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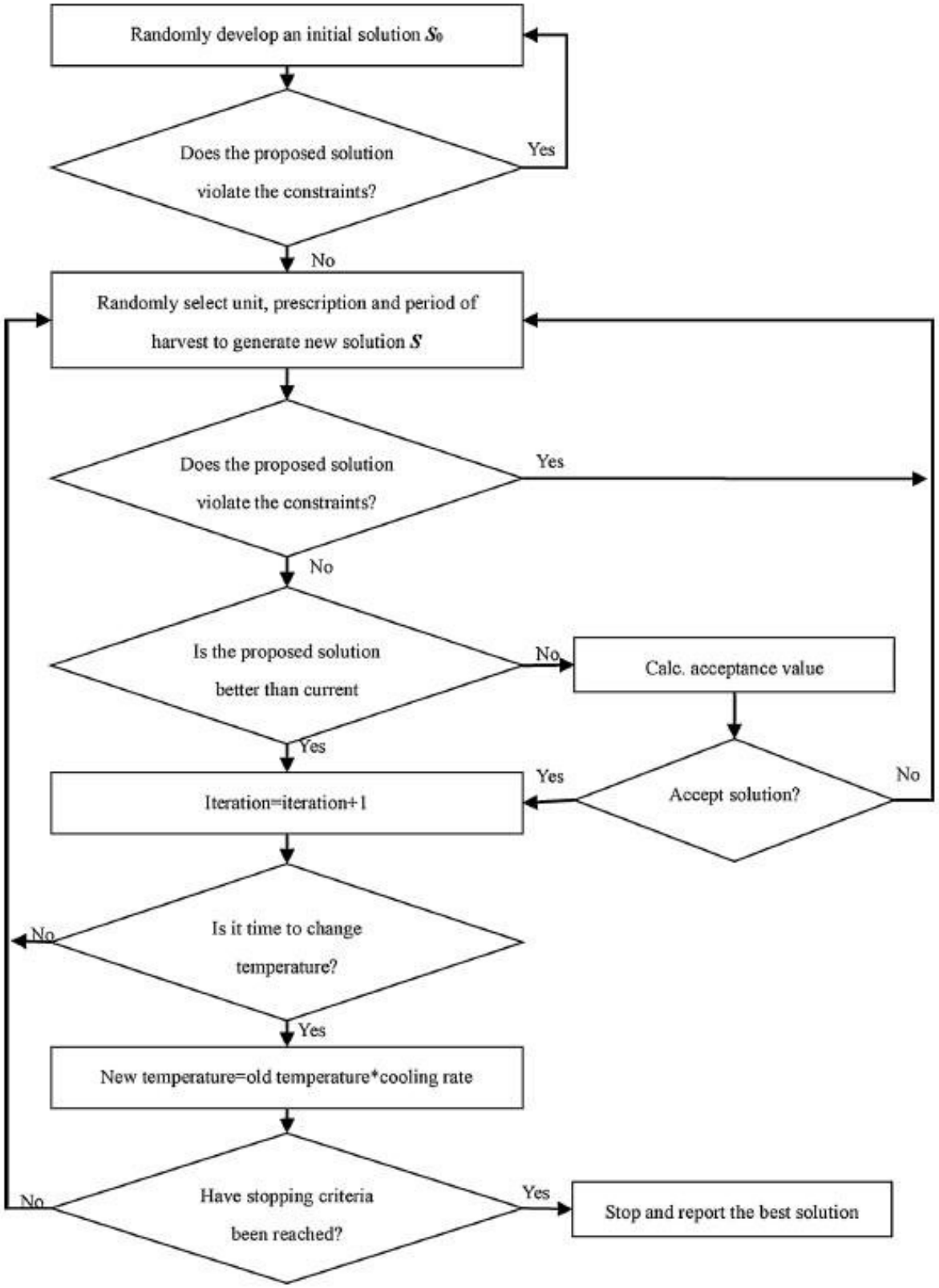
SA

Briefly introduction to the SA and Tabu algorithms by using a flowchart and pseudo-code, with discussion of the pros and cons.

