

# MATLAB-SIMULINK MODELING OF FUZZY SCHEDULING ALGORITHM FOR OPERATING SYSTEM

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# Agenda

- Problem Statement
- Workflow
- Tools Used
- Results
- Takeaways

# PROBLEM STATEMENT

# Problem Statement

- KPI
  - Waiting time
  - Turnaround time
- Multiple deciding factors
- Scheduling is no longer one dimensional
- Ambiguity in decision making
- Real Time Scheduling issues
- CPU Overloading
- Deadline Overrun Scenario handling

# WORKFLOW

# Workflow

## Fuzzy System Design

Determine  
input/output linguistic  
variables

Determine  
input/output  
membership functions

Develop IF-Then  
Rules based on  
knowledge base

## Simulink Modeling

Develop the  
Scheduling System

Import Fuzzy  
System

Generate Process  
and Simulate

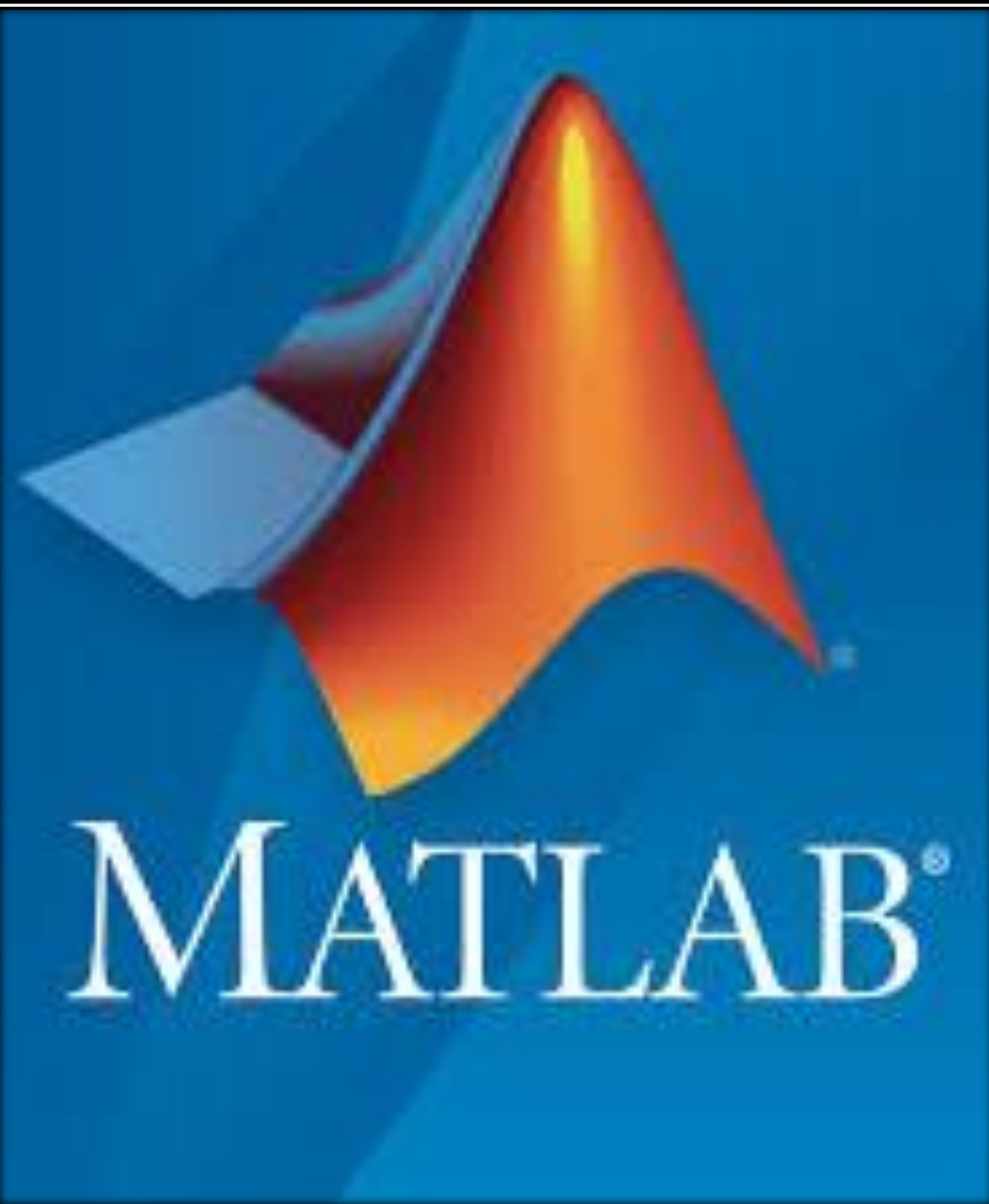
General  
Purpose  
System

Real  
Time  
System

Heavily  
Loaded  
system

Deadline  
Overrun

# TOOLS USED

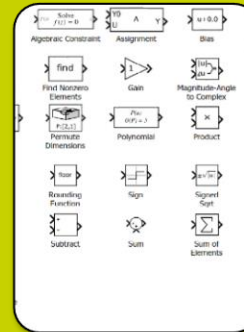


## Tools Used



### Fuzzy Logic Toolbox

- Analyze
- Design
- Simulate



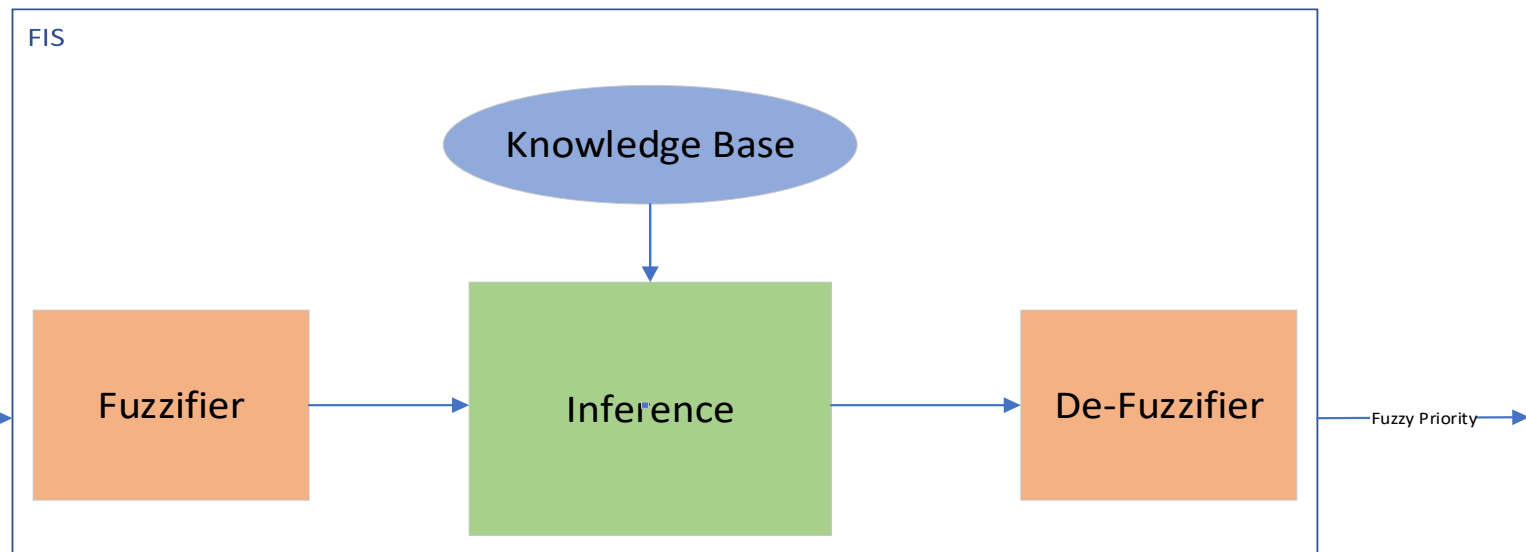
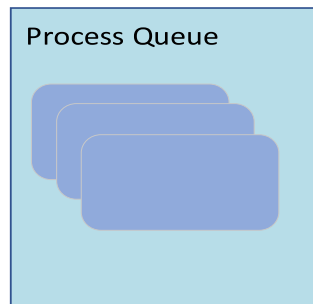
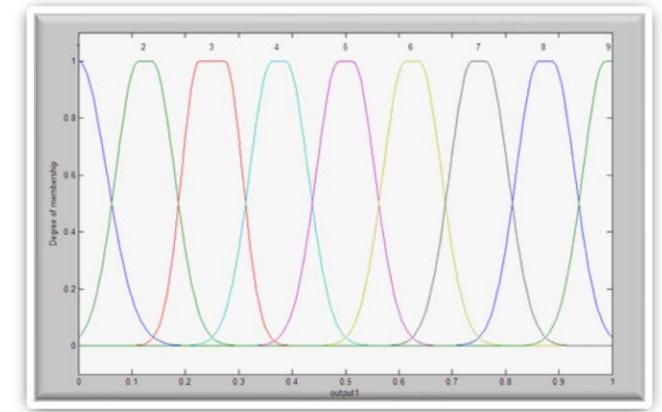
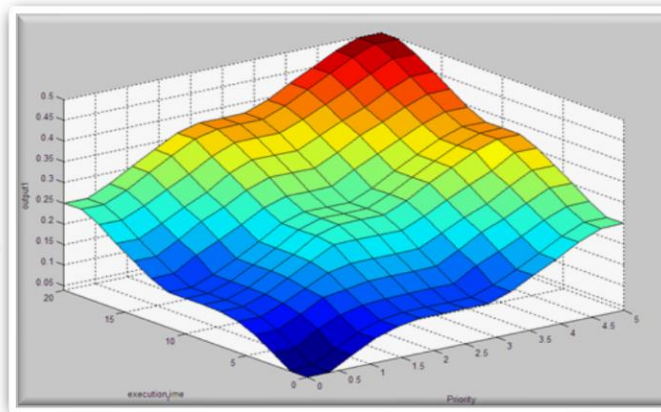
