A Survey on Autonomic Computing Research

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A Survey on Autonomic Computing Research

- Autonomic computing is a new technology to solve crisis of software complexity.
- It aims to establish guidable, state-aware, and self-adaptive computer systems.
- This paper covers 4 aspects on Autonomic Computing

  1) An overview on concept of autonomic computing.

  2) Properties of Autonomic computing and sampling applications.

  3) Important theories and technologies for autonomic computing system models.

  4) The research problems and future directions of autonomic computing

The software complexity crisis

With the expansion of Internet to every corner of society and the emergence of new application models such as grid computing, pervasive computing, the size and complexity of software are increasing. This has created a situation called the software complexity crisis.

Autonomic Computing is aimed at designing and building systems that are self-managing.

By this, the system can realize self-configuration, self-optimization, self-healing and self-protection.

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Autonomic computing is an evolution process

It can be divided into five levels

1) Basic level
2) Management level
3) Predict level
4) Adaptation level, and
5) Full autonomic level.

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In 2001, IBM first proposed the concept of autonomic computing.

IBM pointed that complex computing systems should have four properties to achieve self-management, that is,

1. self-configuration
2. self-optimization
3. self-healing, and
4. self-protection

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To meet self-management, systems should be designed with components that contain an autonomic manager.

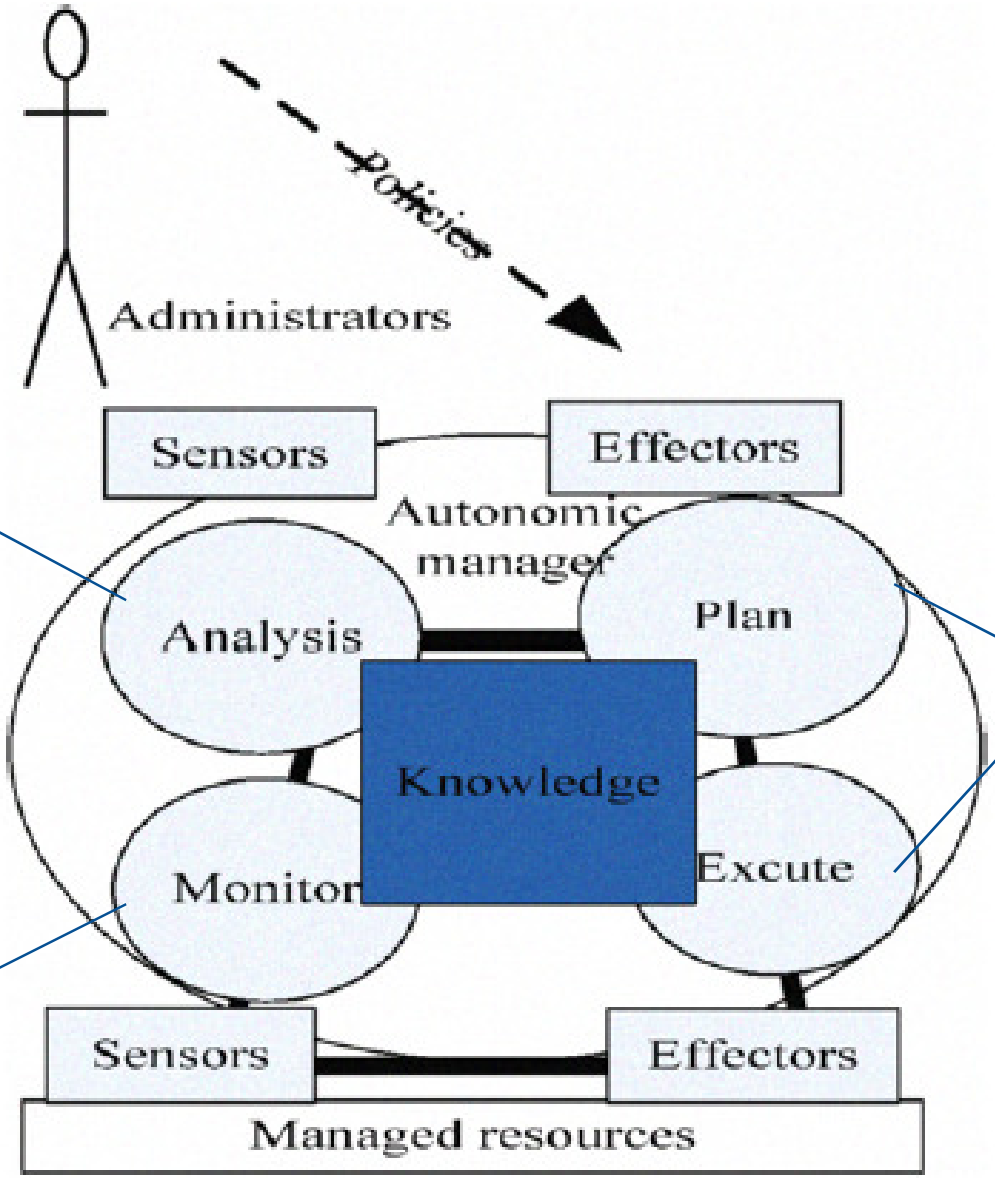
IBM introduced reference model called MAPE-K which comprised of managed resources and an autonomic manager (AM)

