

Workshop 1: Logic

1. Which of the following are statements?

- a. Papaya salad is spicy.
- b. How are you today?
- c. Computer scientists love discrete mathematics.
- d. If I was an animal then I would be a monkey.
- e. Please mind the gap between the train and the platform.

2. Write down the truth tables for implication and equivalence, then:

- a. Use truth tables to prove that $(A \Leftrightarrow B) \Leftrightarrow C$ is the same as $A \Leftrightarrow (B \Leftrightarrow C)$.
- b. Is the same true for $(A \Rightarrow B) \Rightarrow C$ and $A \Rightarrow (B \Rightarrow C)$? Use truth tables to prove it.
- c. Consider a statement S with n variables. How many rows would the truth table for S have?

3. Use the laws of logic (and not truth tables) to simplify the following statements:

- a. $\neg(\neg A \wedge \neg B) \wedge (\neg A \vee B)$
- b. $\neg(A \Rightarrow A) \Rightarrow (A \Rightarrow (B \Rightarrow \neg A))$
- c. $(\neg A \vee B) \Rightarrow ((B \Rightarrow A) \vee (A \Rightarrow B))$

4. Which of the following are either a tautology or a contradiction? Explain why.

- a. $(A \wedge \neg A) \Rightarrow B$
- b. $\neg(A \vee B) \wedge A$
- c. $A \vee B$
- d. $(\neg A \wedge C) \Rightarrow (B \vee C)$

5. In computer hardware, it is common to find a logic gate called NAND (\uparrow). For $A \uparrow B$, the statement is false when both A and B are true, else it is false.

- a. How can you write $A \uparrow B$ using the boolean operators \neg and \wedge ?
- b. Use truth tables to show $A \vee B$ using only \uparrow .
- c. Use laws of logic to show $A \Rightarrow B$ using only \uparrow .