OBJECTIVE : To be able to implement the Ant System algorithm using sample TSP data provided

OUTPUT : Manual Calculation of variable values according to Ant System algorithm for one iteration

TYPE OF PROJECT: Individual

Program SPECIFICATIONS

1. Use the Ant System algorithm (Step 1 and Step 2 for one iteration) for one iteration to solve the TSP data given below:

City	1	2	3	4	5
1	0	5	7	2	1
2	5	0	8	5	3
3	7	8	0	10	3
4	2	5	10	0	4
5	1	3	3	4	0

2. Use Video 15 (From time 00:00 to time 14:32) of our CMSC 173 class as reference for implementing Ant System Algorithm.
3. Generate a path for 3 ants. It is up to you to choose the starting cities of each ant. Just make sure each ant has different starting cities to avoid generating the same paths for all of them.
4. For the value of alpha in the pheromone update step of the algorithm, take the first letter of your family name (Example, letter G from Gamot) and then take its position in the alphabet (G is the 7th letter in the alphabet). Multiply that position with 0.01 (7 * 0.01 = 0.07). Then add 0.60 to it (0.60 + 0.07 = 0.67). This final value will be your alpha (alpha = 0.67).
5. Set all initial values of tau to 1.0 for all edges.
6. You need to provide a solution/submission that is similar to Video 15. You need to show the current path of the ant and the current state of J for that ant as well as the equation of probability for the particular edge being calculated. You also need to show the calculation for the pheromones and as well as decide based on the calculations which of the 3 ants is desirable. For a clearer sample, please see Annex A at the end of this activity guide.
7. Submit this on or before the set deadline in our Canvas class.
8. Save the file as a pdf with filename <surname>_antsystem.pdf (e.g. gamot_antsystem.pdf)

Annex A

Generating path for Ant 1

Ant 1 = {2} J1(2) = {1,3,4,5}

Calc prob from city 2 to city 1

$$p_1(2,1) = \frac{\tau(2,1)[\eta(2,1)]^\beta}{\sum_{u \in J_1(r)} \tau(2,u)[\eta(2,u)]^\beta}$$
$$= \frac{\tau(2,1)[\eta(2,1)]^\beta}{\tau(2,1)[\eta(2,1)]^\beta + \tau(2,3)[\eta(2,3)]^\beta + \tau(2,4)[\eta(2,4)]^\beta + \tau(2,5)[\eta(2,5)]^\beta}$$
$$= \frac{1 \cdot (1/4)^2}{1 \cdot (1/4)^2 + 1 \cdot (1/6)^2 + 1 \cdot (1/8)^2 + 1 \cdot (1/9)^2} = \frac{1/16}{613/5184} = 0.528548124$$

Calc prob from city 2 to city 3

p1(2,3) = formula, expansion of formula, substitution of values and final calculated value here. See above sample. Do not just provide the final calculation.

Calc prob from city 2 to city 4

p1(2,4) = formula, expansion of formula, substitution of values and final calculated value here. See above sample. Do not just provide the final calculation.

Calc prob from city 2 to city 5

p1(2,5) = formula, expansion of formula, substitution of values and final calculated value here. See above sample. Do not just provide the final calculation.

Table of Probs for Ant 1 from city 2 to all other unvisitied cities

pheromone	probability
$p_1(2,1)$	0.528548124
$p_1(2,3)$	0.2349102773
$p_1(2,4)$	0.132137031
$p_1(2,5)$	0.1044045677

Decision : Ant 1 Chooses to go from City 2 to city 1. Updated Ant 1 tour is {2,1} while updated J1(1) = {3,4,5}

Calc prob from city 1 to city etc. This section follows the same idea as above. Please see Video 15 Time 8:24 until Time 9:36 for guide. This is to be completed until Ant 1 completes its tour

The length of tour of Ant 1 is : $L_1 = 4 + 2 + 2 + 2 + 5 = 15.$

Generating path for Ant 2

Ant 2 = {5} J1(5) = {1,2,3,4}

Calc prob from city 5 to city 1

$$p_2(5,1) = \frac{\tau(5,1)[\eta(5,1)]^\beta}{\sum_{u \in J_4(r)} \tau(5,u)[\eta(5,u)]^\beta}$$
$$= \frac{\tau(5,1)[\eta(5,1)]^\beta}{\tau(5,1)[\eta(5,1)]^\beta + \tau(5,2)[\eta(5,2)]^\beta + \tau(5,3)[\eta(5,3)]^\beta + \tau(5,4)[\eta(5,4)]^\beta}$$
$$= \frac{1 \cdot (1/3)^2}{1 \cdot (1/3)^2 + 1 \cdot (1/9)^2 + 1 \cdot (1/2)^2 + 1 \cdot (1/2)^2} = \frac{1/9}{101/162} = 0.1782178218$$

The rest in this section follows from what was done with Ant 1.

Updating of Taus

(Note that the alpha in the example below is 0.75. It should be different for you depending on the first letter of your family name.)

$$\tau(1,2) = (1 - 0.75) \cdot \tau(1,2) + \Delta\tau_1(1,2) + \Delta\tau_2(1,2)$$
$$= (0.25) \cdot (1) + 0 + 0 = 0.25$$

Also put in all the other tau values tau (i,j) where i is not equal to j and max value of i is 5 and max value of j is 5 for the given data above. Format for tau is same as sample above. Pls do not shortcut into giving just the final values. Please show the formula expansion and substitutiton of values. Please see Video 15 Time 12:11 to Time 14:31.

CONCLUSION ON WHICH ANT IS BETTER FOR ITERATION

Answer here which of the 3 ants are desirable and mention the reason why it is desirable.