International Journal of
INTELLIGENT SYSTEMS AND APPLICATIONS IN ENGINEERING
ISSN: 2147-6799 www.ijisae.org Original Research Paper

Multi-Criteria Group Decision Making Approach for scheduling algorithms selection by short term schedular using Fuzzy TOPSIS

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Submitted: **Accepted:**

Abstract:
The primary objective of CPU schedular is to distribute the CPU time fairly and efficiently among competing processes. Short term schedular full fill this objective among the types of schedulers. Short term schedular select the process from the ready queue and execute on the CPU. The decision is based on scheduling algorithms. Chosen of the appropriate algorithm among the scheduling algorithms is a key challenge for short term schedular because incorrect selection can decrease the system performance and increase the waiting and response time of process. To overcome this challenge, we used the Fuzzy TOPSIS method in Multi Criteria Decision Making (MCDM) approach for ranking the scheduling algorithms by considering both quantitative and qualitative factors. Two steps are comprised in proposed approach. In first step, we define the criteria for choosing the scheduling algorithm. Experts deliver linguistic ratings to the possible alternatives in contrast to the selected criteria, in step two. The goal of this study is to apply the fuzzy TOPSIS method based on fuzzy sets to create aggregate scores selection of best alternative.

Keywords: *Short term schedular, MCDM, Fuzzy TOPSIS (Technique for Order Preference by Similarity to Ideal Solution), Scheduling Algorithm.*

1.0 Introduction

Scheduler play a vital role in multitasking environments where several processes compete for CPU time. Schedular [1] is responsible for each process received an equal amount of processing time by effectively managing the CPU and memory resources. The key objective of schedular is to ensure the optimization of system resources and execution of task with fair and timely. Three types of schedular are employed as per the scope of system and scheduling algorithms [2]. Long term schedular is used to load the process from disk to memory and decide the selection of process from pool of new process to system for execution [1].
Medium term schedular take the decision to temporarily transferred the process from main memory to disk (swapped out) in order to free memory space [1]. Short term schedular [1] is commonly used schedular to process the tasks or processes. It is also known as CPU schedular. Short term schedular select the process from available list of process, that are waiting to execute on CPU in ready queue.

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The decision for selection of the process from ready queue is based on scheduling algorithms. Numerous scheduling algorithms are existed like; 'First-Come First-Served (FCFS)', 'Shortest Job First (SJF)', 'Priority Scheduling', 'Multi-level feedback queue (MLFQ)' and 'Round Robin (RR)', is typically used to make the selection. Each algorithm has their strength and weakness. In FCFS, processes are executed in the sequence as they entered in the ready queue (RQ) means the process arrived first get the CPU first [3]. It is non-preemptive in nature. SJF [4] choose the process with the shortest burst time (execution time) next to run. Each process is given a priority during priority scheduling [5], and the process with the highest priority receives the CPU. The priority can be static or dynamic (changed during the process execution). MLFQ is the extension of multi-level queue [6]. Processes can switch between various queues based on their behaviour in MLFQ. Time quantum or time slice are assigned to each process to run on CPU in Round Robin [7]. Execution of process is based on circular order, if a process doesn't complete within its quantum, it is moved to waiting queue. RR distributed the CPU time fairly among the processes. So, the correct choice for the selection of scheduling algorithms can impact on system timeline, performance and fairness but the selection of suitable algorithm among the scheduling algorithms is a crucial task for short term schedular. We used the fuzzy TOPSIS method in MCDM [8] to choose the suitable algorithm. In fuzzy TOPSIS method, we taken the five alternatives (FCFS, SJF, priority scheduling, MLFQ and RR) with four criteria; average response time (ART), average turnaround time (ATAT), average waiting time (AWT) and throughput. Fuzzy TOPSIS approach [9] is implemented to assign the rank of scheduling algorithms in MCDM. The uniqueness of the proposed work is as follow:

1. The proposed work increased the system performance and fairness.
2. It used the fuzzy logic to handle the uncertain or imprecise data of scheduling algorithms criteria.
3. Weights are represented in linguistics term or fuzzy number.
4. Fuzzy TOPSIS method play a vital role to calculate the rank of scheduling algorithms.
5. Avoid the starvation and reduce the context switching, response time.

