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Implementation Of Data Mining In Determining Sales Pattern Of Snack Products Using Apriori Algorithm (Case Study: PT Siantar Top Tbk)

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A B S T R A C T

PT Siantar Top.Tbk is a company engaged in snack manufacturing which is located at Jl Raya Medan Tebing Tinggi, Ujung Serdang, Tanjung Morawa, Deli Serdang Regency, North Sumatra. In the sales transaction data processing process at PT Siantar Top Tbk, it has not been able to provide accurate information about the pattern or relationship of a set of items purchased by customers. So that the company has difficulty knowing every product that is sold, because the sales data is always increasing, but the company does not understand how to manage the sales data of these snack products. Because the snack product sales data is only archived and not managed by the company to get new results. The purpose of this research is to design and build a priori algorithm in determining sales patterns. This system is designed using UML and is built with the programming languages PHP, HTML, CSS, Javascript and Mysql as the database. Then the determination of the sales pattern of snack products that are successful every month at PT Siantar Top Tbk using the Apriori algorithm. A priori algorithm is a data mining technique to find associative rules between a combination of items.

1. Introduction

Technological developments are increasing rapidly throughout the world. Where all humans need a technological system to become the basis of life, especially in companies. Over time, more and more sophisticated technologies have emerged that can help every aspect of human life. Especially in the field of technology, where technology can make it easier for employees to do work, especially for manufacturing industrial companies. So that with the quality technology the products to be marketed have quality and guarantee the quality of the company. However, this company often has problems managing the stock of snack products. So that sometimes it becomes one of the problems for companies engaged in the sale of snacks,

PT Siantar Top.Tbk is a company engaged in snack manufacturing which is located at Jl Raya Medan Tebing Tinggi, Ujung Serdang, Tanjung Morawa, Deli Serdang Regency, North Sumatra. In the process of processing sales transaction data at PT Siantar Top Tbk, it has not been able to provide accurate information about the pattern or relationship of a set of items purchased by customers [1]. So that the company has difficulty knowing every product that is sold, because the sales data is always increasing, but the company does not understand how to manage the sales data of these snack products. Because the snack product sales data is only archived and not managed by the company to get new results.[4]

2. Method

2.1 Research Framework

The research framework discusses the research implementation model which is the steps that will be taken in solving research problems. The stages in this research are as follows:

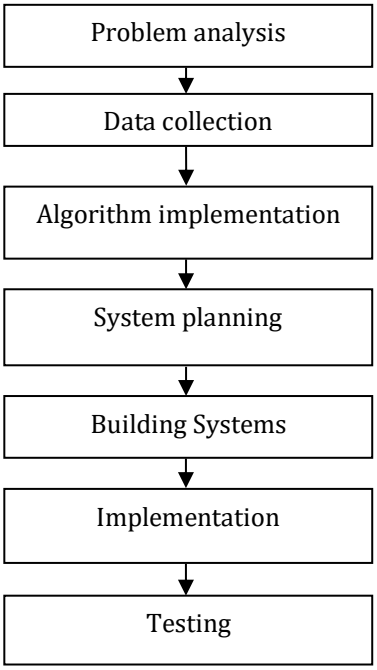

Figure 1. Research Framework

Based on the research method used in Figure 1 above, the discussion of each of these stages can be described as follows:

2.2 Data Collection

At this stage the authors collect the data needed in research needs, including by making observations made by the author directly at PT Siantar Top Tbk by asking some problems that occur in determining the sales pattern of snack products. Then collect data from problems related to determining the pattern of snack products so that there are no disputes over the sales data that are carried out every month.

2.3 Analysis Method with Apriori Algorithm

At this stage the author applies the Apriori algorithm to determine the sales pattern of snack products at PT Siantar Top Tbk starting from taking snack product data which is carried out every month. With the following formula: [7]

The basic methodology of association analysis is divided into two stages, namely:

a) High frequency pattern analysis
At this stage, look for a combination of items that meet the minimum requirements of the support value in the database. The support value of an item is obtained by the following formula:

formula :

$$\text{Support (A)} = \frac{jumlahtransaksimengandungA}{totaltransaksi} \quad (1)$$

