Our learning outcomes

Logic

L-1. Construct a truth table and determine the truth value of statements involving multiple statements and logical connectives.
L-2. Use propositional variables and logical connectives to represent statements; and interpret symbolic logical statements in plain language.
L-3. Find the negation, converse, and contrapositive of a conditional statement.
L-4. Determine if two statements are logically equivalent.
L-5. Find and symbolically represent the negation of a quantified statement.
L-6. Determine if an argument is logically valid.

Proofs

P-1. Given a statement to be proven using a direct proof, identify the assumptions to be made and the statements to be proven.
P-2. Given a statement to be proven using a proof by contrapositive, identify the assumptions to be made and the statements to be proven.
P-3. Given a statement to be proven using a proof by contradiction, identify the assumptions to be made and the statements to be proven.
P-4. Given a statement to be proven using a proof by cases, identify the assumptions to be made and the statements to be proven.
P-5. Set up a framework of assumptions and conclusions for proofs using direct proof, proof by contraposition, proof by contradiction and proof by cases.
P-6. Given a written proof, identify the parts of the proof, including technique(s) being used in the proof and the assumptions being made.

Sets

S-1. Convert a set from roster notation to set-builder notation and vice-versa.
S-2. Determine the powerset of a set.
S-3. Determine set relationships (equality, subset, proper subset, element of).
S-4. Perform set operations (intersection, union, complement, difference, Cartesian product).
S-5. Create and interpret Venn diagrams.
S-6. Find cardinalities of sets.

Functions

F-1. Given a function, determine its domain, target and range.
F-2. Give examples of injective, surjective and bijective functions.
F-3. Determine whether a given function is injective, surjective or bijective.
F-4. Compute the solution to well-known functions (floor, ceiling, exponential and logarithm).
F-5. Find the inverse image of an element in the codomain of a function.
F-6. Compose two functions.

Relations and digraphs

R-1. Convert a relation from arrow diagram to matrix representation and vice-versa.
R-2. Determine whether a given relation is reflexive, anti-reflexive, transitive, symmetric or anti-symmetric.
R-3. Classify a walk in a digraph as a trail, circuit, path or cycle.
R-4. Apply graph power theorem to answer connectivity questions about a given digraph.
R-5. Use matrix multiplication to find powers of a graph.

Growth of functions

G-1. Characterize the growth rate of a given functions as one of the common functions in algorithmic complexity.
G-2. Prove the growth rate for a polynomial by a identifying a valid witness.

Induction

I-1. Given a statement to be proven by mathematical induction, state and then prove the base case; then state...
I-2. Identify the predicate being used in a proof by mathematical induction and use it to set up a framework of assumptions and conclusions for an induction proof.
I-3. Given a proposed proof of a proposition, conduct a critical analysis of the proposition and its proposed proof.

Sequences

Q-1. Given either a closed-form or recursive formula for a sequence, generate several instances of items in the sequence.
Q-2. Find closed formulas for basic examples of recursively-defined sequences.
Q-3. Distinguish between an arithmetic and a geometric sequence, and find the sum of both arithmetic and geometric sequences.

Counting

C-1. Use the sum and product rules to solve basic counting problems.
C-2. Calculate combinations and permutations, and correctly apply combinations and permutations to solve counting problems.
C-3. Use counting by complement to solve counting problems.
C-4. Use the inclusion-exclusion principle to find the cardinality of a union of non-disjoint sets.

Discrete probability

D-1. Compute the probability of a event from a finite or countably infinite sample space.
D-2. Use Bayes Theorem to compute the probability of an event conditioned on a second event.
D-3. Compute the expected value of a random variable.