

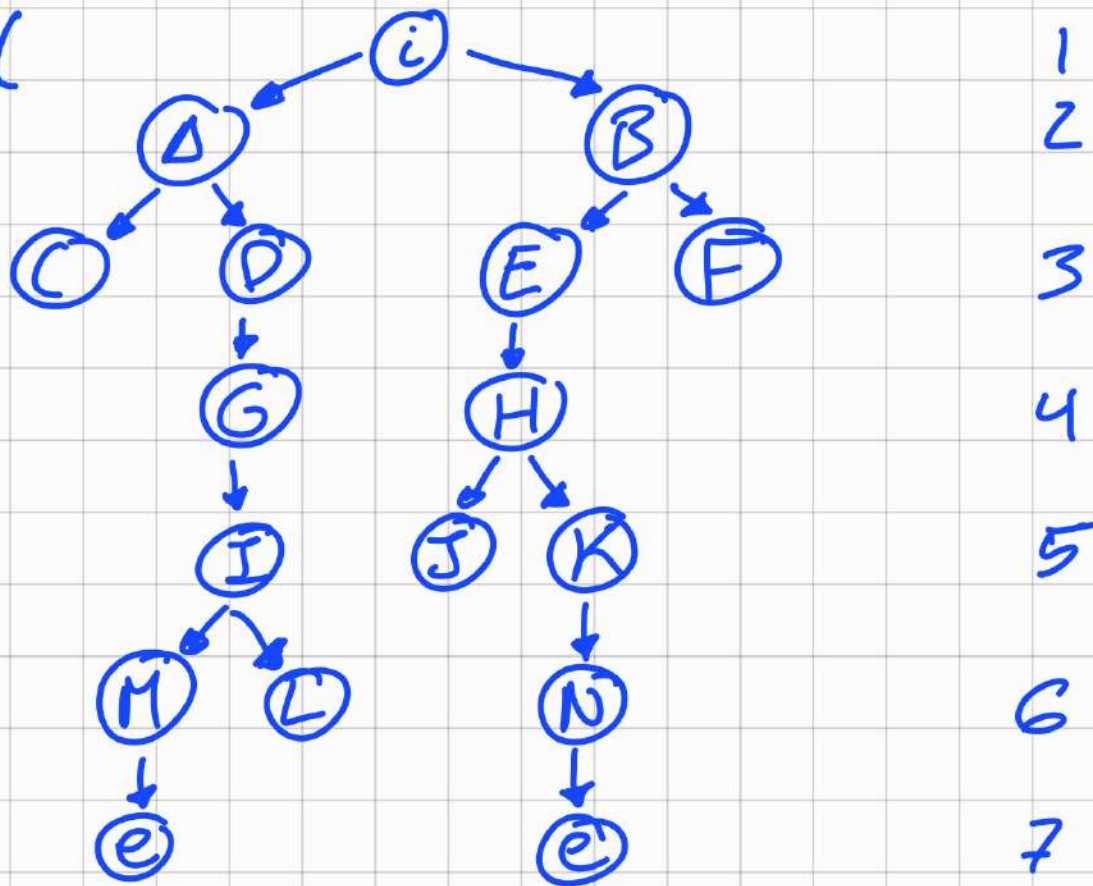
		P	O	L
		e	M	H
				G
e		C	A	D
N	J		i	
K	H	E	B	F

