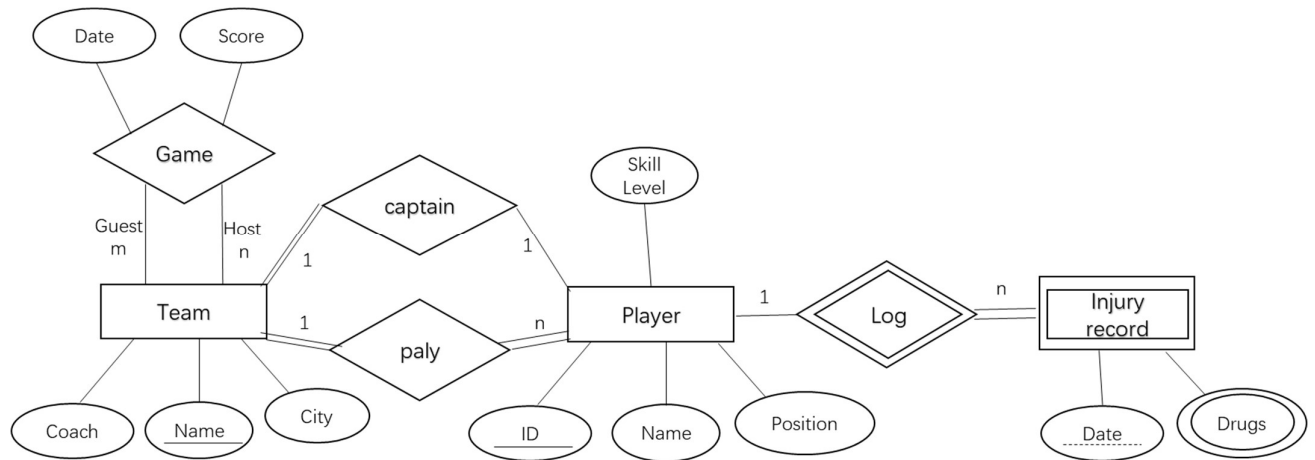
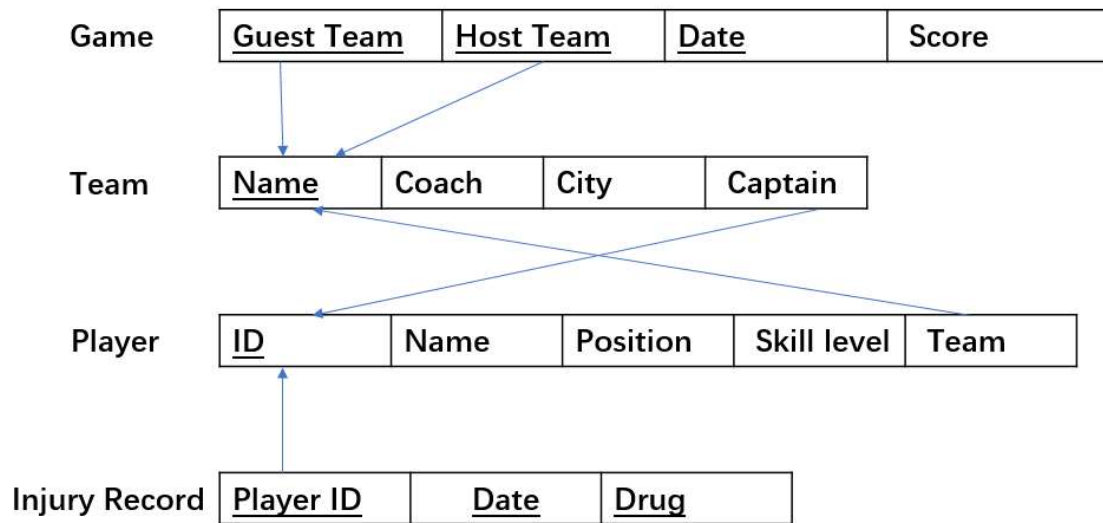


Question A. (total 50 marks)

1) The ER diagram [30 marks]



2) ER->Relational model [20 marks]



Question B. [50 marks]

(a) [10 marks]

$\therefore A \rightarrow \{D, E\}$ (Given)

$\therefore A \rightarrow E$ and $A \rightarrow D$ (decomposition rule))

$\therefore D \rightarrow \{I, J\}$ (Given)

$\therefore D \rightarrow I, D \rightarrow J$ (decomposition rule))

$\therefore A \rightarrow D$ and $D \rightarrow J$ (proved)

$\therefore A \rightarrow J$ (transitive rule)

$\therefore A \rightarrow E$ and $A \rightarrow J$ (proved)

$\therefore A \rightarrow \{E, J\}$ (union rule)

(b) [10 marks]

$\{A, B, C\} \neq \{A, B, C, D, E, F, G, H, I, J\}$ so it is a super key.

$\{AB\} \neq \{A, B, C, D, E, F, G, H, I, J\}$ so $\{A, B, C\}$ is not a candidate key.

(c) [10 marks]

$\{A, F\} \neq \{A, D, E, F, G, H, I, J\}$ so it is not a super key. It is not a candidate key.

(d) [10 marks]

This table only have one candidate key, that is AB, because only AB can determine C.

To normalize into 2NF, we remove the attributes that are functionally dependent on part of the key (A or B) from R and place them in separate relations R1 and R2, along with the part of the key they depend on (A or B), which are copied into each of these relations but also remains in the original relation, which we call R3 below:

$R1 = \{\underline{A}, D, E, I, J\}$, $R2 = \{\underline{B}, F, G, H\}$, $R3 = \{\underline{A}, \underline{B}, C\}$

The new keys for R1, R2, R3 are underlined.

(e) [10 marks]

Next, we look for transitive dependencies in R1, R2, R3. The relation R1 has the transitive dependency $\{A\} \rightarrow \{D\} \rightarrow \{I, J\}$, so we remove the transitively dependent attributes $\{I, J\}$ from R1 into a relation R11 and copy the attribute D they are dependent on into R11. The remaining attributes are kept in a relation R12. Hence, R1 is decomposed into R11 and R12 as follows:

$R11 = \{\underline{D}, I, J\}$, $R12 = \{\underline{A}, D, E\}$

The relation R2 is similarly decomposed into R21 and R22 based on the transitive dependency $\{B\} \rightarrow \{F\} \rightarrow \{G, H\}$:

$R21 = \{\underline{F}, G, H\}$, $R22 = \{\underline{B}, F\}$

The final set of relations in 3NF are $\{R11, R12, R21, R22, R3\}$