Input: Adjacency Matrix $A$ for $G = (V,E)$, $G$ unweighted, undirected
Output: ??

1. $S = 0$
2. for $i = 1$ to $|V|$: 
3.   for $j = 1$ to $i$
4.     $S = S + A(i,j)$
5. return $S$

$|E|$

How many operations?
- Use $\Sigma$ for loops
- Use 1 for $O(1)$ operations

\[ \text{operations} = D + \sum_{i=1}^{|V|} \left( \text{work done inside } i^{th} \text{ loop iteration} \right) \]

\[ = D + \sum_{i=1}^{|V|} \left( \sum_{j=1}^{K} i \right) \]

Write your expression from outer loops to inner loop
Evaluate from the inside out:

\[
\text{# operations} = D + \sum_{i=1}^{\lfloor \sqrt{N}\rfloor} \left( \sum_{j=1}^{i} K \right)
\]

\[
= D + K \sum_{i=1}^{\lfloor \sqrt{N}\rfloor} i
\]

\[
= D + K \left( 1 + 2 + 3 + \ldots + \lfloor \sqrt{N}\rfloor \right)
\]

\[
= D + K \left( \lfloor \sqrt{N}\rfloor + 1 \right) \frac{\lfloor \sqrt{N}\rfloor}{2}
\]

\[
= O(\lfloor \sqrt{N}\rfloor^2)
\]

"Detailed Calculation"

"Rough Calculation"

Outer loop repeats \(O(\lfloor \sqrt{N}\rfloor)\) times

Inner loop repeats \(O(\lfloor \sqrt{N}\rfloor)\) times
Summation Tricks

\[ \sum_{i=2}^{n} (A_i + B) = \sum_{i=2}^{n} A_i + \sum_{i=2}^{n} B \]

\[ = A \sum_{i=2}^{n} i + (n-1)B \]

\[ = A \sum_{i=2}^{n} \frac{n+2}{2} + \frac{(n-2)+(n-1)+n}{n+2} \]

# terms in series

How many pairs? \[ \frac{n-1}{2} \]

Total: \[ \frac{(n-1)(n+2)}{2} \]