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ITU KALEIDOSCOPE
NEW DELHI 2024

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Research on Scenario-based Dynamic Inspection Methodology Using Expression Engine

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JIAN WU presented by Lei Yang/Shangming Gu
China Mobile Communications Group Co. Ltd. China

Session #1.1

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01 Research background and overall architecture design

Research background

In the process of automated operation and maintenance, through the CMDB, one can quickly obtain and manage configuration information, ensuring the accuracy and consistency of automated operations. Therefore, establishing audit rules for the CMDB is an indispensable and important part of achieving intelligent operation and maintenance. The Challenges are as follows:

- There are numerous models, which are dynamically changing
- Data sources are diverse
- Data migrated from legacy management systems

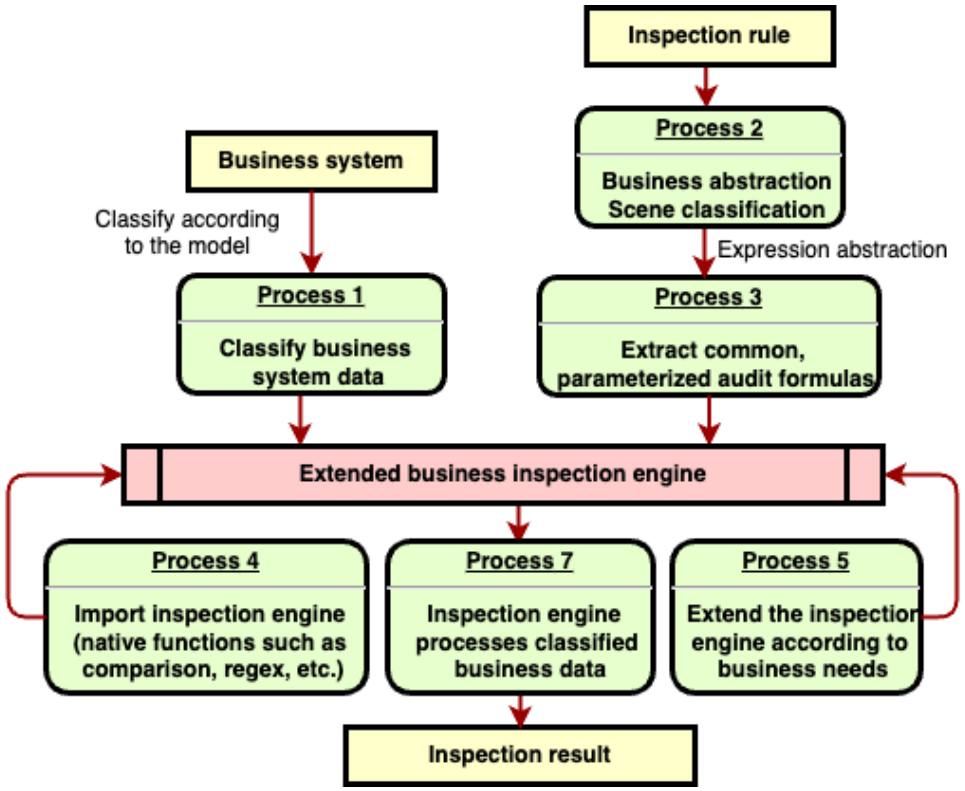
Design goal

Implement a universal, automated solution to ensure compliance of content and logic in various business scenarios.

- Abstraction of inspection rules
- Implementation of inspection rules based on the expression engine
- Visualization of results

Overall architecture design

Our system architecture design includes several key components such as data acquisition, rule abstraction, expression engine extension, and result visualization.



