Problem Set 08: Relational & Logical Operators

New Learning Objectives under Evaluation

14.00 Perform and evaluate relational and logical operations

Learning Objective	Evidence
14.01 Construct relational and logical statements from English statements	Identify correct true/false pattern for the English statement Logical statement is correct Complete work is shown when verifying that the logical statement results in the pattern identified Logical statement is only as complicated as necessary
14.02 Employ relational operators with arrays (scalars, vectors, matrices)	Variables or values are placed correctly within the statement(s) Complete work is shown when evaluating expressions Arrays must have the same dimensions (unless one is a scalar) Correct syntax for relational operators (>, >=, <, <=, ==, ~=) Evaluate or use appropriate relational operators to compare arrays Apply output of relational operation as logical true/false
14.03 Employ order of operations to perform calculations, comparisons, and logical operations	Variables or values are placed correctly within the statement(s) Complete work is shown when evaluating expressions Apply the MATLAB order of precedence: 1. Parentheses () 2. Transpose (.'), power (.^), complex conjugate transpose ('), matrix power (^) 3. Logical negation (~) 4. Multiplication (.*), right division (./), left division (.\), matrix multiplication (*), matrix right division (/), matrix left division (\) 5. Addition (+), subtraction (-) 6. Less than (<), less than or equal to (<=), greater than (>), greater than or equal to (>=), equal to (==), not equal to (~=) 7. Element-wise AND (&) 8. Element-wise OR (|) 9. Short-circuit AND (&&) 10. Short-circuit OR (||) In the absence of parentheses, operators at the same level are read left to right (with some exceptions that are not discussed in ENGR 132, see https://www.mathworks.com/help/matlab/matlab_prog/operator-precedence.html) The mathematical expression a<x<b be coded as a<x & x<b

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14.04 Employ comparison functions with vectors and matrices: any, all	Correct syntax for any command: any(X) Correct syntax for any command: all(X) Use and evaluate vectors or matrices with zero and non-zero value elements within the any command • any(vector) operates on the full vector and returns a logical scalar of 1 if a single value is a non-zero value • any(matrix) operates on the columns of matrix and returns a corresponding vector of logical elements where the values of 1 indicate columns with one or more non-zeros values Use and evaluate vectors or matrices with zero and non-zero value elements within the all command • all(vector) operates on the full vector and returns a logical scalar of 1 if every value is a non-zero value • all(matrix) operates on the columns of matrix and returns a corresponding vector of logical elements where the values of 1 indicate columns with all non-zeros values Differentiate between appropriate use of any or all Apply output from any or all command as logical true/false
14.05 Employ comparison functions with vectors and matrices: find	Correct syntax for find(x) Evaluate a call to find Recognize that the output of find is an array of indices for which the logic statement is true Apply output of find as indices
14.06 Employ logical operations with arrays (scalars, vectors, matrices)	Variables or values are placed correctly within the statement(s) Complete work is shown when evaluating expressions Arrays have the same dimension (unless one is a scalar) Correct syntax for logical operators (&, |, ~) Correct syntax for xor command: xor(X) Evaluate or use appropriate logical operators with arrays • Exclusive or (xor) returns true when only one element is true • Inclusive or (|) returns true when one or both elements are true • AND (&) returns true when both elements are true Example: The mathematical expression a<x<b is coded as a<x & x<b • Logical negation (~) reverse the output (true to false, false to true)

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	Apply output of logical operation as logical true/false
14.07 Construct truth tables to evaluate logical expressions	When there are two variables: • a 2x2 table is used • 2 columns for variable 1 (T/F) • 2 rows for variable 2 (T/F) When there are three variables: • a 2x4 (or 4x2) table is used • 4 columns for an orderly presentation of all combinations of variable 1 (T/F) and variable 2 (T/F) • 2 rows for variable 3 (T/F) When there are four variables: • a 4x4 table is used • 4 columns for an orderly presentation of all combinations of variable 1 (T/F) and variable 2 (T/F) • 4 rows for an orderly presentation of all combinations of variable 3 (T/F) and variable 4 (T/F)