Consider two filter predicates $F_1$ and $F_2$. For example, $F_1$ may be the predicate $R.A = 10$ and $F_2$ may be the predicate $R.B > 10$.

A cost of $c_1$ is incurred for each evaluation of $F_1$. That is, if we have to evaluate $F_1$ on a record, then we will incur a cost of $c_1$. Similarly, a cost of $c_2$ is incurred for each evaluation of $F_2$. (Note: if we evaluate both $F_1$ and $F_2$ on a record, then we will incur a cost of $c_1 + c_2$.)

$s_1$ and $s_2$ are the respective selectivities of $F_1$ and $F_2$. The meaning of selectivity is as follows. Let $n$ be a positive integer and let $\sigma_{F_1}$ be the select operator that evaluates $F_1$. If $\sigma_{F_1}$ processes $n$ records in the database, then it will let $ns_1$ records pass through, and drop the remaining $n(1 - s_1)$ records. That is, on average, $ns_1$ records will satisfy the $F_1$ predicate, and the remaining $n(1 - s_1)$ records will not satisfy the $F_1$ predicate.

**Problem 1:** What condition should $c_1, s_1, c_2, s_2$ satisfy so that it is better to evaluate $F_1$ before $F_2$ in a plan? That is, find the condition that makes the plan in Figure 1(a) have lower overall cost than the plan in Figure 1(b).

**Problem 2:** Suppose we are now given $N$ filter predicates $F_1$, $F_2$, ..., $F_N$ with respective cost and selectivity values $c_1, s_1, c_2, s_2, \ldots, c_N, s_N$. We can evaluate these predicates in any of the possible $N!$ (N factorial) permutations. Give the condition that makes it best to evaluate these predicates in the order $F_1$ first, then $F_2$, then $F_3$, and so on, and finally $F_N$. That is, find the condition that makes the plan in Figure 1(c) have lower overall cost than all the other orderings of the select operators.

*Hint: The answer to Problem 2 is a very elegant condition involving $c_1, s_1, c_2, s_2, \ldots, c_N, s_N$. Work out on paper with 2 filter predicates, and then with 3 filter predicates to see whether you can spot an interesting pattern.*
Figure 1: Plans with select operators for Problems 1 and 2