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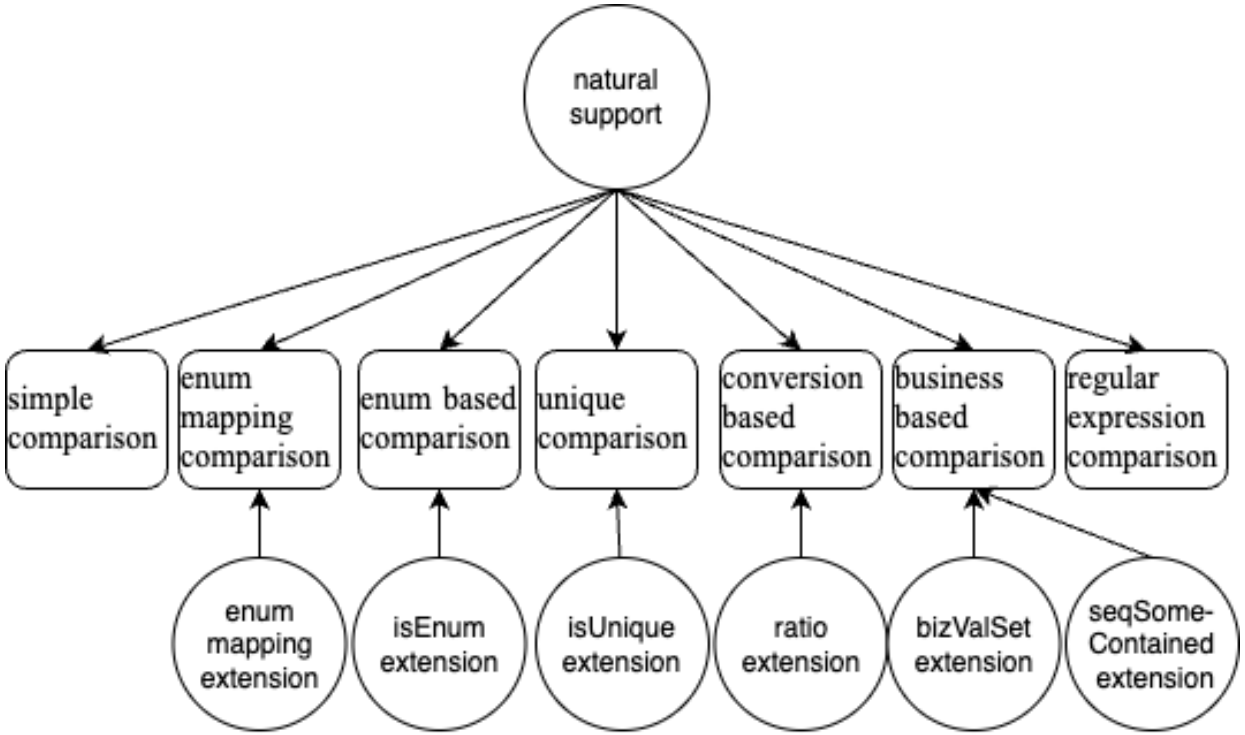
02 Design of scenario-based inspection

General inspection Formula

$$[if\ (precondition)then]ruleExr\ (input)$$

Rule Scenario	Rule Example
1) Simple comparison	The allocated bare metal image cannot be empty and must not be the string 'null'
	The allocatable memory should be greater than or equal to the allocated memory
2) Regular expression comparison	The IPv4 address of the business network must adhere to the IPv4 format. If there are multiple IPv4 addresses for the bare metal business network, please separate them with a semicolon, for example: 1.1.1.1
3) Enum mapping comparison	The CPU specification of the bare metal template <= CPU quantity * cores per CPU * threads(2)
4) Enum Based comparison	The run type for bare metal is enum, and the enumeration values should be selected from 0, 1, and 2
5) Unique comparison	The management IP of bare metal servers within the same cluster must be unique
6) Conversion based comparison	Allocatable VCPU cores < CPU quantity * cores per CPU * threads (2) * oversubscription ratio
7) Business based comparison	The image should match the current operating system

Semantic Extension of the Expression Engine



Inspection Model Based on Scenario Segmentation

For the rule:"The IPv4 address of the business network must adhere to the IPv4 format. If there are multiple IPv4 addresses for the bare metal business network, please separate them with a semicolon, for example: 1.1.1.1". Inspection formula (8) for the business network (businessIp) field:

businessIp = ~/(\d|[1 − 9]\d|1\d{2}|2[0 − 4]\d|25[0 − 5])(\.(\d|[1 − 9]\d|1\d{2}|2[0 − 4]\d|25[0 − 5])){3}*/

