Campus Sonora Norte

Act 4.3 - Actividad Integral de Grafos (Evidencia Competencia)

Curso:

Programación de estructuras de datos y algoritmos fundamentales

(TC1031)

Estudiante:

Daniel Alfredo Barreras Meraz A01254805

Docente:

Baldomero Olvera Villanueva

Fecha de entrega:

12 de noviembre de 2023

Código fuente

- Adjunto en el archivo zip.

Casos de prueba

Caso de prueba	Archivo de Entrada	Resultados
1	input1.txt	Case 1: 5 ports not reachable from port Cai_Mep with MNP = 2. Case 2: 1 ports not reachable from port Cai_Mep with MNP = 3.
2	input2.txt	Case 1: 6 ports not reachable from port Antwerp with MNP = 1. Case 2: 0 ports not reachable from port Ambarli with MNP = 4. Case 3: 0 ports not reachable from port Bandar with MNP = 4. Case 4: 0 ports not reachable from port Barcelona with MNP = 5. Case 5: 0 ports not reachable from port Charleston with MNP = 5. Case 6: 0 ports not reachable from port Barcelona with MNP = 4. Case 7: 0 ports not reachable from port Algeciras with MNP = 7. Case 8: 7 ports not reachable from port Callao with MNP = 1. Case 9: 0 ports not reachable from port Bremen with MNP = 7. Case 10: 0 ports not reachable from port Chennai with MNP = 5. Case 11: 0 ports not reachable from port Barcelona with MNP = 6. Case 12: 0 ports not reachable from port Charleston with MNP = 3. Case 13: 0 ports not reachable from port Callao with MNP = 7. Case 14: 0 ports not reachable from port Antwerp with MNP = 7.

		Case 15: 0 ports not reachable from port Chennai with MNP = 4.
		Case 16: 0 ports not reachable from port Ambarli with MNP = 8.
3	input3.txt	Case 1: 13 ports not reachable from port Colombo with MNP = 1. Case 2: 0 ports not reachable from port Barcelona with MNP = 6. Case 3: 0 ports not reachable from port Alexandria with MNP = 5. Case 4: 0 ports not reachable from port Algeciras with MNP = 9. Case 5: 0 ports not reachable from port Dongguan with MNP = 4. Case 6: 0 ports not reachable from port Colon with MNP = 8. Case 7: 18 ports not reachable from port Cartagena with MNP = 1. Case 8: 1 ports not reachable from port Antwerp with MNP = 2. Case 9: 0 ports not reachable from port Balboa with MNP = 4. Case 10: 0 ports not reachable from port Dammam with MNP = 5. Case 11: 0 ports not reachable from port Barcelona with MNP = 7. Case 12: 2 ports not reachable from port Dammam with MNP = 2. Case 13: 0 ports not reachable from port Dammam with MNP = 6. Case 14: 14 ports not reachable from port Dalian with MNP = 1. Case 15: 1 ports not reachable from port Busan with MNP = 2. Case 16: 0 ports not reachable from port Callao with MNP = 7. Case 17: 0 ports not reachable from port Felixstowe with MNP = 2. Case 18: 0 ports not reachable from port Dammam with MNP = 9. Case 19: 0 ports not reachable from port Colombo with MNP = 7. Case 20: 0 ports not reachable from port Chennai with MNP = 2. Case 21: 0 ports not reachable from port Durban with MNP = 9. Case 22: 0 ports not reachable from port Dubai with MNP = 7.

		Case 23: 0 ports not reachable from port Algeciras with MNP = 6.
		Case 24: 0 ports not reachable from port Felixstowe with MNP = 8.
		Case 25: 0 ports not reachable from port Colombo with MNP = 6.
		Case 26: 0 ports not reachable from port Colombo with MNP = 9.
		Case 27: 7 ports not reachable from port Balboa with MNP = 2.
		Case 28: 0 ports not reachable from port Dandong with MNP = 3.
		Case 29: 0 ports not reachable from port Barcelona with MNP = 3.
		Case 30: 0 ports not reachable from port Charleston with MNP = 6.
		Case 31: 0 ports not reachable from port Chittagong with MNP = 9.
		Case 32: 22 ports not reachable from port Alexandria with MNP = 1.
		Case 33: 0 ports not reachable from port Dubai with MNP = 9.
		Case 34: 0 ports not reachable from port Dalian with MNP = 4.
		Case 35: 0 ports not reachable from port Bremen with MNP = 6.
		Case 36: 0 ports not reachable from port Dalian with MNP = 6.
		Case 37: 1 ports not reachable from port Bremen with MNP = 2.
4	input4.txt	Case 1: 0 ports not reachable from port Algeciras with MNP = 5.
		Case 2: 0 ports not reachable from port Barcelona with MNP = 9.
		Case 3: 0 ports not reachable from port Cartagena with MNP = 9.
		Case 4: 0 ports not reachable from port Bandar with MNP = 6.
		Case 5: 0 ports not reachable from port Colombo with MNP = 3.
		Case 6: 0 ports not reachable from port Busan with MNP = 7.
		Case 7: 0 ports not reachable from port Durban with MNP = 8.
		Case 8: 0 ports not reachable from port Balboa with MNP = 6.
		Case 9: 0 ports not reachable from port Genoa with MNP = 9.

