# 10-B4

# 图

## 邻接矩阵：动态操作

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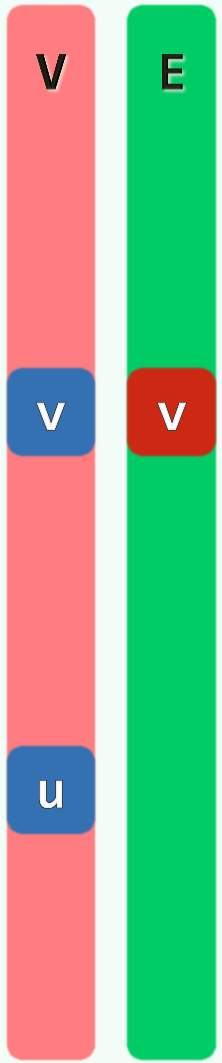
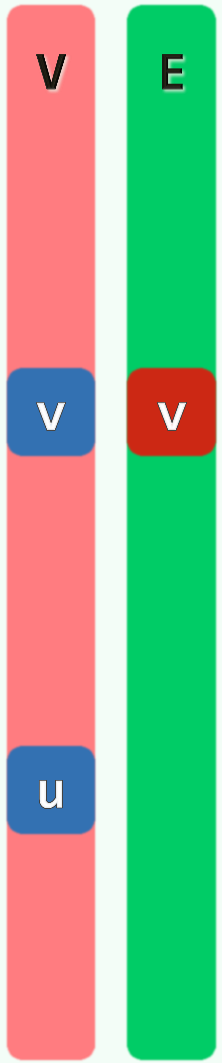
# 边的插入




```
void insert( Te const & edge, int w, Rank v, Rank u ) {
   if ( exists(v, u) ) return; //忽略已有的边
   E[v][u] = new Edge<Te>( edge, w ); //创建新边（权重为w）
   e++; //更新边计数
   V[v].outDegree++; //更新顶点v的出度
   V[u].inDegree++; //更新顶点u的入度
}
```

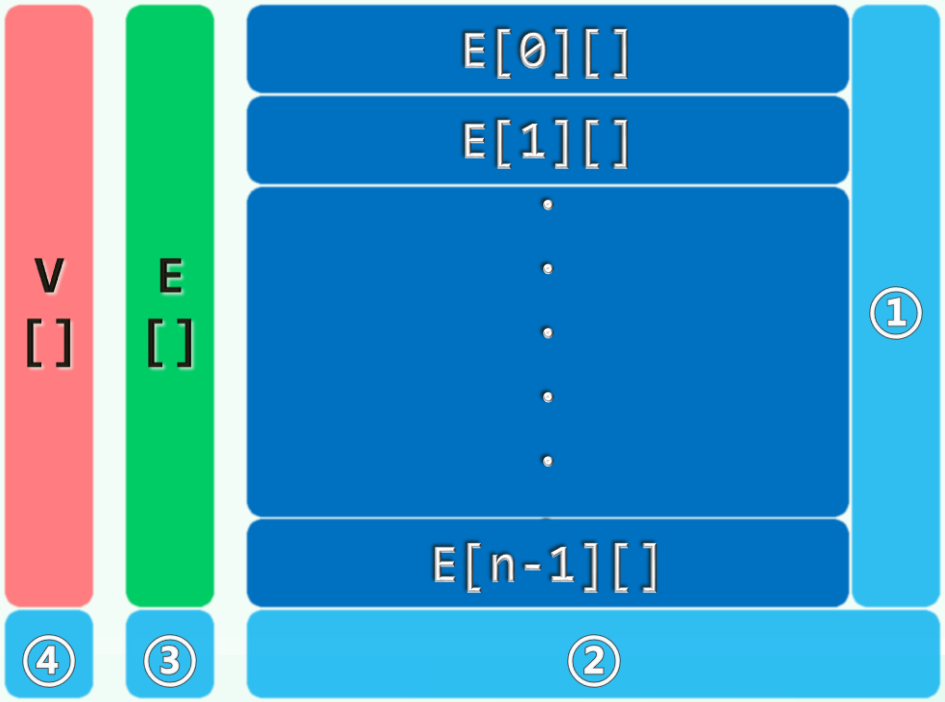
# 边的删除

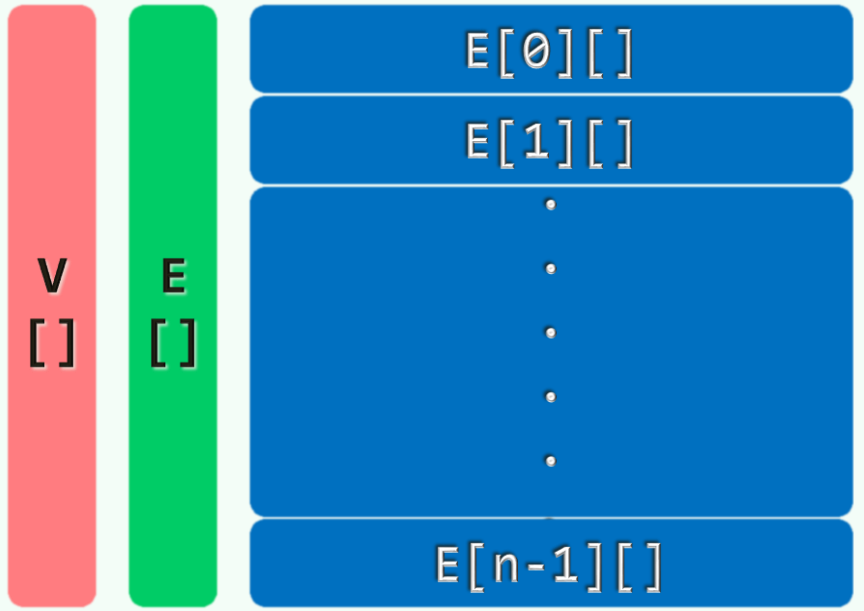



```
Te remove( Rank v, Rank u ) { //删除（已确认存在的）边(v, u)
   Te eBak = edge(v, u); //备份边(v, u)的信息
   delete E[v][u]; E[v][u] = NULL; //删除边(v, u)
   e--; //更新边计数
   V[v].outDegree--; //更新顶点v的出度
   V[u].inDegree--; //更新顶点u的入度
   return eBak; //返回被删除边的信息
}
```

# 顶点插入

```
Rank insert( Tv const & vertex ) { //插入顶点，返回编号
  for ( Rank u = 0; u < n; u++ ) E[u].insert( NULL ); n++; //①
  E.insert( Vector< Edge<Te>* >( n, n, NULL ) ); //②③
  return V.insert( Vertex<Tv>( vertex ) ); //④
}
```



# 顶点删除

```
Tv remove( Rank v ) { //删除顶点及其关联边，返回该顶点信息
   for ( Rank u = 0; u < n; u++ ) //删除所有出边
      if ( exists( v, u ) ) { delete E[v][u]; V[u].inDegree--; e-- }
   E.remove(v); n--; //删除第v行
   Tv vBak = vertex( v ); V.remove( v ); //备份之后，删除顶点v
   for ( Rank u = 0; u < n; u++ ) //删除所有入边及第v列
      if ( Edge<Te> * x = E[u].remove( v ) )
         { delete x; V[u].outDegree--; e--; }
   return vBak; //返回被删除顶点的信息
}
```