Case 1 – regular expression comparison

For the rule:"The CPU specification of the bare metal template <= CPU quantity * cores per CPU * threads(2)". The bare metal template CPU specifications (bmformworkCpu), CPU quantity(cpuNums), and the number of cores per CPU (nucNumPerCpu) must satisfy inspection formula (9):

$$bmformworkCpu \leq (long(enum(cpuNums)) \times nucNumPerCpu) \times 2$$

Case 2 – enum mapping comparison

For the rule:"The run type for bare metal is enum, and the enumeration values should be selected from 0, 1, 2.". The resource deployment status of bare metal (runType) must satisfy inspection formula (10):

$$Y = isEnum(runType, "0,1,2")$$

Case 3 – enum based comparison

For the rule:"Bare metal servers with the same cluster must have unique management IPs.". Same POD implies a specific range, where management IP is a detail field. Cluster (Pod), Management IP (manageIp) must satisfy inspection formula (11):

$$Y = isUnique(manageIp, "Pod")$$

Case 4 – unique based comparison

For the rule:"Allocatable VCPU cores < CPU quantity * cores per CPU * threads (2) * oversubscription ratio". Allocatable VPU cores (vcpuNum), CPU quantity (cpuNums), cores per CPU (nucNumPerCpu), and oversubscription ratio (virtualizationRatio) need to satisfy inspection formula (12):

$$vcpuNum < long(enum(cpuNums)) \times nucNumPerCpu \times 2 \times ratio(virtualizationRatio)$$

Case 5 – conversion based comparison

For the rule:"The image and the current operating system should match.". The image (imageName) and operating system (OsType) need to satisfy the inspection formula (13)：

Y=seqSomeContained(getBizValSet(osType),

Case 6 – business based comparison

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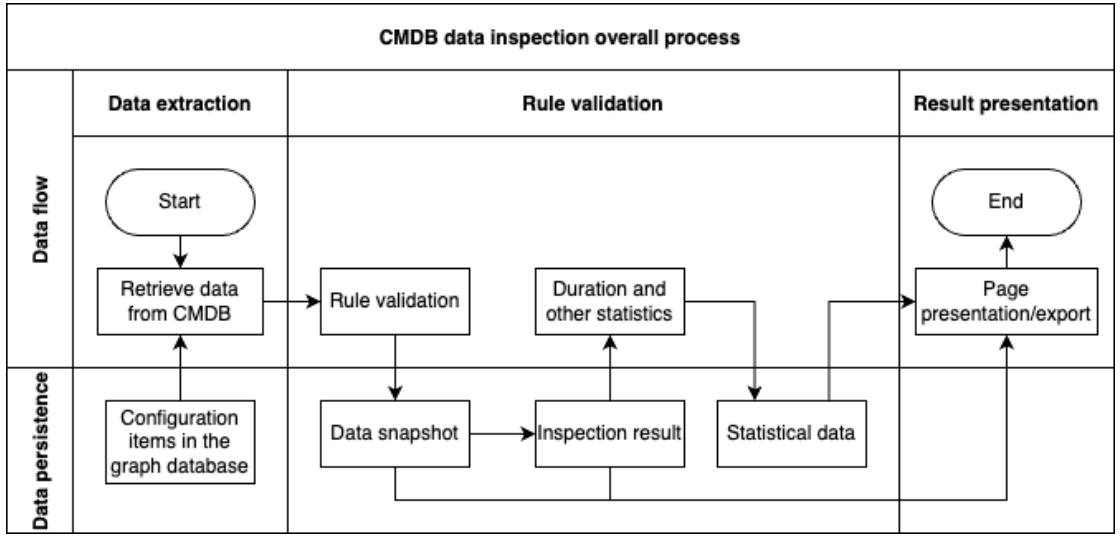
03 Application of dynamic inspection in CMDB business

