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Efficient Order Management: Design and Implementation of a System using Scheduling Algorithms and Expert Validation

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***Abstract*— This research focuses on the crucial role of system interfaces in enhancing user experience, particularly in the context of an online canteen ordering system. A well-designed interface not only improves user satisfaction but also streamlines the ordering process, addressing issues like queuing in canteens. The study employs Expert Validation to gather valuable insights from experts, ensuring a robust foundation for system development and evaluation. The online canteen ordering system facilitates food orders through an application, eliminating the need for users to physically visit the canteen. This approach not only benefits users but also aids canteen management in efficient order handling.The scheduling algorithms, FCFS (First Come First Served) and SJF (Shortest Job First), are utilized to manage incoming orders. FCFS, chosen for its intuitive handling of queuing problems, complements the SJF algorithm, which excels in efficiently managing numerous orders. The system dynamically switches between these algorithms based on the order load, resulting in an effective queuing structure. Usability testing is conducted to evaluate the system's user-friendliness, with an impressive average score of 86.6\%. This indicates that the system is well-received and navigable by users. The website implementation receives an "good" categorization through UEQ (User Experience Questionnaire) testing, with attractive design and high scores in aspects like Perspicuity, Efficiency, Dependability, Stimulation, and Novelty. These findings collectively affirm the success of the designed interface in delivering a positive user experience for the online canteen ordering system.**

***Index Terms*— Expert Validation; FCFS; SJF; Scheduling algorithm; UEQ Testing; Usability testing evaluation**

I. INTRODUCTION

Facilities at universities are the basic tools needed to support the continuity of academic, learning and research activities and can have a major influence on the quality of education provided [1]. One of the facilities available in the university environment is the canteen. The canteen is a place where various kinds of food and drinks are served and traded [2]. Thus, the canteen has an important role to fulfill food needs and build a healthy environment, in this case the environment at the university.

The ordering process, which is an activity carried out by consumers when they want to buy something [3], is still done manually. Buyers must visit the existing canteen outlets first to be able to place food orders. This makes it possible for problems such as queuing, waiting, and order errors to occur. This queue is caused by the number of buyers who are not proportional to the available resources [4]. This is also supported by the high amount of interest in going to the canteen. According to respondents, the cause of the queue is due to waiting for food to be prepared. In addition, based on the results of an interview with one of the food sellers in the canteen, the cause of the queue usually occurs when approaching lunch.

Currently, the development of technology has advanced [5]. Digital technology and the internet are ubiquitous. One way that can be used to overcome the problems describe is to implement a digitized system connected via the internet. Internetconnected systems can certainly increase the effectiveness of information exchange [6]. Therefore, a system is needed that can help the ordering process in this canteen.

An ordering system is a computer-based system that can facilitate the ordering process at a shop or restaurant without having to meet in person. By using this system, the ordering process becomes easier from both the buyer and seller side. Problems such as long waiting times, miscommunication, and ordering errors can be resolved with this system [7]. However, in implementing an ordering system, queue management is important.

The application of scheduling algorithms is one of the solutions in overcoming queuing problems. In this canteen ordering system, the algorithm used is a non-pre-emptive scheduling algorithm. A non- pre-emptive scheduling algorithm is used because this research only focuses on managing the queue when orders come in. Two scheduling algorithms that can be used are First Come First Served (FCFS) and Shortest Job First (SJF). FCFS is the most intuitive and simple scheduling algorithm, where jobs are prioritized based on their

order of entry. Whereas SJF is one of the scheduling algorithms that prioritizes jobs based on smaller jobs [8]. In the context of ordering in the canteen, the work in question is the process of preparing an order. Pre-emptive scheduling algorithms such as Round Robin that equally divide the work portion by the same amount are not relevant to be used in this research because they do not focus on the process of preparing an order.

Previously, there was research that proved that the FCFS algorithm could be applied to the scheduling of the Gojek app. Then there is also research that uses FCFS for applicationbased food ordering systems mobille [9]. The application of the FCFS algorithm can help the scheduling process by calculating the average waiting time and average turnaround time. In addition, there are also studies that apply the SJF algorithm to convection business scheduling systems and jewelry ordering systems. The results of the application of the SJF algorithm are proven to improve customer service in managing order queues, namely by producing a small average waiting time. This shows that both FCFS and SJF algorithms can be applied to manage queues in an ordering system.

