**Report: Comparison of Genetic Algorithm and Ant Colony Optimization for the Knapsack Problem**

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1. Genetic Algorithm Configuration

For the Genetic Algorithm (GA), the following configuration was used:

* Population size: 100
* Generations: 1000
* Tournament size: 5
* Mutation rate: 0.01

The selection method used is tournament selection, which is a simple and widely-used method in genetic algorithms. The crossover operation used is one-point crossover, which provides a good balance between exploration and exploitation. Bit-flip mutation was chosen as it is a simple and effective mutation method for binary encoding (insert [1])

1. Any Colony Optimization Configuration

For the Ant Colony Optimization (ACO) algorithm, the following configuration was used:

* Number of ants: 90
* Number of iterations: 800
* Decay factor: 0.75
* Alpha: 1
* Beta: 1.3
* Rho: 0.5

The parameters alpha and beta were chosen based on the recommendations from the following research paper: Schiff, K., & Bäck, T. (2005). "An Ant Colony Optimization Algorithm Applied to the Knapsack Problem." [2]

1. Experimental Setup

The GA and ACO algorithms were implemented in C++ and tested on 11 problem instances from the literature. The experiments were conducted on a standard personal computer. The following table presents the parameters used in the GA and ACO algorithms:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Algorithm | Pop Size | Generations | Tournament Size | Mutation Rate |
| GA | 100 | 1000 | 5 | 0.01 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Algorithm | No. of ants | No. of iterations | Decay factor | Alpha | Beta | Rho |
| ACO | 90 | 800 | 0.75 | 1 | 1.3 | 0.5 |

1. Results

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Problem Instance** | **Algorithm** | **Best Solution** | **Known Optimum** | **Runtime(seconds)** |
| f1\_l-d\_kp\_10\_269 | ACO  GA | 295  295 | 295 | 0.20  0.53 |
| f2\_l-d\_kp\_20\_878 | ACO  GA | 1024  1024 | 1024 | 0.56  0.60 |
| f3\_l-d\_kp\_4\_20 | ACO  GA | 35  35 | 35 | 0.05  0.41 |
| f4\_l-d\_kp\_4\_11 | ACO  GA | 23  23 | 23 | 0.04  0.46 |
| f5\_l-d\_kp\_15\_375 | ACO  GA | 481.069  481.069 | 481.0694 | 0.32  0.59 |
| f6\_l-d\_kp\_10\_60 | ACO  GA | 52  52 | 52 | 0.17  0.50 |
| f7\_l-d\_kp\_7\_50 | ACO  GA | 107  *105* | 107 | 0.10  0.47 |
| knapPI\_1\_100\_1000\_1 | ACO  GA | 9147  - | 9147 | 14.43  1.62 |
| f8\_l-d\_kp\_23\_10000 | ACO  GA | *9746*  9767 | 9767 | 0.72  0.65 |
| f9\_l-d\_kp\_5\_80 | ACO  GA | 130  130 | 130 | 0.06  0.46 |
| f10\_l-d\_kp\_20\_879 | ACO  GA | *1019*  1025 | 1025 | 0.54  0.64 |

1. Statistical Analysis

Todo

1. Critical Analysis
2. References:

[1]

[2]