Tabu Search

Sequences of solutions are examined similar to simulated annealing, with the difference that the next move is made to the best neighbour of the current solution. In order to avoid cycling, solutions that were recently examined are forbidden, or tabu, for a number of iterations.
To decrease the needed time and memory an attribute of tabu solutions is saved, rather than the solutions themselves.

Granular Tabu Search (GTS) of Toth and Vigo

Granular Tabu Search, or short GTS, is a concept by Toth and Vigo, which relates to the VRP (Vehicle Route Problem).

The main idea is that the longer edges in a graph are less likely to be in the optimal solution. So by eliminating those too long edges, several probably not so good solutions will never be considered by the search process, so we won't spend much time on bad solutions.

To decide which edges to eliminate we calculate a granularity threshold. This is given by $v = Bc$.

B is the sparcification parameter, which is typically chosen in the interval of 1.0 to 2.0
c is the average length of the edges of a solution which we gained by another heuristic

So if the length of an edge oversteps this threshold it is to long and will be eliminated. This leaves us with a new, much smaller Graph. Actually about 80% - 90% of all edges will leave this new graph.

It is now possible to find better solutions on this graph in a rather short amount of time.

Neighbour solutions are obtained by performing a limited number of edge exchanges within the same route or between two routes.

After a fixed amount of iterations, B will be lowered to its initial value (1,25)
we will then generate a new graph with this new threshold. By lowering B the value of the threshold will be smaller than it was before, again eliminating several edges. But also our c has changed. By finding better solutions the average length of our actual solution should be smaller than it was before, which will also decrease the value of our threshold.

This will repeat itself until the algorithm terminates or if after several iterations(less than above) the solution couldn't be improved, B will then be adjusted. By giving B a higher value, more edges will enter into the new Graph and a diversification of the search is initialised.

There is a procedure to examine all possible exchanges in $O(|E(v)|)$ time, where $E(v) = \{(I, j) \in E: cij <= v\} \cup I$.

I is a set of important edges like those incident to the depot or belonging to high-quality solutions.

The granular Tabu search generates excellent solutions within very short time.