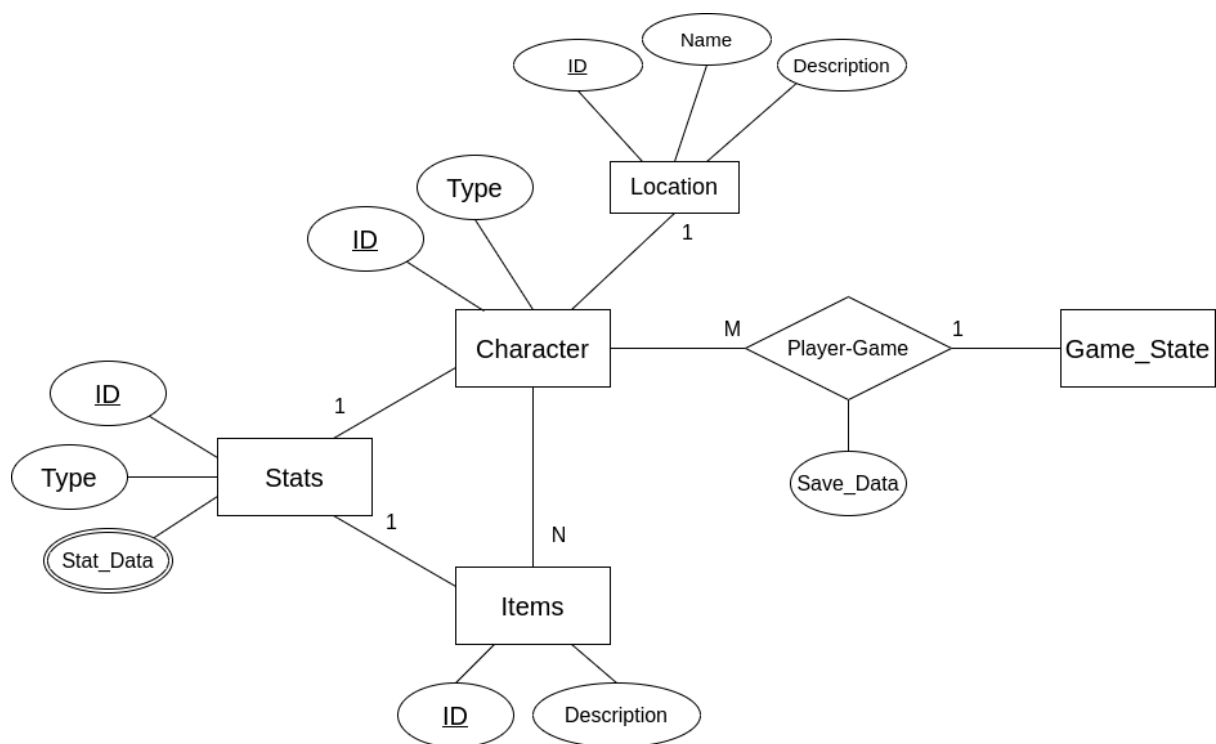


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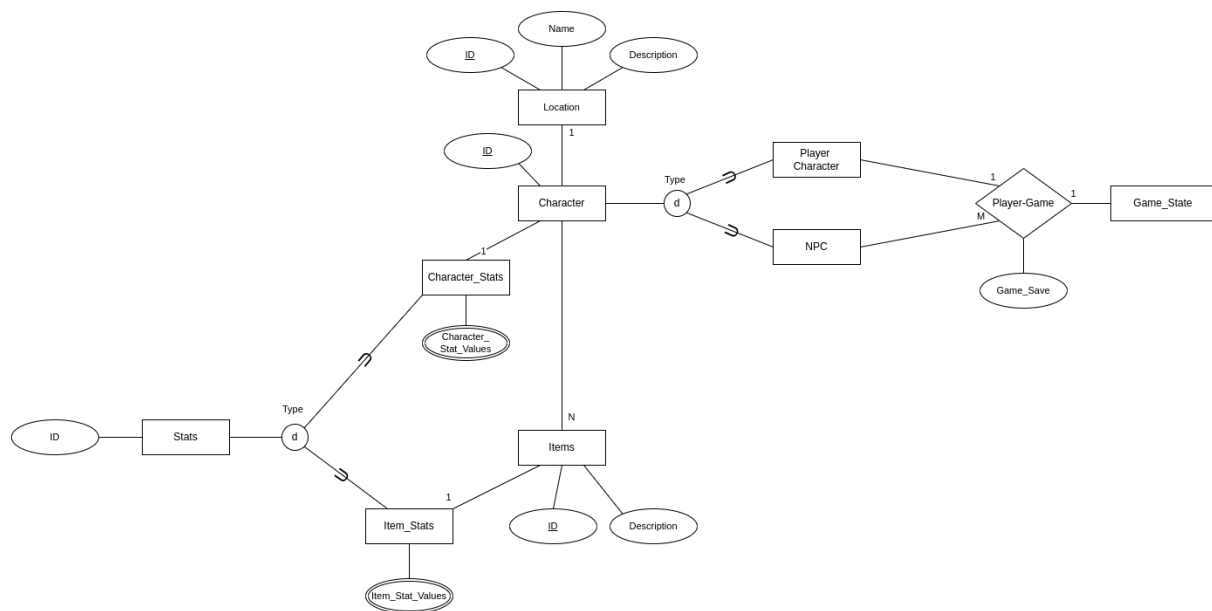
# Assignment 3

## Question 1

A.



B.



