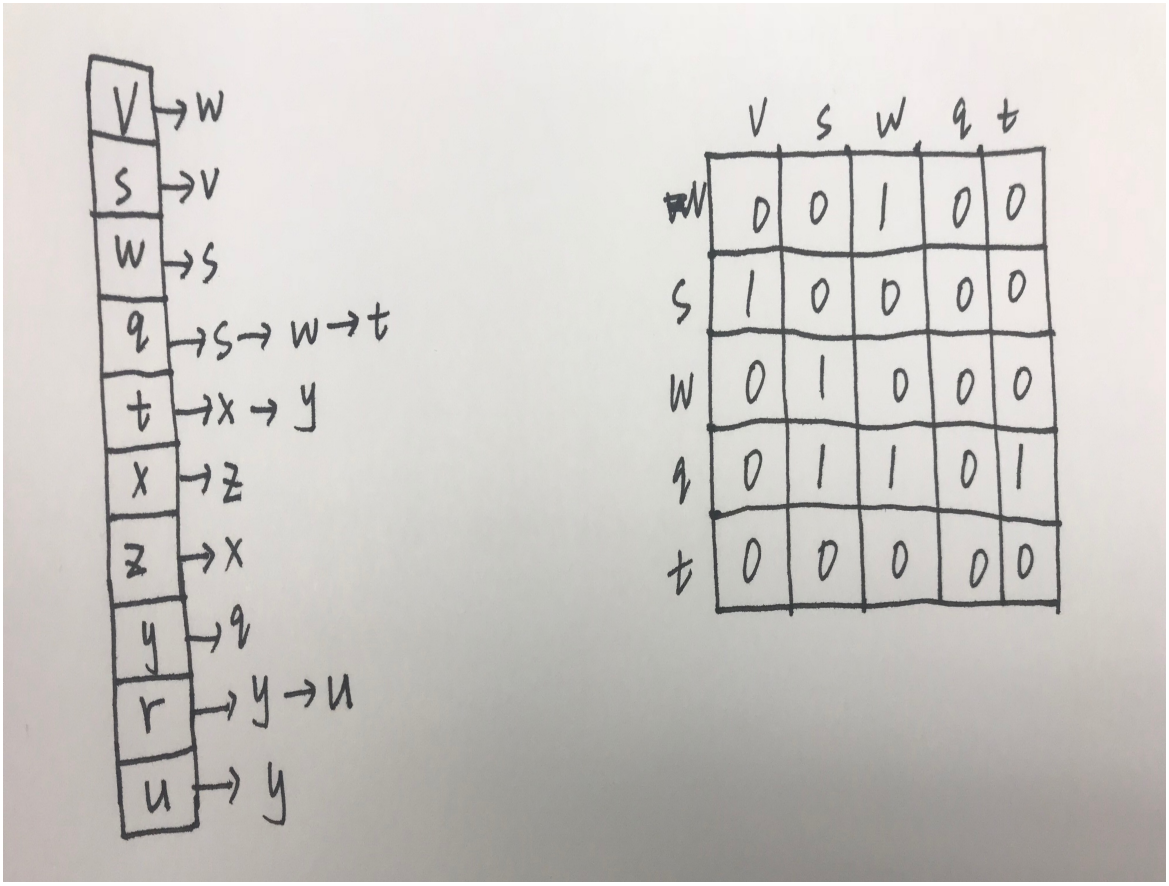
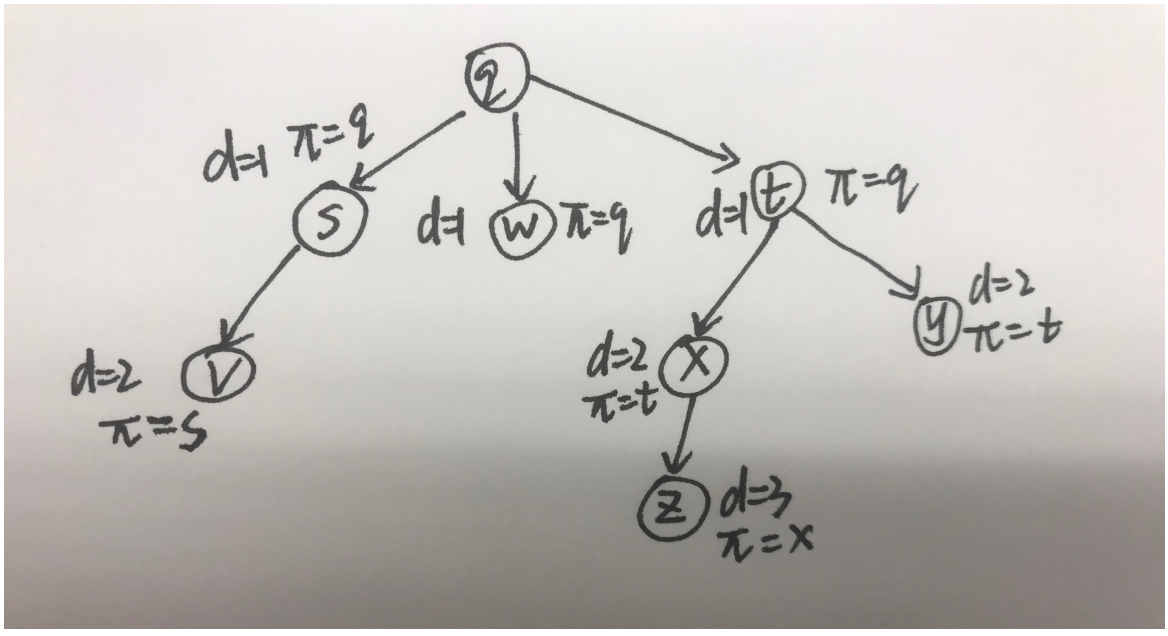
1.



