UNI: am5323 **Name**: Amogh Mishra **Date**: 03/03/2020

1.

i) Get all the student's name and age whose year is more than 2
ii) Get course size whose id is 3
iii) Get student's name whose GPA is greater than 3 and major department is "Art History"
iv) Get all classroom id and size where "Art History" course is taught.
v) Get all student's name who is registered in class size greater than 100
vi) Get course id of courses which not conducted in classes situated in Mudd building

2.

i)

PName	Price	DiscountPrice	Category	Manufacturer
Gizmo	$19.99	$16.99	Gadgets	GWorks
PowerGizmo	$29.99	$25.99	Gadgets	GWorks

ii)

ProdName	Store
Gizmo	Wiz
PowerGizmo	Ritz
Camera	Wiz

iii)

PName	Price	DiscountPrice	Category	Manufacturer
Gizmo	$19.99	$16.99	Gadgets	GWorks
PowerGizmo	$29.99	$25.99	Gadgets	GWorks
SingleTouch	$149.99	$144.99	Photography	Canon
MultiTouch	$203.99	$199.99	Household	Hitachi

iv) f0
$-7

v)

PName	Price	DiscountPrice	Category	Manufacturer	ProdName	Store
Gizmo	$19.99	$16.99	Gadgets	GWorks	Gizmo	Wiz
PowerGizmo	$29.99	$25.99	Gadgets	GWorks	PowerGizmo	Ritz

vi)

ProdName	Store	PName	Price	DiscountPrice	Category	Manufacturer
Gizmo	Wiz	Gizmo	$19.99	$16.99	Gadgets	GWorks
PowerGizmo	Ritz	PowerGizmo	$29.99	$25.99	Gadgets	GWorks

vii)

ProdName	Store	PName	Price	DiscountPrice	Category	Manufacturer
Gizmo	Wiz	Gizmo	$19.99	$16.99	Gadgets	GWorks
PowerGizmo	Ritz	PowerGizmo	$29.99	$25.99	Gadgets	GWorks
Camera	Wiz	NULL	NULL	NULL	NULL	NULL

3.
i) AUB = {2,1,3,4}
ii) BUA = {3,1,2,4}
iii) DUC = {1,x,y,2,1,3,1 }

4.

i)

x.pid	x.PName	x.Price	x.DiscountPrice	x.Category	x.Manufacturer	y.pid	y.PName	y.Price	y.DiscountPrice	y.Category	y.Manufacturer
18	Gizmo	$19.99	$16.99	Gadgets	GWorks	18	Gizmo	$19.99	$16.99	Gadgets	GWorks
70	PowerGizmo	$29.99	$25.99	Gadgets	GWorks	70	PowerGizmo	$29.99	$25.99	Gadgets	GWorks
32	SingleTouch	$149.99	$144.99	Photography	Canon	32	SingleTouch	$149.99	$144.99	Photography	Canon
67	MultiTouch	$203.99	$199.99	Household	Hitachi	67	MultiTouch	$203.99	$199.99	Household	Hitachi

ii)

x.pid	x.PName	x.Price	x.DiscountPrice	x.Category	x.Manufacturer	y.pid	y.PName	y.Price	y.DiscountPrice	y.Category	y.Manufacturer
18	Gizmo	$19.99	$16.99	Gadgets	GWorks	18	Gizmo	$19.99	$16.99	Gadgets	GWorks
70	PowerGizmo	$29.99	$25.99	Gadgets	GWorks	70	PowerGizmo	$29.99	$25.99	Gadgets	GWorks

