The main task in this assignment is modifying the simple query engine of the previous assignment to support recursive Datalog queries without negation, i.e., the language Datalog as described in the textbook.[1] You should implement Datalog using two methods: The first is the *Improved Seminaive Algorithm* along with the improvement for linear Datalog.[2] Your implementation should use the improvement for linear Datalog whenever applicable but must be capable of evaluating nonlinear Datalog programs. The second method is the *Query-Subquery Algorithm with Recursive Control (QSQR)*.[3] In your submission, these two implementations will be invoked using the commands `qengine-sn` and `qengine-qsqr`.

For both the implementations, we will use the input and output format descried in the previous assignment. No lexical change is necessary. However, the input for this assignment will not contain any negation but may contain recursively defined rules.

You should test your implementations on a variety of Datalog programs but, at the very least, you should test them on the *reverse same-generation (RSG)* program and others described in the textbook. Your submission should include a plain-text input file `rsg-in` that includes all the input necessary for running the RSG example outlined in Figure 13.2 in the textbook. That is, invoking `qengine-sn < rsg-in` should produce the output of your implementation of the seminaive algorithm on the EDB and IDB predicates defined in the RSG example. The command `qengine-qsqr < rsg-in` should do the same for your QSQR implementation.

Packaging and Submission: Please follow the packaging and submission procedure described in the previous assignment, making the obvious change of replacing `hw01` with `hw02`. Further, invoking `make` as described there should produce the two executables `qengine-sn` and `qengine-qsqr` noted earlier. If your implementation uses pure Java, you may assume JRE version 1.5 or later. (That is, you are not limited by the older JRE on Gandalf.)

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[1] Serge Abiteboul, Richard Hull, and Victor Vianu, *Foundations of Databases* (Addison-Wesley, 1995).

[2] *Idem*, p. 316.

[3] *Idem*, Section 13.2, p. 324.