While the support value of 2 items is obtained from the following formula:
Supoort (A, B) = P (A, B)

$$\text{Support (A, B)} = \frac{\sum transaksi\ mengandung\ A\ dan\ B}{\sum transaksi} \quad (2)$$

b) Establishment of associative rules
After all high frequency patterns are found, then we look for associative rules that meet the minimum requirements for confidence by calculating AB associative confidence rules. The confidence value is obtained from the following formula:

$$Compidence = P(B / A) = \frac{\sum transaksi\ mengandung\ A\ dan\ B}{\sum transaksi\ mengandung\ A} \quad (3)$$

3. Results and discussion

3.1 Analysis and Application of the Apriori Algorithm

The sales transaction results obtained from PT Siantar Top Tbk are in the form of raw transaction data in excel format which is packaged in table form based on the type of product that makes transactions every month. The data analyzed is preliminary data from the snack product sales transaction report from February 2020, which contains 100 types of snack product sales data selected into 18 items of snack product sales transactions to be able to predict the following month.

Table 1
Preliminary data

No	Kode	Jenis Snack	Tr 1	Tr 2	Tr 3	Tr 4	Tr 5	Tr 6	Tr 7	Tr 8	Tr 9	Tr 10	Tr 11	Tr 12	Tr 13	Tr 14	Tr 15	Tr 16	Tr 17	Tr 18
1	A1	Spik Soba	80	200	305	100	60	150	60	355	500		120	5	130	130	390	60	50	500
2	A2	Spix Sambal Balado(Sbl)	80	200	50	20	400			535			20	50		13	50	650	650	300
3	A3	Deo Go Chocolate	50	725	73	50	10	50	125	152	100	30	55	2		40	50	200		350
4	A4	Gorio Magic	60	200	565	90	130	180	150	640	435	50	50	12	43	46	24	25	12	356
5	A5	Gorio Otam-Tam	65	650	585	324	45	678	124	246		20	45	90		78			45	90
6	A6	Superman Choco	20	190	34	244	344	25	67	556	67	12	75	34	24	14	14	23	22	789
7	A7	Jari-Jari	50	325	200	90	123	876	908	90			45	89	12	20	13	98	98	9
8	A8	Twisko	150	300	324	98	456	124	143						60		80	90	123	123
9	A9	Ketagi	180	30	675	123	123	800	145	90	134	90	98	12	90	13	23	876	124	343
10	A10	Mr Keren BBQ	240	900	898	234	123	12	9	90	9	9	989	9	12	13	9	134	124	234
11	A11	Mr Keren Sambal Balado (Sbl)	110	275	143	675	123	123	124	67	200	90	100	20	14		87	907	78	234
12	A12	Mr Potato BBQ	350	70	90	123	124	123	234	145	90	13	123	67	12	78	90	90	67	456
13	A13	Mr.Potato Sambal Balado(Sbl)	290	35	676	321	456	45	143	178	90	78	678	90	12	34	9	9	143	234
14	A14	French Fries 18 Gr	400	200	877	234	123	211	700	214	200	10	231	20	23	12	7	90	90	897
15	A15	Mr.Bebeto	970	135	143	123	23	14	67	12	88	56	890	12	90	19	9	908	123	12
16	A16	Gorio Vanila	650	245	890	123	233	123	56	340	34	89	213	12	90	19	9	97	123	45
17	A17	Deo Go Potato	550	456	657	123	68	12	90	231	123	67	234	20	21	00	12	324	90	123
18	A18	Gorio Coklat	500	123	878	768	143	123	567	143	980	78	89	89	87	86	87	123	414	123

3.2 Application of the Apriori Algorithm

Table 2
Kind of Snack

No.	Code	Kind of Snack
1	A1	Spik Soba
2	A2	Spix Sambal Balado (Sbl)
3	A3	Deo Go Chocolate
4	A4	Gorio Magic
5	A5	Gorio Otam-Tam
6	A6	Superman Choco
7	A7	Fingers
8	A8	Twisko
9	A9	Next
10	A10	Mr Cool BBQ
11	A11	Mr Keren Sambal Balado (Sbl)
12	A12	Mr. Potato BBQ
13	A13	Mr. Potato Sambal Balado (Sbl)
14	A14	French Fries 18 Gr
15	A15	Mr.Bebeto
16	A16	Gorio Vanilla
17	A17	Deo Go Potato
18	A18	Gorio Chocolate

