This page has been intentionally left blank.

We will not grade any work on this page. If you run out of space for an answer, you can write it on this page but be sure to leave a note to let us know to look here and clearly indicate which part of your work is to be considered for grading.

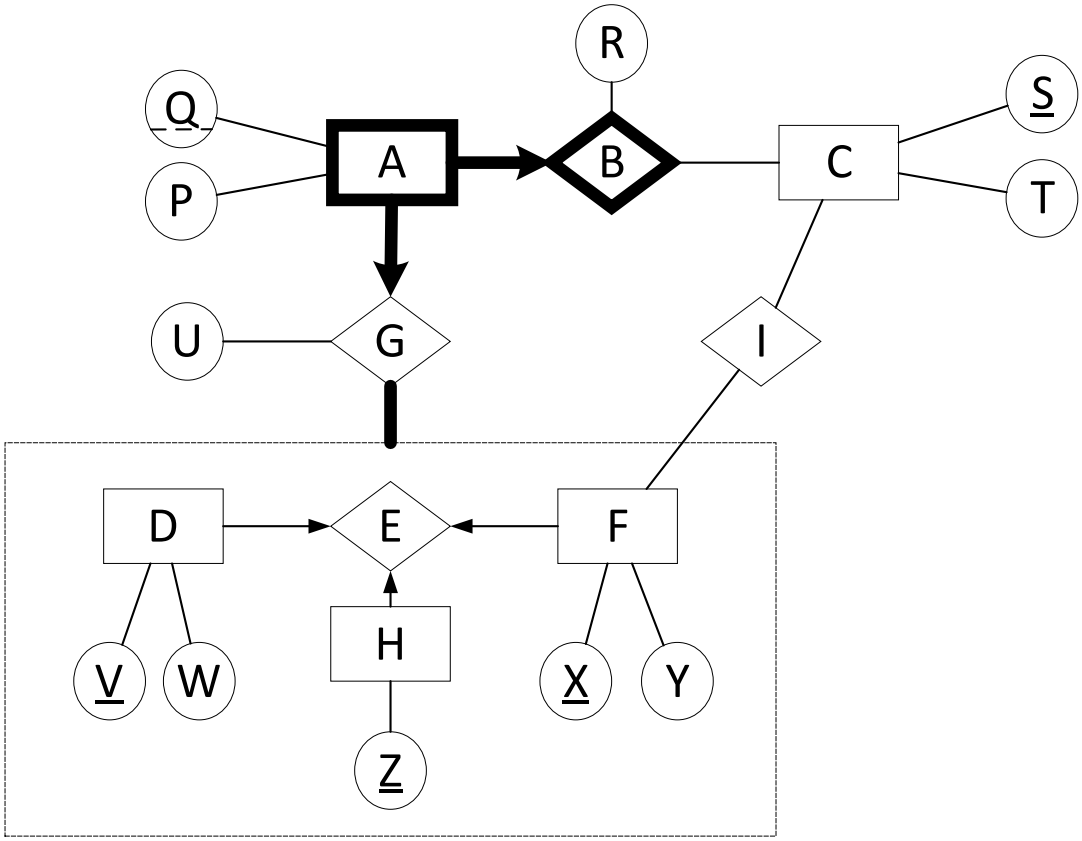
Ambiguous/unreadable answers are automatically considered as incorrect.

[4 marks] True/False Questions

Statement	True	False
If an attribute is a foreign key, it cannot also be a primary key.		
Superkeys cannot be minimal.		
For R(ABCD), ABCD cannot be the primary key.		
For R(ABCD), if D is a candidate key, ABC cannot also be a candidate key.		
Based on the rules of ER diagrams discussed in lecture, it is possible for two different entity sets to have attributes that share the same name.		
Given an ISA relationship with partial and overlapping constraints, the best translation of this relationship into the relational model is to use two relations.		
If an entity has a key and total participation constraint, it must be enforced through a NOT NULL constraint in the SQL DDL statement.		
If an aggregated entity has a participation constraint with a relationship, the entities inside the aggregation must also have a participation constraint.		

[5 marks] True/False Questions Part 2

Consider the following ER diagram:



For each of the following statements, clearly indicate whether it is true or false by putting a check mark in the associated box. Consider each statement individually and with regards to the rules/constraints discussed in class.

