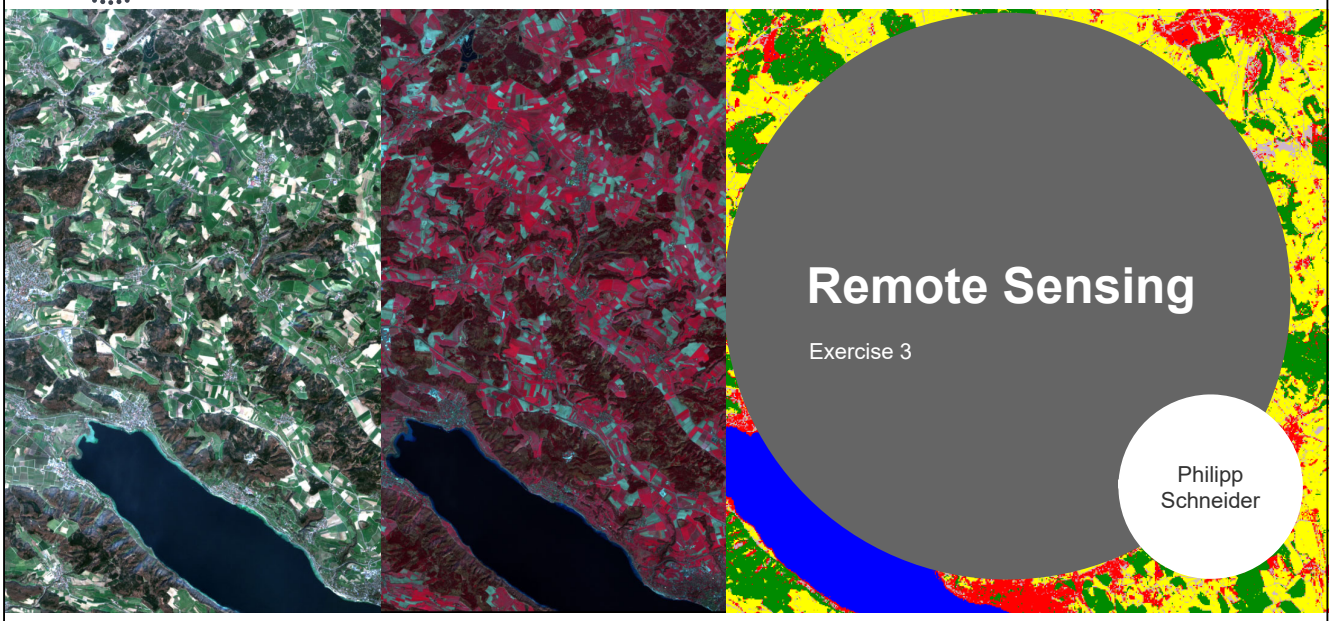
Universität Stuttgart



Remote Sensing

Exercise 3

Philipp Schneider

ifp

Remote Sensing – Exercise 3

organizational

Philipp Schneider

Institut for Photogrammmetry

Philipp.Schneider@ifp.uni-stuttgart.de

0711 685 84092

Remote Sensing – Exercise 3

Goals of this exercise

Exercise 1

- How to download optical image data from Sentinel-2 (an area of your choice)
- Learn how to import it to the ENVI software
- Export a geoTiff from ENVI

Exercise 2 (last time)

- Interpret the different bands
- Do some useful analysis (Vegetation and agricultural monitoring)

Exercise 3

- **Classification (supervised and unsupervised)**

Remote Sensing – Exercise 3

Goals of this exercise

Part 1

- Before we start the demo part we'll have a look on some potential exam questions

Part 2

- I will show you how to solve the homework

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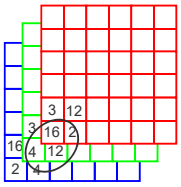
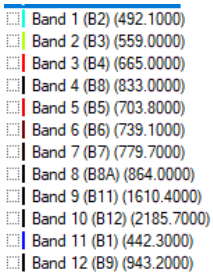
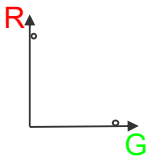
Questions

Q: What is the feature space in pixel-wise spectral classification?

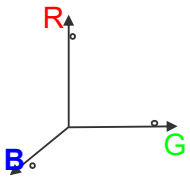




2d $p(G,B)$



3d $p(R,G,B)$



12-d $p(UV,R,G,B,NIR,IR,\dots)$

Thankfully vector algebra does help us!

