MINOR PROJECT

IT700 – ADVANCED ALGORITHMS

Tourism Recommendation System

INDEX

Submitted By

202IT009 | Kodingari Rajasekhar (M.Tech)
202IT028 | Sibangkar basumatary (M.Tech)
202IT030 | Tushar (M.Tech)

203IT001 | Shankaranarayan N (M.Tech[Research] IT)

1. INTRODUCTION & PROBLEM STATEMENT:

Tourism is one of the industry in India with really high profit potential and is important for the country's economy and is growing rapidly. The World Travel and Tourism Council calculated that tourism generated ₹16.91 lakh crore (US$240 billion) or 9.2% of India's GDP in 2018 and supported 42.673 million jobs, 8.1% of its total employment. The sector is predicted to grow at an annual rate of 6.9% to ₹32.05 lakh crore (US$450 billion) by 2028 (9.9% of GDP). **[Data Reference : Wikipedia]**

India is a well known for tourism destination. Every region in India specializes in a specific type of tourism. For example, Kerala is widely known for it's natural tourism while Karnataka and Tamil Nadu are mostly known for it's temple and Historic sites. Similarly every state/region in India is specializes in a specific kind of tourism.

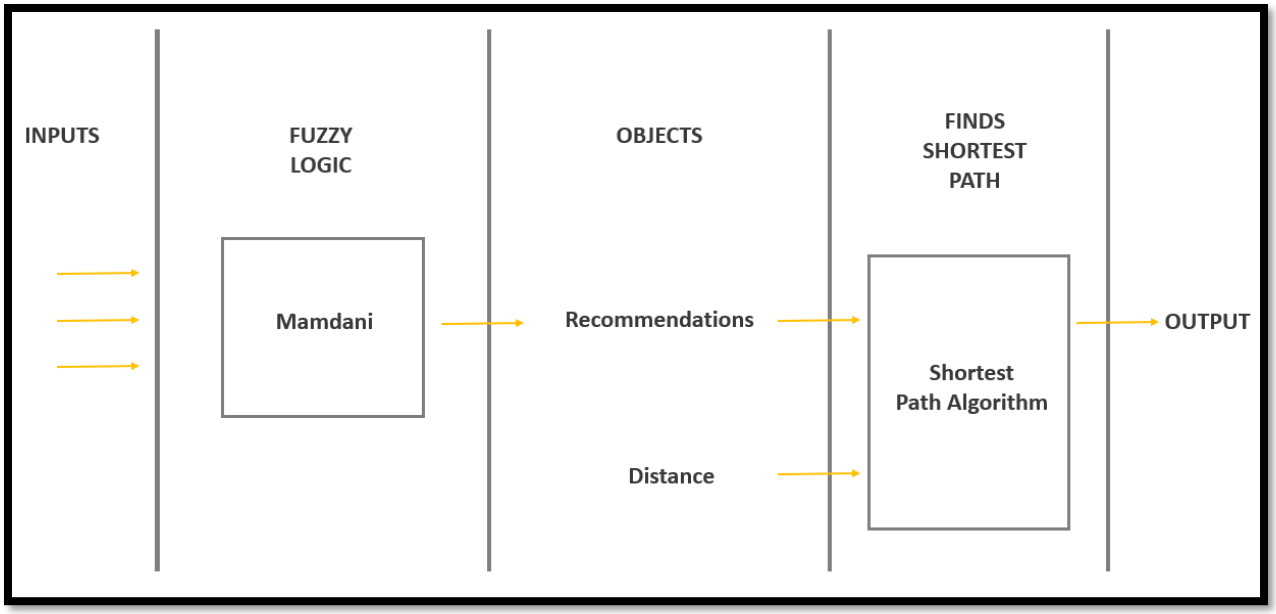
In this mini-project we consider the North Eastern region of the country which is know for Nature tourism as test case. According to a 2015 survey on "Most Visited States of India by Foreign Tourists" non of the north eastern states are in Top 10. Despite it's enormous natural gifts, the north eastern tourism generates less revenue and attracts less non-domestic tourists.

The main reason for this issue is that, foreigners have little to no idea when it comes to planning their trip through a less explored region. Thus to be able to make it easier for the tourists to know about the tourism sights in North East and in turn increase the tourism revenue, we need a system that is able to provide information on tourist attractions to tourists precisely in accordance with what the tourists want.

The proposed system uses the Fuzzy Logic method and Floyd Warshall Algorithm which are combined, so as to obtain results in the form of recommendations for tourist attractions based on the costs the tourist is willing to spend, the amount of time he/she is willing to spend and the distance he/she is willing to travel.