32	SingleTouch	$149.99	$144.99	Photography	Canon	32	SingleTouch	$149.99	$144.99	Photography	Canon
67	MultiTouch	$203.99	$199.99	Household	Hitachi	67	MultiTouch	$203.99	$199.99	Household	Hitachi

iii)

x.pid	x.PName	x.Price	x.DiscountPrice	x.Category	x.Manufacturer	y.pid	y.PName	y.Price	y.DiscountPrice	y.Category	y.Manufacturer
18	Gizmo	$19.99	$16.99	Gadgets	GWorks	18	Gizmo	$19.99	$16.99	Gadgets	GWorks
70	PowerGizmo	$29.99	$25.99	Gadgets	GWorks	70	PowerGizmo	$29.99	$25.99	Gadgets	GWorks
32	SingleTouch	$149.99	$144.99	Photography	Canon	32	SingleTouch	$149.99	$144.99	Photography	Canon
67	MultiTouch	$203.99	$199.99	Household	Hitachi	67	MultiTouch	$203.99	$199.99	Household	Hitachi

iv)

x.pid	x.PName	x.Price	x.DiscountPrice	x.Category	x.Manufacturer	y.pid	y.PName	y.Price	y.DiscountPrice	y.Category	y.Manufacturer
18	Gizmo	$19.99	$16.99	Gadgets	GWorks	NULL	NULL	NULL	NULL	NULL	NULL
70	PowerGizmo	$29.99	$25.99	Gadgets	GWorks	NULL	NULL	NULL	NULL	NULL	NULL

v)

x.pid	x.PName	x.Price	x.DiscountPrice	x.Category	x.Manufacturer	y.pid	y.PName	y.Price	y.DiscountPrice	y.Category	y.Manufacturer
NULL	NULL	NULL	NULL	NULL	NULL	18	Gizmo	$19.99	$16.99	Gadgets	GWorks
NULL	NULL	NULL	NULL	NULL	NULL	70	PowerGizmo	$29.99	$25.99	Gadgets	GWorks

vi)

x.pid	x.PName	x.Price	x.DiscountPrice	x.Category	x.Manufacturer	y.pid	y.PName	y.Price	y.DiscountPrice	y.Category	y.Manufacturer

18	Gizmo	$19.99	$16.99	Gadgets	GWorks	NULL	NULL	NULL	NULL	NULL	NULL
70	PowerGizmo	$29.99	$25.99	Gadgets	GWorks	NULL	NULL	NULL	NULL	NULL	NULL
NULL	NULL	NULL	NULL	NULL	NULL	32	SingleTouch	$149.99	$144.99	Photography	Canon
NULL	NULL	NULL	NULL	NULL	NULL	67	MultiTouch	$203.99	$199.99	Household	Hitachi

5
i) RUS -> [n, n+m]
ii) R∩S -> [0,m]
iii) R inner join S -> [0, nm]
iv) S full outer join S -> [m, m^2]
v) R-S -> [0,n] if n=m and [n-m,n] when n>m
vi) S-R -> [0,m]

6
i) Durability: Although the file system declared the write operation was completed, it was not backed up after hardware recovery
ii) Atomic: Either 0 byte should have been written or 16. No partial data is considered in atomicity.
iii) Consistency: Integrity constraint of balance not less than $100 is not followed.
iv) Isolation: Two users are not able to use the variable as if they were using it alone.
v) Consistency: Integrity constraints aren't followed to keep the credits total sum not more than $1000
vi) Atomic: Either one file should exist or none which is not the case. Partial success is not accepted in atomicity.
vii) Durability: Matrix wasn't restored by the filesystem.
viii) Isolation: Two users aren't able to edit and see the result as they would see if they were editing it alone.

7.
i) Throughput for A: 4/3 jobs/sec and throughput for B: 8/7 jobs/sec
ii) Throughput of A / Through of B = 1.33/1.14 = 1.16. Therefore A has better performance than B by 1.16 times.
iii) New throughput of B/ Old throughput of B = (40/25) / (40/35) = 1.4. New B is 1.4 times better in performance to old B.
iv) Average Latency = 30/40 = 0.75 (Answer B)

8. By Amdhal's Law: Speedup = 1/[(1 − p) + (p/s)]
i) s = 1.1 and p = 0.5. Therefore Speed up = 1/[(1 − 0.5) + (0.5/1.1)] = 1.047
ii) s = 10, p = 0.05. Therefore Speedup = 1/[(1 − 0.05) + (0.05/10)] = 1.047
iii) s = 10, p = 0.15. Therefore Speedup = 1/[(1 − 0.15) + (0.15/10)] = 1.15
iv) The maximum speed up possible is from the 3rd scenario where the speedup is 1.15

