**A1. Here are some of the most popular variations of ACO algorithms.**

1. Ant system (AS)
2. Ant colony system (ACS)
3. Elitist ant system
4. Max-min ant system (MMAS)
5. Rank-based ant system (ASrank)
6. Parallel ant colony optimization (PACO)
7. Continuous orthogonal ant colony (COAC)
8. Recursive ant colony optimization

**Discussion of two variants of ACO:-**

**Max-min ant system (MMAS)**

This algorithm controls the maximum and minimum pheromone amounts on each trail. Only the global best tour or the iteration best tour are allowed to add pheromone to its trail. To avoid stagnation of the search algorithm, the range of possible pheromone amounts on each trail is limited to an interval [τmax,τmin]. All edges are initialized to τmax to force a higher exploration of solutions. The trails are reinitialized to τmax when nearing stagnation.

**Recursive ant colony optimization**

It is a recursive form of ant system which divides the whole search domain into several sub-domains and solves the objective on these subdomains. The results from all the subdomains are compared and the best few of them are promoted for the next level. The subdomains corresponding to the selected results are further subdivided and the process is repeated until an output of desired precision is obtained. This method has been tested on ill-posed geophysical inversion problems and works well.

**A2. List of Five recent (not before 2018) selected Journal Articles in solving problem in different domains using ACO. Answer:-**

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| --- | --- | --- | --- | --- | --- |
| **SI** | **Year of Publication** | **Article Title** | **Problem Domain** | **Name of the Journal** | **Volume, Issue and Page** |
| 1 | **2019** | Ant Colony Optimization Algorithm for Maintenance, Repair and Overhaul Scheduling Optimization in the Context of Industrie 4.0 | MRO Scheduling Optimization problem | Applied Science | Volume 9, Issue 22, Article number 4815. https://doi.org/10.3390/app9224815 |
| 2 | **2019** | An Ant Colony Optimization Based on Information Entropy for Constraint Satisfaction Problems | Constraint Satisfaction Problems | Entropy | Volume 21, Issue 8, Article number 766. https://doi.org/10.3390/e21080766 |
| 3 | **2021** | IMPROVED ANT COLONY OPTIMIZATION FOR MULTI-RESOURCE JOB SHOP SCHEDULING: A SPECIAL CASE OF TRANSPORTATION | Job Shop Scheduling problem | Economic Computation and Economic Cybernetics Studies and Research | Issue 4; Vol. 55, pages 277-294.  https://dx.doi.org/10.24818/18423264/55.4.21.18 |
| 4 | **2021** | PF-BTS: A Privacy-Aware Fog-enhanced Blockchain-assisted task scheduling | Task  scheduling | Science Direct | Volume 58, Issue 1, Article number -102393  https://doi.org/10.1016/j.ipm.2020.102393 |
| 5 | **2018** | Parallel ant colony optimization on multi-core SIMD CPUs | Parallel ant colony optimization -CPU Design Optimization | Science Direct | Volume 79, Part 2, Pages 473-487  https://doi.org/10.1016/j.future.2017.09.073 |