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Q0:

1) The keys which do not contain all attributes of the relation are superkeys.
2)
   a) Student(Name, marks, course)
      A = name, B = marks, C = course
      S = A -> BC
      Since name determine marks and course.
      {A}+ = {B,C}
      But here marks and course dont determine any other attribute.
      Thus, {B}+ = {B} and {C}+ = {C}
   b) Course(Code, name, teacher)
      A = Code, B = Course name, C = Course teacher
      For X+ = {A,B,C} we need two FD's A -> B and B -> C
      Since course code determines course name (A -> B)
      And Course name tells us which teacher teaches we have B -> C
      Taking closure for X = {A} we get
      X+ = {A,B,C} but X != {A,B,C} here.

Q1

Consider a relation with schema R(A,B,C ,D) and FD's A B —> C , C —> D , and D —> A.

a) AB -> D, C -> A, CD -> A, BC -> A, AC -> D, BD -> C, CD -> A, ABC -> D, ABD -> C, BCD -> A
b) AB+={A,B,C,D}, BC+={B,C,D,A}, BD+={B,D,A,C}
   Thus AB, BC and BD since they contain all attributes of R

c) ABC, ABD, BCD, and ABCD.

Q2

a) Let R = {A1,A2…..An}
   This means, {A1, A2…..An}+ = {A1, A2…..An, B}
   Considering A1,A2…..An, C -> B, B is present in the closure of R and thus it will also be present in {A1,A2….An,C}+

b) From the FD, {A1, A2…..An}+ = {A1, A2…..An, B}, by adding C to both sides we get A1,A2….An,C -> BC

c)
d) Assuming

$$\text{FD } A_1A_2\cdots A_nC_1C_2\cdots C_k \rightarrow B_1B_2\cdots B_mD_1D_2\cdots D_j$$

Holds,
If we take closure of {A1,A2,....An}+ from given FD we get {A1,A2,....An}+ -> {A1,A2,....An, B1,B2….Bn}
The same stands for C. By combining both we prove the initial assumption.

Q3

A) If A -> B suppose A stands for StudentID: integer and B stands for name of the student.
In this scenario, each new StudentID refers to a new kid. If we Assumed B -> A then that would mean 2 or more kids with the same name would have the same studentID which is wrong.

B) AB -> C and A ->C then B -> C
A = studentID
B = Date of application
C = name
In this case, AB -> C stands both ID and DOB together can identify a student.
A -> C is valid too since ID can identify a student
But B -> C is not valid since DOB can be same for several students can thus cannot determine a unique student

C) AB -> C, then A -> C or B -> C
A = pincode
B = street number
C = entry pin
Both AB together will give you correct pin to enter the apartment
But only A wont give you the right one nor only street number(B)