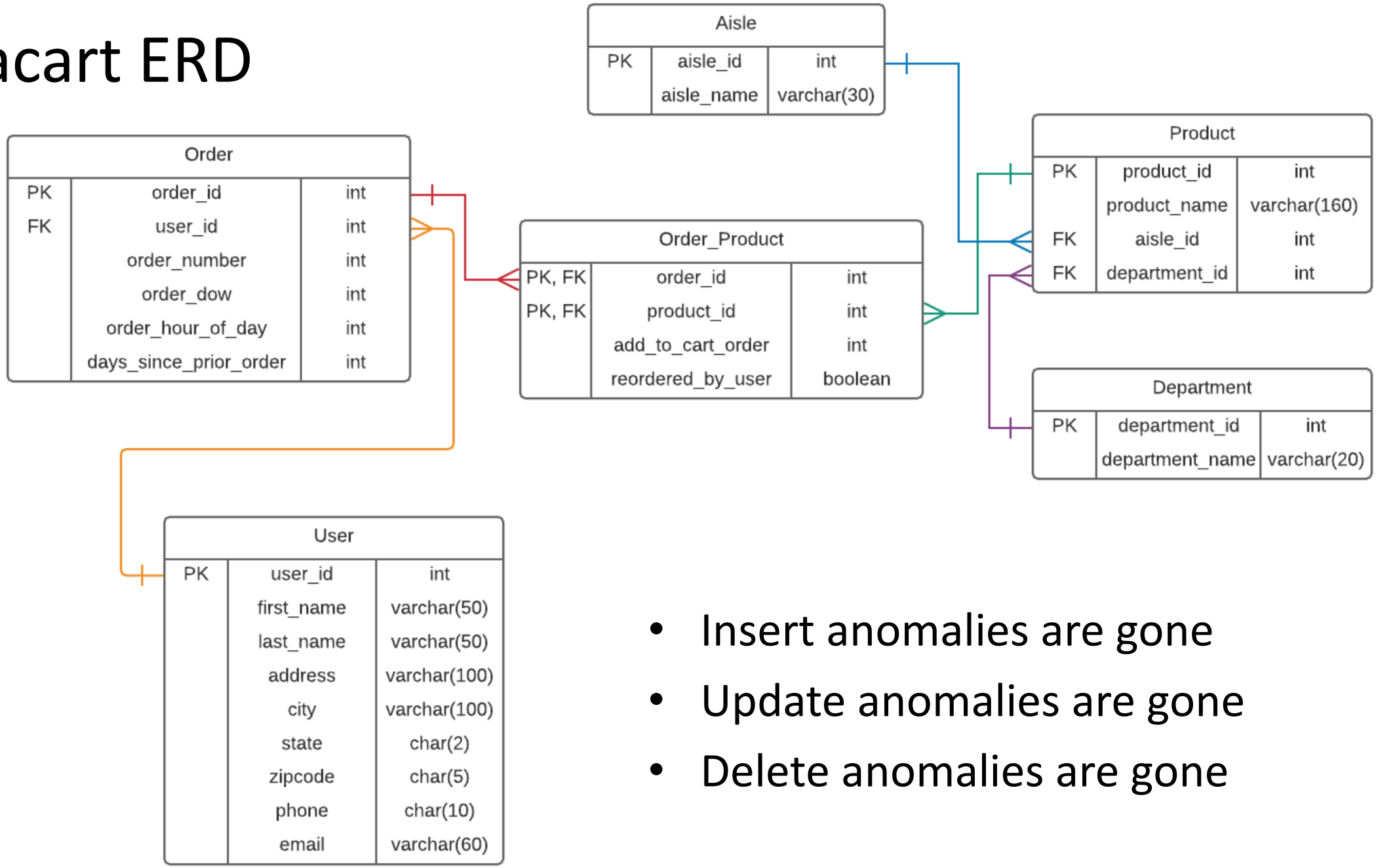
A) True
B) False

Instacart ERD



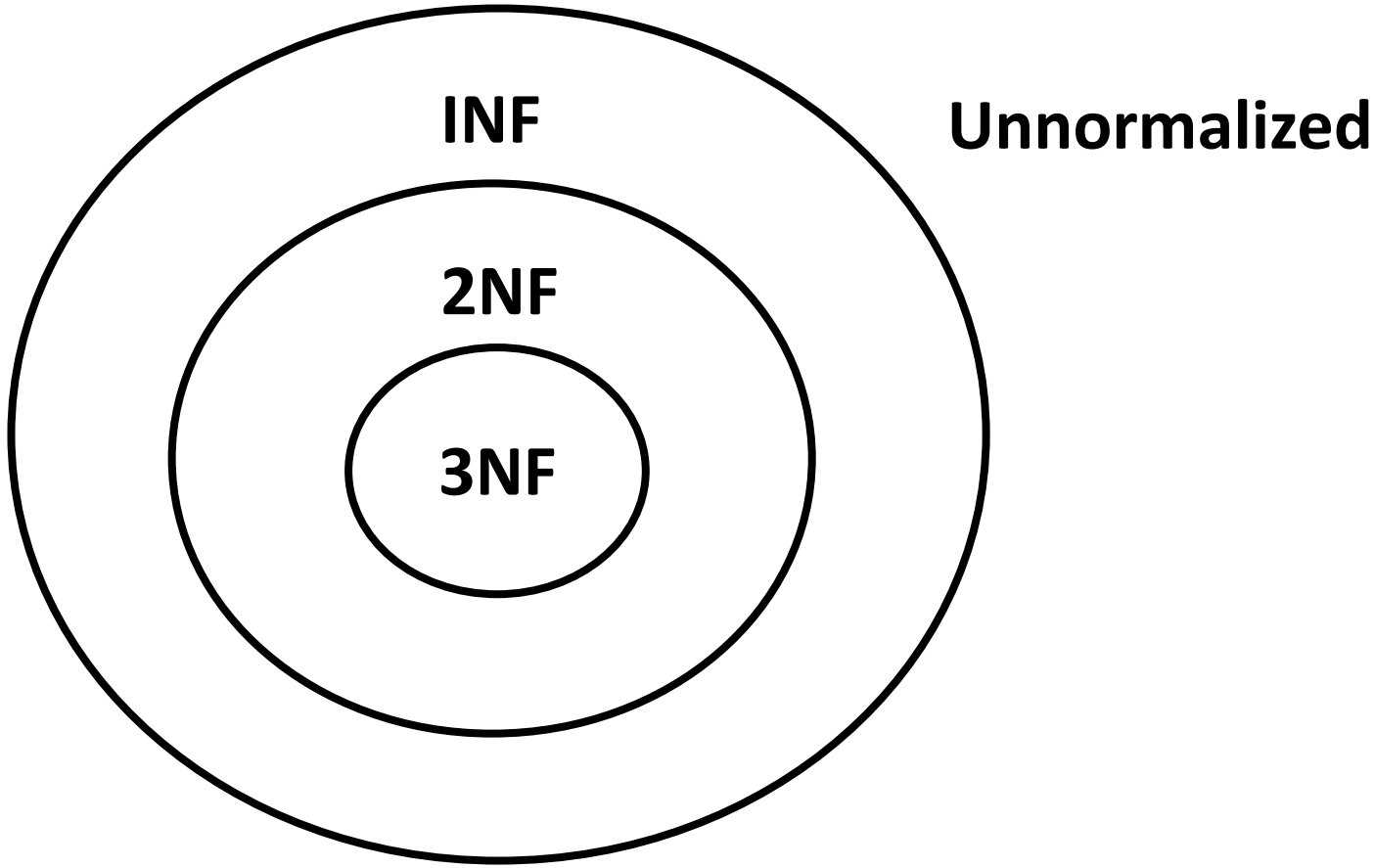
- Insert anomalies
- Update anomalies
- Delete anomalies

Instacart ERD



- Insert anomalies are gone
- Update anomalies are gone
- Delete anomalies are gone

Normalization Theory



Unnormalized to 1NF

Rule: A database schema is in 1NF *iff* all attributes have scalar values.

Student_Semester

EID	Semester	GPA	Classes
alice1	Fall17	3.9	Stats A DB A Alg A-
bob20	Fall17	3.7	DB A Alg B+
carol30	Fall17	3.5	Stats A- Alg B+

