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Selection of Computer Private College to Use Elimination Methods and Options of Expressing Reality (ELECTRE)

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Abstract

Higher education is a continuation of secondary education which is prepared for students to become members of society who have academic and professional abilities who can apply, develop and create science, technology and arts. Higher education contains background problems, problem formulations and research objectives. Choosing a college has many aspects that must be considered, such as the location of the college, tuition fees, distance from residence, accreditation, levels, and choice of computer program majors. The hesitation in choosing a college to major in computer is often an obstacle for every prospective student. Especially with the many universities that exist today, both private and public universities. This makes prospective students often feel unfamiliar, confused, lack of information about tertiary institutions so that they are wrong in making choices. So that the solution from researchers designed information systems that are useful for assisting prospective students in choosing private universities for web-based computer programs, using the ELECTRE mysql database method. The results of research on private universities with the Electre method, it can help and provide recommendations and the best alternative decision solutions to prospective students in making decisions with many criteria.

Keywords: max College; ELECTRE; MYSQL

1.0 INTRODUCTION

At a time when the development of technology is growing rapidly, both in the field of telecommunications technology to computing technology. In the field of computers itself, many things have grown and developed, in the past computers could only be used for teaching and data processing but now computers can also be used as a tool to help make decisions

Higher education is a continuation of secondary education that is prepared for students to become members of society who have academic and professional abilities who can apply, develop and create science, technology and arts as embodied in Law 2 of 1989, article 16, paragraph (1) as well as developing and disseminating science, technology and arts and optimizing their use to improve the standard of living of the community and enrich the national culture as stated in Law 2 of 1989, article 16, Paragraph (91); PP 30 of 1990, article 2, Paragraph (1) (Solikhun, 2017b).

Choosing a college has many aspects to consider, such as the location of the college, tuition fees, distance from residence, accreditation, levels, and choice of computer program majors.

The computer department is one of the favorite majors today because information technology is rapidly developing, so jobs and business in the field of information technology are one of the options that many people are looking for.

Decision Support System (DSS) or Computer Based Decision Support System (DSS) is one part of an information system that is useful for increasing the effectiveness of decision making (Murti, Abdillah, & Sobri, 2015). There are many methods that can be used to produce a decision in a decision support system.

Elimination Method Et Chix Traduisant La Reality (ELECTRE) is a method that produces and ranks based on the advantages and disadvantages of each alternative through pairwise comparisons between alternatives on the appropriate criteria.

The hesitation in choosing a college to major in computer is often an obstacle for every prospective student. Especially with the many universities that exist today, both private and public universities. This makes prospective students often feel unfamiliar, confused, lack of information about tertiary institutions so that they

are wrong in making choices. Choosing the right university is an important decision for prospective students, because it will determine their future and career, especially if the decision has led to the selection of a study program that is really of interest (Murti et al., 2015).

Previous research that has been made is entitled: "Higher Education Selection Decision Support System Using Fuzzy Multi Attribute Decision Making (FMADM) and Simple Additive Weighting (SAW)(Mardiana & Tanjung, 2019). This research is to build a model for college selection decision making using Fuzzy M Quotle Attribute Decision Making (FMADM) with the Simple Addive Weighting (SAW) method which will provide references to users in determining higher education institutions.

The next research which is also related to decision support systems is "Application of Electre Method to Determine the Best Business Location (Wijayanti & Putra, 2015), the results of this study are in the form of a decision support system as a tool in determining the best business location.

2.0 LITERATURE REVIEW

College
Higher education is a continuation of secondary education which is prepared for students to become members of society who have academic and professional abilities who can apply, develop and create science, technology and arts (Solikhun, 2017a).

SPK
Decision Support System (DSS) or Computer Based Decision Support System (DSS) is one part of an information system that is useful for increasing the effectiveness of decision making. Problems that are commonly used as objects in the DSS are semi-structured or structured in nature (Ayu et al., 2017).