Chen, C. T. (2001) used a novel MCDM method to solved the selection of distribution centre location problem in fuzzy environment [10]. He assigned the rating of each alternative and weights for criterion described by linguistic variables and transform in fuzzy number. Evaluation value each alternative with respect of criteria expressed in a triangular fuzzy number. Fasanghari M. et al (2008) [11] proposed the concept of fuzzy TOPSIS in MCDM to solved the customer satisfaction evaluation method. This study developed a customer happiness satisfaction index for a business-to-consumer e-commerce company and assesses customer satisfaction using fuzzy TOPSIS and fuzzy triangular numbers for linguistic variables. Jadhav, V. S. et al (2012) [12] presented a technique of creation schedule of a finite jobs on a finite number of machines of unequal efficiencies by using the TOPSIS Method in fuzzy environment. Ashrafzadeh M. at al (2012) [13] used the MCDM approach to choose the warehouse location under the partial information. The suggested strategy consists of two steps: (1) define the criteria for choosing a warehouse location (2) Against the chosen criteria, experts rate the various choices linguistically. This study shows how fuzzy TOPSIS can be used to solve the real-world problem of choosing the best warehouse location for a large Iran company. Junior F. R. L. et al (2014) [14] gave a study to compared the fuzzy AHP and fuzzy TOPSIS methods in relation to seven variables that are particularly pertinent to the supplier selection issue. In a fuzzy MCDM context, the problem is solved using the fuzzy TOPSIS method. Büyüközkan G. at al (2016) [15] solved the problem selection of smart phone using MCDM. To remove uncertainty and more accurately reflect decision makers' preferences, intuitionistic fuzzy sets with TOPSIS (IF-TOPSIS) can be used. The proposed approach provided a real case study with Intuitionistic fuzzy TOPSIS. Shirvani M. H. et al (2017) [16] used the fuzzy TOPSIS method to solved the high-performance computing (HPC) and cloud data centre in MCDM. Kore N. B. at al. (2017) [17] have provided an easy-to-understand explanation of the fuzzy TOPSIS Technique for Multi-Criteria Decision Making. They illustrated the Fuzzy TOPSIS approach utilizing a real-world example. Additionally, it can be utilized to automate the procedure and get rid of any uncertainty in the selecting process. Irvanizam I. (2018) [18] projected the concept of fuzzy TOPSIS in determine scholarship recipients' problem. They demonstrated how to use a fuzzy TOPSIS as a MADM technique in this work by using a numerical example to construct a triangular fuzzy number for the fuzzy data onto a normalized weight. Normalized values are used to construct the fuzzy decision matrix. When it comes to supplier selection concerns, Modibbo U. M. at al (2022) [19] examined the multi-criteria multi-supplier decision-making process and proposed a mixed-integer linear programming model. An example employing numerical data has been used to illustrate the usefulness of the suggested model. The solution demonstrates how the model may be used to help pharmaceutical companies make wise decisions in the real world. Fuzzy TOPSIS method play an important role to assigned the rank of alternatives with respect of criteria.

The present research work is split into six segments. In the first segment, we gave the primary introduction and uniqueness of proposed policy. Second segment explained the basics of MCDMS, fuzzy TOPSIS method and fuzzy set. We introduced the mathematical approach of proposed work in third segment. In fourth segment, we proposed the basic structure of planned work. In fifth segment, we mentioned numerical computation and performance evaluation. Conclusion of entire work, and future work are the part of sixth segment.

2.0 Basic concepts

2.1 Multi criteria decision making system

A decision support system called a multi-criteria decision-making system (MCDMS) assists people or organizations in making difficult decisions that involve several criteria or objectives [20]. Making judgments in many real-world situations requires taking into account a number of various factors or criteria, some of which may clash or work in concert. To deal with such circumstances, MCDMS offers a methodical and objective way to assess, analyze, and compare various options based on a number of distinct criteria.

Let α be a set of ξ decision alternatives and β be a set of ω evaluation criteria. Each decision alternative $x \in \alpha$ is evaluated based on its performance with respect to each criterion $y \in \beta$.

