CS771 Assignment 1

Savants
Group 10

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Part 1

CAR-PUF Derivation

$$\text{Response} = \begin{cases} 0, & \text{if } |\Delta w - \Delta r| \leq \tau \\ 1, & \text{if } |\Delta w - \Delta r| > \tau \end{cases} \tag{1}$$

The equation for the response is:

$$\frac{1 + \text{sign}(|\Delta w - \Delta r| - \tau)}{2} \tag{2}$$

We have $(\mathbf{u}, p)$ and $(\mathbf{v}, q)$ as the two linear models that can exactly predict the outputs of the two arbiter PUFs sitting inside the CAR-PUF.

$$\frac{1 + \text{sign}(|(\mathbf{u}^\top - \mathbf{v}^\top)\mathbf{x} + p - q| - \tau)}{2} \tag{3}$$

This can be written as

$$\frac{1 + \text{sign}[((\mathbf{u}^\top - \mathbf{v}^\top)\mathbf{x} + p - q)^2 - \tau^2]}{2} \tag{4}$$

Thus we have

$$\frac{1 + \text{sign}(\mathbf{w}^\top \phi(\mathbf{c}) + b)}{2} \tag{5}$$

As we know $\mathbf{x}$ for a each challenge $\mathbf{c}$:

$$x_i = \prod_{j=i}^{31} d_j, \quad \text{for } i = 0, 1, 2, \ldots, 31 \tag{6}$$

where,

$$d_i = 1 - 2c_i, \quad \text{for } i = 0, 1, 2, \ldots, 31 \tag{7}$$

Thus from (4) we get:

$$\phi(\mathbf{c}) = [x_0x_1, x_0x_2, \ldots, x_{30}x_{31}, x_0, x_1, \ldots, x_{31}, 1] \tag{8}$$

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$$\mathbf{w} = [(u_0 - v_0)(u_1 - v_1), (u_1 - v_1)(u_2 - v_2), \ldots, (u_{30} - v_{30})(u_{32} - v_{31}), \\ (u_0 - v_0)(p - q), (u_1 - v_1)(p - q), \ldots, (u_{31} - v_{31})(p - q), b] \quad (9)$$

where

$$b = (u_0 - v_0)^2 + (u_1 - v_1)^2 + \ldots + (u_{31} - v_{31})^2 + (p - q)^2 - \tau^2 \quad (10)$$

Part 3

Ans. 3

Method	Hyperparameters	Training Time(in sec)	Test Accuracy(in %)
LinearSVC	Loss: hinge	9.94	89.79
	Loss: squared hinge	6.52	89.87
	C: 1000	80.82	90.02
	C: 500	64.43	90.03
	C: 100	25.92	90.04
	C: 10	6.18	90.03
	C: 5	6.25	90.02
	C: 1	6.24	90.00
	C: 0.1	5.96	89.87
	C: 0.05	6.05	89.87
	C: 0.01	5.68	89.69
LogisticRegression	C: 1000	29.36	90.07
	C: 500	28.55	90.09
	C: 100	22.00	90.02
	C: 10	15.04	90.00
	C: 5	14.94	89.96
	C: 1	12.19	89.84
	C: 0.1	8.99	89.58
	C: 0.05	8.09	89.38
	C: 0.01	6.73	88.47