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Math for Programmers

Tips:

(i) Stay Clear :- Don't panic, don't stop listening, you are not being graded.

(ii) Rewind:- you will ~~learn~~ learn much faster

(iii) Explain :- try to explain the material outloud to yourself, a friend, or a rubber ducky.

Discrete Math :-

Deals with finite or ~~continuous~~ discrete sets of elements rather than ~~infinite~~ continuous or infinite sets of elements.

eg:- a program running infinite steps of execution is approximated from continuous sets to discrete sets.

eg of infinite set is circle.

sets: collection of distinct objects called elements or members.

$\in$ (symbol):- is an element of

Common sets:

$\phi = \{\}$ null set

$\mathbb{N} = \{1, 2, 3, \ldots\}$ (...) → ellipsis, indicate progression

$\mathbb{N}_0 = \{0, 1, 2, 3, \ldots\}$

$\mathbb{Z} = \{\ldots, -2, -1, 0, 1, 2, \ldots\}$

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Union Operations:

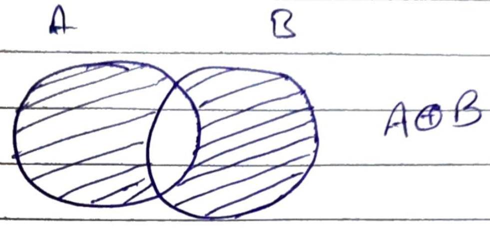
Symmetric differences: $\oplus$

$A \oplus B = (A \setminus B) \cup (B \setminus A)$

$\mathbb{R} \setminus \mathbb{Q} = \mathbb{I}$

Real ↳ rational no. ↳ irrational no.s

Venn Diagrams



Proper Subset: For a set B, all elements of B are in set A and there are some elements of A not in B

denotion:- $C \subsetneq \mathcal{U}$

Complement: $B^\wedge c = \{x \in \mathcal{U} : x \notin B\}$ ↳ universal set

or B^c

Denotion:- subset: $C \subseteq \mathcal{U}$

proper superset:- $C \supset \mathcal{U}$

Idempotence: $A \cup A = A$

$A \cap A = A$

Identities: performing operations on a set with a given identity element.

$A \cup \phi = A$ (A union null set

$\mathcal{U} \cup A = \mathcal{U}$

$A \cap \mathcal{U} = A$

$\phi \cap A = \phi$

Law of Involution: $(A^c)^c = A$

Cyclical nature of function.

Rational no:— a no. that can be representated as the quotient p/q of two integers such that $q \neq 0$

Any rational no. (that is, a fraction in lowest terms) can be written as either a terminating or a repeating decimal.

eg: $10x = 9.999\ldots$

$x = 0.999\ldots$

$10x - x = 9x = 9$

$x = 1$

$10x = 10$

$$Q = \{ a/b : a, b \in \mathbb{Z}, b \neq 0 \}$$

Distributivity:-

Case 1: $A \cap (B \cup C) \subseteq (A \cap B) \cup (A \cap C)$

Case 2:

DeMorgan's Laws:

$(A \cup B)^c \subseteq A^c \cap B^c$

$\cancel{A^c \cap B^c \subseteq (A \cup B)^c}$

$(A \cap B)^c = A^c \cup B^c$

Logic:- "Book of Proof" by Hammack covers foundational mathematics.

An excerpt:- Logic is a systematic way of thinking that allows us to deduce new info from old info & to parse the meaning of sentences.

logic $\rightarrow$ math $\longrightarrow$ algorithms $\longrightarrow$ code

Propositions :- It is simply a declarative statement with a verifiable truth value. Denoted by lowercase letters.

p = " Rain falls from the sky "

r = $5 + 8 = 3$

$4 = \alpha$

q = " Pune is in USA "

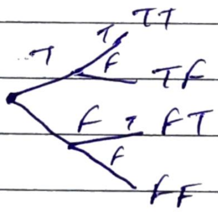
Composite Proposition :- They are made up of subproposition.

Conjunction & Disjunction.

$\downarrow$ AND, $p \wedge q$ $\qquad$ $\downarrow$ OR, $p \vee q$

Truth Tables:

p	q	$p \wedge q$	$p \vee q$



Idempotence: & **Identities**

Primitive proposition →

p	$p \vee p$	$p \wedge p$
T	T	T
F	F	F

T	F	$p \vee F$	$T \vee p$	$p \wedge T$	$p \wedge F$
T	F	T	F	T	F
T	F	F	T	F	F

$p \equiv p \vee p \equiv p \wedge p$

$p \equiv p \vee F \equiv p \wedge T$

$T \equiv p \vee T \quad F \equiv p \wedge F$

Complements:

$p \vee \neg p \equiv T \qquad T \equiv \neg F$

$p \wedge \neg p \equiv F \qquad F \equiv \neg T$

↳ negation of read as "not p"

logical equivalent

Involution: $P \equiv \neg\neg P$

Tautology:- always true

Fallacy. always false

Conditional Statement: a conditional statement contains a hypothesis and a conclusion. These are more formally known as antecedent and a consequent.

conditional : $p \Rightarrow q$ (p implies q)
converse : $q \Rightarrow p$
inverse : $\neg p \Rightarrow \neg q$
contrapositive : $\neg q \Rightarrow \neg p$ (logically equivalent to original conditional)

Logical Quantifiers

Propositional function: $P(x)$
(takes on a value true or false for everything fed to it)

Universal: $\forall$ (for every) $(\forall x \in \mathcal{X})\, p(x)$; $\forall x\, P(x)$
Existensial: $\exists$ (there exists) $(\exists x \in \mathcal{U})\, p(x)$
$\Downarrow$
at least one x

Tautologies:

law of excluded middle : $P \vee \neg P$

Law of Contradiction : $\neg(P \wedge \neg P)$

Modus Tollens ("denying the consequent") : $[(P \Rightarrow q) \wedge \neg q] \Rightarrow \neg P$