Búsqueda por anchura: FIFO  $\uparrow \downarrow \rightleftharpoons$

- 1 Test(i);  $C = \{i\}$ ;  $\Delta = \{\Delta, B\}$
- 2 Test( $\Delta$ );  $C = \{i, \Delta\}$ ;  $\Delta = \{B, C, D\}$
- 3 Test(B);  $C = \{i, \Delta, B\}$ ;  $\Delta = \{C, D, E, F\}$
- 4 Test(C);  $C = \{i, \Delta, B, C\}$ ;  $\Delta = \{D, E, F\}$
- 5 Test(D);  $C = \{i, \Delta, B, C, D\}$ ;  $\Delta = \{E, F, G\}$
- 6 Test(E);  $C = \{i, \Delta, B, C, D, E\}$ ;  $\Delta = \{F, G, H\}$
- 7 Test(F);  $C = \{i, \Delta, B, C, D, E, F\}$ ;  $\Delta = \{G, H\}$
- 8 Test(G);  $C = \{i, \Delta, B, C, D, E, F, G\}$ ;  $\Delta = \{H, I\}$
- 9 Test(H);  $C = \{i, \Delta, B, C, D, E, F, G, H\}$ ;  $\Delta = \{I, J, K\}$
- 10 Test(I);  $C = \{i, \Delta, B, C, D, E, F, G, H, I\}$ ;  $\Delta = \{J, K, L, M\}$
- 11 Test(J);  $C = \{i, \Delta, B, C, D, E, F, G, H, I, J\}$ ;  $\Delta = \{K, L, M, N\}$
- 12 Test(K);  $C = \{i, \Delta, B, C, D, E, F, G, H, I, J, K\}$ ;  
 $\Delta = \{L, M, N\}$
- 13 Test(L);  $C = \{i, \Delta, B, C, D, E, F, G, H, I, J, K, L\}$ ;  
 $\Delta = \{M, N, O\}$
- 14 Test(M);  $C = \{i, \Delta, B, C, D, E, F, G, H, I, J, K, L, M\}$ ;  
 $\Delta = \{N, O, e\}$
- 15 Test(N);  $C = \{i, \Delta, B, C, D, E, F, G, H, I, J, K, L, M, N\}$ ;  
 $\Delta = \{O, e, e\}$
- 16 Test(O);  $C = \{i, \Delta, B, C, D, E, F, G, H, I, J, K, L, M, N, O\}$ ;  
 $\Delta = \{e, e, P\}$

- 17 Test(e);  $C = \{i, \Delta, B, C, D, E, F, G, H, I, J, K, L, M, N, O, e\}$ ;  
 $\Delta = \{e, P\}$
- 18 Test(e);  $C = \{i, \Delta, B, C, D, E, F, G, H, I, J, K, L, M, N, O, e, e\}$ ;  
 $\Delta = \{P\}$

