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UNIVERSITY OF VICTORIA
Faculty of Engineering
Department of Computer Science

CSC 370 (Database Systems)
Instructor: Daniel M. German

Midterm
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Duration: 75 minutes

This is a closed-book exam.

This examination paper consists of **6** pages and **2** sections. Please bring any discrepancy to the attention of an invigilator. The number in parenthesis at the start of each question is the number of points the question is worth.

Answer all questions.

Please write your answers clearly.

For instructor's use:

	Score
1 (44)	
2 (4)	
Total (48)	

For this exam, consider the following schema and instances of the relations. Feel free to remove this page from the exam.

Our database is very simple. It is composed of three relations: *Parts*, *Suppliers* and *Catalog*. The *Catalog* table contains the parts that are being offered by a given supplier at a given price (a part is missing a price if this field is NULL). Every *pid* in *Catalog* exists in *Parts*, and every *sid* in *Catalog* exists in *Suppliers*.

```
Parts(pid: integer, pname character(40), color character(20));
```

Primary key: *pid*.

pid	*pname*	*color*
6	Anti-Gravity Turbine Generator	Cyan
7	Anti-Gravity Turbine Generator	Magenta
8	Fire Hydrant Cap	Red
9	7 Segment Display	Green
10	SQL queries	Green

```
Suppliers(sid: character(10), sname: character(40), address: char(50));
```

Primary key: *sid*.

sid	*sname*	*address*
amazon	Amazon Canada	1 Grub St., Potemkin Village, IL 61801
walmart	Walmart Inc	4 My Way, Bermuda Shorts, OR 90305
rim	Research in Motion	99999 Short Pier, Terra Del Fuego, TX 41299
google	Google Inc.	2 Groom Lake, Rachel, NV 51902

```
Catalog(sid: character(10), pid: integer, price: real);
```

Primary key: *(sid,pid)*.

sid	*pid*	*cost*
amazon	8	11.7
walmart	8	7.95
rim	8	12.5
rim	9	1
amazon	10	10.5
amazon	9	

1. Writing queries in Relational Algebra and SQL

Give both relational algebra and SQL queries to answer the following questions. **Your relational algebra should match your SQL queries.**

1.1) [4] For every supplier, lists its *sname* and the *pid* of each of the parts they offer. Result should contain two attributes.

1.2) [4] List the *pname* of parts that are being offered at $10 or more. Result should contain only one attribute.

1.3) [4] For every *pid* in relation *Parts*, list the number of suppliers that offer it, and the minimal price at which it is offered. Result should contain three attributes.

1.4) [4] How many parts in table *Parts* are not being offered by any supplier? Result should contain only one attribute.

1.5) [4] List the *pid* and *sid* of parts that offered by such supplier and are missing a *price*. Result should contain two attributes.

1.6) [4] For every supplier, list its *sid* and the average *price* of the parts they offer. Result should contain two attributes.

1.7) [4] List the *pid* and the *pname* of parts that are offered by exactly 3 suppliers. Result should contain two attributes.

1.8) [4] List the *pid* of the parts that are being offered by both suppliers: `Amazon` and `Walmart` (these are their *sid*). Result should contain one attribute.

1.9) [4] Compute the difference between the average price of parts with *pid* `12` and `32`. In other words, compute (the average price of partid `12`) minus (the average price of pid `32`). The result should contain one tuple with one attribute.

1.10) [4] For every *pid* in the relation *Catalog*, list the *sname* of the supplier who offers it a the lowest *price*, and such *price*. Result should contain three attributes.

1.11) [4] List the *pid* of parts that are being offered by at least two suppliers at exactly the same price. Your result should contain two columns: the *pid* of the two parts, and their *price*.

2. Relational Model

2.1) [4] Given the relation $R(A, B, C, D)$ and the set of functional dependencies $A \rightarrow BC$, $BC \rightarrow A$, and $B \rightarrow D$. Find all the candidate keys of this relation. Show all your work.

For this you have to compute the closure of each combination of attributes ABCD, ABC, ABD, ... A, B, C, D (15 in total). The candidate keys are only A and BC.

End of examination
Total pages: 6
Total marks: 48