2. SYSTEM MODEL :

The proposed system is an end to end model for tourism recommendation. Initially, the tourism department of respective regions to provide recommendations to their present and future visitors via a web portal. Here, we apply fuzzy logic to the data related to the tourism sites and store them for future use. This stored data is later retrieved and used for computing the recommended sites. This process of fuzzyfication greatly reduces the time that is usually taken to compute and recommend sites. In the visitor/tourist end, the user will be asked to enter how he/she is willing to spend, the time he/she is willing to spend in one place and the distance he/she is willing to travel in a fuzzy state (i.e HIGH / FAR etc).



3. METHODOLOGY :

For the sake of simplicity and explanation, we will be considering only the following three factors[COST – DISTANCE - TIME]. Cost corresponds to the amount of money a tourist is willing to spend in one particular space. Distance corresponds to the how fare a tourist is willing to travel from the city heart and Time corresponded to the amount of time one person is willing to spend is a particular tourist destination.

Let's assume that the tourist department of the respective city has data related to cost, distance and time. Our proposed system fuzzifies this stored data into 3 categories and allots a score to each category based on a fuzzy logic algorithm.

EXAMPLE :

Location	Price	Distance	Time
W	Rs.1200	4KM	1Hour

Price	Cheap	Mid	Costly
W	p	f	s

Distance	Near	Mid	Far
W	b	a	n

Time	Less	Mid	More
W	h	s	q

In the user/tourist end, the user will be asked to enter their choices on price, distance and time as a fuzzy input as shown below. And based on their input the column values of respective tables are summed to come up with a suitable recommendation list. An illustrative example is given below.

EXAMPLE : *assume the varibles

User Input :

- Price = Cheap
- Distance = Mid
- Time = More

Price	Cheap	Mid	Costly
A	a	b	c
B	a	b	s
C	d	a	k
D	e	g	l
E	f	d	i
F	g	s	g
G	h	g	n
H	j	e	d
I	a	f	w
J	f	t	a
K	c	g	v

Distance	Near	Mid	Far
A	a	b	c
B	d	a	k
C	e	g	l
D	f	d	i
E	g	s	g
F	h	g	n
G	j	e	d
H	a	f	w
I	f	t	a
J	c	g	v
K	d	g	m

Time	Less	Avg	More
A	a	b	c
B	d	a	k
C	e	g	l
D	f	d	i
E	g	s	g
F	h	g	n
G	j	e	d
H	a	f	w
I	f	t	a
J	c	g	v
K	d	g	m

Location	Price	Distance	Time	Recommendation Score
A	a	b	c	a+b+c
B	a	a	k	a+a+k
C	d	g	l	d+g+l
D	e	d	i	.
E	f	s	g	.
F	g	g	n	.
G	h	e	d	.
H	j	f	w	.
I	a	t	a	.
J	f	g	v	.
K	c	g	m	c+g+m

Once the recommendation score is generated we sort the locations based on the recommendation score and display the recommended sites.

Additionally we also give a recommended route with the help of Floyd Warshall Algorithm

3.1 FUZZY LOGIC

The term fuzzy refers to things which are not clear or are vague. In the real world many times we encounter a situation when we can't determine whether the state is true or false, their fuzzy logic provides a very valuable flexibility for reasoning. In this way, we can consider the inaccuracies and uncertainties of any situation.

For a better understanding lets take an automatic breaking system where a car applies break when the car in front of it is close. But a binary implementation of this system is illogical as a sudden break can cause accident. So we seek the help of fuzzy logic system which introduces a range such as close, pretty close, far, very far,etc.

