小白专场：如何建立图

浙江大学 陈 越

用邻接矩阵表示图

尽可能的通用,
能让别人看得懂

$$G[i][j] = \begin{cases} 1 & \text{若} <v_i, v_j> \text{是G中的边} \\ 0 & \text{否则} \end{cases}$$

```
typedef struct GNode *PtrToGNode;
struct GNode {
    int Nv;  /* 顶点数 */
    int Ne;  /* 边数  */
    WeightType G[MaxVertexNum][MaxVertexNum];
    DataType Data[MaxVertexNum]; /* 存顶点的数据 */
};
typedef PtrToGNode MGraph; /* 以邻接矩阵存储的图类型 */
```

为什么定义为指向节点的指针?
---后面向函数里面传递一个图的时候,传递一个指针进去比较方便

MGraph初始化

- 初始化一个有VertexNum个顶点但没有边的图

```
typedef int Vertex; /* 用顶点下标表示顶点,为整型 */
MGraph CreateGraph( int VertexNum )
{  Vertex V, W;
   MGraph Graph;
                          /*声明一个图的节点*/
   Graph = (MGraph)malloc(sizeof(struct GNode));
   Graph->Nv = VertexNum;
   Graph->Ne = 0;

   /* 注意：这里默认顶点编号从0开始，到(Graph->Nv - 1) */
   for (V=0; V<Graph->Nv; V++)
      for (W=0; W<Graph->Nv; W++)
         Graph->G[V][W] = 0; /* 或INFINITY */

   return Graph;
}
```

向MGraph中插入边

```
typedef struct ENode *PtrToENode;
struct ENode {
    Vertex V1, V2;      /* 有向边<V1, V2> */
    WeightType Weight;  /* 权重 */
};
typedef PtrToENode Edge;


void InsertEdge( MGraph Graph, Edge E )
{
     /* 插入边 <V1, V2> */
     Graph->G[E->V1][E->V2] = E->Weight;

     /* 若是无向图，还要插入边<V2, V1> */
     Graph->G[E->V2][E->V1] = E->Weight;
}
```

完整地建立一个MGraph

- 输入格式

  Nv Ne

  V1 V2 Weight

  ……

```
MGraph BuildGraph()
{   MGraph Graph;
    Edge E;
    Vertex V;
    int Nv, i;

    scanf("%d", &Nv);
    Graph = CreateGraph(Nv);
    scanf("%d", &(Graph->Ne));
    if ( Graph->Ne != 0 ) {
        E = (Edge)malloc(sizeof(struct ENode));
        for (i=0; i<Graph->Ne; i++) {
            scanf("%d %d %d",
                  &E->V1, &E->V2, &E->Weight);
            InsertEdge( Graph, E );
        }
    }

    /* 如果顶点有数据的话，读入数据 */
    for (V=0; V<Graph->Nv; V++)
        scanf(" %c", &(Graph->Data[V]));

    return Graph;
}
```

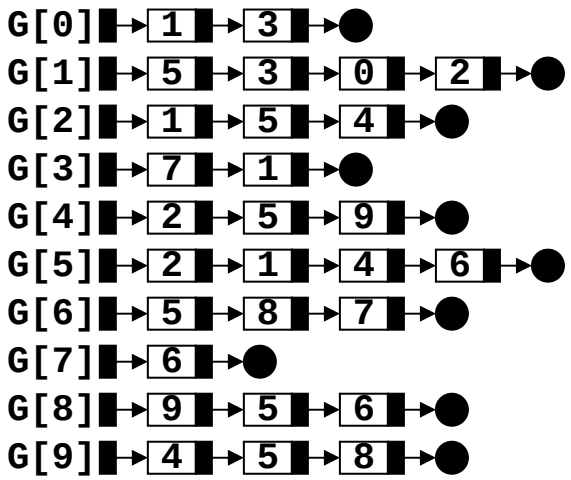
如果不要这么麻烦.....

```
int G[MAXN][MAXN], Nv, Ne;
void BuildGraph()
{   int i, j, v1, v2, w;

    scanf("%d", &Nv);
    /* CreateGraph */
    for (i=0; i<Nv; i++)
       for (j=0; j<Nv; j++)
          G[i][j] = 0; /* 或INFINITY */
    scanf("%d", &Ne);
    for (i=0; i<Ne; i++) {
       scanf("%d %d %d", &v1, &v2, &w);
       /* InsertEdge */
       G[v1][v2] = w;
       G[v2][v1] = w;
    }
}
```

用邻接表表示图

- 邻接表：G[N]为指针数组，对应矩阵每行一个链表，只存非0元素




```
typedef struct GNode *PtrToGNode;
struct GNode {
    int Nv;     /* 顶点数 */
    int Ne;     /* 边数   */
    AdjList G; /* 邻接表 */
};
typedef PtrToGNode LGraph;
/* 以邻接表方式存储的图类型 */
```

```
typedef struct Vnode{
    PtrToAdjVNode FirstEdge;
    DataType Data; /* 存顶点的数据 */
} AdjList[MaxVertexNum];
/* AdjList是邻接表类型 */
```

```
typedef struct AdjVNode *PtrToAdjVNode;
struct AdjVNode {
    Vertex AdjV;  /* 邻接点下标 */
    WeightType Weight;  /* 边权重 */
    PtrToAdjVNode Next; /*指向下一个节点
};  的指针*/
```

LGraph初始化

- 初始化一个有VertexNum个顶点但没有边的图

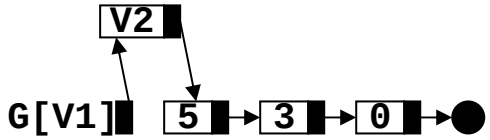
```
typedef int Vertex; /* 用顶点下标表示顶点,为整型 */
LGraph CreateGraph( int VertexNum )
{  Vertex V, W;
   LGraph Graph;

   Graph = (LGraph)malloc(sizeof(struct GNode));
   Graph->Nv = VertexNum;
   Graph->Ne = 0;

   /* 注意：这里默认顶点编号从0开始，到(Graph->Nv - 1) */
   for ( V=0; V<Graph->Nv; V++ )
      Graph->G[V].FirstEdge = NULL;

   return Graph;
}
```

向LGraph中插入边




```
void InsertEdge( LGraph Graph, Edge E )
{   PtrToAdjVNode NewNode;

    /****************** 插入边 <V1, V2> ****************/
    /* 为V2建立新的邻接点 */
    NewNode = (PtrToAdjVNode)malloc(sizeof(struct AdjVNode));
    NewNode->AdjV = E->V2;
    NewNode->Weight = E->Weight;
    /* 将V2插入V1的表头 */
    NewNode->Next = Graph->G[E->V1].FirstEdge;
    Graph->G[E->V1].FirstEdge = NewNode;

    /********** 若是无向图，还要插入边 <V2, V1> **********/
    /* 为V1建立新的邻接点 */
    NewNode = (PtrToAdjVNode)malloc(sizeof(struct AdjVNode));
    NewNode->AdjV = E->V1;
    NewNode->Weight = E->Weight;
    /* 将V1插入V2的表头 */
    NewNode->Next = Graph->G[E->V2].FirstEdge;
    Graph->G[E->V2].FirstEdge = NewNode;
}
```

浙江大学计算机科学与技术学院

完整地建立一个LGraph

```
LGraph BuildGraph()
{   LGraph Graph;

    …… 还会有区别吗？

}
```