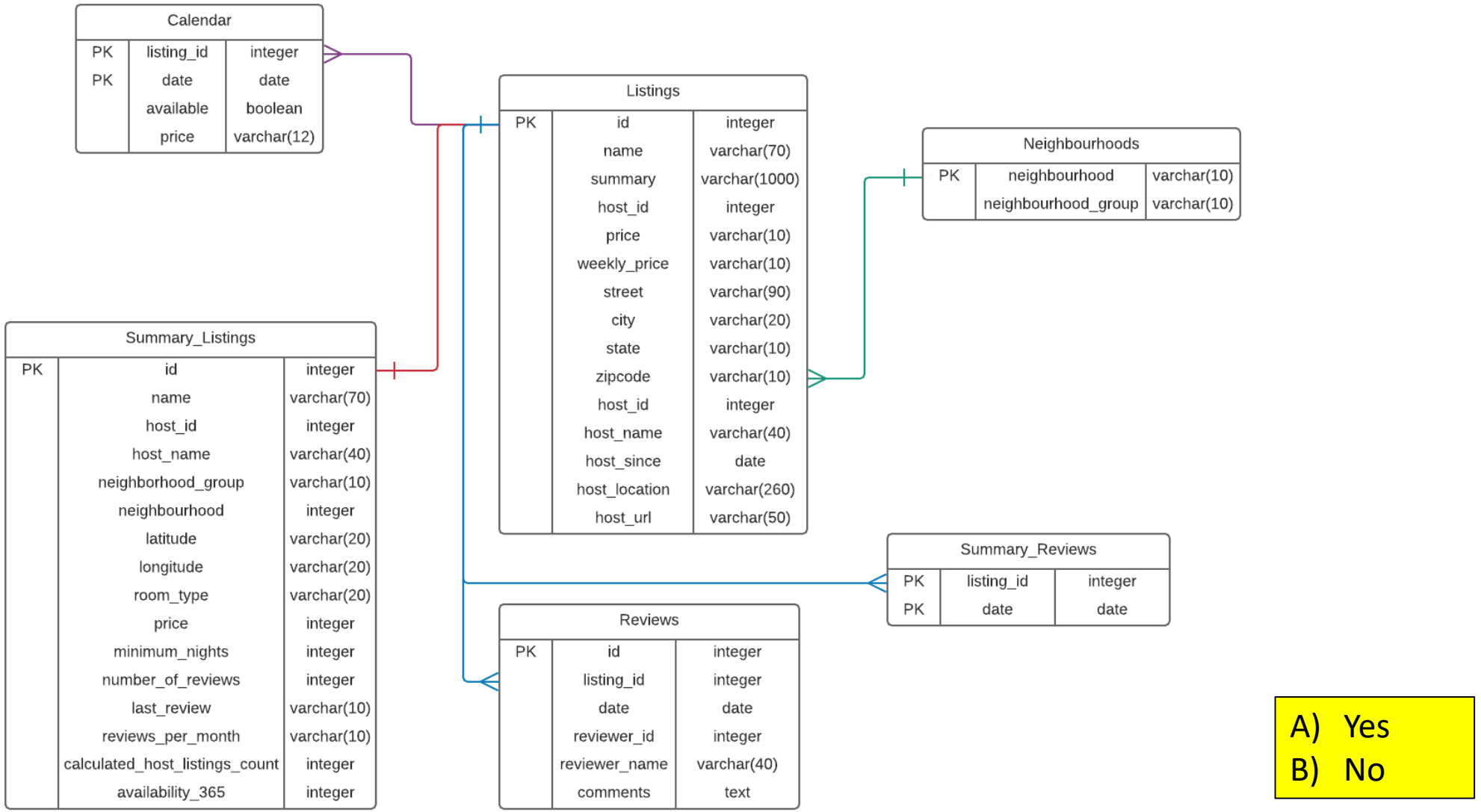
Unnormalized

Student_Semester'

EID	Semester	Class	Grade	GPA
alice1	Fall17	Stats	A	3.9
alice1	Fall17	DB	A	3.9
alice1	Fall17	Alg	A-	3.9
bob20	Fall17	DB	A	3.7
bob20	Fall17	Alg	B	3.7
carol30	Fall17	Stats	3.5	3.5
carol30	Fall17	Alg	3.5	3.5

1NF

Practice Problem 1: Is the Airbnb Staging Schema in 1NF?



A) Yes
B) No

Functional Dependencies

Definition:

If two records agree on the attributes

$A_1, A_2, \ldots, A_n$

then they must also agree on the attributes

$B_1, B_2, \ldots, B_n$

Formally:

$A_1, A_2, \ldots, A_n \rightarrow B_1, B_2, \ldots, B_n$

FD Example

Which FDs **hold** and **do not hold** on this table?