Table 3
Product Sales Transaction Process

Transaction	Product Out
1	spix Sbl, spix buckwheat, gorion magic. Gorio otam-tam, supermen coco, fingers, twisko, ketagi, Mr Keren Sbl, Mr potato Bbq, Mr potato Sbl, French fries 18 gr, Bebeto, Gorio Vanila, Deo go potato, Gorio Coklat.
2	spix soba, spix before, deo go chocolate, gorion magic. Gorio otam-tam, supermen coco, fingers, twisko, ketanggi, mr Keren Sbl, mr Keren bbq, mr potato Bbq, mr.potato Sbl, French fries 18 gr, Bebeto, Gorio Vanila, Deo go potato Gorio Coklat.
3	spix sbl, spix soba, deo go chocolate, gorio magic, gorio otam-tam, superman choco, fingers, kentagi, mr cool sbl, mr cool bbQ, mr potato bbQ, mr potato sbl, french fries 18 gr, mr bebeto , gorio vanilla, deo go potato, brown gorio,
4	Spix soba, Spix sbl, deo go chocolate, gorio magic, Gorio Otam-tam, Superman Choco, Jari-Jari, Ketagi, mr Keren BBQ, Mr Keren Sbl, Mr Potato BBQ, Mr potato SBL, Mr Bebeto, Gorio Vanila
5	Spix soba, Spix sbl, deo go chocolate, gorio magic, Gorio Otam-tam, Superman Choco, Jari-Jari, Ketagi, mr Keren BBQ, Mr Keren Sbl, Mr Potato BBQ, Mr potato SBL, Mr Bebeto, Gorio Vanila, deo go potato, brown gorio.
6	spix soba, Deo go chocolate, Gorio Magic, Jari, Ketagi, Mr cool BBQ, Mr cool SBL, Mr Potato BBQ, Mr Potato SBL, Mr Bebeto, Gorio Vanila, Deo go potato, Gorio Coklat.
7	Spix sbl, Deo go chocolate, Gorio Magic, Gorio Otam-tam, Superman Choco, Jari-Jari, Twisko, Ketagi, Mr Keren BBQ, Mr Keren Sbl, Mr potato BBQ, Mr potato Sbl, Frensh Fries 18 gr, Mr Bebeto, Gorio vanilla, Deo go potato, Gorio Chocolate.
8	Spix Soba, Spix Sbl, Deo go Chocolate, Gorio Magic, gorio Otam-tam, Superman Choco, Radius, Ketagi, Mr Keren BBQ, Mr Keren Sbl, Mr Potato BBQ, Mr Potato Sbl, French Fries 18 gr, Mr Bebeto , Gorio Vanilla, Deo Go potato, Gorio Chocolate.
9	Spix Soba, Deo go chocolate, Gorio Magic, Gorio Otam-tam, Superman Choco, Twisko, Ketagi, Mr Keren BBQ, Mr Keren SBL, Mr Potato BBQ, Mr Potato SBL, French fries 18 gr, Mr Bebeto, Gorio Vanila, Deo go potato, Gorio Coklat.
10	Deo Go Chocolate, Gorio magic, Gorio Otam-tam, Superman Choco, Radius, Ketagi, Mr Keren BBQ, Mr Keren Sbl, Mr Potato BBQ, Mr Potato Sbl, Mr Bebeto, Gorio Vanilla, Deo Go Potato, Gorio chocolate.
11	Spix soba, Spix Sbl, Deo Go Chocolate, Gorio magic, Gorio Otam-tam, Superman Choco, Radius, Twisko, Ketagi, Mr Keren BBQ, Mr Keren Sbl, Mr Potato BBQ, Mr Potato Sbl, French Fries 18 gr, Mr Bebeto, Gorio Vanilla, Deo Go Potato, Gorio chocolate.
12	Spix soba, Spix Sbl, Deo Go Chocolate, Gorio magic, Gorio Otam-tam, Superman Choco, Radius, Ketagi, Mr Keren BBQ, Mr Keren Sbl, Mr Potato BBQ, MrPotatoSbl, French Fries 18 gr, Mr Bebeto, Gorio Vanilla, DeoGoPotato, Gorio chocolate.
13	. Spixsoba, Goriomagic, GorioOtam-tam, Fingers, Twisko, Ketagi, Mr Keren BBQ, Mr Keren Sbl, Mr Potato BBQ, Mr Potato Sbl, French Fries 18 gr, Mr Bebeto, Gorio Vanilla, Deo Go Potato, Gorio chocolate.
14	Spix soba, Spix Sbl, Deo Go Chocolate, Gorio magic, Gorio Otam-tam, Superman Choco, Radius, Twisko, Ketagi, Mr Keren BBQ, Mr Keren Sbl, Mr Potato BBQ, MrPotatoSbl, French Fries 18 gr, Mr Bebeto , Gorio Vanilla, DeoGoPotato, Gorio chocolate
15	Spix soba, Spix Sbl, Deo Go Chocolate, Gorio magic, Gorio Otam-tam, Superman Choco, Radius, Twisko, Ketagi, Mr Keren BBQ, Mr Keren Sbl, Mr Potato BBQ, French Fries 18 gr, Mr Bebeto, Gorio Vanilla, DeoGoPotato, Gorio chocolate.
16	Spix soba, Spix Sbl, Deo Go Chocolate, Gorio magic, Gorio Otam-tam, Jari, Ketagi, Mr Keren BBQ, Mr Keren Sbl, French Fries 18 gr, Mr Bebeto, Gorio Vanilla, Deo Go Potato, Gorio chocolate.
17	Spix soba, Spix Sbl, Gorio magic, Gorio Otam-tam, Superman Choco, Radius, Ketagi, Mr Keren BBQ, Mr Keren Sbl, Mr potato BBQ, Mr Potato Sbl, French Fries 18 gr, Mr Bebeto, Gorio vanilla, Deo Go Potato, Gorio chocolate.
18	Spix soba, Spix Sbl, Deo Go Chocolate, Gorio magic, Gorio Otam-tam, Superman Choco, Jari-Jari, Ketagi, Mr Keren BBQ, Mr Keren before, mr potato bbq, mr potato sbl, French fries 18 gr, mr bebeto , gorio vanilla, deo go potato, brown gorio.