When carrying out design, it is important to pay attention to: interface display. Creating an interface aims to make things easier information system so that it can be said to be user friendly. In order to achieve For a user friendly information system, it is necessary to use the principles of interface design. Heuristic Evaluation is a method of assessing a product digital which aims to improve the appearance of the interface, so that on research into the development of feedback systems from patient experiences is used Heuristic Evaluation method to improve the quality of the interface display which has been made [10]. In research on making portal-based, the ExpertValidation is a method carried out by carrying out validation or collecting data from people who are experts in their fields and reasons The choice of this method is due to a trusted source because it comes from expert [11]. In this research, the method used is Expert-Validation because this principle is in accordance with the development that you want to carry out, namely create a new system with a good interface for ordering in canteen, while the Heuristic Evaluation only corresponds to research on existing digital systems or products and want to improve the display quality the interface. Every system created certainly requires a testing stage determine the level of success of a system. The User Experience Questionnaire method is a method that using questionnaires to measure the User Experience of a system. On Research on developing an ordering system in the canteen will use the method User Experience Questionnaire because the results this method provides a more specific assessment of User Experience that can be measured [12].

Based on the things that have been described, research was made with the topic efficient Ordering System using First Come First Served, and Shortest Job First Scheduling Algorithms. Then to make a good interface will use expert validation and testing using UEQ Questinnare The ordering system is a system that can simplify the food ordering process [13]. So that the ordering process becomes more effective because customer can order food in the canteen from anywhere without having to go to the canteen outlet first. According to research, the implementation of online food ordering can positively increase user satisfaction. In addition, by applying FCFS and SJF algorithms to this ordering system, it is expected that the queue management process will become clearer so that it can support the productivity of activities in the canteen.

To measure the functional level of this online canteen ordering system, it is necessary to evaluate it. The evaluation method used for this research is usability testing. Usability testing is a technique to evaluate a product by experimenting directly with users. Usability testing was chosen because it can provide direct feedback from users and has high efficiency.

II. LITERATURE REVIEW

A. *Ordering System*

The ordering system is an alternative that can make it easier for users to order food at certain stores or restaurants without having to interact physically [7]. Food ordering systems can also positively increase user satisfaction [14]. Usually, the ordering system is packaged in the form of an application or website platform, so it requires an internet connection to use it. Because it is connected via the internet, the application of the booking system can overcome several problems, one of which is the accumulated queue. Some examples of ordering systems available in Indonesia are GoFood and GrabFood [7].

B. *Scheduling Algorithm*

A scheduling algorithm is a staged procedure that is organized systematically and logically with the aim of improving the performance of a system based on certain criteria [15]. Generally, scheduling algorithms are used to optimize CPU performance. But nowadays, many have applied scheduling algorithms to other cases such as ordering systems for example. In the scheduling algorithm, there are several criteria used for assessment, namely average waiting time, burst time, finish time, and average turnaround time [15].

$$WT = FT - AT - BT \quad (1)$$

$$AWT = \frac{\sum WT}{P} \quad (2)$$

$$TT = WT + BT \quad (3)$$

$$ATT = \frac{\sum TT}{P} \quad (4)$$

WT = Waiting time.

AWT = Average waiting time.

TT = Turnaround time/working time.

ATT = Average turn time/working time.

BT = Process duration.

FT = Time when the process is completed.

P = Total Process

C. *First Come First Served (FCFS)*

First Come First Served (FCFS) is one example of a scheduling algorithm. FCFS is the simplest and most intuitive scheduling algorithm, where the priority of jobs is determined based on their order of entry. This algorithm is commonly used for CPU scheduling. But nowadays, the application of this algorithm can also be found in everyday life [15].

The parameter used in the FCFS algorithm is the time component or arrival time [16]. The way this algorithm works is by prioritizing jobs from the earliest arrival time. This means that jobs that arrive first will also be prioritized without considering other factors. The advantages of this algorithm include simplicity and fairness. While the disadvantages are less efficient for handling large queues and poor turnaround time value [17].

D. *Shortest Job First (SJF)*

Shortest Job First (SJF) is a form of scheduling algorithm, which prioritizes a job based on the smallest job duration. Just like FCFS, this algorithm was also originally formed to manage CPU queuing systems, but nowadays it can also be found in many aspects of daily life.

