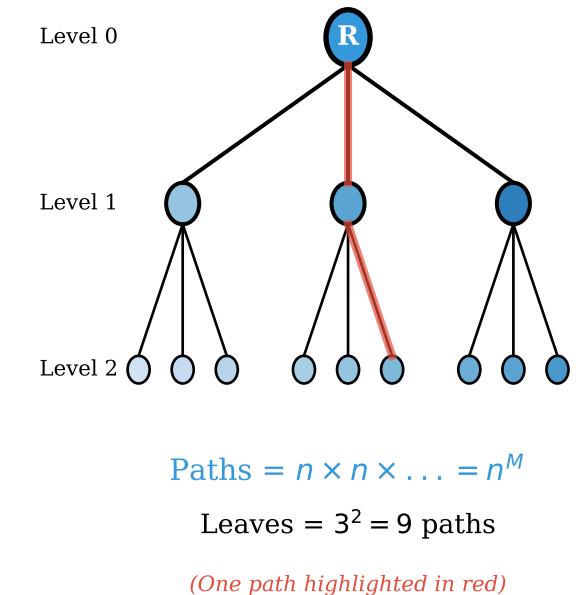
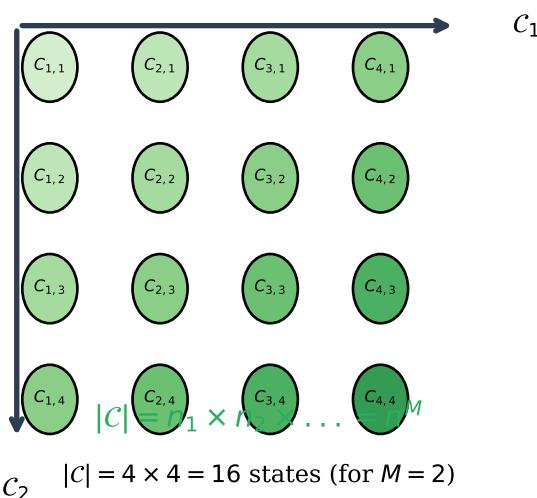
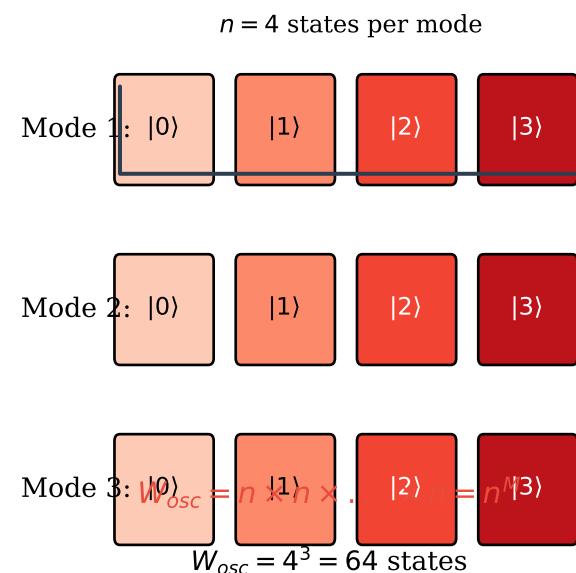


(A) Oscillatory: Counting Quantum States **(B) Categorical: Counting Distinguishable States** **(C) Partition: Counting Paths Through Tree**



(D) Boltzmann's Fundamental Relation

Entropy $S = k_B \ln W$ Microstates

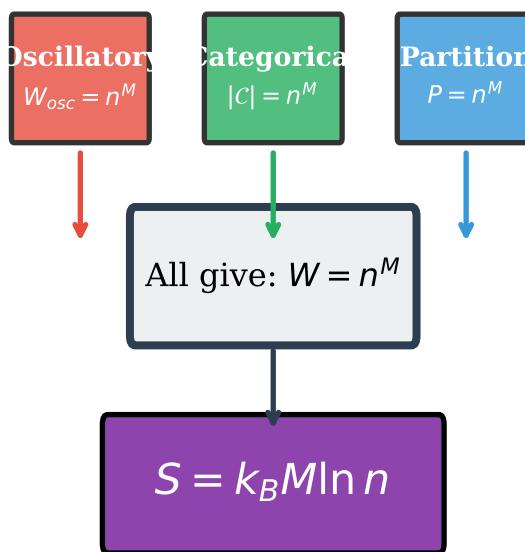
Substitute $W = n^M$:

$$S = k_B \ln(n^M)$$

$$S = k_B \cdot M \ln n$$

$S = k_B M \ln n$

(E) Three Derivations, One Formula



(F) Entropy Scaling: $S = k_B M \ln n$

