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Research on Operational Process Optimization Strategy during Cloud Service Migration

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Abstract: The cloud service migration of enterprises has begun to rely on digital transformation, but in the process of transformation, there may be problems such as disorganization of operational processes, slow response and poor coordination of systems. This paper mainly discusses how artificial intelligence can be applied to process identification, decision analysis, resource allocation and system coordination, and further describes the importance of virtualization technology, data synchronization mechanism and automatic arrangement strategy, proposes to take intelligence as the main line to improve migration rate and intelligent operation, and gives suggestions for enterprises to achieve effective and stable cloud operation architecture.

Keywords: cloud service migration; operation process; artificial intelligence; process optimization; automatic choreography

1. Introduction

With the deepening of enterprise digital transformation, cloud service migration has become an important way to improve enterprise business resilience and resource utilization. However, in the process of cloud service migration, we often face a series of problems, such as complicated processes, slow response, and poor cooperation ability, which seriously affect the effect of the entire cloud migration. Artificial intelligence has shown great advantages in this regard, and it can play an effective role in process identification, decision analysis and resource allocation, which brings new solutions to the process problems in the process of cloud service migration. Based on the perspective of artificial intelligence, this paper explores key support and typical problems in cloud service migration, and proposes a process optimization scheme with certain intelligent characteristics, aiming to provide theoretical basis and implementation path for supporting enterprises to build a stable and efficient cloud service system.

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2. Core Capabilities That Drive the Smooth Landing of Cloud Migration

2.1. Virtualization and Containerization: Improve Flexibility and Compatibility

As enterprise IT moves to the cloud, enterprises are increasingly relying on virtualization and containerization. Its technology optimizes system flexibility and accelerates deployment. Virtualization allows multiple independent environments to run on the same physical device, improving the utilization of existing resources, reducing hardware requirements, and increasing the scalability of the overall system in terms of maintenance. Containers, on the other hand, provide a granular deployment that ensures consistency across environments and accelerates releases and updates [1]. In fact, the combination of these two technologies not only makes the work of technical teams easy, but also helps enterprise business units respond more quickly to the market. For example, container platforms such as Docker and Kubernetes make it very simple for enterprises to go to the

cloud, and realize the full life cycle from research and development to release. In the business management view of the enterprise, this technical foundation means that the enterprise has the opportunity to adjust its resources more flexibly and can trust that the technical support can support mainstream customers in a timely manner. Figure 1 shows the architecture diagram of virtualization and containerization.

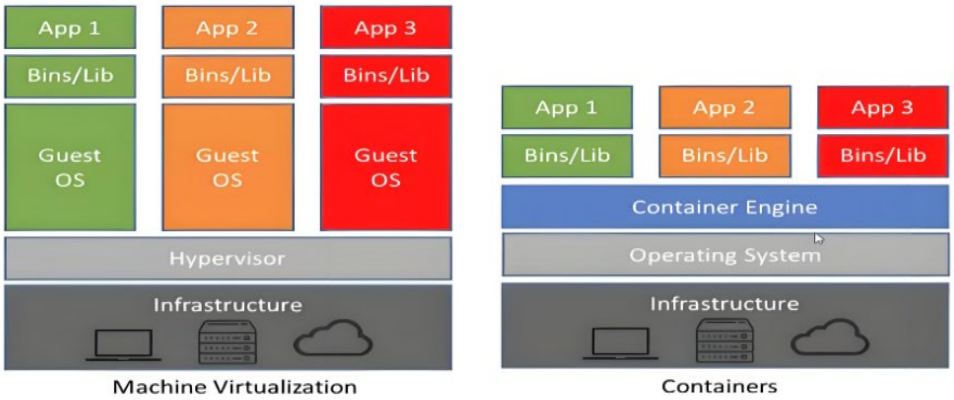

Figure 1. Virtualization and Containerization Architecture Diagram.

2.2. Data Migration and Synchronization: Ensure Integrity and Continuity

When data migration is applied to the cloud, it is critical to ensure a smooth migration of its information, which has a direct impact on business continuity and a seamless customer experience. In essence, both full migration and incremental migration belong to the consistency of business processes and the continuity of customer service experience. In the process of concern, managers are more concerned about the integration of different problems and the configuration of business processes, rather than a specific technical tool, such as which synchronization strategy can be adopted in the migration process to ensure the immediate availability of key data and ensure the slow response of enterprises caused by data delay [2]. At the same time, it is also necessary to determine whether there may be various migration interruption events in the process, whether it is necessary to add redundant data detection links, whether it is necessary to add a double write, so that technical personnel have the opportunity to intervene in the case of data migration problems. With this data migration process set up, you can help companies in the process of migration and adoption of technology solutions, more to ensure customer service continuity, for subsequent data analysis and decision support [3].

