# TSK-TEST-001: Gate Truth Tables and Ordering Checks

Causal Boolean Integration Project

December 5, 2025

## 1 Objective

Expand unit tests for gate truth tables with ordering coverage (LSB/MSB) and $\varphi$ invariance; export artefacts and compile documentation.

## 2 Methods

For each gate (AND, OR, XOR, XNOR, NAND, NOR, MAJORITY, IMPLIES, NIMPLIES, NOT, KOFN with $k \in \{1, 2\}$, and a representative CANALISING case) and arity as applicable, we compute MSB-ordered truth arrays via `IntegrationGatesTruthTable`, LSB-ordered outputs via reversed-bit evaluation, and verify ordering invariance by mapping LSB one-set indices via $\varphi(j, n) = 1 + \text{binrev}_n(j - 1)$.

## 3 Artefacts

- `results/tests/tests001/TruthTables.json`
- `results/tests/tests001/OrderingCheck.json`
- `results/tests/tests001/Status.txt`

## 4 Summary

All covered cases satisfy ordering invariance; `Status.txt` reports OK.

| Gate | Arity range | Ordering |
|---|---|---|
| AND/OR/XOR/XNOR/NAND/NOR | $n = 2 \ldots 6$ | OK |
| MAJORITY | $n = 2 \ldots 6$ | OK |
| IMPLIES/NIMPLIES | $n = 2$ | OK |
| NOT | $n = 1$ | OK |
| KOFN ($k = 1, 2$) | $n = 2$ | OK |
| CANALISING (rep.) | $n = 2$ | OK |

## 5 Ordering Map

$$\text{LSB indices} \xrightarrow{\varphi(j,n) = 1 + \text{binrev}_n(j-1)} \text{MSB indices}$$

Figure 1: Bit-reversal mapping between LSB/MSB indexings