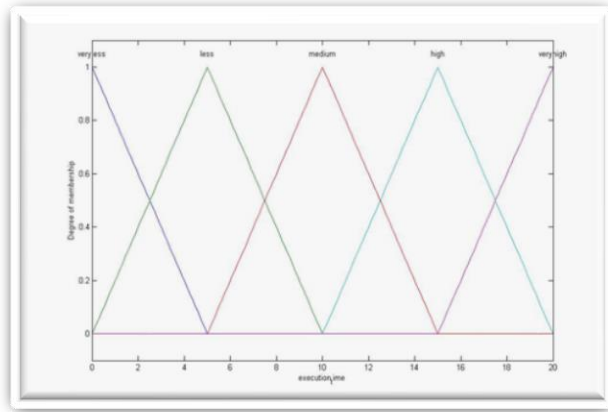
### Simulink

- Design
- Simulate



# RESULTS

# Fuzzy Scheduling System



# KPI for General Purpose System with N=5

FCFS: First Come First Serve  
SJF: Shortest Job First  
PS: Priority Scheduling

Algorithm	Case 1	Case 2	Case 3	Case 4	Case 5
FCFS	16.2	17.2	20.2	23.6	10.4
SJF	14	10.8	11	21.2	10.4
PS	19.8	16	23.4	25	19.8
Proposed	17	11.2	12.6	23.4	12.6

Average Waiting Time for Randomly Generated Processes with N = 5

Algorithm	Case 1	Case 2	Case 3	Case 4	Case 5
FCFS	26.4	27.4	30.2	37	20.4
SJF	24.2	21	21	34.6	20.4
PS	30	26.2	33.4	38.4	29.8
Proposed	27.2	21.4	22.6	36.8	22.6