2.3. Automation and Orchestration Capabilities: Increased Efficiency and Stability

Because there are multiple steps in each stage of the cloud migration process, manual execution may take a long time or cause errors, resulting in slow or problematic process execution. Therefore, process automation is one of the important means to improve process efficiency. Set accurate standards, rules, and configurations in the process design, so that technical personnel can directly initiate and complete the migration task, reduce personnel involvement, and speed up response and accuracy. As a process optimizer, what needs to be considered is which links may cause manual operation to affect efficiency, which businesses have a lack of coherence in scheduling, and whether there is a need to teach technical personnel to optimize task execution rules. After the introduction of intelligent scheduling, it can be deployed more reasonably, avoid unnecessary waiting and waste, and ensure the connection of key nodes. Such process optimization can not only improve the execution efficiency, but also be more conducive to supporting the global operation [4]. Figure 2 below is a cloud migration process and operation collaboration model supported by AWS architecture.

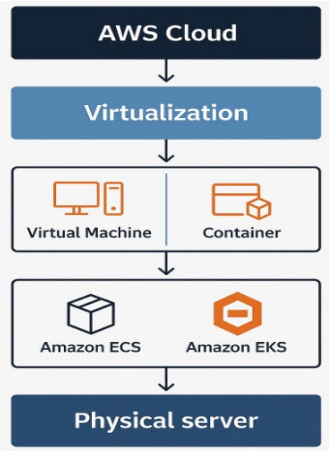

Figure 2. Cloud Migration Process and Operation Collaboration Model Supported by AWS Architecture.

3. Operation Process Dilemma Process during Cloud Service Migration

3.1. The Process Structure Is Complex and Intelligent Analysis Is Difficult

In the process of cloud service migration, there are often many system dependencies, unclear modules and uncertain data sources, which bring complexity and incomprehension to the whole architecture. Although AI has a high ability to analyze processes and customize models, it often fails to accurately identify critical paths, and process points due to the lack of standard processes, unrecorded information, or heterogeneous data. If clear process rules cannot be provided to AI, it will lead to difficulties for later AI to make intelligent decisions, arrangements, and optimization [5]. Most of the flow charts currently used are manually constructed or in the form of static files, lacking real-time and dynamic update functions, which also limits the intervention of AI in process interpretation. Table 1 below analyzes the impact of complex process structure on AI analysis and describes the complex structure flow:

Table 1. Analysis of Influencing Factors of Complex Process Structure on AI Analysis.

Problem type	Form of expression	Limitations on AI
System dependency chaos	Multi-system cross-call, interface standards are not uniform	Unable to construct a clean system call diagram
Data source dispersion	The recording formats of different systems vary greatly, and the log data is incomplete	Process mining algorithm is difficult to restore the exact process path
Absence of structural criteria	There is no unified template for process definition and the documents are not updated	AI is not capable of efficient batch identification and comparison
Historical data deficiency	Frequent system upgrades and lack of complete process running records	The training model sample is insufficient and the algorithm precision is unstable

As can be seen from Table 1, the ability of AI to identify patterns is affected by poor process logic, such as poor system dependence, data dispersion, and uncertain process standards, all of which make it impossible for AI to generate process logic models, thus affecting the subsequent application of scheduling, prediction, and optimization functions.

3.2. Fuzzy Decision Path Reduces Response Efficiency

Cloud service migration will have many decisions to make, such as the resources used, priority services, etc., but most enterprises cannot use data and AI to achieve decision assistance, and still rely on human subjective decision-making or follow preset rules, which easily lead to slow response speed and strategic imbalance. Although AI has the ability to create predictive models and form rules, without sufficient structured input data and samples of past behavior, AI's learning efficiency will be affected, and it will not be able to get accurate recommendations to respond in a timely manner. Table 2 below summarizes the influencing factors of fuzzy AI response of decision path.

Table 2. Influence Dimensions of Decision Path Ambiguity on AI Response Ability.