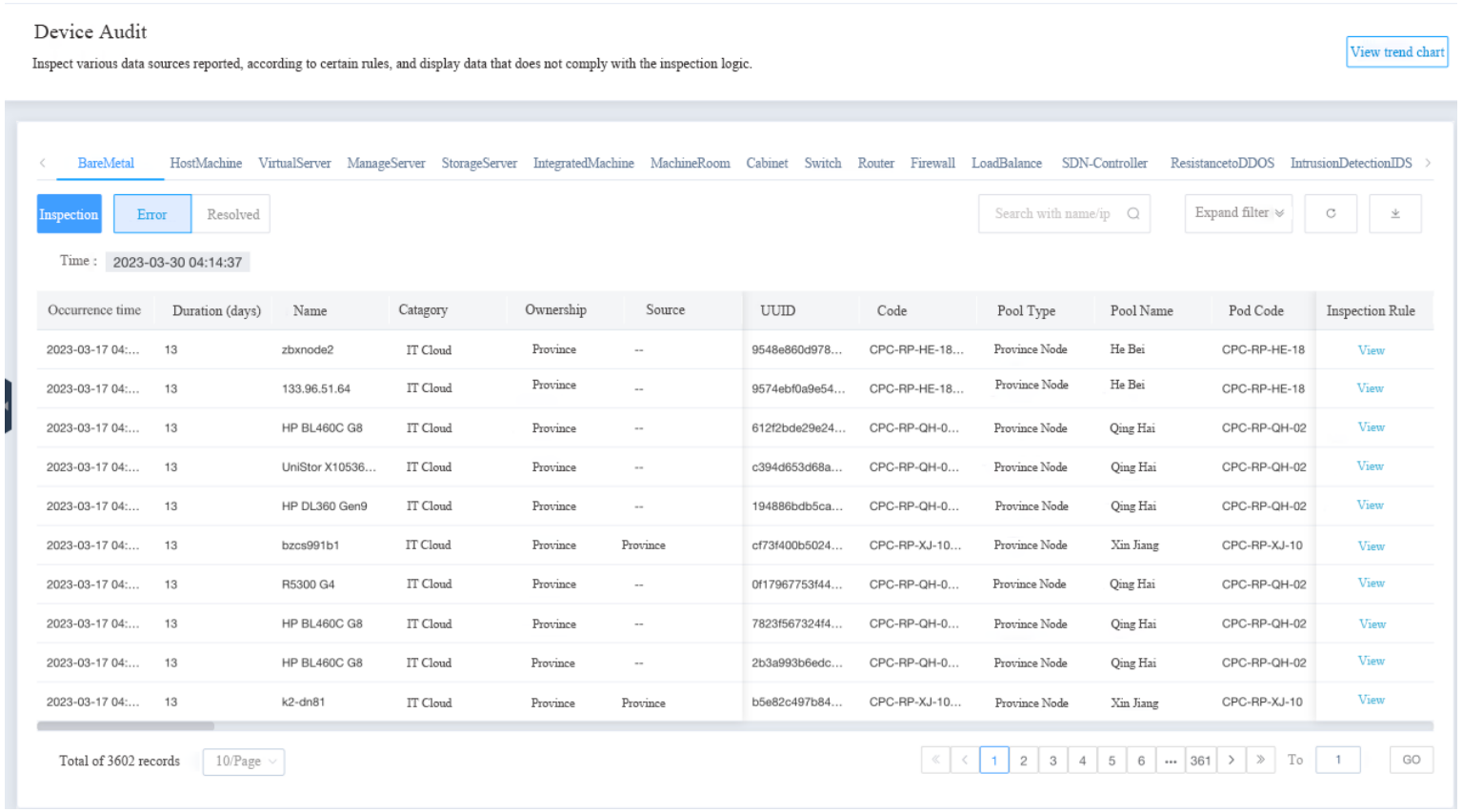
Implementation and Demonstration of Results

The CMDB has completed the management of 80 resource pools, 836 clusters, over 10,000 application systems, and more than 550,000 configuration items, bearing the heavy responsibility of linking performance, alerts, and other core modules.

The current network CMDB consists of 27 models with a total of 779 audit rules. As business requirements increase, the number of audit rules is also continuously rising.



CMDB Device Inspection Result Display Interface



Device Audit

Inspect various data sources reported, according to certain rules, and display data that does not comply with the inspection logic.