Average Turnaround Time for Randomly Generated Processes with N = 5

5 set of process are generated with random execution time and are scheduled using general purpose Scheduling Algorithm and KPIs are presented

# KPI for General Purpose System with N=10

FCFS: First Come First Serve  
SJF: Shortest Job First  
PS: Priority Scheduling

Algorithm	Case 1	Case 2	Case 3	Case 4	Case 5
FCFS	72.3	84.2	50.8	62.6	75.8
SJF	43.5	65.7	27.4	40.9	47
PS	64.9	81.3	66.6	65.1	75.2
Proposed	48.1	70.4	36.9	48.4	58.9

Average Waiting Time for Randomly Generated Processes with N = 10

Algorithm	Case 1	Case 2	Case 3	Case 4	Case 5
FCFS	87.1	104.5	63.2	76.5	91.8
SJF	58.3	86	39.8	54.8	62.4
PS	79.7	101.6	79	79	90.6
Proposed	62.9	90.7	49.3	62.3	74.3

Average Turnaround Time for Randomly Generated Processes with N = 10

With increased number of process in ready queue, proposed algorithm performs better than FCFS and PS algorithm

# Results: Real Time System

RM: Rate Monotonic  
EDF: Earliest Deadline First  
LLF: Lowest Laxity First

Process ID	Period	Execution Time
P1	2	1
P2	5	1
P3	7	2

Highly Loaded System with loading factor 0.98

Process ID	Period	Execution Time
P1	2	1
P2	4	1
P3	7	2
P4	10	3

Overloaded System with Loading factor 1.33

- With underloaded Scenario, RM policy fails to schedule the process, but EDF, LLF and Proposed Algorithm effectively schedule the process within the deadline.
- With overloaded Scenario, Proposed Algorithm performs better than RM policy and equally efficient as EDF and LLF

# Results: Overload Scenario

RM: Rate Monotonic  
EDF: Earliest Deadline First  
LLF: Lowest Laxity First

Process ID	Period	Execution Time
P1	2	1
P2	4	1
P3	8	3

OVERLOADED SYSTEM WITH LOADING FACTOR 1.125

Algorithm		P1	P2	P3
Expected		4	2	3
RM	Scheduled	4	2	2
	Miss	0	0	1
EDF	Scheduled	4	2	2
	Miss	0	0	1
LLF	Scheduled	4	2	2
	Miss	0	0	1
PROPOSED	Scheduled	4	2	2
	Miss	0	0	1