Let Q is be the $n \times m$ decision matrix, ϖ_{ij} represented the evaluation score of alternatives α_i with relation to criterion β_i and the matrix Q is defined as:

$$Q = \left\{ \begin{array}{cccc} \varpi_{12} & \varpi_{12} & \varpi_{13} \ \cdots & \varpi_{1m} \\ \varpi_{21} & \varpi_{22} & \varpi_{23} \ \cdots & \varpi_{2m} \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ \varpi_{n1} & \varpi_{n2} & \varpi_{n3} \ \cdots & \varpi_{nm} \end{array} \right\}$$

The MCDM system's objective is to identify a decision rule or methodology that can rank or choose the best options from α based on the criteria in β. To do this, different MCDM strategies employ a range of mathematical tools and models.

2.2 Fuzzy Technique for Order Preference by Similarity to Ideal Solution (FTOPSIS)

FTOPSIS [21] is a fuzzy set theory-based extension of the conventional TOPSIS approach. Fuzzy TOPSIS is MCDM procedure that ranks options according to how closely they resemble ideal and undesirable solutions. In 1981, Yoon and Hwang developed it. FTOPSIS is particularly useful when a decision-maker needs to find the best compromise choice that is the furthest from the anti-ideal alternative while still satisfying all of the requirements. Two key concepts are employed to determine the best option: the Positive Ideal Solution (PIS) and the Negative Ideal Solution (NIS). The PIS maximizes throughput while minimizing waiting time, whereas the negative ideal maximizes waiting time while minimizing throughput. The FTOPSIS method looks for the alternative that is closest to the PIS and farthest from the negative one. FTOPSIS has gained popularity as a well-liked MCDM technique with a wide range of applications due to its effectiveness and assurance. The conventional TOPSIS approach [22] used the crisp data, where the criterion is represented with single value. However, data may be ambiguous, inaccurate, or confusing while making decisions in the real world. FTOPSIS method deal with such types of situations by nominating the criteria as fuzzy set, where every value has degree of membership between 0 to 1 which represent the level of certainty.

It is used extensively in a variety of fields, including 'supply chain management', 'Manufacturing systems', 'Business and marketing management', 'Health', 'Human resources management', and other subject areas. In short, we can say that The FTOPSIS approach helps in ranking the decision alternatives based on their overall performance concerning the multiple criteria, taking into account both the ideal and anti-ideal solutions. It delivers an organized and objective approach to multi-criteria decision-making problems

2.3 Fuzzy Set

To describe fuzzy set concepts, it is required to comprehend the basic idea of classical set theory. [23]. The concept of a classical set-in mathematics is really simple. A set is a collection of objects with definite boundaries. The elements in fuzzy set theory belong to the set to degrees that vary between 0 and 1, as opposed to the elements in classical/crisp set theory, which either belong to the set or do not. The boundaries of fuzzy set is imprecise or vague.
Uncertainty and imprecision in the membership of elements to a set are mathematically represented by fuzzy sets.

Let K is the universe of discourse and k belong to the K, a fuzzy set $\tilde{A}$ defined on K may be written as a collection of ordered pair

$$\tilde{A} = \{(\mathrm{k}, \mu_{\tilde{A}}(\mathrm{k})) : \mathrm{k} \in \mathrm{K}\}$$

Where $\mu_{\tilde{A}}(\mathrm{k})$ is called the membership function. A membership is nothing but the degree of belongingness and that is varies from 0 to 1. Each ordered pair is called as singleton. To represent degree of membership, a variety of membership functions, including triangular, trapezoidal, Gaussian, sigmoidal, etc. [23], can be utilized. We used the triangular to represent the membership function in fig 1. A triangular fuzzy number is signified $\rho = (a_1, a_2, a_3)$.

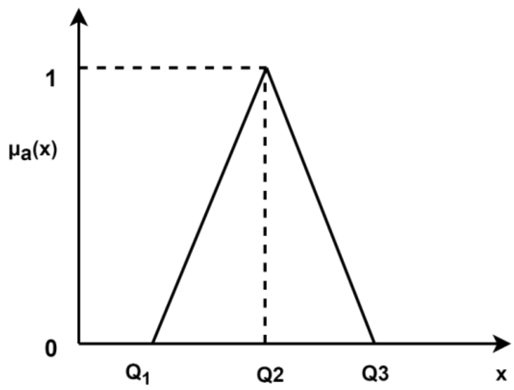

Fig. 1 Triangular membership function

So, the triangular membership function

$$\boldsymbol{\mu_\rho(x)} = \begin{cases} \dfrac{x - Q_1}{Q_2 - Q_1} \; if\ Q_1 \le x < Q_2 \\ \dfrac{Q_2 - x}{Q_3 - Q_2} \; if\ Q_2 \le x \le Q_3 \\ 0 \qquad\qquad else \end{cases}$$

