Applications of Artificial Intelligence in IT

Final Project Report

Group Name: F
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Date: 21/01/2026

Variant Calculations

Determination of Project Datasets

- Sum of Student IDs: 104009 + 103536 + 105375 = 312,920

1. Genetic Algorithm Dataset:

- Formula: 1 + (Sum mod 15)
- Calculation: 1 + (312, 920 mod 15) = 1 + 5 =6
- Selected Dataset: Set 6

2. Fuzzy Logic Controller Topic:

- Formula: 1 + (Sum mod 29)
- Calculation: 1 + (312,920 mod 29) = 1 + 10 =11
- Selected Topic: Topic 11 (Saw blade rotational speed control)

Part I: Genetic Algorithms

Genetic Algorithms (Knapsack Problem)

Problem Description: Finding the optimal set of items for **Dataset Set 6** (Max Capacity: 73).

- **Population Size:** 20
- **Crossover Probability:** 0.8
- **Mutation Probability:** 0.1

Handling Overloaded Exemplars: In our algorithm, if an individual's total weight exceeds the backpack capacity (73), its fitness score is immediately set to **0**. This acts as a penalty, ensuring that invalid solutions (overloaded backpacks) have no chance of being selected for reproduction in the next generation.

Simulation Results:

Generation 1 Results:

ID	Genome	Weight	Value	Fitness
1	[0 1 0 0 0 1 0 0 0 1]	25	29	29
2	[0 0 0 0 1 0 1 1 1 0]	43	40	40
3	[1 0 1 1 1 1 1 1 1 1]	90	74	0
4	[0 0 1 1 1 0 1 0 0 0]	37	37	37
5	[0 0 1 1 1 1 1 0 1 1]	68	63	63
6	[0 1 0 1 0 1 1 0 0 0]	31	42	42
7	[0 0 0 0 0 1 1 0 1 1]	34	38	38
8	[1 1 0 1 0 1 1 1 0 1]	59	56	56
9	[0 1 0 1 0 0 1 0 1 1]	30	40	40
10	[1 1 1 1 1 1 1 1 1 0]	87	83	0
11	[0 1 1 1 1 1 1 1 1 0]	82	79	0
12	[1 0 1 1 0 1 0 1 1 0]	67	47	47
13	[1 0 1 0 0 1 1 0 1 1]	50	51	51
14	[1 0 0 0 0 0 0 0 0 0]	5	4	4
15	[1 0 1 1 1 0 0 0 0 1]	45	32	32
16	[0 0 0 0 0 1 0 1 0 1]	39	24	24
17	[0 0 1 1 1 0 1 0 0 1]	43	40	40
18	[1 0 0 1 1 1 0 0 0 0]	44	34	34
19	[0 0 1 0 0 0 1 0 0 1]	20	24	24
20	[0 0 0 0 0 1 1 1 0 0]	36	33	33

```
>> Best Individual in Gen 1: Value = 63
```

Generation 2 Results:

```
--- Generation 2 Results ---
ID   Genome                          Weight   Value    Fitness
-------------------------------------------------------------------
1    [0 0 0 0 1 0 1 1 1 0]           43       40       40
2    [0 0 0 0 1 0 1 1 0 0]           34       31       31
3    [1 0 1 1 1 1 1 1 1 1]           90       74       0
4    [1 0 0 1 1 0 1 1 1 1]           63       51       51
5    [0 1 0 0 1 1 1 1 1 1]           68       69       69
6    [1 0 1 0 0 1 0 0 0 1]           38       30       30
7    [0 1 0 0 0 1 0 0 0 1]           25       29       29
8    [0 1 0 0 0 1 0 0 0 1]           25       29       29
9    [0 0 0 0 0 1 0 0 0 1]           22       17       17
10   [0 1 0 0 0 1 0 0 0 1]           25       29       29
11   [0 0 0 0 1 1 1 1 1 0]           59       54       54
12   [0 0 0 0 1 0 1 1 1 0]           43       40       40
13   [1 0 1 1 1 1 1 0 0 1]           64       58       58
14   [0 1 0 1 1 1 1 1 1 0]           71       70       70
15   [0 1 0 0 0 1 0 0 0 1]           25       29       29
16   [0 1 1 0 0 1 0 0 1 1]           45       47       47
17   [0 1 0 0 0 0 1 1 1 1]           38       43       43
18   [0 1 1 0 1 1 1 0 0 1]           53       62       62
19   [0 1 0 0 1 0 1 1 1 0]           46       52       52
20   [0 0 0 0 0 1 0 0 0 1]           22       17       17

>> Best Individual in Gen 2: Value = 70
```

Conclusion: The algorithm improved the solution from a value of 63 in the first generation to 70 in the second generation.

PART 2 - FUZZY LOGIC CONTROLLER

Fuzzy Logic Controller

Topic 11: Control system for saw blade rotational speed.

Human Language Description: The goal is to automatically adjust the rotational speed of a saw blade based on two factors: the **Hardness of the Wood** and the **Time Spent Cutting**.

- **Hardness:** If the wood is hard, the blade should spin slower to prevent damage. If it is soft, it can spin fast for efficiency.

- **Time:** If the cutting operation takes a long time, the speed should be reduced to prevent the blade from overheating.

System Design:

- **Input 1 (Hardness):** Soft, Medium, Hard (Range: 0-10)
- **Input 2 (Time):** Short, Medium, Long (Range: 0-60 min)
- **Output (Speed):** Slow, Medium, Fast (Range: 0-5000 RPM)

Fuzzy Rules:

1. IF Hardness is Soft AND Time is Short THEN Speed is Fast.
2. IF Hardness is Medium THEN Speed is Medium.
3. IF Hardness is Hard THEN Speed is Slow.
4. IF Time is Long THEN Speed is Slow.

