Lab W1D2 — Question 2: Comparing Growth Rates

Goal: Arrange the given functions in strict ascending order of growth rate, and identify the relationships among their complexity classes.

Concept: f(n) grows slower than g(n) if lim (n→∞) f(n)/g(n) = 0.

Based on logarithmic, polynomial, exponential, and factorial classes from the lecture (IntroAnalysis & ComparingFunctions notes).

Category	Representative Functions	Growth Relation (slow → fast)
Constants & Logs	1, 10, log(log n), log n, ln n	Θ(1) < Θ(log n)
Roots	n^(1/k) (k>3), n^(1/3), n^(1/2)	n^(1/k) < n^(1/3) < n^(1/2)
Root–Log Mix	n^(1/3)log n, n^(1/2)log n	Above pure roots
Polynomials	n, n^2, n^3, n^k (k>3)	Increasing with exponent
Poly–Log	n log n	Between n and n^2
Exponentials	2^n, 3^n, (log n)^n	2^n < 3^n < (log n)^n
Factorial & Beyond	n!, n^n	n! < n^n

Complete strict ascending order:
1, 10, log(log n), log n, ln n, n^(1/k) (k>3), n^(1/3), n^(1/2), n^(1/3)log n, n^(1/2)log n, n, n log n, n^2, n^3, n^k (k>3), 2^n, 3^n, (log n)^n, n!, n^n

Observation: Constants < Logs < Roots < Polynomials < n log n < Exponentials < Factorials < n!.

Key takeaways:
- log log n grows slower than any logarithm.
- n log n sits strictly between linear and quadratic.
- Exponentials outrun any polynomial; factorial and n! dominate all.