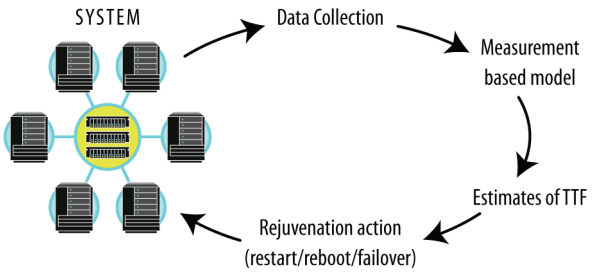
Institute for Next Generation IT Systems (ITng)

North Carolina State University, Dennis Kekas, Director, 919.515.5297, kekas@ncsu.edu
Duke University, Kishor Trivedi, 919.660.5269, kst@ee.duke.edu

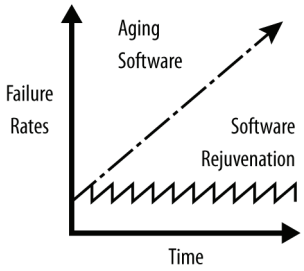
Center websites: http://www.nsf.gov/eng/iip/iucrc/directory/cacc.jsp and http://www.itng.ncsu.edu/

Software Rejuvenation



Researchers led by Kishor Trivedi at Duke University and the Center for Advanced Computing and Engineering (CACC) developed a method to detect problems of memory leak, data corruption, and fragmentation that have plagued a wide range of computer systems and networking components. Problems build up over time and lead to performance degradation, hanging up or freezing, and other failures of computing systems. Such system failures and resulting downtime cost billions of dollars in banking, telecommunications, military and other sectors. Such failures may also cause a loss of life in life-critical systems. Memory leak is a phenomenon in which memory resources in computing systems decrease over time and eventually cause system problems. The problem occurs because software programs request memory but sometimes don't release it. This unreleased memory accumulates over time.

The researchers collected empirical data on these problems and developed a way to monitor the course of the deterioration and to predict when future problems would occur so that preventive measures could be taken. This software rejuvenation method has been adopted by IBM in their X-series servers, and subsequently other companies including Oracle and Microsoft have adopted this technology. This technology has also been adopted in telecommunications sector. The use of software rejuvenation is known postpone or prevent disrupting system failures and hence reduce the cost of downtime. It has also been implemented in NASA's space-based software systems.



Economic Impact: Ramifications of computer system failures and associated downtime, cost the banking, telecommunications, healthcare, armed forces and other like organizations billions of dollars each year. Several studies have analyzed the economic cost of IT systems' downtime. In large systems, direct associated downtime cost has been calculated to average around $125,000 per hour (in data center environments this value can reach $335,000 per hour). However, there is a missing gap in terms of the economic impact of software rejuvenation strategies specifically. Even so, we can extract interesting remarks from these studies. According to the Aberdeen Group Research Report on June 2010, based on the analysis of 125 organizations, the "best in class" companies (top 20%) in terms of time to recover, number of downtimes and percentage of data availability are able to recover their systems 6.5-times faster than the laggard companies (bottom 30%). In absolute economic terms, "best in class" companies were losing 40-times less revenue than laggard organizations. Simply improving from laggard to average (middle 50%) organization, this CACC work will increase the revenue to the company by about $1.3 million USD per year. So, any recovery mechanism (i.e. software rejuvenation) able to reduce the outages and its consequences is reducing significantly the outage invoice while increasing the revenue and productivity of the organizations.

For more information, contact Kishor Trivedi, 919.660.5269, kst@ee.duke.edu.