Simulated annealing solves the problem of local minima(or maxima) by allowing worse moves (lesser quality) to be taken some of the time. That is, it allows some uphill steps so that it can escape from local minima. If the move is better than its current position then simulated annealing will always take it. The problem is, it may take more time than an exhaustive search. So although it may not be practical to find the best solution using simulated annealing.

Stopping criteria (limited_time) An algorithm needs to specify a stopping rule (time), i.e., a time when the process is terminated and a decision is adopted. It is unnecessary to let the temperature reach 0 because the chances of accepting a worse move is are almost the same, need to specify stopping_temperature. Temperature Decrement (cooling_rate). The higher the value of (cooling_rate), the longer it will take to decrement the temperature to the stopping criterion.

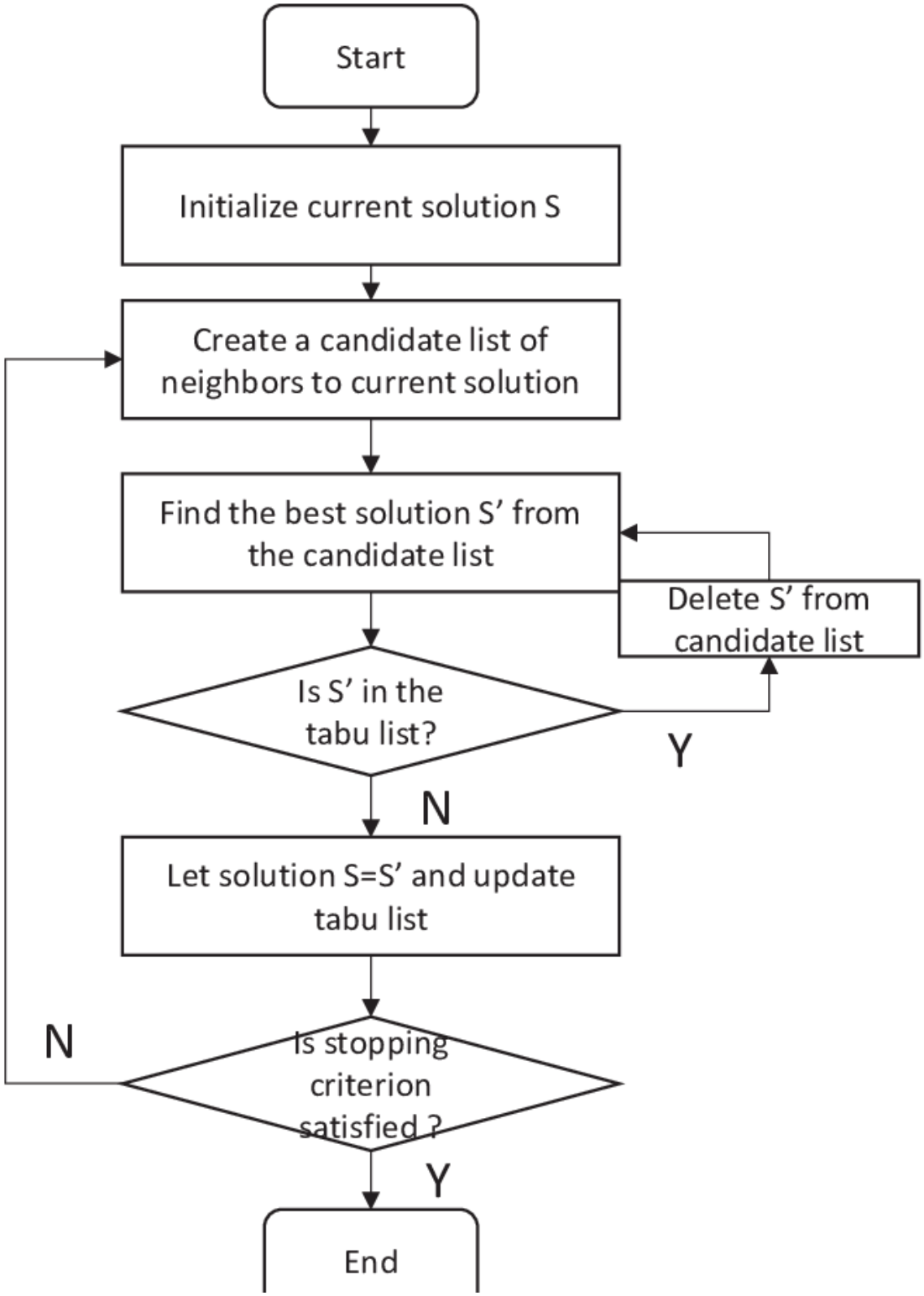
```
procedure simulated annealing
 begin
    initialize T
    select current solution y_c at random
 repeat
    select a new solution y_new
    if eval(y_c)>eval(y_new)
       then y_c←y_new
    else if random[0,1)< e^((eval(y_c)-eval(y_new))/T)
       then y_c←y_new
    T←T*coolingRate
 until T<T_min
```