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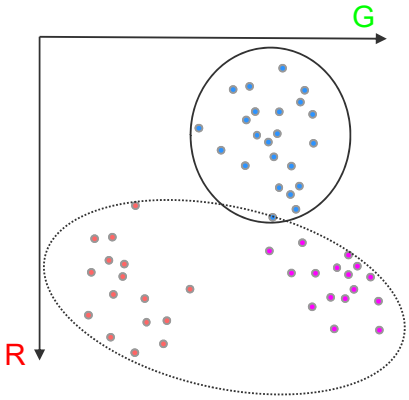
Questions

Q: What is unsupervised classification?

- given: a set of unclassified points in a feature space.
- unsupervised classification will detect clusters in the points
- Problem: you don't know if clusters belong to multiple classes.

„You have to give names to the clusters“

Examples: k-Means, Iso-Data, mean-shift DBSCAN



more

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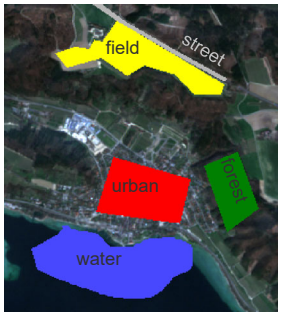
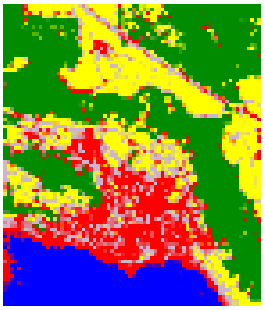
Questions

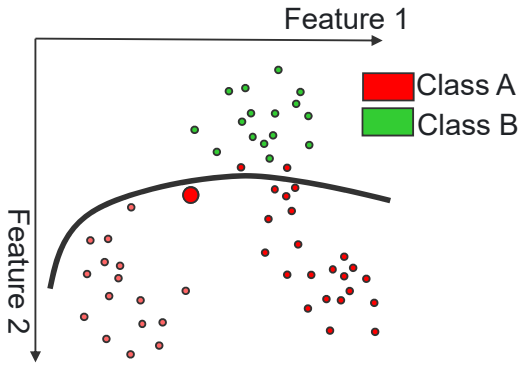
Q: What is Supervised Classification

- given: a set of points in a feature space AND their labels
- Unsupervised classification will derive rules to classify points in this feature space. (Training)
- The class of new points can be predicted.

Examples: maximum-likelihood, random forest, artificial neuronal networks







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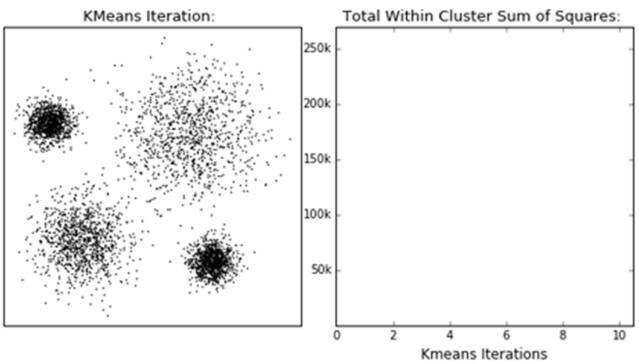
Questions

Q: What is k-Means

- An unsupervised classification method
- Starts with a chosen number of classes and class centers
- Iteratively classifies points to the nearest center and updates the centers
- Stops when the centers convert to a point



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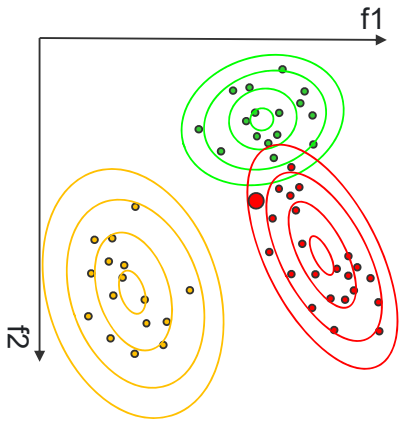
Questions

Q: what is maximum Likelihood

- An supervised classification method
- Estimate the (Gaussian) distribution for each class.
- Classify new points by the most likely distribution.



$P_A(f1, f2)$=0.2

$P_B(f1, f2)$=0.8

$P_C(f1, f2)$=0.01

Remote Sensing – Exercise 3

Questions

Q: What is a confusion matrix? How to calculate Overall, Users and Producers Accuracy?

