Mandatory Exercise: External memory

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1 Databases You are working as a consultant for the company ”Shoes, Shoes and Shoes”, that sells shoes. They want a database containing information about all their shoes. Each shoe has an unique id, a size, a type, a color, and a price. They want to be able to update the database with insertions and deletions of shoes. The database should—in addition to the updates—support the following queries efficiently:

- report-price-size($p_1$, $p_2$): Return the size of all shoes with a price between $p_1$ and $p_2$.
- report-size-price($s_1$, $s_2$): Return the price of all shoes with a size between $s_1$ and $s_2$.
- report-size-type($s_1$, $s_2$): Return the type and id of all shoes with a size between $s_1$ and $s_2$.

Give an I/O efficient data structure supporting the required updates and queries. Analyse the space and the I/O complexity of your data structure.