

Logic, First Course, Winter 2020. Week 3, Homework (due Monday January 27 11:59pm).

## Week 3, Homework

The homework problems in this set fall into three groups:

- [Assessing validity via truth-tables](#)
- [Assessing validity via equivalences and substitution](#)
- [Assessing soundness](#)

There are 20 problems total, each equally weighted. Submitted problems received on time receive 5 points each. Hence, there are 100 possible points. Late submissions receive 2 points each. The cutoff for submitting late homework is one week after the homework is due. At that point, the points recorded in [carnap.io](#) will be transferred to the ccle grading system and no further late work will be accepted.

Please remember to **press the "Submit" button** next to each problem after you are done. If you do not do this, you will **not** get credit for the problem. Once you have submitted your answer, your points are recorded. You can always check your points by going to the "user home" at the top right. You must be signed in in order to submit your answers.

If you want to do some problems at one point in time and other problems at another point in time, you can do that by just coming back to this assignment page. Once submitted, your points are permanently recorded. If you return to this page later or refresh this page, it won't display your previously recorded answers, but again your points are permanently recorded. If you have forgotten which ones you still need to do, you can check your points by going to the "user home" at the top right.

Before you begin the homework, you might consider printing a copy either to work out by hand as you go along, or to work with on a tablet. A nice pdf of this page is at [this link](#).

## Assessing validity via truth-tables

On these problems, again please remember to press the "Submit" button next to each problem after you are done. This will usually be after you've pressed the 'check' or 'counterexample' button.

Use truth-tables to determine whether the following are valid or invalid:

### Problem 1

3.01

$\neg(b \vee c) \vdash \neg b$

<b>b</b>	<b>c</b>	$\neg (b \vee c) \vdash \neg b$					
T	T	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
T	F	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
F	T	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
F	F	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Counterexample

Submit

Check

### Problem 2

3.02

$\neg b \vdash \neg(b \vee c)$

<b>b</b>	<b>c</b>	$\neg b \vdash \neg(b \vee c)$					
T	T	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
T	F	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
F	T	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
F	F	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Counterexample

Submit

Check

### Problem 3

3.03

 $(a \rightarrow b), (b \rightarrow c), \neg a \vdash \neg c$ 

<b>a b c</b>	<b>( a → b ), ( b → c ), ¬ a ⊢ ¬ c</b>											
T T T	T		T	T		T			T			T
T T F	T		T	T		F			T			F
T F T	T		F	F		T			T			T
T F F	T		F	F		F			T			F
F T T	F		T	T		T			F			T
F T F	F		T	T		F			F			F
F F T	F		F	F		T			F			T
F F F	F		F	F		F			F			F

Counterexample

Submit

Check

## Problem 4

3.04

 $(a \rightarrow b), (b \rightarrow c), \neg c \vdash \neg a$ 

<b>a b c</b>	<b>( a → b ), ( b → c ), ¬ c ⊢ ¬ a</b>											
T T T	T		T	T		T			T			T
T T F	T		T	T		F			F			T
T F T	T		F	F		T			T			T
T F F	T		F	F		F			F			T
F T T	F		T	T		T			T			F
F T F	F		T	T		F			F			F
F F T	F		F	F		T			T			F
F F F	F		F	F		F			F			F

Counterexample

Submit

Check

# Problem 5

3.05

$(a \rightarrow b), (c \rightarrow b), \neg c \vdash \neg b$

<b>a</b>	<b>b</b>	<b>c</b>	<b>( a → b ), ( c → b ), ¬ c ⊢ ¬ b</b>											
T	T	T	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>
T	T	F	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>
T	F	T	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>
T	F	F	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>
F	T	T	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>
F	T	F	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>
F	F	T	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>
F	F	F	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>

Counterexample

Submit

Check

# Problem 6

3.06

 $(a \rightarrow (b \vee c)), \neg c \vdash \neg a$ 

<b>a</b>	<b>b</b>	<b>c</b>	<b>( a → ( b ∨ c )), ¬ c ⊢ ¬ a</b>									
T	T	T	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value=""/>
T	T	F	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="T"/>
T	F	T	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="T"/>
T	F	F	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="T"/>
F	T	T	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="F"/>
F	T	F	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="F"/>
F	F	T	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="F"/>
F	F	F	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="F"/>

Counterexample

Submit

Check

## Problem 7

3.07

 $\neg(a \wedge b) \vdash (\neg\neg a \vee \neg\neg b)$ 

<b>a</b>	<b>b</b>	<b>¬ ( a ∧ b ) ⊢ ( ¬ ¬ a ∨ ¬ ¬ b )</b>											
T	T	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="T"/>
T	F	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="F"/>
F	T	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="T"/>
F	F	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="F"/>

Counterexample

Submit

Check

## Problem 7

3.07

 $\neg(a \rightarrow b) \vdash \neg(b \rightarrow a)$ 

<b>a</b>	<b>b</b>	<b><math>\neg ( a \rightarrow b ) \vdash \neg ( b \rightarrow a )</math></b>									
T	T	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
T	F	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
F	T	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
F	F	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Counterexample

