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| **COMPLEXITY SCIENCE AND SYNERGETICS SUMMARY** | | | | |
| **Description** | **Creation** | **Organisation** | **Interaction** | **Other** |
| *Entropy*: maximal Hamiltonian (total energy) of an a priori (from theory) phase space distribution minus logarithm of number of phase space up to constant coefficient of Boltzmann’s constant | *Computational Complexity:* minimal number of computational resources (time and memory) to solve a given class of problem taken up to constant | *Metric Entropy*: asymptotic limit on entropy of the intersection of a measurable partition with all n endomorphisms (metric isomorphisms) of itself divided by the number of endomorphisms. | *Conditional Information*: amount of information a message reveals about something given someone who already knows something else | *Long Range Order:* remote samples exhibit correlated behaviour. Contrast with quenched (supercool) disorder that is complex with rapid evolution in time. Annealed (slow cool) disorder has evolution in time. |
| *Fisher Information:* expected value of observed information. Inverse of Fisher information is lower bound of variance of unbiased estimator of unknown parameter | *Thermodynamic Depth:* relation between entropy of a system to the number of historical paths that led it to observed state. | *Topological epsilon machine size* number of states of a unique minimal representation of stationary stochastic processes whose states are equivalence classes of infinite histories with the same probability distribution over all futures | *Partition function:* sum of all exponents damped with product of total energy and inverse temperature over all possible partitions of the systems into different energy state | *Asymptotic equipartition property:* the typical outcome is part of a large set of outcomes with equal probability despite certain individual outcomes having higher probability than those in this set. |
| *Chernoff Information:* symmetric measure of dissimilarity between two probability measures/upper bound of probability of error of misclassification from Bayesian hypothesis testing | *Crypticity:* measure the difference in a process’s hidden state and observed information | *True Measure Complexity:* amount of information contained in given part of a sequence to predict the next symbol. | *Temperature:* the higher the temperature, the lower the potential for interactions to order the systems since all states are closer towards uniform probability. | *Critical Point*: point with all derivatives of free energy becomes infinite |
| *Code Length* (prefix-free, Huffman, Shannon-Fano, error-correcting, Hamming): number of symbols assigned to a message for various objectives to reduce noise | *Information-Based Complexity:* measure of intrinsic difficulty of problem given partial information. | *Effective measure complexity* measures the relative information required to calculate the probability of the next symbol of the sequence | *Conditional Algorithmic Information Content*: information in symbols given by length of shortest computer program given existing computer programs | *Renormalisation group:* behaviour of system is aggregate of ensemble of subsystems defined at a critical point, which itself behaves as an ensemble of critical sub-sub systems and so forth. |
| *Chaoticity:* states of perturbed system have minimal overlap with unperturbed systems. | *Cost (of energy, money):* amount of resources of next best opportunity forgone to create something | *Schema Length:* total number of nodes in a subset of strings with similarity at certain string position. | *Hierarchical Complexity:* difference from decomposability to simple behaviour. | *Complex Adaptive Systems*: self-similar collective of interacting adaptive agents |
| *Rényi divergence:* > 0 except at equal distributions. | *Logical Depth:* time of shortest program to generate string or pattern. | *Grammatical Complexity:* level of type of grammar with certain language class, automaton interpretability, and rule forms (Chomsky) | *Percolation model:* at criticality, small, disconnected clusters becoming significantly large well-connected clusters when nodes and links are added. |  |
| *Fractal Dimension:* limit of the logarithmic number of intervals at a n-th stage construction divided by the logarithmic magnification | *Computational irreducibility:* computations that cannot be sped up by any shortcut algorithmically | *Sophistication:* measures in bits the structural algorithmic information of a string, the minimum complexity is the best model for a string. |  |  |
| *Lempel-Ziv Complexity:* least possible steps a sequence can be generated via the number and length of repeated sections |  | *Excess entropy:* measures how much more information one must know to determine the actual uncertainty |  |  |
| *Dimension*: number of independent points needed to define a point on it. |  |  |  |  |