

Logic, First Course, Winter 2020. Week 5, Homework (due **Thursday February 6** by 09:15am).

Week 5, Homework

This homework is a review for the midterm exam, and so takes the form of a practice exam. Hence, the problems fall into groups corresponding to the first four weeks:

- [Week 1 problems](#)
- [Week 2 problems](#)
- [Week 3 problems](#)
- [Week 4 problems](#)

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 [INSERT](#).

Week 1 problems

Successively find the main connectives (pressing 'return' to move to next connective), until the tree diagram has been drawn. Be sure to submit your solution after you are done.

Problem 1

5.01

Submit

$(a \vee (b \vee (a \rightarrow b)))$

Problem 2

5.02

Submit

$((a \rightarrow (b \rightarrow a)) \rightarrow a)$

For these next three problems, complete the truth-table. Check your truth-table for correctness and then **submit** it.

Problem 3

5.03

 $(a \vee (b \vee (a \rightarrow b)))$

a	b	(a \vee (b \vee (a \rightarrow b)))							
T	T	<input type="text" value="T"/>	<input type="text"/>	<input type="text" value="T"/>	<input type="text"/>	<input type="text" value="T"/>	<input type="text"/>	<input type="text" value="T"/>	<input type="text"/>
T	F	<input type="text" value="T"/>	<input type="text"/>	<input type="text" value="F"/>	<input type="text"/>	<input type="text" value="T"/>	<input type="text"/>	<input type="text" value="F"/>	<input type="text"/>
F	T	<input type="text" value="F"/>	<input type="text"/>	<input type="text" value="T"/>	<input type="text"/>	<input type="text" value="F"/>	<input type="text"/>	<input type="text" value="T"/>	<input type="text"/>
F	F	<input type="text" value="F"/>	<input type="text"/>	<input type="text" value="F"/>	<input type="text"/>	<input type="text" value="F"/>	<input type="text"/>	<input type="text" value="F"/>	<input type="text"/>

Submit

Check

Problem 4

5.04

 $((a \rightarrow (b \rightarrow a)) \rightarrow a)$

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

Submit

Check

Problem 5

5.05

 $\neg(p \vee (p \wedge \neg p))$

p	$\neg (p \vee (p \wedge \neg p))$					
T	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
F	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Submit

Check

Week 2 problems

The next two problems concern translations into *propositional logic*. Remember that on the translation problems, to check them on the computer you just press 'return.' And don't forget to **submit** them after that.

Problem 6

b = you can be a good neighbor

h = you have good neighbors

5.06

you can be a good neighbor only if you have :

Submit

you can be a good neighbor only if you have good neighbors.

Problem 7

f = the free enterprise system functions well

p = there is world peace.

5.07

The free enterprise system functioning well :

The free enterprise system functioning well is a necessary but not a sufficient condition for there being world peace.

In the next two problems, determine whether the formula is a tautology or not.

Problem 8

5.08

 $((p \rightarrow q) \rightarrow ((o \rightarrow p) \rightarrow (o \rightarrow q)))$

opq	((p → q) → ((o → p) → (o → q)))											
TTT	<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="T"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>
TTF	<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="T"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>
TFT	<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="F"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>
TFF	<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="F"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>
FTT	<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="T"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>
FTF	<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="T"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>
FFT	<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="F"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="T"/>	<input type="text" value=""/>
FFF	<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="F"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>	<input type="text" value="F"/>	<input type="text" value=""/>

Is the formula a tautology?

☐ Yes.

☐ No.

Check

Note: you cannot submit the yes/no question here, but you can check your answer. The reason we don't have the yes/no answer submitted here is that it would mess up the carnap.io's default of assigning five points per problem. In the exam format, we will simply compress the problem and the associated yes/no answer into one single five point problem. Please don't forget to submit your answer to the question immediately above the yes/no answer though!

Problem 9

5.09

$((o \rightarrow p) \rightarrow (o \rightarrow q)) \rightarrow (p \rightarrow q)$

o	p	q	(((o → p) → (o → q)) → (p → q))									
T	T	T	T		T		T		T		T	
T	T	F	T		T		F		T		F	
T	F	T	T		F		T		F		T	
T	F	F	T		F		F		F		F	
F	T	T	F		T		T		T		T	
F	T	F	F		T		F		T		F	
F	F	T	F		F		T		F		T	
F	F	F	F		F		F		F		F	

Non-Tautology

Submit

Check

Is

the formula a tautology?

☐ Yes.

☐ No.

Check

Note: you cannot submit the yes/no question here, but you can check your answer. The reason we don't have the yes/no answer submitted here is that it would mess up the carnap.io's default of assigning five points per problem. In the exam format, we will simply compress the problem and the associated yes/no answer into one single five point problem. Please don't forget to submit your answer to the question immediately above the yes/no answer though!

Problem 10.

Consider the tautology $(\neg a \wedge (\neg b \wedge \neg c)) \leftrightarrow ((\neg a \wedge \neg b) \wedge \neg c)$. Which of the following is this a substitution instance of?

