

NAME: _____

UtorID: _____

CSC343H5S: Databases

Lecture: 9101-9103

Instructor: Michael Liut

Duration: 2 hours

MCS Department

March 31st/April 1st, 2022

Cumulative Test

University of Toronto Mississauga

Read all instructions before starting the test

This test paper includes 10 pages and a total of 5 questions.

Instructions and Policies:

1. The duration of this test is 2-hours, however, you have a 24-hour window (March 31st from 1pm ET to April 1st by 1pm ET) to complete the test in. So you may take breaks in between if needed. *Note: no additional time will be provided to submit, so you must submit your solutions on MarkUs in advance of the submission portal closure time. We recommend you submit regularly while working on each question to proactively prevent system failure.*
2. You must complete the MCS Declaration Form.
3. Read all questions before starting the test, some are easier than others. This test window spans over Thursday and Friday lecture sections which you may attend if you require any clarification about the test.
4. The answers to all questions herein must be submitted to MarkUs as outlined in the “Submission Details” per question. Any permitted handwritten answers must be clear and concise; illegible solutions will not be marked (i.e., a grade of 0 will be assigned).
5. All files submitted must adhere to the “Minimum Standards for Submitted Work” as written in the Course Outline.
6. **This is an open book test.** You may use memory aids, notes, calculators, PostgreSQL, the textbooks, and any on-line documentation during the test.
7. You are **not allowed to be involved in any communication** of any kind. Questions concerning this test must be brought to the attention of the instructional team (either live in lecture or privately posted on Piazza to all “Instructors”). Any attempt of alternative communication will be considered a case of academic dishonesty.
8. The use of websites such as Chegg, StackOverflow, StackExchange, etc., private chat systems such as Messenger, Discord, Slack, Teams, WhatsApp, etc., and/or the use of tutors (or equivalent) are all **strictly prohibited**. Any use of these platforms/support mechanisms will be considered a case of academic dishonesty.

question(s)	mark	out of
1		10
2		10
3		10
4		3
5		7
total		40

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Question 1 [10 marks]

You are given the following relations and their associated data types:

```
Student(sid:integer, sname:vchar, utolid:vchar, degree_year:integer)
Course(cid:integer, cname:vchar, description:vchar)
Taken(sid:integer, cid:integer, gpa:real)
```

Please note: keys for each relation are denoted with an underline. Additionally, the **Taken** relation lists the GPA achieved by the student who took that particular course. GPA is between 0.0 and 4.0.

Create a trigger called **qualifiedTAs** and a function called **qualifiedTAs_func** that will automatically store all students who have taken a course and achieved a GPA of greater than 3.0. These students will be stored in a relation, that you must also create, called **CanTA**(sid:integer, cid:integer). Finally, at the top of your SQL file, be sure to create a new schema (called cumulativetest.utorid, where “utorid” is your UtorID in all lowercase) and change the search path to it.

Submission Details

You must submit one file called **trigger.sql** to the CSC343 MarkUs platform (<https://markus108.utm.utoronto.ca/csc343s22/>) under the assignment called “Test”. **trigger.sql** must be a valid PostgreSQL file (free of syntax errors) that can be executed automatically on the MCS Department’s psql server (aka, *mcsdb.utm.utoronto.ca*, using version 14).

Question 2 [10 marks]

You are given the following relations and their associated data types (keys for each relation are denoted with an underline):

Hospital(hname:varchar, annualbudget:integer, city:varchar, street:varchar)
 Department(dname:varchar, hname:varchar, budget:integer)
 Physician(pid:integer, yearsofpractice:integer, salary:integer,
 specialty:varchar, dname:varchar, hname:varchar)

Below you will find database table instances that you will need to use to help solve your question. The task is to create a separate query (i.e., two queries) that produces the following outputs:

Output 1

specialty	avgsalary
Otolaryngology	190000.000000000000
Radiology	140000.000000000000
Ophthalmology	182500.000000000000
General Surgery	200952.380952380952

(4 rows)

Output 2

specialty	avgsalary
General Surgery	211250.000000000000

(1 row)

Restrictions

1. You must not use any **CREATE** statements. It must be one SQL statement per question.
2. You cannot hard code your solution.
3. For “Output 2” you must use **COUNT** in your solution.