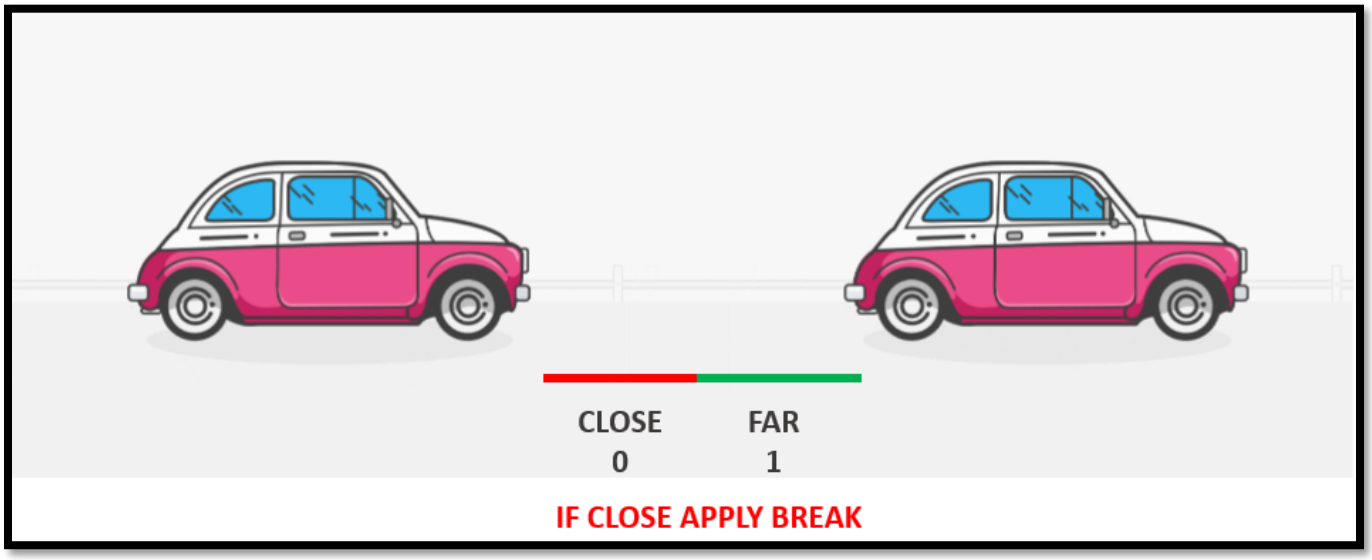


Fig : With Binary Logic

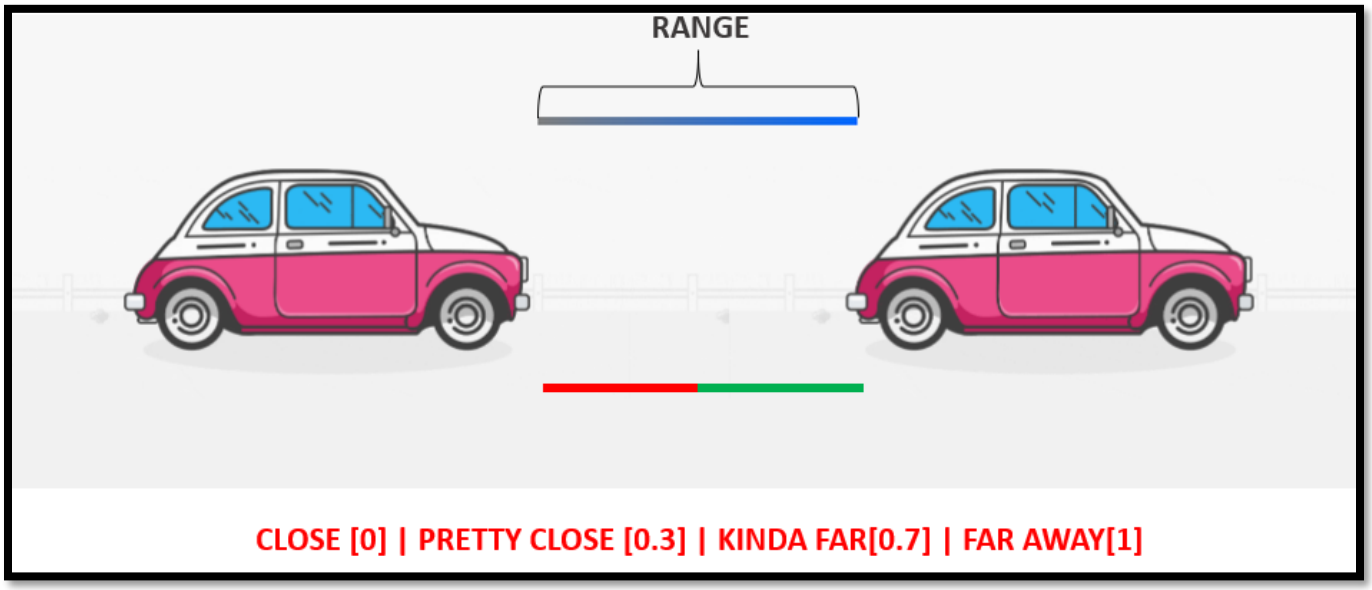
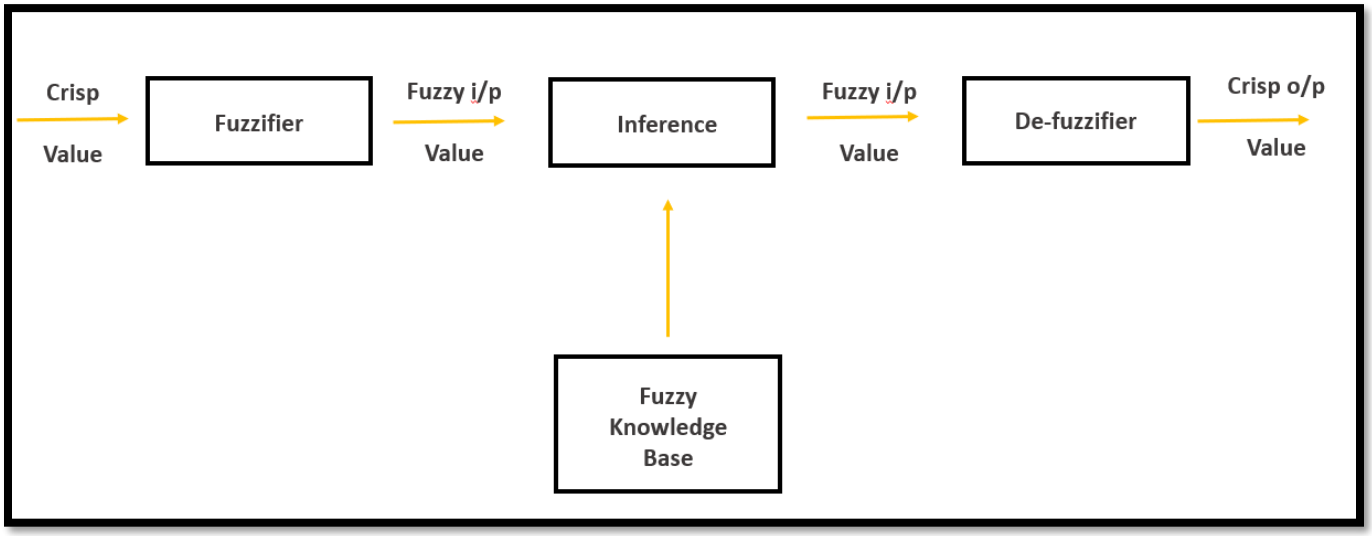


