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An Ant Colony based Algorithm for Test Case Prioritization with Precedence

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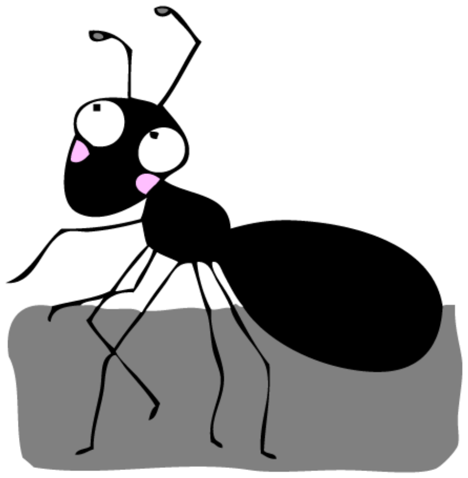
The following topics will be discussed

- Introduction
- Problem definition
- Problem encoding
- The proposed ACO-based algorithm
- Conclusions and future works

INTRODUCTION



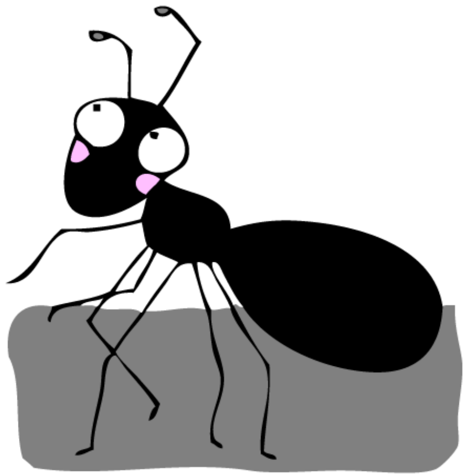
Test Case Prioritization

- The more important ones has to be tested before
  - What is more important for the client?
  - Are there any constraints for the prioritization?

ACO applied to TCP problem

- Few works on TCP
- Precedence of test cases not considered yet
- Application in other problems in our group
- A new approach considering the precedence of test cases

PROBLEM DEFINITION



Requirements

- Set ***R*** of requirements
  - ***N*** elements
- Attributes
  - $importance_i$
  - $volatility_i$

Test Cases

- Set ***C*** of test cases
  - ***M*** elements
- Attributes
  - *precedence*$_j$
  - *coverage*$_j$
  - *executionTime*$_j$
  - $$score_j = \sum \left((importance_i * weight1) + (volatility_i * weight2) \right), \quad \forall\, requirement_i \in coverage_j$$

Mathematical Formulation

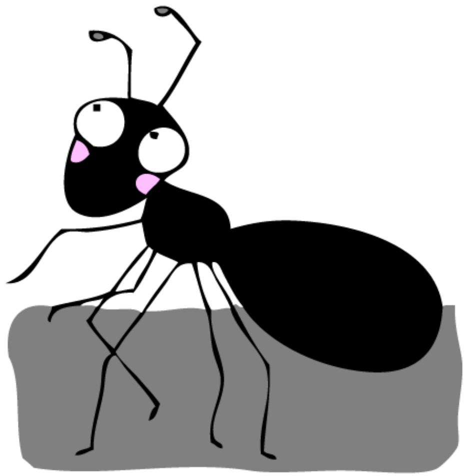
$$Maximize \sum_{j=1}^{M} \left(\frac{score_j}{executionTime_j} * P_j\right)$$

Subject to:

$$\forall\, t_{j1}, t_{j2} \in C, \qquad \left(precedence_{t_{j2}} = t_{j1}\right) \rightarrow \left(q_{t_{j1}} < q_{t_{j2}}\right)$$

- Where $P_j = M - q_j + 1$
- q_j is the position of test case j in the ordered suite

