The rank-one term cancels because both masses are one. Iteration on the compact probability simplex converges to a unique fixed point, with distance at most $2(1-\alpha)^t$ from an arbitrary initial distribution. At $\alpha = 0$ the theorem fails, for example on a directed cycle. Teleportation with restricted support also need not make the entire graph irreducible.

Structural or analytic derivation

The same operator has a convergent Neumann resolvent $[I - (1-\alpha)W^\top]^{-1} = \sum_{k\geq 0}(1-\alpha)^k (W^\top)^k$, whose norm is at most $1/\alpha$. This turns the qualitative graph theorem into an error bound for computation.

Comparative cost and preferred method

To reach ℓ_1 error ε from a probability initialization, $t \geq \lceil \log(2/\varepsilon)/[-\log(1-\alpha)] \rceil$ iterations suffice when $0 < \alpha < 1$; $\alpha = 1$ needs one step. A sparse step costs $O(E+N)$. This is a proved upper bound, not an exact mixing time for every graph.