Aayush L. Roy
1CR17CS003 'A'

ML Assignment 1

Q3) Explain steps to design a learning system in details with example and figure

→ i) Choosing a training experience:

Choose the type of training experience for which the system will learn. Determine whether the training experience direct or indirect feedback.

Eg: Direct training. teacher

Indirect training. without teacher

Is the training ~~without teacher~~ experience a representative of performance goals.

ii) Choosing target function

Determine what kind of knowledge is to be learnt & how this will be used by performance program.

Eg: checkers playing program that generates legal moves from any board state.

choose move: B → M

↳ set of legal moves

↳ set of legal board states

↳ target function

Use evaluation function to assign numerical score to any board state.

V: B → R

↳ set of real numbers

↳ set of legal board states

↳ maps of any legal board state to real value

Define the target value [V(b)] for any arbitrary node state b in B as follows

i) If b is a final board state that is won then

V(b) = 100

ii) If b is a final board state that is won $V(b) = 100$

iii) If b is a final board state that is drawn $V(b) = 0$

iv) If b is not a final state in the game then $V(b) = V(b')$.

Where b' is the best final board state.

iii) Choosing a representation for target function:

Pertaining training examples.

$V(b)$: the true target function

$\hat{V}(b)$: the learnt target function

$V_{train}(b)$: the training value

Here $\hat{V}$ is calculated as a linear combination of board states.

x_1 : the no. of black pieces on the board

x_2 : the no. of red pieces on the board

x_3 : the no. of black kings on the board

x_4 : the no. of red kings on the board

x_5 : the no. of black pieces threatened by red

x_6 : the no. of red pieces threatened by black

Our linear program $\hat{V}(b)$ is represented as linear function

$$\hat{V}(b) = w_0 + w_1 x_1 + w_2 x_2 + w_3 x_3 + w_4 x_4 + w_5 x_5 + w_6 x_6$$

iv) Choosing a function approximation algorithm:

To learn the target function $\hat{V}$, we need a set of training examples

$\langle b, V(b) \rangle$

V training value for b

b board state

a) To minimize squared errors

$$E = \sum \left(V_{train}(b) - \hat{V}(b) \right)^2$$

$\langle b, V_{train}(b) \rangle$ ← training examples

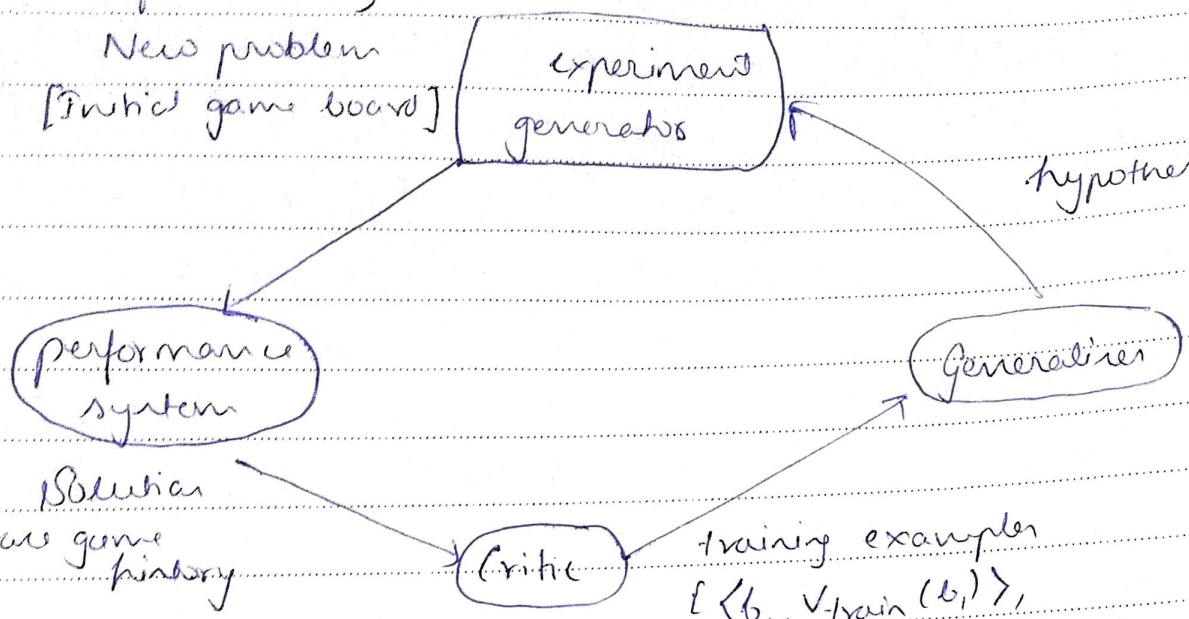
b) Least mean square (LMS) training rule