ID	**Name**	**Phone**	**City**
C0012	Smith	5555	Austin
C3412	Wallace	9876	Houston
C1111	Smith	9876	Dallas
C2323	Johnston	5555	Austin

ID → Name, Phone, City
City → Phone

Not Phone → City
Not Name → Phone

1NF to 2NF

Rule: A database schema is in 2NF *iff* it is in 1NF and there exists no partial FDs on the primary key (i.e. all non-key attributes must be dependent on the entire PK)

Student_Semester

EID	Semester	Class	Grade	Sem_GPA
alice1	Fall17	Stats	A	3.9
alice1	Fall17	DB	A	3.9
alice1	Fall17	Alg	A-	3.9
bob20	Fall17	DB	A	3.7
bob20	Fall17	Alg	B+	3.7
carol30	Fall17	Stats	A-	3.5
carol30	Fall17	Alg	B+	3.5

1NF

FDs:

1. EID, Semester, Class → Grade
2. EID, Semester → Sem_GPA

Student_Semester_Grade

EID	Semester	Class	Grade
alice1	Fall17	Stats	A
alice1	Fall17	DB	A
alice1	Fall17	Alg	A-
bob20	Fall17	DB	A
bob20	Fall17	Alg	B+
carol30	Fall17	Stats	A-
carol30	Fall17	Alg	B+