## Question 2

Identify functional dependencies

- $\text{student\_id} \rightarrow \text{first\_name}, \text{last\_name}, \text{date\_of\_birth}$
- $\text{unit\_code} \rightarrow \text{unit\_name}$
- $\text{degree} \rightarrow \text{school}, \text{degree\_length}$

Define Keys

- $\text{student\_id}$
- $\text{unit\_code}$
- $\text{degree}$
- $\text{student\_id}, \text{unit\_code}, \text{degree}$  (composite key)

# Normalise the schema

## Student Table

- student\_id (Primary Key)
- first\_name
- last\_name
- date\_of\_birth

## Unit Table

- unit\_code (Primary Key)
- unit\_name

## Degree Table

- degree (Primary Key)
- school
- degree\_length

## Enrollment Table

- student\_id (Foreign Key)
- unit\_code (Foreign Key)
- degree (Foreign Key)

Every table fully depends on its primary key, ensuring compliance with third normal form (3NF). The Enrollment table represents the relationship between students and the units they are enrolled in, as well as the degrees these units count towards. Using a composite key prevents students from enrolling in the same unit for the same degree multiple times, thus reducing redundancy and maintaining 3NF compliance.

## Question 3

Database Schema: A, B, C, D, E

Functional Dependancies

1. D  $\rightarrow$  CE
2. A  $\rightarrow$  B
3. B  $\rightarrow$  E
4. C  $\rightarrow$  B

Decomposition

R1 = {CAE}

R2 = {DB}

R3 = {ABD}

Step 1 + 2:

- Create an initial matrix of size attribute i by relations j
- Place Bij in each empty cell

	A	B	C	D	E
R1	B11	B12	B13	B14	B15
R2	B21	B22	B23	B24	B25
R3	B31	B32	B33	B34	B35

Step 3:

- Place Ai in each cell that corresponds to an attribute in the relation row

	A	B	C	D	E
R1	A1	B12	A3	B14	A5
R2	B21	A2	B23	A4	B25
R3	A1	A2	B33	A4	B35

Step 4:

- For all key attributes per row:
- Find cells in row containing key X with  $b_{ij}$
- Place  $A_i$  in each cell associated with Y, if the FD exists in another row
- Repeat for all dependencies

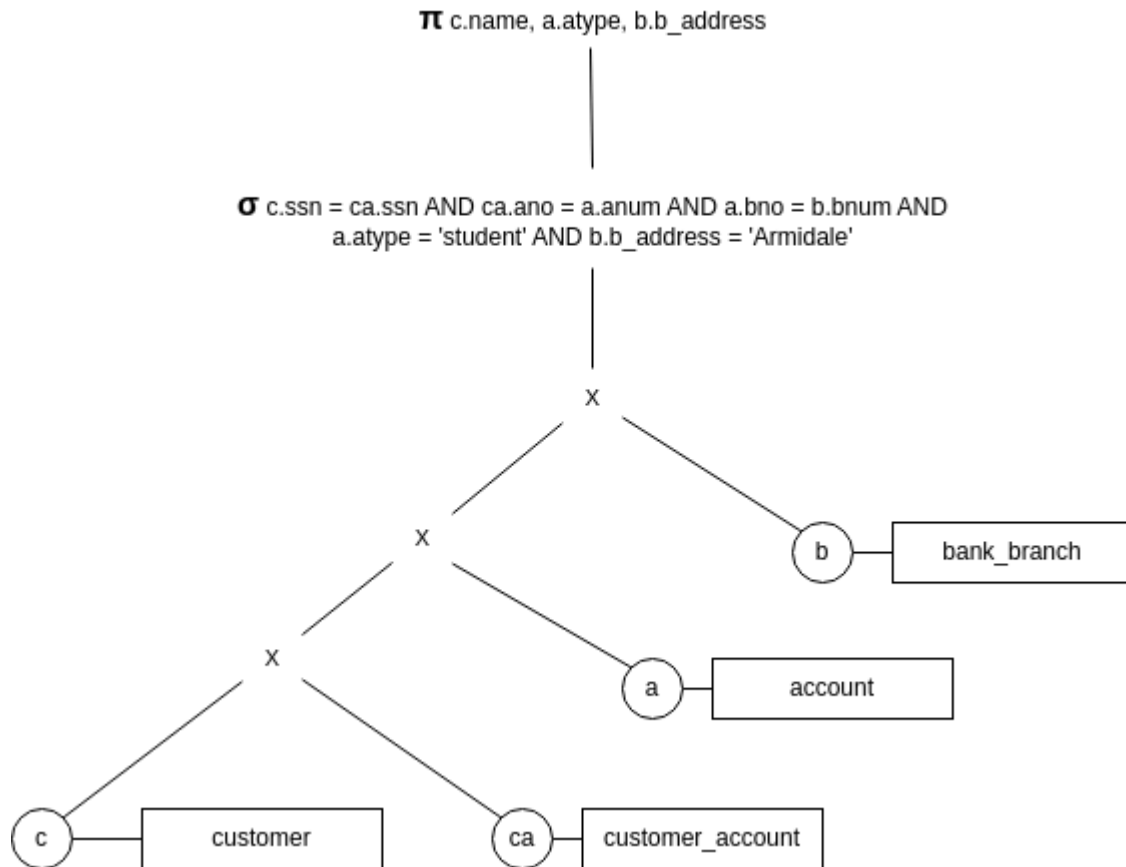
	A	B	C	D	E
R1	A1	A2	A3	B14	A5
R2	B21	A2	B23	A4	A5
R3	A1	A2	B33	A4	A5

Step 5:

- If a row contains all  $A_i$  then the decomposition is lossless
- This decomposition does not satisfy the requirements to be lossless as no row contains all R3 values. In particular, the relation  $D \rightarrow CE$  is not preserved in any rows.

## Question 4

A.



B.

