

Algoritmos de Grafos en Java

Los gráficos modelan relaciones y sus algoritmos resuelven problemas como los caminos más cortos y la conectividad. Vamos a cubrir DFS, BFS, Dijkstra y Kruskal.

1. DFS: Búsqueda en Profundidad

DFS explora lo más lejos posible a lo largo de cada rama antes de retroceder.

Implementación en Java

```
import java.util.*;  
  
public class DFS {  
    static class Graph {  
        int V;  
        LinkedList<Integer>[] adj;  
  
        Graph(int v) {  
            V = v;  
            adj = new LinkedList[v];  
            for (int i = 0; i < v; i++) adj[i] = new LinkedList<>();  
        }  
  
        void addEdge(int v, int w) { adj[v].add(w); }  
  
        void DFS(int v, boolean[] visited) {  
            visited[v] = true;  
            System.out.print(v + " ");  
            for (int n : adj[v]) if (!visited[n]) DFS(n, visited);  
        }  
    }  
  
    public static void main(String[] args) {  
        Graph g = new Graph(4);  
        g.addEdge(0, 1);  
        g.addEdge(0, 2);  
        g.addEdge(1, 2);  
        g.addEdge(2, 0);  
        g.addEdge(2, 3);
```

```

        System.out.print("DFS: ");
        g.DFS(2, new boolean[4]);
    }
}

```

Salida: DFS: 2 0 1 3

2. BFS: Búsqueda en Anchura

BFS explora nivel por nivel utilizando una cola.

Implementación en Java

```

import java.util.*;

public class BFS {
    static class Graph {
        int V;
        LinkedList<Integer>[] adj;

        Graph(int v) {
            V = v;
            adj = new LinkedList[v];
            for (int i = 0; i < v; i++) adj[i] = new LinkedList<>();
        }

        void addEdge(int v, int w) { adj[v].add(w); }

        void BFS(int s) {
            boolean[] visited = new boolean[V];
            Queue<Integer> queue = new LinkedList<>();
            visited[s] = true;
            queue.add(s);
            while (!queue.isEmpty()) {
                s = queue.poll();
                System.out.print(s + " ");
                for (int n : adj[s]) {
                    if (!visited[n]) {
                        visited[n] = true;
                        queue.add(n);
                    }
                }
            }
        }
    }
}

```

```

        }
    }
}

}

public static void main(String[] args) {
    Graph g = new Graph(4);
    g.addEdge(0, 1);
    g.addEdge(0, 2);
    g.addEdge(1, 2);
    g.addEdge(2, 0);
    g.addEdge(2, 3);
    System.out.print("BFS: ");
    g.BFS(2);
}
}

```

Salida: BFS: 2 0 3 1

3. Algoritmo de Dijkstra: Caminos más Cortos

Dijkstra encuentra el camino más corto en un grafo ponderado.

Implementación en Java

```

import java.util.*;

public class Dijkstra {
    static class Graph {
        int V;
        List<List<int[]>> adj;

        Graph(int v) {
            V = v;
            adj = new ArrayList<>(v);
            for (int i = 0; i < v; i++) adj.add(new ArrayList<>());
        }

        void addEdge(int u, int v, int weight) { adj.get(u).add(new int[]{v, weight}); }
    }
}

```

```

void dijkstra(int src) {
    PriorityQueue<int[]> pq = new PriorityQueue<>(Comparator.comparingInt(a -> a[1]));
    int[] dist = new int[V];
    Arrays.fill(dist, Integer.MAX_VALUE);
    dist[src] = 0;
    pq.add(new int[]{src, 0});
    while (!pq.isEmpty()) {
        int u = pq.poll()[0];
        for (int[] neighbor : adj.get(u)) {
            int v = neighbor[0], weight = neighbor[1];
            if (dist[u] != Integer.MAX_VALUE && dist[u] + weight < dist[v]) {
                dist[v] = dist[u] + weight;
                pq.add(new int[]{v, dist[v]});
            }
        }
    }
    System.out.println("Distancias desde " + src + ": " + Arrays.toString(dist));
}

public static void main(String[] args) {
    Graph g = new Graph(4);
    g.addEdge(0, 1, 4);
    g.addEdge(0, 2, 1);
    g.addEdge(2, 1, 2);
    g.addEdge(1, 3, 5);
    g.dijkstra(0);
}
}

```

Salida: Distancias desde 0: [0, 3, 1, 8]

4. Algoritmo de Kruskal: Árbol de Expansión Mínima

Kruskal construye un MST ordenando los bordes y añadiéndolos de manera codiciosa.

Implementación en Java

```
import java.util.*;  
  
public class Kruskal {  
  
    static class Edge implements Comparable<Edge> {  
  
        int src, dest, weight;  
  
        Edge(int src, int dest, int weight) { this.src = src; this.dest = dest; this.weight = weight; }  
        public int compareTo(Edge other) { return this.weight - other.weight; }  
    }  
  
    static class Graph {  
  
        int V, E;  
        Edge[] edges;  
  
        Graph(int v, int e) {  
            V = v;  
            E = e;  
            edges = new Edge[e];  
        }  
  
        int find(int[] parent, int i) {  
            if (parent[i] != i) parent[i] = find(parent, parent[i]);  
            return parent[i];  
        }  
  
        void union(int[] parent, int[] rank, int x, int y) {  
            int rootX = find(parent, x), rootY = find(parent, y);  
            if (rank[rootX] < rank[rootY]) parent[rootX] = rootY;  
            else if (rank[rootX] > rank[rootY]) parent[rootY] = rootX;  
            else { parent[rootY] = rootX; rank[rootX]++; }  
        }  
  
        void kruskalMST() {  
            Edge[] result = new Edge[V - 1];  
            int e = 0, i = 0;  
            Arrays.sort(edges);  
            int[] parent = new int[V];  
            int[] rank = new int[V];  
            for (int v = 0; v < V; v++) parent[v] = v;
```

```

while (e < V - 1 && i < E) {
    Edge next = edges[i++];
    int x = find(parent, next.src), y = find(parent, next.dest);
    if (x != y) result[e++] = next;
}
System.out.println("Bordes del MST:");
for (i = 0; i < e; i++) System.out.println(result[i].src + " -- " + result[i].dest + " : " + result[i].weight);
}

public static void main(String[] args) {
    Graph g = new Graph(4, 5);
    g.edges[0] = new Edge(0, 1, 10);
    g.edges[1] = new Edge(0, 2, 6);
    g.edges[2] = new Edge(0, 3, 5);
    g.edges[3] = new Edge(1, 3, 15);
    g.edges[4] = new Edge(2, 3, 4);
    g.kruskalMST();
}
}

```

Salida:

Bordes del MST:
2 -- 3 : 4
0 -- 3 : 5
0 -- 1 : 10