Ámbol

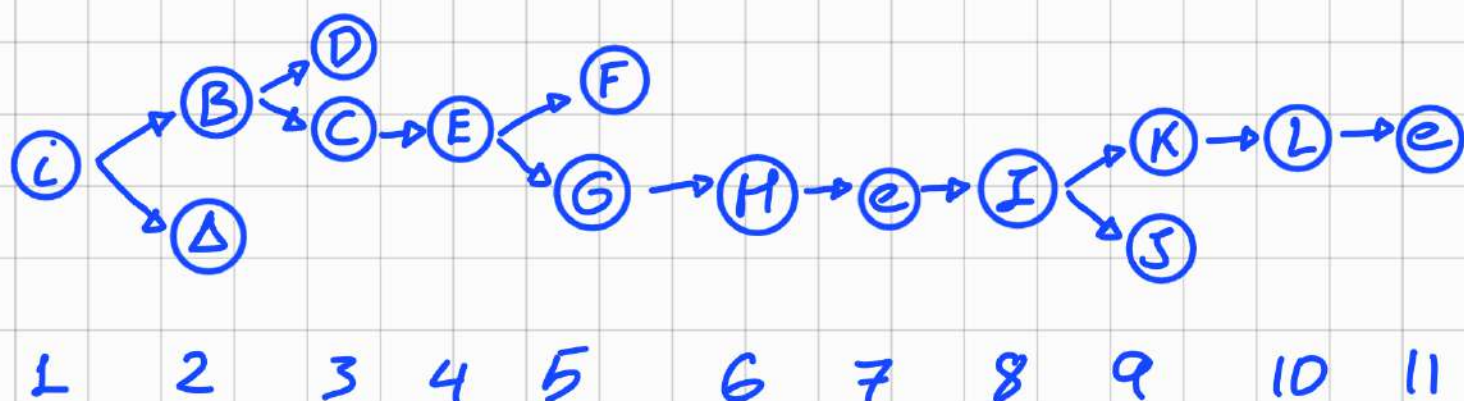




				Q
J	L	e	R	P
I	K			O
e		M	A	N
H	F		i	
G	E	C	B	D

Búsqueda en profundidad: LIFO

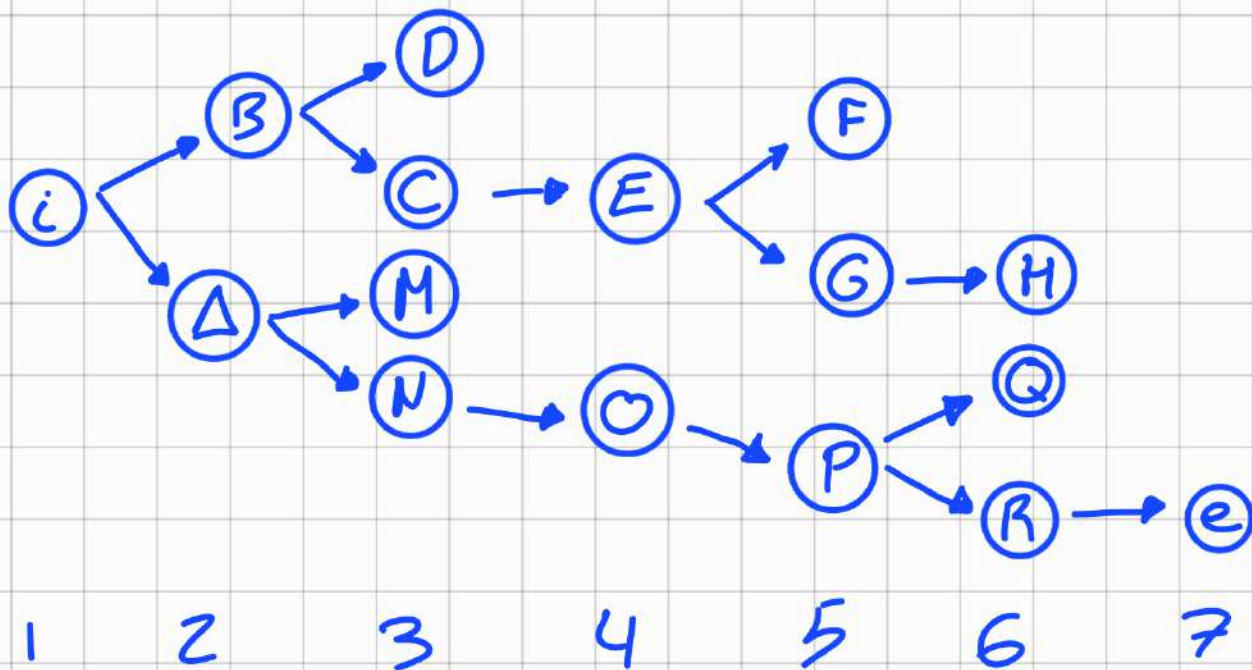
- 1 Test(i);  $C = \{i\}$ ;  $\Delta = \{\Delta, B\}$
- 2 Test(B);  $C = \{i, B\}$ ;  $\Delta = \{\Delta, C, D\}$
- 3 Test(D);  $C = \{i, B, D\}$ ;  $\Delta = \{\Delta, C\}$
- 4 Test(C);  $C = \{i, B, D, C\}$ ;  $\Delta = \{\Delta, E\}$
- 5 Test(E);  $C = \{i, B, D, C, E\}$ ;  $\Delta = \{\Delta, F, G\}$
- 6 Test(G);  $C = \{i, B, D, C, E, G\}$ ;  $\Delta = \{\Delta, F, M\}$
- 7 Test(H);  $C = \{i, B, D, C, E, G, H\}$ ;  $\Delta = \{\Delta, F, e\}$
- 8 Test(e);  $C = \{i, B, D, C, E, G, H, e\}$ ;  $\Delta = \{\Delta, F, I\}$
- 9 Test(I);  $C = \{i, B, D, C, E, G, H, e, I\}$ ;  $\Delta = \{\Delta, F, J, K\}$
- 10 Test(K);  $C = \{i, B, D, C, E, G, H, e, I, K\}$ ;  $\Delta = \{\Delta, F, J, L\}$
- 11 Test(L);  $C = \{i, B, D, C, E, G, H, e, I, K, L\}$ ;  $\Delta = \{\Delta, F, J, e\}$
- 12 Test(e);  $C = \{i, B, D, C, E, G, H, e, I, K, L, e\}$ ;  $\Delta = \{\Delta, F, J\}$





