Ludwig-Maximilians-Universität München
Institut für Informatik
Lehrstuhl für Mobile und Verteilte Systeme
Dr. Juan Bernabé-Moreno

mobile and distributed systems group

Exercise Sheet 4
Intelligent Systems - WS 23/24

Exercise 1: Local Search - Special Cases

(Pkt.)

Give the name of the algorithm resulting from the following special cases:

a. Local Beam Search with $k = 1$

b. Local Beam Search with exactly one initial state and no restriction on the number of maintained states

c. Simulated Annealing with always $T = 0$

d. Simulated Annealing with always $T = \infty$

Exercise 2: Archetypal Analysis

(Pkt.)

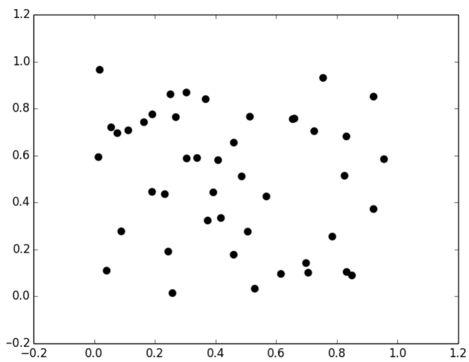

Abbildung 1

a. What is the constraint on minimizing the residual sum of squares with respect to the assignment of an observation to the archetypes?

b. What is the constraint for minimizing the residual sum of squares in terms of assigning an archetype to observations?

c. Explain the structure of the Scree plot and how the elbow criterion works.

d. In Archetypal Analysis, the number k of archetypes must be known before execution. Give three ways how k can be determined.

e. Given is the following 2D point cloud in *Abbildung 1*. Use the templates in *Abbildung 2* and draw k archetypes each with $k = 1, 3, 4, 5$ where you reasonably expect them to be (an estimate is enough).

f. Then draw the approximated convex hull in each case (only for $k = 3, 4, 5$). Which number of archetypes k seems to be best suited for the data set at hand and why?

Exercise 3: Metaheuristics

(Pkt.)

Which of the following statements are true?

a. Simulated Annealing maintains multiple solution candidates at the same time

b. Evolutionary algorithms maintain multiple solution candidates at the same time

c. Simulated Annealing guarantees to find the global optimum at infinite runtime

d. The temperature T in SA controls the tradeoff between exploration and exploitation

Exercise 4: Game Theory 1

(Pkt.)

Let the following game be given:

	Player B, Move 1	Player B, Move 2
Player A, Move 1	5, 6	7, 2
Player A, Move 2	4, 5	9, 1

Decide whether the following statements are true or false:

a. *Player A* has a dominant strategy

b. *Player B* has a dominant strategy

Exercise 5: Game Theory 2

(Pkt.)

a. Calculate the expected reward for the following game with the mixed strategies:
$A = \{0.4, 0.6\}$
$B = \{0.9, 0.1\}$

	A1	A2
B1	A:5, B:3	A:4, B:6
B2	A:0, B:4	A:2, B:2

b. Calculate the Nash equilibrium in mixed strategies for the following game:

	B1	B2
A1	A:4, B:4	A:1, B:0
A2	A:2, B:2	A:6, B:9

Exercise 6: Game Theory 3

(Pkt.)

Let the following game be given (the values represent earnings in million €):

	Mercedes, Ads	Mercedes, no Ads
BMW, Ads	2, 4	4, 2
BMW, no Ads	0.5, 9	3, 6

a. What is the Nash equilibrium (in pure strategies) of the above game?

b. If both companies could commit not to advertise by entering into a binding contract, should they do so? If so, why?

c. Implement a program in Python which finds a Nash Eq assuming pure strategies.

d. Find a game with 3 players and 2 actions with no Nash Eq. Verify your solution using the program from *(c)*.

Exercise 7: Genetic Algorithms

(Pkt.)

The four most important components of an Evolutionary Algorithm are:

- Evaluation
- Selection
- Recombination
- Mutation

Consider the Maximum Clique Problem. How would you implement these four components for this problem?

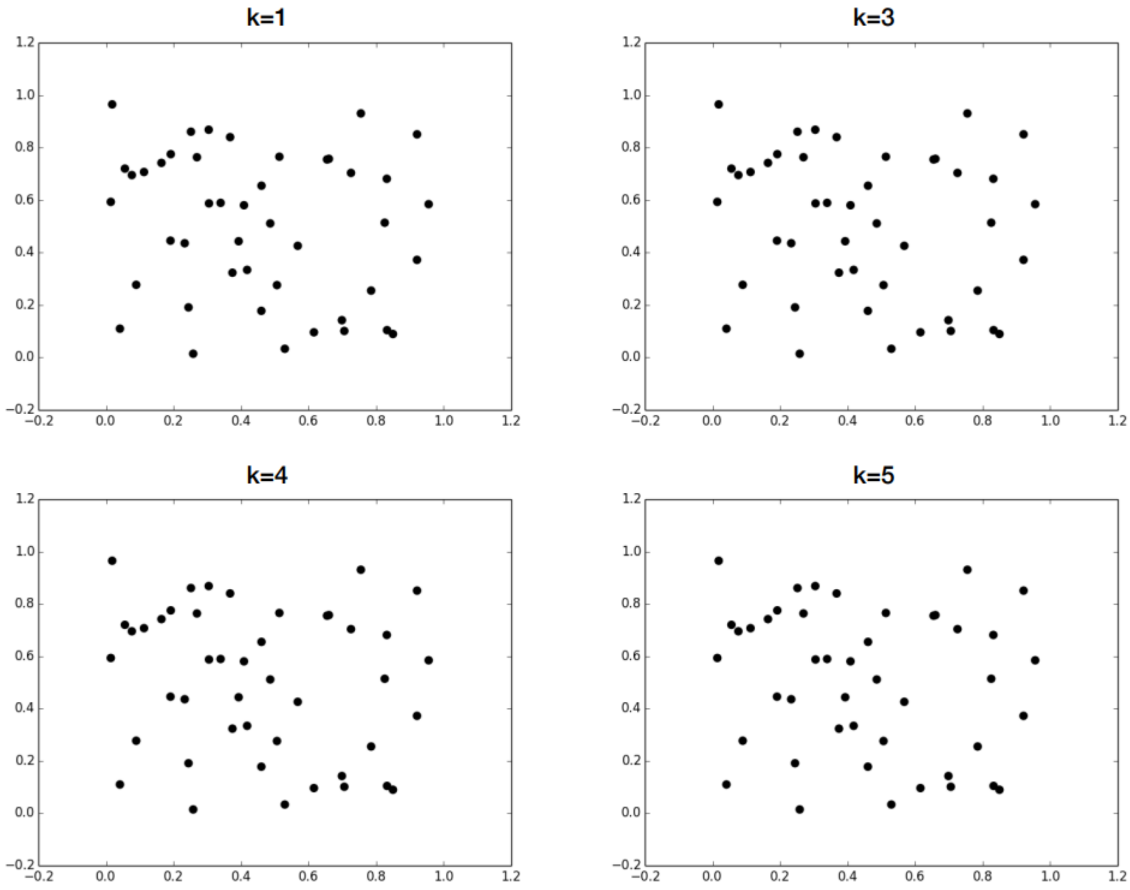

Abbildung 2