Elimination Method Et Chix Traduisant La Reality (ELECTRE)
Electre (Elimination Et Choix Traduisant La Realite) is a multicriteria decision-making method based on the outranking concept by comparing pairs of alternatives based on each appropriate criterion(Mardiana & Tanjung, 2019).

The steps taken in solving the problem using the Electre method are as follows:
1. Normalization of the decision matrix
   Each attribute is converted into an equivalent value.
   $r_{ij} = \dfrac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}$ for i=1,2,3,…,m and j=1,2,3,…,n.
2. Weighted matrix that has been normalized
   After being normalized, each column of the matrix R is multiplied by the weights (w) determined by the decision maker.
   $V = R.W$
3. Determines the set of concordances and strife indexes
   For each pair of alternatives k and l *l* (*k, l*= 1,2,3, …, m and *k ≠ l*) the set J criteria are divided into two subsets, namely concordance and discordance.
   A criterion in an alternative is a concordance if:
   $c_{kl = \{j, v_{kj} \geq v_{ij}\}}$ for j = 1,2,3,…n.
   discordance, a dispute, namely if
   :
   $D_{kl = \{j, v_{kj} < v_{ij}\}}$ for j = 1,2,3,…n.
4. Calculating the concordance and discordance matrices
   Calculating the concordance matrix, to determine the value of the elements in the concordance matrix is to add up the weights included in the mathematical set of concordances. Determining the value of the elements in the discordance matrix is by dividing the maximum difference between the criteria included in the discordance subset with the maximum difference between the values of all existing criteria.
5. Determine the dominant concordance and discordance matrices
   The matrix F as the dominant concordance matrix can be constructed with the help of the threshold value, namely by comparing each value of the concordance matrix element with the threshold value. Calculating the dominant discordance matrix, the matrix G as the dominant discordance matrix can be constructed with the help of the threshold value.
6. Determine the aggregate dominance matrix
   The E matrix as an aggregate dominance matrix is a matrix in which each element is a multiplication between the elements of the F matrix and the corresponding G matrix elements, which can be expressed mathematically as: $e_{kl} = f_{kl} \; x \; g_{kl}$
7. Elimination of less favorable alternatives
   Matrix E provides the order of choice for each alternative, that is, if ecl = 1 then alternative Ak is a better alternative than Al. Thus, rows in matrix E that have the number of ecl = 1 at least can be eliminated. Thus, the best alternative is one that dominates the other alternatives.

3.0 METHODOLOGY

Information Systems Design Methods
Research related to Information Technology (IT) and is an application, the research method commonly used is SDLC (System Development Life Cycle). Figure 1 shows the steps of the SDLC (System Development Life Cycle).
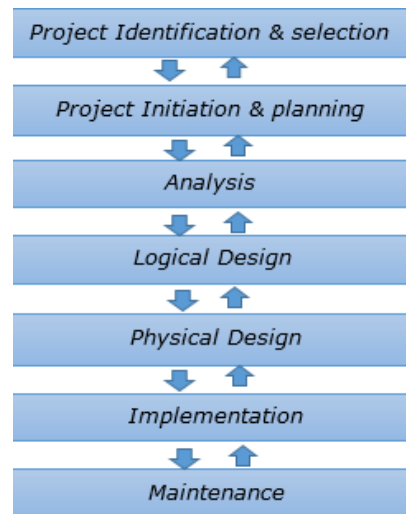
Figure 1. Steps of System Development Life Cycle

3.0 RESULTS AND DISCUSSION

Determination of Criteria
Table 1 shows the determination criteria for this study.

Table 1. Table Criteria

Criteria	Description
C1	Cost criteria
C2	Location
C3	Accreditation
C4	Educational level
C5	Study program
C6	Fasilities

Alternative Determination
Table 2 shows the alternative determination for this study.

