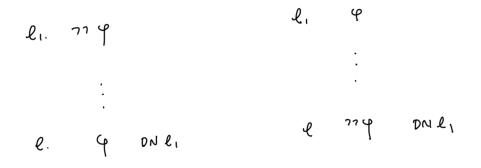
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Logic, First Course, Winter 2020. Week 8, Lecture 1, Handout.

## Double negation rule



Law of the excluded middle

Since we will often want to appeal to double-negation without having to redo this proof over and over, we simply include a new rule for law of the excluded middle which says that one can always put  $\phi \lor \neg \phi$  on a line, and justify it as LEM . Note that no line number is put down as part

of the justification.

. . . φνηφ LEM

## Other derived rules

- Law of excluded middle: p ∨ ¬p is a tautology. Abbreviation: LEM
- Law of non-contradiction:  $\neg(p \land \neg p)$  is a tautology. Abbreviation: LNC
- The law of double-negation: p is equivalent to ¬¬p. Abbreviation: DN
- Law of commutativity for conjunction:  $p \land q$  is equivalent to  $q \land p$ . Abbreviation: LCC
- Law of commutativity for disjunction:  $p \lor q$  is equivalent to  $q \lor p$ . Abbreviation LCD.
- Law of associativity for conjunction: (p ∧ q) ∧ r is equivalent to p ∧ (q ∧ r). Abbreviation:

  LAC
- Law of associativity for disjunction:  $(p \lor q) \lor r$  is equivalent to  $p \lor (q \lor r)$ . Abbreviation: LAD
- Law of distribution, part 1: p ∧ (q ∨ r) is equivalent to (p ∧ q) ∨ (p ∧ r). Abbreviation: LDC (where the final "C" is short for the initial conjunction)
- Law of distribution, part 2: p ∨ (q ∧ r) is equivalent to (p ∨ q) ∧ (p ∨ r). Abbreviation: LDD (where the final "D" is short for the initial disjunction)