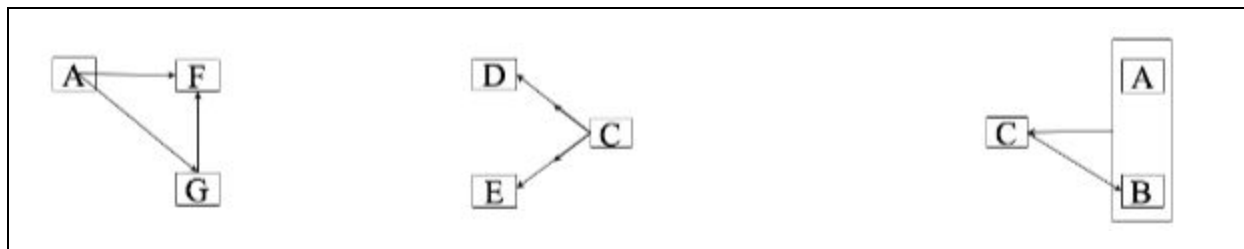


Part 1:

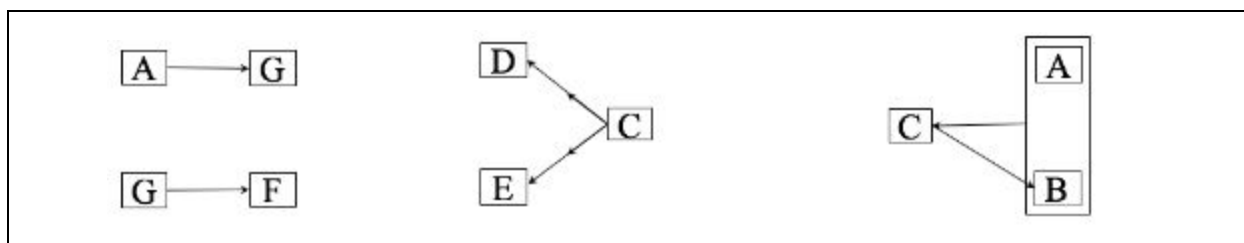
1)

| | | |
|--|---|---|
| <div> <div>A</div> <div>F</div> <div>G</div> </div> <p>Functional: $A \rightarrow G$ $A \rightarrow F$ $G \rightarrow F$</p> | <div> <div>C</div> <div>D</div> <div>E</div> </div> <p>Multivalued: $C \twoheadrightarrow D$ $C \twoheadrightarrow E$</p> | <div> <div>A</div> <div>B</div> <div>C</div> </div> <p>Functional: $AB \rightarrow C$ $C \rightarrow B$</p> |
|--|---|---|



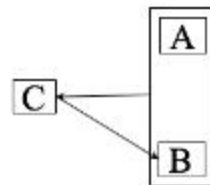
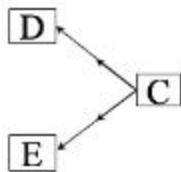
2)

| | | |
|--|---|---|
| <div> <div>A</div> <div>G</div> </div> <div> <div>G</div> <div>F</div> </div> <p>Functional: $A \rightarrow G$ $G \rightarrow F$</p> | <div> <div>C</div> <div>D</div> <div>E</div> </div> <p>Multivalued: $C \twoheadrightarrow D$ $C \twoheadrightarrow E$</p> | <div> <div>A</div> <div>B</div> <div>C</div> </div> <p>Functional: $AB \rightarrow C$ $C \rightarrow B$</p> |
|--|---|---|



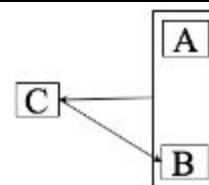
3)

| | | |
|--|---|---|
| <div> <div>A</div> <div>G</div> </div> <div> <div><u>G</u></div> <div>F</div> </div> <div> <p>Functional:</p> <p>$A \rightarrow G$</p> <p>$G \rightarrow F$</p> </div> | <div> <div><u>C</u></div> <div>D</div> <div>E</div> </div> <div> <p>Multivalued:</p> <p>$C \twoheadrightarrow D$</p> <p>$C \twoheadrightarrow E$</p> </div> | <div> <div>A</div> <div><u>C</u></div> </div> <div> <div><u>C</u></div> <div>B</div> </div> <div> <p>Functional:</p> <p>$C \rightarrow B$</p> <p>$A \rightarrow C$</p> </div> |
|--|---|---|