Submit

Check

## Problem 8

3.08

 $(a \rightarrow (b \rightarrow c)), (a \vee b) \vdash c$ 

<b>a</b>	<b>b</b>	<b>c</b>	<b><math>( a \rightarrow ( b \rightarrow c ) ), ( a \vee b ) \vdash c</math></b>											
T	T	T	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
T	T	F	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
T	F	T	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
T	F	F	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
F	T	T	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
F	T	F	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
F	F	T	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
F	F	F	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Counterexample

Submit

Check

## Problem 9

3.09

$$(p \leftrightarrow \neg q) \vdash ((p \vee q) \wedge \neg(p \wedge q))$$

$pq$	$(p \leftrightarrow \neg q)$	$\vdash$	$((p \vee q) \wedge \neg(p \wedge q))$
TT	<input type="text" value="T"/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value="T"/> <input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="T"/> <input type="text" value=""/> <input type="text" value="T"/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value="T"/> <input type="text" value=""/>
TF	<input type="text" value="T"/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value="F"/> <input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="T"/> <input type="text" value=""/> <input type="text" value="F"/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value="T"/> <input type="text" value=""/>
FT	<input type="text" value="F"/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value="T"/> <input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="F"/> <input type="text" value=""/> <input type="text" value="T"/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value="F"/> <input type="text" value=""/>
FF	<input type="text" value="F"/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value="F"/> <input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="F"/> <input type="text" value=""/> <input type="text" value="F"/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value="F"/> <input type="text" value=""/>

Counterexample

Submit

Check

## Problem 10

3.10

$$\neg(p \leftrightarrow q) \vdash ((p \vee q) \wedge \neg(p \wedge q))$$

$pq$	$\neg(p \leftrightarrow q)$	$\vdash$	$((p \vee q) \wedge \neg(p \wedge q))$
TT	<input type="text" value=""/> <input type="text" value="T"/> <input type="text" value=""/> <input type="text" value="T"/> <input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="T"/> <input type="text" value=""/> <input type="text" value="T"/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value="T"/> <input type="text" value=""/>
TF	<input type="text" value=""/> <input type="text" value="T"/> <input type="text" value=""/> <input type="text" value="F"/> <input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="T"/> <input type="text" value=""/> <input type="text" value="F"/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value="T"/> <input type="text" value=""/>
FT	<input type="text" value=""/> <input type="text" value="F"/> <input type="text" value=""/> <input type="text" value="T"/> <input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="F"/> <input type="text" value=""/> <input type="text" value="T"/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value="F"/> <input type="text" value=""/>
FF	<input type="text" value=""/> <input type="text" value="F"/> <input type="text" value=""/> <input type="text" value="F"/> <input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="F"/> <input type="text" value=""/> <input type="text" value="F"/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value="F"/> <input type="text" value=""/>

Counterexample

Submit

Check

## Assessing validity via equivalences and substitution

Consider reviewing the examples in the Week 3 Lecture 1 sections [Valid arguments and equivalences](#) and [Valid arguments from substitution](#) before trying these next five problems. While they are multiple choice and thus in some sense easier, please make sure you understand *how* to get the right answer, since we will be asking similar questions in the exam.

### Problem 11

The following is a valid argument:

$$\neg(\neg a \vee \neg b) \vdash a \wedge b$$

Which laws can you use to see this, by using the valid arguments obtained from equivalences and by replacing equivalents by equivalents?

3.11

Which laws?

- ☐ DeMorgan and law of non-contradiction.
- ☐ Distribution and double-negation.
- ☐ DeMorgan and double-negation.
- ☐ Commutativity of disjunction and DeMorgan.

Submit

Check

### Problem 12

The following is a valid argument:

$$p \vee q, p \vee r \vdash p \vee (q \wedge r)$$

Which laws can you use to see this, by using the valid arguments obtained from equivalences and by viewing the premises of an argument as joined together with conjunctions?

3.12

Which laws?

- ☐ DeMorgan.
- ☐ Distribution.
- ☐ Associativity of disjunction.
- ☐ Commutativity of disjunction.

Submit

Check



### Problem 13

The following is a valid argument:

$$a \wedge (b \wedge c) \rightarrow d \vee (e \vee f), \neg(d \vee (e \vee f)) \vdash \neg(a \wedge (b \wedge c))$$

It can be obtained from modus tollens  $p \rightarrow q, \neg q \vdash \neg p$  by doing a substitution. Which substitution should you do in order to obtain it?

3.13

Which substitution?

- ☐ Substitute  $a \wedge (b \wedge c)$  for  $\sim p$ , and substitute  $d \vee (e \vee f)$  for  $\sim q$ .
- ☐ Substitute  $a \wedge (b \wedge c)$  for  $p$ , and substitute  $d \vee (e \vee f)$  for  $q$ .
- ☐ Substitute  $a \wedge (b \wedge c)$  for  $\sim p$ , and substitute  $d \vee (e \vee f)$  for  $q$ .
- ☐ Substitute  $a \wedge (b \wedge c)$  for  $q$ , and substitute  $d \vee (e \vee f)$  for  $p$ .