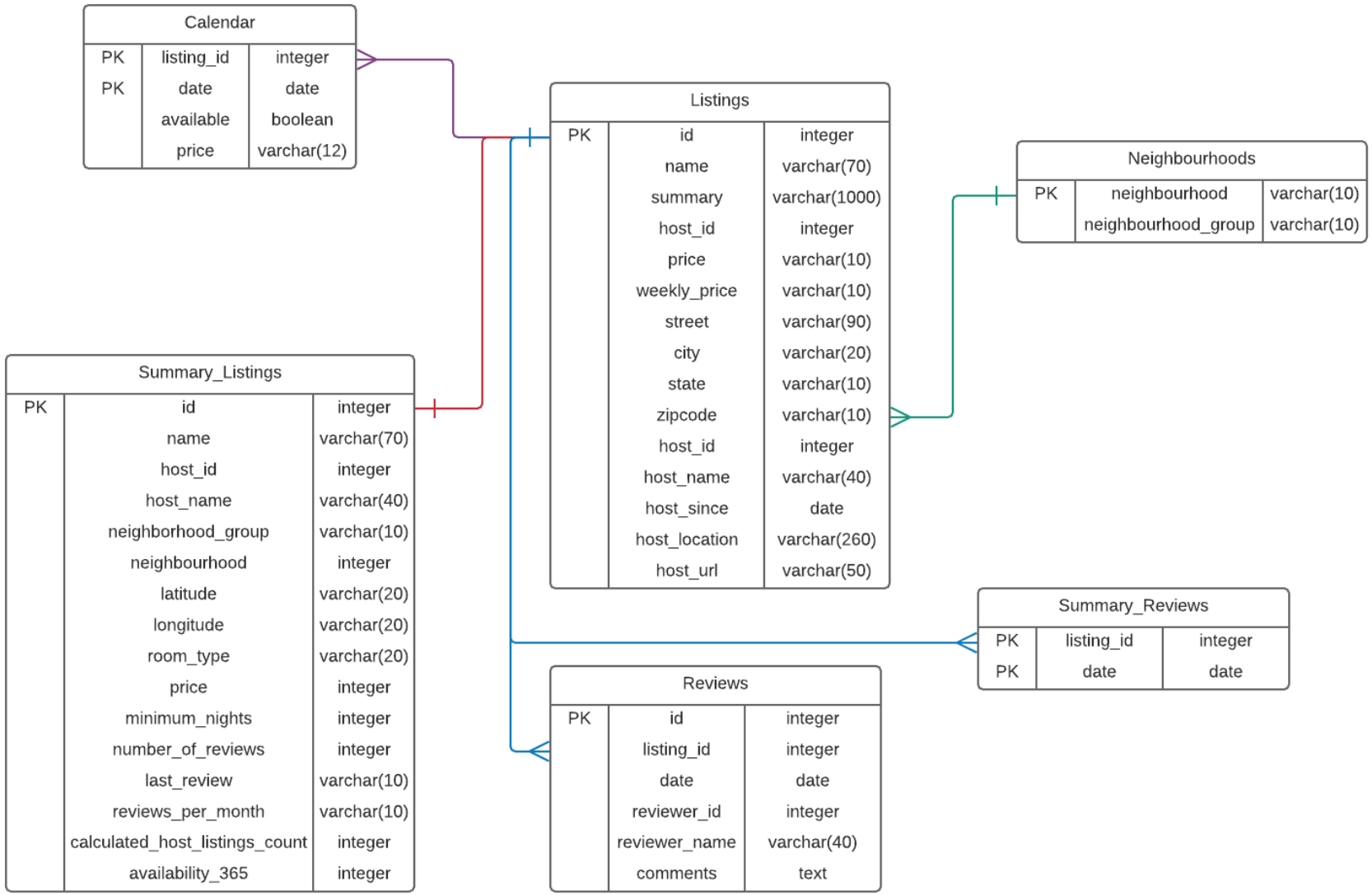
2NF

Student_Semester_GPA

EID	Semester	GPA
alice1	Fall17	3.9
bob20	Fall17	3.7
Carol30	Fall17	3.5

2NF

Practice Problem 2: Is the Airbnb Staging Schema in 2NF?



A) Yes
B) No

2NF to 3NF

Rule: A database schema is in 3NF *iff* it is in 2NF and there exists no non-key attributes that are functionally determined by other non-key attributes.

