Ant colony algorithm ppt

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Some common problems associated with combiner optimization are a traveling vendor problem (" TSP") and the minimum covering of trees problem.Combinatorial optimization is a subset of mathematical optimization, which is associated with operational research, algorithm theory, andcomputational complexity theory. It is an important application in a number of areas including artificial intelligence, machine learning, mathematics, auction theory, and software engineering. Metaheuristic denotes a computational method that optimizes the problem by iteratively trying to improve the candidate's solution for a specific quality measure. Metaheuristics make some or no assumptions about a problem that is being optimized and can look for very large space candidates for solutions. 1. BY - JOY DUTTA ROLL - 91/CSE/101006 BTECH - CSE CALCUTTA UNIVERSITY 2. Introduction ⌑ In COMPUTER SCIENCE AND OPERATIONS RESEARCH, the Ant Colony Optimisation Algorithm (ACO) is a probbilistical method for solving computing problems that can be reduced to find good paths through graphs. ⌑ This algorithm is an ant colony algorithm for a flock member of a swarm of intelligence methods, and it has some metaheiistic optimizations. ⌑ There are various algorithms that are a member of ant colony optimization algorithms, aimed at looking for optimal paths in the graph based on the behavior of ants looking for a path between colony and food source. ⌑ Since then, the original idea has been diversified to solve a wider class of numerical problems, resulting in a number of problems based on different aspects of the behaviour of furnaces. 3. Introduction to Cont. ▲ Next generation wireless communication systems will require networks that can develop without any requirements for existing infrastructure. ▲ Mobile ad hoc networks (MANETS) - Mobile networks mean that the reciprocal nodes are not secured to stay in one place, but can move from one place to another. Ad hoc means that network is independent of previous infrastructure, such as routers. ▲ One of the most important operational parameters in ad hoc networks is to minimise the overall level of transmission power on the path and extend the battery life of the nodes. 4. Introduction to Cont... ▲ There is a protocol for Minimum Transmission Power Routing (MTPR) that seeks to reduce total transmission power . THE WHOLE CONCEPT OF ANT COLONY OPTIMIZATION IS TO REDUCE ROAD AND ENERGY CONSUMPTION. 5. Ant Colony Optimization (ACO) Review Ant Colony Optimization (ACO) explores artificial systems that take inspiration from the behavior of real ant colonies and which are used to solve discreet optimization problems. -Source: ACO website, mdorigo/ACO/about.html 6. Practically..... ▲Ants go through food while setting pheromom trails ▲The shortest path is discovered along pheromon trails ▲ Each ant moving randomly (first) ▲ Pheromon is deposited on the path shorter path, more pheromon rails (positive feedback) ▲ ants follow intensive pheromonical trails 7. Ant Colony Optimization (AC) Practical scenario Everything is good in the world ant. Naturally Observed Ant Behavior Oh no! The obstacle has blocked our way! 9. Ant Colony Optimization (ACO) Naturally Observed Ant Behavior Where Are We Going? Everybody, flip the coin. 10. Naturally Observed Ant Behavior Shorter path reinforced. 11. ▲Actual scenario ▲Bars intellect ▲Stigmergy ▲Autocataching ▲Actual scenario Ant system 12. ▲Unable to achieve only complex tasks. ▲Rely on the phenomenon of swarm intelligence survival. ▲Capable of creating the shortest trajectories from the colony to the power supplies and back. ▲Use stigma along pheromonical paths. THE ACTUAL SCENARIO !!! 13. ▲Follow existing pheromon pheromont trails with high probability. ▲What appears is a form of autokatalytic behavior: the more ants follow the trail, the more attractive that trail becomes what to follow. ▲Thus, the process is characterized by a positive feedback loop, where the probability of selecting a discrete path increases with the number of times the same path was previously chosen. Actual scenario!!! (cont's) 14. Swarm of intellect ▲ A collective system capable of performing complex tasks in a dynamic and diverse environment without external guidance or control and without central coordination ▲ Achievement of collective performance, which cannot normally be achieved by a person acting alone, which is a natural model specifically suited to shared problem solving. Ant Colony Optimization (ACO) Stigmergic ⌑ Two individuals interact indirectly when one of them changes the environment and the other reacts to the new environment later. It's stigmergy. Real ants use stigmergy. How's it going again? Pheromones!!! 16. Autocatalyzation Autocatalysis is a positive feedback loop that drives the antiques to explore promising aspects of the search space over Areas. 