3.0 A mathematical approach for ranking the scheduling algorithms using FTOPSIS approach

Step 1: Formulate the fuzzy decision matrix (FDM) P with α number of alternative ($\alpha_1, \alpha_2, \alpha_{3,} \ldots \ldots . \alpha_n$) and δ number of criteria ($\delta_1, \delta_2, \delta_3, \ldots . . \delta_n$) and assign the fuzzy rating to alternatives with relation of criteria.

$$\mathrm{P} = \begin{matrix} \boldsymbol{\alpha_1} \\ \boldsymbol{\alpha_2} \\ \boldsymbol{\alpha_3} \\ \vdots \\ \vdots \\ \boldsymbol{\alpha_n} \end{matrix} \left\{ \begin{matrix} \boldsymbol{\delta_1} & \boldsymbol{\delta_2} & \cdots & \boldsymbol{\delta_n} \\ P_{11} & P_{12} & \cdots & P_{1a} \\ P_{21} & P_{22} & \cdots & P_{2a} \\ \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots \\ P_{b1} & P_{b2} & P_{b3} \ldots & P_{ba} \end{matrix} \right\}$$

Where P_{ij} represent the performance or evaluation score of alternatives with respect to criteria. Table 1 show the assigned rating of alternatives and weights (linguistic terms).

Table – 1 Rating of alternatives and weights

Fuzzy Number	Alternative Assessment	Weights
(1,2,3)	Very low (VL)	Very poor (VP)
(1,3,5)	Low (L)	Poor (P)
(3,5,7)	Average (AV)	Fair (F)
(5,7,9)	High (H)	Good (G)
(7,8,9)	Very high (VH)	Very good (VG)

Step 2: Used the ideal linguistic terms to represent the evaluation score and transform into triangular fuzzy numbers (TFN). Apply the TFN for the alternatives in the FDM.

Table-2 evaluation score in triangular fuzzy numbers

	δ_1	δ_2	δ_3	δ_4
α_1	7,8,9	3,5,7	1,3,5	7,8,9
α_2	1,3,5	1,2,3	9,7,5	1,2,3
α_3	1,3,5	7,8,9	5,7,9	1,3,5
α_4	3,5,7	1,3,5	1,3,5	3,5,7
α_5	5,7,9	1,2,3	7,8,9	3,5,7

Transformation of linguistic terms into TFN is represented in table 2.

Step 3: Normalize the fuzzy decision matrix P to remove the effect of different units of measurement by using

$\widetilde{m_{ij}} = \left[\frac{p_{ij}}{\partial_j^*}, \frac{q_{ij}}{\partial_j^*}, \frac{r_{ij}}{\partial_j^*}\right]$ and $\partial_j^* = max_i\{r_{ij}\}$(benefit criteria)

$\widetilde{m_{ij}} = \left[\frac{\overline{p_j}}{r_{ij}}, \frac{\overline{p_j}}{q_{ij}}, \frac{\overline{p_j}}{p_{ij}}\right]$ and $\overline{p_j} = min\{p_{ij}\}$(cost criteria)

Where $i = 1, 2 \ldots \ldots m$ and $j = 1, 2 \ldots \ldots n.$

Step 4: Assign the weights (w) to each criterion to reflect their relative importance and compute the weighted normalized FDM by multiply with weights

$\acute{\omega} = (\acute{\omega}_{ij})$ where $\acute{\omega}_{ij} = \widetilde{m_{ij}} \times \overline{w_j}$

$\tilde{\zeta_1} \otimes \tilde{\zeta_2} = (\eta_1, \vartheta_1, \kappa_1) \otimes (\eta_2, \vartheta_2, \kappa_2) = (\eta_1 * \eta_2, \vartheta_1 * \vartheta_2, \kappa_1 * \kappa_2)$

Step 5: Calculate the 'fuzzy positive ideal solution (FPIS)' and 'fuzzy negative ideal solution (FNIS)'

