

CS2022/MA2201
HW#1

DUE: Thursday, September 4

1. (6 points) Do **Exercise 1.1.10** from our text.
2. (3 points) Do **Exercise 1.1.22** from our text.
3. (3 points) (a) Is an implication logically equivalent to its converse?
(b) Is an implication logically equivalent to its contrapositive?
(c) Is an implication logically equivalent to its inverse?
4. (5 points) Do **Exercise 1.3.10** from our text.
5. (9 points) Suppose the universe of discourse is all living people, and the predicates are:
 $M(x)$: x is a male
 $F(x)$: x is a female
 $A(x,y)$: x is an ancestor of y .
 $H(x,y)$: x is the mother of y .

Write each of the following statements using the above predicates and any needed quantifiers:

- (a) *Ben* is *Maia*'s mother.
- (b) All mothers are women.
- (c) If you are a female ancestor, then you are a mother.
- (d) There is a person who is male and female.
- (e) There is a female.
- (f) There is a male who is not a mother.

Write each of the following in good English.

- (g) $H(\text{Isaac}, \text{Maia})$
- (h) $\neg(\exists z)A(\text{Isaac}, z)$
- (i) $(\forall x)((\exists y)H(y, x) \rightarrow M(x))$

6. (4 points) For each of the following, tell whether or not the statement is a tautology, a contingency or a contradiction.

- (a) $(\forall x)(P(x) \vee \neg P(x))$
- (b) $(\forall x)(P(x) \wedge \neg P(x))$
- (c) $(\forall x)(P(x) \rightarrow \neg P(x))$
- (d) $(\forall x)(P(x) \rightarrow P(x))$