View trend chart

BareMetal | HostMachine | VirtualServer | ManageServer | StorageServer | IntegratedMachine | MachineRoom | Cabinet | Switch | Router | Firewall | LoadBalance | SDN-Controller | ResistancetoDDOS | IntrusionDetectionIDS

Inspection | Error | Resolved

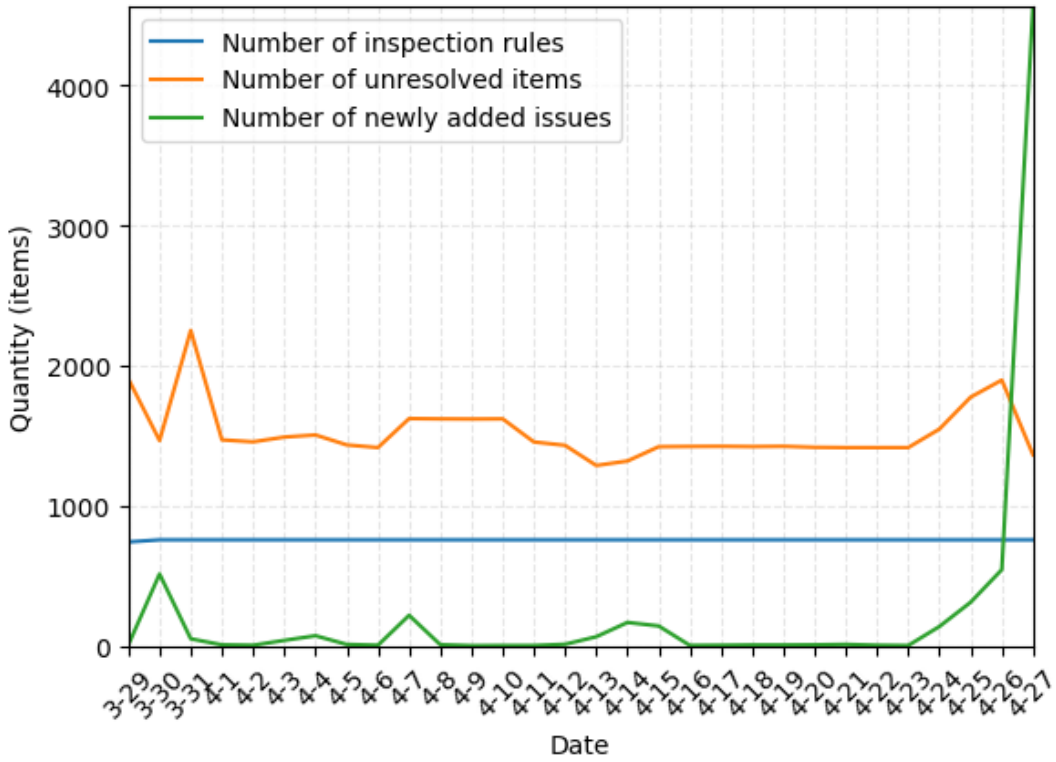
Search with name/ip | Expand filter

Time : 2023-03-30 04:14:37

Occurrence time	Duration (days)	Name	Catagory	Ownership	Source	UUID	Code	Pool Type	Pool Name	Pod Code	Inspection Rule
2023-03-17 04:...	13	zbxnode2	IT Cloud	Province	--	9548e860d978...	CPC-RP-HE-18...	Province Node	He Bei	CPC-RP-HE-18	View
2023-03-17 04:...	13	133.96.51.64	IT Cloud	Province	--	9574ebf0a9e54...	CPC-RP-HE-18...	Province Node	He Bei	CPC-RP-HE-18	View
2023-03-17 04:...	13	HP BL460C G8	IT Cloud	Province	--	612f2bde29e24...	CPC-RP-QH-0...	Province Node	Qing Hai	CPC-RP-QH-02	View
2023-03-17 04:...	13	UniStor X10536...	IT Cloud	Province	--	c394d653d68a...	CPC-RP-QH-0...	Province Node	Qing Hai	CPC-RP-QH-02	View
2023-03-17 04:...	13	HP DL360 Gen9	IT Cloud	Province	--	194886bdb5ca...	CPC-RP-QH-0...	Province Node	Qing Hai	CPC-RP-QH-02	View
2023-03-17 04:...	13	bzcs991b1	IT Cloud	Province	Province	cf73f400b5024...	CPC-RP-XJ-10...	Province Node	Xin Jiang	CPC-RP-XJ-10	View
2023-03-17 04:...	13	R5300 G4	IT Cloud	Province	--	0f1796753f44...	CPC-RP-QH-0...	Province Node	Qing Hai	CPC-RP-QH-02	View
2023-03-17 04:...	13	HP BL460C G8	IT Cloud	Province	--	7823f567324f4...	CPC-RP-QH-0...	Province Node	Qing Hai	CPC-RP-QH-02	View
2023-03-17 04:...	13	HP BL460C G8	IT Cloud	Province	--	2b3a993b6edc...	CPC-RP-QH-0...	Province Node	Qing Hai	CPC-RP-QH-02	View
2023-03-17 04:...	13	k2-dn81	IT Cloud	Province	Province	b5e82c497b84...	CPC-RP-XJ-10...	Province Node	Xin Jiang	CPC-RP-XJ-10	View

