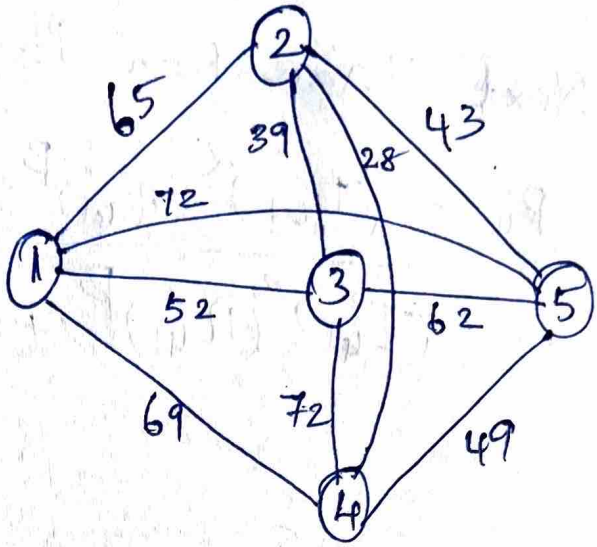
Initially no. of ants = no. of cities.




Start at 4.

Given, $Q = 100$

$\alpha = 0.5$

$\beta = 0.75$

$\rho = 0.1$

Take, random values for $\tau_{ij}$ initially.

$\tau_{12} = \tau_{21} = 0.54$

$\tau_{13} = \tau_{31} = 0.53$

$\tau_{14} = \tau_{41} = 0.35$

$\tau_{15} = \tau_{51} = 0.24$

$\tau_{23} = \tau_{32} = 0.53$

$\tau_{24} = \tau_{42} = 0.39$

$\tau_{25} = \tau_{52} = 0.18$

$\tau_{34} = \tau_{43} = 0.32$

$\tau_{35} = \tau_{53} = 0.90$

$\tau_{45} = \tau_{54} = 0.68$

Next Transition Probability

$$P_{41} = \frac{(\tau_{41})^{\alpha} (\eta_{41})^{\beta}}{(\tau_{41})^{\alpha}(\eta_{41})^{\beta} + (\tau_{42})^{\alpha}(\eta_{42})^{\beta} + (\tau_{43})^{\alpha}(\eta_{43})^{\beta} + (\tau_{45})^{\alpha}(\eta_{45})^{\beta}}$$

$$= \frac{(0.35)^{0.5} (0.016)^{0.75}}{(0.35)^{0.5}(0.014)^{0.75} + (0.398)^{0.5}(0.036)^{0.75} + (0.326)^{0.5}(0.014)^{0.75} + (0.683)^{0.5}(0.02)^{0.75}}$$

$$= \frac{0.024}{0.143} = 0.168$$

$\eta_{ij} = \gamma_{dij}$

$\eta_{41} = \gamma_{19} = 0.014$

$\eta_{42} = \gamma_{28} = 0.036$

$\eta_{43} = \gamma_{72} = 0.014$

$\eta_{45} = \gamma_{49} = 0.02$

$$P_{42} = \frac{0.053}{0.142} = 0.364 \text{ Max}$$

$$P_{43} = \frac{0.023}{0.143} = 0.160$$

$$P_{45} = 0.308$$

Since $P_{42}$ is max, move from 4 to 2.

current visit list (4, 2)

## Pheromone updation (t=1)

$\tau_{12} = \rho(\tau_{12}) + \Delta\tau_{12}$ excepting for (4,2) & (2,4) $\Delta\tau_{ij}$ is zero for all other (i,j)

$= 0.054$.

$\tau_{13} = 0.053$, $\tau_{14} = 0.035$,

$\tau_{15} = 0.026$, $\tau_{23} = 0.05$,

$\tau_{24} = 0.039 + Q/d_{ij} = 0.039 + 100/28 = 3.610$

$\tau_{25} = 0.018$, $\tau_{34} = 0.032$, $\tau_{35} = 0.09$

$\tau_{45} = 0.068$.

Now ant is at 2.

$P_{21} = 0.320$

$P_{23} = (0.429)$ Max.

$P_{25} = 0.250$

Now ant moves to 3!

Pheromone updation (t=2).

$\tau_{12} = 0.005$, $\tau_{13} = 0.005$, $\tau_{14} = 0.003$,

$\tau_{15} = 0.002$, $\tau_{23} = 0.005 + 100/39 = 2.569$

$\tau_{24} = \rho(3.616) = 0.361$, $\tau_{25} = 0.001$

$\tau_{34} = 0.003$, $\tau_{35} = 0.009$, $\tau_{45} = 0.006$

From 3, find $P_{31}$, $P_{35}$

$P_{31} = 0.500$

$P_{35} = 0.5571$ - Max.

From 3, ant moves to 5.

Tabu list [4, 2, 3, 5]

Pheromone updation $t = 3$.

$\tau_{12} = 0.0005$, $\tau_{13} = 0.0005$, $\tau_{14} = 0.0003$,

$\tau_{15} = 0.0002$, $\tau_{23} = 0.25$, $\tau_{24} = 0.03$,

$\tau_{25} = 0.0001$, $\tau_{34} = 0.0003$, $\tau_{35} = 0.0009 + 100\%$
$= 1.613$

$\tau_{45} = 0.0006$

From 5, move to 1 since it is the only non-visited city. Update pheromone..

$\tau_{12} = 0.00005$, $\tau_{13} = 0.00005$, $\tau_{14} = 0.00003$,

~~$\tau_{15} = 0.00002$, $\tau_{23} = 0$~~ $\tau_{15} = 1.388$, $\tau_{23} = 0.025$

$\tau_{24} = 0.003$, $\tau_{25} = 0.00001$, $\tau_{34} = 0.00003$

$\tau_{35} = 0.16$, $\tau_{45} = 0.00006$.

Now back to origin, since all the states are visited.

update $\tau_{14} = \tau_{41} = 0.00003 \times 100/69$

$= 1.449$

Final route,

$$\boxed{4-2-3-5-1-4.}$$