Overview

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Contents

Beyond Classical Search 超越经典搜索

- In previous chapter, we addressed a single category of problems, where the solution is a sequence of actions with following features:

  上一章，我们讨论了一个单一类别的问题，其解决方案是具有如下特点的一系列动作：

  - observable,
    可观测、
  - deterministic,
    确定性、
  - known environments.
    已知环境。
- In this chapter, we will discuss:
  - Local search, and Swarm intelligence.

    本章我们将讨论：局部搜索和群体智能。

Classic Search 经典搜索

- The search algorithms we have learned are designed to explore search spaces systematically.

  我们已经学到的搜索算法被设计成系统地探索问题的空间。

  - This systematicity is achieved by keeping one or more paths in memory, and recording which alternatives have been explored at each point along the path.

    该系统性是由以下方法得到的：在内存中保持一条或多条路径，并且在沿着该路径的每个点上记录哪些已被探索过。

  - When a goal is found, the *path* also constitutes a *solution* to the problem.

    目标被找到时，该路径也就构成问题的一个解。

- In many problems, however, the path to the goal is irrelevant.

  然而，在许多问题中，到达目标的路径是无关紧要的。

Local Search 局部搜索

- Local search is a different class of algorithms that do not worry about paths.

  局部搜索是一种不同类型的算法，它不介意什么路径。

- Local search algorithms operate using a single current node (rather than multiple paths), and generally move only to neighbors of that node.

  局部搜索算法使用一个当前节点（而不是多条路径），并且通常仅移动到该节点相邻的节点。

Local Search 局部搜索

- Typically, the paths followed by the search are not retained.
  通常，搜索后不保留该路径。
- Local search algorithms have two key advantages:
  - use very little memory;
  - can find reasonable solutions in large or infinite (continuous) state spaces.

局部搜索算法有如下两个主要优点：使用很少的内存；
在大的或无限（连续）状态空间中，能发现合理的解。

Applications of Local Search 局部搜索的应用

- In many application problems, the path is irrelevant, the goal state itself is the solution, such as:

  许多应用问题是与路径无关的，目标状态本身就是解。例如：

integrated-circuit design	■	集成电路设计
factory-floor layout	■	工厂车间布局
job-shop scheduling	■	车间作业调度
automatic programming	■	自动规划
telecommunications	■	通讯
network optimization	■	网络优化
vehicle routing	■	车辆路由
portfolio management	■	投资组合管理

Optimization Problem of Local Search 局部搜索的优化问题

- In addition to finding goals, local search algorithms are useful for solving pure optimization problems.

  除了寻找目标之外，局部搜索算法对解决纯优化问题也很有效。

- The aim in optimization is to find the best state according to an objective function.

  优化的目的是根据一个目标函数找到其最好的状态。

- But many optimization problems do not fit using the search algorithms introduced in previous Chapter.

  但是许多优化问题并不适合采用上一章介绍的搜索算法。

- E.g., Darwinian evolution could be seen as attempting to optimize, but for this problem there is no “goal test”, and no “path cost”.

  例如，达尔文进化论可以被看作是试图优化，但对于这一问题，即没有“目标测试”、也没有“路径代价”。

Swarm Intelligence 群体智能

- Study of computational systems inspired by the ‘collective intelligence’.
  研究来自于“集群智能”灵感的计算系统。
- Collective Intelligence emerges through the cooperation of large numbers of homogeneous agents in the environment. Examples: schools of fish, flocks of birds, and colonies of ants.
  集群智能是环境中大量的同类智能体通过合作来实现的。例如：鱼群、鸟群、以及蚁群。
- Such intelligence is decentralized, self-organizing and distributed through out an environment.
  这样的智能是分散式、自组织、并且在一个环境内分布。
- In nature, such systems are commonly used to: effective foraging for food, prey evading, colony relocation, etc.
  事实上，这类系统通常用于：有效觅食、猎物躲避、群体搬迁、等等。

Algorithms of Swarm Intelligence 群体智能的算法

- Altruism algorithm 利他算法
- Ant colony optimization 蚁群优化
- Bee colony algorithm 蜂群算法
- Artificial immune systems 人工免疫系统
- Bat algorithm 蝙蝠算法
- Differential evolution 差分进化
- Multi-swarm optimization 多群体优化

Algorithms of Swarm Intelligence 群体智能的算法

- Gravitational search algorithm 引力搜索算法
- Glowworm swarm optimization 萤火虫群优化
- Particle swarm optimization 粒子群优化
- Bacterial colony optimization 细菌群优化
- River formation dynamics 河流形成动力学
- Self-propelled particles 自行式粒子系统
- Stochastic diffusion search 随机扩散搜索

Typical Algorithms of Swarm Intelligence 群体智能的典型算法

Ant Colony Optimization 蚁群优化

inspired by the behavior of ants, such as:

- stigmergy,
- foraging.

受蚁群的行为所启发，诸如：间接协调、觅食。

Particle Swarm Optimization 粒子群优化

inspired by the social behavior of birds and fishes , such as:

- flocking,
- herding.

受鸟群和鱼群的社会行为所启发，诸如：群集、从众。

Thank you for your attention!