**[Que-50.20 - What are the different types of kernels used in SVM and when would you use each?**

* Support Vector Machines (SVMs) use kernel functions to transform the input data into a higher-dimensional space where it becomes easier to separate the data linearly. The choice of kernel function can significantly impact the performance of an SVM model. Here are the different types of kernels commonly used in SVMs and when to use each:

### **1. Linear Kernel**

* **Formula:** K(x,y)=x⋅y
* **Use Case:**
* When the data is linearly separable.
* When the number of features is very large compared to the number of samples.
* It's computationally efficient and often used as a baseline.

### **2. Polynomial Kernel**

* **Formula:** K(x,y)=(γx⋅y+r)d
* **Hyperparameters:**
* γ (scale factor)
* r (constant term, also known as the bias term)
* d (degree of the polynomial)
* **Use Case:**
* When the data is not linearly separable but can be separated by a polynomial decision boundary.
* Useful in cases where the relationship between the features is polynomial in nature.
* *d=2d = 2*d=2 (quadratic kernel) is often used for capturing interactions between features.

### **3. Radial Basis Function (RBF) Kernel (Gaussian Kernel)**

* **Formula:** K(x,y)=exp(−γ∥x−y∥2)
* **Hyperparameters:**
* γ (controls the width of the Gaussian)
* **Use Case:**
* When the data is not linearly separable and has a complex structure.
* It can handle the situation when the decision boundary is highly non-linear.
* Effective in most cases, often used as a default kernel in SVM.

### **4. Sigmoid Kernel**

* **Formula:** K(x,y)=tanh(γx⋅y+r)
* **Hyperparameters:**
* γ (scale factor)
* r (constant term)
* **Use Case:**
* When the data has a sigmoidal distribution.
* It can behave like a neural network.
* Less commonly used compared to other kernels but can be effective in specific scenarios.

### **5. Custom Kernels**

* **Formula:** Defined by the user, tailored to the specific problem.
* **Use Case:**
* When domain knowledge suggests a particular similarity measure.
* For specific applications where standard kernels do not perform well.