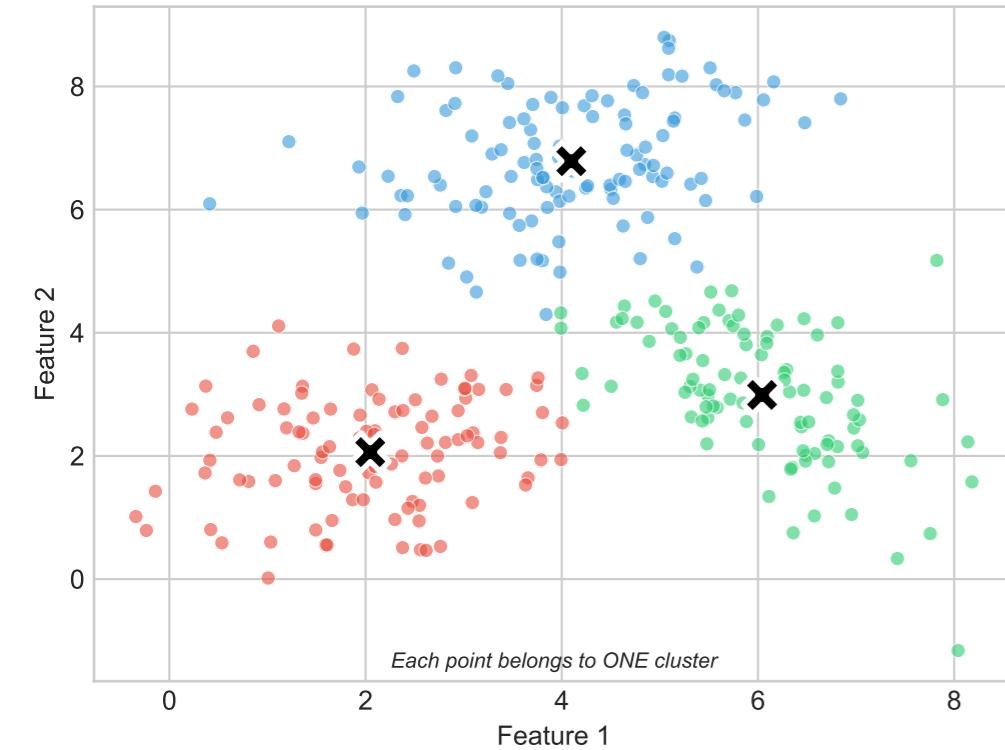


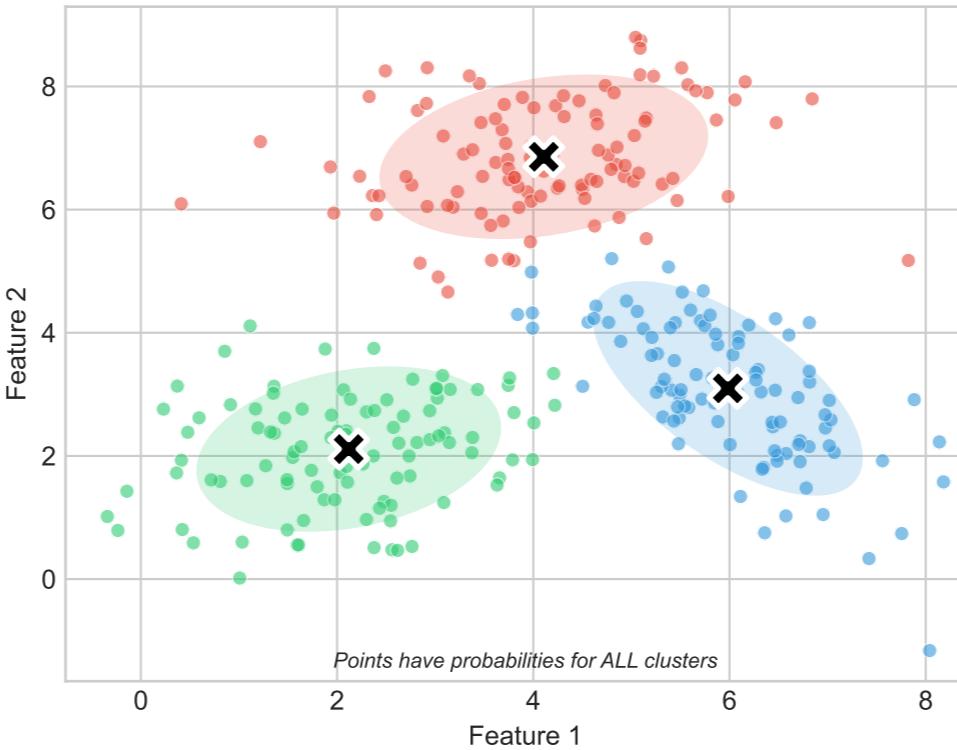
Gaussian Mixture Models (GMM): Soft Clustering for Innovation