Table 2. Alternative Tables

Alternative	Description
A1	Institute of Business and Technology
A2	University Abdurab
A3	Riau Islamic University
A4	Univerity Sassy Yellow
A5	Amik Mahaputra
A6	Stmik Amik
A7	University Muhamaddiyah
A8	Stmik Hangtuah
A9	Amik Tri Darma
A10	Stmik Dharmapala

In this study, the selection of higher education institutions as decision makers gave preference weights as follows:

C1 = Cost criteria = 3
C2 = Location = 2
C3 = Accreditation = 2
C4 = education level = 3
C5 = Study Program = 2
C6 = Facilities = 1

Table 3. The Weighted Rating Table

Alternative	C1	C2	C3	C4	C5	C6
A1	2	3	2	2	3	3
A2	3	3	2	2	2	3
A3	2	2	2	2	2	3
A4	2	1	2	2	3	3
A5	1	2	1	1	2	3
A6	1	1	2	2	3	3
A7	3	3	2	2	3	3
A8	3	2	2	2	3	3
A9	1	2	1	1	2	2
A10	1	3	1	1	1	2

Based on the data in table 3, the X matrix value is obtained

$$x = \begin{bmatrix} 2 & 3 & 2 & 2 & 3 & 3 \\ 3 & 3 & 2 & 2 & 2 & 3 \\ 2 & 2 & 2 & 2 & 2 & 3 \\ 2 & 1 & 2 & 2 & 3 & 3 \\ 1 & 2 & 1 & 1 & 2 & 3 \\ 1 & 1 & 2 & 2 & 3 & 3 \\ 3 & 3 & 2 & 2 & 3 & 3 \\ 3 & 2 & 2 & 2 & 3 & 3 \\ 1 & 2 & 1 & 1 & 2 & 2 \\ 1 & 3 & 1 & 2 & 1 & 2 \end{bmatrix}$$

To solve the problem using the ELECTRE method, the first step that must be done is to normalize the decision matrix X.

$$r_{11=} \frac{x_{11}}{\sqrt{\Sigma_i^m - 1X_{i1}^2}} = \frac{2}{\sqrt{2^2+3^2+2^2+2^2+1^2+1^2+3^2+3^2+1^2+1^2}} = \frac{2}{\sqrt{43}} = \frac{2}{6.5} = 0{,}30$$

$$r_{12=} \frac{x_{12}}{\sqrt{\Sigma_i^m - 1X_{i1}^2}} = \frac{3}{\sqrt{3^2+3^2+2^2+1^2+2^2+1^2+3^2+2^2+2^2+3^2}} = \frac{3}{\sqrt{54}} = \frac{3}{7{,}3} = 0{,}41$$

$$r_{13=} \frac{x_{13}}{\sqrt{\Sigma_i^m - 1X_{i1}^2}} = \frac{2}{\sqrt{2^2+2^2+2^2+2^2+1^2+2^2+2^2+2^2+1^2+1^2}} = \frac{2}{\sqrt{31}} = \frac{2}{5.5} = 0{,}36$$

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$$r_{116=} \frac{x_{106}}{\sqrt{\Sigma_i^m - 1X_{i10}^2}} = \frac{2}{\sqrt{3^2+3^2+23^2+3^2+3^2+3^2+3^2+3+2^2+2^2}} = \frac{2}{\sqrt{80}} = \frac{2}{8.9} = 0{,}22$$

From the calculation process, the normalization matrix is obtained which is called the matrix R.