$A^+ = \{\omega_1^+, \omega_2^+, \omega_3^+ \ldots \ldots \ldots, \omega_n^+\}$

Where $\omega_j^+ = max_i\ (\omega_{ij3})$ for benefit typet

$A^- = \{\omega_1^-, \omega_2^-, \omega_3^- \ldots \ldots \ldots, \omega_n^-\}$

Where $\omega_j^- = min_i\ (\omega_{ij1})$ for cost typet

Step 6: Evaluate the distance from individually alternative to the FPIS and FNIS by apply

$$D(\tilde{x}, \tilde{y}) = \sqrt{1/3\{(\breve{a}_1 - \breve{a}_2)^2 + (\breve{b}_1 - \breve{b}_2)^2 + (\breve{c}_1 - \breve{c}_2)^2\}}$$

Step 7: Calculate how closely each alternative to the ideal solution by using

$$R_i = \frac{d_i^-}{d_i^+ + d_i^-}$$

Step 8: Based on their relative closeness values, assigned the rank to the alternatives. According to the relative closeness value of alternative, ranks are considered. Maximum relative closeness value means first rank while lowest value means rank last. The alternative with highest rank considered the best compromise solution.

4.0 Architectural Diagram for scheduling algorithm selection using fuzzy TOPSIS

The proposed method's structural layout is shown in Figure 2.

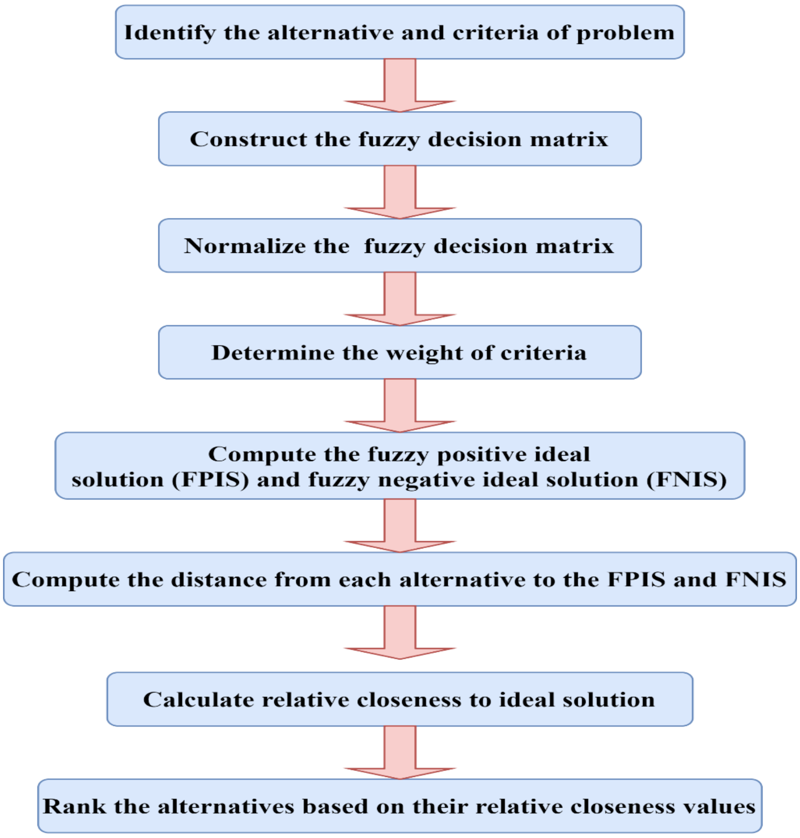

Fig. 1 architectural diagram of planned approach.

5.0 Numerical computation

Let take an example of scheduling algorithm selection problem for short term schedular. Number of scheduling algorithms are existed for scheduling the processes but making the decision for selection of appropriate algorithm is very difficult for short term schedular so to overcome this issue we used the fuzzy TOPSIS method in MCDM. In fuzzy TOPSIS, algorithm is judge on the basis of criteria for the alternatives. We used the linguistic terms like VL, L, AV, H and VH in FDM, we applied a scale of 1 to 9 for rating the criteria. Fuzzy TOSIS method solved this problem by following some steps.

Step 1: We find the alternative; FCFS, SJF, Priority scheduling, RR, MLFQ and criteria; ART, ATAT, AWT, Throughput of problem and formulate the decision matrix. Assigned the rating to the alternatives with respect of criteria. The Table 3 show the FDM after the rating.