4)

| | | |
|--|--|---|
| <div> <div>A</div> <div>G</div> </div> <div> <div><u>G</u></div> <div>F</div> </div> <div> <p>Functional:</p> <p>$A \rightarrow G$</p> <p>$G \rightarrow F$</p> </div> | <div> <div><u>C</u></div> <div><u>D</u></div> </div> <div> <div><u>C</u></div> <div><u>E</u></div> </div> <div> <p>Multivalued:</p> <p>$C \twoheadrightarrow D$</p> <p>$C \twoheadrightarrow E$</p> </div> | <div> <div>A</div> <div><u>C</u></div> </div> <div> <div><u>C</u></div> <div>B</div> </div> <div> <p>Functional:</p> <p>$C \rightarrow B$</p> <p>$A \rightarrow C$</p> </div> |
|--|--|---|



Part 2:

1. $X \rightarrow Y$ and $Z \subseteq Y$ and $W \subseteq Z \models X \rightarrow W$

$Z \subseteq Y$ then $Y \rightarrow Z$ (R1)

$W \subseteq Z$ then $Z \rightarrow W$ (R1)

$X \rightarrow Y, Y \rightarrow Z, Z \rightarrow W$ then $X \rightarrow W$ (R3)

2. $X \rightarrow Y, Z \rightarrow Y \models X \rightarrow Z$

| X | Y | Z |
|----|----|----|
| x1 | y1 | z1 |
| x1 | y1 | z2 |

Relation satisfies $X \rightarrow Y, Z \rightarrow Y$, but not $X \rightarrow Z$ since (x1, z1) and (x1, z2)

3. $X \rightarrow Y, XY \rightarrow Z \models X \rightarrow Z$

$X \rightarrow XX$ (R0)

$X \rightarrow Y$ (given) then $XX \rightarrow XY$ (R2)

$X \rightarrow XX, XX \rightarrow XY, XY \rightarrow Z$ then $X \rightarrow Z$ (R3)

4. $X \twoheadrightarrow Y \models X \rightarrow Y$

| Z | X | Y |
|----|----|----|
| z1 | x1 | y1 |
| z1 | x2 | y2 |
| z2 | x1 | y1 |
| z2 | x2 | y2 |

Relation satisfies $X \twoheadrightarrow Y$, but not $X \rightarrow Y$ since (x1, y1) and (x1, y2)

5. $X \rightarrow Y, Z \rightarrow W \models XZ \rightarrow YW$

$X \rightarrow Y$ then $XZ \rightarrow YZ$ (R2)

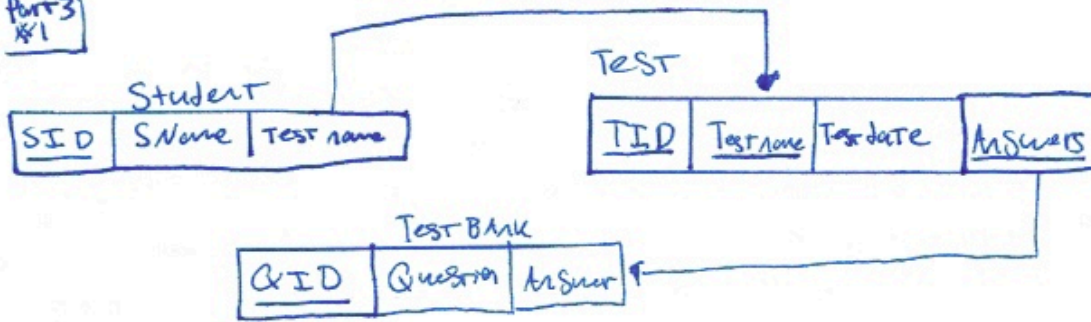
$Z \rightarrow W$ then $YZ \rightarrow YW$ (R2)

$XZ \rightarrow YZ, YZ \rightarrow YW$ then $XZ \rightarrow YW$

PART 3)