Submit

Check

### Problem 14

The following is a valid argument:

$$(a \rightarrow b) \rightarrow \neg c, a \rightarrow b \vdash \neg c$$

It can be obtained from modus ponens  $p \rightarrow q, p \vdash q$  by doing a substitution. Which substitution should you do in order to obtain it?

3.14

Which substitution?

- ☐ Substitute  $a$  for  $p$ , and substitute  $b \rightarrow \sim c$  for  $q$ .
- ☐ Substitute  $(a \rightarrow b)$  for  $q$ , and substitute  $\sim c$  for  $p$ .
- ☐ Substitute  $(a \rightarrow b) \rightarrow \sim c$  for  $p$ , and substitute  $a \rightarrow b$  for  $q$ .
- ☐ Substitute  $(a \rightarrow b)$  for  $p$ , and substitute  $\sim c$  for  $q$ .

Submit

Check

### Problem 15

One and only one of the following is a valid argument. Which is it? *Hint: it can be obtained from the disjunctive syllogism together with DeMorgan.*

3.15

Which one is valid?

- ☐  $\sim(a \wedge (b \wedge c)), a \vdash \sim b \vee \sim c$
- ☐  $\sim(a \wedge (\sim b \wedge \sim c)), a \vdash \sim b \vee \sim c$
- ☐  $\sim(a \wedge (\sim b \wedge \sim c)), \sim b \vdash b \vee \sim c$
- ☐  $\sim(a \wedge (\sim b \wedge \sim c)), \sim c \vdash \sim b \vee c$

Submit

Check

## Assessing soundness

In the following three problems, we focus on the following set of facts from [this Wikipedia page](#) on American cities, their state, and their size:

- Phoenix, Arizona, 1,660,272
- Philadelphia, Pennsylvania, 1,584,138
- San Antonio, Texas, 1,532,233
- San Diego, California, 1,425,976
- Dallas, Texas, 1,345,047
- San Jose, California, 1,030,119
- Austin, Texas, 964,254
- Jacksonville, Florida, 903,889
- Fort Worth, Texas, 895,008
- Columbus, Ohio, 892,533
- San Francisco, California 883,305

### Problem 16

The following are four valid arguments which would be translated by substitution instances of modus ponens. But only one of the arguments is sound. Which one is it?

Which one is sound?

☐

If Austin is in Arizona, then Austin is in the same state as Dallas. Austin is in Arizona. Therefore, Austin is in the same state as Dallas.

☐

If Dallas is in Texas, then Dallas is in the same state as Fort Worth. Dallas is in Texas. Therefore, Dallas is in the same state as Fort Worth.

☐

If Austin is in Texas, then Austin is in the same state as Phoenix. Austin is in Texas. Therefore, Austin is in the same state as Phoenix.

☐

If Dallas is in Arizona, then Dallas is in the same state as Phoenix. Dallas is in Arizona. Therefore, Dallas is in the same state as Phoenix.

Submit

Check

### *Problem 17*

The following are four valid arguments which would be translated by substitution instances of modus tollens. But only one is sound. Which one is it?

Which one is sound?

☐

If San Jose is bigger than New York, then San Jose is bigger than Jacksonville. But San Jose is not bigger than Jacksonville. Therefore, San Jose is not bigger than New York.

☐

If San Diego is bigger than San Jose, then San Diego is bigger than Jacksonville. But San Diego is not bigger than Jacksonville. Therefore, San Diego is not bigger than San Jose.

☐

If San Jose is bigger than New York, then San Jose is bigger than LA. But San Jose is not bigger than LA. Therefore, San Jose is not bigger than New York.

☐

If San Diego is bigger than Jacksonville, then San Diego is bigger than San Jose. But San Diego is not bigger than San Jose. Therefore San Diego is not bigger than Jacksonville.

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### Problem 18

The following are four valid arguments which would be translated by substitution instances of disjunctive syllogism. But only one is sound. Which one is it?

3.18

Which one is sound?

☐

Not both Austin and Fort Worth are the biggest cities in Texas. But Austin is the biggest city in Texas. Therefore, Fort Worth is not the biggest city in Texas.

☐

Not both Los Angeles and San Jose are the biggest cities in California. But Los Angeles is the biggest city in California. Therefore, San Jose is not the biggest city in California.

☐

Not both Austin and Fort Worth are in Texas. But Austin is in Texas. Therefore, Fort Worth is not in Texas.

☐

Not both Los Angeles and Fort Worth are in California. But Fort Worth is in California. Therefore, Los Angeles is not in California.

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### Problem 19

One and only one of the following statements is always true about valid arguments:

3.19

Which of the following is always true?

☐

If a valid argument has a true conclusion, then it has a true premise.

☐

If a valid argument has a true conclusion, then it has a false premise.

☐

If a valid argument has a false conclusion, then it has a true premise.

☐

If a valid argument has a false conclusion, then it has a false premise.

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Problem 20

Which of the following is impossible?

3.20

Which of the following is impossible?

- ☐ a valid unsound argument
- ☐ a valid sound argument
- ☐ an invalid sound argument
- ☐ an invalid unsound argument

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This is a homework set for [this course](#). It is run on the Carnap software, which is an:

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