Table-3 FDM in linguistic term

	ART	ATAT	AWT	Throughput
FCFS	VH	AV	L	VH
SJF	L	VL	H	VL
Priority scheduling	L	VH	H	L
RR	AV	L	L	AV
MLFQ	H	VL	VH	AV

Step 2: Five points scale are fuzzified. Here we taken triangular membership function and every linguistic term transform into a fuzzy number. Table 4 represent the fuzzy decision matrix with fuzzy number.

Table-4 fuzzy decision matrix in term of fuzzy number

	ART	**ATAT**	**AWT**	**Throughput**
FCFS	7,8,9(VH)	3,5,7(AV)	1,3,5(L)	7,8,9(VH)
SJF	1,3,5(L)	1,2,3(VL)	5,7,9(H)	1,2,3(VL)
Priority scheduling	1,3,5(L)	7,8,9(VH)	5,7,9(H)	1,3,5(L)
RR	3,5,7(AV)	1,3,5(L)	1,3,5(L)	3,5,7(AV)
MLFQ	5,7,9(H)	1,2,3(VL)	7,8,9(VH)	3,5,7(AV)

Step 3: Our aim to minimized the criteria ART, ATAT, AWT (Cost criteria) and maximized the criterion throughput (Benefit criteria) by normalized the decision table. All criteria are the part for same objective. Table 5 represented the fuzzy normalized decision matrix.

Table-5 fuzzy normalized decision matrix

	ART	**ATAT**	**AWT**	**Throughput**
FCFS	1/9,1/8,1/7	1/3,1/5,1/7	1/5,1/3,1/1	7/9,8/9,9/9
SJF	1/5,1/3,1/1	1/3,1/2,1/1	1/9,1/7,1/5	1/9,2/9,3/9
Priority scheduling	1/5,1/3,1/1	1/7,1/8,1/9	1/9,1/7,1/5	1/9,3/9,5/9
RR	1/3,1/5,1/7	1/1,1/3,1/5	1/1,1/3,1/5	3/9,5/9,7/9
MLFQ	1/5,1/7,1/9	1/1,1/2,1/3	1/7,1/8,1/9	3/9,5/9,7/9

Table-6 fuzzy normalized decision matrix

	ART	**ATAT**	**AWT**	**Throughput**
FCFS	0.11,0.12,0.14	0.14,0.2,0.33	1,0.33,0.2	0.77,0.88,1
SJF	0.2,0.33,1	0.33,0.5,1	0.11,0.14,0.2	0.11,0.22,0.33
Priority scheduling	0.2,0.33,1	0.11,0.12,0.14	0.11,0.14,0.2	0.11,0.33,0.55
RR	0.14,0.2,0.33	0.2,0.33,1	0.2,0.33,1	0.33,0.55,0.77
MLFQ	0.11,0.14,0.2	0.33,0.5,1	0.11,0.12,0.14	0.33,0.55,0.77

In table 6, We can saw the ranges of normalized TFN belong to (0, 1).

Step 4: We used the linguistic term to represent the evaluation score of weights and transform into fuzzy numbers in table 6.

Table-6 fuzzy number for weights

Fuzzy Number	Weights
(1,2,3)	VP
(1,3,5)	P
(3,5,7)	F
(5,7,9)	G
(7,8,9)	VG

Assign the weights ($\overline{w}_1 = 1{,}2{,}3$ $\overline{w}_2 = 3{,}5{,}7$ $\overline{w}_3 = 5{,}7{,}9$ and $\overline{w}_4 = 1{,}3{,}5$) to the criteria and calculate the weighted fuzzy normalized decision matrix by multiply the fuzzy normalized decision matrix with weights. Now the weighted fuzzy normalized decision matrix in table 8.