Table Instances**Hospital**

hname	annualbudget	city	street
Hamilton General Hospital	2800000	Hamilton	237 Barton St E
University of Toronto Medical Centre	5000000	Mississauga	3359 Outer Circle Road
Trillium Health Partners	3500000	Mississauga	100 Queensway W
Toronto Western Hospital	6000000	Toronto	399 Bathurst St
Toronto General Hospital	8000000	Toronto	200 Elizabeth St

(5 rows)

Department

dname	hname	budget
Intensive Care Unit	Hamilton General Hospital	200000
Radiology	Hamilton General Hospital	250000
General Surgery	Hamilton General Hospital	330000
Ophthalmology	Hamilton General Hospital	190000
Otolaryngology	Hamilton General Hospital	150000
Intensive Care Unit	University of Toronto Medical Centre	400000
Radiology	University of Toronto Medical Centre	450000
General Surgery	University of Toronto Medical Centre	330000
Ophthalmology	University of Toronto Medical Centre	250000
Otolaryngology	University of Toronto Medical Centre	220000
Intensive Care Unit	Trillium Health Partners	380000
Radiology	Trillium Health Partners	370000
General Surgery	Trillium Health Partners	300000
Ophthalmology	Trillium Health Partners	280000
Otolaryngology	Trillium Health Partners	250000
Intensive Care Unit	Toronto Western Hospital	500000
Radiology	Toronto Western Hospital	550000
General Surgery	Toronto Western Hospital	500000
Ophthalmology	Toronto Western Hospital	450000
Otolaryngology	Toronto Western Hospital	400000
Intensive Care Unit	Toronto General Hospital	700000
Radiology	Toronto General Hospital	800000
General Surgery	Toronto General Hospital	700000
Ophthalmology	Toronto General Hospital	400000
Otolaryngology	Toronto General Hospital	500000
Neonatal ICU	University of Toronto Medical Centre	220000
Oncology and hematology	Toronto General Hospital	290000
Dermatology	Toronto General Hospital	320000

(28 rows)

Physician

pid	yearsofpractice	salary	specialty	dname	hname
99652593	20	280000	General Surgery	Intensive Care Unit	Hamilton General Hospital
99633175	18	260000	General Surgery	General Surgery	Hamilton General Hospital
99663720	8	140000	Ophthalmology	Radiology	Hamilton General Hospital
99661144	7	120000	General Surgery	General Surgery	Hamilton General Hospital
99652816	15	230000	Ophthalmology	Ophthalmology	Hamilton General Hospital
99620705	21	300000	General Surgery	Otolaryngology	Hamilton General Hospital
99653992	19	270000	General Surgery	Intensive Care Unit	University of Toronto Medical Centre
99647491	5	130000	General Surgery	General Surgery	University of Toronto Medical Centre
99610181	8	160000	General Surgery	Radiology	University of Toronto Medical Centre
99627835	10	180000	General Surgery	General Surgery	University of Toronto Medical Centre
99612965	10	170000	Ophthalmology	Ophthalmology	University of Toronto Medical Centre
99654063	5	120000	General Surgery	Otolaryngology	University of Toronto Medical Centre
99644768	14	210000	General Surgery	Intensive Care Unit	Trillium Health Partners
99657102	10	175000	General Surgery	General Surgery	Trillium Health Partners
99655103	22	320000	Otolaryngology	Radiology	Trillium Health Partners
99632485	18	230000	General Surgery	General Surgery	Trillium Health Partners
99634773	16	210000	General Surgery	Ophthalmology	Trillium Health Partners
99615651	3	110000	Otolaryngology	Otolaryngology	Trillium Health Partners
99639675	9	170000	General Surgery	Intensive Care Unit	Toronto Western Hospital
99623984	7	160000	General Surgery	General Surgery	Toronto Western Hospital
99653805	4	140000	Radiology	Radiology	Toronto Western Hospital
99635031	17	230000	General Surgery	General Surgery	Toronto Western Hospital
99611308	12	190000	Ophthalmology	Ophthalmology	Toronto Western Hospital
99640489	13	200000	Otolaryngology	Otolaryngology	Toronto Western Hospital
99635488	15	220000	General Surgery	Intensive Care Unit	Toronto General Hospital
99659765	6	150000	General Surgery	General Surgery	Toronto General Hospital
99622868	19	270000	General Surgery	Radiology	Toronto General Hospital
99643450	18	265000	General Surgery	General Surgery	Toronto General Hospital
99656383	2	110000	General Surgery	Ophthalmology	Toronto General Hospital
99645180	3	130000	Otolaryngology	Otolaryngology	Toronto General Hospital

(30 rows)

Submission Details

You must submit two files, one for each of the outputs. For Output 1, you will submit a file called `1.sql`. For Output 2, you will submit a file called `2.sql`. Both submissions are to be made on the CSC343 MarkUs platform (<https://markus108.utm.utoronto.ca/csc343s22/>) under the assignment called “Test”. `1.sql` and `2.sql` must be a valid PostgreSQL file (free of syntax errors) that can be executed automatically on the MCS Department’s psql server (aka, *mcsdb.utm.utoronto.ca*, using version 14).