PROBLEM ENCODING



Overview

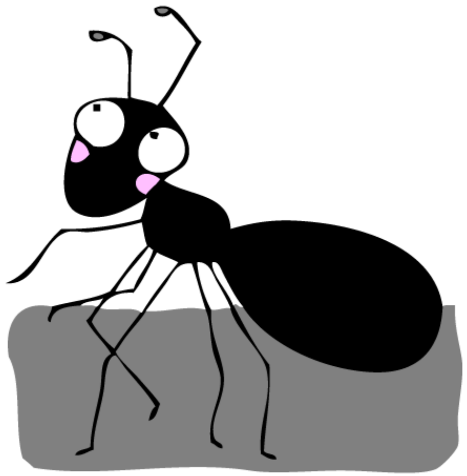
- Directed graph G = (V,E)
- Each test case represents a vertice on the graph
  - *V* has *M* elements
- All vertices are connected with all others
- Pheromone equally distributed

The Proposed Approach

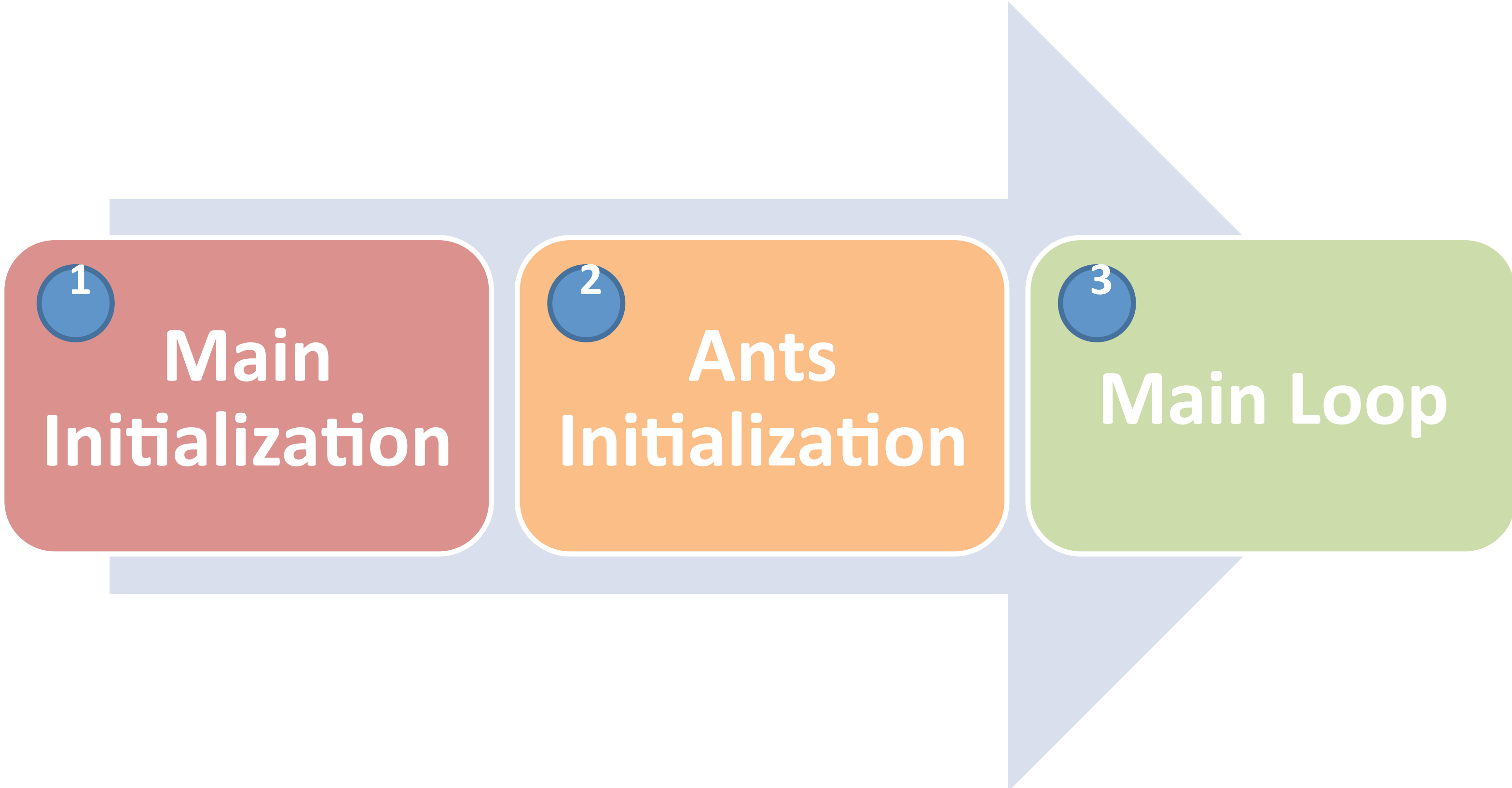
- Each **ant** has the following information
  - nextNode
  - visitedNodes
  - allowedNodes
- Heuristic Function