To calculate the support value for each type of snack, you can use the following methods:
Step 1: Given a minimum support value ≥ 10% from 100 sales data for snack products, data that meets the minimum support value will be obtained. The support value is obtained by the following formula:

$$\text{Support (A)} = \frac{\textit{Jumlah transaksi mengandung A}}{\textit{Total transaksi}} \text{ x } 100\%$$

Table 4
Results of Support I-Itemset

No.	Itemset Code	Frequency of Appearance	Support 1 Itemset

1	A1	16	$\frac{16}{18}$ x 100% = 88.89%
2	A2	14	$\frac{14}{18}$ x 100% = 77.78%
3	A3	15	$\frac{15}{18}$ x 100% = 83.33%
4	A4	18	$\frac{18}{18}$ x 100% = 100%
5	A5	17	$\frac{17}{18}$ x 100% = 94.44%
...	...	...	...
18	A18	17	$\frac{17}{18}$ x 100% = 94.44%

With the support value obtained, a minimum support of 90% is determined, then eliminating the support value of 1 itemset that does not meet the minimum support requirements, namely as follows:

Table 5
Results of Minimum Support I-Itemset

No.	Itemset Code	Frequency of Appearance	Support 1 Itemset
1	A4	18	100%
2	A5	17	94.44%
3	A7	17	94.44%
4	A9	18	100%
5	A10	17	94.44%
...	...	...	....
11	A18	17	94.44%

Step 2: Furthermore, from the transaction data in table 3 and the results of the minimum support 1 itemset in table 5, you can search for the support value of 2 itemset with the following formula:

$$\textbf{\textit{Support}}\ \textbf{(A, B)} = \frac{\sum jumlahtransaksimengandungAdanB}{totaltransaksi} * 100\%$$

So that you can find the support value for 2 itemset in the table below:

Table 6
Candidate support for 2 itemset

No.	Item Code	Frequency of Appearance	Support 2 Itemset
1	A4, A5	17	$\frac{17}{18}$ x 100% = 94.44%
2	A4, A7	17	$\frac{17}{18}$ x 100% = 94.44%
3	A4, A9	18	$\frac{18}{18}$ x 100% = 100%
4	A4, A10	17	$\frac{17}{18}$ x 100% = 94.44%
5	A4, A11	18	$\frac{18}{18}$ x 100% = 100%
etc.	.....	.....	.....
41	A17, A18	17	$\frac{17}{18}$ x 100% = 94.44%

