* **a class of rectangular matrices** with two advantages
  + **incidence matrices of graphs**
  + **every entry** is **1, -1, 0**
    - ***L*** and ***U*** and **basis vectors** for all four subspaces have same property
* **graph**(can be **directed** or **nondirected**)
  + a set of **vertices**(nodes)
  + a set of **edges** that connect nodes
* **edgenode incidence matrix** (**connectivity matrix** or **topology matrix**)
  + ***m***(edges) by ***n***(nodes) (normally *m* > *n*)
  + if the edge goes from node *j* to node *k* ( *j* ---> *k*)
    - then that **row** has ***-1*** in column *j* and ***+1*** in column *k* ( **a*jn*= -1 ; a*kn* = 1** )
* **loops** correspond to linearly dependent **rows**
* **tree**: graph without loops.
* **#nodes - #edges + #loops =1**
* ***e = Ax ; y = Ce; ATy = f ⇒ ACATy =f* (current)**