KRR: Unit 2 Formative Activities
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2: Sets, Set Theory, Truth Tables and Logic
Partee

1. Read Partee et al (1993) Chapter 1 and then attempt exercises 1 and 4, located at the end of the chapter.

Exercise 1

1. Given the following sets:

$$A = \{a, b, c, 2, 3, 4\} \quad E = \{a, b, \{c\}\}$$
$$B = \{a, b\} \quad F = \emptyset$$
$$C = \{c, 2\} \quad G = \{\{a, b\}, \{c, 2\}\}$$
$$D = \{b, c\}$$

classify each of the following statements as true or false

(a) $c \in A$ (g) $D \subset A$ (m) $B \subseteq G$
(b) $c \in F$ (h) $A \subseteq C$ (n) $\{B\} \subseteq G$
(c) $c \in E$ (i) $D \subseteq E$ (o) $D \subseteq G$
(d) $\{c\} \in E$ (j) $F \subseteq A$ (p) $\{D\} \subseteq G$
(e) $\{c\} \in C$ (k) $E \subseteq F$ (q) $G \subseteq A$
(f) $B \subseteq A$ (l) $B \in G$ (r) $\{\{c\}\} \subseteq E$

a) T
b) F
c) F
d) T
e) F
f) T
g) T
h) F
i) F
j) T
k) F
l) T. B is a member of G
m) F. B is a subset of A, not G
n) T. The set of B is a subset of G
o) F
p) F
q) F
r) T. The member {c} of set {{c}} is subset of {a,b,{c}}

Exercise 2

4. Consider the following sets:

$$
\begin{aligned}
S1 &= \{\{\emptyset\}, \{A\}, A\} & \quad S6 &= \emptyset \\
S2 &= A & \quad S7 &= \{\emptyset\} \\
S3 &= \{A\} & \quad S8 &= \{\{\emptyset\}\} \\
S4 &= \{\{A\}\} & \quad S9 &= \{\emptyset, \{\emptyset\}\} \\
S5 &= \{\{A\}, A\}
\end{aligned}
$$

Answer the following questions. Remember that the members of a set are the items separated by commas, if there is more than one, between the outermost braces only; a subset is formed by enclosing within braces zero or more of the members of a given set, separated by commas.

(a) Of the sets $S1$ - $S9$ which are members of $S1$?

(b) which are subsets of $S1$?

(c) which are members of $S9$?

(d) which are subsets of $S9$?

(e) which are members of $S4$?

(f) which are subsets of $S4$?

a) S3, S4, S8, S7
b) S1, S3, S4, S5, S6, S8
c) S6, S7, S8
d) S6, S7, S8
e) S6
f) S6

Truth Table Prep

Read the wiki at Sharma et al (2022) and then attempt the exercises below:

    i.   For each clause (a) - (f) below, create truth tables for each to answer the question of when each statement is false.
- a. ~ P
- b. P ∧ Q
- c. P ∨ Q
- d. P → Q
- e. P ←→ Q
- f. P → (~ Q)

P	Q	NOT ~P	NOT ~Q	AND P∧Q	OR P∨Q	NAND P↑Q	NOR P↓Q	IMPLY P→Q	XOR P⊻Q	XNOR P ←→ Q	P → (~ Q)	~(P) → (~ Q)
T	T	F	F	T	T	F	F	T	F	T	F	T
T	F	F	T	F	T	T	F	F	T	F	T	T
F	T	T	F	F	T	T	F	T	T	F	T	F
F	F	T	T	F	F	T	T	T	F	T	T	T

1. Consider the statement (~ Q) -> (~ P).
       i.   When is it false?

Implies is false when T→F, so when ~Q is T and ~P is F.

    ii.   Now consider P → Q. When is it false?

When P is T and Q is F.

    iii.   Do you believe these two compound statements mean the same thing?

They both mean T → F = F, but find F for opposites

    iv.   Construct the truth table for the statement (~ Q) −> (~ P). Then revisit your answer to (c).

Above

    v.   Construct the truth table for P XOR Q.

Above

vi. Construct truth tables for the following statements.
a. ~ (P ∧ Q)
b. P ∨ (Q ∧ R)
c. P ∨ (Q ∨ R)
d. (P ∨Q) ∨ R (Compare to the previous statement.)
e. (P → Q) ∧ (Q → P)

P	Q	R	AND P∧Q	OR P∨Q	IMPLY P → Q	IMPLY Q→P	NOR ~ (P ∧ Q)	P ∨ (Q ∧ R)	(P ∨ Q) ∨ R	(P → Q) ∧ (Q → P)
T	T	T	T	T	T	T	F	T	T	T
T	T	F	T	T	T	T	F	T	T	T
T	F	T	F	T	F	T	T	T	T	F
T	F	F	F	T	F	T	T	T	T	F
F	T	T	F	T	T	F	T	T	T	F
F	T	F	F	T	T	F	T	F	T	F
F	F	T	F	F	T	T	T	F	T	T
F	F	F	F	F	T	T	T	F	F	T