Structural or analytic derivation

Forward mode transports a tangent vector through the graph; reverse mode transports a covector through the transposed local differentials. Their equality here follows from the associativity of the Jacobian product: for a scalar chain, transposition only reverses the order of multiplication and accumulation. The common numerical test evaluates both on a grid bounded away from zero.

Comparative cost and preferred method

Both modes traverse the six-node graph once after the primal values are known. With one input and one output each is $\Theta(L)$ for L nodes; neither has a dimensional advantage. Reverse mode stores the primal tape, while forward mode can discard values after their last use. This source problem is a tie in asymptotic arithmetic and a small-memory preference for forward mode.