$$\frac{score_j}{executionTime_j}$$

THE PROPOSED ACO-BASED ALGORITHM



Steps of the Algorithm



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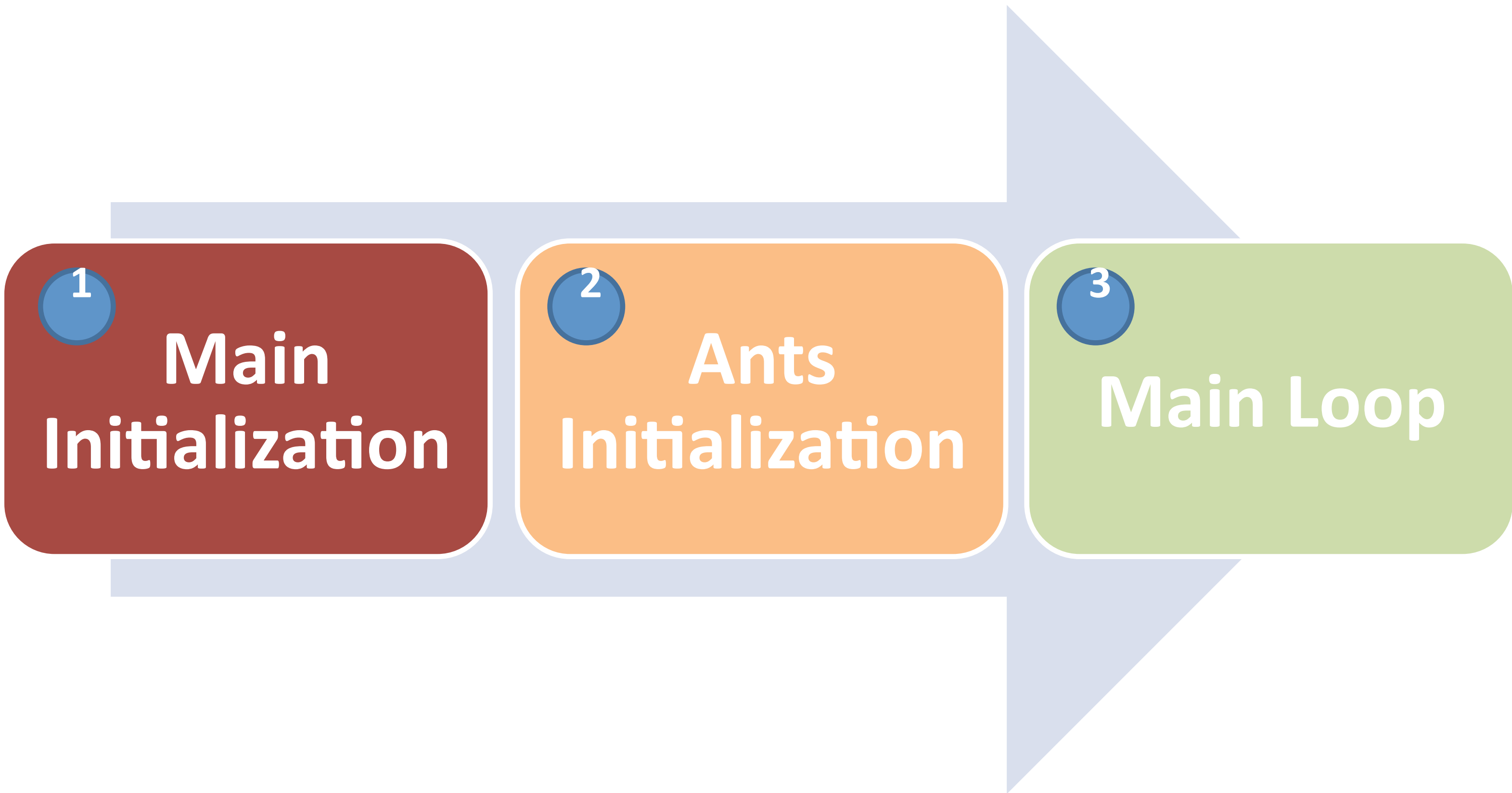

