UMBC

Logic Practice Module

CMSC 471

Propositional Consequence

- Is this entailment True or False?
  - $P \wedge Q \models P$

Propositional Consequence

- Is this entailment True or False?
  - $P \wedge Q \models P$
  - True

Propositional Consequence

- Is this entailment True or False?
  - $P \models P \vee Q$

Propositional Consequence

- Is this entailment True or False?
  - $P \models P \vee Q$
  - True

Propositional Consequence

- Is this entailment True or False?
  - $\neg P \models P \rightarrow Q$

Propositional Consequence

- Is this entailment True or False?
  - $\neg P \models P \rightarrow Q$
  - True

Propositional Consequence

- Is this entailment True or False?
  - $\neg P \models \neg \neg P$

Propositional Consequence

- Is this entailment True or False?
  - $\neg P \models \neg \neg P$
  - False

English to FOL

- All students are smart.
- There exists a student.
- There exists a smart student.

English to FOL

- All students are smart.
  - $\forall x$ (Student (x) $\Rightarrow$ Smart (x))
- There exists a student.
  - $\exists x$ Student(x)
- There exists a smart student.
  - $\exists x$ (Student(x) $\wedge$ Smart (x))

English to FOL

- Bill is a student.
- Bill takes Analysis or Geometry (or both).
- Bill takes Analysis and Geometry.
- Bill takes either Analysis or Geometry (but not both).

English to FOL

- Bill is a student.
  - Student(Bill)
- Bill takes Analysis or Geometry (or both).
  - Takes(Bill, Analysis) ∨ Takes(Bill, Geometry)
- Bill takes Analysis and Geometry.
  - Takes(Bill, Analysis) ∧ Takes(Bill, Geometry)
- Bill takes either Analysis or Geometry (but not both).
  - Takes(Bill, Analysis) ⇔ ¬Takes(Bill,Geometry)
  - (Takes(Bill, Analysis) ∧ ¬Takes(Bill,Geometry)) ∨ (¬ Takes(Bill, Analysis) ∧ Takes(Bill,Geometry))
  - ¬(Takes(Bill, Analysis) ⇔ Takes(Bill,Geometry))

English to FOL

- Bill has at least one sister.
- Bill has no sister.
- Bill has at most one sister.
- Bill has exactly one sister.
- Bill has at least two sisters

English to FOL

- Bill has at least one sister.
  - $\exists x\ \text{Sister}(x, \text{Bill})$
- Bill has no sister.
  - $\neg\exists x\ \text{Sister}(x, \text{Bill})$
- Bill has at most one sister.
  - $\forall x\ \forall y\ (\text{Sister}(x, \text{Bill}) \wedge \text{Sister}(y, \text{Bill}) \Rightarrow x=y)$
- Bill has exactly one sister.
  - $\exists x\ (\text{Sister}(x, \text{Bill}) \wedge \forall y\ (\text{Sister}(y, \text{Bill}) \Rightarrow x=y))$
- Bill has at least two sisters
  - $\exists x\ \exists y\ (\text{Sister}(x, \text{Bill}) \wedge (\text{Sister}(y, \text{Bill}) \wedge \neg(x=y))$

English to FOL

- Only one student failed History.
- No student failed Chemistry, but at least one student failed History.
- Every student who takes Analysis also takes Geometry.
- No student can fool all the other students.

English to FOL

- Only one student failed History.
  - $\exists x\ (Student(x) \wedge Failed(x, History) \wedge \forall y\ (Student(y) \wedge Failed(y, History) \Rightarrow x=y))$
- No student failed Chemistry, but at least one student failed History.
  - $\neg\exists x\ (Student(x) \wedge Failed(x, Chemistry)) \wedge \exists x\ (Student(x) \wedge Failed\ (x, History))$
- Every student who takes Analysis also takes Geometry.
  - $\forall x\ (Student(x) \wedge Takes(x, Analysis) \Rightarrow Takes(x, Geometry))$
- No student can fool all the other students.
  - $\neg\exists x\ (Student(x) \wedge \forall y\ (Student(y) \wedge \neg(x=y) \Rightarrow Fools(x, y)))$

English to FOL

- Some dog is larger than every cat.
- Every dog chases some cat (or other).
- There is a (particular) cat that every dog chases
- Jimmy is the largest dog.

English to FOL

- Some dog is larger than every cat.
- $\exists x\ (Dog(x) \wedge \forall y\ (Cat(y) \rightarrow Larger(x, y)))$
- Every dog chases some cat.
- $\forall x\ (Dog(x) \rightarrow \exists y\ (Cat(y) \wedge Chases(x, y)))$
- There is a (particular) cat that every dog chases
- $\exists y\ (Cat(y) \wedge \forall x\ (Dog(x) \rightarrow Chases(x, y)))$
- Jimmy is the largest dog.
- $Dog(Jimmy) \wedge \forall y\ ((Dog(y) \wedge \neg(y=Jimmy)) \rightarrow Larger(Jimmy, y))$