

Name: _____

- COS 480 students should answer non-* questions; optional * questions are for extra credit.
- COS 580 students should answer all questions, including * questions.

1. (1 pt.) Write your name in the space provided above.
2. (14 pts.) Consider a relation **Requests**(*ipv4*, *ipv6*, *sdate*, *stime*, *url*) that stores information on requests to a Web server. The last three attributes record the date and time a connection was initiated and the URL of the Web page that was accessed. The first two attributes record the IPv4 or IPv6 address of the remote host sending the request, and exactly one of the two is non-null in any tuple.

Provide the *simplest SQL expressions* of the following constraints, assuming the table **Requests** already exists.

- (a) Exactly one of *ipv4* and *ipv6* is non-null for any tuple.
- (b) None of the other attributes is null.

3. (15 pts.) For the database of Question 2, implement the following feature: Instead of rejecting insertions with both `ipv4` and `ipv6` non-null, insert a tuple with the `ipv6` attribute replaced by null, and also insert in another table, `AddrMaps(ipv4, ipv6, date, time)`, a tuple recording the corresponding fields from the inserted tuple (with the non-null IPv4 and IPv6 addresses). Provide all the SQL statements needed to implement this feature, *assuming the statements of Question 2 have already executed*.

4. (30 pts.) We say an IPv4 and IPv6 address are *linked to each other for a time interval* $[b, e]$ if, for all instants of time $t_1 \in [b, e]$, there is a time instant t_2 and a tuple $(p, q, d, t) \in \text{AddrMaps}$ where the pair (d, t) denotes the instant t_2 .

Provide a SQL query to find address pairs and the maximal intervals of their linking (maximal: making the interval any larger would violate the requirements for linking). The desired result is a set of all tuples (p, q, b, e) such that IPv4 address p is linked with IPv6 address q for the interval $[b, e]$ and that interval is maximal.

[additional space for answering the earlier question]

5. (20 ★ pts.) Provide likely logical and physical query plans for the query of Question 4, stating any important assumptions you make, and briefly explaining your answer.

[additional space for answering the earlier question]