The managed resources can be operating systems, wired or wireless network, CPU, database, servers, routers, application modules, Web service or virtual machine and so on.

Autonomic manager consists of monitoring component, analysis component, planning component, and execution component and knowledge repository.

carries out autonomic decision-making and decides the adaptive goal of system

provides the ability of self-awareness and detects the external environment



achieve the adaptive function when the system state departures from the expected goal

The reference model of autonomic element

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- The monitoring component provides the ability of self-awareness and detects the external environment.
- The analysis component then carries out autonomic decision-making and decides the adaptive goal of system
- planning and execution components achieve the adaptive function when the system state departures from the expected goal
- The operation of four components is supported by the knowledge repository.

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So far, the concept of autonomic computing is still in the development process, but its basic content has been clear. That is, the information system whose properties are established for reducing the workload on the system administrators, improving reliability, availability and fault tolerance of system

- **AUTONOMIC COMPUTING PROPERTIES AND APPLICATIONS**
- *A. Self-configuration*

An autonomic computing system configures itself based on the needs of the platform or a strategy provided by IT professionals to adapt to changing environment.

- **AUTONOMIC COMPUTING PROPERTIES AND APPLICATIONS**
- *B. Self-healing*

An autonomic computing system detects, diagnoses abnormalities and makes the appropriate repair measures. Self-healing component can detect system failure and in the case of uninterrupted service, it initiates repair measures automatically based on pre-specified strategy by IT professionals.

- **AUTONOMIC COMPUTING PROPERTIES AND APPLICATIONS**
- C. *Self-protection*

An autonomic computing system predicts, identifies and prevents the threat which is from anywhere. Self-protection component can detect hostile acts and take appropriate measures to ensure stability of the system.

