An Adaptive Evolutionary Algorithm Applied to the Fixed Charge Transportation Problem

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Contents
I. Introduction
II. The fixed charge transportation problem
III. Adaptive Link Adjustment Evolutionary Algorithm (ALA-EA)
   I. ALA-EA algorithm
   II. ALA-EA algorithm design
IV. Experimental Results
V. Conclusion

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2. Background(1)

Fixed Charge Transportation Problem

Problem Definition: FCSP

\[ \text{Minimize } Z = \sum_{i \in I} \sum_{j \in J} c_{ij}x_{ij} + \sum_{k \in K} (b_kx_k) \]  

subject to

\[ \sum_{j \in J} x_{ij} = a_i \quad \text{for } i \in I \]  
\[ \sum_{i \in I} x_{ij} = b_j \quad \text{for } j \in J \]  
\[ x_{ij} \geq 0 \quad \text{for all } (i, j) \]  
\[ x_{ij} \geq 0 \quad \text{for all } (i, j) \]  

Without loss of generality, we assume that

\[ \sum_{i \in I} x_{ij} = \sum_{j \in J} x_{ij} = 0 \]  

2. Background(2)

General Genetic Algorithm

Initiation  \[ \rightarrow \] Evaluation  \[ \rightarrow \] Selection  \[ \rightarrow \] Crossover  \[ \rightarrow \] Mutation

2. Background(3)

Algorithms based on Evolution

Search Spaces

Gamete Search Space  \[ \rightarrow \] Phenotype Search Space  \[ \rightarrow \] Fitness Search Space

3. Background(4)

The evidence that learning can help the evolution

4. Background(5)

Algorithms based on Evolution

<table>
<thead>
<tr>
<th>Algorithms based on Evolution</th>
<th>Darwinian Algorithm</th>
<th>Lamarckian Algorithm</th>
<th>Baldwinian Algorithm</th>
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<tbody>
<tr>
<td>Darwinian Adaptation</td>
<td>Selection</td>
<td>Individual</td>
<td>Genetic theory</td>
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<td>Lamarckian Adaptation</td>
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3. Adaptive Link Adjustment EA (ALA)

**Main Idea**
- We don't need to find the same solution again.
  - Adaptive Link Adjustment using Lamarckian Adaptation.

The differences between EA and ALA

1. All gene values are initialized \( \theta \) value
2. Incorporating a learning process for adaptation into evaluation process
3. Gene values indicates a frequency that a gene appears in a good solution.
5. Experimental Results

Table 5. Experimental Results on FC1P Instances

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<tr>
<th>Instance</th>
<th>clique</th>
<th>Max Max</th>
<th>Max Min</th>
<th>Avg Max</th>
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Figure 5. Results tested on various θ values

Table 6. Degree of Improvement of the optimized ALA vs. the previous algorithm.

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<tr>
<th>Instance</th>
<th>Max Max</th>
<th>Max Min</th>
<th>Avg Max</th>
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Figure 6. Experimental results in case using different n and θ, and result comparison with the variation of the ALO/αLON algorithm.
6. Conclusion and Future Works

Summary
- Introduce a new evolutionary algorithm applied to FCTP.
- ALA is incorporating a dynamic learning process.
- ALA finds the best solution on the previous benchmark instances.
- ALA can be a very useful method for optimization problems in logistics.

Conclusion
- ALA can be the best in FCTP or alternative method for network optimization problems.

Future Works