Simulation Results (Scenarios):

- **Scenario 1 (Soft Wood, Short Time):**
  - Input: Hardness=2, Time=10
  - **Output Speed:** 3322.26 RPM (High speed, as expected)
- **Scenario 2 (Hard Wood, Long Time):**
  - Input: Hardness=9, Time=50
  - **Output Speed:** 1321.05 RPM (Low speed to protect the blade)

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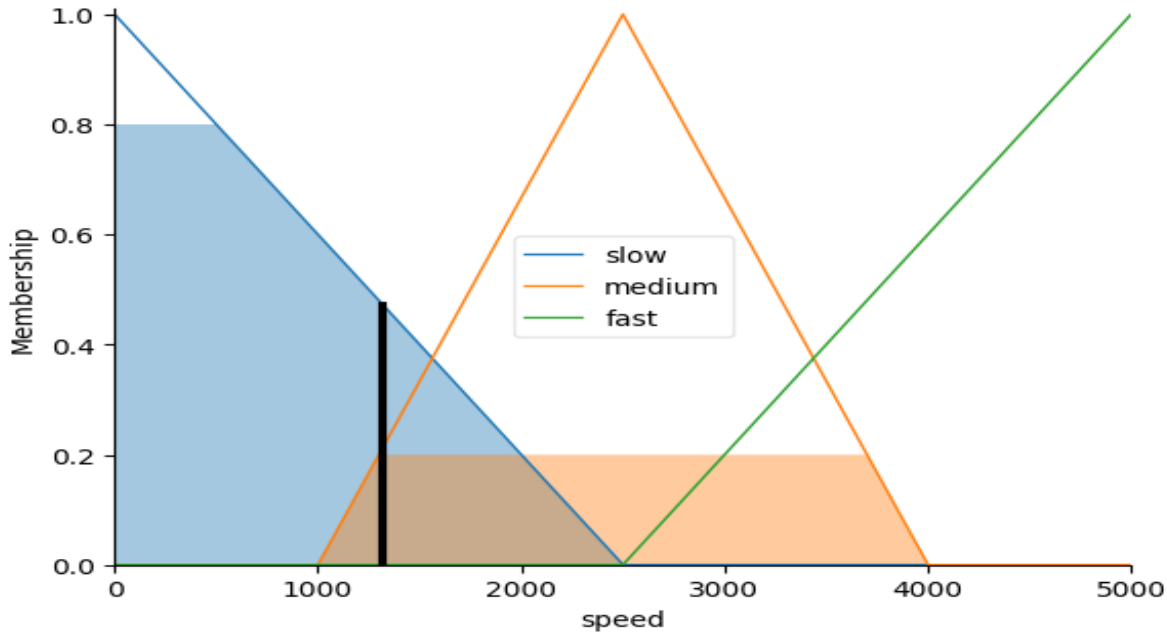


PART 3 & 4 - MACHINE LEARNING

Decision Trees & Naive Bayes

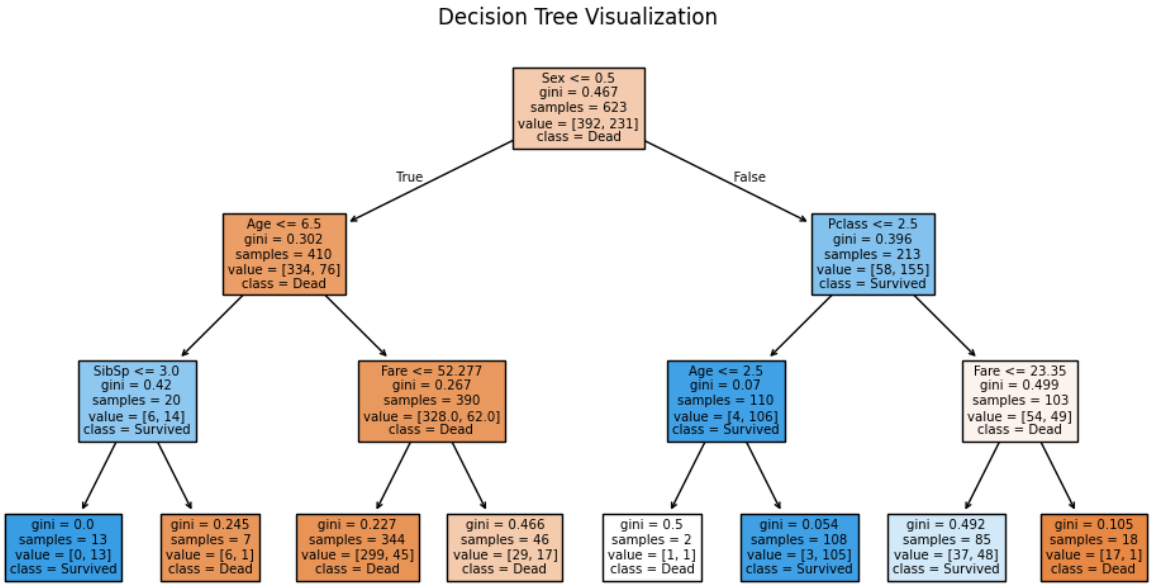
Dataset: Titanic (Predicting survival based on passenger data).

Method 1: Decision Tree Classifier

- **Model Accuracy:** 80.97%

Method 2: Naive Bayes Classifier

- **Model Accuracy:** 79.10%



Comparison: The Decision Tree model performed slightly better (80.97%) than the Naive Bayes model (79.10%) on this dataset.