Using Genetic Algorithms to Search for Failure Scenarios

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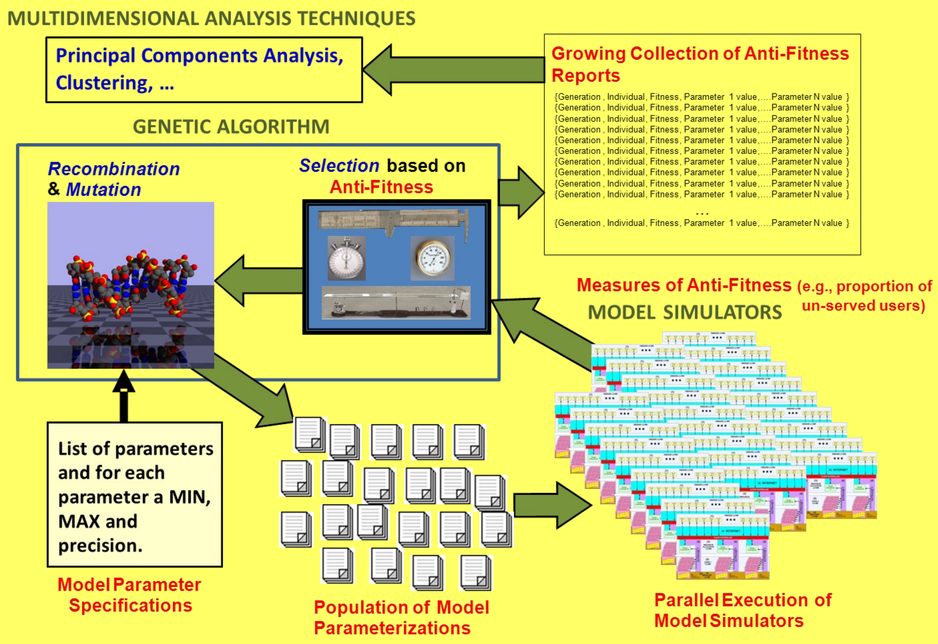
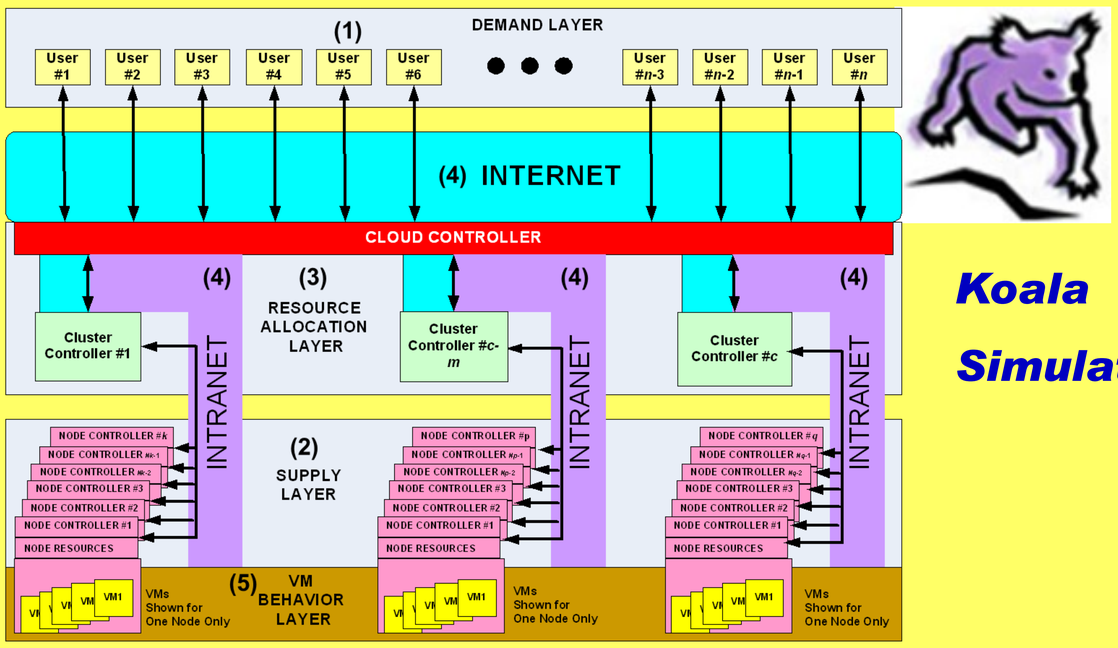
We are investigating the use of genetic algorithms (GAs) to steer system models into anti-optimal behavioral directions. In this example, we demonstrate the application of our ideas to search for performance degradation in Koala, an IaaS (Infrastructure-as-a-Service) cloud simulator. We adopt the proportion of users not served as a measure of anti-fitness and use a GA to steer a population of Koala simulators, over 500 generations, into scenarios that maximize anti-fitness. We show that the proportion of users not served is > 0.50 for about 75% of the 100,000 scenarios explored. We plan to apply cluster analysis and other multidimensional data analysis techniques to identify causes of performance degradations.

