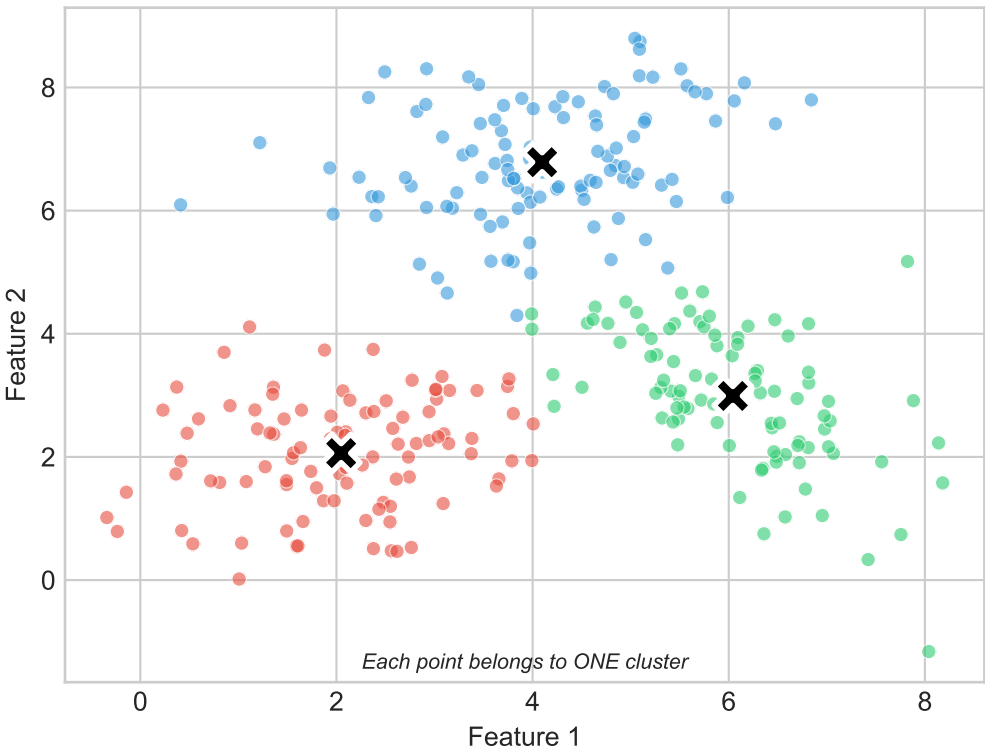


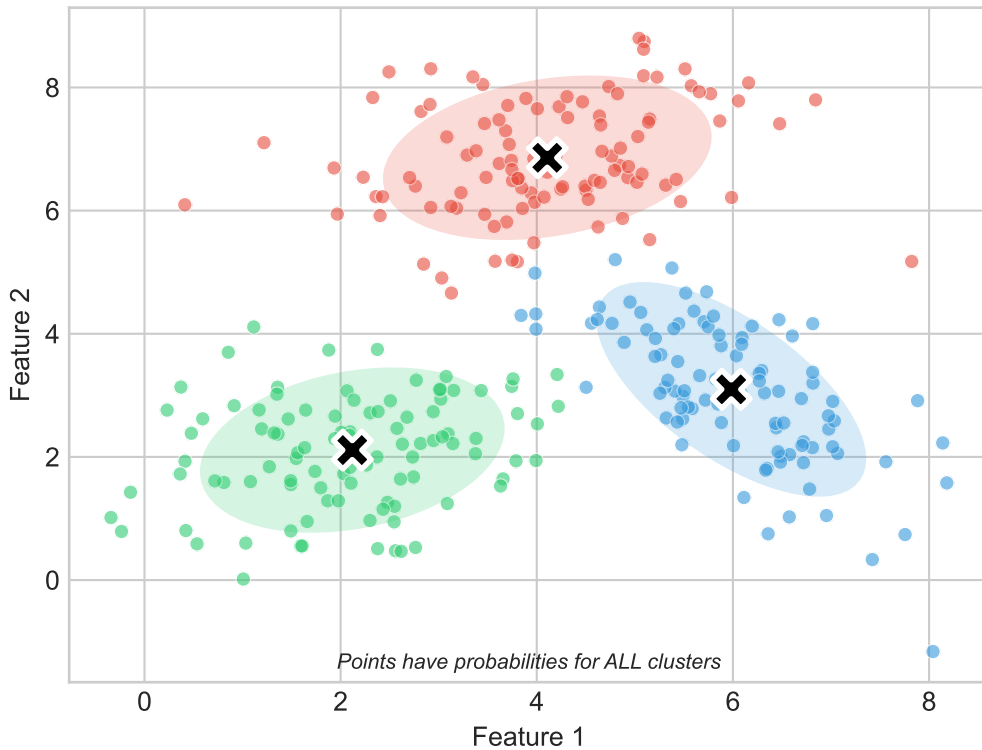
Gaussian Mixture Models (GMM): Soft Clustering for Innovation

