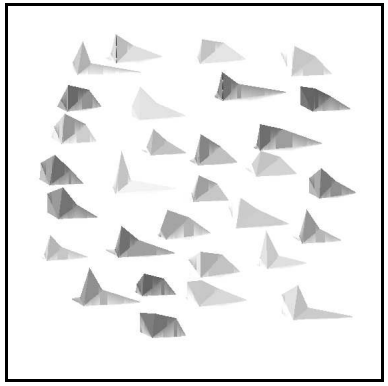
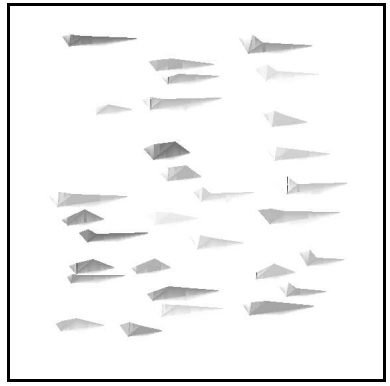
Constrained Random Boolean Models

Class 1



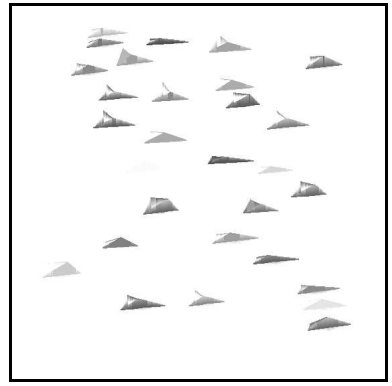
5 Sided Polyhedrons

Class 2



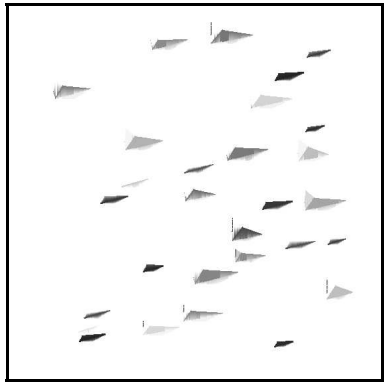
4 Sided Polyhedrons

Class 3



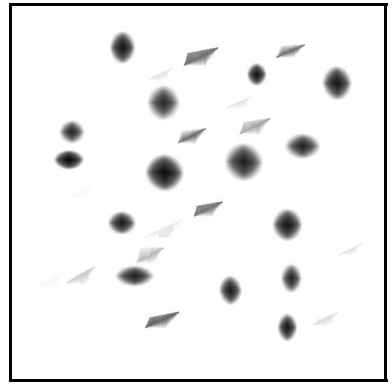
3 Sided Polyhedrons

Class 4



Mixture: 3 and 4 Sided Polyhedrons

Class 5



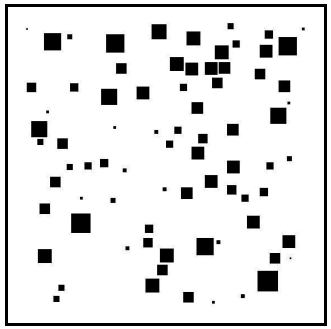
Mixture: 3 Sided Polyhedrons and Ellipses

Granulometries

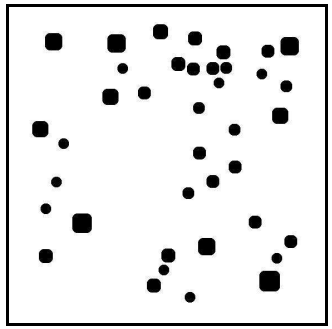
- Granulometries model parameterized sieving process on random sets;
- The most common granulometry is of the form:

$$\Psi_t(S) = \bigcup_{B \in \mathcal{G}} S \circ tB$$

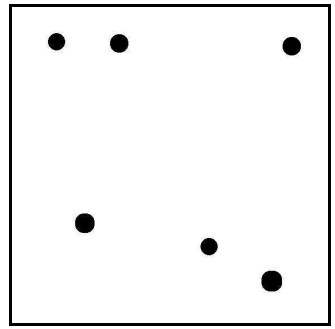
where $\mathcal{G}$ is composed of convex structuring elements.