		Reference Data			
		Water	Forest	Urban	Total
Classified Data	Water	21	6	0	**27**
	Forest	5	31	1	**37**
	Urban	7	2	22	**31**
	Total	**33**	**39**	**23**	***95***

more

Overall Accuracy = 74/95 = 77.9%

Producer's Accuracy Water:
Correctly classified reference sites = 21
Total # of reference sites = 33
Producer's Accuracy = 21/33 = 64%

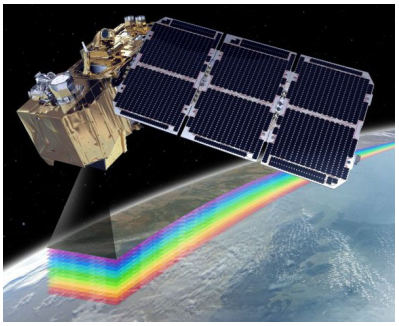
User's Accuracy Water:
Correctly classified sites = 21
Total # of classified sites = 27
Omission Error = 21/27 = 78%

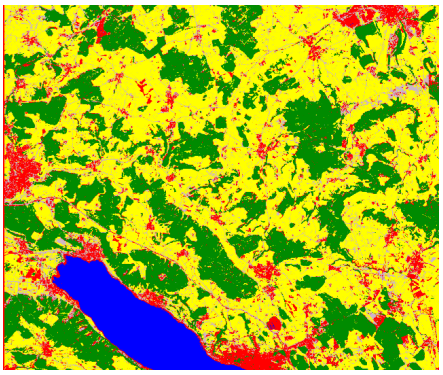
In this confusion matrix, "Reference" columns represent true classes, while "Classified" rows represent the classifier's predictions. The matrix is square, with all correct classifications along the upper-left to lower-right diagonal.

Remote Sensing – Exercise 3

Goals of todays exercise

- Classify your area with k-means
- Define a training area for supervised classification
- Define a test area for unsupervised classification
- Use maximum-likelihood to classify your image
- Create a confusion matrix

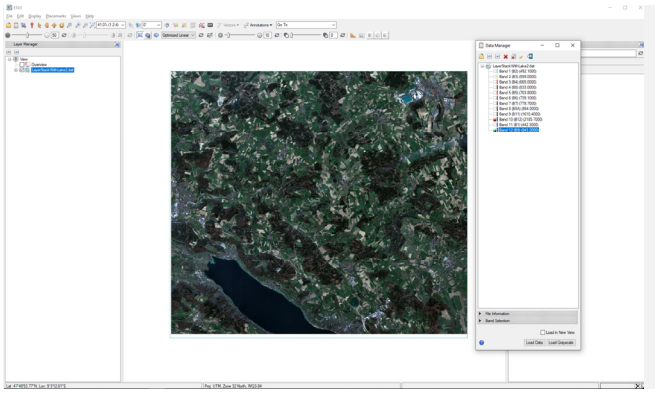




Remote Sensing – Exercise 3

Open your Sentinel-2 data

- Import the layer stack from Excersie 1 to Envi
  - File-> Open -> select the .dat file
  - Make sure you have all 12 Bands in the Data Manager (F4)

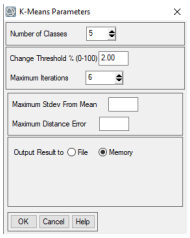


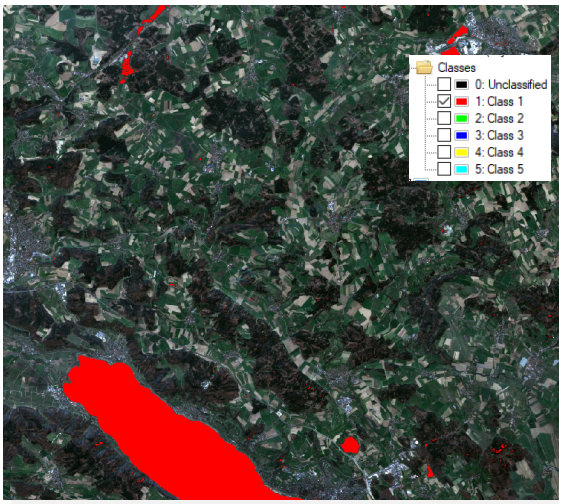
Remote Sensing – Exercise 3

K-Means

- Toolbox->Classification->unsupervised learning->k-means
- Select your 12 Band layerstack
- Select parameters i.e. 5 Classes
- >5 Itterations

Interpret each class in your report!





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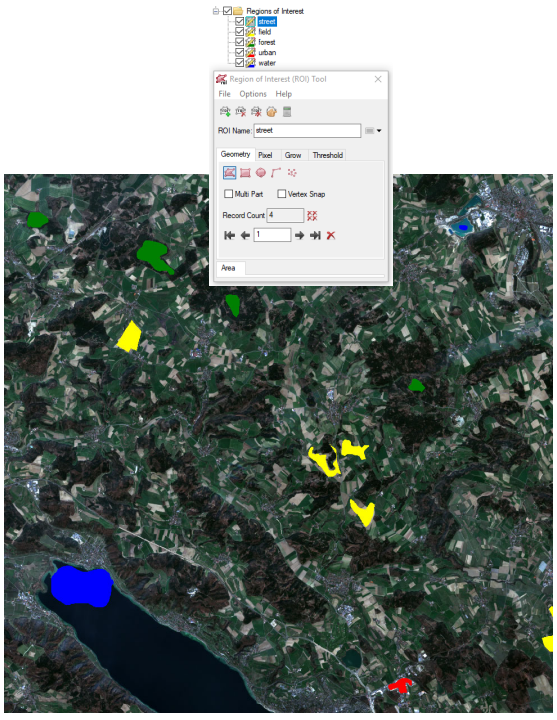
Create ROIs for supervised learning

