Automated Texture Classification and Landform Taxonomy for Populating a GIS

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Classifying objects using textual analysis and displaying the results in a taxonomy

Today's Talk

- Methodology
- Results
- Where next
- Discussion
- Questions?

Methodology

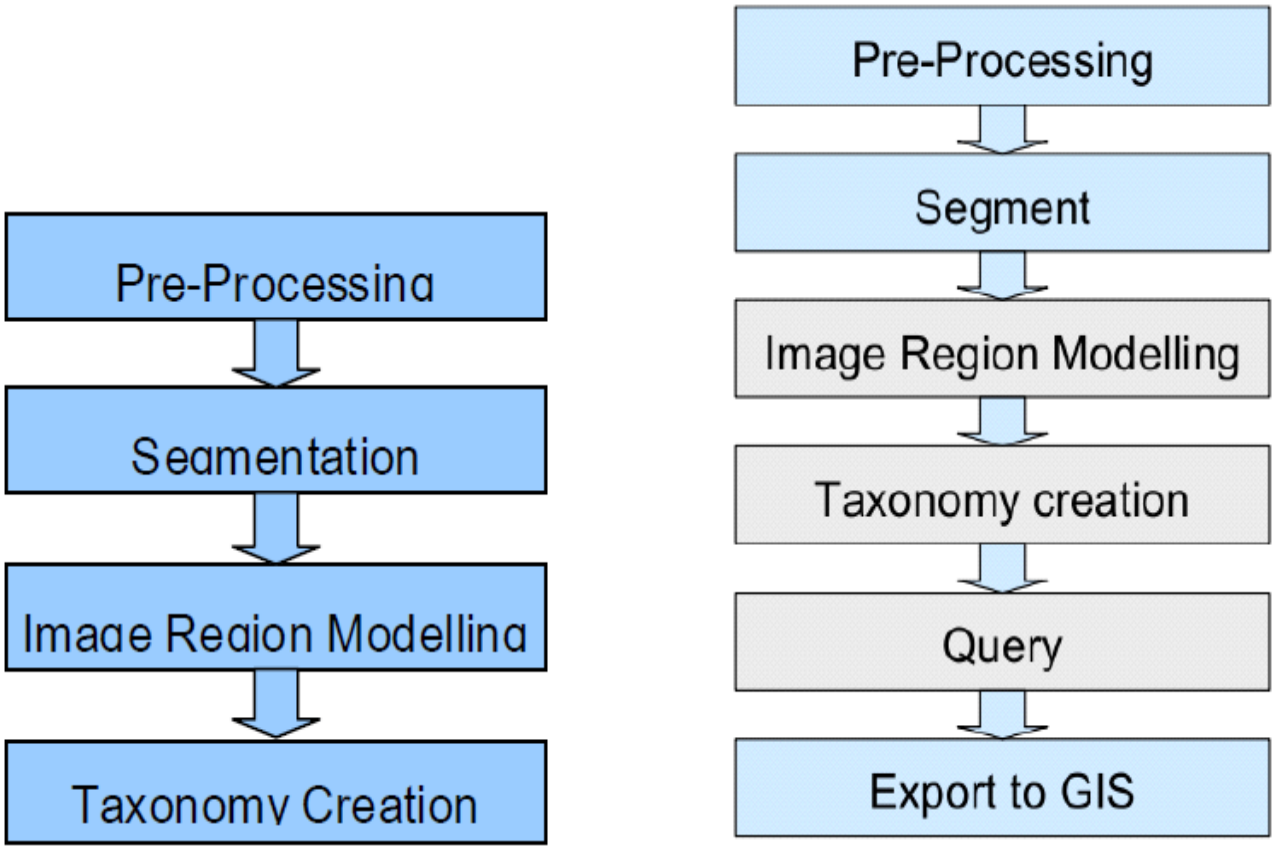


Figure 1. (a) Left: Flow Chart showing Gibbens' (2008) methodology (b) Right: Flow Chart showing extension to Gibbens' methodology, blue indicating where work is currently under way and white indicating where work is to begin.

Methodology - Segmentation

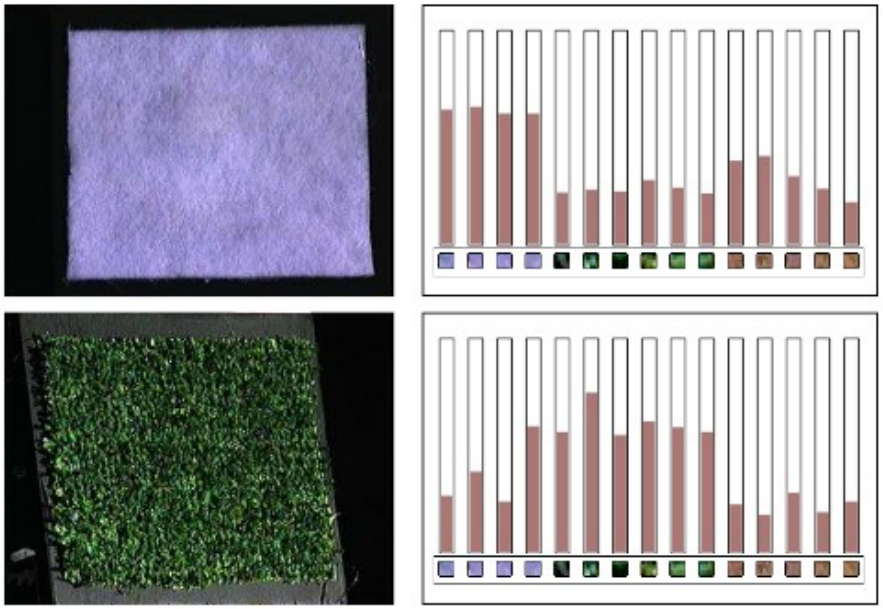
- Automated
- Manual hand marked and other sources
  - Manually Segment by hand
  - Meta or vectors data, e.g. Master map

Methodology - Automated

Watershed

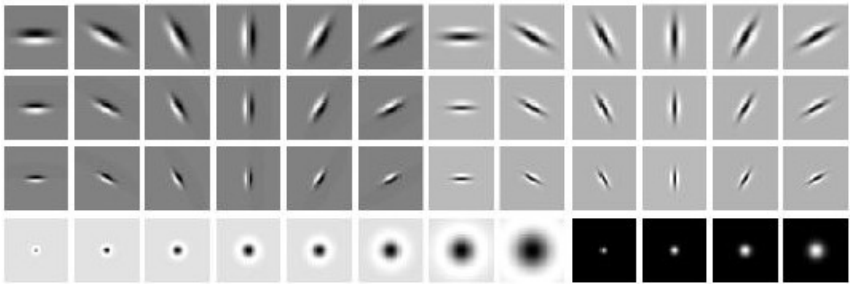
Image Region modelling - Textures

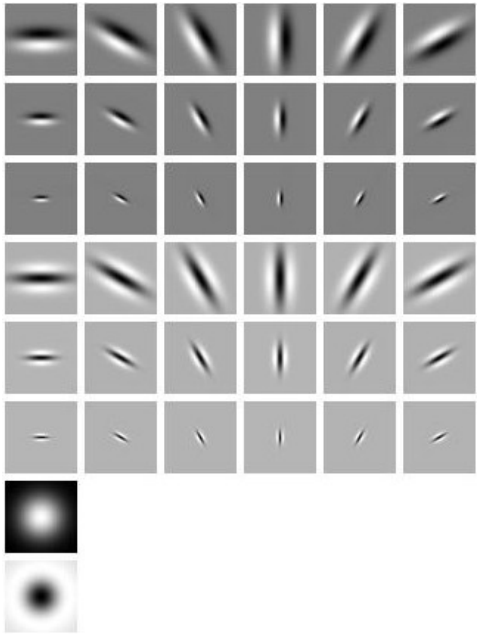
- Textural Analysis
- Textons are reoccuring features (Caelli and Julesz (1978))
- Create a model of textons
- Construct a Dictionary

