CS252.HACD — Solutions to Lecture Exercises

CS252.HACD.1: Introduction

Three reasons why the given table cannot represent a relation:

1. Two columns have the same heading. The attribute names of a relation are unique.
2. The second row shows nothing in column B. A tuple must have a value for every attribute.
3. The last row is identical to the first. No tuple appears more than once in the body of a relation.

The question mark in the fifth row looks suspect, but we cannot deduce form the table what are the declared types of the attributes. Certainly the attribute represented by the third column cannot be of type INTEGER, but it might be of some type (CHAR?) such that each of the symbols shown in the third column denotes a value of that type.

CS252.HACD.2: Values, Types, Variables, Operators

Consider the expression "X = 1 OR Y = 2" and insert the appropriate word(s) to complete each of the sentences below.

Choose your fillings from the following:
=, :=, ::=, argument, arguments, body, bodies, BOOLEAN, cardinality, CHAR, CID, degree, denoted, false, heading, headings, INTEGER, list, lists, literal, literals, operator, operators, parameter, parameters, read-only, set, sets, SID, true, type, types, update, variable, variables.

1. In the given expression, = and OR are **operators** whereas X and Y are **variables**.
2. X and 1 are **arguments** to an invocation of **=**.
3. The value **denoted** by the given expression is of **type** BOOLEAN.
4. 1 and 2 are both **literals** of **type** INTEGER.
5. The operators used in the given expression are **read-only** operators.

Now consider the expression "RELATION { X SID, Y CID } { }".

Choosing from the same set of fillings, complete the following:

6. It denotes a relation whose **cardinality** is zero and whose **degree** is two. *Explanation:* the cardinality is the number of tuples in the body and the degree is the number of attributes in the heading.
7. It is a relation **literal**. *(Because it is an expression that denotes a relation and references no variables.)*
8. The declared type of Y is **CID**.
9. In general, the heading of a relation is a possibly empty **set** of attributes and its body is a possibly empty **set** of tuples.
10. It is **true** that the assignment RV **:=** RELATION { X SID, Y CID } { } is legal if the **heading** of RV is { Y CID, X SID }, **false** that it is legal if the **heading** of RV is { A SID, B CID }, **false** that it is legal if the **heading** of RV is { X CID, Y SID }, and **false** that it is legal if the **heading** of RV is { X CHAR, Y CHAR }.

    Explanation:

    { Y CID, X SID } is okay because it is the same heading as { X SID, Y CID }—the order in which the attributes are listed is of no significance.

{ A SID, B CID } is no good because it is not the same heading as { X SID, Y CID }—the attribute names are different.

{ X CID, Y SID } is no good because it is not the same heading as { X SID, Y CID }—the declared type of X is different (and so is the declared type of Y).

{ X CHAR, Y CHAR } is no good because it is not the same heading as { X SID, Y CID }—again, the declared types of the attributes do not match.

CS252.HACD.3: Predicates and Propositions

Assume that the membership predicate for the relation depicted in the following table is "Student *StudentId,* named *Name,* is enrolled on course *CourseId*."

StudentId	Name	CourseId
S1	Anne	C1
S1	Anne	C2
S2	Boris	C1
S3	Cindy	C3
S4	Devinder	C1

For each of the following propositions, state whether it is true or false:

1. There exists a course *CourseId* such that some student named Anne is enrolled on *CourseId*. **True**—C1 is such a course.

2. Every student with StudentId S1 who is enrolled on some course is named Anne. **True**—we might guess that the students named Anne who are enrolled on both C1 and C2 are in fact the same student, but we are not actually told that. Even if for some strange reason they are different people, they are both named Anne and no other enrolment is for somebody with StudentId S1.

3. Every student who is enrolled on course C4 is named Anne. **True**—there does not exist a student who is enrolled on C4 and is not named Anne. Recall that "for all *x*, *P*(*x*)" is logically equivalent to "there does not exist *x* such that NOT (*P*(*x*))".

4. Some student who is enrolled on course C4 is named Anne. **False**—as nobody at all is enrolled on C4 it cannot be possible for anybody named Anne to be enrolled on it.

5. There are exactly 5 students who are enrolled on some course. **False**—there are 4. However, this relies on the assumption that no two students have the same StudentId, in which case those two S1's are indeed the same student; so the answer "can't tell" is perhaps even more acceptable.

6. It is not the case that there is no course on which no student who is enrolled on some course but is not named Boris is not enrolled. **False**—Cindy is not enrolled on C1; Cindy and Devinder are not enrolled on C2; Anne and Devinder are not enrolled on C3. If course C4 exists, then nobody is enrolled on it, so Anne, Cindy and Devinder are each not enrolled on it. So for each course there is at least one student who is not enrolled on it but is enrolled on some course and is not named Boris. So it *is* the case there is no course having no such student.

7. There are 10 pairs of StudentIds (*SID1, SID2*) such that there is some course on which student *SID1* is enrolled and student *SID2* is enrolled. **True**—the pairs in question are

(Anne, Boris), (Anne, Devinder), (Boris, Devinder), (Devinder, Boris), (Devinder, Anne), (Boris, Anne), (Anne, Anne), (Boris, Boris), (Devinder, Devinder), and (Cindy, Cindy).

8. There are 3 pairs of StudentIds (*SID1, SID2*) such that there is some course on which student *SID1* is enrolled and student *SID2* is also enrolled. **False**—we have already shown that there are 10.

9. If a student named Eve is enrolled on course C1, then student S1 is named Adam. **True**—because "a student named Eve is enrolled on course C1" is false. Recall that a proposition of the form "If *p,* then *q*" is defined to be **False** only when *p* is **True** and *q* is **False**. So, whenever *p* is **False**, "If *p,* then *q*" is **True**.

10. If student S1 is named Anne, then S1 is enrolled on course C2. **True**—because "S1 is named Anne" and "S1 is enrolled on course C1" are both true.

End of solutions