- Use the ROI tool in the Topbar, to mark 5 regions with polygons: street, field, forest, urban, water.
- Choose proper colors
- Save your ROI‘s as „training rois“.
  (right click in layer manager)

- Repeat the same process with different regions and save as „test rois“.

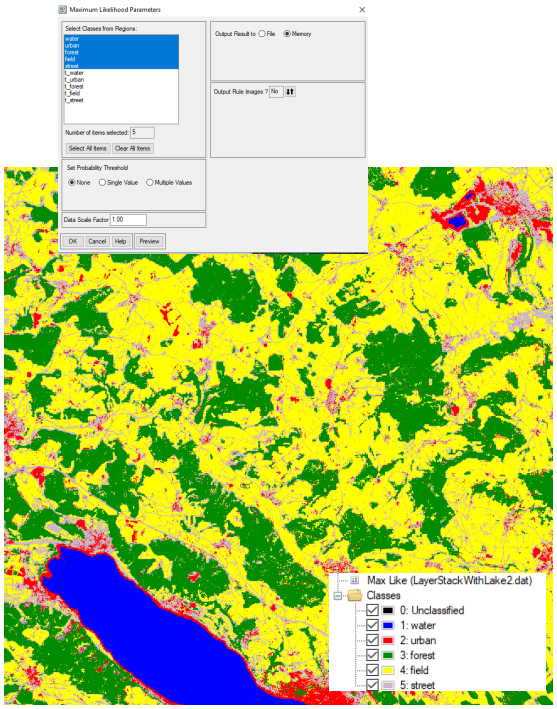


Remote Sensing – Exercise 3

Maximum-Likelihood

- Toolbox->Classification-> unsupervised -> Max. Likelihood
- Select your train ROIs
- Save the output layer as tif and present in your report

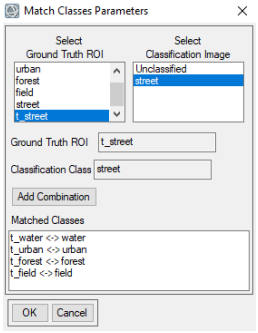
Discuss results, point out the importance of training areas



Remote Sensing – Exercise 3

Confusion Matrix

- Toolbox->Classification-> post Class. -> Confusion Matrix
- Select your „test ROIS“ as ground truth and the output of the classification
- Match the classes
- Generate Confusion matrix and present in your report.
- Point out the influence of your ground truth labeling.

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Confusion Matrix: [Memory2] (2162x1962x1)

Overall Accuracy = (34897/40215)  86.7761%
Kappa Coefficient = 0.8152

                Ground Truth (Percent)
   Class          t_water      t_urban      t_forest      t_field      t_street
Unclassified         0.00         0.00          0.00         0.00          0.00
       water       100.00         0.00          0.00         0.00          0.00
       urban         0.00        35.46          0.68         0.34          0.00
      forest         0.00         0.60         97.85         0.00          0.00
       field         0.00         8.25          1.28        96.46         19.47
      street         0.00        55.68          0.19         3.20         80.53
       Total       100.00       100.00        100.00       100.00        100.00


                Ground Truth (Percent)
   Class            Total
Unclassified         0.00
       water        44.43
       urban         6.92
      forest        23.47
       field        13.97
      street        11.21
       Total       100.00


       Class   Commission      Omission          Commission           Omission
                 (Percent)     (Percent)            (Pixels)            (Pixels)
       water         0.00          0.00                0/17866             0/17866
       urban         2.95         64.54               82/2781          4912/7611
      forest         0.49          2.15              46/9440           206/9600
       field        13.75          3.54             773/5620           178/5025
      street        97.98         19.47            4417/4508             22/113


       Class   Prod. Acc.    User Acc.          Prod. Acc.           User Acc.
                 (Percent)     (Percent)            (Pixels)            (Pixels)
       water        100.00        100.00      17866/17866         17866/17866
       urban         35.46         97.05        2699/7611           2699/2781
      forest         97.85         99.51        9394/9600           9394/9440
       field         96.46         86.25        4847/5025           4847/5620
      street         80.53          2.02          91/113              91/4508
```