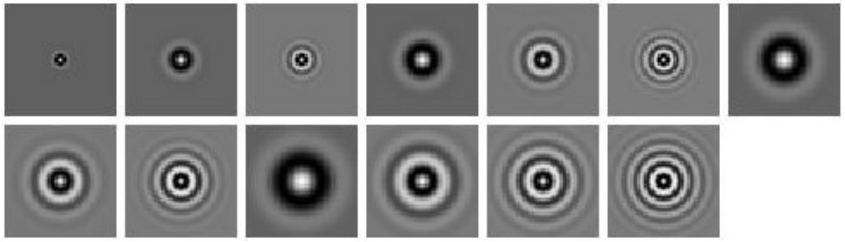


Methodology - Textual Analysis

- Filter Bank
  - Leung Malik
  - Maximum Response
  - Schmid

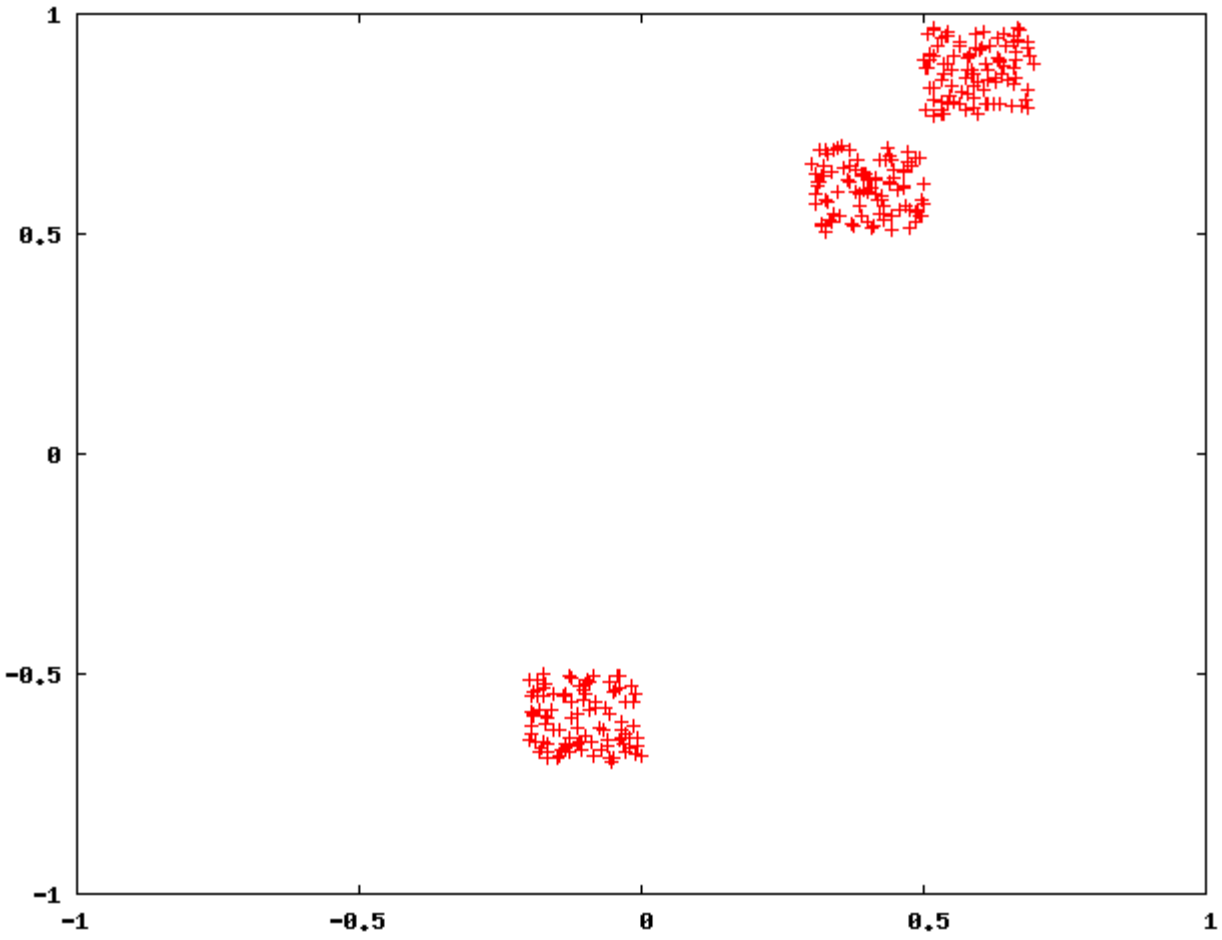




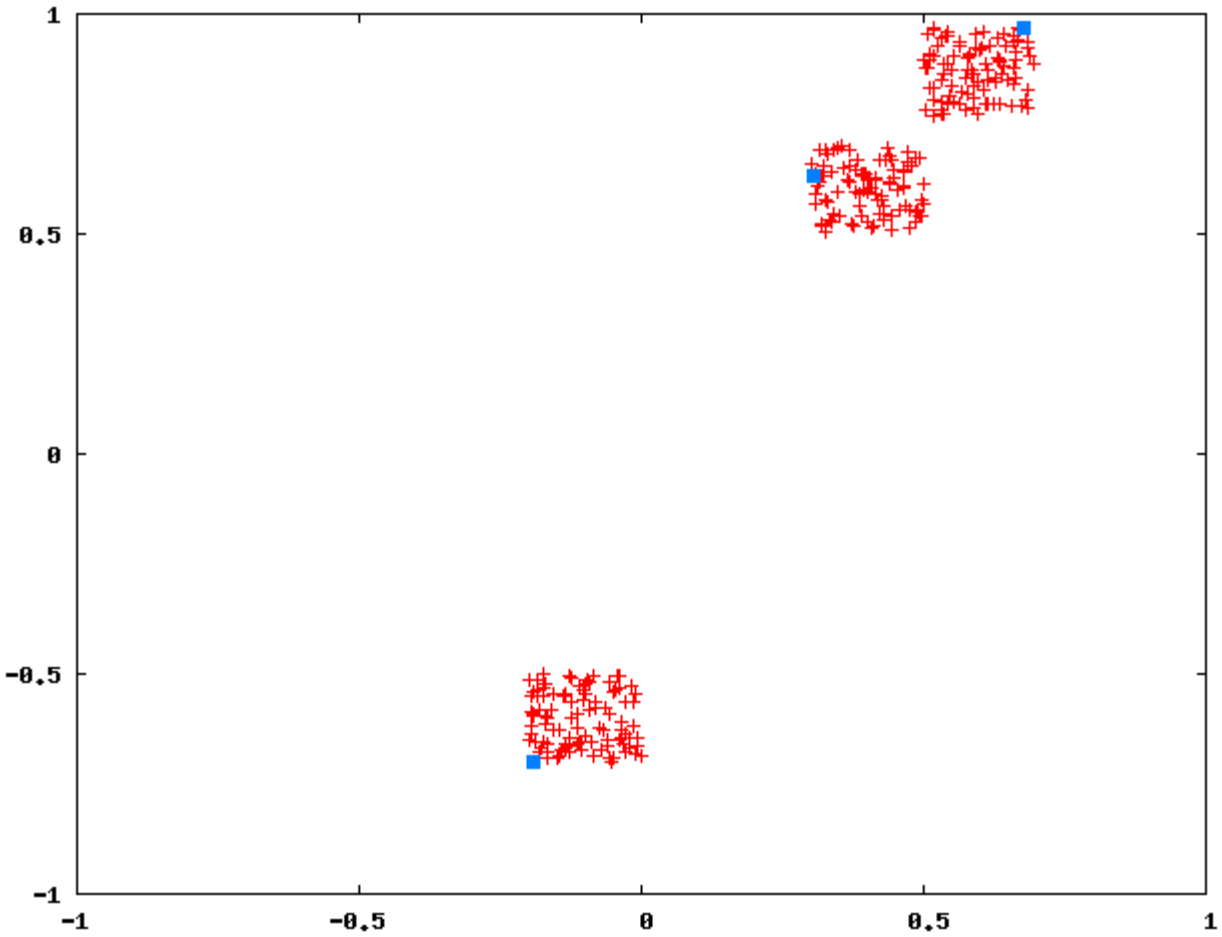


Methodology - Textual Analysis

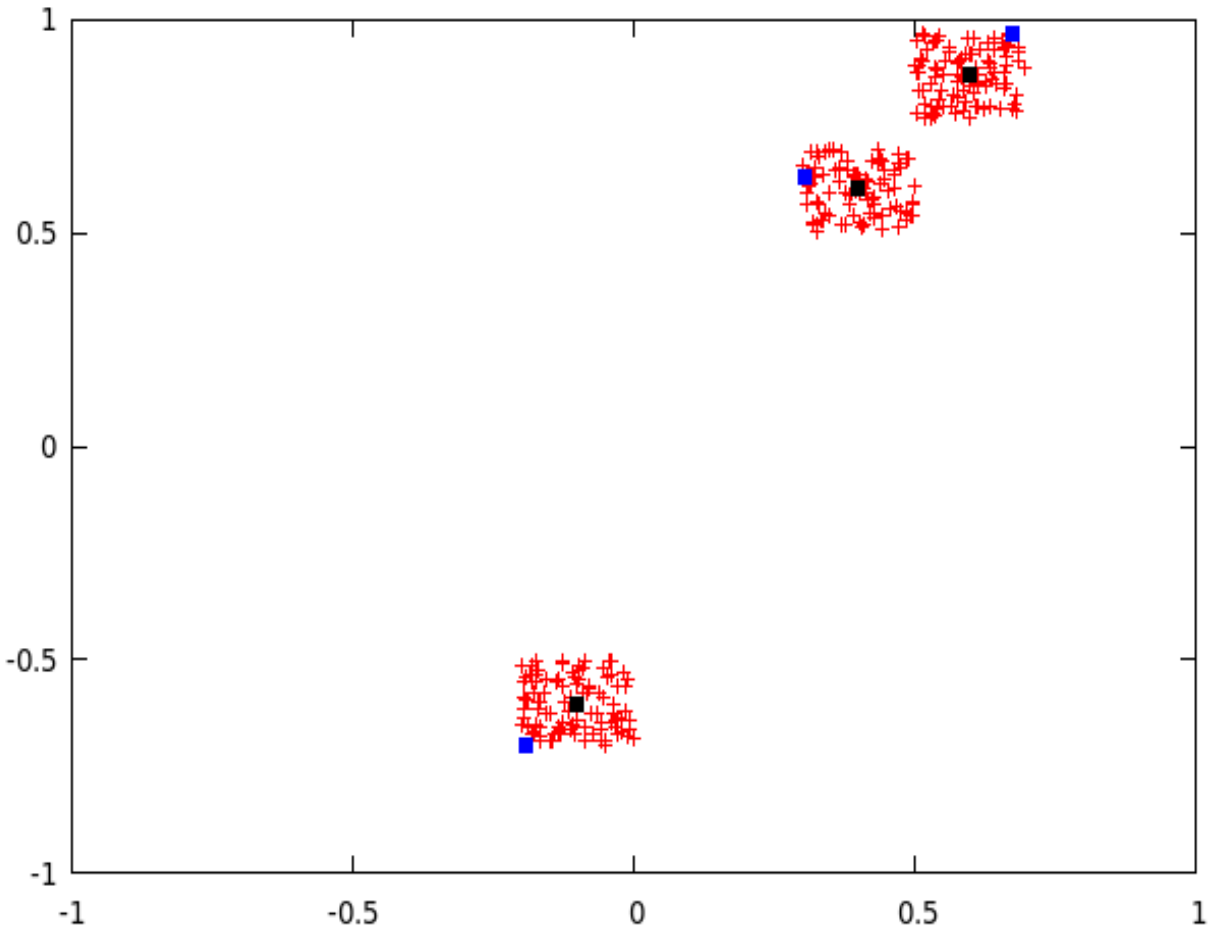
- Clustering
  - K-Means
    - Randomly assign k-centers
    - Assign each point to nearest center
    - Calculate optimum center
    - Repeat until no change in center