		Case 10: 3 ports not reachable from port Alexandria with MNP = 1.
		Case 11: 0 ports not reachable from port Chittagong with MNP = 3.
		Case 12: 0 ports not reachable from port Dammam with MNP = 3.
		Case 13: 0 ports not reachable from port Dalian with MNP = 1.
		Case 14: 0 ports not reachable from port Ambarli with MNP = 8.
		Case 15: 0 ports not reachable from port Bandar with MNP = 7.
		Case 16: 0 ports not reachable from port Colombo with MNP = 8.
		Case 17: 2 ports not reachable from port Durban with MNP = 1.
		Case 18: 0 ports not reachable from port Bremen with MNP = 7.
		Case 19: 1 ports not reachable from port Algeciras with MNP = 1.
		Case 20: 0 ports not reachable from port Callao with MNP = 7.
		Case 21: 0 ports not reachable from port Bremen with MNP = 3.
		Case 22: 0 ports not reachable from port Dammam with MNP = 5.
		Case 23: 0 ports not reachable from port Balboa with MNP = 8.
		Case 24: 0 ports not reachable from port Cai_Mep with MNP = 9.
		Case 25: 2 ports not reachable from port Bremen with MNP = 1.
		Case 26: 0 ports not reachable from port Dalian with MNP = 6.
		Case 27: 0 ports not reachable from port Cartagena with MNP = 4.
		Case 28: 0 ports not reachable from port Algeciras with MNP = 9.
		Case 29: 0 ports not reachable from port Durban with MNP = 2.
		Case 30: 0 ports not reachable from port Felixstowe with MNP = 5.
		Case 31: 0 ports not reachable from port Antwerp with MNP = 2.
		Case 32: 0 ports not reachable from port Alexandria with MNP = 2.
		Case 33: 0 ports not reachable from port Busan with MNP = 6.
		Case 34: 0 ports not reachable from port Durban with MNP = 5.
		Case 35: 0 ports not reachable from port Balboa with MNP = 9.

Case 36: 0 ports not reachable from port Dongguan with MNP = 8.

Case 37: 0 ports not reachable from port Gdansk with MNP = 7.

Case 38: 1 ports not reachable from port Antwerp with MNP = 1.

Case 39: 0 ports not reachable from port Colombo with MNP = 4.

Case 40: 0 ports not reachable from port Durban with MNP = 4.

Case 41: 0 ports not reachable from port Antwerp with MNP = 3.

Case 42: 0 ports not reachable from port Bremen with MNP = 4.

Case 43: 0 ports not reachable from port Colombo with MNP = 9.

Case 44: 0 ports not reachable from port Colon with MNP = 3.

Case 45: 0 ports not reachable from port Balboa with MNP = 5.

Case 46: 0 ports not reachable from port Callao with MNP = 2.

Case 47: 0 ports not reachable from port Ambarli with MNP = 3.

Case 48: 0 ports not reachable from port Busan with MNP = 3.

Case 49: 0 ports not reachable from port Cai_Mep with MNP = 2.

Case 50: 0 ports not reachable from port Chennai with MNP = 4.

Case 51: 0 ports not reachable from port Barcelona with MNP = 2.

Case 52: 0 ports not reachable from port Barcelona with MNP = 5.

Case 53: 0 ports not reachable from port Bandar with MNP = 3.

Case 54: 0 ports not reachable from port Chennai with MNP = 8.

Case 55: 0 ports not reachable from port Ambarli with MNP = 2.

Case 56: 0 ports not reachable from port Gdansk with MNP = 9.

Case 57: 3 ports not reachable from port Dubai with MNP = 1.