$$R = \begin{bmatrix} 0{,}30 & 0{,}41 & 0{,}36 & 0{,}34 & 0{,}38 & 0{,}34 \\ 0{,}46 & 0{,}41 & 0{,}36 & 0{,}34 & 0{,}25 & 0{,}34 \\ 0{,}30 & 0{,}27 & 0{,}36 & 0{,}34 & 0{,}25 & 0{,}34 \\ 0{,}30 & 0{,}14 & 0{,}36 & 0{,}34 & 0{,}38 & 0{,}34 \\ 0{,}15 & 0{,}27 & 0{,}18 & 0{,}17 & 0{,}25 & 0{,}34 \\ 0{,}15 & 0{,}14 & 0{,}36 & 0{,}34 & 0{,}38 & 0{,}34 \\ 0{,}46 & 0{,}41 & 0{,}36 & 0{,}34 & 0{,}38 & 0{,}34 \\ 0{,}46 & 0{,}27 & 0{,}36 & 0{,}34 & 0{,}38 & 0{,}34 \\ 0{,}15 & 0{,}27 & 0{,}18 & 0{,}17 & 0{,}25 & 0{,}22 \\ 0{,}15 & 0{,}41 & 0{,}18 & 0{,}34 & 0{,}13 & 0{,}22 \end{bmatrix}$$

The second step after obtaining the R matrix is the normalized matrix weighting. Weighting is done by transferring the value to the matrix R with a predetermined preference value (w)

Matrix V = R. w

$$v = \begin{bmatrix} 0,90 & 0,82 & 0,72 & 1,02 & 0,76 & 0,34 \\ 1,38 & 0,82 & 0,72 & 1,02 & 0,50 & 0,34 \\ 0,90 & 0,54 & 0,72 & 1,02 & 0,50 & 0,34 \\ 0,90 & 0,28 & 0,72 & 1,02 & 0,76 & 0,34 \\ 0,45 & 0,54 & 0,36 & 0,51 & 0,50 & 0,34 \\ 0,45 & 0,28 & 0,72 & 1,02 & 0,76 & 0,34 \\ 1,38 & 0,82 & 0,72 & 1,02 & 0,76 & 0,34 \\ 1,38 & 0,54 & 0,72 & 1,02 & 0,76 & 0,34 \\ 0,45 & 0,54 & 0,36 & 0,51 & 0,50 & 0,22 \\ 0,45 & 0,82 & 0,36 & 1,02 & 0,26 & 0,22 \end{bmatrix}$$

The third step is to determine the set of concordance and discordance indexes. For each pair of alternative k and l (k, l = 1,2,3, ..., m and k ≠ l) the set J criteria are divided into two subsets, namely concordance and discordance

concordance if : $C_{kl=\{j,v_{kj} \geq v_{ij}\}}$ for j = 1,2,3,...n.

C12 = {j, v1j ≥ v2j} = {2,3,4,5,6}
C13 = {j, v1j ≥ v3j} = {1,2,3,4,5,6}
C14 = {j, v1j ≥ v4j} = {1,2,3,4,5,6}

discordance, if : $D_{kl=\{j,v_{kj} < v_{ij}\}}$ for j = 1,2,3,...n

D12 = {j, v1j ≥ v2j} = {1}
D13 = {j, v1j ≥ v3j} = {-}
D14 = {j, v1j ≥ v4j} = {-}

The fourth step is calculating the concordance matrix, to determine the value of the elements in the concordance matrix is to add the weights included in the mathematical set of concordances.

C12 = w2 + w3 + w4 + w5 + w6 = 2 + 2 + 3 + 2 + 1 = 10
C13 = w1 + w2 + w3 + w4 + w5 + w6 = 3 + 2 + 2 + 3 + 2 + 1 = 13
C14 = w1 + w2 + w3 + w4 + w5 + w6 = 3 + 2 + 2 + 3 + 2 + 1 = 13