Student_Major

2NF

EID	**Name**	**Major**	**College**
alice1	Alice	Math	Natural Sciences
bob20	Bob	CS	Natural Sciences
carol30	Carol	Math	Natural Sciences

FDs:

1. EID → Name, Major
2. Major → College

Student_Major'

3NF

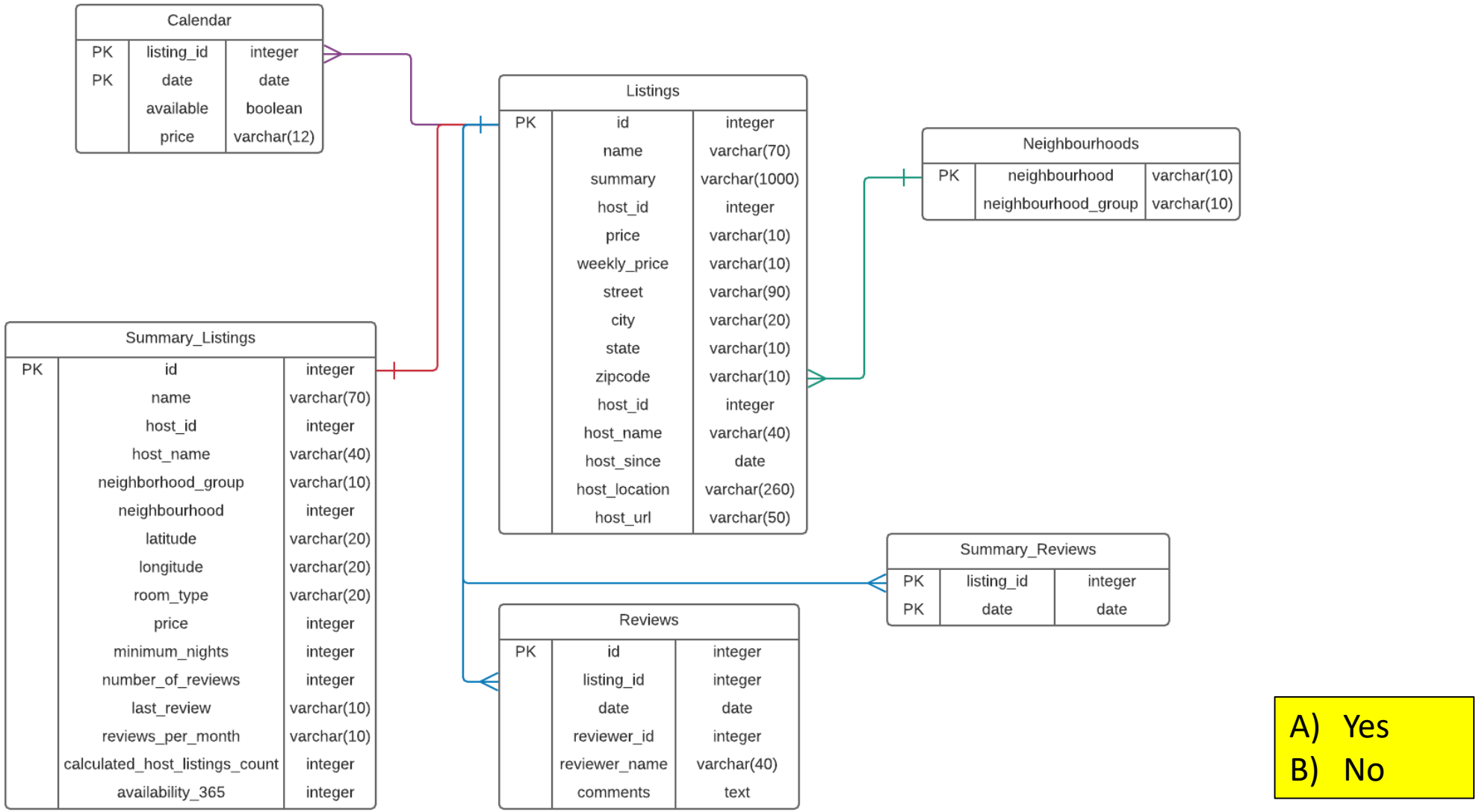
EID	**Name**	**Major**
alice1	Alice	Math
bob20	Bob	CS
carol30	Carol	Math

