

进化算法(evolution algorithm (EA))学习笔记

前言介绍

遗传算法介绍

GP

进化硬件

前言：

GitHub <https://github.com/kongzz311/MachineLearningNotes>

假如有帮助欢迎加星

水平有限，若有错误欢迎指出：kozenzei@outlook.com

1. 进化算法(evolution algorithm (EA))学习笔记

1.1. 前言介绍

介绍：功能：无论回归，分类，聚类都能做

用来做建模上的统筹优化更加是得奖的节奏

局部最优

np hard

进化：

- initial population
- Fitness calculation
- mutation and reproduction
- Go to fitness calculation and repeat.

It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is the most adaptable to change.

—— Charles Darwin

孟德尔的粒子说

Learning from Nature

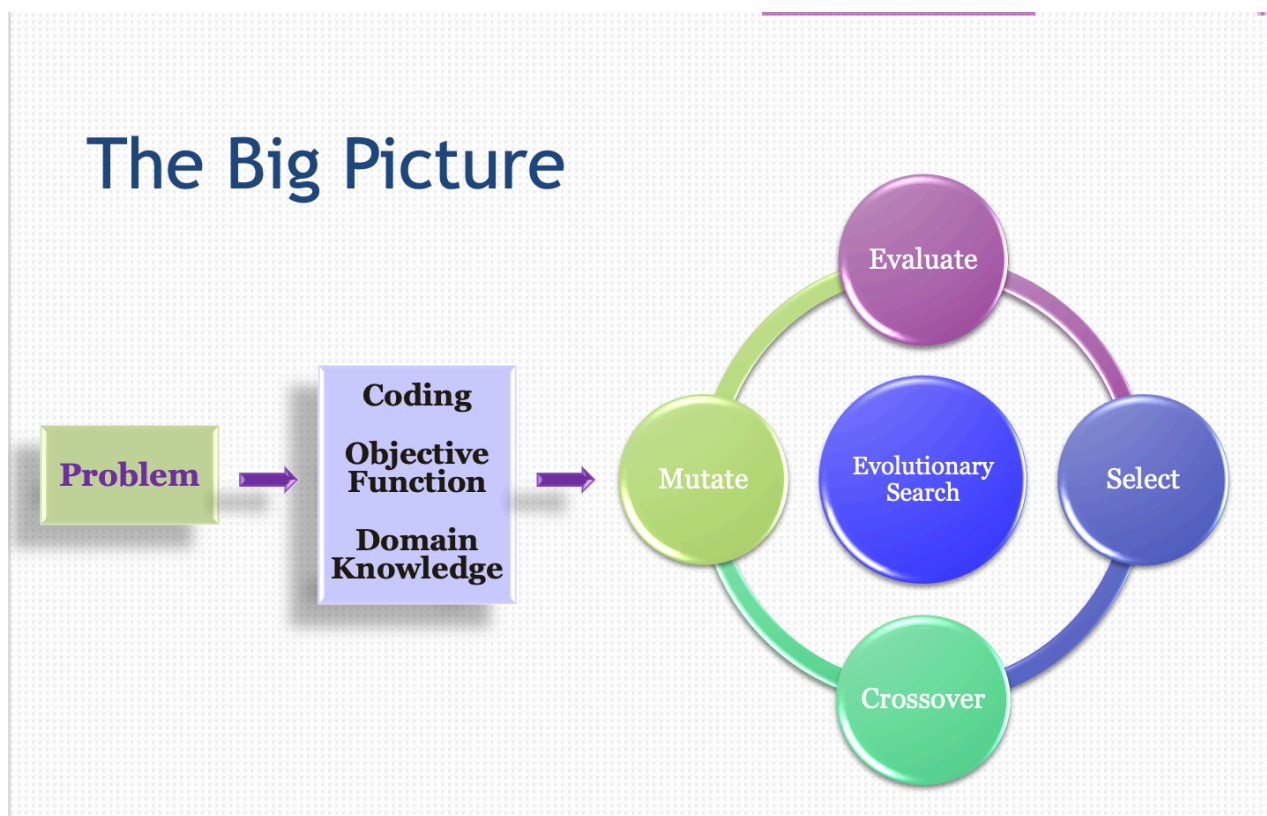
Motivation of EAs

- what can EAs do for us
 - optimization
 - help people understand the evolution in nature;

- what is optimizations?
 - the process of searching for the optimal solution from a set of candidates to the problem of interest based on certain **performance criteria**
 - Accomplish a predefined task to the highest standard
 - Job shop Problem
 - Produce maximum yield given limited resources.
 - Investment strategy
 - 工厂生产

Key Concepts

- Population-Based Stochastic Optimization Methods (多点 随机)
- Inherently Parallel (并行, 不容易局部最优)
- A Good Example of Bionics in Engineering
- Survival of the Fittest
- Chromosome, Crossover, Mutation
- Metaherristics (启发式算法)
- Bio-/Nature Inspired Computing



EA Family

- GA: Genetic Algorithm
- GP: Genetic Programming
- ES: Evolution Strategies
- EP: Evolution Programming
- EDA: Estimation of Distribution Algorithm
- PSO: Particle Swarm Optimization 离子群优化
- ACO: Ant Colony Optimization 蚂蚁群体搜索 信息素浓 蚁群算法

- DE: Differential Evolution

目标函数

input $x \rightarrow f \rightarrow$ output y

Portfolio Optimization

Travelling Salesman Problem (np hard)

Knapsack Problem

Bin Packing Problem

局部最小问题

怎么解决:

- 并行搜索

1.2. 遗传算法介绍

Biology Background Introduction

- gene
 - a working subset of DNA
- gene trait
 - Colors of eyes
- allele
 - Possible settings for a trait
- genotype
 - The actual genes carried by an individual
- phenotype
 - The physical characteristics into which genes are translated

GA:

- Chromosome
- Crossover
- Mutation
- Selection(Survival of the Fittest)

Basic Components

- Representation
 - How to encode the parameters of the problem?
 - Binary Problems (Select or it)
 - 10001 00111 11001
 - Binary vs. Gray

- Continuous Problems
 - 0.8 1.2 -0.3 2.1
- Individual(Chromosome)
 - A vector that represents a specific solution to the problem
 - Each element on the vector corresponds to a certain variable/parameter
- Genetic Operators
 - Crossover:
 - Exchange genetic materials between two chromosomes
 - Mutation:
 - Randomly modify gene values at selected locations
- Selection Strategy
 - Which chromosomes should be involved in reproduction?
 - Which offspring should be able to survive?
 - Roulette Wheel Selection
 - 值越高概率越高
 - 资源过于集中
 - Rank Selection
 - 限定差距
 - Tournament Selection
 - PK
 - Elitism精英选择
 - 保送到下一代
 - Offspring Selection
 - 子代父代一起挑
- CrossOver
 - One point CrossOver
 - two point CrossOver
 - Uniform CrossOver
 - 杂交不合法
 - 修复
 - 重来
- Mutation
 - random select and change it
 - 保持多样性
 - 防止错误收敛
- Offspring Selection: Create a new population from offspring and P

调参数

Parameters

- Population Size:

- Too big: Slow convergence rate
 - Too small: Premature convergence
- Crossover Rate"
 - recommend 0.8
- Mutation Rate:
 - Recommend 1/L
- Selection Strategy
 - Tournament Selection
 - Truncation Selection(Select top T individuals)
 - Need to be careful about the selection pressure.
- No Free Launch
- Randomness
- Why does it works?

1.3. GP

GP is a branch of GAs

1.4. 进化硬件

chip

天线

车动力学