



BITS Pilani
Pilani Campus



CS/IS F214 Logic in Computer Science

MODULE: PROPOSITIONAL LOGIC

Satisfiability and Validity

Validity

- A propositional logic formula ϕ is said to be **valid** if it is TRUE for all valuations
 - i.e. for any assignment of truth values to the atomic propositions occurring in it, ϕ will evaluate to TRUE
- This can be formally stated as
 - $\models \phi$
- A valid formula is also referred to as a **tautology**.
- (Trivial) Question:
 - If you construct a combinational circuit for a valid formula ϕ , what will be its output?



Satisfiability

- A propositional logic formula ϕ is said to be **satisfiable** if there is at least one valuation for which it is TRUE
 - i.e. for at least one assignment of truth values to the atomic propositions occurring in it, ϕ will evaluate to TRUE
- This can be formally stated as follows:
 - If p_1, p_2, \dots, p_n are the atomic propositions in ϕ , then there exists a combination L_1, L_2, \dots, L_n such that
$$L_1, L_2, \dots, L_n \models \phi$$
where each L_i is p_i or $\neg p_i$



Satisfiability

- Given a combinational circuit C for a propositional logic formula ϕ :
 - if ϕ is satisfiable what can you say about C ?
 - if ϕ is not satisfiable what can you say about C ?



Satisfiability and Validity

- Is there a relation between satisfiability and validity?
- Consider a formula ϕ
 - If ϕ is valid, *is it satisfiable*?
 - If ϕ is satisfiable, *is it valid*?
- Consider a formula ϕ :
 - If ϕ is valid, what can you say about $\neg\phi$?
 - If ϕ is satisfiable, what can you say about $\neg\phi$?