17. E D CH B A (b) 30 ants 30 ants 15 ants 15 ants 15 ants t = 0 d = 0,5 d = 0,5 d = 1 d = 1 E D CH B A (a) E D CH B A c 30 ants 30 ants 20 20 ants 10 ants 10 ants t = 1 τ = 30 τ = 30 τ = 15 τ = 15 Initial position: 18. Paragraph 1. Autocatalyzation This is why ACO algorithms are called autocatalytic positive feedback algorithms! 19. Ant Colony Optimization 20. At each stage, the ant chooses to move from one city to another according to some rules: ▲ It must visit each city exactly once; ▲ A remote city has fewer chances of being selected (visibility); ▲ The more intense the pheromont trail set on the edge between the two cities, the more likely it is that this edge will be chosen; ▲ On completion of the journey, ant deposits more pheromoms on all the edges it crossed when the journey is short; ▲ Pheromon pheromon trails evaporate after each iteration. 21. Ant System ⌑ First introduced Marco Dorigo in 1992 ⌑ Stem with the Ant Colony System, later discussed the result of a ant computing intelligence approach to combine techno optimization ⌑ Originally applied traveling vendor Problem ⌑ Applied later to various hard optimization problems 22. Traveling Seller Problem • The problem is NP hard • Classical combinatorial optimization problem to check. TSP PROBLEM: Given N cities, and the distance function d between cities, find a tour that: 1. Go through each city once and only once in 2. Reduces the total distance. 23. HOW TO IMPLEMENT THE PROGRAM ⌑Ants: Simple computer agents ⌘ ✎. Ant Systems (AS) Ant Systems for TSP Graph (N, E): where N = city / nodes, E = edge = travel costs from city i to city j (edge weight) Ant move from one city i to the next j with some transition probability. ijd A D C B 25. Algorithm TSP (AS) Initialize Place each ant in a randomly selected city Select NextCity (For each Ant) more cities to visit For each Ant Return to the original city Update pheromon level using the travel cost for each ant Print Best tour yes No Stop criteria yes No 26. See this small example: Iteration 1 A E D C B 1 [A] 5 [E] 3 [C] 2 [B] 4 [D] 27. Iteration 2 A E D C B 3 [C,B] 5 [E,A] 1 [A,D] 2 [B,C] 4 [D,E] 28. Iteration 3 A E D C B 4 [D,E,A] 5 [E,A,B] 3 [C, B, E] 2 [B, C, D] 1 [A, D, C] 29. Iteration 4 A E D C B 4 [D,E,A,B] 2 [B, C, D, A] 5 [E, A, B, C] 1 [A, D, C, E] 3 [C, B, E, D] 30. Iteration 5 A E D C B 1 [A,D,C,E,B] 3 [C, B, E, D, D] 4 [D, E, A, B, C] 2 [B, C, D, A], E] 5 [E,A,B, C, D] 31. Iteration 6 A E D C B 1 [A,D,C,E,B,A] 3 [C, B, E, D, C] 4 [D, E, A, B, C, D] 2 [B, C, D, E, B] 5 [E, A, B, C, D, E] 32.2. End of first run 4. All antiques die 5. New antiques are born 3. Save the best tour and length) calculation 1. Road and Pheromons Grade 33. Distributed ACO ALGORITHM EXTENSIONS Here are some of the most popular variants of ACO algorithms- ⌑ The elite Ant system (EAS) MMAS ⌑ Asrank ⌑ ACS + ACS ⌑ ACO WITH FUZZY 34. ⌑ Max-Min ant system (MMAS) Added Maximum and minimum pheromon sums [τmax, τmin] Only the world's best or iterations best trip deposited pheromon. All edges are initialized to τmax and reinitialized to τmax when approaching stagnation. ⌑ Rank-based ant system (ASrank) All solutions are ranked according to their length. Each solution is then watched in a precipitated amount of pheromones so that solutions with shorter paths precipitate more pheromones than solutions with longer roads. Extensions(continued) 35. Extensions (continued..) ⌑ Ant Colony System (ACS) It is presented above. ⌑ The mechanism of the continuous orthogonal ant colony (COAC) COAC pheromon sludg is to allow ants to search for solutions together and effectively. Using the orthogonal design method, shards in a possible domain can quickly and efficiently explore your selected regions with improved global search capabilities and accuracy. The orthogonal design method and adaptive radius adjustment method can also be applied to other optimization algorithms to provide a wider advantage in solving practical problems. ⌑ Ant colony optimization with fuzzy logic (ACO AR fluffy) This method introduces fuzzy intelligence to ants to speed up search capability. 