Fig : With Fuzzy Logic

3.2 GENERAL FUZZY ARCHITECTURE



- **Initial input** is a crisp value.
  A crisp value is usually a number such as Price = Rs50 or Distance = 10KM
- **Fuzzifier :** Takes the input crisp value and converts it into a fuzzy input value.
- **Fuzzy Knowledge Base :**This are set of rules created by a domain expert which helps the Inference system in processing the input.
- **Inference :** Inference system is the heart of the fuzzy logic system, it processes the input and produces a fuzzy output with the help of set of rules defines in the Fuzzy Knowledge base.
- **De-fuzzifier :** Converts the fuzzy output into a crisp output for processing purposes.

Please note that the fuzzy system can also work without Fuzzifier and De-fuzzifier by taking a direct fuzzy input and providing a fuzzy output

3.3 ROUTE RECOMMENDATION

For route recommendation we are using Floyd Warshall algorithm. Please note that other shortest path algorithms could also be used to perform the route recommendation. In this project we will use using Floyd warshall because of it's ease of implementation.

The distance between the tourism sites are stored in a matrix and the shortest path algorithm is applied to it to generate the shortest path. We can also use Google API or other distance calculating API to find the distance between the tourist sites. But to reduce the time time taken to generate the route recommendation it is better to pre-record the distance and store it along with other details related to the tourism site.

