The Theory of Computation

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Solution Manual
Chapter 2, Problem 2.40

Diagonalization is normally used to prove that some set cannot be enumerated, but of course every finite set is trivially enumerable. Thus diagonalization cannot be used for that purpose.

Diagonalization, however, is a bit more general: it is really a process whereby one uses an enumeration (real or assumed) to construct a new object that cannot be in the enumeration. In that sense, there is no reason why it could not be used with a finite set to construct an object not in that finite set; however, there is little incentive to use it for such a purpose, since finite sets are generally simple enough that producing an element not in a finite set is an easy task that does not require such an elaborate tool.