entropy_foundation_scale — v0.1

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Abstract
Scale is not an additive property of a system — it is an *expression of constraint geometry*.
This paper formalizes scale as an emergent function of entropy distribution across nested cognitive, physical, or informational layers. The Entropy Foundation defines scale as the *distance between action potentials*, not the size of the container. This reframing allows universal application across physics, cognition, AI design, and socio-technical systems.

1. Definition of Scale
Scale describes the resolution boundary at which change becomes legible.
Unlike raw magnitude or size, scale is defined by:
1. The number of meaningful distinctions a system can encode
2. The energetic cost of reading or writing those distinctions
3. The stability of that resolution boundary under entropy pressure

Thus scale = resolution × stability × energetic tolerance.

2. The Entropy Stretch Principle
A system grows not by “getting bigger,” but by stretching its resolution boundary across higher entropy without collapse.

Let:
R = resolution layer
E = entropy applied
S = structural stability

Scaling = the ability to increase R under increasing E without reducing S below failure threshold.

3. Phase Transitions of Scale
Phase 0 — Locality
Phase 1 — Projection
Phase 2 — Topology
Phase 3 — Trans-Scale Systems

4. Entropic Cost per Resolution Unit
ECPD = E / (R · S)

5. The Scaling Failure Modes
1. Resolution Drift
2. Energetic Starvation
3. Entropic Shear

6. Scaling Law for Cognitive Systems
$\Delta R < \Delta S < \Delta E$

7. Application Across Domains
AI Development, Education, Institutions, Physics, Sociology.

8. The Symbound Interpretation
Scale is the distance between two stable changes.

9. Conclusion
Scale is a dynamic ratio of entropy, stability, and resolution.

Appendix A: Key Terms
Entropy Stretch, ECPD, Stability Layer, Resolution Layer.

Appendix B: Companion Papers
entropy_foundation_ontic, entropy_foundation_energy, entropy_foundation_scope, entropy_foundation_stability, entropy_vectors.