Randomly assign k-centers

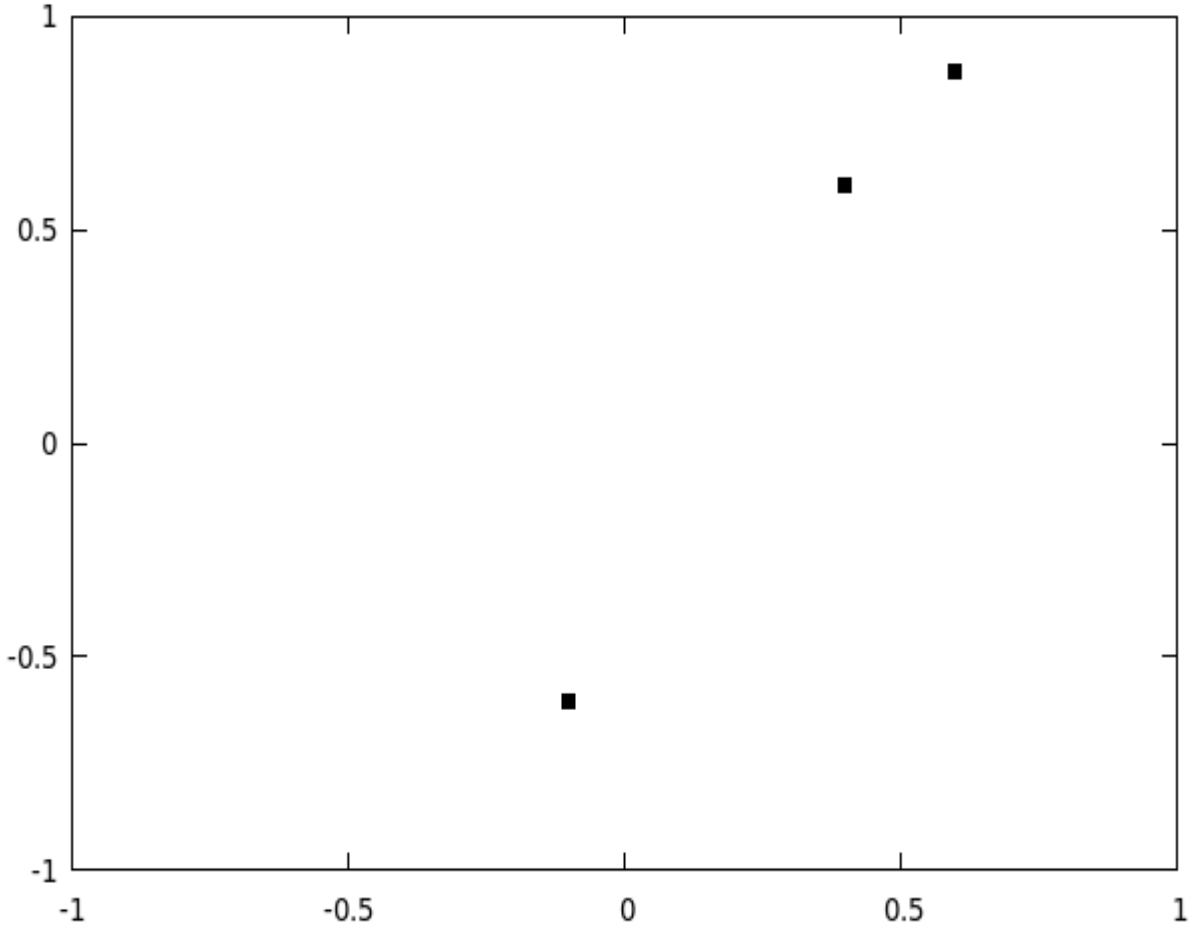


Assign each point to nearest center



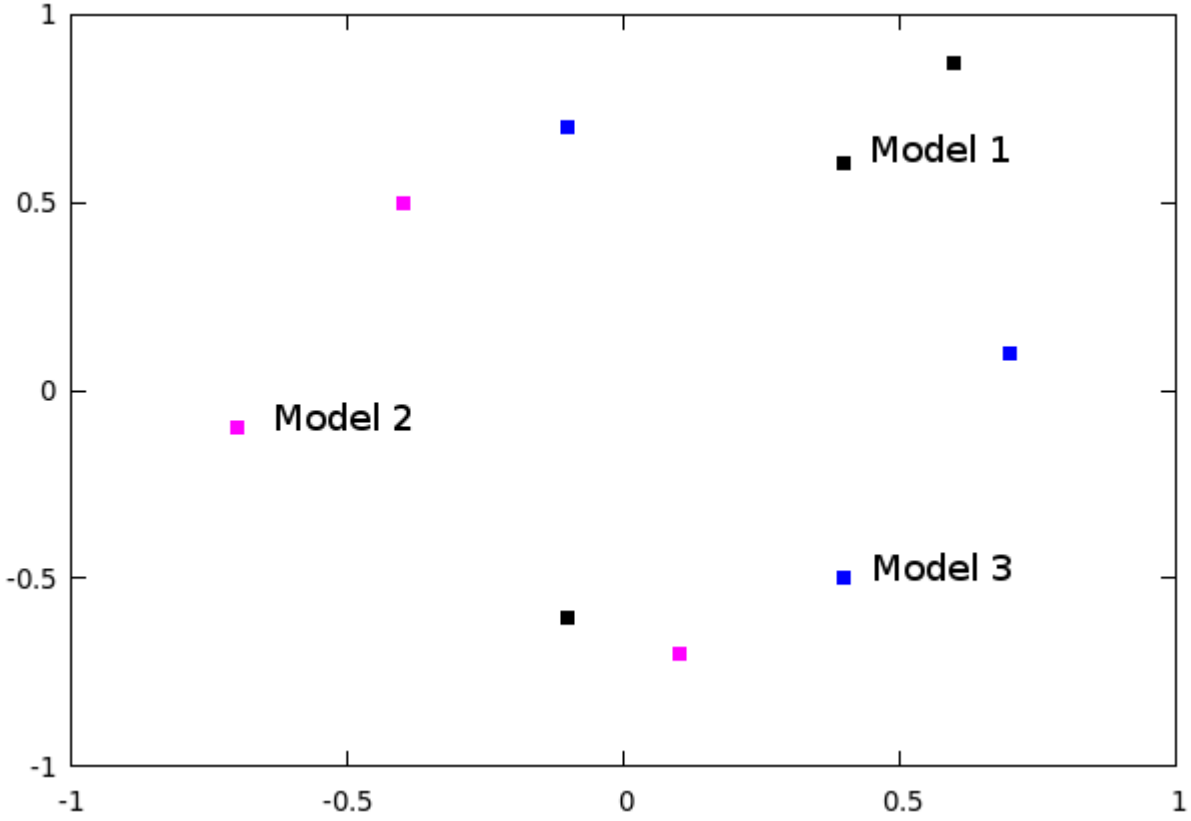
Calculate optimum center

Repeat until no change in center


1
0.5
0
-0.5
-1
-1
-0.5
0
0.5
1

Methodology - Textual Analysis

- Model
  - Sample of textures from a population of textures
  - Further clustering may be required
  - For each of the final cluster centers we have a texton
  - These textons are used as a histogram bin


