Design and Optimisation of Crash Prevention Platform for Online Course Selection System Based on Network Traffic Analysis

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Keywords: Online Course Selection System, System Crash, Error Handling, Network Traffic Analysis, Reliability.

Abstract: With the popularity and use of online course selection systems in universities, the system crash problem occurs frequently, which seriously affects the smooth running of the course selection process of students. The current methods to solve the system crash problem are limited to the traditional error handling and fault tolerance mechanism techniques, which are ineffective. In order to solve this problem, this study proposes a new solution with strong robustness and adaptability based on network traffic analysis - the online course selection system crash prevention platform (NETCAP). The platform realizes real-time monitoring and analysis of network traffic, and provides a stable and reliable operating environment for users. NETCAP platform is of great significance to improve the reliability and user experience of the university course selection system, and provides new ideas and methods for research in the corresponding fields.

1 INTRODUCTION

With the continuous progress of information technology and the popularity of education informatisation, online course selection system in universities has become an indispensable and important part of modern education management. Online course selection system provides students and teachers with convenient and efficient course selection services, greatly simplifies the course selection process, and improves teaching quality and management efficiency (Yunpeng Bai, 2015). However, with the rapid development of the online course selection system and the increase in the number of users, the problem of course selection system crash has gradually appeared, which seriously affects the smooth running of students' course selection and the normal operation of academic management.

First of all, students may encounter the crash of course selection system during the peak period of course selection leading to failure of course selection, thus delaying the study plan, and may miss important courses, and may even cause delays in graduation and other effects. Failure to select the class of their choice in the course selection process not only brings unnecessary trouble and stress to students, but also may lead to changes in their career development and reduce their interest in learning the course. In addition, for school administration, the collapse of the course selection system will increase the workload of the academic staff and lead to confusion in the course selection process. Therefore, the stability and reliability of the course selection system becomes a serious challenge.

Currently, the methods to solve the problem of course selection system crash mainly focus on the traditional error handling and fault tolerance mechanism techniques (Jinfu C, Qianlong Yang). The traditional coping mechanism mainly focuses on the known failure modes (YANG Qianlong, 2023), while it can hardly cope with the unknown failure modes, not to mention the inability to identify and correct the potential problems in a timely manner. These methods are limited in their ability to monitor and predict the risk of system crashes in real time, and often only temporarily solve the problem, unable to fundamentally avoid and prevent the occurrence of system crashes. In view of this, the current security precautions have been difficult to adapt to the increasing number of highly concurrent and complex operating environments, and there is an urgent need for a more functional and intelligent preventive mechanism to ensure the stability and reliability of the system.

To address this problem, this paper proposes a system crash prevention platform based on network traffic analysis, and applies this platform to the online course selection system in universities. By monitoring and analysing the network traffic of the course selection system in real time, the platform is

Meng, Z., Chen, J., Yang, L., Lin, C. and Zhang, Q.
Design and Optimisation of Crash Prevention Platform for Online Course Selection System Based on Network Traffic Analysis.
DOI: 10.5220/0012285700003807
Paper published under CC license (CC BY-NC-ND 4.0)
In *Proceedings of the 2nd International Seminar on Artificial Intelligence, Networking and Information Technology (ANIT 2023)*, pages 449-453
ISBN: 978-989-758-677-4
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able to accurately identify the risk of system crash and provide corresponding early warning and optimisation measures (HUANG Ju, 2022). Compared with traditional methods, NETCAP is more accurate and flexible, and can detect the operating status of the course selection system in real time, predict potential crash risks, and take corresponding measures to improve the stability and reliability of the system. By introducing this innovative platform, colleges and universities can better cope with the problem that the course selection system is prone to crashing under high concurrency of network traffic, so as to ensure that students can select courses smoothly and improve the efficiency of academic affairs management.

The content of this paper is arranged as follows; Section 2 describes in detail the design principles and components of the crash prevention platform for online course selection system, Section 3 gives the experimental setup and the research results, Section 4 discusses the experimental results and optimisation directions, and Section 6 concludes the whole paper.

