

**Autonomous Intelligent Systems,
Institute for Computer Science VI, University of Bonn**

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Exercises for Artificial Life (MA-INF 4201), SS24

Exercises sheet 10, till: Mon 23. June, 2025

16.6.2025

Assignment 65 (2 Points)

Show by calculation, that the relation

$$N(s) = a \frac{1}{s^\alpha}$$

will show a linear dependency in a *log - log* plot.

Assignment 66 (2 Points)

A function $f(z)$ is called *scale invariant* if scaling the argument z with a constant factor k yields a proportional scaling of the function value

$$f(kz) \sim f(z).$$

Show, that the function $N(s) = a \frac{1}{s^\alpha}$ is *scale invariant*.

Give another function, or family of functions, that is *scale invariant*.

Assignment 67 (3 Points)

Zipf's Law describes the relation between the frequency of a word within a text, and the rank of that very word.

Propose a set-up to check if *Zipf's Law* is valid for source-code of computer programs.

What are the problems you will have to focus for this task?

What data do you propose for such an investigation?

Assignment 68 (1 Point)

Derive a formula to implement an exponential decay (pheromones for an ant algorithm) that calculates the pheromone concentration to decay to 10% after 17 steps of iteration.

Assignment 69 (2 Points)

Explain in your own words, how the Ant Algorithms (e.g. Ant Colony Optimization) can be used to find the shortest route in a given graph.

Assignment 70 (3 Points)

Advise: As an exercise for the exam, try to answer this Assignment (70) in 5 minutes.

Explain why the *evaporation of pheromones* in Ant Algorithms is helpful, if the environment is dynamic.

Use an easy exemplary set-up to support your explanation.

Assignment 71 (2 Points)

Which part in an Ant Algorithm is contributing to the principle of *Exploitation* and which part is contributing to *Exploration*?

Explain your answer using one sentence for each part.