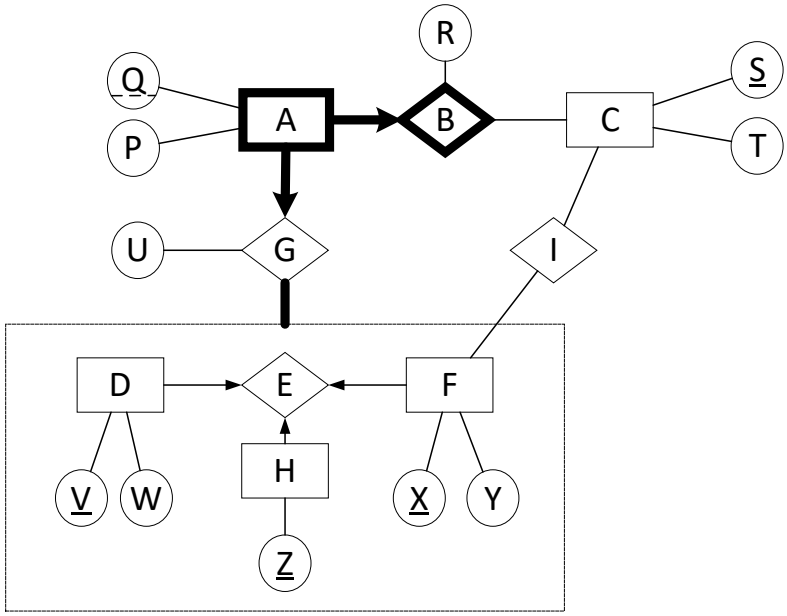
Statement	True	False
X is a candidate key of the relationship set E.		
If there are no entities in entity set D, then there are no relationships in relationship set I.		
If there is one entity in entity set A, there must be at least one entity in entity set D, H, and F.		

Statement	True	False
The number of entities in entity set A must always equal the number of relationships in relationship set G.		
The number of entities in entity set H must always be equal to the number of relationships in relationship set G.		
The number of entities in entity set H must always be equal to the number of relationships in relationship set E.		
The number of entities in entity set C is always greater than or equal to the number of entities in entity set A.		
There are always more entities in entity set A than there are in C.		
Relationship set I cannot be aggregated because the entity set F is already involved in another aggregation.		

[4 marks] Relational Model (True/False)

Consider the same ER diagram, repeated for your convenience, and assume that you have the following:

- a1 and a2 are the only entities of A
- c1 and c2 are the only entities of C
- d1 and d2 are the only entities of D
- f1 and f2 are the only entities of F
- h1 and h2 are the only entities of H



Which of the following relationship sets for B, E, or G are possible according to the diagram, where B={(a1,c1)} means that a relationship between a1 and c1 exists in relationship set B. To extend this to the aggregation G, G{{a1,E{d1, f1, h1}} means that a relationship between a1 and the relationship E(d1, f1, h1}} exists in the relationship set G.

Assume that any relationships not explicitly listed in the question are correct according to the diagram. Write true or false in the blank provided. Ambiguous or unreadable answers will be counted as incorrect.

Question	True	False
E = {{d1, f1, h1}, G{a1, E{d1, f1, h1}}, G(a2, E{d1, f1, h1}}		
B = {{a1, c1}, {a1,c2}}		
B = {{a1,c1},{a2,c1}}		
E = {{d1,f1,h1}, {d1,f1,h2}}		

[22.5 marks] ER to Relational

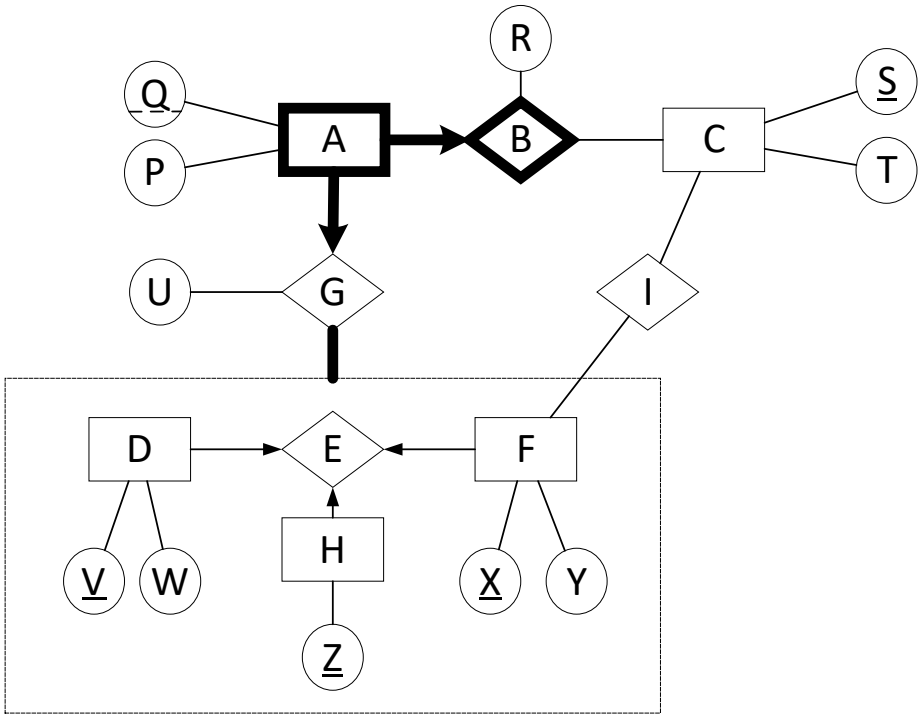
Consider the ER diagram from the first question, repeated on the next page for your convenience. The following questions are about the translation of the ER diagram to the relational model.