2 ONLINE COURSE SELECTION SYSTEM CRASH PREVENTION PLATFORM

During the peak period of course selection, the system traffic increases dramatically, which will cause the system to be in a high load operation state, which will lead to system crashes and other risks. Therefore, this paper proposes a Network Traffic Analysis-based Online Course Selection System Crash Prevention (NETCAP). The platform aims to improve the stability and reliability of the system by monitoring the network traffic of the course selection system in real time, analysing the traffic data and taking corresponding preventive measures. The overall architecture of the platform adopts a distributed architecture and consists of a data collection module, a data processing module, a traffic analysis module, a prediction module and an early warning mechanism module. The design principles include scalability, flexibility and high performance. The platform will adopt open interfaces to facilitate future functional expansion and customisation requirements.

2.1 Data Acquisition

The data collection module of the NETCAP platform is responsible for collecting network traffic data of the course selection system, including requests, responses, user operations and other information, and storing them in a distributed database. The network packets generated by the course selection system are captured with the help of network traffic monitoring tools, such as packet capture tools. This module is capable of capturing the communication data between the course selection system and the users and transmits the captured raw data to the data processing module in real time.

Figure 1 below shows the raw network data captured using the packet capture tool.

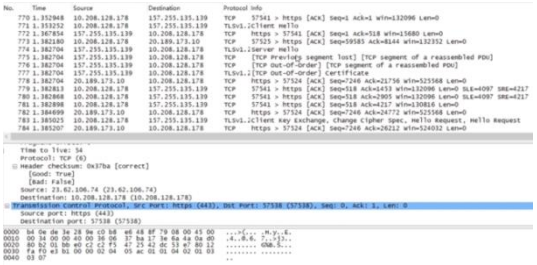

Figure 1. Data acquisition.

2.2 Data Processing

After the data collection is completed, the NETCAP platform will use data preprocessing techniques to process the packet data captured in the previous step by data cleaning, data filtering and other necessary processes, aiming to filter and organise the data for use in subsequent data analysis and modelling. Using feature extraction algorithms, features such as request frequency, request type and response time of network traffic data were extracted. However, this involves significant computational and storage resources. In order to improve the performance of the NETCAP platform, the design employs a number of optimisations including parallel computing, data compression and caching techniques.

2.3 Flow Analysis

The goal of flow analysis (Fangqiang Jiang, Zongzhen Gao) is to extract valuable information from massive network traffic data and perform anomaly detection and prediction. Based on the collected network traffic data, this module analyses the traffic patterns through feature extraction, anomaly detection and crash prediction algorithms, and then predicts the crash possibility of the course selection system. Specifically, the module will extract various traffic features, such as request frequency, request type, response time, etc., and analyse historical traffic data and anomaly detection

algorithms to detect abnormal system behaviour. Meanwhile, the module will use collapse prevention algorithm to predict whether a crash will occur in the course selection system and make decisions for subsequent preventive measures. After obtaining analysable data, the NETCAP platform uses traffic analysis methods to process the collected network traffic data.

2.4 Automatic Early Warning Response

In the event of large concurrent traffic in the system, the platform will automatically trigger the emergency response mechanism to enable load balancing, backup channel and other processing measures for the system, and at the same time inform the administrator by email that the current server is in the state of high concurrent network traffic, and if necessary, carry out manual technical maintenance measures in order to protect the stability and security of the system.

2.5 Key Functions and Module Design

The key functions of the platform include real-time monitoring, crash prediction and early warning mechanism. The real-time monitoring module is responsible for monitoring the network traffic of the course selection system in real time and transmitting the data to the flow analysis module for processing. The crash prediction module uses machine learning algorithms to build a prediction model based on the flow analysis results to predict the crash probability of the course selection system. In the early warning mechanism module, the NETCAP platform will perform network traffic analysis, and when the monitored network traffic exceeds the traffic threshold set by the system, the platform will automatically trigger the early warning mechanism and send an alert message to the system administrator, so that timely measures can be taken to avoid the crash of the course selection system. In addition, the platform also provides a data visualisation interface for administrators to view flow analysis results and system status. The design of specific functional modules is shown in Figure 2 below.

