Good Morning, Colleagues
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Are there any questions?
Logistics

• Questions about the syllabus?
Logistics

- Questions about the syllabus?
  - Office hours up
Logistics

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  - Office hours up
  - Assignments for next week up
Logistics

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  – Office hours up
  – Assignments for next week up
  – Trying to keep a high pace, but push back if you’re lost
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- Email class-related questions to me, TA, and proctor (or better yet, use piazza)
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- Modules star: Prof. Adam Klivans
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  – Make sure the laws make sense while watching modules
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• Module questions: last is free form
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  – Post it also on piazza!
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- Module questions: last is free form
  - Post it also on piazza!
  - And ask in class!
Logistics (cont.)

- How to treat the book
Logistics (cont.)

- How to treat the book
  - Work problems
Logistics (cont.)

- How to treat the book
  - Work problems
  - Students guide
Logistics (cont.)

• How to treat the book
  – Work problems
  – Students guide

• Class sessions: for working problems
Logistics (cont.)

- How to treat the book
  - Work problems
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- Class sessions: for working problems
  - Even if you get it, be engaged as a teacher
Logistics (cont.)

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  - Point out my mistakes
Logistics (cont.)

• How to treat the book
  – Work problems
  – Students guide

• Class sessions: for working problems
  – Even if you get it, be engaged as a teacher
  – Can’t have the right pace for everyone
  – Point out my mistakes

• Go to discussion section
Logistics (cont.)

• How to treat the book
  – Work problems
  – Students guide

• Class sessions: for working problems
  – Even if you get it, be engaged as a teacher
  – Can’t have the right pace for everyone
  – Point out my mistakes

• Go to discussion section

• Quizzes may happen in class or discussion section
Some important concepts

- Notation: ¬
Some important concepts

• Notation: \( \neg \vee \)
Some important concepts

- Notation: $\neg \lor \land$
Some important concepts

• Notation: $\neg \lor \land \Rightarrow$
Some important concepts

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- Proposition vs. predicate
Some important concepts

- Notation: $\neg \lor \land \Rightarrow$
- Proposition vs. predicate
- Truth table
Some important concepts

- Notation: \( \neg \lor \land \Rightarrow \)

- Proposition vs. predicate

- Truth table
  - Especially for \( P \Rightarrow Q \)
Some important concepts

- **Notation:** \( \neg \lor \land \Rightarrow \)

- **Proposition vs. predicate**

- **Truth table**
  - Especially for \( P \Rightarrow Q \)
  - (Correlation vs. causation)
Some important concepts

• Notation: \( \neg \lor \land \Rightarrow \)

• Proposition vs. predicate

• Truth table
  – Especially for \( P \Rightarrow Q \)
  – (Correlation vs. causation)

• DeMorgan’s laws
Some important concepts

- Notation: ¬ ∨ ∧ ⇒
- Proposition vs. predicate
- Truth table
  - Especially for $P \Rightarrow Q$
  - (Correlation vs. causation)
- DeMorgan’s laws
- CNF and DNF
Some important concepts

- Notation: ¬ ∨ ∧ ⇒

- Proposition vs. predicate

- Truth table
  - Especially for $P \Rightarrow Q$
  - (Correlation vs. causation)

- DeMorgan’s laws

- CNF and DNF
  - Why do we care in practice?
Simplify

\[ (\neg T \lor F) \land (\neg F \lor T) \land \neg (F \lor F) \]
Simplify

\begin{itemize}
  \item \((\neg T \lor F) \land (\neg F \lor T) \land \neg (F \lor F)\)
  \item \(\neg (F \lor \neg (T \land \neg (\neg T \lor \neg (F \land T))))\)
\end{itemize}
Simplify

• \((\neg T \lor F) \land (\neg F \lor T) \land \neg (F \lor F)\)

• \(\neg (F \lor \neg (T \land \neg (\neg T \lor \neg (F \land T))))\)
  \(\equiv \neg (F \lor \neg (T \land \neg (\neg T \lor \neg F)))\)
  \(\equiv \neg (F \lor \neg (T \land \neg (F \lor T)))\)
  \(\equiv \neg (F \lor \neg (T \land \neg T))\)
  \(\equiv \neg (F \lor \neg (T \land F))\)
  \(\equiv \neg (F \lor \neg F)\)
  \(\equiv \neg (F \lor T)\)
  \(\equiv \neg T\)
  \(\equiv F\)
Satisfiable?

\[ (P \lor Q) \land (P \lor \neg Q) \land (\neg P \lor Q) \land (\neg P \lor \neg Q) \]
Satisfiable?

- \((P \lor Q) \land (P \lor \neg Q) \land (\neg P \lor Q) \land (\neg P \lor \neg Q)\)

- \(\neg (A \lor C \lor \neg (B \land \neg A \land \neg (\neg B \lor A \lor C)))\)
CNF, DNF, or neither?

