OPTIMISATION METHODS & ALGORITHMS WORKGROUP GROUP 3

STSP SOLVED BY HYBRID METAHEURISTICS

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OUR META-HEURISTICS

- STSP
  - Symmetric distance matrix (Euclidean Distance)
  - I: #numbers
- GENERAL APPROACH: HYBRID META-HEURISTICS
  - Genetic Algorithm plus Tabu Search
  - At each iteration:
    I. GA first generates one offspring, then two sons are chosen
    II. Tabu Search is employed on both the two sons in order to improve them
      - Tabu Search employs both INTENSIFICATION and DIVERSIFICATION techniques to get better solutions

BASIC BLOCKS

- **Solution Representation**
  - Ordered List of Customers
  - OF Evaluation
    - Full and Incremental
- **Offspring generation for the GA**
  - Crossover randomly chosen at each iteration among different ones
- **Neighbourhood generation for the TS**
  - 2-opt moves in INTENSIFICATION phase

    Basic Concept: two edges, let's say A-B & D-E, are replaced by A-D & B-E
  - Special 2-opt move in DIVERSIFICATION phase

    This move deletes the two most frequent non consecutive edges and applies a 2-opt move on them

GA BASIC BLOCKS (CONT.)

- **Initial Solution**
  - Nearest City approach
- **Crossover**
  - SCX, ERX, PMX, OX
- **Killing policy**
  - The two worst sons of each offspring are killed, and replaced by the two ones modified with the Tabu Search
- **Fitness Function for min problems**
  - 1/fitness function
- **Evolution of the population**
  - Pseudo-probabilistic approach (the behaviour is fixed according to the specific seed which is used)

TS BASIC BLOCKS (CONT.)

- **Aspiration Criteria**
  - Standard: solution extracted from the neighbourhood is globally improving
- **Tabu List**
  - Reactive Tabu List
    Tabu List with variable tenure (starting from 7)
    Tenure increased for non-improving iterations (min(MAX_TENURE, current tenure+2))
    Tenure decreased for new best solution found (max(7, 0.75*current tenure))
- **Tabu Move**
  - Attribute: deleted edges considered in the move
- **Backtrack**
  - It happens if the max number of non-improving iterations is performed consequently
    An old best solution is set and slightly modified to generate new neighbours
    The number of maximum non-improving iterations decreases as the search goes deep in the tree

PARAMETERS TUNING

- GA
  - Max Generations: 100
  - Population Size: 100
  - Crossover Probability: 0.8
  - Random Selection chance: 10

    It lets occasionally select sons for the Tabu exploration which are not the best of the offspring
  - Chromosome mutation probability: 0.15

    Sometimes new sons can be modified again after the crossover, before selecting the individuals for the Tabu Search
- TS
  - Max Iterations for each search: 700
  - Max non-improving iterations: 400
  - Min non-improving iterations: 100
  - Neighbourhood size: n*(n-1)/2
  - Max Tenure: number of customers/2

RESULTS

Istanze	Best (%)	Mean (%)	Time
berlin52	0,00	0,00	2
eil51	0,00	0,00	2
eli76	0,00	0,00	5
pr152	0,00	0,10	23
pr1002	3,07	3,37	301
rat195	0,04	0,39	39
Mean	**0,52**	**0,64**	**62**

- Note
  - The previous results for each instance are to be intended as a mean value, due to the non-completely deterministic approach of the meta-heuristics, which depends on the seed
- Very efficient for small problems, still accurate for bigger instances