Total of 3602 records | 10/Page | 1 2 3 4 5 6 ... 361 | To 1 | GO

CMDB Inspection System Trend Chart



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04 Result analysis and discussion

CMDB Inspection Accuracy

Trend chart | Accuracy

Resource Pool: All

Reset | Confirm | Export

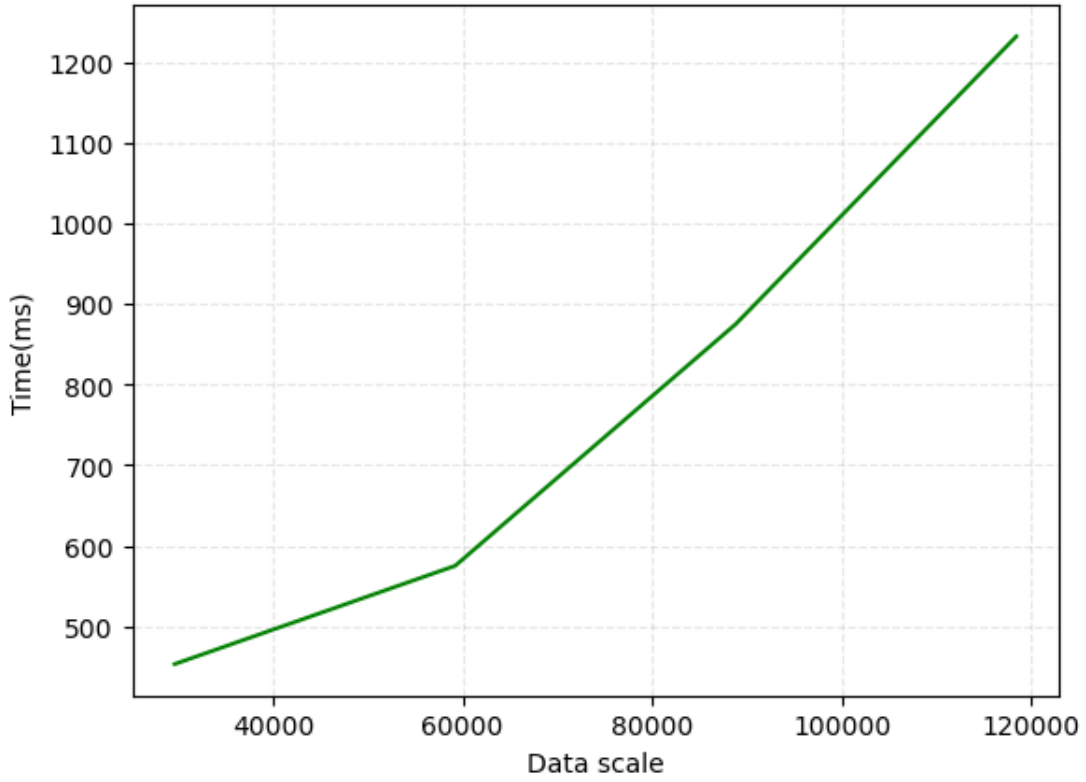
Accuracy = (1 - (cumulative number of problem data entries in the current month + unresolved problem data entries from the previous month) / end-of-month server scale) * 100%