\( \bullet (A \land \neg B) \lor (B \land \neg C) \)
CNF, DNF, or neither?

- \((A \land \neg B) \lor (B \land \neg C)\)

- \((A \land B) \lor (\neg B \land C) \lor \neg (A \land C)\)
Prove equivalence

\[(P \lor Q) \land (\neg P \lor Q) \land \neg(P \lor Q) \equiv F\]
Prove equivalence

\[ (P \lor Q) \land (\neg P \lor Q) \land \neg(P \lor Q) \equiv F \]

Proof

\[ (P \lor Q) \land (\neg P \lor Q) \land \neg(P \lor Q) \text{ (original)} \]
Prove equivalence

\( (P \lor Q) \land (\neg P \lor Q) \land \neg(P \lor Q) \equiv F \)

Proof

\[
(P \lor Q) \land (\neg P \lor Q) \land \neg(P \lor Q) \quad (\text{original})
\]

\[
\equiv ((P \land \neg P) \lor Q) \land \neg(P \lor Q) \quad (\text{dist.})
\]
Prove equivalence

\[ (P \lor Q) \land (\neg P \lor Q) \land \neg (P \lor Q) \equiv F \]

Proof

\[ (P \lor Q) \land (\neg P \lor Q) \land \neg (P \lor Q) \; (\text{original}) \]

\[ \equiv ((P \land \neg P) \lor Q) \land \neg (P \lor Q) \; (\text{dist.}) \]

\[ \equiv (F \lor Q) \land \neg (P \lor Q) \; (\text{negation}) \]
Prove equivalence

\[(P \lor Q) \land (\neg P \lor Q) \land \neg(P \lor Q) \equiv F\]

Proof

\[(P \lor Q) \land (\neg P \lor Q) \land \neg(P \lor Q) \text{ (original)}\]

\[\equiv ((P \land \neg P) \lor Q) \land \neg(P \lor Q) \text{ (dist.)}\]

\[\equiv (F \lor Q) \land \neg(P \lor Q) \text{ (negation)}\]

\[\equiv Q \land \neg(P \lor Q) \text{ (\lor ident.)}\]
Prove equivalence

\[
(P \lor Q) \land (\neg P \lor Q) \land \neg(P \lor Q) \equiv F
\]

Proof

\[
(P \lor Q) \land (\neg P \lor Q) \land \neg(P \lor Q) \quad \text{(original)}
\]
\[
\equiv ((P \land \neg P) \lor Q) \land \neg(P \lor Q) \quad \text{(dist.)}
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\equiv (F \lor Q) \land \neg(P \lor Q) \quad \text{(negation)}
\]
\[
\equiv Q \land \neg(P \lor Q) \quad \text{(\lor ident.)}
\]
\[
\equiv Q \land \neg P \land \neg Q \quad \text{(De Morgan)}
\]
Prove equivalence

\[ (P \lor Q) \land (\neg P \lor Q) \land \neg (P \lor Q) \equiv F \]

Proof

\[ (P \lor Q) \land (\neg P \lor Q) \land \neg (P \lor Q) \text{ (original)} \]
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\[ \equiv Q \land \neg P \land \neg Q \text{ (De Morgan)} \]
\[ \equiv Q \land \neg Q \land \neg P \text{ (commut.)} \]
Prove equivalence

• \((P \lor Q) \land (\neg P \lor Q) \land \neg(P \lor Q) \equiv F\)

Proof

\((P \lor Q) \land (\neg P \lor Q) \land \neg(P \lor Q)\) (original)
\[\equiv ((P \land \neg P) \lor Q) \land \neg(P \lor Q)\] (dist.)
\[\equiv (F \lor Q) \land \neg(P \lor Q)\] (negation)
\[\equiv Q \land \neg(P \lor Q)\] (\(\lor\) ident.)
\[\equiv Q \land \neg P \land \neg Q\] (De Morgan)
\[\equiv Q \land \neg Q \land \neg P\] (commut.)
\[\equiv F \land \neg P\] (negation)
Prove equivalence

\( (P \lor Q) \land (\neg P \lor Q) \land \neg(P \lor Q) \equiv F \)

Proof

\((P \lor Q) \land (\neg P \lor Q) \land \neg(P \lor Q) \) (original)
\(\equiv ((P \land \neg P) \lor Q) \land \neg(P \lor Q) \) (dist.)
\(\equiv (F \lor Q) \land \neg(P \lor Q) \) (negation)
\(\equiv Q \land \neg(P \lor Q) \) (\lor ident.)
\(\equiv Q \land \neg P \land \neg Q \) (De Morgan)
\(\equiv Q \land \neg Q \land \neg P \) (commut.)
\(\equiv F \land \neg P \) (negation)
\(\equiv F \) (\land domination)
Assignments for Thursday

- Module 3 with associated readings
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- Start on first HW assignment (requires module 3 to complete)