1
0.5
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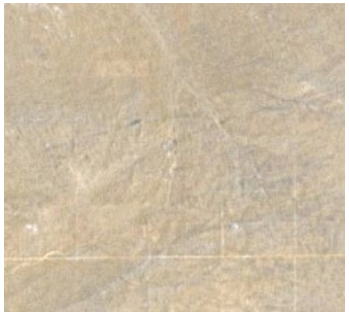
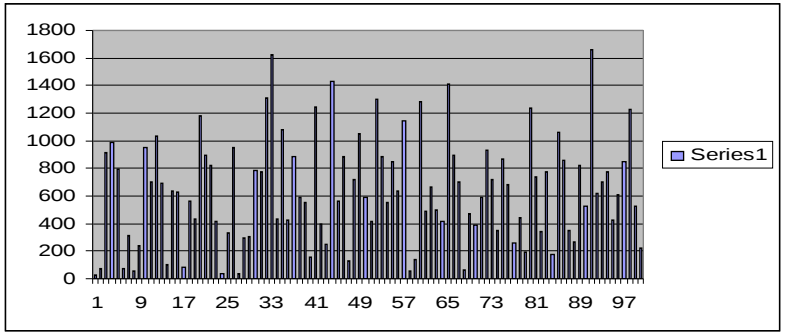
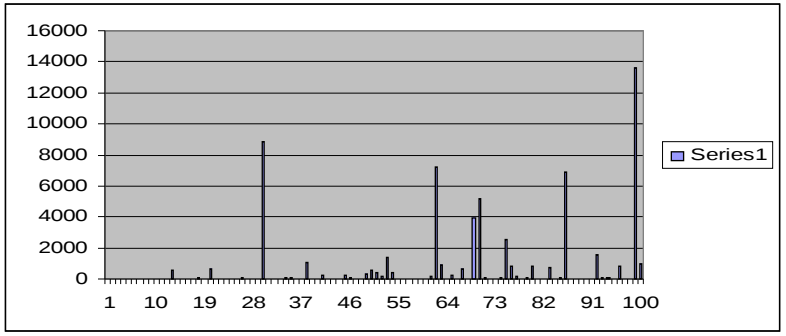
0.5
1
Model 1
Model 2
Model 3

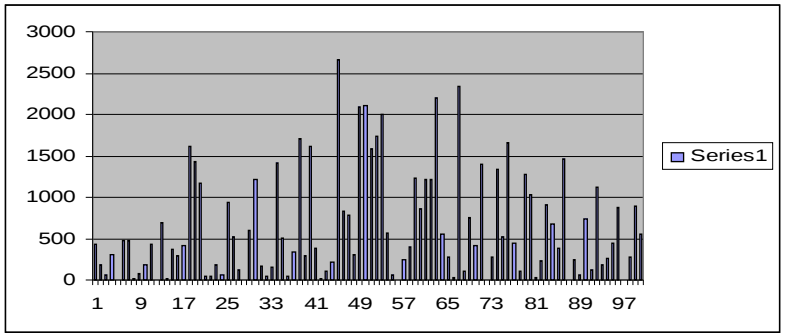
Methodology - Textual Analysis

- Training

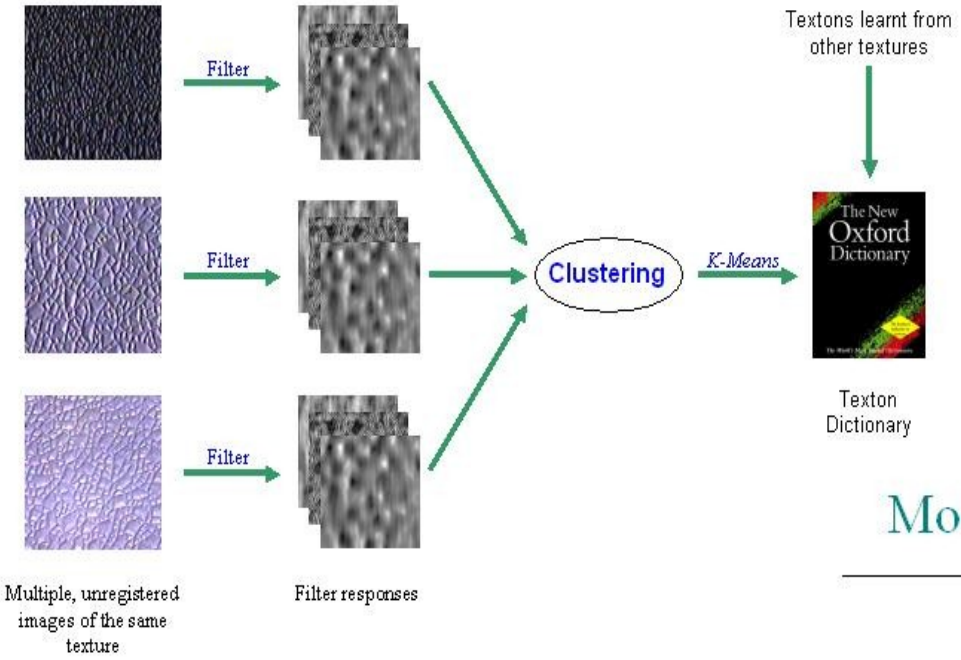




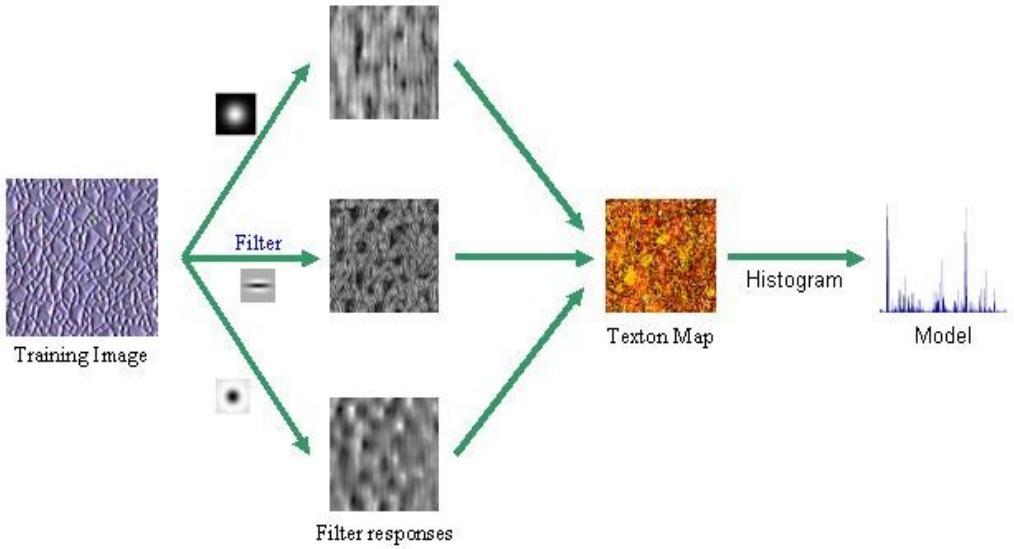




Modelling I – Learning the Texton Dictionary



Modelling II – Multiple Models Per Texture



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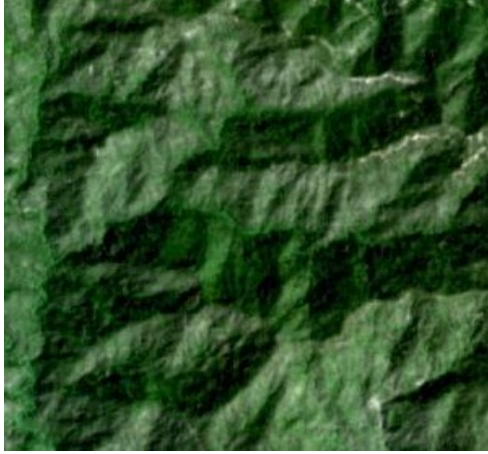
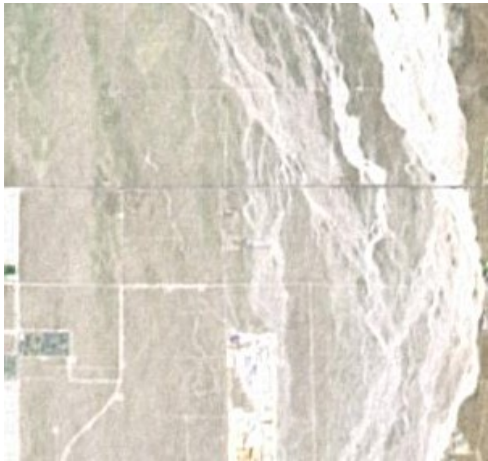