Problem dimension	performance	Interference factors to AI intelligent decision-making
Decision logic is fragmented	Each module is independent and lacks a unified strategy engine	It is difficult to form a unified input framework, and AI is difficult to model
Rule not retroactive	The decision basis is not recorded, and the operation is arbitrary	The lack of reliable label data in algorithm training affects the learning efficiency
Response path confusion	Lack of clear priority and path dependence, task flow disorder	It is difficult for AI to predict the result path and feedback mechanism, and the response effect becomes worse
No feedback on decision results	There is no systematic backtracking mechanism after execution, and no data precipitation	The model cannot continue to learn and optimize, and the intelligence level is stagnant

It can be found from Table 2 that the existing decision-making stage has features such as unclear structure and lack of traceability, which affect the intervention and participation of AI in the decision-making stage.

3.3. Resource Configuration Is Rigid and Scheduling Mechanism Is Unbalanced

Resource scheduling also plays a crucial role in process efficiency. Many enterprises continue to use the traditional rigid setting, without the introduction of artificial intelligence dynamic management mechanism. In this case, there will be a lack of peak resources and inefficient idle time of resources, resulting in inefficient use of the entire resource. Artificial intelligence scheduling will pay attention to the load of the entire system, the previous access trend and the importance of tasks and other multiple dimensions, and conduct corresponding analysis, but now most enterprises do not have a suitable data source or interface path to combine with artificial intelligence scheduling. Some enterprises do not trust the automatic scheduling work of artificial intelligence, believing that they will lose control of themselves and hinder the development of automated resource scheduling. Table 3 below provides an overview of the impact of resource scheduling offset on AI configuration capabilities.

Table 3. Constraints of Resource Scheduling Imbalance on AI Configuration Capability.

Performance problem	Resource allocation characteristics	AI scheduling function limited reasons
Fixed allocation strategy	Static allocation is dominant, and there is no real-time adjustment mechanism	There is no access to real-time data streams, and the model cannot make dynamic decisions

Usage is not visible	Lack of resource monitoring system, status information lag	AI lacks feedback data, leading to misjudgments
Priority is not defined	All tasks are executed sequentially and cannot be dynamically adjusted	The model lacks scheduling basis, and it is difficult to make resource tilt strategy
Conservative management rights	Resource scheduling still needs manual approval control	The algorithm is limited in execution and cannot implement end-to-end automatic scheduling

As can be seen from Table 3, the current resource allocation management methods are static management methods, which are difficult to meet the dynamic and complex process load scheduling requirements.

3.4. System Coordination Is Weak and Process Linkage Is Blocked

Process collaboration becomes very important when there are multiple systems working together. However, because the platform is not unified, the interface standard is different, and the data cannot be shared, there are often information islands between the systems, and the collaboration is inefficient. Although artificial intelligence has the ability to integrate multiple system data and conduct intelligent joint analysis, at present, in the absence of a unified hub control platform for various departments, it is difficult for artificial intelligence to call multi-system data and carry out intelligent management and control and forecast in advance. In fact, departments generally use their own business systems, and collaboration mainly relies on human communication, which greatly reduces the extent to which artificial intelligence plays a role in collaboration. Table 4 below shows the analysis and statistics of the impact of system synergy disorder.

Table 4. Analysis of the Influence of System Collaboration Barriers on AI Linkage Ability.

Type of coordination problem	Performance characteristics	Inhibition of AI intelligence collaboration
The system platform is disconnected	The different platforms operate separately and lack a unified access point	AI does not have access to global data, making it difficult to model uniformly
Interface standard confusion	The data interfaces are diverse and irregular, and the information formats are inconsistent	It is difficult for the model to read and integrate data, and the linkage policy fails to be executed
Limited data sharing	Due to rights isolation and privacy concerns, data cannot be communicated between departments	AI strategy development is hampered by a lack of data input sources
Lack of support in the middle	There is no process center to coordinate the task flow of each module	The process status cannot be managed in a unified manner, and the intelligent linkage path is interrupted

As can be seen from Table 4, the application difficulty of AI process linkage is inter-system linkage. There are unclear platform division, unclear interface, and data fragmentation, and no central overall control system is formed, so that AI cannot coordinate task adjustment and process closure in the global scope.

