Algorithm	**Representation**	**Evaluation**	**Optimization**
K-NN	$knn(\mathbf{x}) = \{nn_1(\mathbf{x}), \ldots, nn_K(\mathbf{x})\}$ $v_c = \sum_{k \in knn(\mathbf{x})} \mathbb{I}(y_k = c)$ $y = f(\mathbf{x}) = arg\max_{c=1,\ldots,C} v_c$	Classification accuracy $\frac{1}{M}\sum_{m=1}^{M} \mathbb{I}(f(\mathbf{x_m}) = y_m)$	Exhaustive/Greedy search
Linear Perceptron	$y = \begin{cases} 1, & \mathbf{w}^T\mathbf{x} > 0 \\ -1, & \text{otherwise} \end{cases}$	Classification accuracy $\frac{1}{M}\sum_{m=1}^{M} \mathbb{I}(f(\mathbf{x_m}) = y_m)$	Greedy update using misclassified sample $(\mathbf{x_s}, y_s)$ $\mathbf{w(t+1)} = \mathbf{w(t)} + y_s\mathbf{x_s}$
Linear Regression	$y = \mathbf{w}^T\mathbf{x}$	Residual sum of squares (RSS) $RSS(\mathbf{w}) = (\mathbf{y} - \mathbf{Xw})^T(\mathbf{y} - \mathbf{Xw})$	Analytic/closed-form solution $\mathbf{w}^* = (\mathbf{X}^T\mathbf{X})^{-1}\mathbf{X}^T\mathbf{y}$ Numerical solution $\mathbf{w} := \mathbf{w} - \alpha(k) \cdot \left(-2\mathbf{X}^T\mathbf{y} + 2\mathbf{X}^T\mathbf{Xw}\right)$
Non-Linear Regression	$y = \mathbf{w}^T\boldsymbol{\phi}(\mathbf{x})$	Residual sum of squares (RSS) $RSS(\mathbf{w}) = (\mathbf{y} - \boldsymbol{\Phi}\mathbf{w})^T(\mathbf{y} - \boldsymbol{\Phi}\mathbf{w})$	Analytic/closed-form solution $\mathbf{w}^{LMS} = (\boldsymbol{\Phi}^T\boldsymbol{\Phi})^{-1}\boldsymbol{\Phi}^T\mathbf{y}$ Numerical solution $\mathbf{w} := \mathbf{w} - \alpha(k) \cdot \left(-2\boldsymbol{\Phi}^T\mathbf{y} + 2\boldsymbol{\Phi}^T\boldsymbol{\Phi}\mathbf{w}\right)$
Linear Regression w/ Regularization *	$y = \mathbf{w}^T\mathbf{x}$	Regularized RSS $RSS(\mathbf{w}) = (\mathbf{y} - \mathbf{Xw})^T(\mathbf{y} - \mathbf{Xw}) + \lambda\|\mathbf{w}\|_2^2$	Analytic/closed-form solution $\mathbf{w}^* = (\mathbf{X}^T\mathbf{X} + \lambda\mathbf{I}_{D\times D})^{-1}\mathbf{X}^T\mathbf{y}$ Numerical solution $\mathbf{w} := \mathbf{w} - \alpha(k) \cdot \left(-2\mathbf{X}^T\mathbf{y} + 2\mathbf{X}^T\mathbf{Xw} + 2\lambda\mathbf{w}\right)$

* Similar for non-linear regression with regularization