Question 3 [10 marks]

Given the following integer elements (i.e., key values): 2, 3, 5, 7, 11, 17, 19, 23, 29, and 31, you are required to do the following:

1. create a $B+$ tree¹ with the set of elements above, using nodes that only have 4 pointers.
2. re-create the same $B+$ tree as in 1., but instead of 4 pointers per node, create it with 8.
3. take your answer in 1. and perform the following operations:
 - (a) insert 9
 - (b) insert 10
 - (c) insert 8
 - (d) delete 23
 - (e) delete 19
 - (f) delete 29 and 31

You must show all of your work! This means that you will have one $B+$ tree for 1., a second $B+$ tree for 2., and then six (6) more $B+$ trees for 3.. This totals eight (8) that you are required to draw and submit.

Submission Details

You must submit one PDF file called `index.pdf` on the CSC343 MarkUs platform (<https://markus108.utm.utoronto.ca/csc343s22/>) under the assignment called “Test”. `index.pdf` may be hand drawn and must be legible, clear, and concise.

¹Assumption: the tree is initially empty. Note: values are added in ascending order.

Question 4 [3 marks]

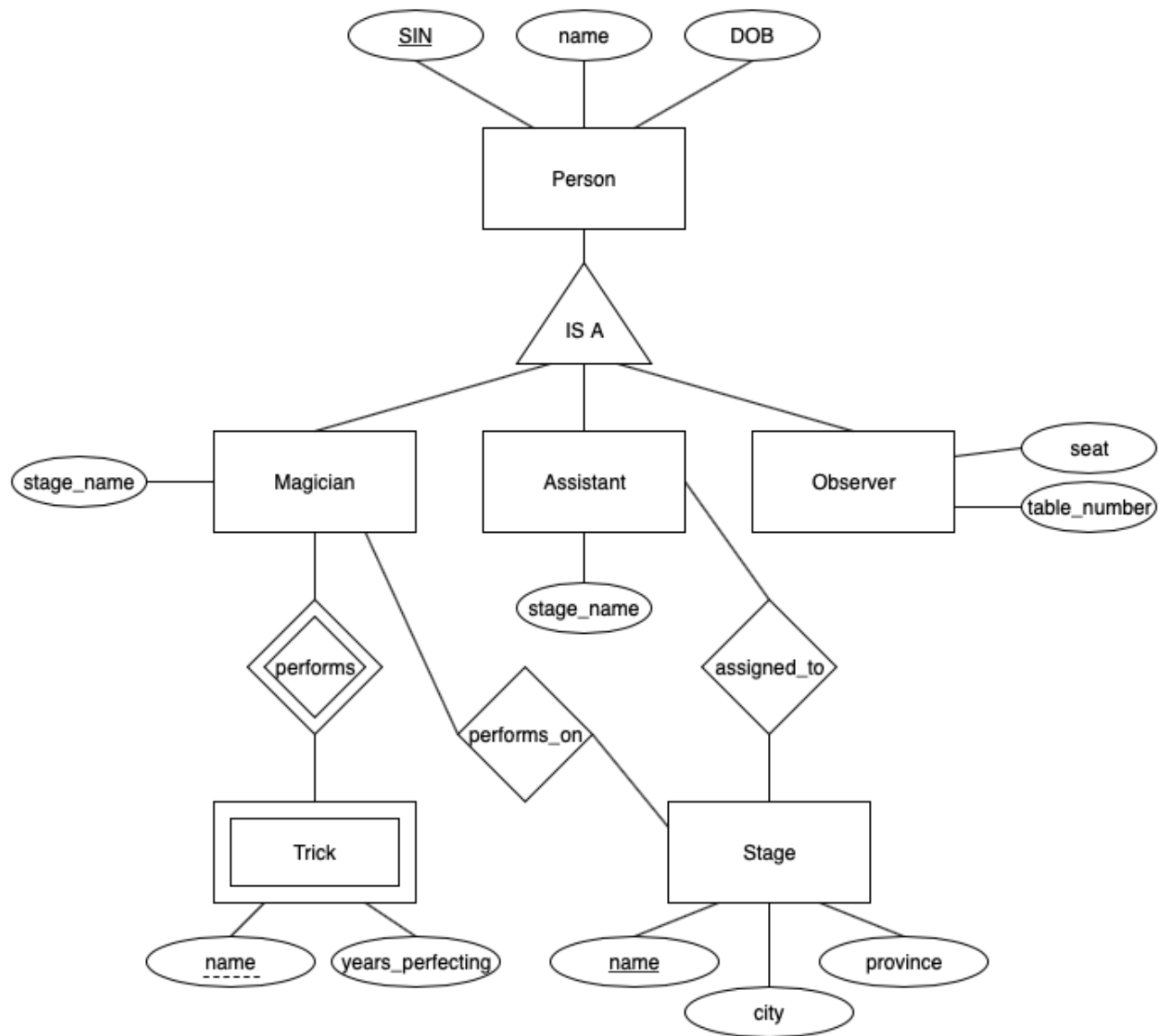
Consider a relation schema R with a set of attributes $\alpha = \{A, B, C, D, E\}$ and the set of functional dependencies $\mathcal{F} = \{A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A\}$. List all of the candidate keys for R and show your work as to how you derived it.