Table-8 Weighted fuzzy normalized decision matrix

Weights	**ART** $\boldsymbol{w_1 = 1,2,3}$	**ATAT** $\boldsymbol{w_2}$ =3,5,7	**AWT** $\boldsymbol{w_3 = 5,7,9}$	**Throughput** $\boldsymbol{w_4 = 1,3,5}$
FCFS	0.11,0.24,0.42	0.42,1,2.31	5,2.31,1.8	0.77,2.64,5
SJF	0.2,0.66,3	0.99,2.5,7	0.55,0.98, 1.8	0.11,0.66,1.65
Priority scheduling	0.2,0.66,3	0.33,0.6,0.98	0.55,0.98, 1.8	0.11,0.99,2.75
RR	0.14,0.4,0.99	0.6,1.65,7	1,2.31,9	0.33,1.65,3.85
MLFQ	0.11,0.28,0.6	0.99,2.5,7	0.55,0.84,1.26	0.33,1.65,3.85

Step 5: Compute the FPIS and FNIS

$v_1^+ = 0.2,0.66,3$ $v_2^+ = 0.99,2.5,7$ $v_3^+ = 0.5,2.31,9$ $v_4^+ = 0.77,2.64,5$

$v_1^- = 0.11,0.24,0.42$ $v_2^- = 0.33,0.6,0.98$ $v_3^- = 0.55,0.84,1.26$ $v_4^- = 0.11,0.66,1.65$

So, the $A^+ = \{(0.2,0.66,3),(0.99,2.5,7),(0.5,2.31,9),(0.77,2.64,5)\}$ and $A^+ = \{(0.11,0.24,0.42),(0.33,0.6,0.98),(0.55,0.84,1.26),(0.11,0.66,1.65)\}$

Step 6: Now calculate the distance (d_i^+) from individually alternative to the FPIS and FNIS, so the distance matrix from the FPIS in table 9.

Table-9 Calculated d_i^+ from FPIS and distance matrix from the FNIS in table 10.

	ART	**ATAT**	**AWT**	**Throughput**	d_i^+ $\{\sum_{j=1}^{n} d(v_{ij}, v_j^+)\}$
FCFS	1.52	2.7	4.5	0	8.72
SJF	0	0	4.9	2.2	7.1
Priority scheduling	0	3.6	4.9	2.8	11.3
RR	1.17	0.54	2.3	0.91	4.92
MLFQ	1.4	0	5.2	0.91	7.51

Table-10 Calculated d_i^+ from FNIS

	ART	**ATAT**	**AWT**	**Throughput**	d_i^- $\{\sum_{j=1}^{n} d(v_{ij}, v_j^-)\}$
FCFS	0	0.8	2.7	2.3	5.8
SJF	1.5	3.6	0.3	0	5.4
Priority scheduling	1.5	0	0.3	0.66	2.46
RR	0.35	0.17	4.5	1.4	6.42
MLFQ	0.1	3.6	0	1.4	5.1

Step 7: Determine the relative closeness (R_i) of each alternative to the ideal solution

$$R_1 = \frac{5.8}{5.8+8.72} = 0.39$$
$$R_2 = \frac{5.4}{5.4+7.1} = 0.43$$
$$R_3 = \frac{2.46}{2.46+11.3} = 0.18$$
$$R_4 = \frac{6.42}{6.42+4.92} = \mathbf{0.56}$$
$$R_5 = \frac{5.1}{5.1+7.51} = 0.4$$

Step 8: Now assigned the rank to alternatives based on their relative closeness values.

Table-11 All alternatives with rank

	d_i^+	d_i^-	R_i	*Rank*
FCFS	8.72	5.8	0.39	4
SJF	7.1	5.4	0.43	2
Priority scheduling	11.3	2.46	0.18	5
RR	4.92	6.42	**0.56**	**1**
MLFQ	7.51	5.1	0.4	3

Now on the basis of calculated ranking in table 11, we can say that rank of RR is very high compare to FCFS, SJF, Priority scheduling and MLFQ scheduling algorithms so, it is very convenance to schedular to select the algorithm (high rank) for the execution of processes/tasks on CPU.

5. Conclusion and Future Work

Selection of the scheduling algorithm is a MCDM problem including both quantitative and qualitative. In this algorithm, we provide a MCDM approach for Selection of the scheduling algorithm under fuzzy environment. We used a mathematical approach for ranking the scheduling algorithms using Fuzzy TOPSIS method. Fuzzy TOPSIS approach play a vital role in MCDM to reducing the efforts for selection the scheduling algorithm. Selection of the optimized algorithm by schedular, got increased the system performance and reducing the waiting time response time and context switching of processes. A suitable tool to deal with uncertainties and complicated environments is provided by fuzzy theory. The proposed approach creates the new paths to use the extension of fuzzy set. In future research, we can use the neutrosophic [24] environment in place of fuzzy set environment.

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