5.10

Which one?

☐ Law of commutativity for conjunction.

☐ Law of distribution.

☐ Law of associativity for conjunction.

☐ DeMorgan.

Submit

Check

Week 3 problems

In the next two problems, determine whether the argument is valid or not.

Problem 11.

5.11

(a ∧ ¬b) ⊢ ¬(a → b)

a	b	(a	∧	¬	b)	⊢	¬	(a	→	b)	
T	T	T	↕		↕		↕	T	↕		↕		↕	T	↕
T	F	T	↕		↕		↕	F	↕		↕		↕	T	↕
F	T	F	↕		↕		↕	T	↕		↕		↕	F	↕
F	F	F	↕		↕		↕	F	↕		↕		↕	F	↕

CounterexampleSubmitCheck

Is the argument valid?

☐ Yes.

☐ No.

Check

Note: you cannot submit the yes/no question here, but you can check your answer. The reason we don't have the yes/no answer submitted here is that it would mess up the carnap.io's default of assigning five points per problem. In the exam format, we will simply compress the problem and the associated yes/no answer into one single five point problem. Please don't forget to submit your answer to the question immediately above the yes/no answer though!

Problem 12.

5.12

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

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

Counterexample

Submit

Check

Is the argument valid?

☐ Yes.☐ No.

Check

Note: you cannot submit the yes/no question here, but you can check your answer. The reason we don't have the yes/no answer submitted here is that it would mess up the carnap.io's default of assigning five points per problem. In the exam format, we will simply compress the problem and the associated yes/no answer into one single five point problem. Please don't forget to submit your answer to the question immediately above the yes/no answer though!

Problem 13.

The following is a valid argument:

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

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

5.13

Which substitution?

- ☐ Substitute $a \vee b$ for p , and substitute $a \vee \neg b$ for q .
- ☐ Substitute $a \vee \neg b$ for p , and substitute $a \vee b$ for q .
- ☐ Substitute $a \vee b$ for p , and substitute $a \wedge b$ for q .
- ☐ Substitute $\neg a \vee b$ for p , and substitute $\neg a \wedge b$ for q .

Submit

Check

Problem 14

One and only one of the following is a valid argument. Which is it?

5.14

Which one is valid?

- ☐ $a \vee (b \wedge c) \vdash a \wedge c$
- ☐ $a \vee (b \vee c), \neg a \vdash b$
- ☐ $a \rightarrow b, b \rightarrow c, c \rightarrow d \vdash a \rightarrow d$
- ☐ $\neg a \rightarrow \neg b, \neg b \vdash \neg a$

Submit

Check

Problem 15

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

5.15

Which of the following is always true?

- ☐ If an argument is valid, then its conclusion is a tautology.
- ☐ If an argument has a conclusion which is a tautology, then it is valid.
- ☐ If an argument has premises which are all tautologies, then it is valid.
- ☐ If an argument is valid and has a true conclusion, then it has all true premises.

Submit

Check

Week 4 problems

In the following four problems we use the following key:

a = "1996"

b = "2001"

c = "2008"

L = "was a leap year"

D = "has a Democratic winner "

R = "has a Republican winner"

S = "was a year of economic stagnation"

Remember that on the translation problems, to check them on the computer you just press 'return.' And don't forget to **submit** them after that.

Problem 16

5.16

If 1996 was a leap year and 1996 was not a year of economic stagnation, then not every leap year is a year of economic stagnation.

If 1996 was a leap year and 1996 was not a year of economic stagnation, then not every leap year is a year of economic stagnation.

Problem 17

5.17

2001 was not a leap year and every leap year has a Democratic winner or a Republic winner.

2001 was not a leap year and every leap year has a Democratic winner or a Republic winner.

Problem 18

5.18

Find an equivalent of "some year is not a leap year and is a year of economic stagnation" in predicate logic without using a quantifier, under the hypothesis that there are only three years a,b,c under discussion.

Find an equivalent of "some year is not a leap year and is a year of economic stagnation" in predicate logic without using a quantifier, under the hypothesis that there are only three years a,b,c under discussion.

Problem 19

e = this is a year of economic stagnation

l = this is a leap year (note: the symbol l is a lower-case L)

5.19

Insert a propositional consequence of "Every year of economic stagnation is a leap year".

Insert a propositional consequence of "Every year of economic stagnation is a leap year".

Problem 20

5.20

Which of the following is $\sim \text{Ex}(\text{Fx} \wedge \sim \text{Fx})$ equivalent to?

☐ $\text{Ax}(\sim \text{Fx} \vee \text{Fx})$

☐ $\text{Ax}(\sim \text{Fx} \wedge \text{Fx})$

☐ $\text{Ex}(\sim \text{Fx} \vee \text{Fx})$

☐ $\text{Ex}(\sim \text{Fx} \wedge \text{Fx})$

Submit

Check

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