> **Note 4.1   SQL AND MULTISET RELATIONAL ALGEBRA - PART 4**
>
> The relational algebra supports the left outer-join operation, denoted by $⟕_\theta$, the right outer-join operation, denoted by $⟖_\theta$, and the full outer-join operation, denoted by $⟗_\theta$. It also supports the natural join operation, denoted by $⋈$, as well as the natural join versions of the left, right and full outer-join operations, denoted by $⟕, ⟖$, and $⟗$. The definitions of all these operations are identical to the definitions of the corresponding operations in SQL, which we have seen in Section 4.1.

4.1.4   Join Types and Conditions

To distinguish normal joins from outer joins, normal joins are called **inner joins** in SQL. A join clause can thus specify **inner join** instead of **outer join** to specify that a normal join is to be used. The keyword **inner** is, however, optional. The default join type, when the **join** clause is used without the **outer** prefix, is the **inner join**. Thus,

> **select** *
> **from** *student* **join** *takes* **using** (*ID*);

is equivalent to:

> **select** *
> **from** *student* **inner join** *takes* **using** (*ID*);

Similarly, **natural join** is equivalent to **natural inner join**.

Figure 4.7 shows a full list of the various types of join that we have discussed. As can be seen from the figure, any form of join (inner, left outer, right outer, or full outer) can be combined with any join condition (natural, using, or on).

Join types
inner join
left outer join
right outer join
full outer join

Join conditions
natural
on < predicate>
using $(A_1, A_2, \ldots, A_n)$

Figure 4.7   Join types and join conditions.