36. ACO Applications ⌑ Scheduling problem ▲ Job store scheduling problem (JSP) ▲ Open Shop Scheduling Problem (OSP) ▲ Resource Limited Project Planning Problem (RCPSP ▲) ▲ Group Store Scheduling Problem (VPS) ⌑ Vehicle Routing Problem ▲ Multi-Depot Vehicle Routing problem (MDVRP) ▲ Vehicle Routing Period Problem (PVRP) ▲ Shared-delivery Vehicle Routing Problem (SDVRP) ▲ Stochastic Vehicle Routing Problem (SVRP) ▲ Vehicle Routing Problem with Time Windows (VRPTW) 37. Applications (cont.) ⌑ Allocation problem ▲ Square time allocation problem (QAP) ▲ General allocation problem (GAP) ▲ Frequency allocation problem (FAP) ▲ Redundancy distribution problem ⌑ Set up a problem (SCP) ▲ Set up a partition problem (SPP) ▲ Multi-backpack problem (MQP) ▲ Maximum independent cluster problem (MIS) 38. Applications (continued) Others ▲ Connection-oriented network routing ▲ Connectionless network routing ▲ Data mining ▲ Discounted cash flow project planning Distributed ▲ Information retrieval ▲ Grid Workflow Scheduling ▲ Problem Imaging ▲ Intelligent testing system ▲ System identification ▲ Protein bending ▲ Power Electronic Circuit Design 39. Problem name Algoritma nosaukums Gads Ceļojumā pārdevējs Dorigo, Maniezzo & Colorni AS 1991 Gamberdella & Dorigo Ant-Q 1995 Dorigo & Gamberdella ACS &ACS 3 opt 1996 Stutzle & Hoos MMAS 1997 Bullnheimer, Hartl & Strauss ASrank ASrank Cordon, et al. BWAS 2000 Quadratic Task Maniezzo, Colorni & Dorigo AS-QAP 1994 Gamberdella, Taillard & Dorigo HAS-QAP 1997 Stutzle & Hoos MMAS-QAP 1998 Maniezzo ANTS-QAP 1999 Maniezzo & Colorni AS-QAP 1994 Scheduling Problems Color, Dorigo & Maniezzo AS-JSP 1997 Stutzle AS-SMTTP 1999 Barker et al ACS-SMTTP 1999 den Besten, Stutzle & Dorigo ACS-SM TWTP 2000 Merkle, Middenderf & Schmeck ACO-RCPS 1997 Vehicle Routing Bullnheimer , Hartl & Strauss AS-VRP 1999 Gamberdella , Taillard & Agazzi HAS-VRP 1999 ACO Algorithms: Overview 40. Problem name Authors Algorithm name Year To-oriented Schoonderwood et al. ABC 1996 Network Routing White, Pagurek & Oppacher ASGA 1998 Di Caro & Dorigo AntNet-FS 1998 Bonabeau et al. ABC-smart ants 1998 Connection-less Di Caro & Dorigo AntNet & AntNet-FA 1997 Network Subramanian, Druschel & Chen Regular ants 1997 Heusse et al. CAF 1998 van der Put & Rethkrantz ABC-backward 1998 Sequential ordering Gamberdella & Dorigo HAS-SOP 1997 Graph coloring Costa & Hertz ANTCOL 1997 Shortest common super sequence Michel & Middendorf AS_SCS 1998 Frequency assignmentz Manizo ... Druschel & Chen Regular ants 1997 Heusse et al. Carbonaro ANTS-FAP 1998 Generalized Task Ramalhinho Lourenco & Serra MMAS-GAP 1998 Multiple Backpack Leguizamon & Michalewicz AS-MKP 1999 Optical networks routing Navarro Varela & Sinclair ACO-VWP 1999 Redundancy Sharing Liang & Smith ACO-RAP 1999 Constraint Satisfaction Solnon Ant-P-solver 2000 ACO Algorithms Review: cont ... 41. Related methods • Genetic algorithms (GA) maintain a solution instead of just one. The process of finding superior solutions mimics evolutionary solutions that are combined or modified to change the range of solutions by discarding lower-quality solutions. • Simulated glowing (SA) involves a global optimization technique that crosses the search space, creating solutions for an adjacent current solution. Superior class neighbor is always accepted. A inferior neighbor is taken probabilistically based on the difference in quality and temperature parameters. The temperature parameter is modified as the algorithm progresses to change the nature of the search. • Jet search engine optimization focuses on combining machine learning with optimization by adding an internal feedback loop to self-regulate algorithm-free parameters problems, such as local situations around current solution properties. 42. •Tabbed search (TS) is similar to simulated resusving, as both pass through the solution space by testing mutations in a single solution. While simulated glowing creates only one mutation solution, taboo search creates many mutated solutions and moves to a solution with the lowest suitability for those created. To prevent cycling and encourage greater movement through the solution room, a list of taboo with partial or complete solutions is maintained. go to a solution that contains elements of taboo taboo updated as the solution crosses the solution space. • Stochastic Diffusion Search (SDS), an agent-based probabilistic global search and optimization technique best suited for problems where the lens function can be divided into several independent partial functions. •etc Related methods (continued) 43. Advantages ▲Positive feedback constitutes rapid detection of good solutions ▲Distributed computing avoids premature convergence Greedy heuristic helps to find an acceptable solution at an early stage of the search process. ▲Collective drug group interactions. 44. Disadvantages ▲Slower convergence than other heirists (Poorly met TSP problems greater than 75 cities. ▲There is no centralised processor to guide the AS towards good solutions 45. Conclusion ▲ ACO is a newly proposed metaheuristic approach to solving difficult combination optimisation problems (NP HARD problems). ▲ Artificial carets implement randomised construction heuristics that make probabilistic decisions. ▲ Cumulated search experience is taken into account when adjusting the pheromont trail. ▲ ACO shows excellent performance with poorly structured issues such as network routing. ▲ Local searches for ACO are of paramount importance for obtaining good results. Results.

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