Theory of Operation



Koala Simulator

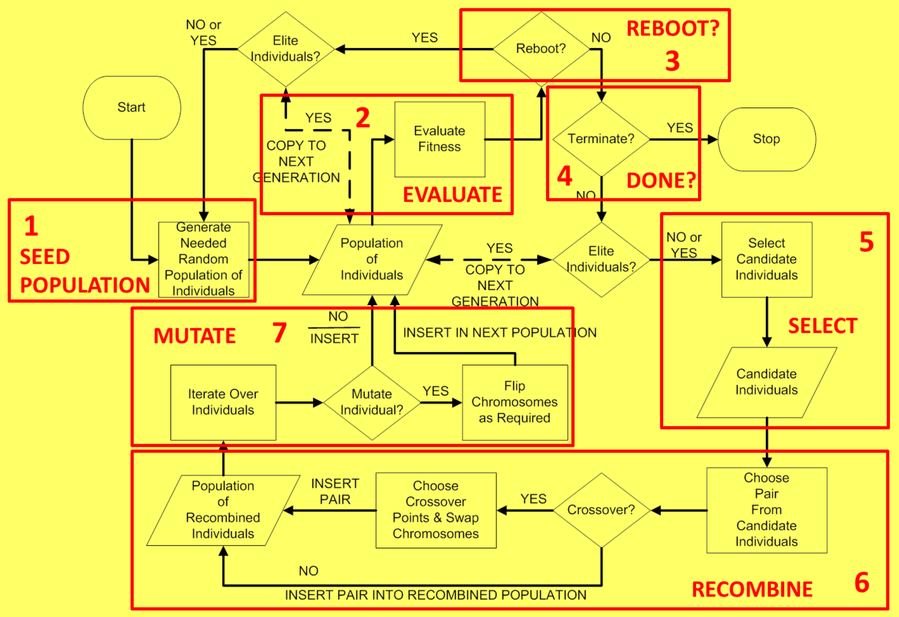


Parameter Search Space 6**130

Parameters by Category

Model Element	Structure	Dynamics	Failures	Asymmetries	Total
Users	1	29	0	4	34
Cloud Controller	3	23	0	2	28
Cluster Controllers	4	14	0	1	19
Nodes	0	7	13	0	20
Intra-Net/ Inter-Net	5	12	10	2	29
				Total	130

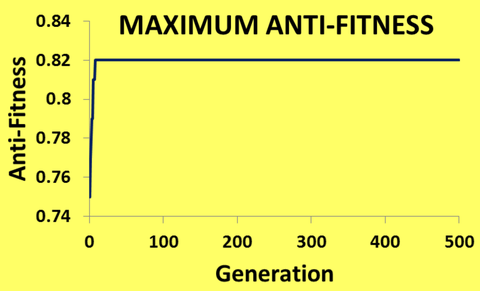
Genetic Algorithm Flowchart

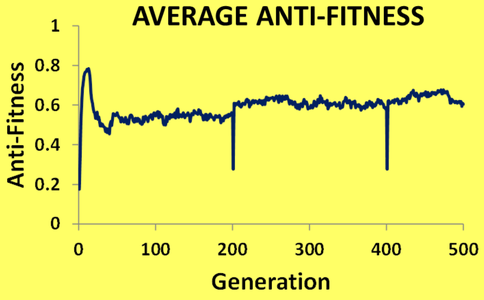


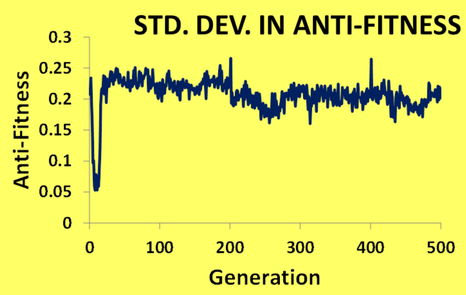
Genetic Algorithm Search Dynamics

GENETIC ALGORITHM CONTROL PARAMETERS

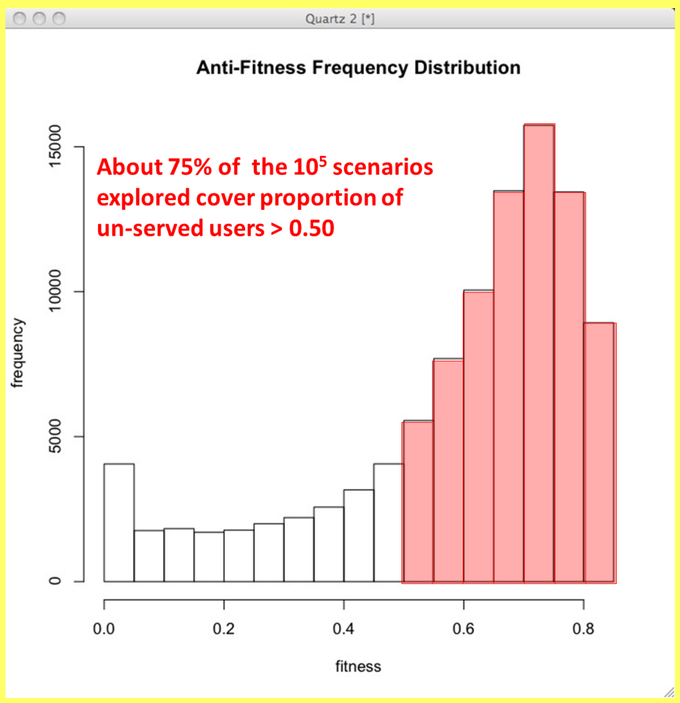
Generations	500
Population Size	200 Individuals
Elite Per Generation	16 Individuals
Reboot After	200 Generations
Selection Method	Stochastic Uniform Sampling
# Crossover Points	3
Mutation Rate	Adaptive







Distribution of Anti-Fitness Scenarios Discovered by the Genetic Algorithm



http://www.nist.gov/itl/antd/emergent_behavior.cfm