AI Programming
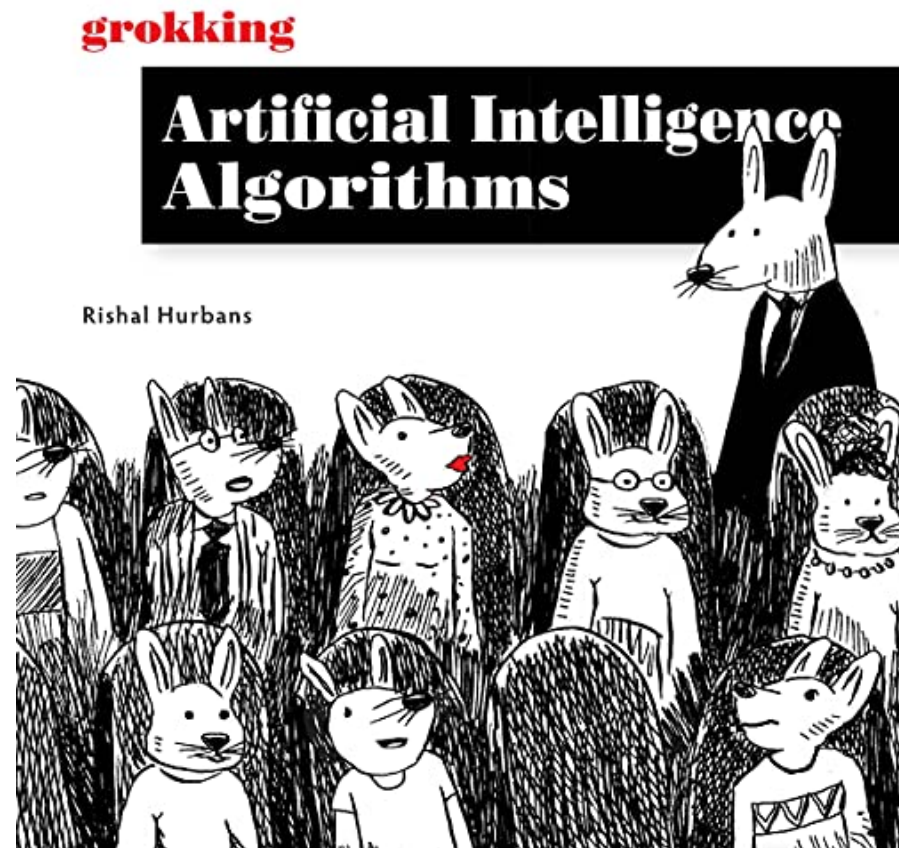
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VIVES University of Applied Sciences Bachelor in electronics-ICT

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Chapter 1 – Intuition of artificial intelligence

- Why is there no unanimous **definition** for artificial intelligence?
- What is the difference between **quantitative data** and **qualitative data**? Give some concrete examples of both types of data.
- What is the difference between **data**, **information** and **knowledge**?
- What is an **algorithm**? What is an **AI algorithm**? What are the **components** of an algorithm?
- Give a few **categories of problems** that people are trying to solve via (AI) algorithms.
- What is the difference between a **local best solution** and a **global best solution**?
- What is the difference between **super intelligence**, **general intelligence** and **narrow intelligence**?
- What is the relationship between **biology-inspired algorithms**, **machine learning**, **deep learning** and **search algorithms**?
- Which three types of **'learning'** fall under **machine learning** and concisely explain each type of 'learning'?

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Chapter 2 – Search fundamentals

- What is a **data structure** and give some concrete examples of data structures?

- Explain the following terms: **graph**, **vertex, node** and **edge**.

- <u>Given</u>: a **graph**
  - ○ <u>Assignment</u>: determine the '**array of edges**', the '**incidence matrix**' and the '**adjacency matrix**'

- <u>Explain</u>: a tree is **a connected acyclic graph**

- Explain the following 'tree' terms: **root node**, **parent node**, **sibling node**, **descendent**, **ancestor**, **leaf node**, **goal node**, **path**, **cost**, **degree** and **depth**.

- Explain the **Breadth-First Search** (BFS) algorithm and which data structure is used?

- <u>**Given**</u>: a search tree
  - ○ <u>Assignment</u>: apply the Breadth-First Search (BFS) algorithm to find any solution

- Explain the **Depth-First Search** (DFS) algorithm and which data structure is used?

- <u>**Given**</u>: a search tree
  - ○ <u>Assignment</u>: apply the Depth-First Search (DFS) algorithm to find any solution

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Chapter 3 – Intelligent search

- **Heuristics**
  - What is a heuristic?
  - Why can heuristics improve the efficiency of search problems?
  - Give a few concrete examples of heuristics.

- **A* Search**
  - Explain how the A* search algorithm works.
  - How is the cost function determined?

- **A* Search**
  - given: a search tree with the cost per node.
  - question: determine the sequence of searching the search tree, using the A* algorithm.

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Chapter 3 – Intelligent search

- **Min-Max Adversarial Search**

  - Explain how the min-max adversarial search algorithm works.

- **Min-Max Adversarial Search**

  - <u>given</u>: a search tree with the cost for each leaf node.

  - <u>question</u>: determine the value of each node in the min-max search tree.

- **Alpha-Beta Pruning**

  - Explain how the alpha-beta pruning adversarial search algorithm works.

  - What is alpha? What is beta?

  - What makes alpha-beta pruning a much more efficient search algorithm?