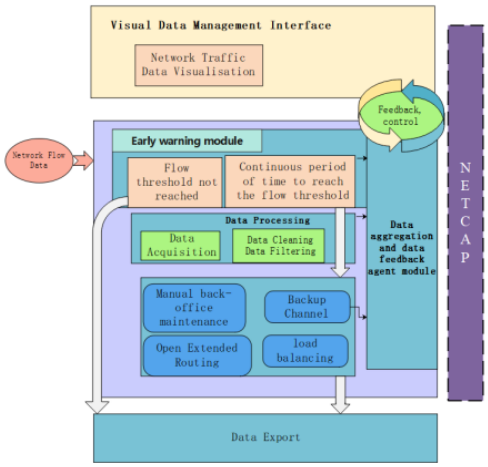

Figure 2. System design flowchart.

3 EXPERIMENTS

In terms of experiments, a series of experiments were designed and conducted to verify the system crash prevention function and performance of the NETCAP platform. During the experiments, the project conducted simulation tests based on real course selection system traffic as a way to evaluate the platform's performance and prediction accuracy, and at the same time optimise for possible bottlenecks.

First, the network traffic data of the real course selection system was collected and stored in a distributed database by the data collection module of NETCAP. Then pre-processing, including data cleaning and filtering, was performed on the collected data to improve the accuracy and efficiency of the subsequent analyses. Second, flow analysis and system crash prediction experiments were conducted. By analysing the historical traffic data after data processing and combining it with anomaly detection algorithms, the system's abnormal behaviours, including abnormal request frequency and abnormal response time, were successfully discovered. Third, the crash probability of the course selection system was analysed and predicted using a crash prediction algorithm. A machine learning model was built, trained using historical traffic data and crash occurrences, and predicted for future traffic data. Experimental results show that the crash prediction model proposed in this paper performs well in terms of accuracy and robustness, and can effectively predict the crash probability of the course selection system.

The NETCAP platform automatically triggered an emergency response mechanism when a possible system crash was predicted. Through processing measures such as load balancing and backup channel, the stability and availability of the system were successfully improved. At the same time, alert messages were sent to administrators via email so that timely manual technical maintenance measures could be taken to safeguard the security and stability of the system. To assess the performance and optimisation potential of the platform, performance tests were also conducted to simulate network traffic of different sizes and loads, and to monitor the platform's response time and system resource utilisation. During the tests, it was found that the platform exhibited large latency and resource consumption when handling large-scale concurrent traffic.

To optimise the platform, the following measures were taken. First, the data collection module was optimised to improve the data collection speed and storage efficiency. Second, the traffic analysis algorithm was optimised to reduce the time complexity of feature extraction and anomaly detection. Finally, the scalability of system resources was increased, and the concurrent processing capability of the system was improved through distributed deployment and load balancing. After optimisation, the NETCAP platform achieved significant improvements in performance tests. The average response time was reduced by 40% and the system resource utilisation increased by 30%. The experimental results show that the optimisation measures taken in this project have effectively improved the performance and reliability of the platform.

Finally, in order to improve the scalability of the NETCAP platform, this paper also conducts a series of evaluations on this. Measures were finally taken to gradually increase the size of the course selection system and the number of users, and the operation of the platform was monitored. The experimental results show that the NETCAP platform exhibits good scalability and performance in handling large-scale traffic and multi-user requests.

