Assignment 1 *(Concept learning)*

Assignment 1.1 *(4p)*

Given the general boundary G={Strong,?,?} and the specific boundary S = {Strong, Sunny, warm} ∨ {Strong, cloudy, cool}, which were learned using the *Candidate Elimination* algorithm. Provide the complete version space, including *more general than* relations. Provide a definition of your choice of displaying *more general than* relations.

Assignment 1.2 *(3p)*

What is the inductive bias of a learner? Provide an example using the "weather" problem, which was discussed in the lecture.

Assignment 2 *(Decision Trees)*

Assignment 2.1 *(2p)*

Draw a decision tree for the following logical function

$(A \wedge B) \vee (\neg A \wedge ((C \wedge \neg B) \vee (\neg C \wedge D)))$

Example	a_1	a_2	Classification
1	A	D	+
2	A	E	−
3	B	D	+
4	C	D	+
5	B	E	+

Table 1: Training Data

Assignment 2.2 *(5p)*
Calculate the entropy $E(S_v)$ for the data given in Table 1, where S_v is the subset of S for which an attribute X has value v. $X = (a_1, a_2)$. That is, calculate the entropy for each attribute value. It is sufficient to provide the formula in the form $x \cdot log_2(y)$. Exact calculation of the logarithm is not necessary.

Assignment 2.3 *(2p)*
What is the information gain of a_1 and a_2 relative to the given training examples?

Assignment 3 *(Clustering)*

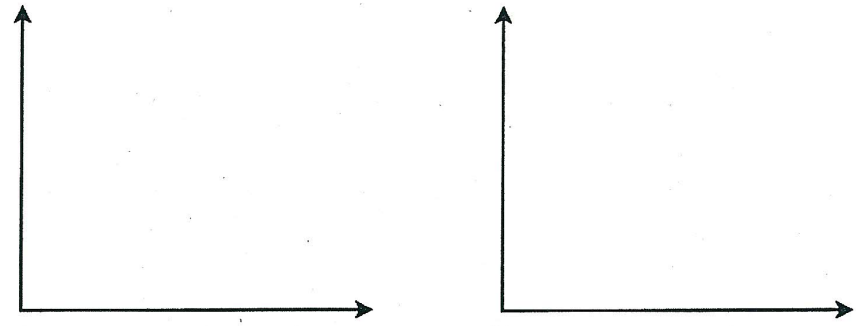
Assignment 3.1 *(5p)*

Provide a pseudocode algorithm for agglomerative hierarchical complete linkage clustering.

Assignment 3.2 *(3p)*
What changes would be necessary in your algorithm to implement Ward's minimum variance clustering? Provide a formula for the new measure.

Assignment 3.3 *(4p)*
What is the Rosner test? Describe its purpose and provide its formal definition

Assignment 4 *(Dimensionality reduction)*



a) b)

Assignment 4.1 *(2p)*
Draw a data distribution for which PCA works well in coordinate system a). Draw a data distribution for which PCA fails in b).

Assignment 4.2 *(2p)*
Draw the principal components for the data distributions inside each diagram.

Assignment 4.3 *(2p)*
What is the purpose of using projection indices?

Assignment 4.4 *(4p)*
Name two projection indices and describe their properties.

Assignment 4.5 *(3p)*
What is the curse of dimensionality? Explain its relevance for pattern classification.

Assignment 5 *(Neural Networks)*

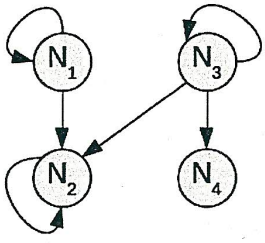
Assignment 5.1 *(2p)*
Provide the Hebb rule and explain it.

Assignment 5.2 *(3p)*
Describe the components, structure and layout of a multi-layer perceptron.

Assignment 5.3 *(6p)*
Provide the backpropagation algorithm in pseudocode (be sure to include the error calculations and update rules). Use the error threshold as stopping criterion.

Assignment 5.4 *(3p)*
Describe one method for avoiding local minima in the backpropagation algorithm.

Assignment 5.5 *(2p)*
Provide the connectivity matrix for the given network.



Assignment 6 *(Glyphs)*

Assignment 6.1 *(3p)*
What are glyphs? What are they useful for? Provide an example