- **Alpha-Beta Pruning**

  - <u>given</u>: a search tree with the cost for each leaf node.

  - <u>question</u>: determine the value of each node in the search tree and explain why certain branches in the search tree may be pruned.

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Chapter 4 – Evolutionary algoritms

- **Genetic Algorithm: Life cycle**
  - Briefly explain the **life cycle** of a genetic algorithm.
- **Enter diversity**
  - Genetic algorithms use **crossover** and **mutation** as principles to ensure the **diversity** of the next generations.
    - Explain this principle.
    - Give some examples of crossover and mutation.
- **Genetic Algorithm parameters**
  - Name 5 parameters to configure a genetic algorithm.
  - How does each parameter affect the generation of solutions?
- **Fitness function**
  - What is a **fitness function** within genetic algorithms?
  - Why is the correct choice of the right fitness function crucial for the performance of the algorithm?

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Chapter 5 – Advanced evolutionary approaches

- **Selection mechanisms**
    - Briefly discuss the principle of following selection mechanisms in the evolutionary algorithm and discuss the advantages and disadvantages of each selection mechanism:
        - roulette-wheel selection
        - rank selection
        - tournament selection
        - elitism selection
- **Mutation mechanisms**
    - Briefly discuss the principle of following mutation mechanisms in the evolutionary algorithm:
        - boundary mutation
        - arithmetic mutation
- **Tree encoding and tree crossover**
    - Briefly discuss the principle of:
        - tree encoding
        - tree crossover

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Chapter 6 – Swarm intelligence

- **Swarm intelligence**
  - Explain what swarm intelligence is and on what principles is this form of intelligence based.
  - Why is the analogy to ants selected in the ant optimization algorithm?
- **Ant colony optimization algorithm**
  - Discuss the different steps in the ant colony optimization algorithm
  - Discuss the mathematical formula for destination selection based on pheromones and distance heuristics.
  - How is the best solution ultimately determined?
  - What criteria can be used to stop the algorithm?
- **Ant colony optimization algorithm – selection of the destination**
  - given: a figure showing the distances between different objects and the intensity of the pheromones on each of the paths.
  - question: discuss how the destination with the highest probability is determined. Use the mathematical formula for selecting the destination and choose your own value for **alpha** and **beta**.
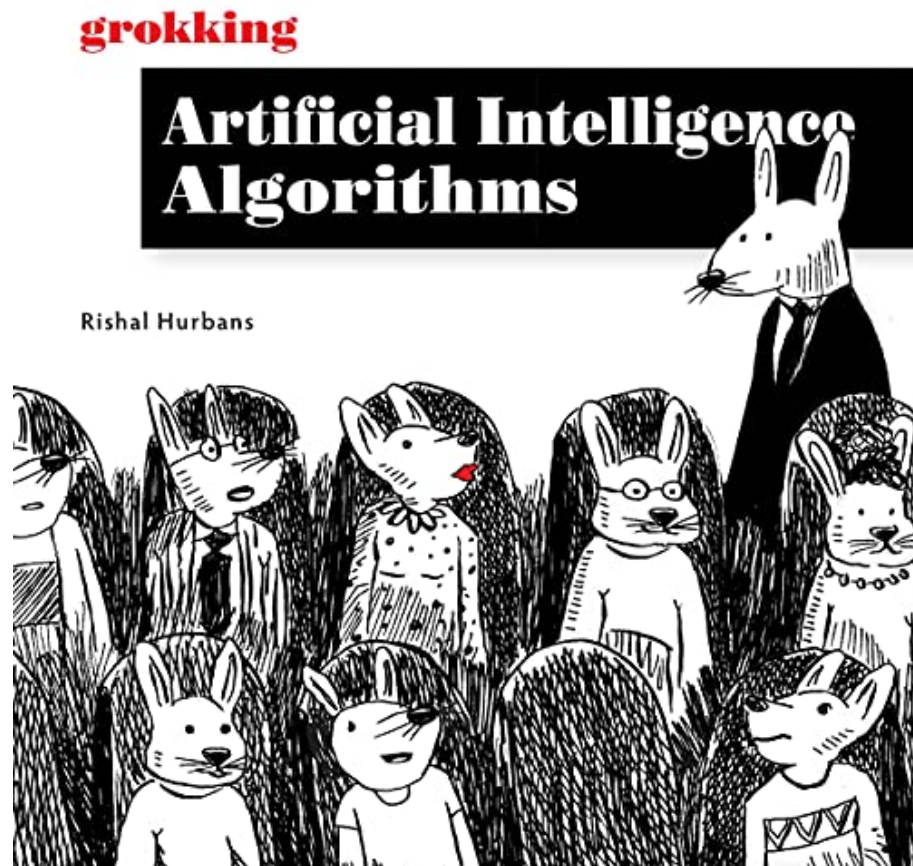
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Chapter 7 – Swarm intelligence: Particles

- **Particle swarm intelligence: bird flocks**
  - What do the following terms mean for simulating the movement of individual birds in relation to bird flocks?
    - Alignment
    - Cohesion
    - Separation

- **Particle swarm optimization algorithm**
  - Discuss the different steps in the particle swarm optimization life cylce algorithm
  - Discuss how the position of the particles is updated
  - How is the best solution ultimately determined?
  - What criteria can be used to stop the algorithm?

- **Particle swarm optimization algorithm**
  - Explain the following relation:
    - new velocity = inertia component + cognitive component + social component
  - What is the function of?
    - The inertia component
    - The cognitive component
    - The social component

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