14 entries

2.



3.I think the running time is also O(V^2), because every node need to compare |V| times to test if current node has an edge with the node.

4.

Vertexs in traversal order	Discovery time	Finishing time
q	1	16
s	2	7
v	3	6
w	4	5
t	8	15
x	9	12
y	10	11
z	13	14

5.DFS(G)

```
for each u∈G.V
    u.colour=white
    u.π=nil
time =0
stack s
s.push(first vertex in G.V)
while(s is not empty)
    v=s.top()
    time = time +1
    if v.colour=white
        v.colour=white
        v.colour=gray
        v.d=time
        for each u∈G.Adj[v]
            if u.colour=white
                u.π=v
                s.push(u)
```

else if v.colour=gray

s.pop()

v.colour=black

v.f=time

6. For adjacency list, G = (V, E) and consists of an array Adj of |v| lists. For every entry of vertices v in Adj[u], I would put it in a new list of G^T where u in $Adj^T[v]$. The running time would be O(V + E).

For the adjacency matrix, I would just flip flop the rows and columns. The time algorithm is $O(V^2)$.

7. If we divide the input into groups of 7 instead of 5, the number of elements which are smaller than median of input is at least $4\left(\left\lfloor\frac{1}{2}\left\lceil\frac{n}{7}\right\rceil\right\rfloor-2\right)\geq\frac{2n}{7}-8$, so the algorithm in step 5, calls itself recursively on a problem of size at most n-($\frac{2n}{7}-8$)=$\frac{5n}{7}+8$, so $T(n)\leq O(n)+T\left(\frac{n}{7}\right)+T(\frac{5n}{7}+8)$, we use substitution method to verify if T(n)≤ $c\cdot n$

Check: T(n)≤ $c\cdot n$

$$T(n)\leq d\cdot n+c\cdot\frac{n}{7}+c\cdot(\frac{5n}{7}+8)$$

so $$d\cdot n+c\cdot\frac{n}{7}+c\cdot\left(\frac{5n}{7}+8\right)\leq c\cdot n$$

$$n\cdot d\leq c(\frac{n}{7}-8)$$

$$c\geq\frac{nd}{\frac{n}{7}-8}=\frac{7nd}{n-56}$$

so we should choose n>56 then s constant c exists such that c>$\frac{7nd}{n-56}$, when we choose n=56*2, then $c\geq 14d$, since the conditions for choosing c is satisfied, so the running time could be O(n) when we divided input into groups of 7.

Likewise, when we divide the input into groups of $3T(n)=O(n)+T\left(\frac{n}{3}\right)+T(\frac{2n}{3}+4)$, the running time for this is not O(n), because according to recursion tree method, at each

level of the tree we have a subproblem of size n and we perform O(n) work at each level of the tree, so overall running time cannot be linear.

8.In the algorithm,firstly I calculate the number of 15% of the generals which is m, then I use deterministicselect algorithm to find the mth largest of the generals, this will cost O(n), the I traverse the general list, find all of generals who is greater than the rank 15% general whose running time is O(n), so the total running time is O(n).

9.The recursion stops when $\frac{n}{2^i} = k$, so i=log$\frac{n}{k}$, the recursion takes O(n log$\frac{n}{k}$), and then in every subarray of size k, we use insertion sort whose running time is $O(n^2)$, so the average time for this insertion sort is $\frac{n}{k}O(k^2) = O(nk)$.

If k is chosen too big, then O(nk) is bigger than $\Theta(nlogn)$, so k must be O(logn),and it must be that$O(nk + n\log\frac{n}{k})$=O(nlogn), if the constant factors in big_Oh notation is ignored, then O(nk+nlogn-nlogk)=O(nlogn), so k must be such that k<logk, which is impossible, ans the error comes from ignoring constant factors. So let c_1 be the constant factor in quicksort, and c_2 be the constant factor in insertion sort, so k must be chosen such that $c_2k + c_1 \log\left(\frac{n}{k}\right) < c_1 logn$ which requires $c_1k < c_2 logk$. In practice, these constants cannot be ignored, and k should be chosen experimentally.

10. In this algorithm, I will traverse the list of g grudges, every time I put two people who has grudge with each other into separate rooms, if there is a pair of people that has already in the same room, then it is possible to assign all people into two rooms so that no one with a grudge is in the same room.

11.I use quicksort to sort the n music files, if the result is 0, let the computer to calculate again until the result is 1 or -1, in this case, the worst running time is also O(nlogn), because the comparison time is a constant.