[报告]SGU **Matrix Multiplication**

[Source]

http://acm.sgu.ru/problem.php?contest=0&problem=196

[Description]

Let us consider an undirected graph G = <V, E> which has N vertices and M edges. Incidence matrix of this graph is an N × M matrix A = {a_{ij}}, such that a_{ij} is 1 if i-th vertex is one of the ends of j-th edge and 0 in the other case. Your task is to find the sum of all elements of the matrix A^TA where A^T is A transposed, i.e. an M × N matrix obtained from A by turning its columns to rows and vice versa.

[Solution]

大家都 A 了，我就先说一下当时的想法。第一个，暴力 N^3，直接否定；然后想优化，没想起来…。最后找规律，题目要求求矩阵乘，而且该矩阵是点与边的关联矩阵，于是想到应该是与顶点的度有关系。按照一次的关系没找到，二次平方刚好符合，然后自己造的 sample 也过了，就水了一下。

以下是参考某牛博客的证明，ans=sigma d[i]^2;

A 是图 G 的关联矩阵，求 B=A^TA 的元素和。

对于图的关联矩阵，有性质：

$$ans = \sum_{i,j} B_{ij} = \sum_{i,j}\sum_{k} A_{ki}A_{kj} = \sum_{k}\sum_{i,j} A_{ki}A_{kj} = \sum_{k=0}^{n} d(v_k)^2$$

（0<=k<n;0<=i,j<m）

其中 d(v_k)为定点 k 的度数。复杂度为 O(n+m)。

[Code]

```
#include<iostream>
#include<cstdio>
#include<string.h>
#include<string>
#include<math.h>
#include<algorithm>
```

```cpp
#include<queue>
using namespace std;

int a[100009];
int m,n;

int main(){
    int u,v;
    long long ans = 0;
    scanf("%d%d",&n,&m);
    for(int i=1;i<=m;i++){
        scanf("%d%d",&u,&v);
        a[u]++;
        a[v]++;
    }
    for(int i=1;i<=n;i++){
        ans+=a[i]*a[i];
    }
    printf("%lld\n",ans);
    return 0;
}
```