Display data for the last 13 calendar months

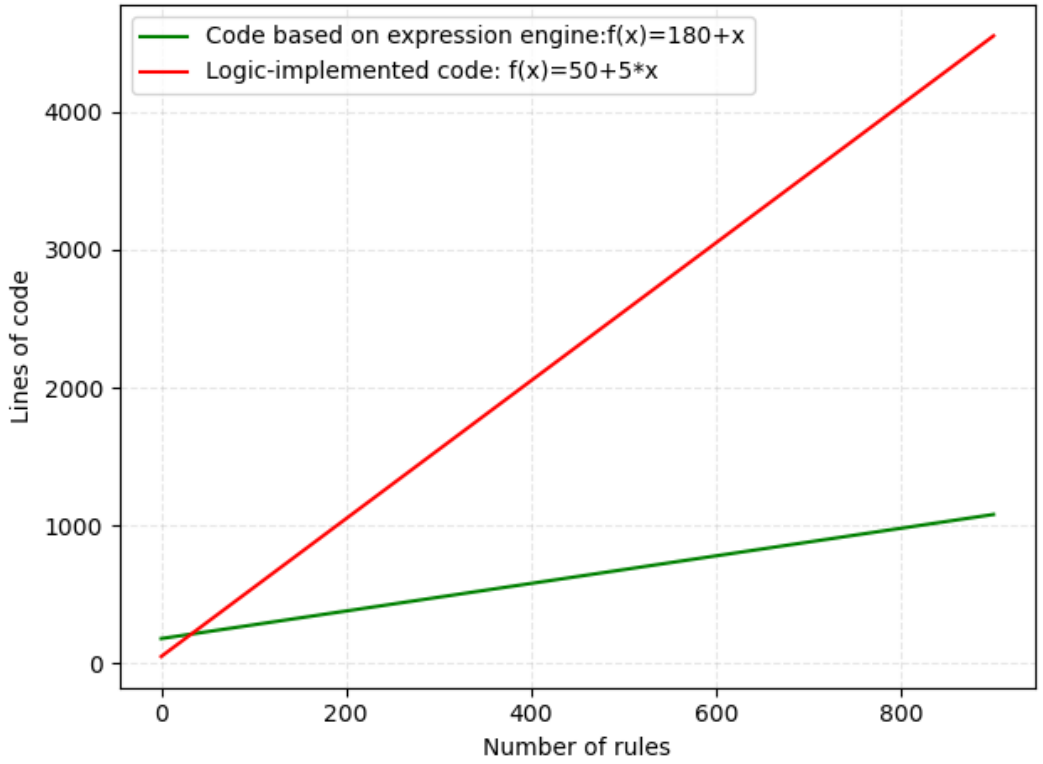
Region	2022-04	2022-05	2022-06	2022-07	2022-08	2022-09	2022-10	2022-11	2022-12	2023-01	2023-02
Regional Center	--	--	--	--	--	--	95%	97%	95%	98%	99%
Province	--	--	--	--	--	--	89%	93%	94%	100%	99%

Resource Pool	2022-04	2022-05	2022-06	2022-07	2022-08	2022-09	2022-10	2022-11	2022-12	2023-01	2023-02
Shang Hai	--	--	--	--	--	--	98%	94%	100%	100%	100%
Yun Nan	--	--	--	--	--	--	94%	95%	94%	100%	94%
Nei Meng Gu	--	--	--	--	--	--	66%	99%	88%	100%	100%

Audit Performance Analysis



Code Quantity



Iterative Complexity Analysis

$$complex=a(n)+b(n)+c(n)$$

Traditional Method

$$complex = 5n + b(n) + t,\ t \in [1, 30]$$

VS

Method Based on Expression Engine

$$complex = n$$

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05 Meaning

Meaning

Scenario-based Dynamic Inspection Method Based on Expression Engine:

- Successful Implementation: Applied in actual CMDB scenarios, it not only meets customer business needs but also meets the high accuracy and performance requirements of the production environment.
- Data Quality Assurance: Effectively detect and identify problematic data to ensure data security and compliance.
- Strong Method Universality: The expression engine is semantically extended according to different business scenarios, capable of adapting to a variety of data challenges.
- Reducing Iterative Complexity: Significantly reducing the amount of code, reducing the cut-over costs in the production environment, and lowering the entire requirement iteration cycle.


Thank you!