Randomly develop an initial solution S_0
Does the proposed solution violate the constraints?
Yes
No
Randomly select unit, prescription and period of harvest to generate new solution S
Does the proposed solution violate the constraints?
Yes
No
Is the proposed solution better than current
No
Calc. acceptance value
Yes
Accept solution?
Yes
No
Iteration=iteration+1
Is it time to change temperature?
No
Yes
New temperature=old temperature*cooling rate
Have stopping criteria been reached?
No
Yes
Stop and report the best solution

Tabu

1. Choose a random initial state
2. Enters in a loop checking if a condition to break given by the user is met(lower bound)
3. Creates an empty candidate list. Each of the candidates in a given neighbor which does not contain a tabu element are added to this empty candidate list
4. It finds the best candidate on this list and if it's cost is better than the current best it's marked as a solution.
5. If the number of tabus on the tabu list have reached the maximum number of tabus (you are defining the number) a tabu expires. The tabus on the list expires in the order they have been entered .. first in first out.

```
Input:
  n_d:  Number of components to be removed
  tt:  Tabu tenure
Output:
  S_b:  Best solution generated
1  S_d ← ∅,  L_tabu ← ∅;
2  S' ← Greedy-construction(S_d);
3  S ← Local-search(S');
4  S_b ← S;
5  while Stop-condition is not reached do
6  |   {S_d, L_tabu} ←Tabu-enhanced-destruction(S, n_d, L_tabu, tt);
7  |   S_c ← Greedy-construction(S_d);
8  |   S_ls ← Local-search(S_c);
9  |   if S_ls is better than S_b then
10 |   |   S_b ← S_ls;
11 |   end
12 |   S ← Acceptance-criterion(S, S_ls);
13 end
14 return S_b;
```



Pros:

Generated generally good solutions for optimisation problems compared with other AI methods

Cons:

Tabu list construction is problem specific

No guarantee of global optimal solutions

Parameters are and how you tuned them

The cooling schedule of a simulated annealing algorithm consists of four components.

- Starting Temperature
- Final Temperature
- Temperature Decrement
- Iterations at each temperature

cooling_rate = 0.9995 should be between 0.8 and 0.99, with better results being found in the higher end of the range.

stopping_temperature = 1e-8 The final temperature is chosen as the temperature that returns the best cost function during the search phase.

In a Tabu search:

maximum number of iteration = limited_time

Average result and standard deviations obtained over the 30 runs of the algorithm

Statistical comparison

compare the results obtained by SA and Tabu search statistically You should explain the meaning of the statistical test and how the results indicate the performance comparision between SA and Tabu.