Comprobación de casos de prueba

```
Caso de prueba 1:
Case 1: 5 ports not reachable from port Cai_Mep with MNP = 2.
Case 2: 1 ports not reachable from port Cai_Mep with MNP = 3.
```

```
Caso de prueba 2:
Case 1: 6 ports not reachable from port Antwerp with MNP = 1.
Case 2: 0 ports not reachable from port Ambarli with MNP = 4.
Case 3: 0 ports not reachable from port Bandar with MNP = 4.
Case 4: 0 ports not reachable from port Barcelona with MNP = 5.
Case 5: 0 ports not reachable from port Charleston with MNP = 5.
Case 6: 0 ports not reachable from port Barcelona with MNP = 4.
Case 7: 0 ports not reachable from port Algeciras with MNP = 7.
Case 8: 7 ports not reachable from port Callao with MNP = 1.
Case 9: 0 ports not reachable from port Bremen with MNP = 7.
Case 10: 0 ports not reachable from port Chennai with MNP = 5.
Case 11: 0 ports not reachable from port Barcelona with MNP = 6.
Case 12: 0 ports not reachable from port Charleston with MNP = 3.
Case 13: 0 ports not reachable from port Callao with MNP = 7.
Case 14: 0 ports not reachable from port Antwerp with MNP = 7.
Case 15: 0 ports not reachable from port Chennai with MNP = 4.
Case 16: 0 ports not reachable from port Ambarli with MNP = 8.
```

```
Caso de prueba 3:
Case 1: 13 ports not reachable from port Colombo with MNP = 1.
Case 2: 0 ports not reachable from port Barcelona with MNP = 6.
Case 3: 0 ports not reachable from port Alexandria with MNP = 5.
Case 4: 0 ports not reachable from port Algeciras with MNP = 9.
Case 5: 0 ports not reachable from port Dongguan with MNP = 4.
Case 6: 0 ports not reachable from port Colon with MNP = 8.
Case 7: 18 ports not reachable from port Cartagena with MNP = 1.
Case 8: 1 ports not reachable from port Antwerp with MNP = 2.
Case 9: 0 ports not reachable from port Balboa with MNP = 4.
Case 10: 0 ports not reachable from port Dammam with MNP = 5.
Case 11: 0 ports not reachable from port Barcelona with MNP = 7.
Case 12: 2 ports not reachable from port Dammam with MNP = 2.
Case 13: 0 ports not reachable from port Dammam with MNP = 6.
Case 14: 14 ports not reachable from port Dalian with MNP = 1.
Case 15: 1 ports not reachable from port Busan with MNP = 2.
Case 16: 0 ports not reachable from port Callao with MNP = 7.
Case 17: 0 ports not reachable from port Felixstowe with MNP = 2.
Case 18: 0 ports not reachable from port Dammam with MNP = 9.
Case 19: 0 ports not reachable from port Colombo with MNP = 7.
Case 20: 0 ports not reachable from port Chennai with MNP = 2.
Case 21: 0 ports not reachable from port Durban with MNP = 9.
Case 22: 0 ports not reachable from port Dubai with MNP = 7.
Case 23: 0 ports not reachable from port Algeciras with MNP = 6.
Case 24: 0 ports not reachable from port Felixstowe with MNP = 8.
Case 25: 0 ports not reachable from port Colombo with MNP = 6.
Case 26: 0 ports not reachable from port Colombo with MNP = 9.
Case 27: 7 ports not reachable from port Balboa with MNP = 2.
Case 28: 0 ports not reachable from port Dandong with MNP = 3.
Case 29: 0 ports not reachable from port Barcelona with MNP = 3.
Case 30: 0 ports not reachable from port Charleston with MNP = 6.
Case 31: 0 ports not reachable from port Chittagong with MNP = 9.
Case 32: 22 ports not reachable from port Alexandria with MNP = 1.
Case 33: 0 ports not reachable from port Dubai with MNP = 9.
Case 34: 0 ports not reachable from port Dalian with MNP = 4.
Case 35: 0 ports not reachable from port Bremen with MNP = 6.
Case 36: 0 ports not reachable from port Dalian with MNP = 6.
Case 37: 1 ports not reachable from port Bremen with MNP = 2.
```

```
Caso de prueba 4:
Case 1: 0 ports not reachable from port Algeciras with MNP = 5.
Case 2: 0 ports not reachable from port Barcelona with MNP = 9.
Case 3: 0 ports not reachable from port Cartagena with MNP = 9.
Case 4: 0 ports not reachable from port Bandar with MNP = 6.
Case 5: 0 ports not reachable from port Colombo with MNP = 3.
Case 6: 0 ports not reachable from port Busan with MNP = 7.
Case 7: 0 ports not reachable from port Durban with MNP = 8.
Case 8: 0 ports not reachable from port Balboa with MNP = 6.
Case 9: 0 ports not reachable from port Genoa with MNP = 9.
Case 10: 3 ports not reachable from port Alexandria with MNP = 1.
Case 11: 0 ports not reachable from port Chittagong with MNP = 3.
Case 12: 0 ports not reachable from port Dammam with MNP = 3.
Case 13: 0 ports not reachable from port Dalian with MNP = 1.
Case 14: 0 ports not reachable from port Ambarli with MNP = 8.
Case 15: 0 ports not reachable from port Bandar with MNP = 7.
Case 16: 0 ports not reachable from port Colombo with MNP = 8.
Case 17: 2 ports not reachable from port Durban with MNP = 1.
Case 18: 0 ports not reachable from port Bremen with MNP = 7.
Case 19: 1 ports not reachable from port Algeciras with MNP = 1.
Case 20: 0 ports not reachable from port Callao with MNP = 7.
Case 21: 0 ports not reachable from port Bremen with MNP = 3.
Case 22: 0 ports not reachable from port Dammam with MNP = 5.
Case 23: 0 ports not reachable from port Balboa with MNP = 8.
Case 24: 0 ports not reachable from port Cai_Mep with MNP = 9.
Case 25: 2 ports not reachable from port Bremen with MNP = 1.
Case 26: 0 ports not reachable from port Dalian with MNP = 6.
Case 27: 0 ports not reachable from port Cartagena with MNP = 4.
Case 28: 0 ports not reachable from port Algeciras with MNP = 9.
Case 29: 0 ports not reachable from port Durban with MNP = 2.
Case 30: 0 ports not reachable from port Felixstowe with MNP = 5.
Case 31: 0 ports not reachable from port Antwerp with MNP = 2.
Case 32: 0 ports not reachable from port Alexandria with MNP = 2.
Case 33: 0 ports not reachable from port Busan with MNP = 6.
Case 34: 0 ports not reachable from port Durban with MNP = 5.
Case 35: 0 ports not reachable from port Balboa with MNP = 9.
Case 36: 0 ports not reachable from port Dongguan with MNP = 8.
Case 37: 0 ports not reachable from port Gdansk with MNP = 7.
Case 38: 1 ports not reachable from port Antwerp with MNP = 1.
Case 39: 0 ports not reachable from port Colombo with MNP = 4.
Case 40: 0 ports not reachable from port Durban with MNP = 4.
Case 41: 0 ports not reachable from port Antwerp with MNP = 3.
Case 42: 0 ports not reachable from port Bremen with MNP = 4.
Case 43: 0 ports not reachable from port Colombo with MNP = 9.
Case 44: 0 ports not reachable from port Colon with MNP = 3.
Case 45: 0 ports not reachable from port Balboa with MNP = 5.
Case 46: 0 ports not reachable from port Callao with MNP = 2.
Case 47: 0 ports not reachable from port Ambarli with MNP = 3.
Case 48: 0 ports not reachable from port Busan with MNP = 3.
Case 49: 0 ports not reachable from port Cai_Mep with MNP = 2.
Case 50: 0 ports not reachable from port Chennai with MNP = 4.
```

