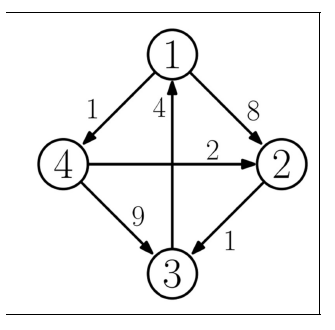
1. (30+20=50 points) Apply Floyd Warshall Algorithm to find the all-pair shortest path from

the following graph (show all the steps of your work). Mention the shortest path for each vertex to every other vertex. Also, find the transitive closure of the graph (show all the steps of your work).



D(0) π(0)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |  |  | 1 | 2 | 3 | 4 |
| 1 | 0 | 8 | ∞ | 1 | 1 | NIL | 1 | NIL | 1 |
| 2 | ∞ | 0 | 1 | ∞ | 2 | NIL | NIL | 2 | NIL |
| 3 | 4 | ∞ | 0 | ∞ | 3 | 3 | NIL | NIL | NIL |
| 4 | ∞ | 2 | 9 | 0 | 4 | NIL | 4 | 4 | NIL |

D(1) min(d(0)ij , d(0)i1+d(0)1j) π(1)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |  |  | 1 | 2 | 3 | 4 |
| 1 | 0 | 8 | ∞ | 1 | 1 | NIL | 1 | NIL | 1 |
| 2 | ∞ | 0 | 1 | ∞ | 2 | NIL | NIL | 2 | NIL |
| 3 | 4 | 12 | 0 | 5 | 3 | 3 | 1 | NIL | 1 |
| 4 | ∞ | 2 | 9 | 0 | 4 | NIL | 4 | 4 | NIL |

D(2) min (d(1)ij , d(1)i2+d(1)2j) π(2)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |  |  | 1 | 2 | 3 | 4 |
| 1 | 0 | 8 | 9 | 1 | 1 | NIL | 1 | 2 | 1 |
| 2 | ∞ | 0 | 1 | ∞ | 2 | NIL | NIL | 2 | NIL |
| 3 | 4 | 12 | 0 | 5 | 3 | 3 | 1 | NIL | 1 |
| 4 | ∞ | 2 | 3 | 0 | 4 | NIL | 4 | 2 | NIL |

D(3) min (d(2)ij , d(2)i3+d(2)3j) π(3)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |  |  | 1 | 2 | 3 | 4 |
| 1 | 0 | 8 | 9 | 1 | 1 | NIL | 1 | 2 | 1 |
| 2 | 5 | 0 | 1 | 6 | 2 | 3 | NIL | 2 | 3 |
| 3 | 4 | 12 | 0 | 5 | 3 | 3 | 1 | NIL | 1 |
| 4 | 7 | 2 | 3 | 0 | 4 | 3 | 4 | 2 | NIL |

D(4) min (d(3)ij , d(3)i4+d(3)4j) π(4)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |  |  | 1 | 2 | 3 | 4 |
| 1 | 0 | 3 | 4 | 1 | 1 | NIL | 4 | 4 | 1 |
| 2 | 5 | 0 | 1 | 6 | 2 | 3 | NIL | 2 | 3 |
| 3 | 4 | 7 | 0 | 5 | 3 | 3 | 4 | NIL | 1 |
| 4 | 7 | 2 | 3 | 0 | 4 | 3 | 4 | 2 | NIL |

The shortest path between evert 2 points:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |
| 1 | 0(NIL) | 3(1-4-2) | 4(1-4-2-3) | 1（1-4） |
| 2 | 5(2-3-1) | 0(NIL) | 1(2-3) | 6(2-3-1-4) |
| 3 | 4(3-1) | 7(3-1-4-2) | 0(NIL) | 5(3-1-4) |
| 4 | 7(4-2-3-1) | 2(4-2) | 3(4-2-3) | 0(NIL) |

The transitive closure of the graph：

T(0)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |
| 1 | 1 | 1 | 0 | 1 |
| 2 | 0 | 1 | 1 | 0 |
| 3 | 1 | 0 | 1 | 0 |
| 4 | 0 | 1 | 1 | 1 |

T(1)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |
| 1 | 1 | 1 | 0 | 1 |
| 2 | 0 | 1 | 1 | 1 |
| 3 | 1 | 1 | 1 | 1 |
| 4 | 0 | 1 | 1 | 1 |

T(2)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |
| 1 | 1 | 1 | 1 | 1 |
| 2 | 0 | 1 | 1 | 1 |
| 3 | 1 | 1 | 1 | 1 |
| 4 | 0 | 1 | 1 | 1 |

T(3)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |
| 1 | 1 | 1 | 1 | 1 |
| 2 | 1 | 1 | 1 | 1 |
| 3 | 1 | 1 | 1 | 1 |
| 4 | 1 | 1 | 1 | 1 |

T(4)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |
| 1 | 1 | 1 | 1 | 1 |
| 2 | 1 | 1 | 1 | 1 |
| 3 | 1 | 1 | 1 | 1 |
| 4 | 1 | 1 | 1 | 1 |