Beyond Hard Boundaries: Probabilistic Innovation Classification

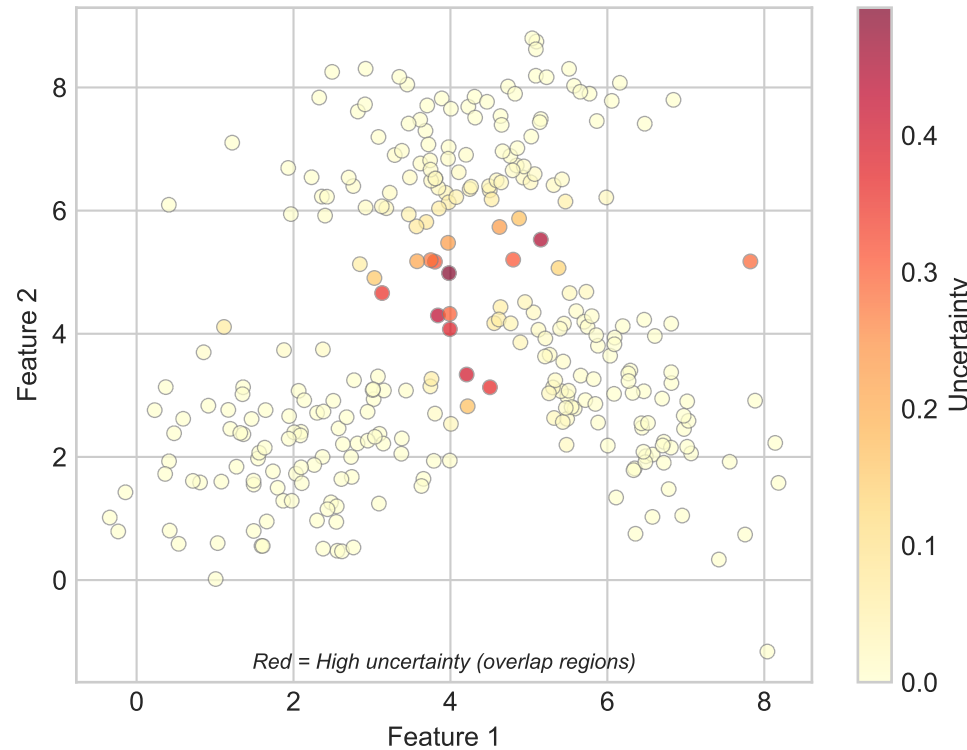
K-Means: Hard Assignment



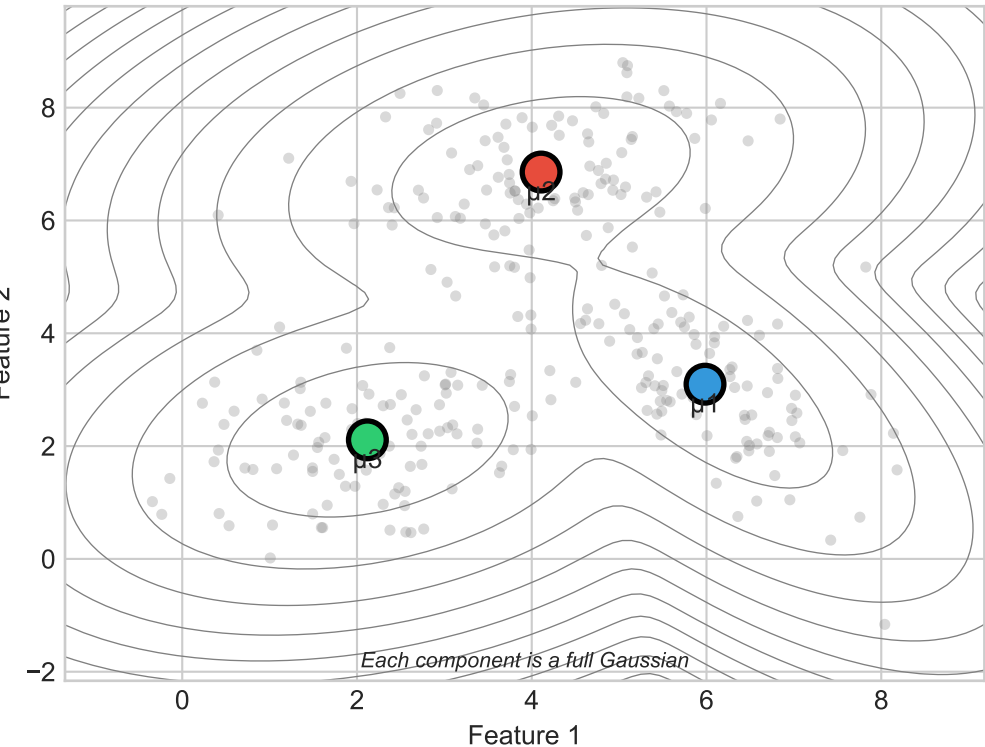
GMM: Soft Assignment



Uncertainty Map



Gaussian Components



GMM vs K-means

GMM Advantages:

- Soft assignments (probabilities)
- Captures cluster shape (elliptical)
- Handles overlapping clusters
- Provides uncertainty estimates
- Models data generation process

K-means Advantages:

- Faster computation
- Simpler interpretation
- Less parameters
- More stable results
- Works well for spherical clusters

When to use GMM:

- Overlapping innovation categories
- Need probability scores
- Non-spherical clusters
- Uncertainty quantification needed

Innovation Category Probabilities

Innovation	Tech	Service	Social
AI Assistant	0.85	0.10	0.05
Sharing Platform	0.30	0.45	0.25
Green Energy	0.60	0.15	0.25
Digital Health	0.40	0.50	0.10

GMM provides probability of belonging to each category

$$p(x) = \sum_{k=1}^K \pi_k \mathcal{N}(x | \mu_k, \Sigma_k)$$