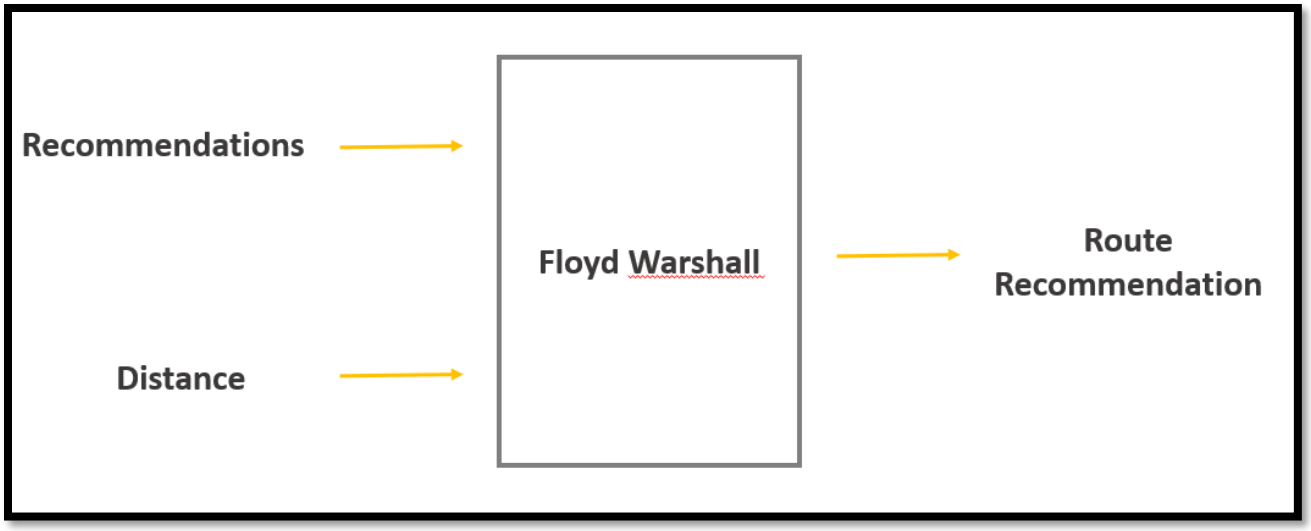


Fig : Route Recommendation

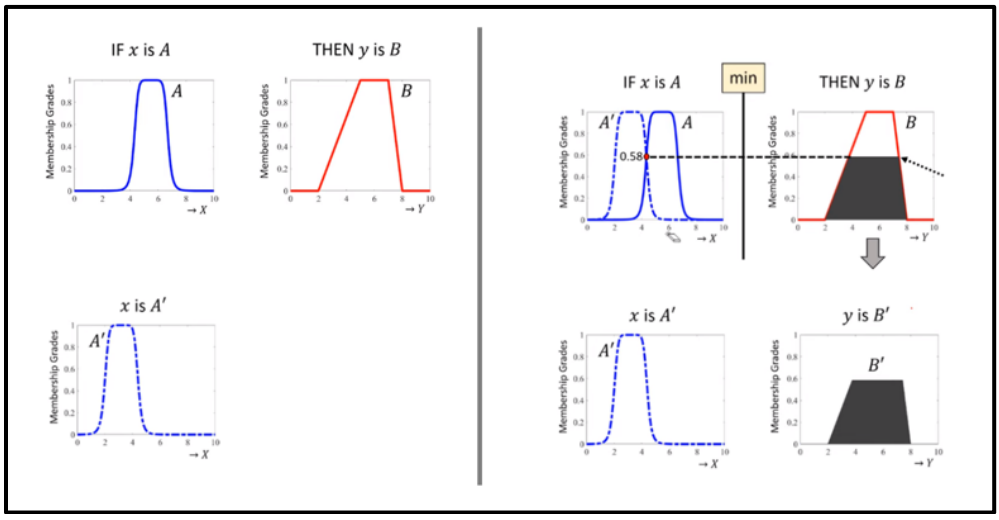
4. EXECUTION :

4.1 FUZZY LOGIC ALGORITHMS USED

- The base paper primarily discussed about the implementation of **MAMDANI FUZZY LOGIC** in the tourism recommendation system.

MAMDANI FUZZY LOGIC

- Step 1 – Coming up with a set of fuzzy rules
- Step 2 – Use the input membership function to make the input fuzzy.
- Step 3 – Establish the rule strength by combining the fuzzified inputs according to fuzzy rules.
- Step 4 – Determine the consequent of rule by combining the rule strength and the output membership function.
- Step 5 – For getting output distribution combine all the consequents.
- Step 6 – We get a defuzzied crisp output.



5. IMPLEMENTATION RESULTS

In this section we shall discuss the results obtained.

1. IMPLEMENTATION RESULTS [Paper 1 Implementation]

In this section we are trying to replicate the result obtained in the paper by using the same data from paper.

INPUT : L – Low ; M-Medium; H-High

```
Enter Pric [L/M/H]::M
Enter Dist [L/M/H]::L
Enter Time [L/M/H]::M

-------------------------------------
```

PRICE FUZZIFICATION RESULT: This table represents the fuzzy score with respect to “price” of locations in respective categories.

```
-------------------------------------
```

	NAME	PRICE	LOW	MID	HIGH
0	Guwahati	0	1	0	0
1	Kaziranga National Park	10	1	0	0
2	Majuli	40	0	0.666667	0
3	Manas National Park	10	1	0	0
4	Dibrugarh	15	0	0.222222	0
5	Dibru Saikhowa National Park	0	1	0	0
6	Barpeta	15	0	0.222222	0
7	Hajo	10	1	0	0
8	Mayong	10	1	0	0
9	Pobitora Wildlife Sanctuary	5	1	0	0

```
-------------------------------------
```