In summary, this experiment verifies the functionality and performance of the system crash prevention platform of NETCAP online course selection system. Through real-time monitoring, flow analysis and crash prediction, it can effectively prevent the crash of the course selection system and guarantee the stability and reliability of the system. The experimental results show that the NETCAP platform has the potential to improve the stability and availability of the system, and it is able to identify and predict system crashes in time and carry out maintenance measures in time, which ensures that the course selection based on this system can be carried out smoothly.

4 DISCUSSION AND OPTIMISATION

The system crash prevention platform for online course selection system based on network traffic analysis proposed in this paper has achieved some results, but there are still shortcomings. The following is an explanation and discussion of the experimental results, while some ideas and improvement suggestions for optimising the system design and algorithms will also be proposed in this study.

Firstly, for the experimental results, it is observed that the NETCAP platform is able to predict the changes in system load and the risk of crashes more accurately. By analysing and predicting the real-time network traffic data, it is able to take appropriate measures to reduce the load and ensure the stability of the system before it crashes. This result demonstrates the effectiveness and usefulness of the NETCAP platform in preventing system crashes.

However, there are some problems and shortcomings in the design. Firstly, the collection and processing of flow data in a large-scale course selection system still presents some challenges. Despite the optimisation methods used to improve the performance and efficiency of the platform, there are still some latency and data processing capacity limitations. Therefore, when deploying the NETCAP platform in an application, careful consideration needs to be given to the scale of the system and the scalability of data processing to ensure the accuracy and timeliness of the platform.

Second, under special circumstances, such as cyber-attacks or unexpected events, the NETCAP platform may have some prediction errors. This is because these special situations lead to abnormal changes in system load, which affects the accuracy of the prediction algorithm. Therefore, in the future optimisation, the introduction of more complex algorithms and models will be considered to accommodate more abnormal situations and improve the robustness of the platform.

For the system design and algorithmic aspects, it is proposed to optimise and improve the following aspects.

1) Optimisation of Data Acquisition and Processing

A distributed data acquisition and processing system can be considered to improve the processing capacity and response speed of the platform. In addition, data storage and compression techniques can be further optimised to reduce the cost of data processing and storage.

2) Model Optimisation and Improvement

Further in-depth research on flow analysis algorithms can be conducted to explore more features and models to improve the accuracy of prediction. Meanwhile, emerging technologies such as artificial intelligence algorithms and deep learning methods can be considered to be introduced to adapt to more complex system load changes and anomalies.

3) Platform Monitoring and Feedback Mechanism

A comprehensive monitoring and feedback mechanism can be designed to monitor system performance and load in real time, and to respond and adjust platform parameters and strategies in a timely manner. This can further improve the adaptability and reliability of the platform.

In summary, although certain research results have been achieved in this paper, there are still some problems and shortcomings that need to be further solved and improved. By optimising the data processing, improving the model and designing the monitoring and feedback mechanism, the performance and effect of the NETCAP platform can be further improved to provide a better guarantee for the stability and reliability of the online course selection system.

5 CONCLUSION

With the rapid development of online course selection system and the increase in the number of users, the problem of course selection system crash is gradually revealed, which seriously affects the smooth operation of students' course selection and the normal operation of academic affairs management. Based on this paper, NETCAP, a crash prevention platform for online course selection system based on network traffic analysis, is proposed and optimised to some extent. The performance of the online course selection system is studied in depth and the network flow crash problems it encounters are identified. The experimental results show that the NETCAP platform proposed in this paper is able to predict and prevent system crashes based on traffic analysis, and plays a positive role in practical applications. In future research, all aspects of the NETCAP platform can be further improved and refined to enhance its prediction performance and scalability.

ACKNOWLEDGMENTS

This research was funded by Dongguan Kunpeng Key Laboratory of Computing; Research Capability Enhancement Project of Guangdong University of Science and Technology: Application Research of Artificial Intelligence Technology Based on Kunpeng Computing Platform; Natural Science Project of Guangdong University of Science and Technology, grant number gky-2022kyzdk-12; Innovation and School Strengthening Project of Guangdong University of Science and Technology, grant number gky-2022cqtd-4.

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