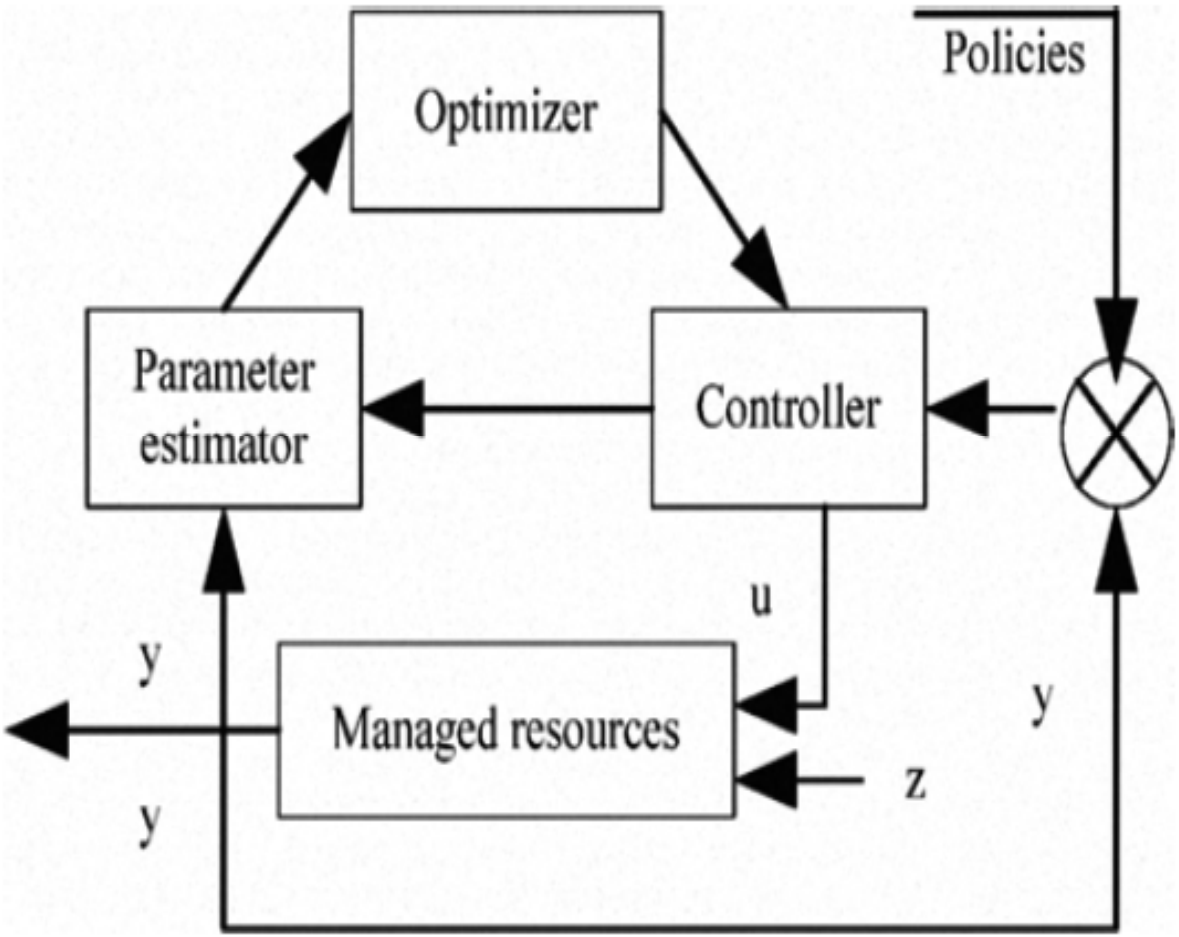
- **AUTONOMIC COMPUTING PROPERTIES AND APPLICATIONS**
- *D. Self-optimization*

An autonomic computing system automatically optimizes managed resources, and the optimization component adjusts itself to meet the needs of their end-user and business needs

THEORIES AND TECHNOLOGIES

Autonomic computing system involves service-oriented technology, Agent technology, adaptive control theory, machine learning, and optimization theory and so on

A. *Adaptive Control Theory*



Autonomic Element Based on Adaptive Control Theory

Here, Adaptive Control System measures the input /output information, obtains the dynamic characteristics of the managed object and systematic errors in time and makes decisions and modifies the controller parameters autonomously to adapt control signal to meet the changes of object and disturbance, to maintain optimal control performance of system.