The values of the matrix components are arranged based on the set of concordances with weights (W) and added up, resulting in a cocordance matrix as follows:

$$C = \begin{bmatrix} - & 10 & 13 & 13 & 13 & 13 & 10 & 10 & 13 & 13 \\ 11 & - & 13 & 11 & 13 & 11 & 11 & 11 & 13 & 13 \\ 9 & 8 & - & 11 & 13 & 11 & 6 & 6 & 11 & 11 \\ 11 & 8 & 11 & - & 11 & 13 & 8 & 8 & 11 & 11 \\ 1 & 3 & 5 & 3 & - & 6 & 1 & 1 & 11 & 8 \\ 8 & 8 & 8 & 10 & 11 & - & 8 & 8 & 11 & 11 \\ 13 & 13 & 13 & 13 & 13 & 13 & - & 13 & 13 & 13 \\ 13 & 13 & 13 & 13 & 13 & 13 & 13 & - & 13 & 13 \\ 2 & 4 & 4 & 2 & 12 & 5 & 2 & 2 & - & 8 \\ 5 & 5 & 5 & 5 & 10 & 8 & 5 & 5 & 11 & - \end{bmatrix}$$

To calculate the value of an element in the discordance matrix is to divide the maximum difference in the value of the criteria included in the discordance subset by the maximum difference in the value of all existing criteria.

$$D12 = \frac{max\{0,90-1,38\}}{max\{0,90-1,38|;|0,82-0,82|;|0,72-0,72|;|1,02-1,02|;|0,76-0,50|;|0,34-0,34|\}}$$
$$= \frac{max\,0,48}{max\{0,48;0;0;0;0,26;0\}} = \frac{0,48}{0,48} = 1$$

$$D13 = \frac{max\{0\}}{max\{0,90-0,90|;|0,82-0,54|;|0,72-0,72|;|1,02-1,02|;|0,76-0,50|;|0,34-0,34|\}}$$
$$= \frac{max\,0}{max\{0;0,28;0;0;0,26;0\}} = \frac{0}{0,28} = 0$$

$$D14 = \frac{max\{0\}}{max\{|0,90-0,90|;|0,82-0,28|;|0,72-0,72|;|1,02-1,02|;|0,76-0,76|;|0,34-0,34|\}}$$

$$= \frac{max\,0}{max\{0;0,54;0;0;0;0\}} = \frac{0}{0,54} = 0$$

So the discordance matrix is:

$$D = \begin{bmatrix}
- & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \\
0,54 & - & 0 & 0,48 & 0 & 0,28 & 1 & 0,93 & 0 & 0 \\
1 & 1 & - & 1 & 0 & 0,58 & 1 & 1 & 0 & 0,62 \\
1 & 1 & 1 & - & 0,51 & 0 & 1 & 1 & 0,51 & 1 \\
1 & 1 & 1 & 1 & - & 1 & 1 & 1 & 0 & 1 \\
1 & 1 & 1 & 1 & 0,51 & - & 1 & 1 & 0,51 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & - & 0 & 0 & 0 \\
0,58 & 1 & 0 & 0 & 0 & 0 & 1 & - & 0 & 0,30 \\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & - & 1 \\
1 & 1 & 1 & 0.93 & 0,47 & 0,93 & 1 & 1 & 0,47 & -
\end{bmatrix}$$

The fifth step is concordance dominant matrix. In this section the concordance matrix will be compared with the threshold value (c). The calculation of the dominant matrix concordance threshold value (C) is as follows.

= 10 + 13 + 13 + 13 + 13 + 10 + 10 + 13 + 13 + 11 + 13 + 11 + 13 + 11 + 11 + 11 + 13 + 13 + 9 + 8 + 11 + 13 + 11 + 6 + 8 + 13 + 11 + 11 + 8 + 11 + 11 + 13 + 8 + 8 + 11 + 11 + 1 + 3 + 5 + 3 + 6 + 1 + 3 + 13 + 8 + 8 + 8 + 10 + 11 + 8 + 8 + 11 + 11 + 13 + 13 + 13 + 13 + 13 + 13 + 13 + 13 + 13 + 11 + 11 + 13 + 13 + 13 + 13 + 13 + 13 + 11 + 0 + 2 + 4 + 2 + 12 + 5 + 0 + 2 + 8 + 5 + 5 + 5 + 5 + 10 + 8 + 5 + 5 + 11/10 (10-1)
= 844/90
= 9.37