9. Average Latency = (% of CPU cache hits * CPU cache latency) + (% of memory hits * memory latency) + (% of flash hits * flash latency)

i) $0.8 * 5 + 0.2 * 25 = 9$ns
ii) $0.95 * 5 + 0.05 * 1000000 = 50004.75$ns
iii) $0.85 * 25 + 0.15 * 1000000 = 150021.25$ns

10.
i) T_{rot} = (60/10000) seconds = 6 ms
ii) T_{transfer} = 0.0039/100 = 0.039 ms
iii) Access Time = seek time + Transfer time + rotation time = 4 + 6/2 + 0.039 = 7.039 ms. Rate of I/O in MB/s = 0.0039*1000/7.039 MB/s = 0.55 Mb/s
iv) Access time for the first 4KB page = 7.039 ms. Following this read, seek time and rotational latency = 0 as reads are sequential. Therefore, access time = transfer time = 0.039 ms. Hence, total time to transfer 125 MB = 7.039 ms + ((125 * 1024) / 4) * 0.039) = 1255.038 ms. Therefore, Rate of I/O is 125 * 1000 / 1255.038 = 99.60 MB/s3

11. PUE = Total Facility Power Server / Network Power

i) PUE = 6000/(10*10+16*200) = 1.81
ii) PUE = 6000/(4*10+19*200) = 1.56
iii) PUE = 6000/(21*200) = 1.42857142857

12.
i)

Name	Title	Salary
A	Professor	99

ii)

Name	Title	Salary
A	Professor	99
E	Student	35
F	Student	35

iii)

Name	Title	Salary
A	Professor	99
E	Student	35
F	Student	35

13.
i) R-W: a,c W-R: c W-W: c,d No-conflict: b
ii)

a) T1 is granted a shared lock(S) for R(A) which would be used by T2 R(A) operation. However, any shared lock cannot be converted to exclusive lock and therefore, T2 would not be able to get an exclusive lock (X) for W(A) until T1 releases a shared lock.
b) No conflicts
c) T1 acquires a shared lock and afterwards, T1 acquires an exclusive lock for W(A). Since this transaction is not committed, Strict 2PL disallows T2 to acquire the lock for R(A) and W(A)
d) Strict 2PL restricts T2 for W(A) as T1 has acquired the exclusive lock for W(A) and W(C) and hasn't released them.

iii) Because R-R doesn't alter the data and therefore respects the ACID property of the database.

14.

(14) Q. T1: | R(X) | W(X) | R(Y) | W(Y) |

T2: | R(X) | W(X) | R(Y) | W(Y) |

A (i) T1: | R(X) | W(X) | - - - - - - | R(Y) | W(Y) |

T2: | R(X) | W(X) | R(Y) | W(Y) |

(b) T1 acquires shared lock for R(X) and then exclusive lock for W(X) [NOTE:→ shared lock isn't converted to exclusive. It's released]. Strict 2PL therefore disallows T2 to acquire (S) shared lock for R(X).

(c) Deadlock is resolved by letting T1 complete first and then scheduling T2. In a sequential process. This process is through conservative 2PL.

15. The splitting method performance is case dependent. It neither completes fails nor it is successful in all scenarios. If the transactions X and Y were long, splitting them into smaller chunks can greatly reduce the frequency of deadlocks and the wait time for S would be reduced. For example: If T was a long transaction accessing W(X) and W(Y) then S would wait a long time for the lock for W(Y). If the splitting method is used then S can concurrently work on W(Y) while T works on W(X). However, if S was also performing W(X) then there will be no improvement. Therefore, the performance depends on a case by case basis.

16. Protocol:

i) Shared lock on the reading operation

ii) If following a strong consistency then the exclusive lock is given for the write lock and no other read operation is allowed across the other geographical location

iii) If following a weak consistency then the exclusive lock is only given to the nearest database and is replicated later. At that moment, read operation is allowed on other geographically located databases

iv) If following a single write and multiple read region then the protocol will be read is a shared lock but write will only happen in one database.

v) If multiple read-write region protocol is followed then the write operation will be successful/ lock will be released only when it is replicated across other databases.