To answer the questions, we recommend using the space on the next page to first fully translate the ER diagram to the relational model. As you are going, if you had to make any choices where there are other plausible options, you may find it helpful to keep track of these choices.

If you use a single relation to represent more than one entity or relationship, put the combined relation in FIRST appropriate row in the table, and put 'N/A' in each box for the rows for the remaining entities/relationships. For example, if you create a single relation to represent both "C" and "G", since "C" is first in the table, write your answers for the combined relation in the row for "C", and put "N/A" in each entry in row "G". If a relation does not have any entry for a box, write "N/A".

PLEASE ALPHABETIZE (I.E., PUT IN ALPHABETICAL ORDER) THE ATTRIBUTES IN A GIVEN CELL.

The relation containing...	**All attributes in the relation**	**Primary key attribute(s)**	**Foreign key attribute(s)**	**Attributes that have NOT NULL constraints that must be stated explicitly**	**Attributes that must be declared as unique**
Entity Set A					
Entity Set C					
Entity Set D					
Entity Set F					
Entity Set H					
Relationship Set B					
Relationship Set E					
Relationship Set G					
Relationship Set I					



This space intentionally left blank so you can plan your translation from the ER diagram to the relational model.

[6 marks] Constraints in the Relational Model

Consider your translation from the ER to the relational model in the previous question. List as many answers as are correct in the box. If the answer is "none", then write "none" in the box. If there is more than one possible relational model, consider ***all*** possible relational models.

1. Which of the constraints cannot be represented in the relational model without assertions?

    1. The total participation constraint between A and B
    2. The total participation constraint between A and G
    3. The total participation constraint between E and G
    4. The total participation constraint between E and F
    5. The total participation constraint between E and D
    6. The total participation constraint between E and H
    7. The key constraint between A and B
    8. The key constraint between A and G
    9. The key constraint between E and G
    10. The key constraint between E and F
    11. The key constraint between E and D
    12. The key constraint between E and H

Answer:

[2 marks] Functional Dependencies

You are analyzing your peers' UBC learning experiences with their course choices and studying habits. You decided to create a database that will store students' information (ID, Name and GPA) and their overall feedback (Exp) about each course they took (Dept, Cnum, Sect, Prof, Mark).

You started from a relation R (ID, Name, Dept, Cnum, Sect, Prof, Mark, GPA, Exp) with the following relational instance:

ID	Name	Dept	Cnum	Sect	Prof	Mark	GPA	Exp
1	John Doe	CPSC	301	101	Prof. Smith	90	3.7	Excellent
2	Jane Smith	MATH	302	102	Prof. Smith	85	3.5	Interesting
3	Mike Brown	CPSC	301	102	Prof. Kim	75	3	Good
4	Sarah Lee	MATH	302	101	Prof. Kim	92	3.9	Informative
5	Bob Adams	CPSC	301	103	Prof. Smith	80	3.7	Excellent

What functional dependencies cannot be true given the instance above?
Write the letter(s) corresponding to your choices in the box below.

A. ID → Name, GPA
B. GPA, Prof → Exp
C. Prof → Dept
D. Exp → Dept
E. Cnum → Dept
F. Prof → Name, Dept
G. All can be true

Answer:

[3 marks] Minimal Keys

Consider the relation R (I, N, D, C, S, P, M, G, E) and the following FDs:

I –> N, G
I, N, D, C –> S
D, C, S –> P
P –> D
E –> D
G, P –> E
C, S, E –> P

Find all the minimal keys for R (I, N, D, C, S, P, M, G, E). Write your final answer in the box, but show your work below. Please list the attributes in alphabetical order within a key and the keys in alphabetical order.

Answer:

[12 marks] 3NF Normalization

1. [2 pts] Is the relation R (I, N, D, C, S, P, M, G, E) in 3NF?
   I –>N, G
   I, N, D, C –> S
   D, C, S –> P
   P –> D
   E –> D
   G, P –> E
   C, S, E –> P

   Explicitly state yes or no.
   Provide reasoning (approximately 1 to 4 sentences) to justify your point (based on the definition of the Third normal form).

2. [6 pts] Follow the 3-step process discussed in class to find a minimal cover of the set of FDs. Perform each step in the appropriate box below:

Step 1
Step 2
Step 3

3. [4 pts] Use the **synthesis method** to bring R (I, N, D, C, S, P, M, G, E) into 3NF, while preserving all functional dependencies from the minimal cover (if you did not find one above, please use the given set of FDs). Write the resulting relations.

[4 marks] BCNF Normalization

Consider a Relation S(A, B, C, D, E, F) with the following FDs:

C→B
C→F
AB→C
D→E

Someone has attempted to start decomposing this into BCNF using the lossless join method by decomposing it into two relations, S1(A,B,C), S2(ABDEF). Answer the following questions:

a. [2 marks] Does this follow the lossless join decomposition rules? If so, why? If not, why not?

b. [1 mark] Regardless of whether this is a correct decomposition or not, what are the keys of S2?

c. [1 mark] Regardless of whether this is a correct decomposition or not, is S1 in BCNF? State yes or no.