With the 2 itemset support value obtained, a minimum support of 90% is determined, then eliminating the 2 itemset support value that does not meet the minimum support requirements, namely as follows:

Table 7
The minimum yield supports 2 itemset

No.	Item Code	Frequency of Appearance	Support 2 Itemset

1	A4, A5	17	94.44%
2	A4, A7	17	94.44%
3	A4, A9	18	100%
4	A4, A10	17	94.44%
5	….	…	….
6	A17, A18	17	94.44%

Step 3 : After getting the minimum support for 2 itemset, the next step is to calculate the confidence value, the confidence value is determined from each combination in table 8, using the following formula:

$$\text{Confidence} = P(B \mid A) = \frac{\sum jumlahtransaksimengandungAdanB}{\sum jumlahtransaksimengandungA} * 100\%$$

Table 8
Confidence Results

No.	Item Code	Frequency of Occurrence A.	Frequency of Occurrence A. $\cap B$	Confidence
1	A4, A5	18	17	$\frac{17}{18}$ x 100 = 94.44%
2	A5, A4	17	17	$\frac{17}{17}$ x 100 = 100%
3	A4, A7	18	17	$\frac{17}{18}$ x 100 = 94.44%
4	A7, A4	17	17	$\frac{17}{17}$ x 100 = 100%
5	A4, A9	18	18	$\frac{18}{18}$ x 100 = 100%
…	…	…	…	…
76	A18, A17	17	17	$\frac{17}{17}$ x 100 = 100%

With the confidence value obtained, a minimum confidence value of 95% is determined, then eliminating the confidence value that does not meet the minimum confidence requirements, namely as follows:

Table 9
Minimum Confidence Results

No.	Item Code	Frequency of Occurrence A.	Frequency of Occurrence A. $\cap B$	Confidence
1	A4, A9	18	18	100%
2	A9, A4	18	18	100%
3	A4, A11	18	18	100%
4	A11, A4	18	18	100%
5	A4, A15	18	18	100%
….	……	….	….	…
35	A18, A17	17	17	100%

Based on association rules that meet the minimum value of support and the minimum value of confidence. So that the confidence value can be obtained where all the confidence values have met the minimum value, then it can be concluded that the combination rule for the sales pattern at PT Siantar Top Tbk is as follows:
Rule 1: If you sell A4, then sell A9 with 100% support and 100% confidence
Rule 2: If you sell A9, then sell A4 with 100% support and 100% confidence
Rule 3: If you sell A4, then sell A11 with 100% support and 100% confidence
Rule 4: If you sell A11, then sell A4 with 100% support and 100% confidence

Rule 5: If you sell A4, then sell A15 with 100% support and 100% confidence
Etc…..
Rule 35: If you sell A12, then sell A16 with support at 94.44% and 100% confidence

3.2 System Implementation

a. Use case diagram

Use Case The diagram is a usecase diagram that is used to briefly describe who uses the system and what it does, here is a usecase diagram based on this research.

