CSE215
Foundations of Computer Science

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September 14, 2022

Today

Homework 01

- To finish by 4h25

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* Exercise 1 (score = 10)
Construct the truth table for the following statement forms:

1. false \/ p
2. True /\ p
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Solution

p	false \/ p
true	true
false	false

p	true \/ p
true	true
false	false

* Exercise 2 (score = 30)

Write truth tables for the following statement forms.

1. p -> q
2. ~p \/ q
3. q -> p
4. ~q \/ p
5. ~q -> ~p
6. ~p -> ~q

* Exercise 3 (score = 15)

  Among the six statement forms in Exercise 2, find at least five pairs that are equivalent? For example, if you believe statement forms 1 and 2 in Exercise 2 are equivalent, you have found a pair (1, 2).

Solution

Exercise 2

		1.	2.	3.	4.	5.	6.
P	q	$P \to q$	$\sim P \vee q$	$q \to P$	$\sim q \vee P$	$\sim q \to \sim P$	$\sim P \to \sim q$
T	T	T	T	T	T	T	T
T	F	F	F	T	T	F	T
F	T	T	T	F	F	T	F
F	F	T	T	T	T	T	T

Exercise 3

- 1, 2, 5 are equivalent
- 3, 4, 6 are equivalent

* Exercise 4. (score = 20)

Make a truth table for the prroposition ~P ∧ (Q → P). What can you conclude about P and Q if you know the statement is true?

Solution

P	Q	~P	Q->P	~P∧(Q->P)
T	T	F	T	F
T	F	F	T	F
F	T	T	F	F
F	F	T	T	T

If the whole statement is true, then P is false and Q is false.

* Exercise 5. (score = 15)
For each statement form below, use truth tables to determine if it is a tautology, contradiction, or neither.

1. (~p\/q)\/(p/\~q)
2. (p/\~q)∧(~p\/q)
3. (p/\q)\/(~p\/(p/\~q))

Solution

5.

P	Q	~P∨Q	P∧~Q	(~P∨Q) ∨(P∧~Q)
T	T	T	F	T
T	F	F	T	T
F	T	T	F	T
F	F	T	F	T

(~P∨Q)∨(P∧~Q) is a tautology.

P	Q	P∧~Q	~P∨Q	(P∧~Q) ∧(~P∨Q)
T	T	F	T	F
T	F	T	F	F
F	T	F	T	F
F	F	F	T	F

(P∧~Q)∧(~P∨Q) is a contradiction.

P	Q	P∧Q	P∧~Q	~P∨(P∧~Q)	(P∧Q)∨(~P∨(P∧~Q))
T	T	T	F	F	T
T	F	F	T	T	T
F	T	F	F	T	T
F	F	F	F	T	T

(P∧Q)∨(~P∨(P∧~Q)) is a tautology.

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* Exercise 6. (score = 10)

  Check if the two statement forms below are logically equivalent using a truth table

-  p \/ q -> r
- (p -> r) /\ (q ->r)
```

Solution

6.

P	Q	R	PVQ	(PVQ)->R	P->R	Q->R	(P->R)∧(Q->R)
T	T	T	T	T	T	T	T
T	T	F	T	F	F	F	F
T	F	T	T	T	T	T	T
T	F	F	T	F	F	T	F
F	T	T	T	T	T	T	T
F	T	F	T	F	T	F	F
F	F	T	F	T	T	T	T
F	F	F	F	T	T	T	T

They are logically equivalent.