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chapter - 1; section - 2

35. A detective has interviewed four witnesses to a crime. From the stories of the witnesses the detective has concluded that
if the butler is telling the truth then so is the cook;
the cook and the gardener cannot both be telling the truth;
the gardener and the handyman are not both lying;
and if the handyman is telling the truth then the cook is lying.
For each of the four witnesses, can the detective determine whether that person is telling the truth or lying?
Explain your reasoning.

Ans:
Butler is lying.
Cook is lying.
Handyman or Gardener or both are telling the truth.

Let us assume:
p : "Butler tells the truth."
q : "Cook tells the truth."
r : "Gardener tells the truth."
s : "Handyman tells the truth."

Rewriting the given sentences as propositions,
(1) $p \rightarrow q$
(2) $\neg(q \wedge r)$
(3) $\neg(\neg r \wedge \neg s)$
(4) $s \rightarrow \neg q$

Let us create a truth table :

p	q	r	s	1	2	3	4
T	T	T	T	T	F	T	F
T	T	T	F	T	F	T	T
T	T	F	T	T	T	T	F
T	T	F	F	T	T	F	T
T	F	T	T	F	T	T	T
T	F	T	F	F	T	T	T
T	F	F	T	F	T	T	T
T	F	F	F	F	T	F	T
F	T	T	T	T	F	T	F
F	T	T	F	T	F	T	T
F	T	F	T	T	T	T	F
F	T	F	F	T	T	F	T
F	F	T	T	T	T	T	T
F	F	T	F	T	T	T	T
F	F	F	T	T	T	T	T
F	F	F	F	T	T	F	T

We then note that there are three options in the table that lead to all four of the propositions to be true.

thus the Butler and the Cook are lying. the Handyman or the Gardener or both are telling the truth.