DISTANCE FUZZIFICATION RESULT:

This table represents the fuzzy score with respect to “distance” of locations in respective categories.

```
-------------------------------------
```

	NAME	Distance	LOW	MID	HIGH
0	Guwahati	2.3	1	0	0
1	Kaziranga National Park	0.55	1	0	0
2	Majuli	17.8	0.88	0.024	0
3	Manas National Park	65.8	0	0	1
4	Dibrugarh	26.6	0	0.728	0
5	Dibru Saikhowa National Park	30.3	0	0.976	0
6	Barpeta	25.6	0	0.648	0
7	Hajo	34.4	0	0.648	0
8	Mayong	35.9	0	0.528	0
9	Pobitora Wildlife Sanctuary	21.3	0	0.304	0

```
-------------------------------------
```

TIME FUZZIFICATION :

This table represents the fuzzy score with respect to “time” of locations in respective categories.

	NAME	Time	LOW	MID	HIGH
0	Guwahati	10	1	0	0
1	Kaziranga National Park	2	1	0	0
2	Majuli	54	0	0.85	0
3	Manas National Park	107	0	0	1
4	Dibrugarh	52	0	0.8	0
5	Dibru Saikhowa National Park	64	0	0.9	0
6	Barpeta	54	0	0.85	0
7	Hajo	73	0	0.675	0
8	Mayong	66	0	0.85	0
9	Pobitora Wildlife Sanctuary	46	0	0.65	0

RECOMMENDATION LIST GENERATION AND SORTING

Here we can see the list of recommendations. The first table represents the list of locations with their respective score. The second table represents the a sorted list of locations where the locations are sorted in decreasing based on their recommendation score.

	NAME	PRICE	DIST	TIME	RESULT
0	Guwahati	0	1	0	1
1	Kaziranga National Park	0	1	0	1
2	Majuli	0.666667	0.88	0.85	2.39667
3	Manas National Park	0	0	0	0
4	Dibrugarh	0.222222	0	0.8	1.02222
5	Dibru Saikhowa National Park	0	0	0.9	0.9
6	Barpeta	0.222222	0	0.85	1.07222
7	Hajo	0	0	0.675	0.675
8	Mayong	0	0	0.85	0.85
9	Pobitora Wildlife Sanctuary	0	0	0.65	0.65

	NAME	PRICE	DIST	TIME	RESULT
2	Majuli	0.666667	0.88	0.85	2.39667
6	Barpeta	0.222222	0	0.85	1.07222
4	Dibrugarh	0.222222	0	0.8	1.02222
0	Guwahati	0	1	0	1
1	Kaziranga National Park	0	1	0	1
5	Dibru Saikhowa National Park	0	0	0.9	0.9
8	Mayong	0	0	0.85	0.85
7	Hajo	0	0	0.675	0.675
9	Pobitora Wildlife Sanctuary	0	0	0.65	0.65
3	Manas National Park	0	0	0	0

COMPARING OUR RESULTS WITH BASE PAPER'S RESULT

No.	Tourist Attraction	Price	Distance	Time	Result
1.	Malioboro	0	1	0	1
2.	Keraton	0	1	0	1
3.	Prambanan Temple	0.67	0.88	0.85	2.4
4.	Indrayanti Beach	0	0	0	0
5.	Parangtritis Beach	0.22	0	0.8	1.02
6.	Maria Cave Sendangsono	0	0	0.9	0.9
7.	The World Land Mark Merapi Park	0.22	0	0.85	1.07
8.	Sri Getuk Waterfall	0	0	0.675	0.675
9.	Kalibiru	0	0	0.85	0.85
10.	Pine forests Pengger	0	0	0.65	0.65

Here, we can see that the result that we have obtained in our experimentation exactly matches with the results given in the Reference paper 1.

---

2. IMPLEMENTATION AND RESULTS [Mamdani + Route Recommendation - Customized for our data]

In this section we have customized the price, distance and time data with respect to our new locations. We have also made respective changes to the Mamdani fuzzy logic so that we can generate an optimal recommendation with respect to the new data..

```
Enter Pric [L/M/H]::H
Enter Dist [L/M/H]::M
Enter Time [L/M/H]::H

-------------------------------------
```

Here we take the following input from the user,

- Price : H [High]
- Distance : M [Medium]
- Time : H [High]

The following results are obtained.

PRICE FUZZIFICATION RESULT

This table represents the fuzzy score with respect to “price” of locations in respective categories.