MAIN_INITIALIZATION

ITERATION = 0

Read test case precedence information

Generate directed graph

Initialize pheromone

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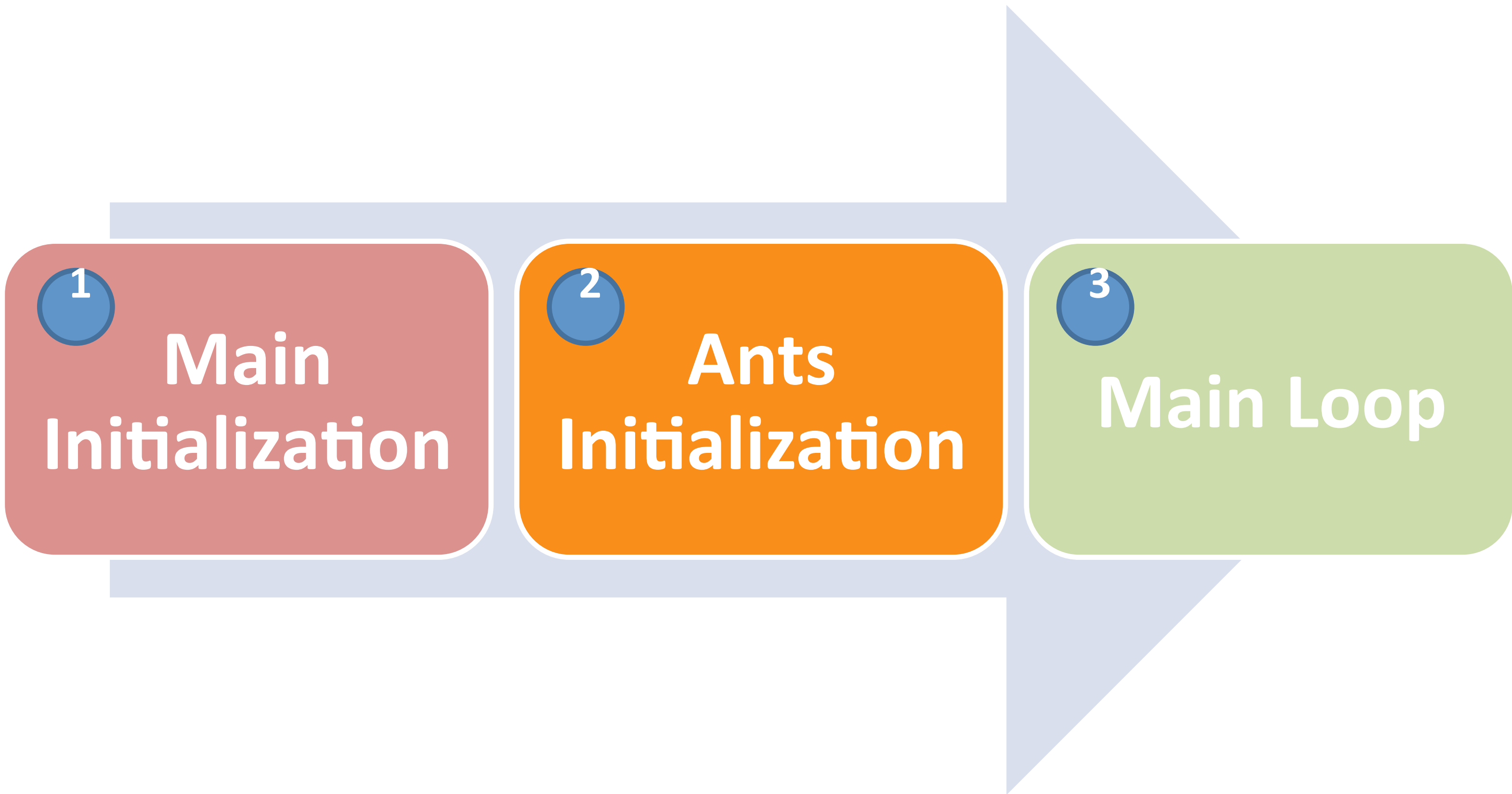