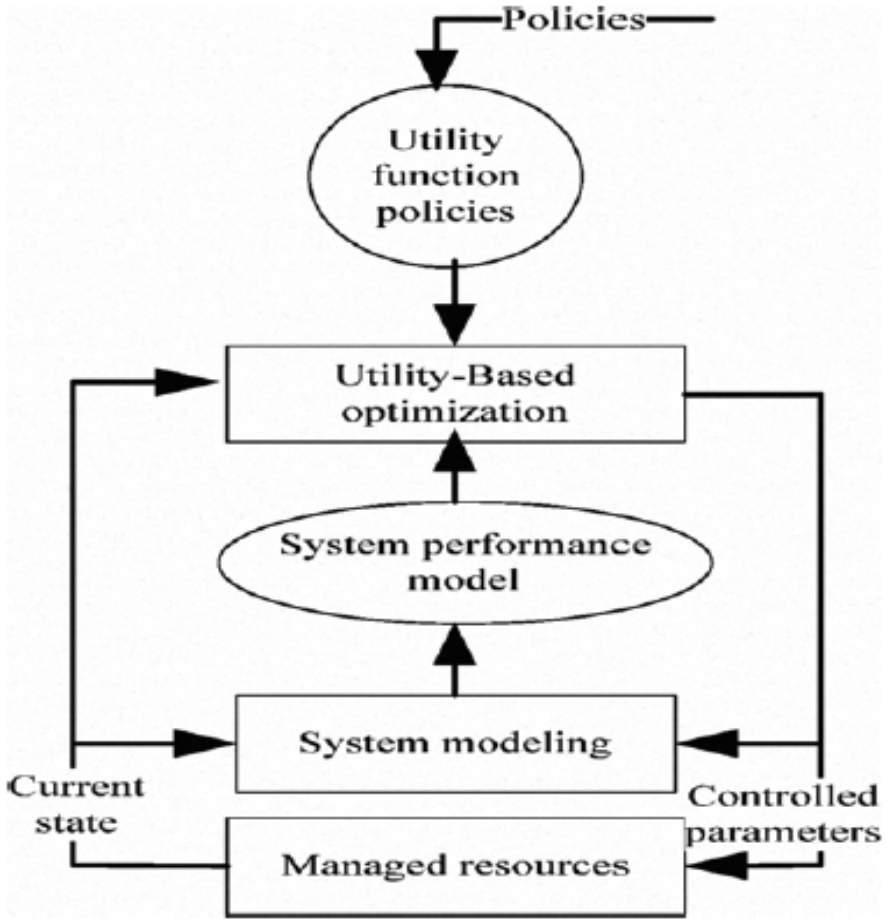
B. Agent Technology

Agent called intelligent agent has the properties of reactivity, autonomy and social. It can sense the environment to make a reaction (Reaction Agent) or to achieve the goal-oriented behavior (Deliberative Agent) by plan

Also, agent has been widely known as the key technology which supports the large-scale, open and distributed information systems to achieve dynamic service integration and teamwork

C. *Utility Function*

Utility is one of the most commonly used concepts in economics. In autonomic computing, utility function maps each possible state (system performance) of the entity (autonomic element) to a real number, for showing the value which corresponds to system performance (such as reaction time, delay, throughput, etc.).



Autonomic element based on utility function

AUTONOMIC COMPUTING RESEARCH PROBLEMS AND FUTURE DIRECTIONS

At present, some problems of autonomic computing have been studied at home and abroad. However, the research of theory, method and techniques on this new computing model is far from being systematically carried out. There are many problems that have not yet discovered and have to be resolved.

Some of the problems are as follows :

A. *Autonomic Computing System Architecture*

B. *Software Engineering Tools for Autonomic Computing System*

C. *Strategies for Autonomic Computing*

CONCLUSIONS

With the promotion of researchers and practitioners, autonomic computing research has infiltrated into pervasive computing, grid computing, software architecture and other fields. It has achieved fruitful research results. However, it remains a relatively immature topic. In this paper, an introduction to autonomic computing is presented, and point out that the current research problems and research prospects hoping to provide a useful reference for the further study of autonomic computing.

THANK YOU

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