	NAME	PRICE	LOW	MID	HIGH
0	Guwahati	0	1	0	0
1	Kaziranga National Park	10	1	0	0
2	Majuli	40	0	0.666667	0
3	Manas National Park	10	1	0	0
4	Dibrugarh	15	0	0.222222	0
5	Dibru Saikhowa National Park	0	1	0	0
6	Barpeta	15	0	0.222222	0
7	Hajo	10	1	0	0
8	Mayong	10	1	0	0
9	Pobitora Wildlife Sanctuary	5	1	0	0

DISTANCE FUZZIFICATION RESULT

This table represents the fuzzy score with respect to “distance” of locations in respective categories.

	NAME	DISTANCE	LOW	MID	HIGH
0	Guwahati	0	1	0	0
1	Kaziranga National Park	198	0	0.52	0
2	Majuli	341	0	0	1
3	Manas National Park	138	0	0.88	0
4	Dibrugarh	447	0	0	1
5	Dibru Saikhowa National Park	9999	0	0	1
6	Barpeta	96	0.08	0.46	0
7	Hajo	36	1	0	0
8	Mayong	43	1	0	0
9	Pobitora Wildlife Sanctuary	48	1	0	0

TIME FUZZIFICATION RESULT

This table represents the fuzzy score with respect to “Time” of locations in respective categories.

	NAME	TIME	LOW	MID	HIGH
0	Guwahati	0	1	0	0
1	Kaziranga National Park	240	0	0.666667	0
2	Majuli	499	0	0	1
3	Manas National Park	184	0	0.977778	0
4	Dibrugarh	600	0	0	1
5	Dibru Saikhowa National Park	1300	0	0	1
6	Barpeta	155	0	0.791667	0
7	Hajo	66	-0.1	0.05	0
8	Mayong	89	-0.483333	0.241667	0
9	Pobitora Wildlife Sanctuary	103	-0.716667	0.358333	0

RECOMMENDATION LIST GENERATION AND SORTING

	NAME	PRICE	DIST	TIME	RESULT
0	Guwahati	0	0	0	0
1	Kaziranga National Park	0	0.52	0	0.52
2	Majuli	0	0	1	1
3	Manas National Park	0	0.88	0	0.88
4	Dibrugarh	0	0	1	1
5	Dibru Saikhowa National Park	0	0	1	1
6	Barpeta	0	0.46	0	0.46
7	Hajo	0	0	0	0
8	Mayong	0	0	0	0
9	Pobitora Wildlife Sanctuary	0	0	0	0

	NAME	PRICE	DIST	TIME	RESULT
2	Majuli	0	0	1	1
4	Dibrugarh	0	0	1	1
5	Dibru Saikhowa National Park	0	0	1	1
3	Manas National Park	0	0.88	0	0.88
1	Kaziranga National Park	0	0.52	0	0.52
6	Barpeta	0	0.46	0	0.46
0	Guwahati	0	0	0	0
7	Hajo	0	0	0	0
8	Mayong	0	0	0	0
9	Pobitora Wildlife Sanctuary	0	0	0	0

ROUTE RECOMMENDATION[For the top 5 recommended locations]

```
----------------------------------------------------------
2---->4---->1---->3---->5---->

Majuli---->Dibrugarh---->Kaziranga National Park---->Manas National Park---->Dibru Saikhowa National Park---->
```

---

3. IMPLEMENTATION AND RESULTS [Gaussian + Route Recommendation]

In this section we shall discuss the results obtained.

```
Enter Pric [L/M/H]::H
Enter Dist [L/M/H]::M
Enter Time [L/M/H]::H
---------------------------------------
```

Here we are making use of a gaussian fuzzifier to fuzzify the same data which was used in section 2[Custom data]. We obtain the following result.

PRICE FUZZIFICATION RESULT

This table represents the fuzzy score with respect to “price” of locations in respective categories.

	NAME	PRICE	LOW	MID	HIGH
0	Guwahati	0	1	0	0
1	Kaziranga National Park	10	1	0.0225301	0
2	Majuli	40	0	0.744828	0
3	Manas National Park	10	1	0.0225301	0
4	Dibrugarh	15	0	0.300553	0
5	Dibru Saikhowa National Park	0	1	0	0
6	Barpeta	15	0	0.300553	0
7	Hajo	10	1	0.0225301	0
8	Mayong	10	1	0.0225301	0
9	Pobitora Wildlife Sanctuary	5	1	0	0

DISTANCE FUZZIFICATION

This table represents the fuzzy score with respect to “distance” of locations in respective categories.