ANTS_INITIALIZATION

FOR ALL ants

FOR ALL vertices t_j of V, $visited_j \leftarrow$ False

ant_k.allowedNodes = UPDATE_ALLOWED_NODES()

ant_k.nextNode = FIND_INITIAL_NODE()

ant_k.visitedNode.add(nextNode)

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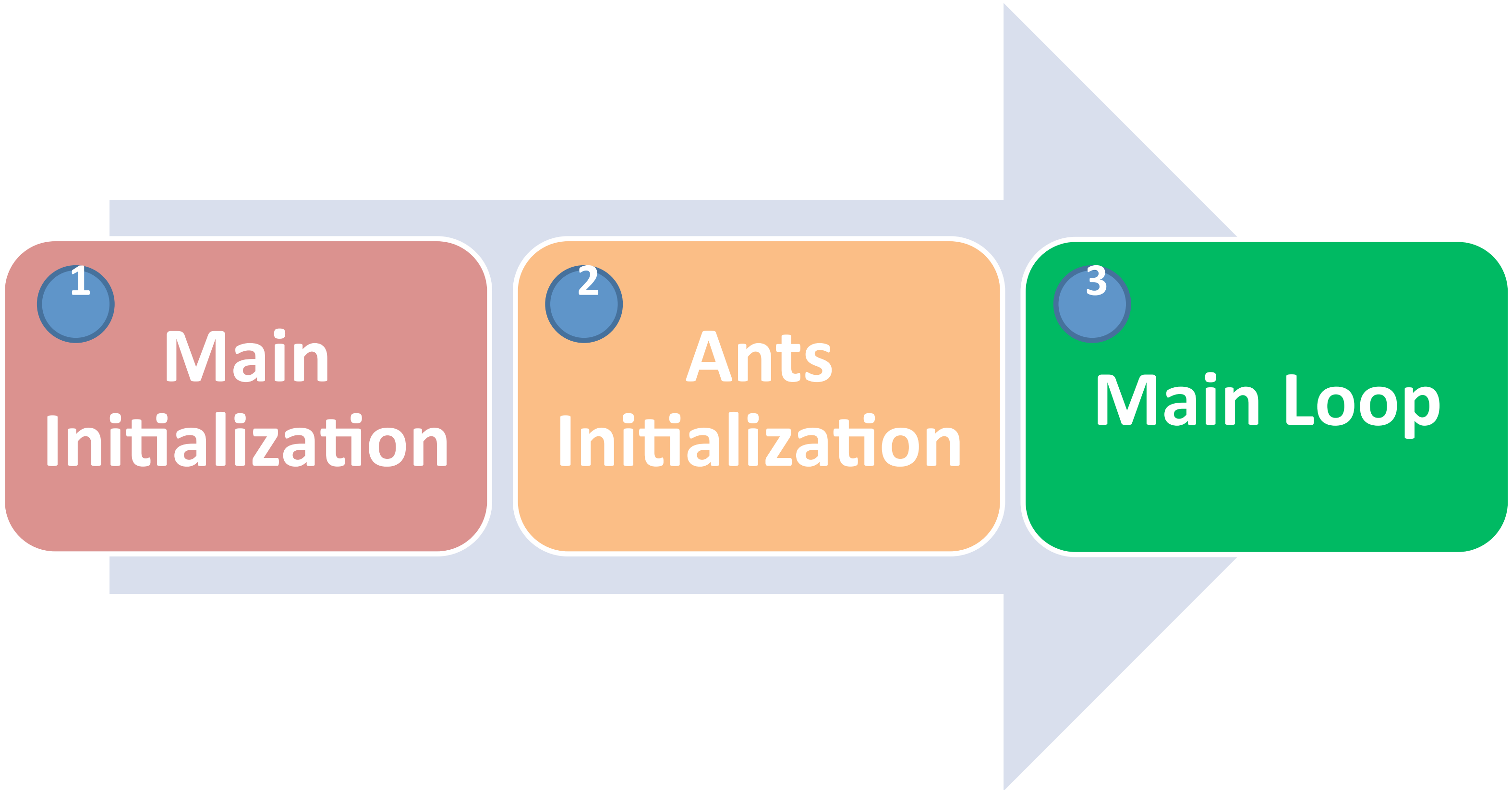

