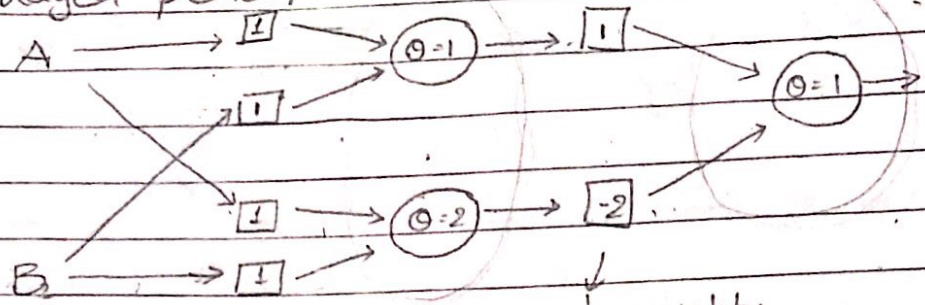
Problem set 1

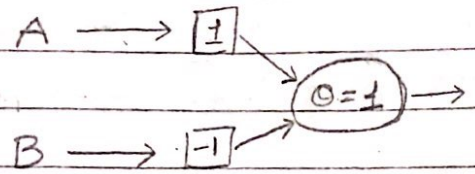
Q2 2 Layer perceptron for XOR ($A \oplus B$)



↳ These represent weights

A	B	XOR
0	0	0
1	0	1
0	1	1
1	1	0

2 Input perceptron for $A \wedge \neg B$



A	B	$A \wedge \neg B$
0	0	0
1	0	1
0	1	0
1	1	0

$1(0)+(-1)(0)=0 \not\geq 1$; $1(1)+(-1)(0)=1 \geq 1$, $1(0)+(-1)(1)=-1 \not\geq 1$, $1(0)+(-1)(1)=-1 \not\geq 1$

* In perceptron layer, every output should be got by giving weights to every input of previous layer

Q5 Lazy learning ⇒ Algorithms which have easy learning, and are slow examples at producing the answer.

A clear example of this kind is KNN.
- It doesn't learn until it has to query.

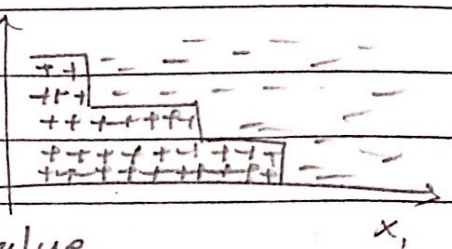
We can extend this logic to decision tree as well, where we be ID3 like decision tree only when a branch contains the value of the attribute in the query.
- Advantage: We don't build branches of the tree that are irrelevant to the query
- Disadvantage: Querying is slow.

This method is only suitable for lesser number of queries. For large no. of queries, this isn't robust

Q6. KNN

- Decision tree is mostly suitable for a non-linearly seperable dataset
- Decision tree always segments the space by drawing dividing planes / lines that are drawn at a split value of a particular attribute.

- If the given dataset is linearly seperable w.r.t a unique attribute value, then Decision tree would be most suitable



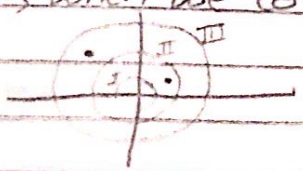
- However in a general case, KNN would be most suitable, for most of the points. The ambiguity only arises around the linear seperator

Q7. i) Hypothesis space: Circle with center at origin

We defined the function $f(x) \geq 0$ if the point x lies within the circle and $f(x) < 0$ otherwise.

Hence by this definition, we can clearly shatter 1 point by choosing a circle too small to contain the point → -ive
circle very large and contains the point → +ive
Therefore, $VC \geq 1$

Now, when we consider two points as below:



Here, circles I, II, III satisfy the cases of −−, −+ & ++ respectively.

PAGE No.
DATE

However, keeping the points unchanged, we can't draw another hypothesis that produces +,- by the definition of f(x) as defined before

2) Here too we adopt the same function def^{n} f(x) as in previous case
i.e $f(x) \geq 0$ if x lies within the sphere and is < 0 otherwise
1 point can clearly be shattered by this definition.
By the same argument as before if we are able to satisfy 3 cases with 2 points in space we are unable to satisfy the 4th case, (same as prev quest)

Hence, VC dimension of the origin centered hypothesis spaces of circle and sphere are both 1, by the function definition $f(x) \geq 0$ if x inside or < 0 otherwise