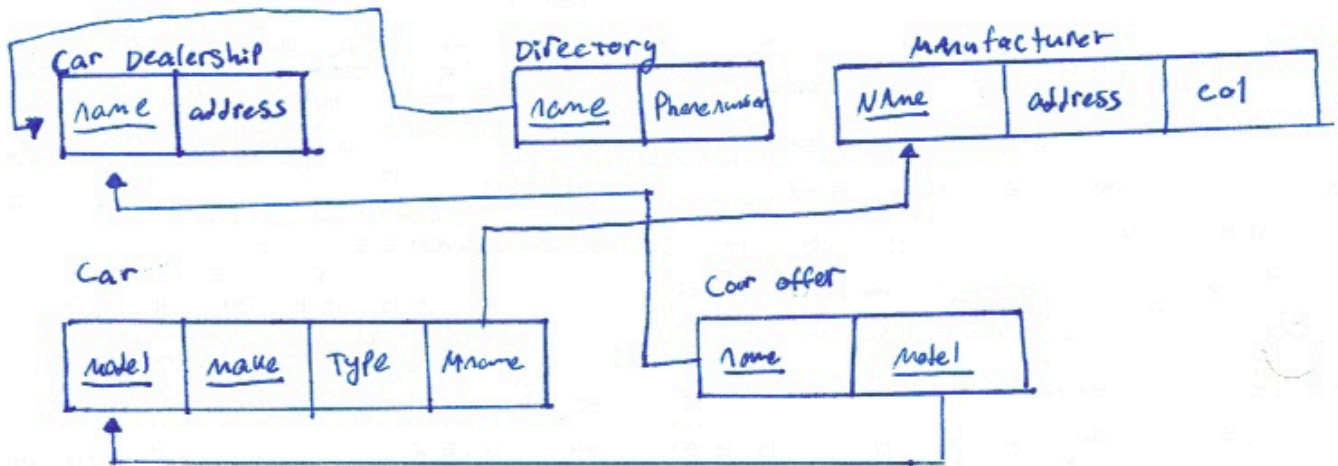
- A) Each students writes at least one car
B) Each test has at least one question

Part 3
#1



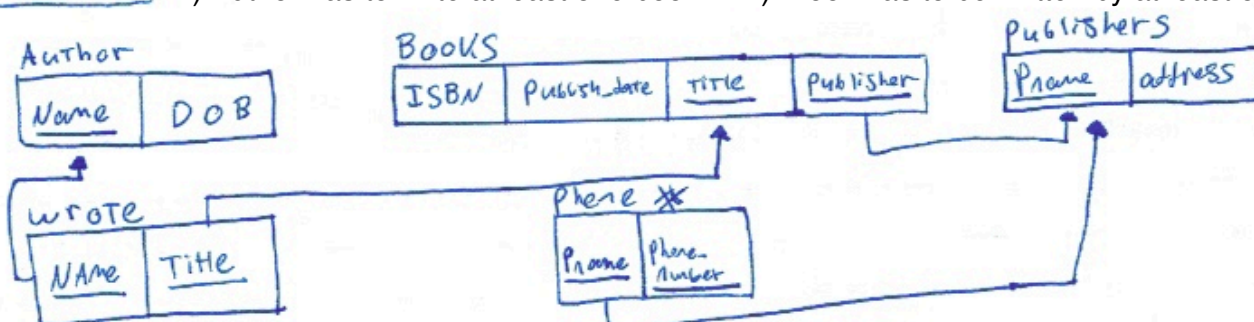
Part 3
#2

- A) Each manufacturer builds at least one car
B) Each dealership sells at least one car



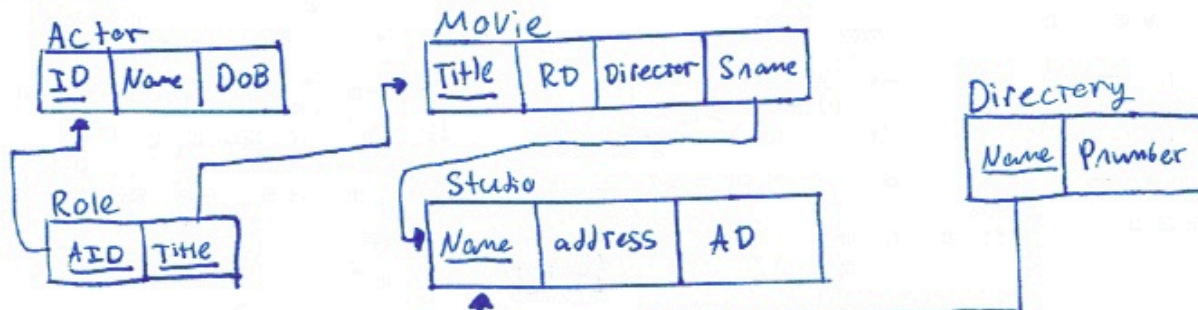
Part 3 #3

- A) Author has to write at least one book B) Book has to be written by at least one author.



