1-2 1

2-4 1

4-3 1

3-5 1

1-5 8

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 |
| 1 | 0 | 1 | \* | \* | 8 |
| 2 | \* | 0 | \* | 1 | \* |
| 3 | \* | \* | 0 | \* | 1 |
| 4 | \* | \* | 1 | 0 | \* |
| 5 | \* | \* | \* | \* | 0 |

插入1后

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 |
| 1 | 0 | 1 | \* | \* | 8 |
| 2 | \* | 0 | \* | 1 | \* |
| 3 | \* | \* | 0 | \* | 1 |
| 4 | \* | \* | 1 | 0 | \* |
| 5 | \* | \* | \* | \* | 0 |

每个点先到1，然后再到对应的点

dis{x,y}=Min(dis{x,y},dis{x,1}+dis{1,y})

插1个点达到最短路径

插入2后

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 |
| 1 | 0 | 1 | \* | 2 | 8 |
| 2 | \* | 0 | \* | 1 | \* |
| 3 | \* | \* | 0 | \* | 1 |
| 4 | \* | \* | 1 | 0 | \* |
| 5 | \* | \* | \* | \* | 0 |

每个点先到2，然后再到对应的点

dis{x,y}=Min(dis{x,y},dis{x,2}+dis{2,y})

插2个点达到最短路径，由于已经是在允许插1个点的情况下再插1个点，故插2个点也能达到最短路径。

插入3后

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 |
| 1 | 0 | 1 | \* | 2 | 8 |
| 2 | \* | 0 | \* | 1 | \* |
| 3 | \* | \* | 0 | \* | 1 |
| 4 | \* | \* | 1 | 0 | 2 |
| 5 | \* | \* | \* | \* | 0 |

…

插入4后

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 |
| 1 | 0 | 1 | 3 | 2 | 4 |
| 2 | \* | 0 | 2 | 1 | \* |
| 3 | \* | \* | 0 | \* | 1 |
| 4 | \* | \* | 1 | 0 | 2 |
| 5 | \* | \* | \* | \* | 0 |

….

插入5后

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 |
| 1 | 0 | 1 | 3 | 2 | 4 |
| 2 | \* | 0 | 2 | 1 | \* |
| 3 | \* | \* | 0 | \* | 1 |
| 4 | \* | \* | 1 | 0 | \* |
| 5 | \* | \* | \* | \* | 0 |

最后允许插N个点达到最短路径

如果有环的路径和为负数，那么图就没有最小路径可言，一直循环环，最短路径就会一直减少。

上面是直接递归的思路

也可通过动态规划计算，i起始点，j目标点，k是否包含点k，则状态方程为：

dp[i,j,k]=min(dp[I,j,k-1],dp[I,k,k-1]+dp[k,j,k-1])