Unlike FCFS, the parameter used in this algorithm is the duration of the burst time. So, without taking into account the arrival time, this algorithm will sort the existing jobs based on the smallest job duration. The advantage of this SJF algorithm is that it provides a smaller average waiting time than FCFS. So it can be said that SJF can handle a large number of queues when compared to FCFS [16], [18].

E. *Usability Testing*

Usability testing is one of the most efficient and commonly used evaluation methods. This method will measure how easy a system can be used. Usability testing makes it possible to conduct direct observations of users interacting with the system, collect data on performance, system, and user satisfaction, and identify problems that occur [19].

The application of usability testing can be done in a variety of ways, but the most common way is to provide a series of tasks for the user to complete. The tester will then record user actions, completion time, satisfaction, errors, and other parameters.

After the test is conducted, it will be analyzed related to the test results using usability metrics. There are 3 main things that will be covered by usability metrics, namely user behavior which includes performance, speed, efficiency, expectations and goal fulfilment; opinions which includes opinions on design aspects, and captured data which includes pages, visits, documents, and heatmap [20].

F. *Expert Validation*

Expert Validation is testing carried out on a system or a program by conducting a survey with an expert [11]. Survey action This can be done directly by conducting interviews or in person indirectly by providing an assessment list to the expert. Validation from experts plays an important role in increasing the value of the feasibility of a system. The information provided can be completely trusted because it is sourced from experts been in a field for a long time. Experts can provide analysis and opinions not many people give it so the improvements given can improve value of the system.

III. SYSTEM IMPLEMENTATION

The Figure 1. Home Menu Interface is an image of the final result of the Home page display. On this page, there is a search button, banner, tenant section, and menu section. The function of Home interface is to easier navigation to all function in the apps.

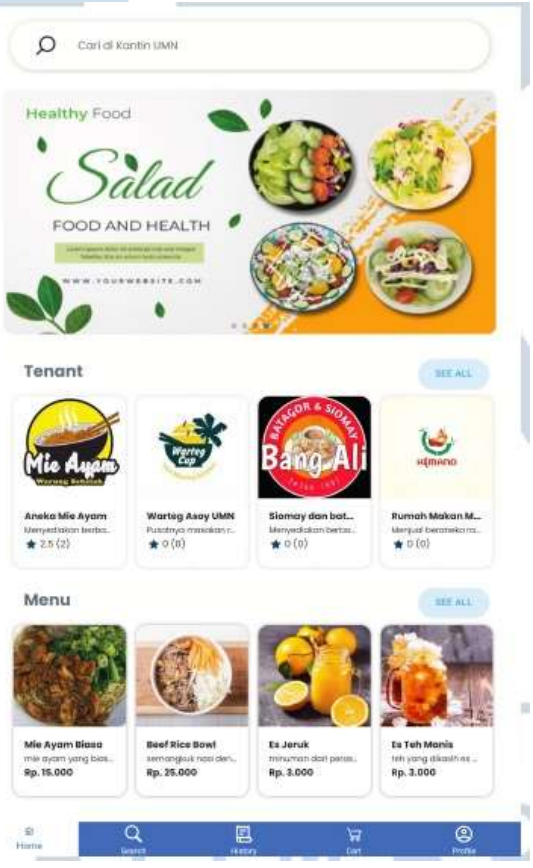

Figure 1. Home Menu Interface

The figure 2. FCFS and SJF Combination Flowchart 2 is the process flow performed when the tenant wants

to see the list of incoming orders. There is a switching process or switching algorithm that depends on the number of orders currently running. If the number of running orders reaches more than 3, then the algorithm used is SJF, and if the number of running orders is not more than 3, then the algorithm used is FCFS [17].

