

## Math 114, Extra Midterm Prep

- Translate the following sentences into (a) first order logic (if the sentence is ambiguous, make sure you know how to translate all reasonable interpretations, and what the difference is):
  - Every student in this class is smarter than Jim.
  - There is a person who, when they drink, everyone drinks.
  - Every cube is left of a tetrahedron.
  - Every cube is left of two tetrahedrons.
  - Everyone likes someone.
  - If something is a cube, it is not a tetrahedron.
  - Every farmer who owns a donkey buys hay.
  - Every farmer who owns a donkey beats it.
- Given an English sentence corresponding to each of the following:
  - $\forall x(Bx \rightarrow \exists yCxy)$
  - $\forall x((\exists yDxy) \rightarrow \forall zQxz)$
  - $\exists x(Px \rightarrow \forall yCy)$

- Which variables occur free in the formula

$$\forall v_3 \exists v_2 (Pv_4 \wedge Rv_5 \wedge \forall v_4 Qv_3 v_2 v_4).$$

- Which variables occur free in the formula

$$\forall v_1 P v_1 \wedge v_1$$

(hint: the answer is not the empty set)