Linear Classifier – Perceptron Algorithm

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Finding linear classifier with zero *training* error is simply modeled as a problem of solving system of linear inequalities:

Let $\mathbf{x}_i$ be the i-th sample from the feature space and y_i its class indicator:

$$\mathbf{w}\mathbf{x}_i + b \geq 0, \forall i : y_i = 1,$$
$$\mathbf{w}\mathbf{x}_i + b < 0, \forall i : y_i = 2,$$

After a simple data transformation

$$\mathbf{v} = [\mathbf{w}, b],$$
$$\mathbf{x}_i^* = [\mathbf{x}_i, 1], \forall i : y_i = 1,$$
$$\mathbf{x}_i^* = -[\mathbf{x}_i, 1], \forall i : y_i = 2,$$

we can solve the problem with respect to one condition only $\mathbf{v}\mathbf{x}_i^* > 0, \forall i = 1 \dots N$, using following algorithm:

Data: $\{\mathbf{x}_i^*\}_{i=1}^N$ transformed data samples
Result: $\mathbf{v}$ weights of the classifier
begin
    $\mathbf{v} \longleftarrow 0$;
    while $\exists \mathbf{x}_i : \mathbf{v}\mathbf{x}_i^* \leq 0$ **do**
        $\mathbf{v} \longleftarrow \mathbf{v} + \mathbf{x}_i^*$;
    end
end