**División de Ingeniería**

**Departamento de Tecnologías de Información y Electrónica**

**Análisis y Diseño de Algoritmos (TC2017****)**

**Profesor: Dr. Vicente Cubells Nonell**

# Ejercicios en Clase No. 2

### Algoritmos de Dijkstra y Floyd-Warshall

**1. Solución con Dijkstra**

| **Iteración 1** | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **D** | **∞** | **∞** | **0** | **∞** | **∞** | **∞** | **∞** | **∞** | **∞** | **∞** | **∞** | **∞** | **∞** | **∞** |
| **P** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |

***Q = 1,2,3,4,5,6,7,8,9,10,11,12,13,14***

***S = -***

***u = -***

| **Iteración 2** | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **D** | **∞** | **1** | **0** | **∞** | **∞** | **∞** | **2** | **∞** | **∞** | **∞** | **∞** | **∞** | **∞** | **∞** |
| **P** | **-** | **3** | **-** | **-** | **-** | **-** | **3** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |

**Q = *1,2,4,5,6,7,8,9,10,11,12,13,14***

**S = 3**

**u = 3**

| **Iteración 3** | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **D** | **7** | **1** | **0** | **∞** | **∞** | **∞** | **2** | **9** | **∞** | **∞** | **∞** | **∞** | **∞** | **∞** |
| **P** | **2** | **3** | **-** | **-** | **-** | **-** | **3** | **2** | **-** | **-** | **-** | **-** | **-** | **-** |

**Q = *1,4,5,6,7,8,9,10,11,12,13,14***

**S = 2,3**

**u = 2**

| **Iteración 4** | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **D** | **7** | **1** | **0** | **∞** | **∞** | **6** | **2** | **5** | **∞** | **∞** | **∞** | **∞** | **∞** | **4** |
| **P** | **2** | **3** | **-** | **-** | **-** | **7** | **3** | **2** | **-** | **-** | **-** | **-** | **-** | **7** |

**Q = *1,4,5,6,8,9,10,11,12,13,14***

**S = 2,3,7**

**u = 7**

| **Iteración 5** | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **D** | **7** | **1** | **0** | **∞** | **∞** | **6** | **2** | **5** | **∞** | **8** | **∞** | **∞** | **∞** | **4** |
| **P** | **2** | **3** | **-** | **-** | **-** | **7** | **3** | **2** | **-** | **14** | **-** | **-** | **-** | **7** |

**Q = *1,4,5,6,8,9,10,11,12,13***

**S = 2,3,7,14**

**u = 14**

| **Iteración 6** | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **D** | **7** | **1** | **0** | **∞** | **∞** | **6** | **2** | **5** | **15** | **8** | **∞** | **∞** | **∞** | **4** |
| **P** | **2** | **3** | **-** | **-** | **-** | **7** | **3** | **2** | **6** | **14** | **-** | **-** | **-** | **7** |

**Q = *1,4,5,9,10,11,12,13***

**S = 2,3,6,7,14,8**

**u = 8**

| **Iteración 7** | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **D** | **7** | **1** | **0** | **∞** | **∞** | **6** | **2** | **5** | **15** | **8** | **∞** | **∞** | **∞** | **4** |
| **P** | **2** | **3** | **-** | **-** | **-** | **7** | **3** | **2** | **6** | **14** | **-** | **-** | **-** | **7** |

**Q = *1,4,5,9,10,11,12,13***

**S = 2,3,7,14,8,6**

**u = 6**

| **Iteración 8** | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **D** | **7** | **1** | **0** | **14** | **18** | **6** | **2** | **5** | **15** | **8** | **∞** | **∞** | **∞** | **4** |
| **P** | **2** | **3** | **-** | **1** | **1** | **7** | **3** | **2** | **6** | **14** | **-** | **-** | **-** | **7** |

**Q = *4,5,9,10,11,12,13***

**S = 2,3,7,14,8,6,1**

**u = 1**

| **Iteración 9** | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **D** | **7** | **1** | **0** | **14** | **18** | **6** | **2** | **5** | **15** | **8** | **16** | **15** | **∞** | **4** |
| **P** | **2** | **3** | **-** | **1** | **1** | **7** | **3** | **2** | **6** | **14** | **10** | **10** | **-** | **7** |

**Q = *4,5,9,11,12,13***

**S = 2,3,7,14,8,6,1,10**

**u = 10**

| **Iteración 10** | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **D** | **7** | **1** | **0** | **14** | **18** | **6** | **2** | **5** | **15** | **8** | **16** | **15** | **∞** | **4** |
| **P** | **2** | **3** | **-** | **1** | **1** | **7** | **3** | **2** | **6** | **14** | **10** | **10** | **-** | **7** |

**Q = *5,9,11,12,13***

**S = 2,3,7,14,8,6,1,10,4**

**u = 4**

| **Iteración 11** | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **D** | **7** | **1** | **0** | **14** | **18** | **6** | **2** | **5** | **15** | **8** | **16** | **15** | **∞** | **4** |
| **P** | **2** | **3** | **-** | **1** | **1** | **7** | **3** | **2** | **6** | **14** | **10** | **10** | **-** | **7** |

