CS 436
Database Systems
Mid-Semester Exam – 2

Fall 2020

Duration: …

Instructions:

1. **You are required to answer ALL questions**.
2. Please use the white space provided below each question to answer the question. If additional space is needed, you can use the backside of the sheet.
3. **IMPORTANT:** Enter your information below and make sure that you enter the same information on top of each page:

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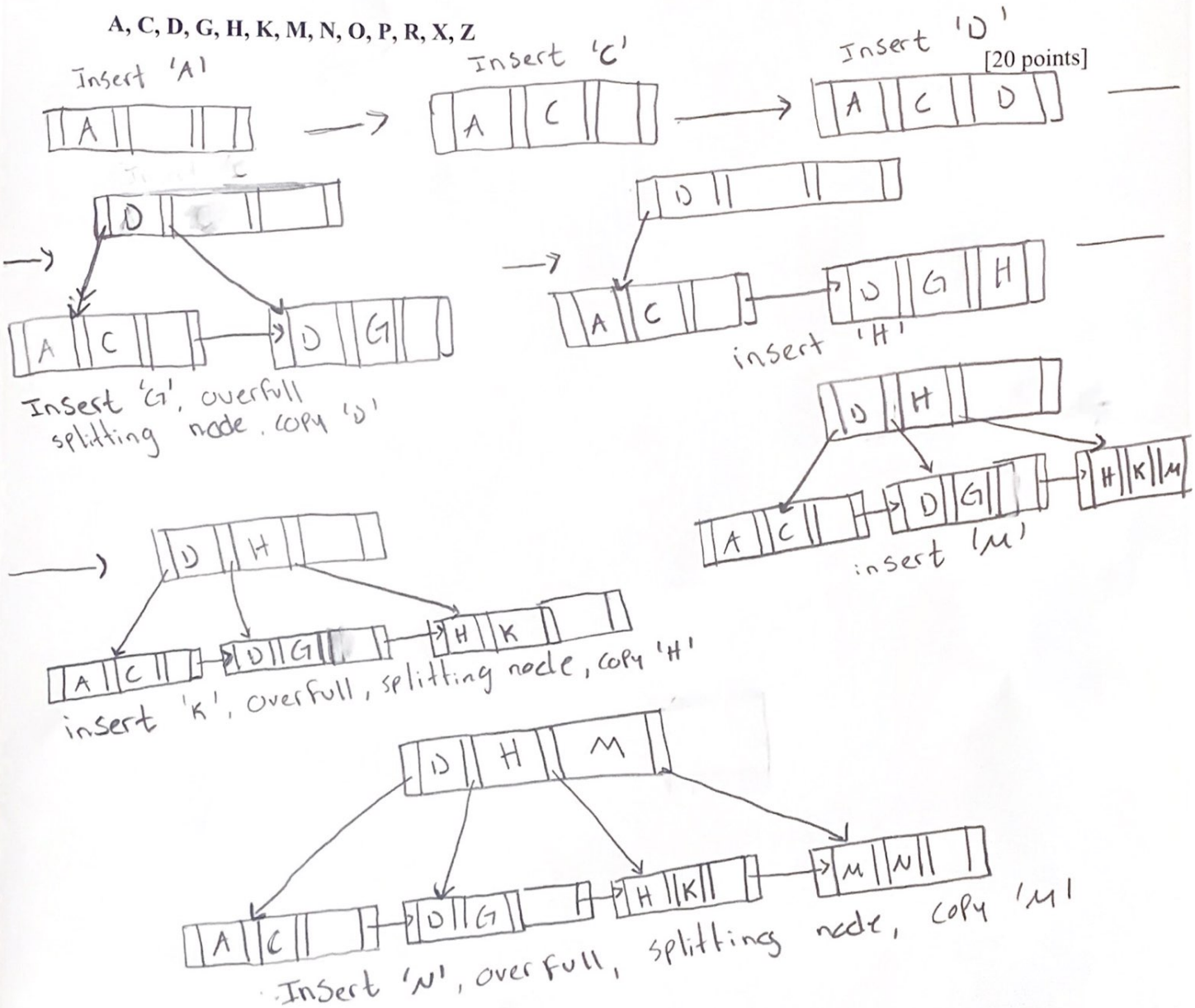
Student Name:	Student ID:

Q1.