Original Image



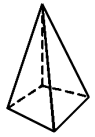
$t = 19$



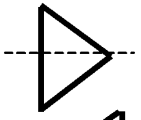
$t = 31$

Structuring Elements

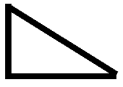
The following structuring elements are used for feature extraction:

(1)  Cone

(2)  Triangle

(3)  Triangle, 90°

(4)  Triangle, Increasing

(5)  Triangle, Decreasing

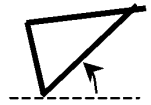
(6)  Flat

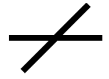
(7) Linear

(8) Vertical

(9)  Linear, 45 °

(10)  Union of Linear 's, 0 ° & 45°

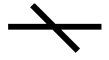
(11)  Triangle, 45°

(12)  Cross, 45 °

(13)  Linear, 135 °

(14)  Union of Linear 's, 0 ° & 135 °

(15)  Triangle, 135°

(16)  Cross, 135 °

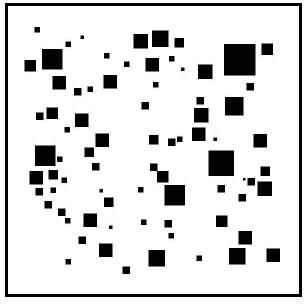
(17)  Cross, 90 °

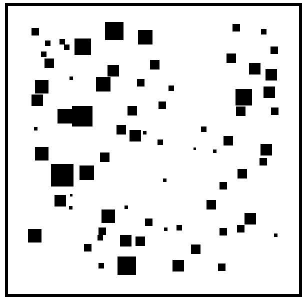
Size Distribution

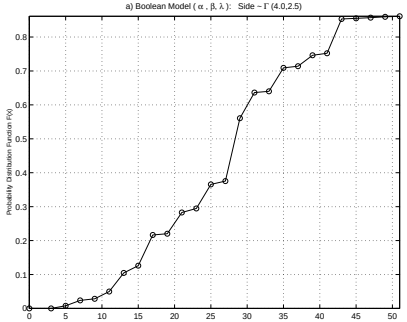
- For a compact set S, we defi ne the *size distribution* as
$$\Omega(t) = \nu[S] - \nu[\Psi_t(S)].$$
- Ω measures the area removed by Ψ_t.
- Ω is an increasing function.
- $\Omega(0) = 0$ and $\Omega(t) = \nu[S]$ for suffi ciently large t.

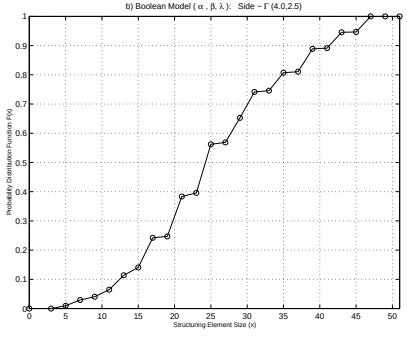
Pattern Spectrum

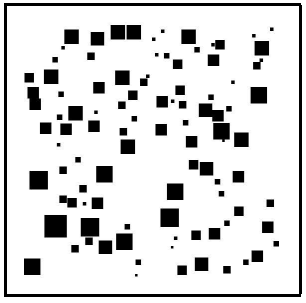
- The *pattern spectrum*, which is a random function, is defi ned by $\Phi(t) = \Omega(t)/\nu[S] = 1 - \nu[\Psi_t(S)]/\nu[S]$.
- $\Phi(t)$ is a probability distribution with moments being random variables.