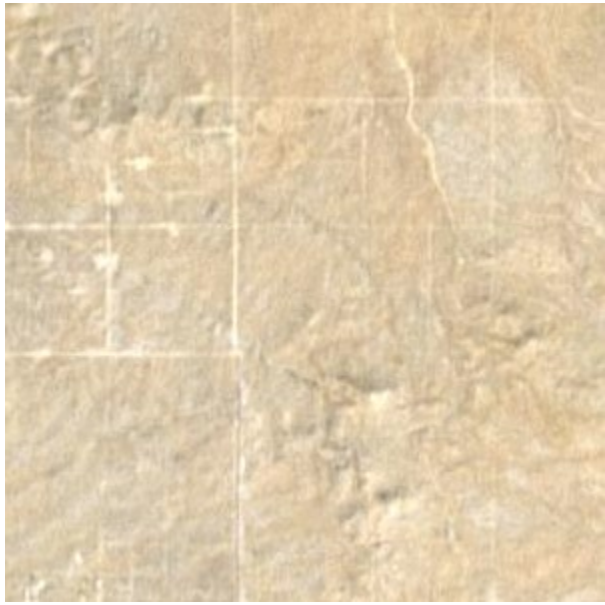


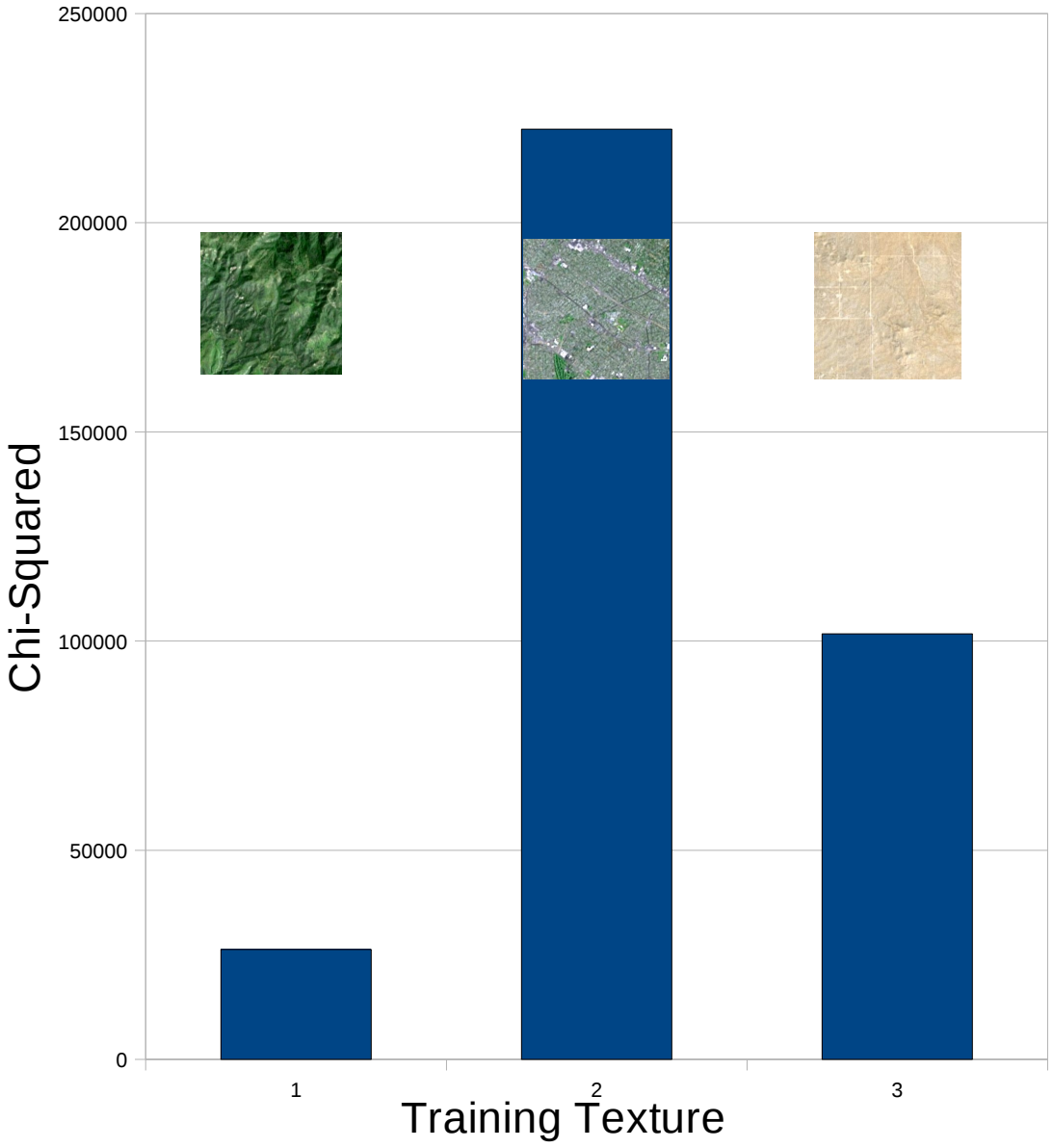


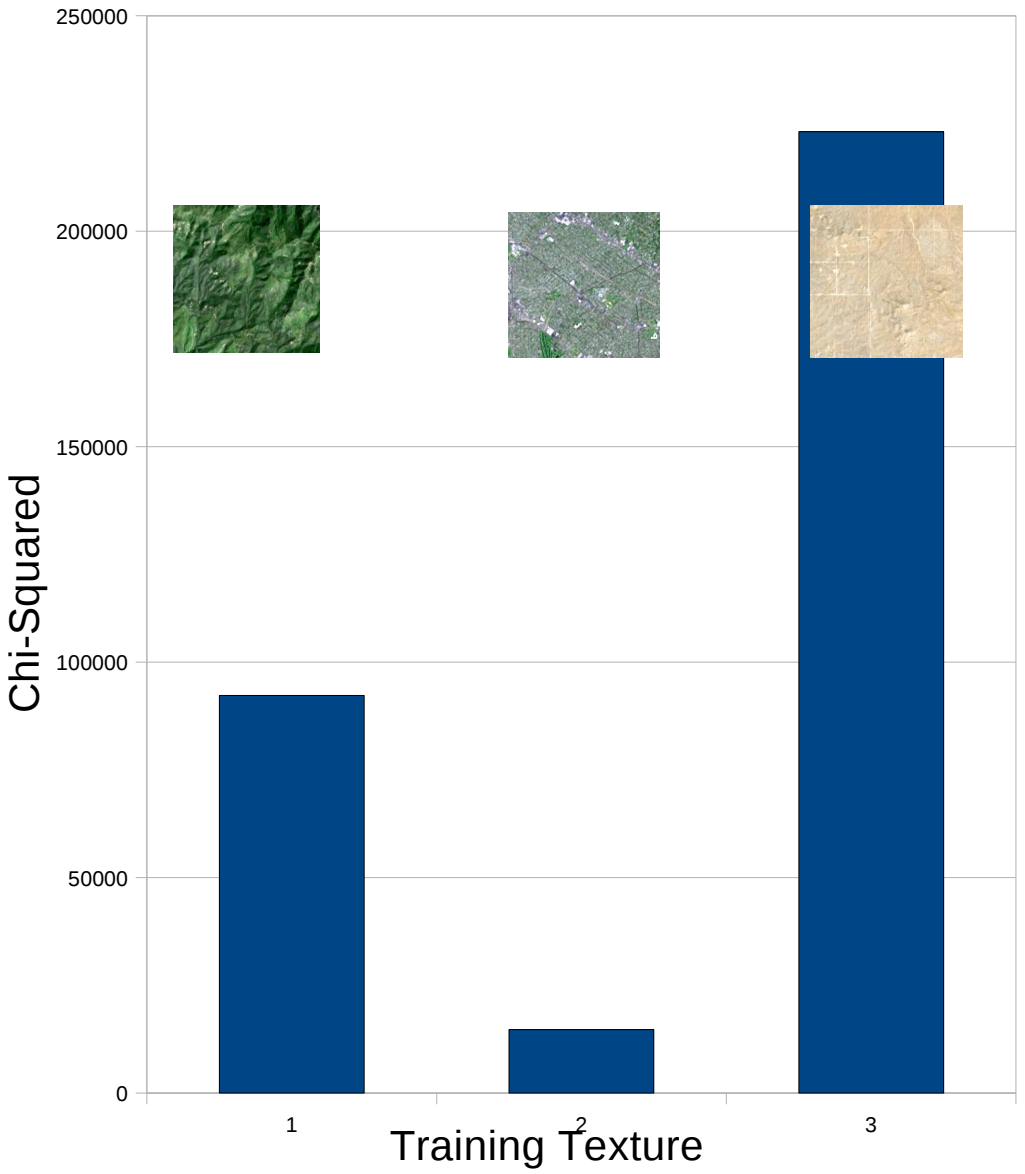


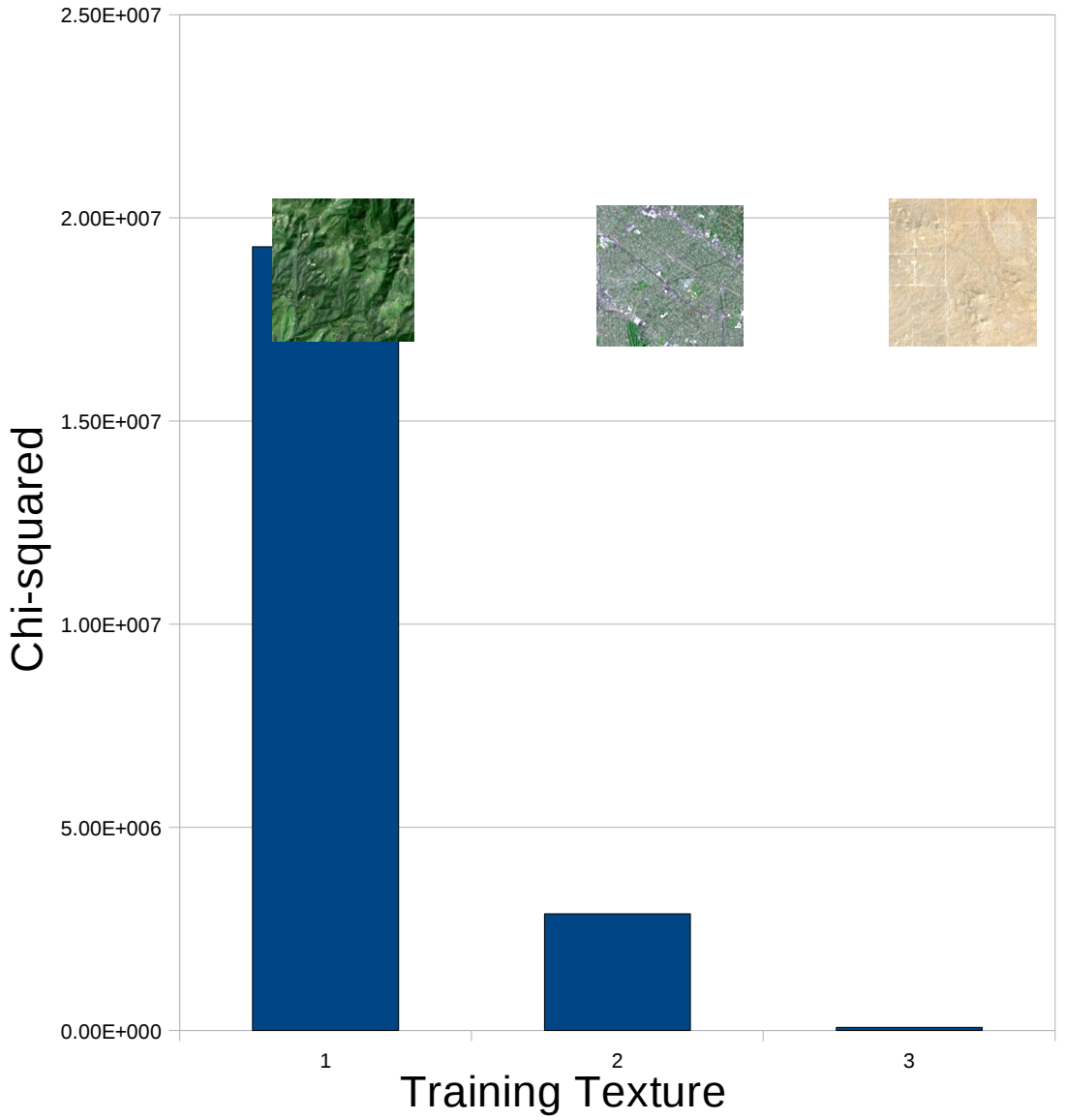
Training Textures





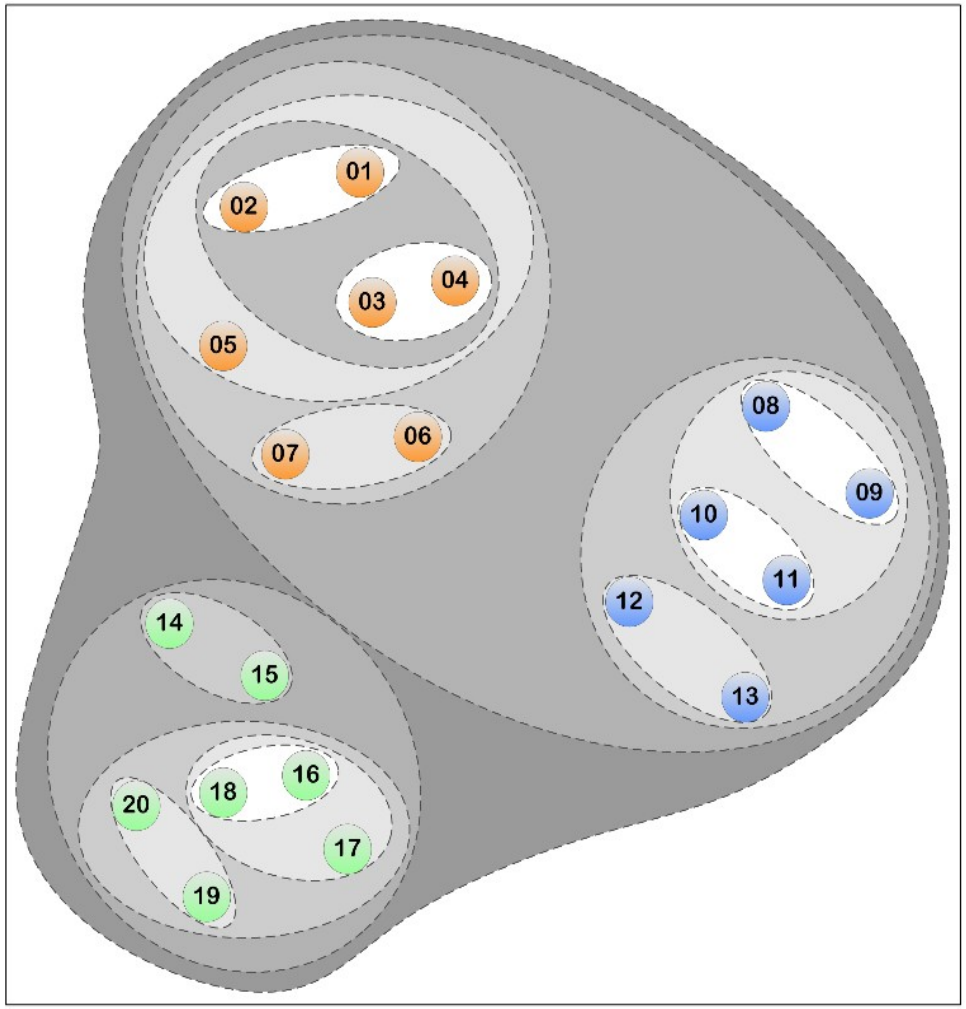

250000
200000
150000
100000
50000
0
Chi-Squared
1
2
3
Training Texture


250000
200000
150000
100000
50000
0
Chi-Squared
1
2
3
Training Texture


2.50E+007
2.00E+007
1.50E+007
1.00E+007
5.00E+006
0.00E+000
Chi-squared
1
2
3
Training Texture