Build a B^+-Tree index with n = 4 for the following values of the attribute First_Initial.
Start your insertion from left to right.
Show your steps and **write a short description for each step,** e.g. inserting value A, overfull, Splitting the node of X, Copying the value X to node of Z, Deleting the node of X, Merging node of X and node of Y, etc.

A, C, D, G, H, K, M, N, O, P, R, X, Z

[20 points]



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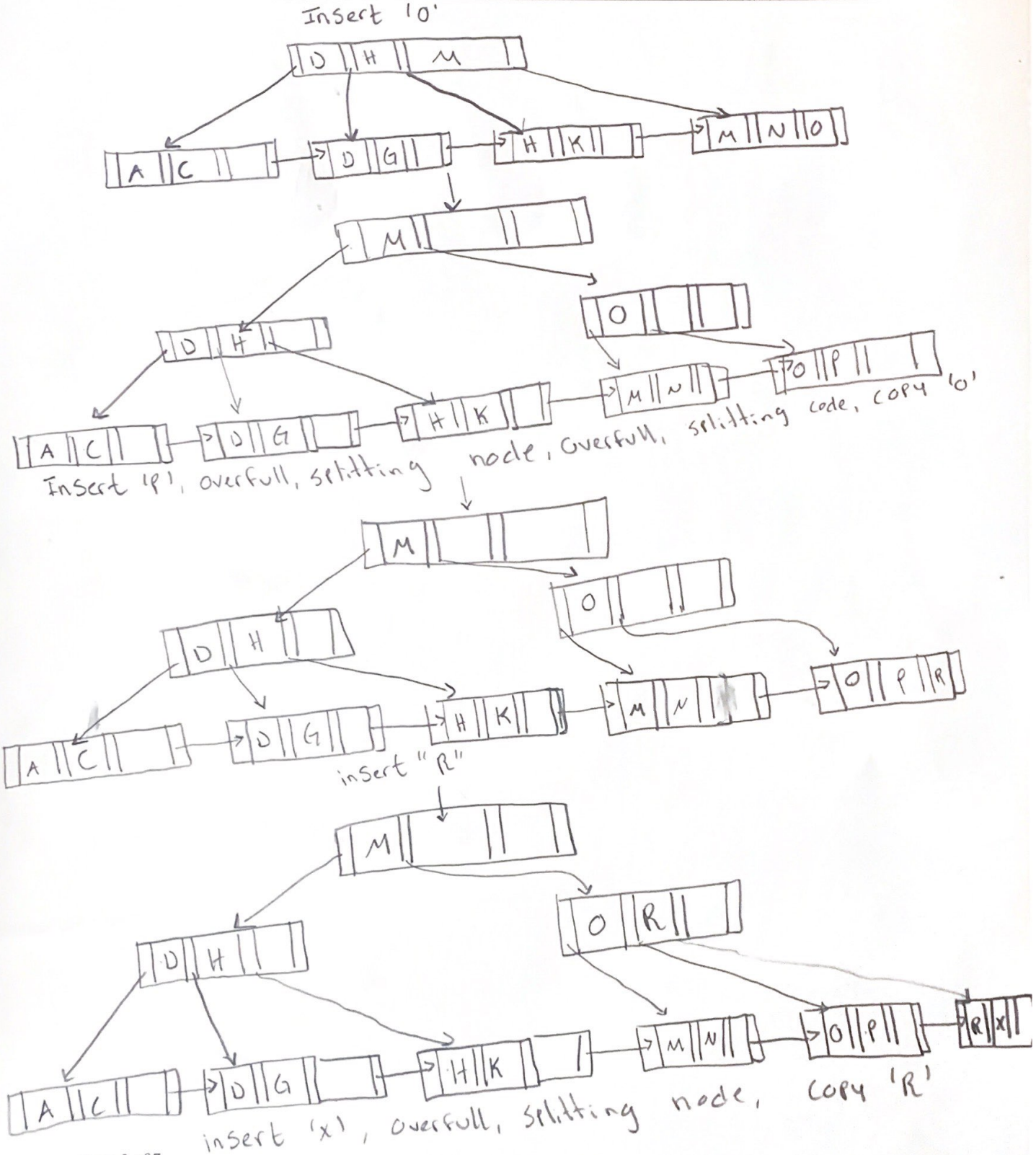

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Q2. Answer the following:

[20 points]

a) Outer join can be expressed using basic operations. For example, r ⟗ s can be expressed as (r ⋈ s) U (r – ∏R(r ⋈ s) X {(null, …, null)}).