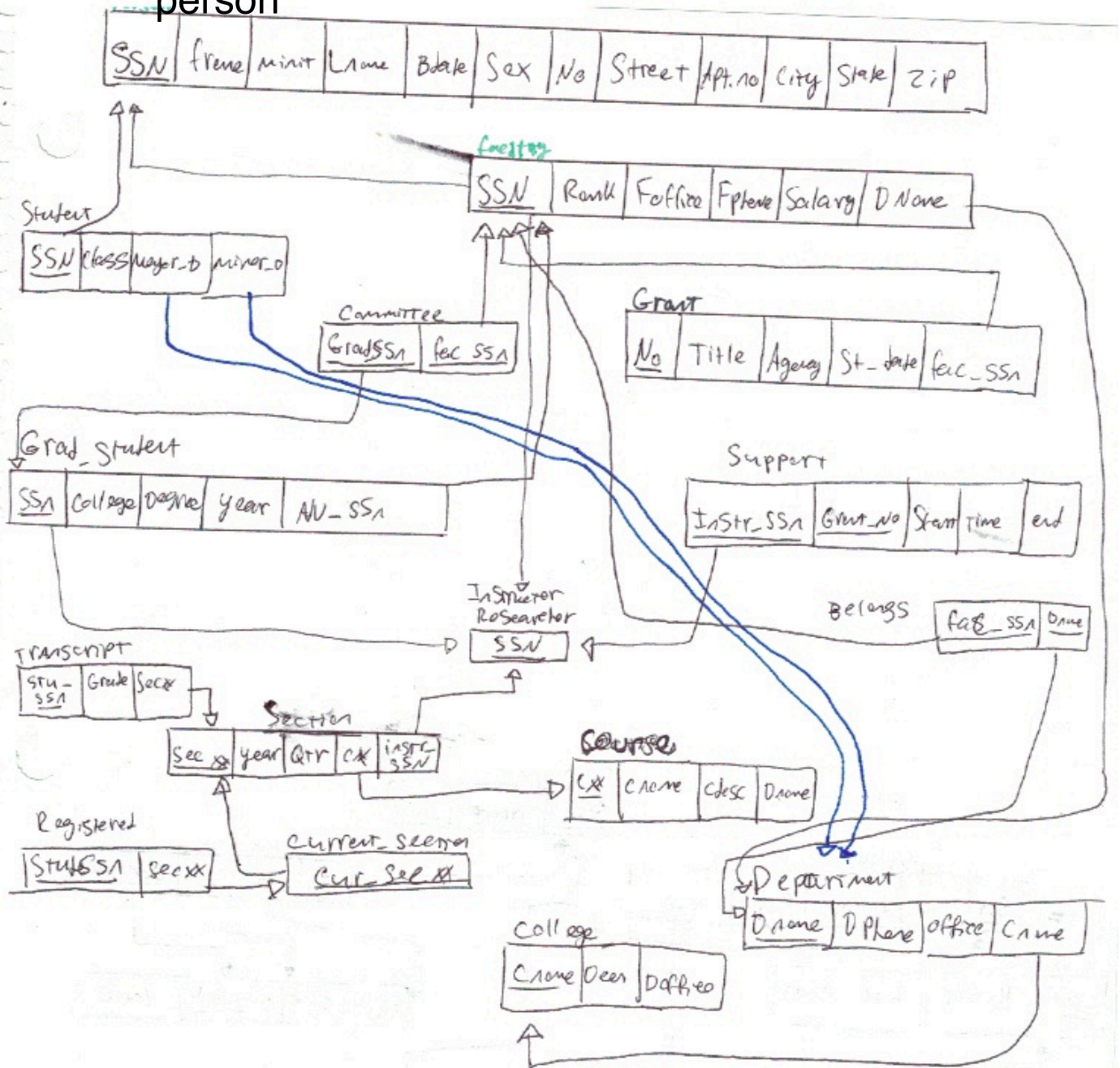
Part 3 #4

- A) A movie has at least one actor B) Every actor played in at least one movie



Part 4

person



Part 5