	NAME	DISTANCE	LOW	MID	HIGH
0	Guwahati	0	1	0	0
1	Kaziranga National Park	198	0	0.622872	0
2	Majuli	341	0	0	1
3	Manas National Park	138	0	0.916713	0
4	Dibrugarh	447	0	0	1
5	Dibru Saikhowa National Park	9999	0	0	1
6	Barpeta	96	0.08	0.566671	0
7	Hajo	36	1	0	0
8	Mayong	43	1	0	0
9	Pobitora Wildlife Sanctuary	48	1	0	0

TIME FUZZIFICATION

This table represents the fuzzy score with respect to “time” of locations in respective categories.

	NAME	TIME	LOW	MID	HIGH
0	Guwahati	0	1	0	0
1	Kaziranga National Park	240	0	0.604388	0
2	Majuli	499	0	0	1
3	Manas National Park	184	0	0.977529	0
4	Dibrugarh	600	0	0	1
5	Dibru Saikhowa National Park	1300	0	0	1
6	Barpeta	155	0	0.851004	0
7	Hajo	66	-0.1	0.11612	0
8	Mayong	89	-0.483333	0.342094	0
9	Pobitora Wildlife Sanctuary	103	-0.716667	0.466155	0

RECOMMENDATION LIST GENERATION AND SORTING

	NAME	PRICE	DIST	TIME	RESULT
0	Guwahati	0	0	0	0
1	Kaziranga National Park	0	0.622872	0	0.622872
2	Majuli	0	0	1	1
3	Manas National Park	0	0.916713	0	0.916713
4	Dibrugarh	0	0	1	1
5	Dibru Saikhowa National Park	0	0	1	1
6	Barpeta	0	0.566671	0	0.566671
7	Hajo	0	0	0	0
8	Mayong	0	0	0	0
9	Pobitora Wildlife Sanctuary	0	0	0	0

	NAME	PRICE	DIST	TIME	RESULT
2	Majuli	0	0	1	1
4	Dibrugarh	0	0	1	1
5	Dibru Saikhowa National Park	0	0	1	1
3	Manas National Park	0	0.916713	0	0.916713
1	Kaziranga National Park	0	0.622872	0	0.622872
6	Barpeta	0	0.566671	0	0.566671
0	Guwahati	0	0	0	0
7	Hajo	0	0	0	0
8	Mayong	0	0	0	0
9	Pobitora Wildlife Sanctuary	0	0	0	0

ROUTE RECOMMENDATION[For the top 5 recommended locations]

```
2---->4---->1---->3---->5---->

Majuli---->Dibrugarh---->Kaziranga National Park---->Manas National Park---->Dibru Saikhowa National Park---->
```

Here we can observe that even though there are minor differences in the recommendation score we are obtaining results similar to the recommendation list generated by Mamdani fuzzy logic.

6. RELATED WORK:

In this section we will be discussing different approaches to solve the same problem.

METHORD 1 : IMPLEMENTING MODEL WITH DIFFERENT FUZZY SYSTEMS

The same proposed model can be implemented with different fuzzy logics. As an example we have implemented and executed a gaussian fuzzy logic and Tsukamoto fuzzy logic results of which were be discussed in the previous section.

METHORD 2 : MACHINE LEARNING

A much more efficient tourism recommendation system can be implemented with the help of machine learning. Reference Link [https://ieeexplore.ieee.org/document/8308293].

A hybrid recommender system that combines the three most known recommender methods which are the collaborative filtering, the content-based filtering and the demographic filtering. But implementing such a system will require more data and computational power which is not applicable in all scenario.

7. CONCLUSIONS:

The proposed system provides a less computationally complex and less computationally heavy solution for Tourism site and route recommendation. Even though other complex and better result producing models are available, the proposed system is considered better because of it's computational requirements and it can be easily implemented everywhere.

8. REFERENCE :

1. Recommendations for Tourism Sites Using the Mamdani Fuzzy Logic Method and Floyd Warshall Algorithm (Case Study in Yogyakarta) [IEEE XPLORE]
Baltra Agusti Pramajuri, Alfredo Gormantara, Erni Widarti, Albertus Joko Santoso
[https://ieeexplore.ieee.org/document/8938592]

2. A Personalized Hybrid Tourism Recommender System [IEEE XPLORE]
Mohamed Elyes Ben Haj Kbaier, Hela Masri, Saoussen Krichen
[https://ieeexplore.ieee.org/document/8308293].

--- /REPORT END

Undertaken Responsibilities

203IT001 | Shankaranarayan N [Paper Implementation-Mamdani Logic, Presentation and Report Writing]
202IT009 | Kodingari Rajasekhar [Mamdani Logic customization, Route Recommendation]
202IT030 | Tushar [Gaussian Logic]
202IT028 | Sibangkar basumatary [Tsukamoto Fuzzy Logic - Incomplete]