Chapter 1 - Sutroduction logic = 'the word' / 'what is spoken' (fluient Greek)

-> 'thought' / 'reason' (today) Chapter 2 - Logic logical deduction:

premises — "All humans are mortal."

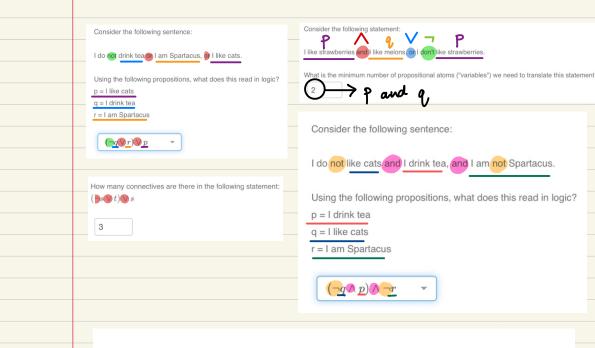
Socrates is human."

conclusion — Socrates is mortal." proposition—a statement that has a truth value ex. Delft is a city. - either true or false subject predicate quantifiers - 'all', 'some', 'none' 1. Propositional Logic 1.1. Propositions - statement that is either true or Salse p.g.r - propositional variable

mathematical generality

1.2 Logical operators/connectives 'and' 'or' 'wot' conjunction disjunction negation Ded p \ q = true only when p=true and q = true p \ q = false only when p = false and q = false p = true only when p = false 1.3. Precedence rules compound proposition—made up of simpler

J J. /		) <b>-</b> '	V				
$\Lambda$ - associative	p	9	r	<i>p</i> ∧ <i>q</i>	$q \wedge r$	$(p \wedge q) \wedge r$	$p \wedge (q \wedge r)$
main connective	0	0	0	0	0	0	0
	0	0 1	1 0	0	0	0	0
	0	1 0	1 0	0	1 0	0 0	0
	1	0 1	1	0 1	0	0	0
	1	1	1	1	1	1	1



### Consider the following sentence:

I like dogs or I am Spartacus, and I am a madman with a box.

Using the following propositions, what does this read in logic?

p = I am a madman with a box

q = I like dogs

r = I am Spartacus



1.4. Logical equivalence truth table situation - individual combination logically equivalent

Co	Consider the following proposition:			
((e	$q \wedge p) \vee p$	= P		
р	q	resulting truth value		
0	0	0		
0	1	0		
1	0	1		
1	1	1		

Consider a statement which is comprised of unique atoms and 12 connectives.

If we want to show all intermediate steps, how many *rows* should our truth table have?

Consider a statement which is comprised of 4 unique atoms and 13 connectives.

If we want to show all intermediate steps, how many *columns* should our truth table have?

17 = 4 + 13

## 1.5. More logical operaters

conditional operator >> biconditional operator <> exclusive or operator

-				
р	q	$p \rightarrow q$	$p \leftrightarrow q$	$p \oplus q$
0	0	1	1	0
0	1	1	0	1
1	0	0	0	1
1	1	1	1	0

## 1.6. Luplications in English

p → q — implication/conditional

p implies q

if p — hypothesis/antecedant

frue q — conclusion/consequent

p is sufficient for q/q is necessary for p

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Consider the following sentence:

I do not like dogs if and only if I do not drink tea, if and only if I like lorek the bear.

Using the following propositions, what does this read in logic?

p = I like dogs

q = I like lorek the bear

r = I drink tea

$$(\neg p \leftrightarrow \neg r) \leftrightarrow q$$

Consider the following sentence:

I like dogs and I drink tea, and I am not a lawyer.

Using the following propositions, what does this read in logic?

p = I am a lawyer

q = I like dogs

r = I drink tea

$$(q \wedge r) \wedge \neg p$$

Exy 
$$\Rightarrow$$
 associative?  
 $(p \rightarrow q) \rightarrow r \stackrel{?}{=} p \rightarrow (q \rightarrow r)$   
 $p \neq r \quad s \quad t \quad s \rightarrow r \quad p \rightarrow t$   
 $0 \quad 0 \quad 0 \quad 1 \quad 1 \quad 0 \quad 1$   
 $0 \quad 1 \quad 0 \quad 1 \quad 0 \quad 1$   
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$$(p \leftrightarrow q) \leftrightarrow r \stackrel{?}{=} p \leftrightarrow (q \leftrightarrow r)$$
associative

Ex.S a) pVq b) p \( \phi \)

Ex.S a) Galileo wasn't accused and the Earth is the centre of the universe.

b) The Earth moves, therefore the Earth is not the centre of the universe.

c) The Earth moves if and only if the Earth is not the centre of the universe

d) The Earth moves so Galileo was accused or the Earth is the centre of the universe so Galileo wasn't accused.

Ex. F a) If you are good, Sinter blaas brings you toys converse. If sinter blaas brings you toys, you are good, contrapositive: If Sinter blaas doesn't bring you toys, you are not good.

b) If the package weighs more than one kilo, then you need exerce and a

b) If the package weighs more than one kilo, then you need extra postage is you need extra postage, then the package weighs more than one kilo.

contrapositive: If you don't need extra postage, then the package doesn't weigh more than one kilo.

c) If I have a choice, I don't eat conrecte.

If I don't ead conrecte, I have a choice.

If I eat conrecte, I don't have a choice.

Ex.8

a) 1 b) 7 c) 1 d) 1

TA 1/1

#### 1. Formulating precisely

Consider the following claims and arguments written in English. Formulate a logically precise claim in propositional logic using logical operators to represent the claim. For instance for "I like puzzles and like tea", one might use  $p \land q$  where p is "I like puzzles" and r is "I like tea.".

 $Q(p) \vee Q(\neg p)$ 

- (a) (2 min.) If I do this homework, then I have a greater chance at passing the course.
- (b) (2 min.) Only if I do this homework will I get feedback from TA's.
- (c) (2 min.) I can choose to do the MC-test in week 3 or I can choose not to.
- (d) (4 min.)

If I pass the course, then I have practiced well.

If I pass the course, then I have passed the endterm.

I have practiced well and passed the endterm.

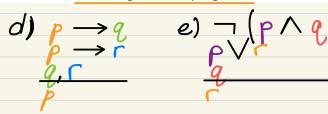
Therefore, I have passed the course.

(e) (4 min.)

It is not true that: I do the homework and I do not get feedback from TA's. I do the homework or I do not have a greater chance of passing the course.

I do not get feedback from the TA's

Therefore, I do not have a greater chance of passing the course.



## d. Boolean Algebra

Double negation	$\neg(\neg p) \equiv p$
Excluded middle	$p \lor \neg p \equiv \mathbb{T}$
Contradiction	$p \land \neg p \equiv \mathbb{F}$
Identity laws	$\mathbb{T} \wedge p \equiv p$
	$\mathbb{F}\vee p\equiv p$
Idempotent laws	$p \wedge p \equiv p$
	$p \lor p \equiv p$
Commutative laws	$p \wedge q \equiv q \wedge p$
	$p \lor q \equiv q \lor p$
Associative laws	$(p \wedge q) \wedge r \equiv p \wedge (q \wedge r)$
	$(p \lor q) \lor r \equiv p \lor (q \lor r)$
Distributive laws	$p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$
	$p \lor (q \land r) \equiv (p \lor q) \land (p \lor r)$
DeMorgan's laws	$\neg(p \land q) \equiv (\neg p) \lor (\neg q)$
	$\neg(p\vee q)\equiv(\neg p)\wedge(\neg q)$