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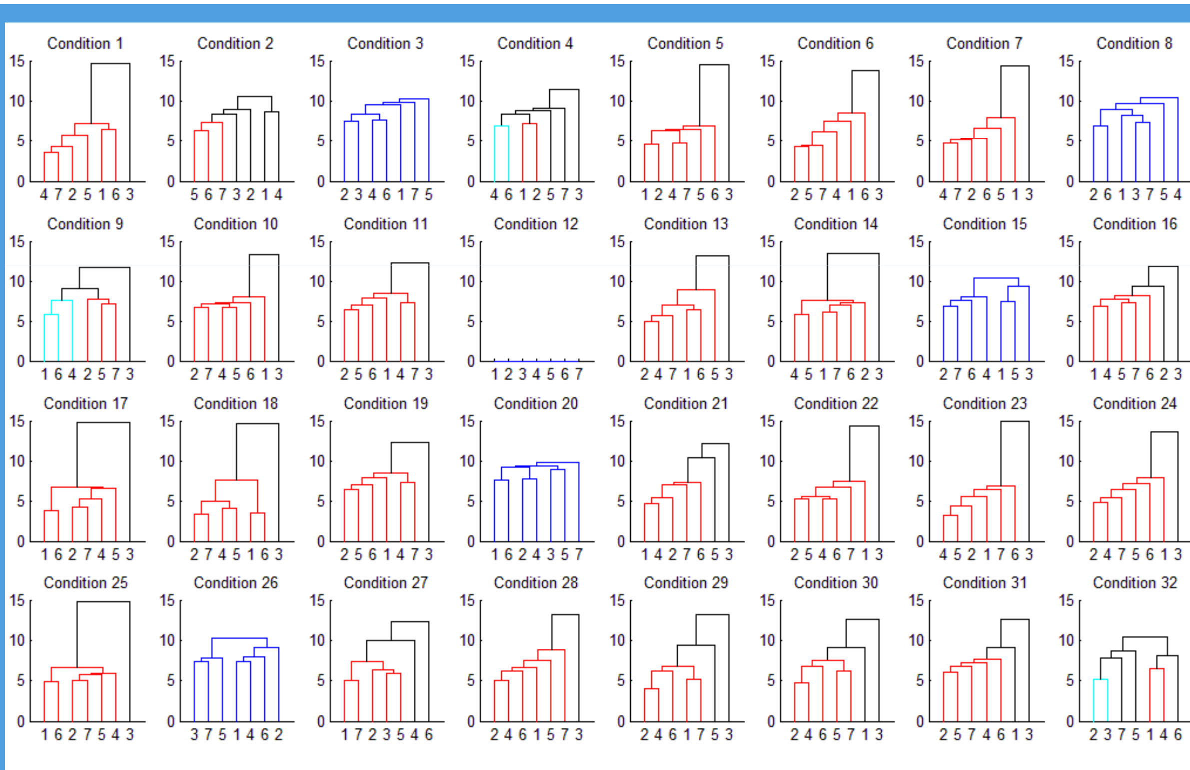
complex systems September

IMAGE OF THE MONTH

Cluster Analysis of System Responses for Congestion Control Algorithms



A cluster analysis of the differences in one time period from among 45 responses. The X axis represents 7 congestion control algorithms. Each "small" figure represents one of 32 conditions applied to the 7 algorithms. Note that in condition 12 we see an identical response from each algorithm (due to no congestion on the network). Also note that in many of the conditions the largest distance graphed is from algorithm number 3 and the rest of the algorithms. Number 3 is the "FAST" TCP congestion control algorithm which performs markedly different.

More information available at: http://www.itl.nist.gov/ITLPrograms/ComplexSystems

Abstract—This data is the result of simulations of the internet operating under TCP traffic. Each graph compares 45 responses for each of seven congestion control algorithms given one of (32) specified conditions. The Y axis in each graph represents the joint distance between all responses for a given algorithm or cluster of algorithms. The larger the distance between clusters the larger the difference in responses of the congestion control algorithms to the various input conditions. TCP flows consist of 3 phases of interest: 1) a connection phase; 2) slow start phase and 3) congestion control. If all of the work takes place in the slow start phase, as is true with no congestion, then the responses of the system using different congestion control algorithms will not vary, as evidenced by condition 12. Under increasing congestion the various algorithms may produce different system responses. This cluster analysis technique is used to identify IF and WHEN different responses exist but not WHAT the differences are. Specific differences are determined by further analysis.

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The Complex Systems Program is part of the National Institute of Standards and Technology's Information Technology Laboratory. Complex Systems are composed of large interrelated, interacting entities which taken together, exhibit macroscopic behavior which is not predictable by examination of the individual entities. The Complex Systems program seeks to understand the fundamental science of these systems and develop rigorous descriptions (analytic, statistical, or semantic) that enable prediction and control of their behavior.

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