Math2101 Handout 1: Set Formulae 2019

- Basic Definitions

Terminology	Notation	Definition
Complement	$\overline{S}$ (or S^c)	not in S
Intersection	$S \cap T$	in both S and T
Union	$S \cup T$	in either S or T *or* in both
Disjoint Union	$S \triangle T$	in either S or T *but not* both
Universal Set	$\mathcal{U}$	all elements
Empty Set	$\varnothing$	no elements

- Set Relationships

  If element z is inside a set S we write $z \in S$, otherwise we write $z \notin S$.

  Two sets are equal if every element in one is also in the other, and vice-versa; we write $S = T$.

  If a set S is wholly inside of another set T (or equal to it) we write $S \subseteq T$.

  The cardinality of a set S is written $|S|$ and is the number of unique elements in S.

  We define $R := \{x \ : \ f(x)\}$ if R contains all elements x from the universal set for which $f(x)$ is true.

- Set Algebra

  The following are the various set relationships we will establish using Venn Diagrams:

Complementation	$\overline{(\overline{S})}$	$=$	S
Commutativity	$(S \cup T)$	$=$	$(T \cup S)$
	$(S \cap T)$	$=$	$(T \cap S)$
Associativity	$(R \cup S) \cup T$	$=$	$R \cup (S \cup T)$
	$(R \cap S) \cap T$	$=$	$R \cap (S \cap T)$
De Morgan	$\overline{(S \cup T)}$	$=$	$(\overline{S} \cap \overline{T})$
	$\overline{(S \cap T)}$	$=$	$(\overline{S} \cup \overline{T})$
Distributive	$(R \cup S) \cap T$	$=$	$(R \cap T) \cup (S \cap T)$
	$(R \cap S) \cup T$	$=$	$(R \cup T) \cap (S \cup T)$
Idempotent	$(S \cup S)$	$=$	S
	$(S \cap S)$	$=$	S
Absorbtion	$(S \cup T) \cap S$	$=$	S
	$(S \cap T) \cup S$	$=$	S
Identity	$(S \cup \varnothing)$	$=$	S
	$(S \cap \mathcal{U})$	$=$	S
Domination	$(S \cap \varnothing)$	$=$	$\varnothing$
	$(S \cup \mathcal{U})$	$=$	$\mathcal{U}$
Inverse	$(S \cup \overline{S})$	$=$	$\mathcal{U}$
	$(S \cap \overline{S})$	$=$	$\varnothing$

- Inclusion Exclusion

$$|S \cup T| = |S| + |T| - |S \cap T|$$

$$|R \cup S \cup T| = |R| + |S| + |T| - |R \cap S| - |R \cap T| - |S \cap T| + |R \cap S \cap T|$$