- 1 Test(i);  $C = \{i\}$ ;  $\Delta = \{\Delta, B\}$
- 2 Test(B);  $C = \{i, B\}$ ;  $\Delta = \{\Delta, C, D\}$
- 3 Test(D);  $C = \{i, B, D\}$ ;  $\Delta = \{\Delta, C\}$
- 4 Test(C);  $C = \{i, B, D, C\}$ ;  $\Delta = \{\Delta, E\}$
- 5 Test(E);  $C = \{i, B, D, C, E\}$ ;  $\Delta = \{\Delta, F, G\}$
- 6 Test(G);  $C = \{i, B, D, C, E, G\}$ ;  $\Delta = \{\Delta, F, M\}$
- 7 Test(H);  $C = \{i, B, D, C, E, G, H\}$ ;  $\Delta = \{\Delta\}$
- 8 Test( $\Delta$ );  $C = \{i, B, D, C, E, G, H, \Delta\}$ ;  $\Delta = \{M, N\}$
- 9 Test(N);  $C = \{i, B, D, C, E, G, H, \Delta, N\}$ ;  $\Delta = \{M, O\}$
- 10 Test(O);  $C = \{i, B, D, C, E, G, H, \Delta, N, O\}$ ;  $\Delta = \{M, P\}$
- 11 Test(P);  $C = \{i, B, D, C, E, G, H, \Delta, N, O, P\}$ ;  $\Delta = \{M, Q, R\}$
- 12 Test(R);  $C = \{i, B, D, C, E, G, H, \Delta, N, O, P, R\}$ ;  $\Delta = \{M, Q, e\}$
- 13 Test(e);  $C = \{i, B, D, C, E, G, H, \Delta, N, O, P, R, e\}$ ;  $\Delta = \{M, Q\}$

< Aplicando  
profundidad 5





			O	L
		e	M	I
				G
e		C	A	D
N	J		i	
K	H	E	B	F

Búsqueda de coste uniforme:  $\uparrow \downarrow \xleftrightarrow{2} n^{g-g'+C}$

