

## PORTFOLIO OF OPEN PROBLEM SETS. PT. 1

ENGLISH SEMANTICS  
DUE ON WED, 12 OCT 2016

- (1) Let  $A = \{a, b, c\}$  and  $A' = \{A\}$ .
- Is  $A$  a subset of  $A'$ ?
  - Is  $\{A\}$  a subset of  $A$ ?
  - Is  $a$  a member of  $A'$ ?
  - List all of the subsets of  $A$ .
- (2) Let  $A = \{a, b, c\}$  and  $B = \{a, d, e\}$ .
- What is the intersection of  $A$  and  $B$ ?
  - What is the union of  $A$  and  $B$ ?
  - What is the complement of  $A$  in  $B$ ?
- (3) Are the following true or false?
- $\langle a, b \rangle = \langle b, a \rangle$
  - $\{a, b\} = \{b, a\}$
- (4) Which of the following relations is a function? Justify your answer.
- a.  $\begin{bmatrix} a \mapsto b \\ c \mapsto b \\ d \mapsto c \end{bmatrix}$                       b.  $\begin{bmatrix} a \mapsto a \\ c \mapsto b \\ d \mapsto c \end{bmatrix}$
- (5)
- What is the domain of the relation in (4a)?
  - What is its range?
- (6) Let  $U = \{a, b, c\}$  and let the predicate ‘love’ denote the following function:  $f_{\heartsuit} = \{\langle a, b \rangle, \langle b, c \rangle, \langle c, c \rangle\}$ .
- What is the characteristic function of  $f_{\heartsuit}$  ( $\text{CHAR}_{f_{\heartsuit}}$ )? State it in Schönfinkelised format.
- (7) Reduce the following expressions as much as possible using  $\lambda$ -conversion.
- $(\lambda x. \text{CAT}(x))(jason)$
  - $(\lambda P. P(jason))(\text{CAT})$
  - $(\lambda x. (\lambda P. P(x)))(jason)(\text{CAT})$
  - $(\lambda x. \forall y. \text{BITE}(x)(y))(y)$
  - $(\lambda P. P(jason))(\lambda x. \text{CAT}(x))$
  - $(\lambda P. \forall x. P(x))(\lambda y. \text{BITE}(x)(y))$

- (8) Solve the following equation by reducing the  $\lambda$ -terms. Provide a step-by step procedure.
- i.  $\lambda f[f(3)](\lambda y[5 + y])$