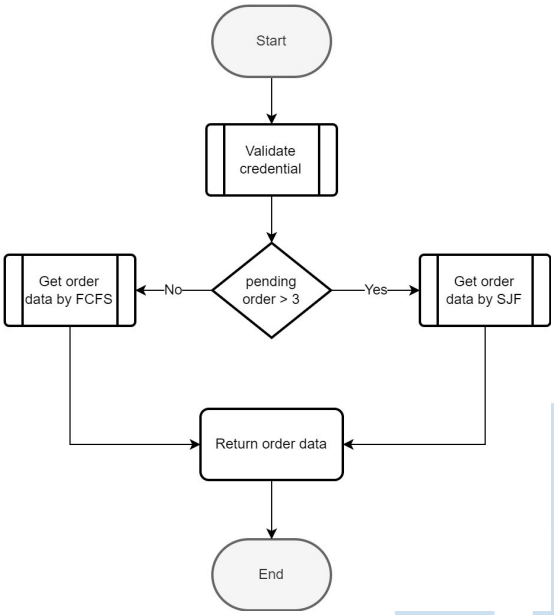

Figure 2. FCFS and SJF Combination Flowchart

Figure 3. Implementation of Order List Page 3 shows the implementation of the current Order page. There are some changes to the order-on-progress section, namely the action button on the order card.

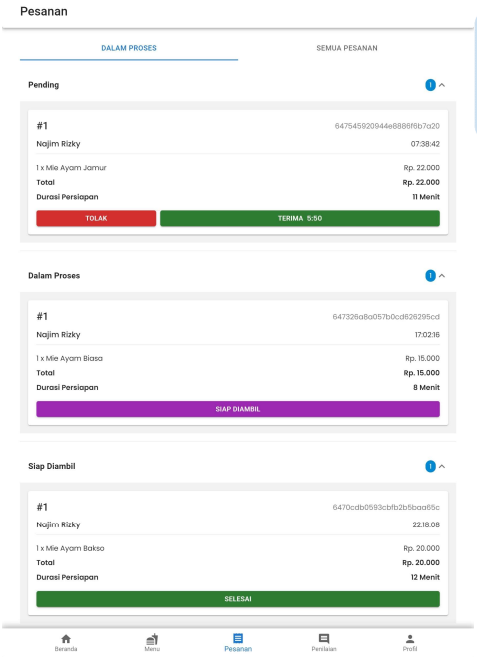

Figure 3. Implementation of Order List Page

A. *FCFS Algorithm Implementation*

The following order data will be used as a test material for the FCFS algorithm.

- Order 1 (P1)
  Menu: Jumbo Regular Chicken Noodles x 1
  Preparation Duration: 12 minutes
  Order Time: 12:00
- Order 2 (P2)
  Menu: Vegetarian Chicken Noodle x 1
  Preparation Duration: 15 minutes
  Order Time: 12:01
- Order 3 (P3)
  Menu: Regular Chicken Noodles x
  Preparation Duration: 8 minutes
  Ordering Time: 12:02

In the lists order, since the number of incoming orders is not more than 3, the algorithm used is FCFS. Order sorting will be done using the ordering time. Then the arrival Table I FCFS Order Arrival Table of each simplified order is as follows.

TABLE I. FCFS ORDER ARRIVAL TABLE

No	Burst Time (Minute)	Arrival Time	Order Number
1	12	0	P1
2	15	1	P2
3	8	2	P3

Based on table I FCFS Order Arrival Table shown , P1 will be processed first at time 0, followed by P2 at time 12 after waiting 11 times, and P3 at time 27 after waiting 25 times. Thus, the waiting time and turnaround time of each order are as follows.

WT P1 = 12 - 0 - 12 = 0

WT P2 = 27 - 1 - 15 = 11

WT P3 = 35 - 2 - 8 = 25

AWT = (0 + 11 + 25) / 3 = 12

TT P1 = 0 + 12 = 12

TT P2 = 11 + 15 = 26

TT P3 = 25 + 8 = 33

ATT = (12 + 26 + 33) / 3 = 23.66

After the calculation, the average waiting time (Average Waiting Time) is 12 minutes. While the average processing time for each order (Average Turnaround Time) is 23.66 minutes. From the implementation results, it can be seen that the order of order is in accordance with those in the previous trial calculation. So it can be concluded that the FCFS (First Come First Served) algorithm is successfully implemented to this online canteen ordering system.

B. SJF Algorithm Implementation

The following order data will be used as a test material for the SJF algorithm.

