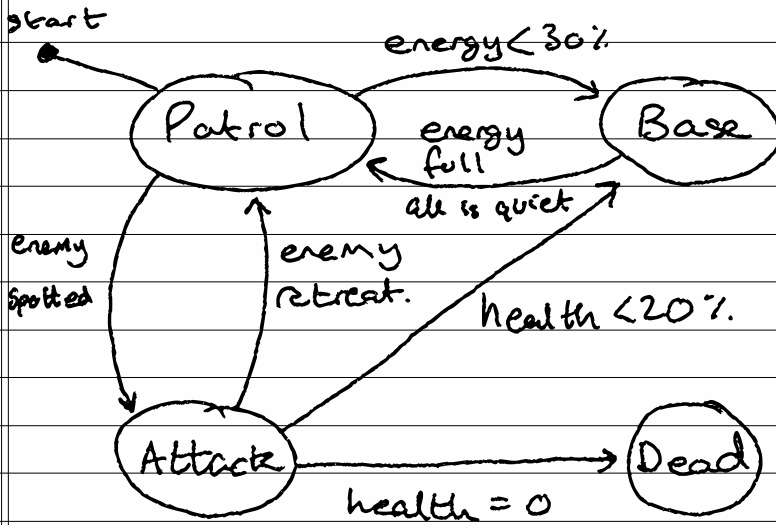


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1.a)i)



1a) ii) Switch (state)

{

case Patrol:

{
:

}

case Base:

{
:

}

case Attack:

{

Switch (event)

{

case Enemy_retreat:

{

state = Patrol;
break;

case HP_below_20:

{ state = Base;
break;

case HP_Zero:

{ state = Dead;
break;

break;

case Dead:

{

:

}

}

1 b) Switch Patterns can be problematic for implementing a FSM as they are not very extensible. Lookup tables and State Patterns are better options as they are easier to develop further.

transition function:

- + Straight forward to implement
- Costly to maintain and expand

Lookup table / transition Array:

- + More efficient data structures
- + effective event management

State Pattern:

- + Consistent method to implement FSM
- + uses OOP + UML

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AI + ML Question 2

- 2 a) Fuzzy logic expert systems work by fuzzifying the input values into fuzzy membership functions, then perform the relevant rules in the rule set to calculate the fuzzy output functions, and finally de-fuzzifying the output functions to calculate the crisp output.

2 b) Mamdani-style inference and Sugeno fuzzy inference are two defuzzification techniques.

Sugeno fuzzy inference is more efficient computationally than Mamdani-style as it uses a function instead of a fuzzy set.

2 c) Power = 11
damage = 6

$$\mu_{\text{power}}^{\text{low}}(11) = \frac{15 - 11}{5} = \frac{4}{5} = \underline{0.8}$$

$$\mu_{\text{power}}^{\text{Med}}(11) = \frac{11 - 10}{5} = \frac{1}{5} = \underline{0.2}$$

$$\mu_{\text{power}}^{\text{high}}(11) = \underline{0}$$

$$\mu_{\text{damage}}^{\text{low}}(6) = \frac{7.5 - 6}{2.5} = \frac{1.5}{2.5} = \underline{0.6}$$

$$\mu_{\text{damage}}^{\text{high}}(6) = \frac{6 - 5}{5} = \frac{1}{5} = \underline{0.2}$$

2 c)
cont.

$$\begin{aligned}\mu_{\text{power}}^{\text{low}} &= 0.8 \\ \mu_{\text{power}}^{\text{med}} &= 0.2 \\ \mu_{\text{power}}^{\text{high}} &= 0\end{aligned}$$

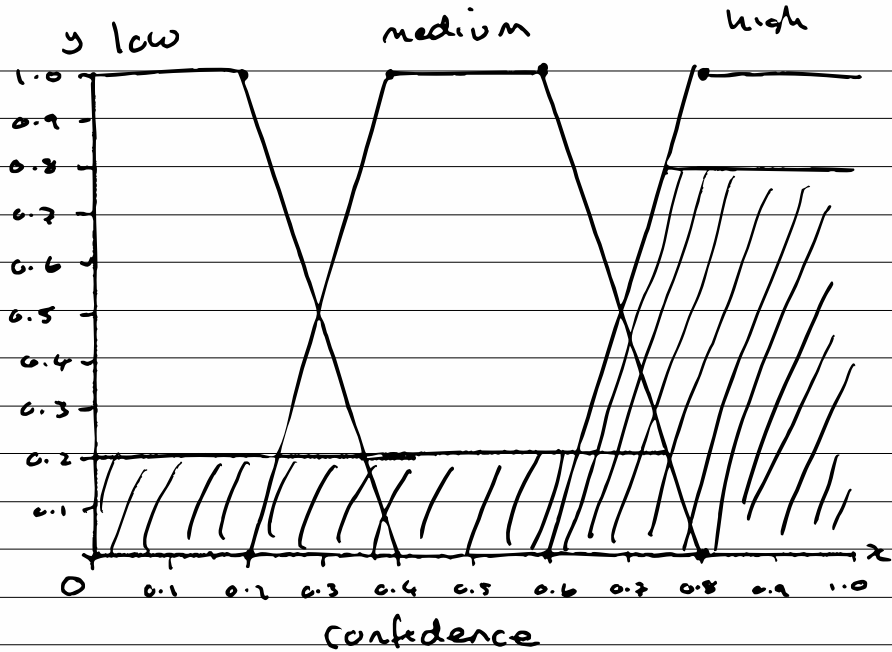
$$\begin{aligned}\mu_{\text{damage}}^{\text{low}} &= 0.6 \\ \mu_{\text{damage}}^{\text{high}} &= 0.2\end{aligned}$$

$$\text{low confidence} = \max|0, 0.2| = \underline{0.2}$$

$$\text{medium confidence} = \min|0.2, 0.6| = \underline{0.2}$$

$$\text{high confidence} = \underline{0.8}$$

2 c)
Cont



x	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
low	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Med	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.0
high	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.8	0.8	0.8
result	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.5	0.8	0.8	0.8

$$COG = \frac{0.2(0.0 + 0.1 + 0.2 + 0.3 + 0.4 + 0.5 + 0.6) + 0.5(0.7) + 0.8(0.8 + 0.9 + 1.0)}{0.2(7) + 0.5(1) + 0.8(3)}$$

$$= \frac{0.42 + 0.35 + 2.16}{1.4 + 0.5 + 2.4}$$

$$= \frac{2.91}{4.30} = \underline{\underline{0.677}}$$

[illegible]

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4 a) The weights allow the neuron to learn from examples.

Excitatory connections have positive weights.

Inhibitory connections have negative weights.

Activity is calculated using a weighted summation of the input signals.

Learning is achieved through modifying the connection weights only (including Bias) with gradient descent.

4 b)

$$\begin{aligned} \text{i)} \quad y &= (0.9 \times 0.4) + (0.8 \times -0.2) + (-0.12 \times 0.12) \\ &\quad + 0.3 \\ &= 0.36 - 0.16 - 0.0144 + 0.3 \\ &= 0.4856 \end{aligned}$$

$$\phi(y) = \max(0, 0.4856) = \underline{0.4856}$$

ii)

$$\phi(0.4856) = \text{sigmoid}(0.4856)$$

$$= \frac{1}{1 + e^{-0.4856}}$$

$$= \underline{0.619}$$

4 c) The 'Dying ReLU' Problem occurs because the gradient is zero when $x < 0$.
As there is no gradient it can't learn using gradient descent.
This can be alleviated by using leaky ReLU which has a slight gradient when $x < 0$.