Gaussian Mixture Models (GMM)

Model-based soft clustering approach

📊 Model Components

Data generated from mixture of k Gaussian distributions

μ	**Σ**	**π**
Mean	Covariance	Weight

⚖️ K-means vs GMM

K-means	**GMM**
Hard assignment Spherical clusters	Soft assignment Elliptical clusters

🔄 EM Algorithm

E — **Expectation Step**
Assign probabilities to clusters

M — **Maximization Step**
Update parameters (μ, Σ, π)

↻ — **Iterate**
Repeat until convergence

💪 Advantages

✓ Probability distribution over clusters

✓ Models elliptical clusters

✓ Soft assignment flexibility

✓ Captures uncertainty

☑️ Model Selection

`BIC • AIC`

Choose optimal k

⚠️ **Assumes Gaussian distribution**