Express r ⟗ s using the basic operations.

[5 points]

```
Select *
From r
Full outer Join s;
```

r ⟗ s = (r ⋈ s) ∪ (r ⟗ s)

b) In the instance of the relation R(W, X, Y, Z, V) shown below, **write an SQL query** to check if the attribute **X** defines attribute **Y** based on the Functional Dependency concept.
In other words, write SQL query to check if **X** → **Y** holds on R.

[10 points]

```
SELECT X,Y
From R
Group By X
Having Count (Distinct Y) > 1;
```

W	X	Y	Z	V
1	2	3	4	5
1	4	3	4	5
1	2	4	4	1

c) Consider relation R(A,B,C,D,E) with FDs

A→ B, AB→CD, D→ABCE. Which of the following are **Candidate** keys of the relation R?
Choose one.

[5 points]

I) A
II) ~~A~~B
III) ~~C~~D

not candidate keys

AB/BD super keys

a) I only.
b) II only.
c) III only.
d) I and II only.
e) I, II, and III.
f) None

A⁺ = {A, B, C, D, E}

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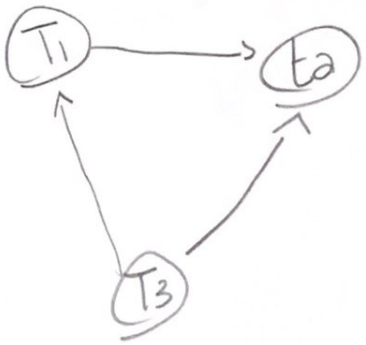
Q3.

[20 points]

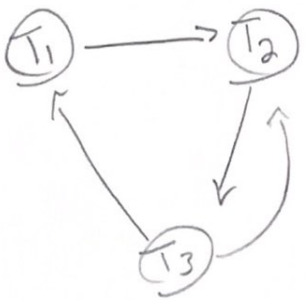
(a) For the following schedules: (i) Draw the precedence graph, (ii) find the equivalent serial schedule(s), if the schedule is conflict serializable, and if it is not conflict serializable, justify your answer, [10 points]

S1: R1(X), R2(Z), R1(Z), R3(X), R3(Y), W1(X), W3(Y), R2(Y), W2(Z), W2(Y)



not cyclic,
so it is conflict serializable
Serial schedule : $T_3 \rightarrow T_1 \rightarrow T_2$

S2: R1(X), R2(Z), R3(X), R1(Z), R2(Y), R3(Y), W1(X), W2(Z), W3(Y), W2(Y)



It is cyclic so it is not conflict serializable

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(b) Convert the following schedule to:

(i) A Recoverable Schedule BUT not a Cascadeless Schedule

(ii) A Cascadeless Schedule

[10 points]

Time	T1	T2	T3
1	Read(Y)		
2	Write(Y)		
3		Read(X)	
4		Write(X)	
5			Read(X)
6			Read(Y)
7			Commit
8	Read(X)		
9	Commit		
10		Read(Z)	
11		Write(Z)	
12		Commit	

(i)

Time	T1	T2	T3
1	Read(Y)		
2			Read(Y)
3	write(Y)		
4		Read(X)	
5	Read(X)		
6	Commit		
7			Read(X)
8			Commit
9		write(X)	
10		Read(Z)	
11		write(Z)	
12		Commit	

(ii)

Time	T1	T2	T3
1	Read(Y)		
2	write(Y)		
3		Read(X)	
4		write(X)	
5		Read(Z)	
6		write(Z)	
7		Commit	
8	Read(X)		
9	Commit		
10			Read(X)
11			Read(Y)
12			Commit

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Q4 [10 points]

Decompose the following relation R into BCNF relations. Show your steps.

R (A,B,C,D,E),

F = {AB → E, D → C}

R(A,B,C,D,E) AB → E, D → C

Key: $[ABD]^+$ = ABD
= ABDE
= ABDEC

only one Key ABD

Prime attribute {A, B, D} non prime {C, E}

check 2NF: AB → E & D → C are in 2NF decompose into 2NF

R

R_1(ABE) R_2(DC) ✓ 2NF

AB → E D → C

Key AB Key: D

This decomposition is in 3NF and BCNF also become for X → P, X is Key

For instructor use only:

Question	Points
Q1	/ 20
Q2	/ 20
Q3	/ 20
Q4	/10
Total:	/ **70**