Major_College

Major	**College**
Math	Natural Sciences
CS	Natural Sciences

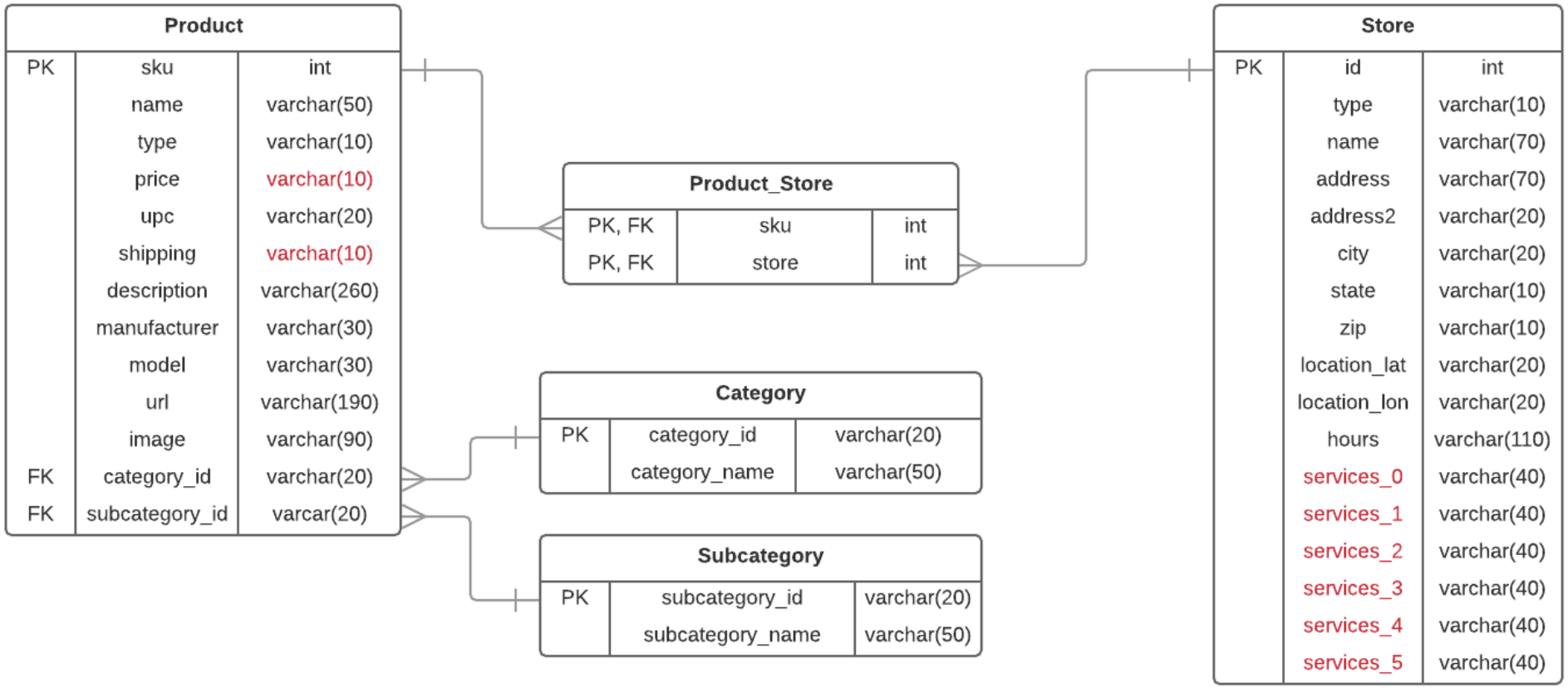
3NF

Practice Problem 3: Is the Airbnb Staging Schema in 3NF?



A) Yes
B) No

Best Buy Schema Demo



Best Buy Schema Demo