Submission Details

You must submit one PDF file called **design.pdf** on the CSC343 MarkUs platform (<https://markus108.utm.utoronto.ca/csc343s22/>) under the assignment called “Test”. **design.pdf** may be hand drawn and must be legible, clear, and concise.

Question 5 [7 marks]

Without knowing the specifics of the multiplicity, you are given a rough draft of an Entity-Relationship Diagram (ERD)² from a member of your design team:



²a reference sheet has been provided for notational consistency, see the end of this test paper. Note: you **must** adhere to the notation on the reference sheet when solving the problem.

Given the ERD on the previous page, you are to directly³ correct⁴ the ERD to reflect the following:

1. Every magician must perform exactly 2 tricks or no tricks at all.
2. Each observer can only visit a stage once. Observers may visit many different stages. Each visit will have an associated **entry_time:datetime**, signifying the date and time which the observer will be permitted to visit that stage. There can be several (or no) observers visiting any stage. Observers' attributes have no bearing on the visit.
3. Every assistant must be assigned to exactly one stage. Additionally, every stage may be assigned multiple assistants and not every stage must have an assistant assigned.

NOTE: you may not make any additional assumptions (i.e., you must take all avenues in to consideration) and if there is no valid way to demonstrate this in an ERD, then you must explain why and how you would validate this from a DDL/DML perspective.

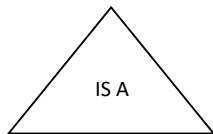
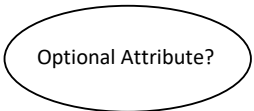
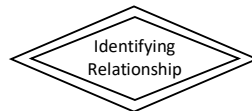
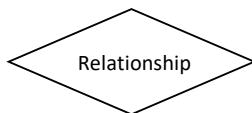
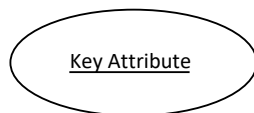
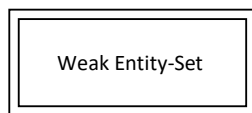
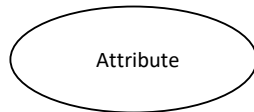
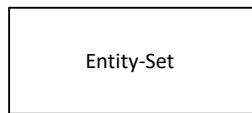
Submission Details

You must submit one PDF file called **erd.pdf** on the CSC343 MarkUs platform (<https://markus108.utm.utoronto.ca/csc343s22/>) under the assignment called "Test". **erd.pdf** may be hand drawn and must be legible, clear, and concise.

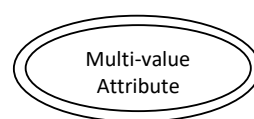
³you should write your answers directly on the ERD that was given, rather than drawing a new ERD. You are, however, welcome to draw a new one if you'd prefer.

⁴you must utilize Chen's Notation. A reference sheet has been provided towards the end of this exam.

REFERENCE SHEET



Hierarchical Construct



Participations
Cardinality can be shown or hidden

Mandatory

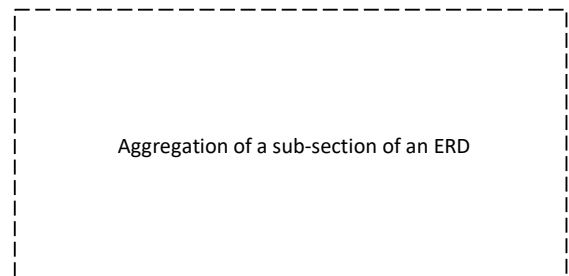
_____ 1 (0:1)
1 _____ 1 (1:1)
_____ M (0:M)
1 _____ M (1:M)

Recursive Relationship
Cardinality can be shown or hidden

===== 1 (0:1)
===== 1 (1:1)
===== M (0:M)
===== M (1:M)

Optional

----- 1 (0:1)
1 ----- 1 (1:1)
----- M (0:M)
1 ----- M (1:M)



REFERENCE SHEET