MAIN_LOOP

FOR EACH ant_k

WHILE ant_k.allowedNodes.size() > 0

k = ant_k.actualNode

ant_k.nextNode = ant_k.FIND_NEXT_NODE()

j = ant_k.actualNode

ant_k.visitedNodes.add(ant_k.nextNode)

ant_k.allowedNodes = UPDATE_ALLOWED_NODES()

Update pheromone in edge (k,j),with

$$\tau_{kj} = (1 - \varphi) \cdot \tau_{kj} + \varphi \cdot \tau_0$$

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MAIN_LOOP_FINALIZATION

```
currentSolution = EVALUATE_BEST_SOLUTION()
IF ((bestSolution.value() is null)
        or (bestSolution.value() < currentSolution.value())) THEN
            bestSolution = currentSolution
ITERATION ++
```

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```

The bestSolution variable is the result of the algorithm

ant_k.UPDATE_ALLOWED_NODES()

```
ant_k.allowedNodes.clear()
FOR ALL vertices t_i ∈ V
    IF (t_i respects the precedence constraint and is not yet in solution)
        ant_k.allowedNodes.add(t_i)
```

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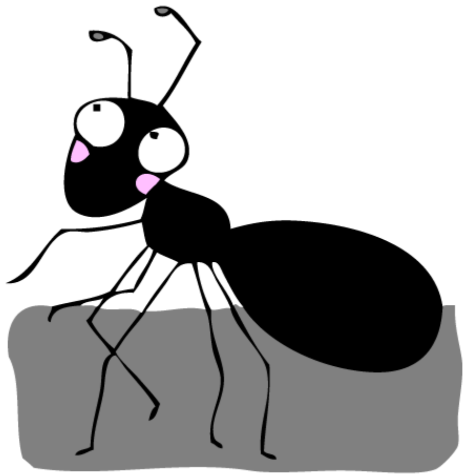
ant$_k$.FIND_NEXT_NODE()

Move ant *k* to a vertex t_i with probability p_{ij}^{k} or considering $max(\tau_{ij} \cdot w_j^{\beta})$, considering only nodes in allowedNodes set

Return t_i

CONCLUSIONS AND FUTURE WORKS



Conclusions

- Currently
  - Implementation phase
  - Preliminary results not already to present
- Future
  - Evaluate and compare to other search-based algorithms

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