- find incidence matrix A
- $N(A)$, $N(A^T) = $?
- Trace $(A^T A) = $?

Incidence matrix : encode how nodes connect to the edges.

row = edges

column = nodes

$$A = \begin{array}{c|c|c|c|c|c}
 & \text{①} & \text{②} & \text{③} & \text{④} & \text{⑤} \\
\hline
1 & -1 & 1 & & & \\
2 & & -1 & 1 & & \\
3 & -1 & & 1 & & \\
4 & & -1 & & 1 & \\
5 & & & & -1 & 1 \\
6 & & & 1 & & -1 \\
\end{array}$$

$Ax = 0$ (potential differences)

$$N(A) = \left\{ \begin{pmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{pmatrix} \right\}$$

$N(A^T) = ?$ (current)

$A^T y = 0$

$$y = \begin{pmatrix} 1 \\ 1 \\ -1 \\ 0 \\ 0 \\ 0 \end{pmatrix}_{\triangle}, \quad y = \begin{pmatrix} 0 \\ -1 \\ 0 \\ 1 \\ 1 \\ 1 \end{pmatrix}_{\square}$$

superposition of the 2 loops (sum)

- Trace $(A^T A) = 2 + 3 + 3 + 2 + 2$
$$= 12$$

* number of edges connecting nodes
↳ degree of nodes