CS166 Database Management Systems

You are commissioned by the Ministry of Magic to design a database for the Hogwarts School of Witchcraft and Wizardry. Your database should capture the following information:

- The database only needs to record information about current students and teachers. Therefore, you may assume that each person is either a student or teacher, but not both
- Each person has a unique id assigned by the School, a name, a pet, and a wand. The Ministry is interested in keeping only a short description of one's current pet (e.g., Hedwig the Snowy Owl) and the core of one's wand (e.g., phoenix feather). You may assume that all wands are single-core.
- The School offers different subjects of study. Each subject has a unique name. In any given school year, a given subject can be taught by only one teacher (e.g., Severus Snape taught Defense Against the Dark Arts during 1996-97).
- Each student studying this subject receives a grade at the end of the school year. A subject can be taught over multiple years and a student may study the same subject multiple times.
- For each student, you need to additionally record the year when he or she entered the School.
- Students are divided into Houses with unique names (e.g., Gryffindor and Slytherin). You need to track each House's head teacher (e.g., Gryffindor's head is Minerva McGonagall) and its current students.
- Students earn points for their Houses: points are rewarded for good deeds, winning a Quidditch match, etc.; they are taken away for breaking rules. The Ministry wants to you to track the points earned and lost by each deed of each student over time. From your database, it should be possible to, for example, tally the points accumulated by each House since the beginning of the school year, calculate each student's contribution during any time period, and look up a particular deed.

If any of the above deviates from the "canon," use the assumptions above (with apologies to Harry Potter fans). If you think some aspects of the above are unclear, feel free to make additional, reasonable assumptions, but state them clearly in your answer. Also, keep in mind that there is no single "correct" design; if you think you are making a non-obvious design decision, please explain it briefly.

(a) Design an E/R diagram for this database. Very briefly explain the intuitive meaning of any entity and relationship sets as needed. Do not forget to indicate keys and multiplicity of relationships, as well as ISA relationships and weak entity sets (if any), using appropriate notation.

(b) Design a relational schema for this database. (You can start by translating the E/R design.) You may ignore attribute types, and you do not need to show any sample data. Indicate all keys and non-trivial functional dependencies in the schema.

(c) Using Relational Algebra, write an answer for the following queries using the relations you created.

1. The names of all students in Gryffindor
2. The head of Hufflepuff House
3. The total number of points per student. You can use aggregation function like (Sum, Min, Max, Avg, Count).
4. The names of the teachers who taught the 'Defense Against the Dark Arts'
5. Come up with your own query