4. Optimization Path of Operation Process in Cloud Service Migration

4.1. Clarify the Process Structure and Improve the Intelligent Identification Capability

In a cloud service environment, processes need to be migrated intelligently. Because of the large number of modules, the large number of branch paths, the nodes are inextricably linked to each other. Therefore, in order to solve the problem by artificial intelligence, it is necessary to use historical traces to dig out which task nodes have real dependence and successive connections. Then the trust score is assigned according to the frequency of task conversion and the relevance of task context, so as to determine the main route and node of the process. Scoring process path function:

$$S(i,j) = \alpha \cdot F(i,j) + \beta \cdot C(i,j) \quad (1)$$

In this model, $S(i,j)$, $F(i,j)$and $C(i,j)$ are selected to represent the three measures of path weight, number of jumps and context coupling degree in the process of information passing through two nodes, and the adjustable weight coefficients α and β are selected to further adjust the measurement of flow migration intensity and the recognition of logical correlation, which are used as the weight reference value of AI process organization.

4.2. Optimize the Decision-Making Mechanism and Speed up the Response Processing

In cloud service migration, resource allocation, workflow switching, fault solving and other work are the decisive work in the process of cloud service migration, and the response time of work will affect the effectiveness of cloud service migration. Existing systems often use inherent criteria or human judgments to determine the next response, leading to delays in decision making and increasing the likelihood of workflow disruption. The introduction of artificial intelligence can form automatic decisions through big data on past action patterns and can react online.

In the process of decision optimization, AI mainly adopts the form of classification, regression and reinforcement learning to make decisions and predictions, and calculates the optimal decision path according to the input (task type, resource state, duration, etc.). For example, when a resource conflict occurs, the optimal resource allocation sequence is selected based on the policy results of similar conflict events in history to avoid the superposition of waiting time or conflicts. In addition, based on the decision tree, graph search, and policy ranking formula, AI can also score various options, ranking alternatives according to the score, so as to select the best solution, improving the consistency and resilience of process execution.

4.3. Strengthen Resource Scheduling to Implement Dynamic Configuration Management

In the process of cloud migration, the dynamic nature of resource scheduling determines the effectiveness of cloud migration process. Traditional resource scheduling is dominated by specific methods or existing classification mechanisms, which is not suitable for the sudden load changes and task urgency changes in the real-time migration process. After using artificial intelligence, the scheduling method can carry out adaptive scheduling according to multi-dimensional factors such as task type, system state and predicted load, so as to meet the needs and automatically adjust the process.

In AI scheduling schemes, one of the most common resource scoring methods is to design a resource fit function to describe how well a task matches a pre-selected resource. The function can be expressed as:

$$R(i,j) = \lambda_1 \cdot U(j) + \lambda_2 \cdot A(j) - \lambda_3 \cdot L(i,j) \quad (2)$$

Where, $R(i,j)$ is the adaptation score of resource point j assigned to task i. $U(j)$ is the utilization rate of the resource (high utilization rate is good), $A(j)$ is the currently available resource, $L(i,j)$ is the estimated delay (such as queue waiting time), and there are three weight factors λ_1, λ_2, λ_3 to balance the weight of each factor. Based on the result of score calculation, AI independently makes the optimal configuration policy and dynamically refreshes the scheduling sequence in real time.

4.4. Build a Collaborative Center and Promote the Linkage of the Process System

The problem of system collaboration is also a frequent problem in the process of cloud service migration, especially for the system with multiple platforms in multiple departments working in parallel, the task chain is easy to interrupt, repeat, and lag. In this regard, artificial intelligence can play the role of a central dispatcher room to promote collaboration between various systems in a process sensing, event-driven way. The establishment of this central coordination, the key is to build a universal intelligent interaction architecture, so that AI can be involved in various aspects of different sub-processes on a variety of different platforms, while realizing real-time monitoring of various events, based on the context of the status quo, and then automatically mobilize the behavior of the operation unit. Through this centralized AI organization, every business process can be placed into it for status monitoring and job assignment, so as to ensure that there is an optimal choice in every link. For example, when the business has been processed on subsystem A, AI can determine the optimal next behavior unit according to the context of the job category, based on the current task load, the efficiency parameters of the past behavior results, etc., so that system B is triggered to realize the continuation of the next step, thus avoiding human waiting.

5. Conclusion

With the widespread application of cloud computing, improving the effective execution of the cloud migration process has become an urgent problem to be solved. This paper uses AI technology to optimize process identification, intelligent decision making, resource scheduling, coordination and cooperation, aiming at establishing an agile, intelligent and sustainable cloud migration process system. In the future, the application of AI in self-management and autonomy, dynamic execution, etc., will promote the stability and intelligence of cloud services.

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