

# Download File PDF Solution Discret Mathematics

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Section 1.5 Rules of Inference 23

18. a) If we use modus tollens starting from the back, then we conclude that I am not sad. Another application of modus tollens then tells us that I did not give back.  
b) We only can't conclude anything specific here.  
c) By universal instantiation, we conclude from the first conditional statement by modus ponens that the doggie has six legs, and we conclude by modus tollens that quips are not insects. We continue using universal generalization that, for example, there exists a six-to-legged creature that eats a six-legged creature, and that there exists a non-insect that eats an insect.  
d) We can apply universal instantiation to the conditional statement and conclude that if Homer (respectively, Maggie) is a student, then he (she) has an internet account. Now modus tollens tells us that Homer is not a student. There are no conclusions to be drawn about Maggie.  
e) The first conditional statement is that if  $x$  is lucky to eat, then  $x$  does not taste good. Universal instantiation and modus ponens therefore tell us that tofu does not taste good. The third sentence says that if you eat  $x$ , then  $x$  tastes good. Therefore the fourth hypothesis already follows (by modus tollens) from the first three. No conclusion can be drawn about showstoppers from these statements.  
f) By disjunctive syllogism, the first two hypotheses allow us to conclude that I am hallucinating. Therefore by modus ponens we know that I see elephants running down the road.

12. Applying Exercise 11, we want to show that the conclusion  $r$  follows from the five premises  $(p \wedge q) \rightarrow (r \vee s)$ ,  $s \rightarrow (t \wedge u)$ ,  $u \rightarrow p$ ,  $\neg r$ , and  $q$ . From  $q$  and  $u \rightarrow (r \vee s)$  we get  $s$  by modus ponens. From there we get both  $s$  and  $t$  by simplification (and the commutative law). From  $s$  and  $u \rightarrow p$  we get  $p$  by modus ponens. From  $p$  and  $t$  we get  $p \wedge t$  by conjunction. From that and  $(p \wedge t) \rightarrow (r \vee s)$  we get  $r \vee s$  by modus ponens. From that and  $\neg r$  we finally get  $s$  by disjunctive syllogism.

14. In each case we set up the proof in two columns, with reasons, as in Example 6.

a) Let  $s(x)$  be " $x$  is in this class," let  $f(x)$  be " $x$  owns a red motorcycle," and let  $h(x)$  be " $x$  has gotten a speeding ticket." We are given premises  $\forall x(L(x) \rightarrow f(x))$ ,  $\forall x(f(x) \rightarrow h(x))$ , and we want to conclude  $\exists x(s(x) \wedge h(x))$ .

| Step                                  | Reason                               |
|---------------------------------------|--------------------------------------|
| 1. $\forall x(f(x) \rightarrow h(x))$ | Hypothesis                           |
| 2. $f(L(a)) \rightarrow h(L(a))$      | Universal instantiation using (1)    |
| 3. $f(L(a))$                          | Hypothesis                           |
| 4. $h(L(a))$                          | Modus ponens using (2) and (3)       |
| 5. $s(L(a))$                          | Hypothesis                           |
| 6. $s(L(a)) \wedge h(L(a))$           | Conjunction using (3) and (5)        |
| 7. $\exists x(s(x) \wedge h(x))$      | Existential generalization using (6) |

b) Let  $f(x)$  be " $x$  is one of the five minimum bets," let  $s(x)$  be " $x$  has taken a course in discrete mathematics," and let  $a(x)$  be " $x$  can take a course in algorithms." We are given premises  $\forall x(f(x) \rightarrow s(x))$  and  $\forall x(s(x) \rightarrow a(x))$ , and we want to conclude  $\forall x(f(x) \rightarrow a(x))$ . In what follows  $p$  represents an arbitrary person.

| Step                                  | Reason                                   |
|---------------------------------------|--|
| 1. $\forall x(f(x) \rightarrow s(x))$ | Hypothesis                               |
| 2. $f(p) \rightarrow s(p)$            | Universal instantiation using (1)        |
| 3. $\forall x(s(x) \rightarrow a(x))$ | Hypothesis                               |
| 4. $s(p) \rightarrow a(p)$            | Universal instantiation using (3)        |
| 5. $f(p) \rightarrow a(p)$            | Hypothetical syllogism using (2) and (4) |
| 6. $\forall x(f(x) \rightarrow a(x))$ | Universal generalization using (5)       |

c) Let  $s(x)$  be " $x$  is a movie produced by Sony," let  $c(x)$  be " $x$  is a movie about cool movies," and let

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