- Order 1 (P1)
  Menu: Jumbo Regular Chicken Noodles x 1
  Preparation Duration: 12 minutes
  Order Time: 12:00
- Order 2 (P2)
  Menu: Vegetarian Chicken Noodle x 1
  Preparation Duration: 15 minutes
  Order Time: 12:01
- Order 3 (P3)
  Menu: Regular Chicken Noodles x 1
  Preparation Duration: 8 minutes
  Order Time: 12:02
- Order 4 (P4)
  Menu: Meatball Chicken Noodles x 1
  Preparation Duration: 13 minutes
  Ordering Time: 12:03
- Order 5 (P5)
  Menu: Mushroom Chicken Noodles x 1
  Preparation Duration: 11 minutes
  Ordering Time: 12:04

In the list order, since the number of incoming orders is more than 3, the algorithm used is SJF. Order sorting will be done using the smallest preparation time. Then the arrival table of each simplified order is as Table II SJF Order Arrival Table.

TABLE II. SJF ORDER ARRIVAL TABLE

No	Burst Time (Minute)	Arrival Time	Order Number
1	12	0	P1
2	8	2	P3
3	11	4	P5
4	13	3	P4
5	15	1	P2

Based on the Table II SJF Order Arrival Table shown, P1 will be processed first at time 0. P1 will be processed first because P1 is the only order that comes at time 0. Next P3 at time 12 after waiting 10 time. Then P5 at time 20 after waiting 16 time. Next P4 at time 31 after waiting 28 time. And P2 at time 44 after waiting 43 time. P3 is processed first because it has a shorter preparation duration than P5 and P4, even though P5 and P4 have a faster arrival time. Thus, the waiting time and processing time of each order are as follows.

WT P1 = 12 - 0 - 12 = 0
WT P2 = 59 - 1 - 15 = 43
WT P3 = 20 - 2 - 8 = 10
WT P4 = 44 - 3 - 13 = 28
WT P5 = 31 - 4 - 11 = 16
AWT = (0 + 43 + 10 + 28 + 16) / 3 = 19.4
TT P1 = 0 + 12 = 12
TT P2 = 43 + 15 = 58
TT P3 = 10 + 8 = 18
TT P4 = 28 + 13 = 41
TT P5 = 16 + 11 = 27
ATT = (12 + 58 + 18 + 41 + 27) / 5 = 31.2

After the calculation, the average waiting time (Average Waiting Time) is 19.4 minutes. While the average processing time for each order (Average Turnaround Time) is 31.2 minutes. From the implementation results, it can be seen that the order order is in accordance with those in the previous trial calculations. So it can be concluded that the SJF (Shortest Job First) algorithm was successfully implemented into this online canteen ordering system.

C. Expert Validation

This research will be assisted by experts who specialize in the UI / UX field. Table III Expert Infromation, criteria used in selecting experts are having extensive knowledge in UI/UX and understanding the design principles of building prototypes and have experience working or teaching in the UI/UX field.

TABLE III. EXPERT INFORMATION

No	Role	Working experience
1	Source Person	UI/UX Designer at Promise
2	First Evaluator	UX/UI Designer at Hashtag You
3	Second Evaluator	Lecture at Private University

The following are the answers given by experts based on the questions.

1) Make a wireframe first to determine the structure and layout system.
2) When creating a wireframe or prototype, it is importan to search as many references as possible from systems that people are already familiar with many people.
3) The flow of a system is so important that it must be created from scratch prototyping process.
4) Put yourself in the shoes of the user, how the user will use it later system built Interface Design.
5) Create features or system components according to your needs.
6) Choosing the right color will affect the system created, try to ensure that the business system has a dominant white color so that information can be obtained provided is easy to read (60% white, 30% primary color, and 10%
7) The placement of each component being made is not too close or far.

8) If you apply a design method or principle in manufacturing wireframe, use it according to your needs and don't force it too much a principle into the manufacturing process.
9) Use a priority matrix in the design process so that the features what is important and urgent will be resolved optimally.
10) Understand well the tools used in making agar designs the manufacturing process can run well.

IV. EVALUATION

A. *Usability Testing Evaluation*

Usability testing used in this research is usability testing. This test is carried out by asking the user to perform several predetermined tasks. The following is a brief profile of the user used in this test:

- User 1: Male, 50 years old Nasi Uduk Seller
- User 2: Female, 21 years old Cake Seller
- User 3: Female, 34 years old Chicken Noodle Seller

In this test, there are 2 things that are measured, namely completion time and user behaviour. Completion time is measured by recording the time required by the user to complete the given task. Meanwhile, user behaviour is measured by recording the user's behaviour when completing the given task. The user behaviour recorded is the behaviour that occurs when the user tries to complete the given task. Figure 4 Usability Testing results are the results of the usability testing conducted with a total of 20 tasks.