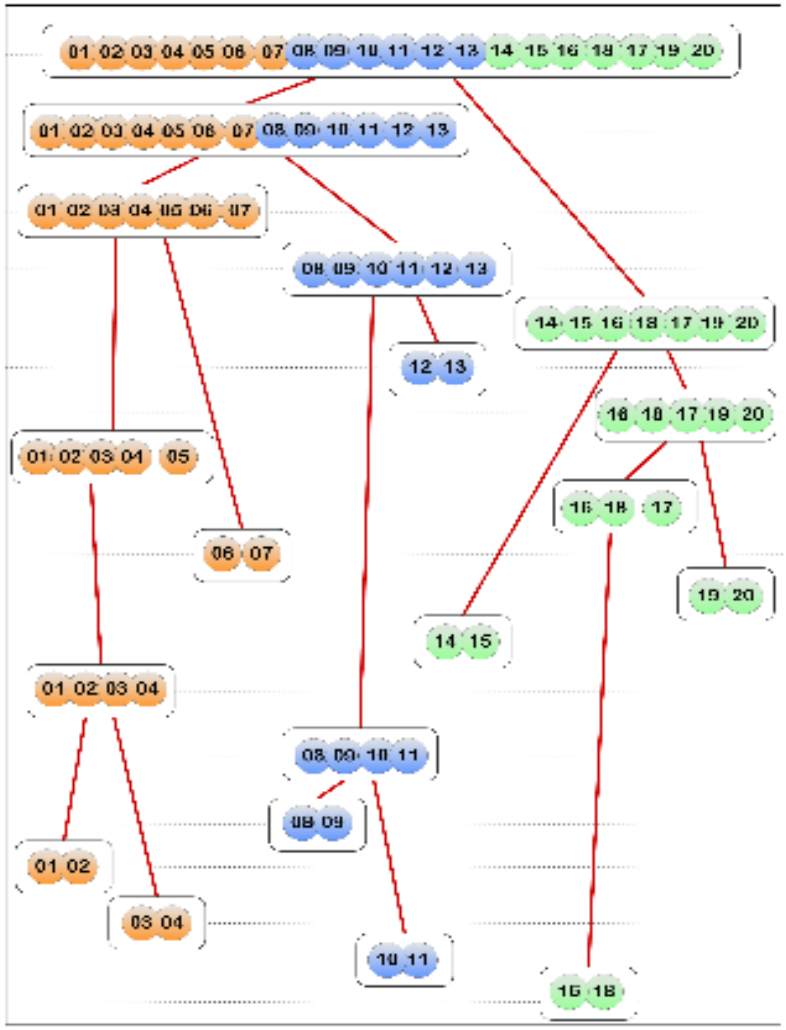
Methodology – Taxonomy Creation

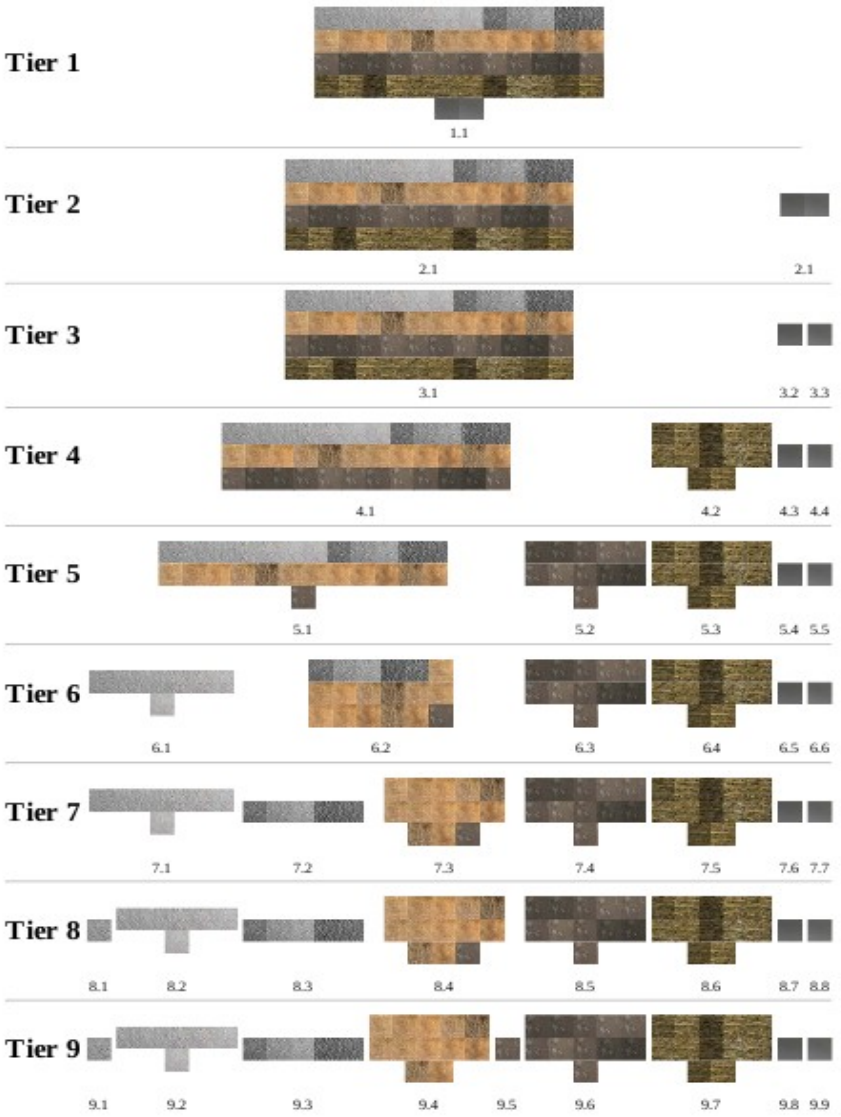
- Hierarchical Clustering



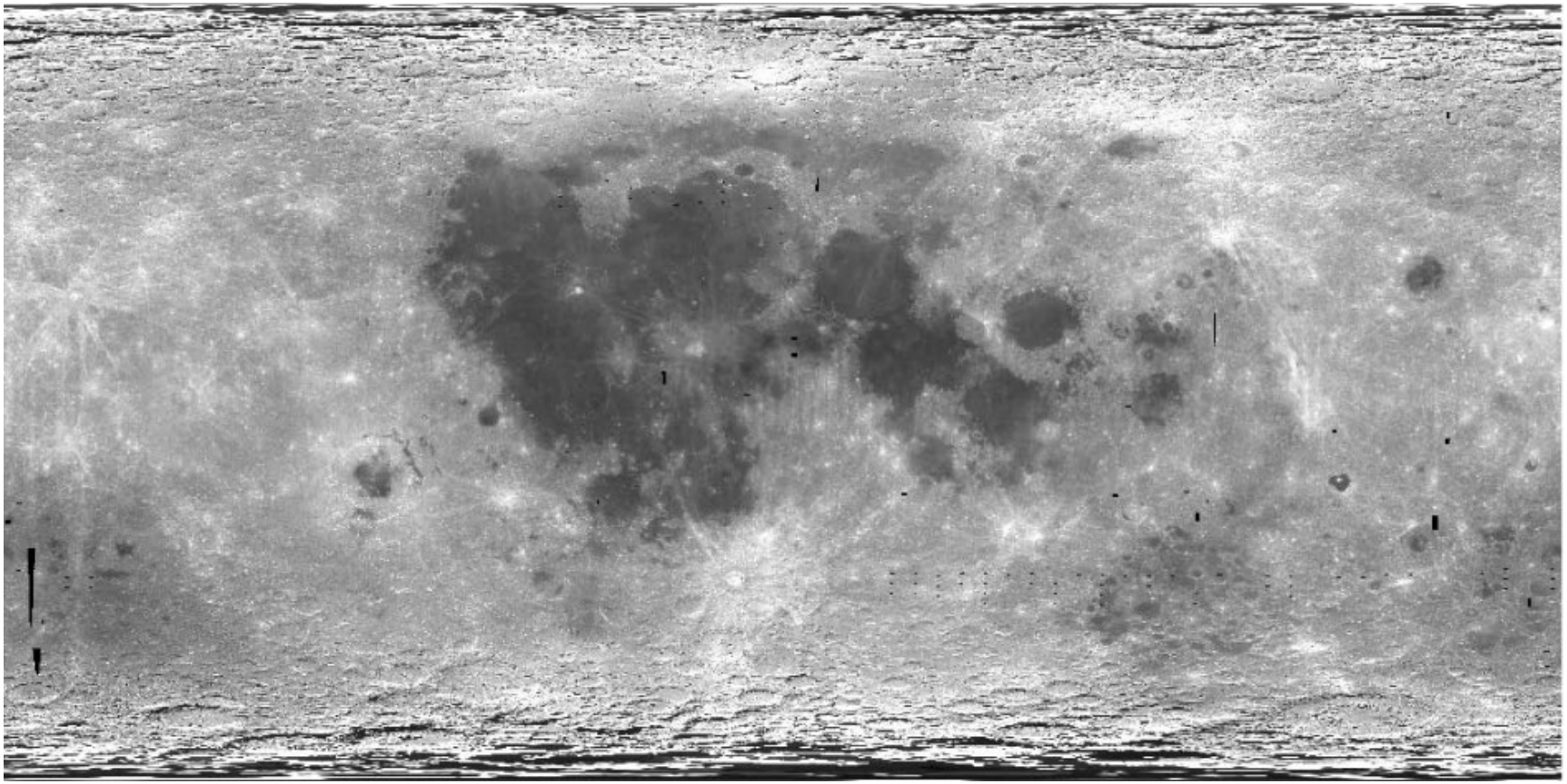
Methodology – Taxonomy Creation

- Dendogram



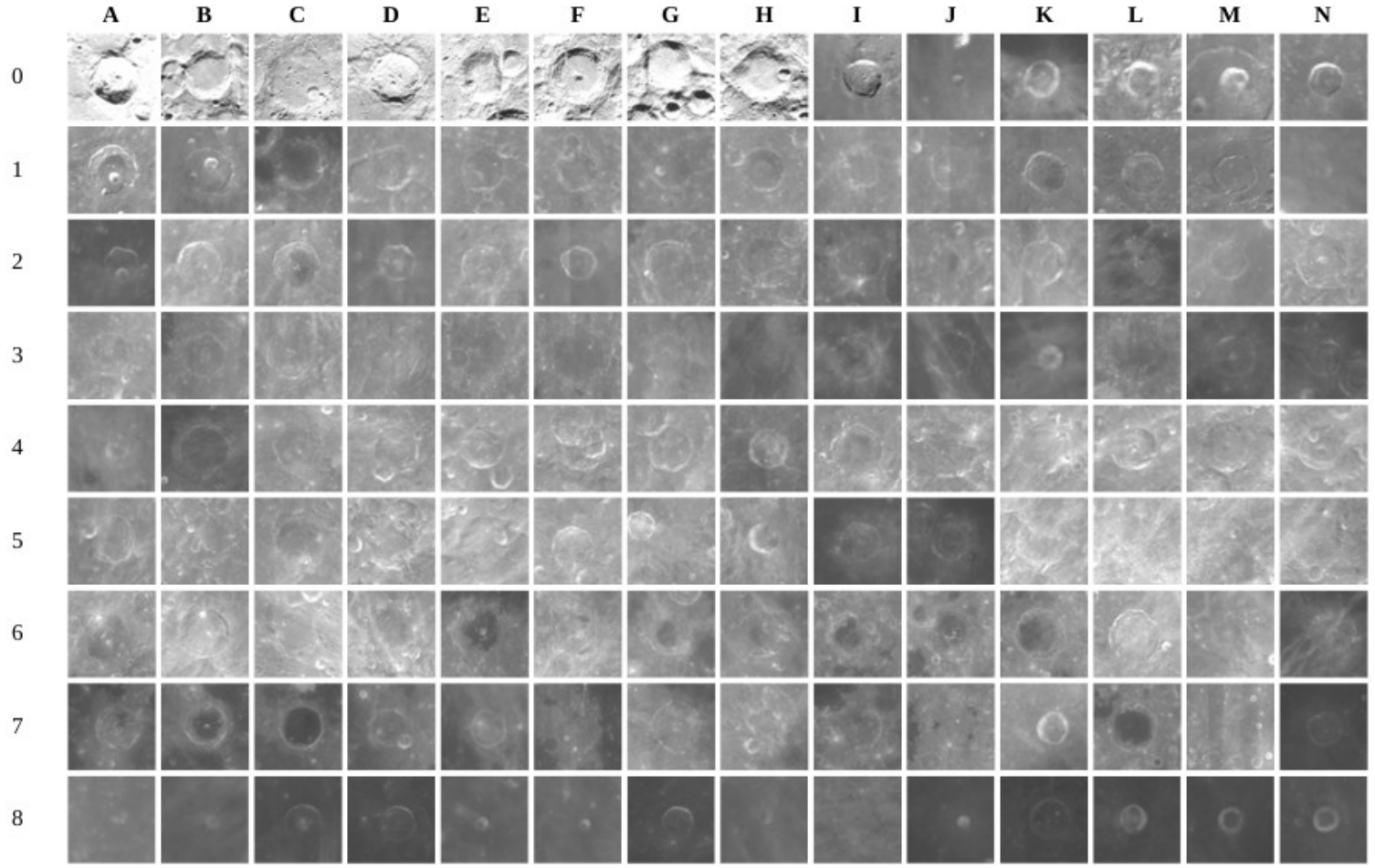


Results - Clementine Lunar spacecraft data

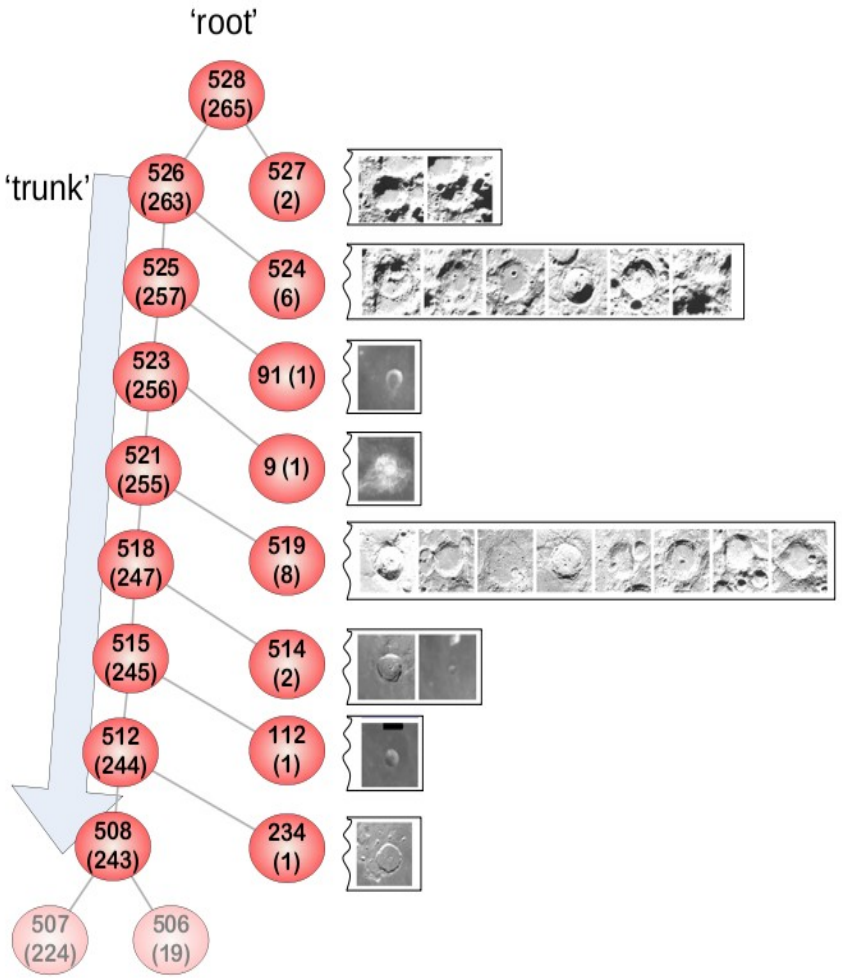


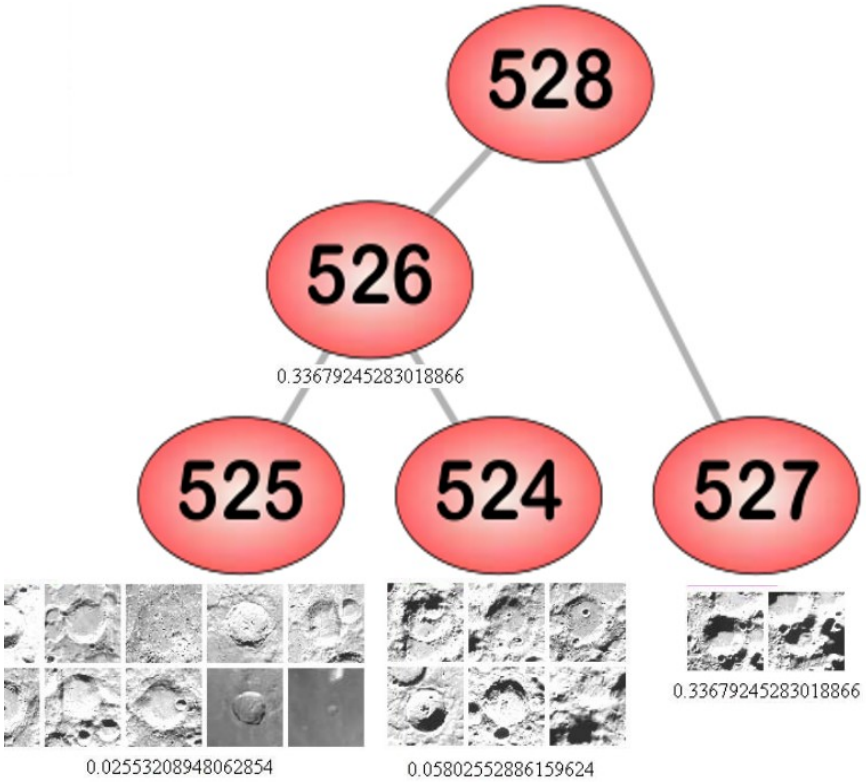
Segmented using NASA lunar crater database (Blue, J., 2004)

Clementine Lunar spacecraft data



Clementine Lunar spacecraft data





Clementine Lunar spacecraft data

Class	Description	Frequency
1	The newest-appearing and least deformed craters	154
2	Class 2,3 and 4 are progressively older in appearance	39
3	As above	18
4	As above	1
5	Partially filled with some dark substance	53
	Total	265

Table 8.1: Frequency distribution for Baldwin's hand-classified crater classes

Where next?

- Improve automated segmentation
- Explore Texton analysis for Remote Sensing applications
- 3D Textons
- Query interface and GIS integration

Discussion

- Heavily dependant upon segmentation
- Baldwin Classification
  - Image, view and illumination differences
  - Craters within craters
- A taxonomy is a useful way to visualise textural information
- More work to be conducted, little has been done with textons and remote sensing data

Thank you

Questions?