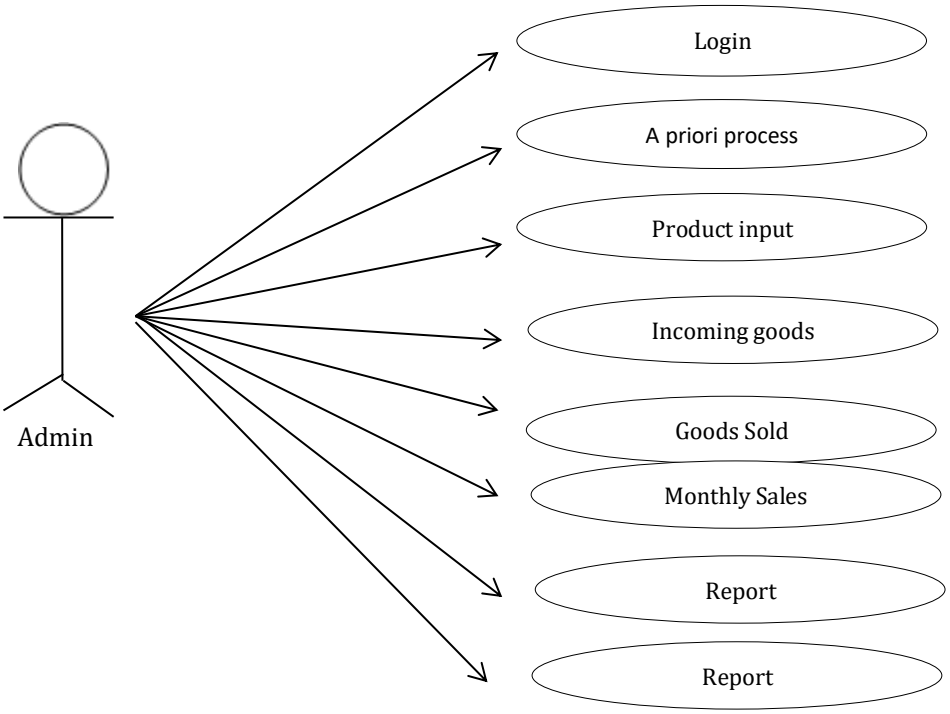

Figure 2. Use case diagram

Table 10
Description of the Use Case Diagram

Use Case Name	Description
Login	The first step Admin must log in
A priori provisions	Admin can determine the value of the minimum support and confidence conditions
Product input	Admin can input incoming data and goods sold
Incoming goods	Admin can input incoming goods
Items sold	Admin can input the items sold
Monthly Sales	Enter all sales items including incoming and sold items
Report	The report will display the results of a priori calculations and rule provisions and will also display monthly reports and tabulation tables
Exit	Admin Exit system

b. Result Display (Output)

The following is a display of confidence results and results in the form of rules from the system that has been built as follows:

Confidence

No.	Kode Item	Nama	Frekuensi A	Frekuensi A dan B	Confidence
1	{ A4 } -> { A9 }	Gorio Magic, Ketagi	18	18	100.00%
2	{ A9 } -> { A4 }	Ketagi, Gorio Magic	18	18	100.00%
3	{ A4 } -> { A11 }	Gorio Magic, Mr Keren Sambal Balado (sbl)	18	18	100.00%
4	{ A11 } -> { A4 }	Mr Keren Sambal Balado (sbl), Gorio Magic	18	18	100.00%
5	{ A4 } -> { A15 }	Gorio Magic, Mr. Bebeto	18	18	100.00%
6	{ A15 } -> { A4 }	Mr. Bebeto, Gorio Magic	18	18	100.00%
7	{ A4 } -> { A16 }	Gorio Magic, Gorio Vanila	18	18	100.00%
8	{ A16 } -> { A4 }	Gorio Vanila, Gorio Magic	18	18	100.00%

Figure 3. *Confidence Results*

Ketentuan Rule

Rule	Keterangan
1	100.00% penjualan snack dengan kode A4 (Gorio Magic), akan menjual snack dengan kode A9 (Ketagi)pada setiap bulannya dengan support 100.00% dan confidence100.00%.
2	100.00% penjualan snack dengan kode A9 (Ketagi), akan menjual snack dengan kode A4 (Gorio Magic)pada setiap bulannya dengan support 100.00% dan confidence100.00%.
3	100.00% penjualan snack dengan kode A4 (Gorio Magic), akan menjual snack dengan kode A11 (Mr Keren Sambal Balado (sbl))pada setiap bulannya dengan support 100.00% dan confidence100.00%.
4	100.00% penjualan snack dengan kode A11 (Mr Keren Sambal Balado (sbl)), akan menjual snack dengan kode A4 (Gorio Magic)pada setiap bulannya dengan support 100.00% dan confidence100.00%.

Figure 4. Final Result of Rule Provisions

4. Conclusion

Based on the research and implementation carried out on the data mining implementation system in determining the sales pattern of snack products using the a priori algorithm, the following conclusions can be drawn: A priori algorithm with association rules for a combination of sales of snack products, and knowing which snack products are most sold to customers . The application of data mining using a priori algorithm is very efficient and accelerates the process of forming the trend of Itemet combination patterns from the sales of snack products at PT Siantar Top Tbk, with a support value of 100% and the highest confidence is 100%.

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