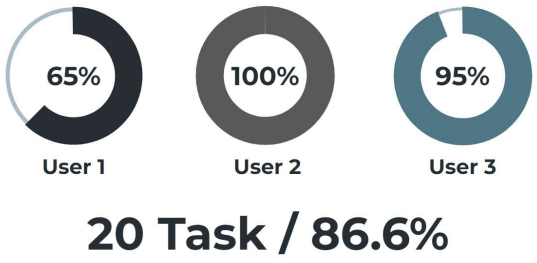

Figure 4. Usability Testing Result

Based on the results of Figure 4 Usability Testing results, user 1 can complete 13 out of 20 tasks (65%) given. There are 7 tasks that cannot be completed by user 1. Observations made during testing of user 1 showed that one of the factors that might cause this to happen is due to the limited knowledge of technology possessed by the user. After being given an explanation on how to use the system, the user became familiar with the online canteen ordering system. Meanwhile, user 2 was able to complete all the tasks (100%) given, and user 3 was able to complete 19 out of 20 (95%). Since the test results on user 2 and user 3 showed relatively similar results, the evaluation process was stopped after user 3. This approach is in accordance with the recommendations of the usability testing method, which recommends that testing be carried out on no more than 5 users, given that the usability testing method is time-consuming and resource-intensive [21].

Based on this usability testing, the average success rate is 86.6%. Then for the average time of the main tasks, is 10.62 seconds. However, based on observations in the usability testing conducted, there are several things that need to be improved on this system. So it can be concluded that this system can be used well. Input provided by users will be an important consideration for making improvements and enhancements to this system.

B. *UEQ Evaluation*

At the testing stage using the UEQ method, respondents were obtained as many as 31 respondents. After conducting a user satisfaction survey against the system using the UEQ method, obtained results at Figure 5 Result UEQ Evaluation shows that the website falls into the "good" category based on test results with the UEQ benchmark with the average value of Attractiveness aspect is 2.073; Perspicuity 2,000; Efficiency 2,016; Dependability 1.812; Stimulation 1,789; and Novelty 1,789

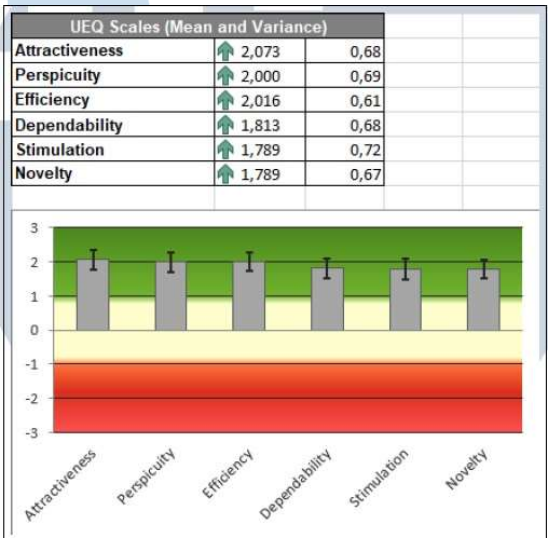

Figure 5. Result UEQ Evaluation

V. CONCLUSION AND SUGGESTION

The implementation of the FCFS (First Come First Serve) and SJF (Shortest Job First) algorithms on the online canteen ordering system has been successfully done well. The results of the usability testing showed that this system can be used well. This is shown by the success rate of users in completing the given task of 86.6% for three different users with each task done is 20. While the average time for the task done is 10.62 seconds. The result UEQ Evalution in Good Category, so it's can be improved.

However, the application of algorithms to solve the queuing problem in this canteen ordering system is still quite simple. It would be better if this system can apply more complex algorithms, for example, this system can apply the priority scheduling, multilevel queue, multilevel feedback queue algorithms, to be able to solve the queuing problem better. In addition, add feature Payment Gateway system in the food ordering process and add User Experience method, by using Expected Utility Theory.

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