$$w_i \leftarrow w_i + \eta \left(V_{train}(b) - \hat{V}(b) \right) x_i$$

η : small constant 0.01

x) ~~The final design~~

v) The final design



Modules

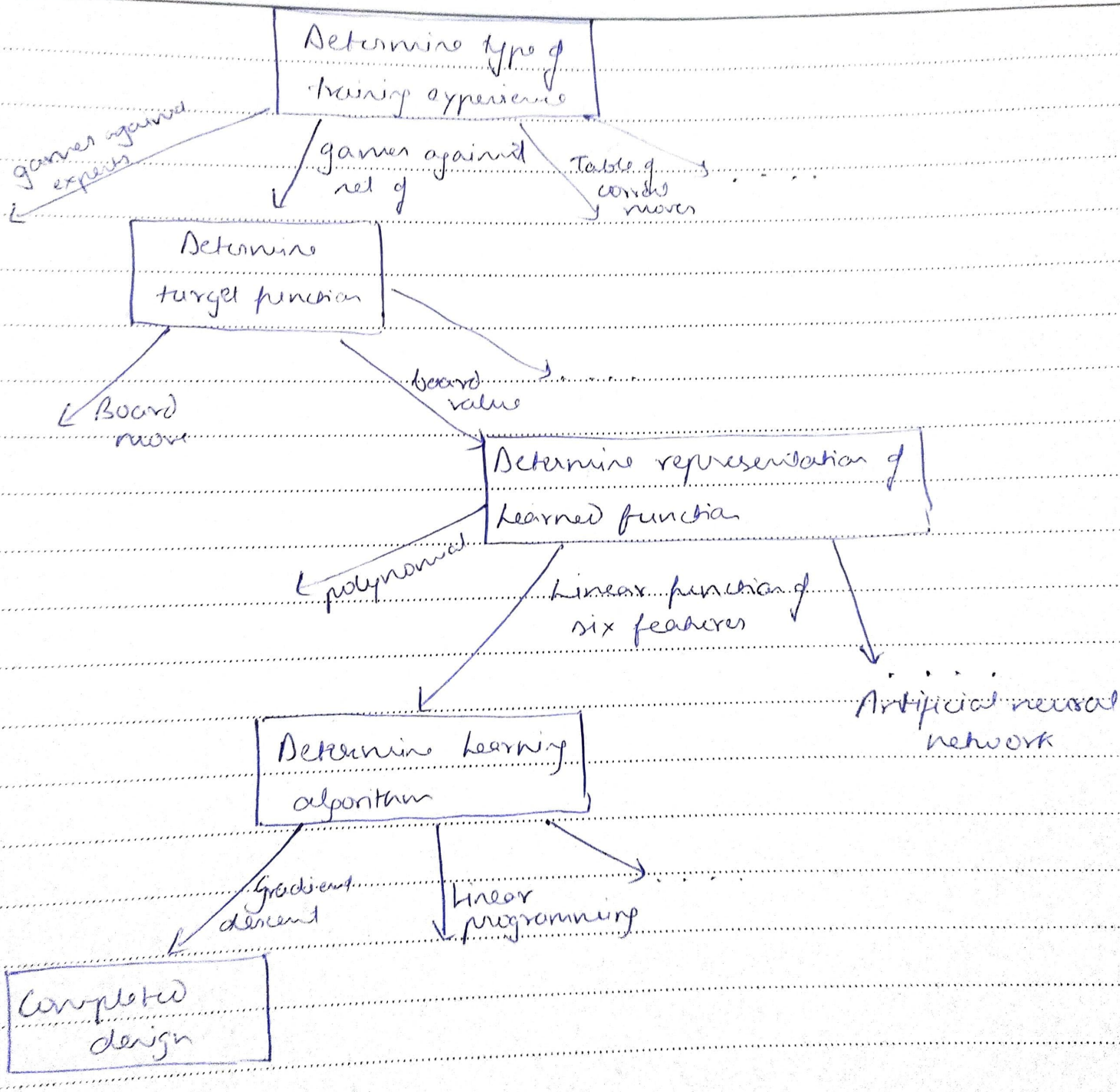
→ performance system solves the given performance task

→ critic: takes input as history or trace of the game and produces o/p as set of training examples of target function

→ generalizer: takes training examples as input and produces hypothesis as o/p.

→ experiment generator. Takes current hypothesis i/p and outputs a new problem.

The sequence of design choices made for checker program is summerized below.


Determine type of training experience
games against experts
games against self
Table of correct moves
Determine target function
Board move
board value
Determine representation of learned function
polynomial
Linear function of six features
Artificial neural network
Determine learning algorithm
Gradient descent
Linear programming
Completed design