**Q = *5,11,12,13***

**S = 2,3,7,14,8,6,1,10,4,9**

**u = 9**

| **Iteración 12** | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **D** | **7** | **1** | **0** | **14** | **18** | **6** | **2** | **5** | **15** | **8** | **16** | **15** | **∞** | **4** |
| **P** | **2** | **3** | **-** | **1** | **1** | **7** | **3** | **2** | **6** | **14** | **10** | **10** | **-** | **7** |

**Q = *5,11,13***

**S = 2,3,7,14,8,6,1,10,4,9,12**

**u = 12**

| **Iteración 13** | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **D** | **7** | **1** | **0** | **14** | **18** | **6** | **2** | **5** | **15** | **8** | **16** | **15** | **18** | **4** |
| **P** | **2** | **3** | **-** | **1** | **1** | **7** | **3** | **2** | **6** | **14** | **10** | **10** | **11** | **7** |

**Q = *5,13***

**S = 2,3,7,14,8,6,1,10,4,9,12,11**

**u = 11**

| **Iteración 14** | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **D** | **7** | **1** | **0** | **14** | **18** | **6** | **2** | **5** | **15** | **8** | **16** | **15** | **18** | **4** |
| **P** | **2** | **3** | **-** | **1** | **1** | **7** | **3** | **2** | **6** | **14** | **10** | **10** | **11** | **7** |

**Q = *13***

**S = 2,3,7,14,8,6,1,10,4,9,12,11,5**

**u = 5**

| **Iteración 15** | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| **D** | **7** | **1** | **0** | **14** | **16** | **6** | **2** | **5** | **15** | **8** | **16** | **15** | **18** | **4** |
| **P** | **2** | **3** | **-** | **1** | **1** | **7** | **3** | **7** | **6** | **14** | **10** | **10** | **11** | **7** |

**Q = *null***

**S = 2,3,7,14,8,6,1,10,9,4,12,11,5,13**

**u = 13**

**2. Solución con Floyd-Warshall**

| **Después de iteración 1** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **1** | 0 | 6 | **∞** | 10 | **∞** | **∞** | **∞** | **∞** | **∞** |
| **2** | 6 | 0 | 5 | **∞** | 10 | **∞** | **∞** | **∞** | **∞** |
| **3** | **∞** | 5 | 0 | **∞** | **∞** | **∞** | **∞** | **∞** | **∞** |
| **4** | 10 | **∞** | **∞** | 0 | 9 | **∞** | 5 | **∞** | **∞** |
| **5** | **∞** | 10 | **∞** | 9 | 0 | **∞** | **∞** | **∞** | 2 |
| **6** | **∞** | **∞** | **∞** | **∞** | **∞** | 0 | **∞** | 5 | 1 |
| **7** | **∞** | **∞** | **∞** | 5 | **∞** | **∞** | 0 | 4 | **∞** |
| **8** | **∞** | **∞** | **∞** | **∞** | **∞** | 5 | 4 | 0 | **∞** |
| **9** | **∞** | **∞** | **∞** | **∞** | 2 | 1 | **∞** | **∞** | 0 |

| **Después de iteración 2** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **1** | 0 | 6 | **∞** | 10 | **∞** | **∞** | **∞** | **∞** | **∞** |
| **2** | 6 | 0 | 5 | **16** | 10 | **∞** | **∞** | **∞** | **∞** |
| **3** | **∞** | 5 | 0 | **∞** | **∞** | **∞** | **∞** | **∞** | **∞** |
| **4** | 10 | **16** | **∞** | 0 | 9 | **∞** | 5 | **∞** | **∞** |
| **5** | **∞** | 10 | **∞** | 9 | 0 | **∞** | **∞** | **∞** | 2 |
| **6** | **∞** | **∞** | **∞** | **∞** | **∞** | 0 | **∞** | 5 | 1 |
| **7** | **∞** | **∞** | **∞** | 5 | **∞** | **∞** | 0 | 4 | **∞** |
| **8** | **∞** | **∞** | **∞** | **∞** | **∞** | 5 | 4 | 0 | **∞** |
| **9** | **∞** | **∞** | **∞** | **∞** | 2 | 1 | **∞** | **∞** | 0 |

| **Después de iteración 3** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **1** | 0 | 6 | **11** | 10 | **16** | **∞** | **∞** | **∞** | **∞** |
| **2** |  | 0 | 5 | **16** | 10 | **∞** | **∞** | **∞** | **∞** |
| **3** |  |  | 0 | **21** | **15** | **∞** | **∞** | **∞** | **∞** |
| **4** |  |  |  | 0 | 9 | **∞** | 5 | **∞** | **∞** |
| **5** |  |  |  |  | 0 | **∞** | **∞** | **∞** | 2 |
| **6** |  |  |  |  |  | 0 | **∞** | 5 | 1 |
| **7** |  |  |  |  |  |  | 0 | 4 | **∞** |
| **8** |  |  |  |  |  |  |  | 0 | **∞** |
| **9** |  |  |  |  |  |  |  |  | 0 |