Beyond Hard Boundaries: Probabilistic Innovation Classification

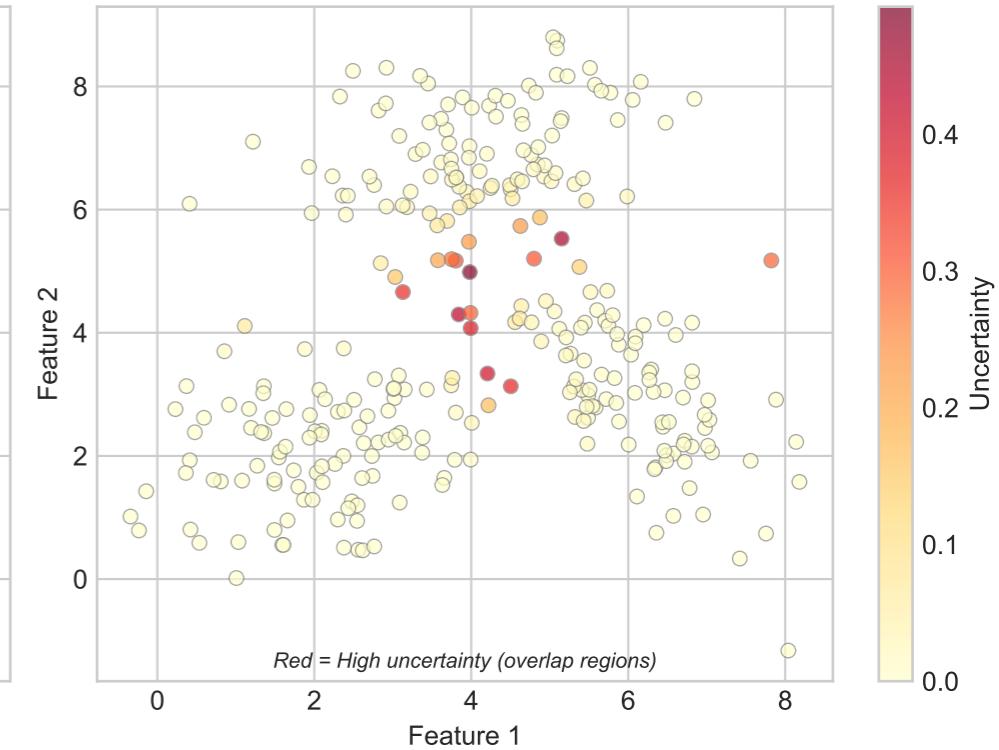
K-Means: Hard Assignment



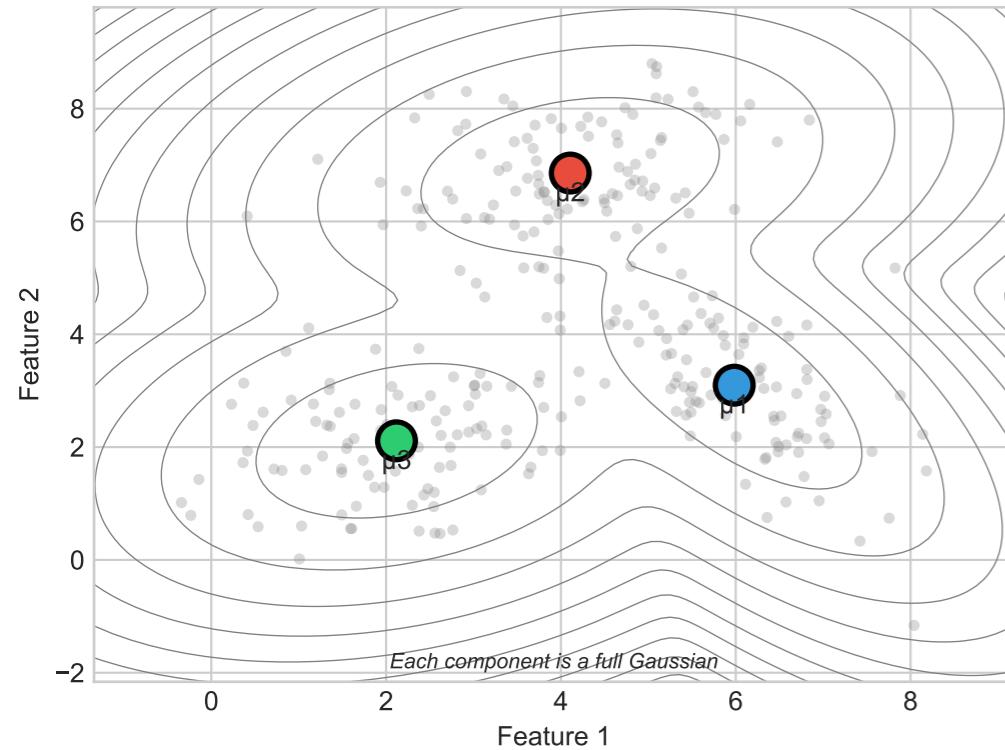
GMM: Soft Assignment



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

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