INF273 – Assignment #4

Use the following adjusted Simulated Annealing and define your own operators!

You should define 3 operators!

You need to show creativeness in designing the new operators!

Problem dependent operators are highly recommended! Problem dependent operators use the input data, and they take advantage of the having knowledge about the problem.

You should explain (in short) why you think your operator will help (support your idea).

There are two versions of the algorithm that you should implement. One with equal weights for all three operators during the search ($P_1 = P_2 = P_3$) and the second is to run it with tuned weights (by try and error)

You should fill in the below table. You should keep all the previous results (from assignment 2 and 3) in the table.

Report the best solutions you get from the simulated annealing with the new operators (best of the two new implementations).

Like assignment #3, run 10 times for each of the 6 instances. (Report the time in seconds)

The quality and robustness of the operators are more important than their running time.

Although there is no limit and you are totally free to design your operator, we reserve the right to reject an idea and ask for resubmission (has never happened before!)

You must submit a PDF file starting with the tables and best solutions of this new implementation and then follow up by short explanation (support) of the operators. Make sure the solutions can be selected and copied from the PDF file. Do not put screenshots in the PDF.

This time you must submit your code (in a zip file) as well but in a separate assignment called "Assignment #4, Codes"

Instance name (e.g. Call_7_Vehicle_3)				
	Average objective	Best objective	Improvement (%)	Running time in seconds
Random Search	Copy from A#2	Copy from A#2	Copy from A#2	Copy from A#2
Local Search-1-insert	Copy from A#3	Copy from A#3	Copy from A#3	Copy from A#3
Local Search-2-exchange	Copy from A#3	Copy from A#3	Copy from A#3	Copy from A#3
Local Search-3-exchange	Copy from A#3	Copy from A#3	Copy from A#3	Copy from A#3
Simulated Annealing-1-insert	Copy from A#3	Copy from A#3	Copy from A#3	Copy from A#3
Simulated Annealing-2-exchange	Copy from A#3	Copy from A#3	Copy from A#3	Copy from A#3
Simulated Annealing-3-exchange	Copy from A#3	Copy from A#3	Copy from A#3	Copy from A#3
SA-new operators (equal weights)				
SA-new operators (tuned weights)				

Simulated Annealing (modified for assignment #4)

Input: initial solution (s_0),
Input: neighborhood operators: *OP1*, *OP2*, and *OP3*
Parameters: T_f (final temperature) = 0.1
Parameters: P_1 (probability of using *OP1*), P_2, and P_3
Input: evaluation function f, $f(s) \longrightarrow$ the cost of s
$Incumbent \Leftarrow s_0$, $BestSolution \Leftarrow s_0$
for w = 1 to 100
    $NewSolution \Leftarrow$ select & apply an Operator on $Incumbent$ **(Roulette wheel selection)**
    $\Delta E \Leftarrow f(NewSolution) - f(Incumbent)$
    if $NewSolution$ is feasible and $\Delta E < 0$ then
        $Incumbent \Leftarrow NewSolution$
        if $f(Incumbent) < f(BestSolution)$ then
            $BestSolution \Leftarrow Incumbent$
        end if
    elseif $NewSolution$ is feasible
        if $Rand < 0.8$ then
            $Incumbent \Leftarrow NewSolution$
        end if
        $\Delta_w \Leftarrow \Delta E$
    end if
end for
DeltaAvg = mean (Δ_w)
$T_0 = \frac{-\text{DeltaAvg}}{\ln(0.8)}$, $\alpha = \sqrt[9900]{T_f / T_0}$
$T \Leftarrow T_0$
for iteration = 1 to 9900
    $NewSolution \Leftarrow$ select & apply an Operator on $Incumbent$ **(Roulette wheel selection)**
    $\Delta E \Leftarrow f(NewSolution) - f(Incumbent)$
    if $NewSolution$ is feasible and $\Delta E < 0$ then
        $Incumbent \Leftarrow NewSolution$
        if $f(Incumbent) < f(BestSolution)$ then
            $BestSolution \Leftarrow Incumbent$
        end if
    elseif $NewSolution$ is feasible and $Rand < p = e^{\frac{-\Delta E}{T}}$
        $Incumbent \Leftarrow NewSolution$
    end if
    $T = \alpha * T$
end for