The elements of the F matrix are defined as follows:

$$f_{kl} = \begin{cases} 1, jika\ c_{kl \geq \underline{c}} \\ 0, jika\ c_{kl < \underline{c}} \end{cases}$$

So that the dominant concordance matrix is

$$= \begin{bmatrix}
- & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\
1 & - & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\
0 & 0 & - & 1 & 1 & 1 & 0 & 0 & 1 & 1 \\
1 & 0 & 1 & - & 1 & 1 & 0 & 0 & 1 & 1 \\
0 & 0 & 0 & 0 & - & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 1 & 1 & - & 0 & 0 & 1 & 1 \\
1 & 1 & 1 & 1 & 1 & 1 & - & 1 & 1 & 1 \\
1 & 1 & 1 & 1 & 1 & 1 & 1 & - & 1 & 1 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & - & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & -
\end{bmatrix}$$

Calculating the dominant matrix discordance threshold value (d) is

= 1 + 0 + 0 + 0 + 0 + 1 + 1 + 0 + 0 + 0.54 + 0 + 0.48 + 0 + 0.28 + 1 + 0.93 + 0 + 0 + 1 + 1 + 1 + 0 + 0.58 + 1 + 1 + 0.62 + 1 + 1 + 1 + 0.51 + 0 + 1 + 1 + 0.51 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 0 + 1 + 1 + 1 + 1 + 1 + 0.51 + 1 + 1 + 0.51 + 1 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0, 58 + 1 + 0 + 0 + 0 + 0 + 1 + 0 + 0.30 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 0.93 + 0.47 + 0, 93 + 1 + 1 + 0.47 / 10 (10-1)

The elements of the matrix G are defined as follows:

$$g_{kl} = \begin{cases} 1, jika\ c_{kl \geq \underline{d}} \\ 0, jika\ c_{kl < \underline{d}} \end{cases}$$

So that the dominant concordance matrix is

$$G = \begin{bmatrix}
- & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \\
0 & - & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \\
1 & 1 & - & 1 & 0 & 0 & 1 & 1 & 0 & 1 \\
1 & 1 & 1 & - & 0 & 0 & 1 & 1 & 0 & 1 \\
1 & 1 & 1 & 1 & - & 1 & 1 & 1 & 0 & 1 \\
1 & 1 & 1 & 1 & 0 & - & 1 & 1 & 0 & 1 \\
0 & 1 & 0 & 0 & 0 & 0 & - & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & - & 0 & 0 \\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & - & 1 \\
1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 0 & -
\end{bmatrix}$$

The sixth step is to determine the aggregate dominance matrix.

$$e_{kl} = f_{kl} \, x \, g_{kl}$$

$$E = \begin{bmatrix}
- & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \\
0 & - & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \\
0 & 0 & - & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\
1 & 0 & 1 & - & 0 & 0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & - & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & - & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & - & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 1 & - & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & - & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -
\end{bmatrix}$$

The final step is eliminating less favorable alternatives. Matrix E provides the order of choice for each alternative, that is, if ecl = 1 then alternative Ak is a better alternative than Al. Thus, rows in matrix E that have the number of ecl = 1 at least can be eliminated. the best alternative is the alternative that dominates the other alternatives, namely E1 Institute of business and technology with a final result of 3 and E4 Lancang Kuning with a final result of 3.

4.0 CONCLUSION

Based on the analysis, design, testing that has been carried out, the following conclusions are obtained: (1) With the existence of a decision support system for the selection of private tertiary institutions, computers with the Electre method can help and provide recommendations and the best alternative decision solutions to prospective students in making decisions with many criteria. (2) With a database to create a website, it can help prospective students to get clear information. (3) With the application of the Electre method as a calculation in order to get accurate results so that it can be used as a tool in the decision making process.

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