OBSERVATIONS FOR THE PROCESSES IN READY QUEUE

For an Overload Scenario, with loading factor 1.125 all the algorithms miss P3



# Results: Overload Scenario

RM: Rate Monotonic  
EDF: Earliest Deadline First  
LLF: Lowest Laxity First

Process ID	Period	Execution Time
P1	2	1
P2	4	1
P3	8	3
P4	16	1

Overloaded System With Loading Factor 1.1875

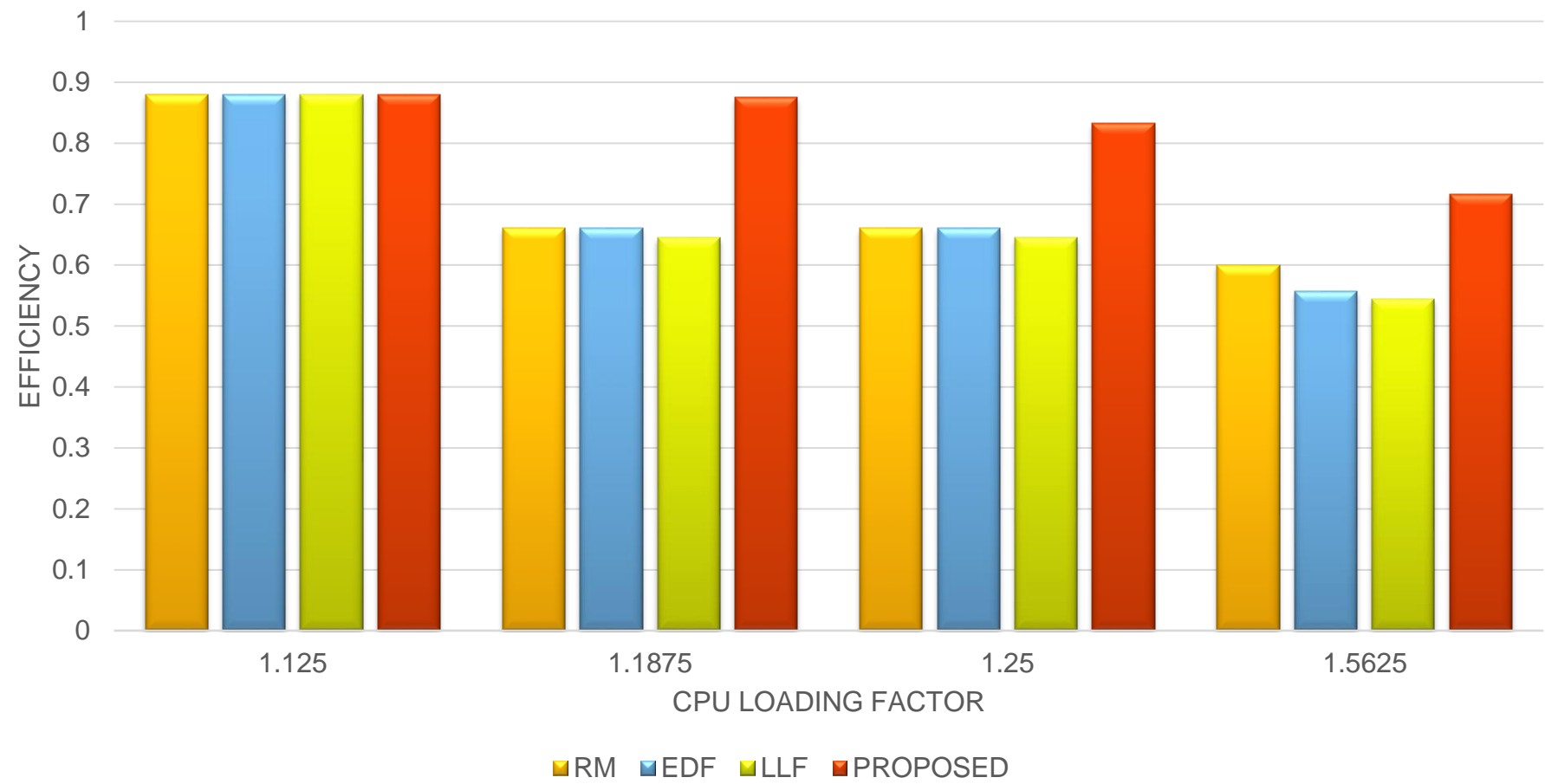
Algorithm		P1	P2	P3	P4
Expected		8	4	6	1
RM	Scheduled	8	4	4	0
	Miss	0	0	2	1
EDF	Scheduled	8	4	4	0
	Miss	0	0	2	1
LLF	Scheduled	8	3	5	0
	Miss	0	1	1	1
PROPOSED	Scheduled	8	4	3	1
	Miss	0	0	3	0

Observations for the processes in Queue

- For an overloaded scenario with loading factor 1.875, RM, EDF and LLF miss at least 2 process
- Proposed Algorithm miss only process P3

# Results

RM: Rate Monotonic  
EDF: Earliest Deadline First  
LLF: Lowest Laxity First





# TAKEAWAYS

# Takeaways

- Fuzzy Logic Based Scheduling Algorithm provides better performance as with conventional algorithms
- Fuzzy Logic Tool box by MATLAB enables effective modeling and simulation of Fuzzy Inference System.
- Simulink Modeling is carried out to evaluate the performance of the proposed algorithm



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