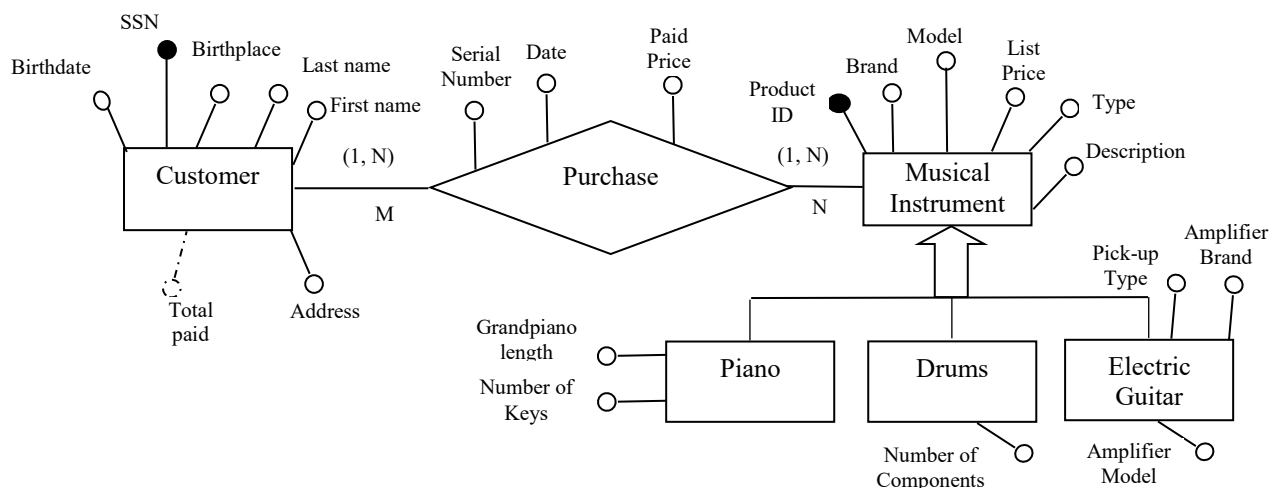**First and Last Name:**   **Matricola/Alias:**

(Write in the space below each exercise. If needed, you can also use the page's rear. <u>No other sheets will be accepted other than these.</u>)

Given the following conceptual schema of a store of musical instruments:

The database stores data of the latest 5 years, during which the store sells about 500 musical instruments, for about 250 customers (on average each customer request purchases 2 instruments in 5 years). Moreover, 30% of the articles on sale (not to be confused with the sold ones) are pianos, 20% drums, and 25% electric guitars. The operations to be executed on this database are 10, among which the 2 most frequent ones are:

OP1) New purchase (from what said, only 50% of cases is for a new customer).

OP2) Monthly print of a report with customers' data, and the Total amount paid for purchases.

1. **Exercise1 (score 8 out of 30)** – Develop the workload (Volume, Operation, and Access tables), and based on it, restructure the conceptual schema, evaluating whether to keep or to eliminate the redundant attribute *TotalPaid*. Moreover, remove the generalization hierarchy, motivating the strategy chosen for the elimination.

Exercise2 (score 4 out of 30) – By applying mapping rules to the restructured schema of exercise 1, design the logic relational schema (avoiding redundant tables), graphically showing foreign keys and primary keys.

Exercise3 (score 5 out of 30) – Write a query using relational algebra in order to list first name, lastname and address of customers that have purchased an half-length grandpiano.

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Exercise4 (score 7 out of 30) – Write a query using relational algebra to extract the data of customers that have purchased at least 2 musical instruments in the last 5 years.

Exercise5 (score 6 out of 30) – Rewrite the query of exercise 4 by using JDBC. In particular, given an integer X in input, extract the data of customers that have purchased at least X musical instruments in the last 5 years, by showing the number of purchases for each customer.