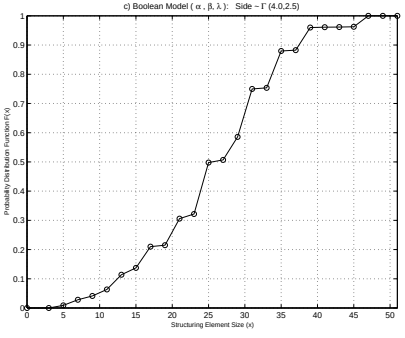








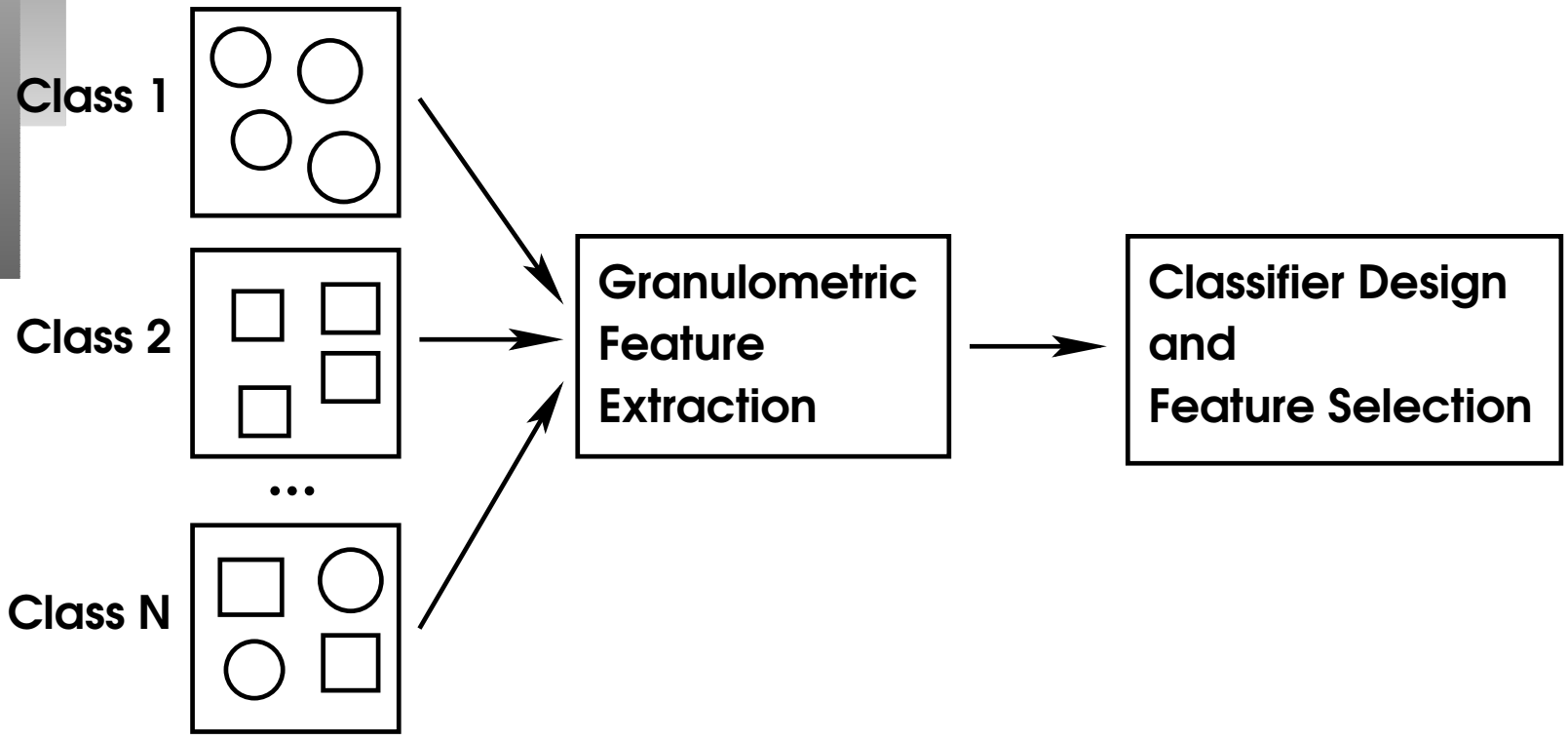




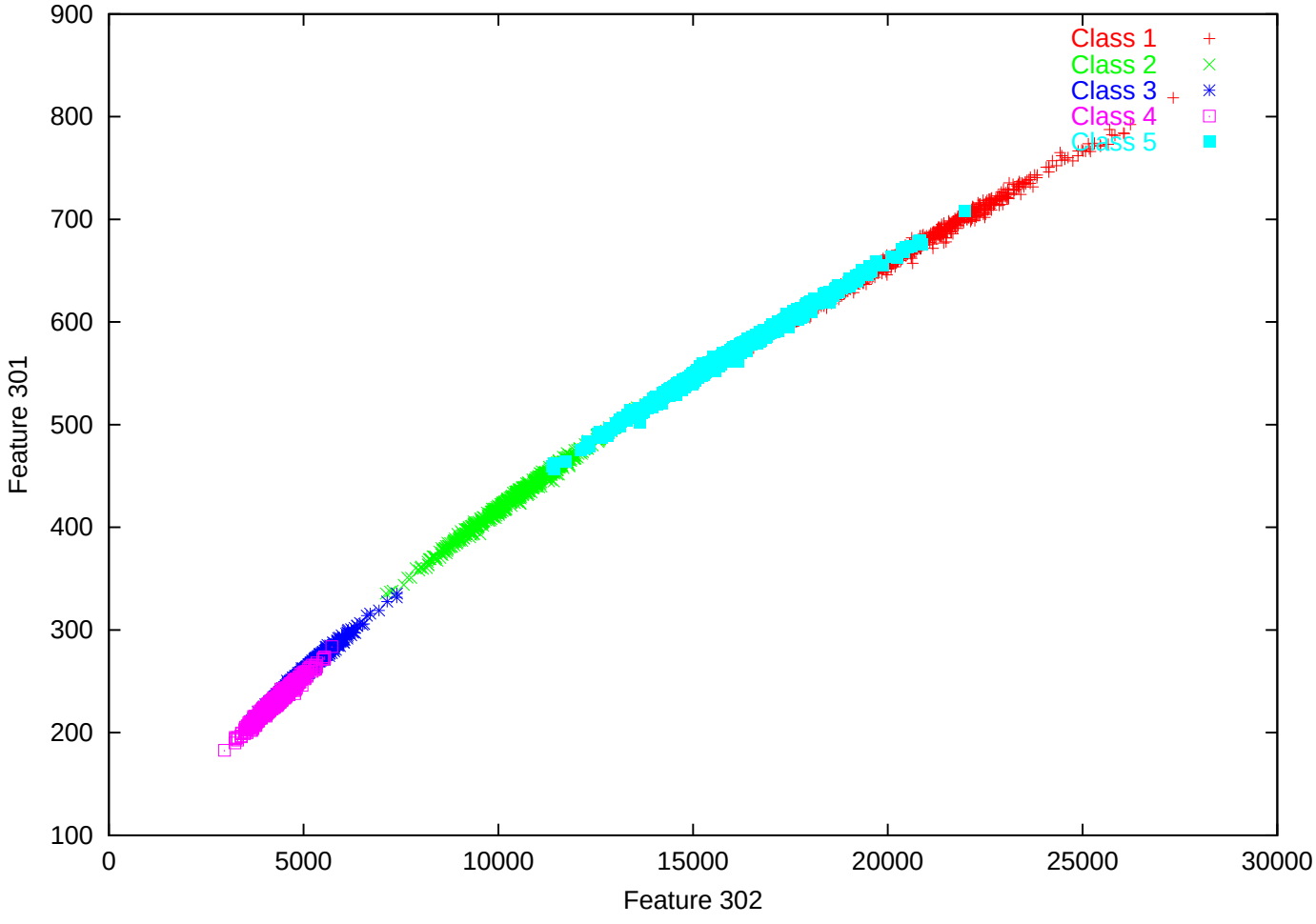
Granulometries

- Morphological granulometry and its size distribution moments are good quantitative shape descriptors (Matheron 75, Serra 82);
- They are successfully used to classify image texture in binary and gray-scale images (Dougherty 92, Chen 94);

Problem Overview



Feature Selection Problem



Feature Selection Problem