| **Después de iteración 4** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **1** | 0 | 6 | **11** | 10 | **16** | **∞** | **∞** | **∞** | **∞** |
| **2** |  | 0 | 5 | **16** | 10 | **∞** | **∞** | **∞** | **∞** |
| **3** |  |  | 0 | **21** | **15** | **∞** | **∞** | **∞** | **∞** |
| **4** |  |  |  | 0 | 9 | **∞** | 5 | **∞** | **∞** |
| **5** |  |  |  |  | 0 | **∞** | **∞** | **∞** | 2 |
| **6** |  |  |  |  |  | 0 | **∞** | 5 | 1 |
| **7** |  |  |  |  |  |  | 0 | 4 | **∞** |
| **8** |  |  |  |  |  |  |  | 0 | **∞** |
| **9** |  |  |  |  |  |  |  |  | 0 |

| **Después de iteración 5** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **1** | 0 | 6 | **11** | 10 | **16** | **∞** | **15** | **∞** | **∞** |
| **2** |  | 0 | 5 | **16** | 10 | **∞** | **21** | **∞** | **∞** |
| **3** |  |  | 0 | **21** | **15** | **∞** | **26** | **∞** | **∞** |
| **4** |  |  |  | 0 | 9 | **∞** | 5 | **∞** | **∞** |
| **5** |  |  |  |  | 0 | **∞** | **14** | **∞** | 2 |
| **6** |  |  |  |  |  | 0 | **∞** | 5 | 1 |
| **7** |  |  |  |  |  |  | 0 | 4 | **∞** |
| **8** |  |  |  |  |  |  |  | 0 | **∞** |
| **9** |  |  |  |  |  |  |  |  | 0 |

| **Después de iteración 6** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **1** | 0 | 6 | **11** | 10 | **16** | **∞** | **15** | **∞** | **18** |
| **2** |  | 0 | 5 | **16** | 10 | **∞** | **21** | **∞** | **12** |
| **3** |  |  | 0 | **21** | **15** | **∞** | **26** | **∞** | **17** |
| **4** |  |  |  | 0 | 9 | **∞** | 5 | **∞** | **11** |
| **5** |  |  |  |  | 0 | **∞** | **14** | **∞** | 2 |
| **6** |  |  |  |  |  | 0 | **∞** | 5 | 1 |
| **7** |  |  |  |  |  |  | 0 | 4 | **16** |
| **8** |  |  |  |  |  |  |  | 0 | **∞** |
| **9** |  |  |  |  |  |  |  |  | 0 |

| **Después de iteración 7** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **1** | 0 | 6 | **11** | 10 | **16** | **∞** | **15** | **∞** | **18** |
| **2** |  | 0 | 5 | **16** | 10 | **∞** | **21** | **∞** | **12** |
| **3** |  |  | 0 | **21** | **15** | **∞** | **26** | **∞** | **17** |
| **4** |  |  |  | 0 | 9 | **∞** | 5 | **∞** | **11** |
| **5** |  |  |  |  | 0 | **∞** | **14** | **∞** | 2 |
| **6** |  |  |  |  |  | 0 | **∞** | 5 | 1 |
| **7** |  |  |  |  |  |  | 0 | 4 | **16** |
| **8** |  |  |  |  |  |  |  | 0 | **6** |
| **9** |  |  |  |  |  |  |  |  | 0 |

| **Después de iteración 8** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **1** | 0 | 6 | **11** | 10 | **16** | **24** | **15** | **19** | **18** |
| **2** |  | 0 | 5 | **16** | 10 | **30** | **21** | **25** | **12** |
| **3** |  |  | 0 | **21** | **15** | **35** | **26** | **30** | **17** |
| **4** |  |  |  | 0 | 9 | **14** | 5 | **9** | **11** |
| **5** |  |  |  |  | 0 | **23** | **14** | **18** | 2 |
| **6** |  |  |  |  |  | 0 | **9** | 5 | 1 |
| **7** |  |  |  |  |  |  | 0 | 4 | **16** |
| **8** |  |  |  |  |  |  |  | 0 | **6** |
| **9** |  |  |  |  |  |  |  |  | 0 |

| **Después de iteración 9** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **1** | 0 | 6 | **11** | 10 | **16** | **19** | **15** | **19** | **18** |
| **2** |  | 0 | 5 | **16** | 10 | **13** | **21** | **25** | **12** |
| **3** |  |  | 0 | **21** | **15** | **18** | **26** | **30** | **17** |
| **4** |  |  |  | 0 | 9 | **12** | 5 | **9** | **11** |
| **5** |  |  |  |  | 0 | **3** | **14** | **18** | 2 |
| **6** |  |  |  |  |  | 0 | **9** | 5 | 1 |
| **7** |  |  |  |  |  |  | 0 | 4 | **16** |
| **8** |  |  |  |  |  |  |  | 0 | **6** |
| **9** |  |  |  |  |  |  |  |  | 0 |