Complejidad temporal

loadGraph: $O(n^2)$ - Esta función carga los arcos del grafo y los almacena en una Matriz de

Adyacencia y en una Lista de Adyacencia. Como cada vértice puede estar conectado con

todos los demás, en el peor de los casos, la función debe recorrer todos los pares de vértices, lo que da una complejidad de tiempo de O(n^2).

La función **unreachablePorts()** escrita para esta tarea es una implementación del algoritmo de búsqueda en anchura (BFS) para un grafo representado por una lista de adyacencia. El análisis de complejidad de esta función es el mismo que el del algoritmo general de BFS, que es O(V + E), donde V es el número de vértices (puertos) y E es el número de aristas (conexiones).

El algoritmo de BFS consiste en explorar el grafo desde un vértice inicial, visitando todos sus vecinos y añadiéndolos a una cola. Luego, se extrae el primer vértice de la cola y se repite el proceso con sus vecinos, hasta que la cola esté vacía o se cumpla alguna condición de parada. El análisis de complejidad de esta función se divide en dos partes: la inicialización y el bucle principal.

La inicialización consiste en crear un mapa de visitados y una cola, y añadir el vértice inicial a la cola. Esto tiene un costo de O(V) en espacio y O(1) en tiempo.

El bucle principal consiste en extraer el primer vértice de la cola, marcarlo como visitado y explorar sus vecinos. Esto se repite hasta que la cola esté vacía o se cumpla la condición de MNP. Cada vértice se extrae y se marca una sola vez, lo que tiene un costo de O(V) en tiempo. Cada arista se examina una o dos veces, dependiendo de si el grafo es dirigido o no, lo que tiene un costo de O(E) en tiempo. Por lo tanto, el bucle principal tiene un costo de O(V + E) en tiempo.

Sumando las dos partes, obtenemos que la complejidad temporal total del algoritmo es O(V + E). La complejidad espacial es O(V), ya que solo se necesita almacenar el mapa de visitados y la cola.