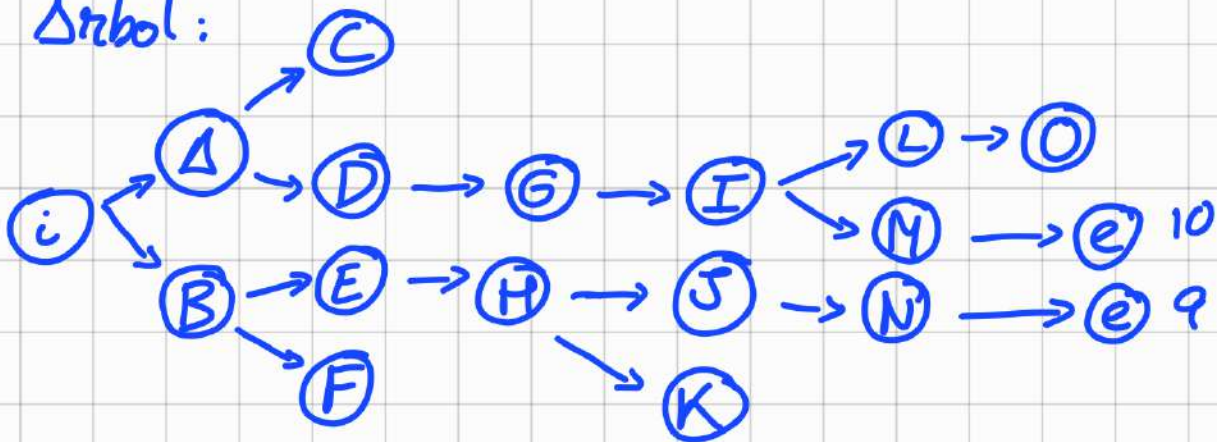
- 1 Test(i);  $C = \{i^0\}$ ;  $\Delta = \{\Delta^1(i), B^1(i)\}$
- 2 Test(A);  $C = \{i^0, \Delta^1(i)\}$ ;  $\Delta = \{B^1(i), C^3(A), D^3(A)\}$
- 3 Test(B);  $C = \{i^0, \Delta^1(i), B^1(i)\}$ ;  
 $\Delta = \{C^3(A), D^3(A), E^3(B), F^3(B)\}$
- 4 Test(C);  $C = \{i^0, \Delta^1(i), B^1(i), C^3(A)\}$ ;  
 $\Delta = \{D^3(A), E^3(B), F^3(B)\}$
- 5 Test(D);  $C = \{i^0, \Delta^1(i), B^1(i), C^3(A), D^3(A)\}$ ;  
 $\Delta = \{E^3(B), F^3(B), G^4(D)\}$
- 6 Test(E);  $C = \{i^0, \Delta^1(i), B^1(i), C^3(A), D^3(A), E^3(B)\}$ ;  
 $\Delta = \{F^3(B), G^4(D), H^5(E)\}$ ;
- 7 Test(F);  $C = \{i^0, \Delta^1(i), B^1(i), C^3(A), D^3(A), E^3(B), F^3(B)\}$ ;  
 $\Delta = \{G^4(D), H^5(E)\}$ ;
- 8 Test(G);  $C = \{i^0, \Delta^1(i), B^1(i), C^3(A), D^3(A), E^3(B), F^3(B), G^4(D)\}$ ;  
 $\Delta = \{H^5(E), I^6(G)\}$ ;
- 9 Test(H);  $C = \{i^0, \Delta^1(i), B^1(i), C^3(A), D^3(A), E^3(B), F^3(B), G^4(D), H^5(E)\}$ ;  
 $\Delta = \{I^6(G), J^6(H), K^7(H)\}$
- 10 Test(I);  $C = \{i^0, \Delta^1(i), B^1(i), C^3(A), D^3(A), E^3(B), F^3(B), G^4(D), H^5(E), I^6(G)\}$ ;  
 $\Delta = \{J^6(H), K^7(H), L^7(I), M^8(I)\}$ ;



- 11 Test(J);  $C = \{i^\emptyset, \Delta^1(i), B^1(i), C^3(\Delta), D^3(\Delta), E^3(B), F^3(B), G^4(D), H^5(E), I^6(G), J^6(H)\}; \Delta = \{L^7(I), M^8(I), N^8(J)\};$
- 12 Test(L);  $C = \{i^\emptyset, \Delta^1(i), B^1(i), C^3(\Delta), D^3(\Delta), E^3(B), F^3(B), G^4(D), H^5(E), I^6(G), J^6(H), L^7(I)\}; \Delta = \{M^8(I), N^8(J), O^9(L)\};$
- 13 Test(M);  $C = \{i^\emptyset, \Delta^1(i), B^1(i), C^3(\Delta), D^3(\Delta), E^3(B), F^3(B), G^4(D), H^5(E), I^6(G), J^6(H), L^7(I), M^8(I)\}; \Delta = \{N^8(J), \cancel{O^9(L)}, e^{10}(M)\};$
- 14 Test(N);  $C = \{i^\emptyset, \Delta^1(i), B^1(i), C^3(\Delta), D^3(\Delta), E^3(B), F^3(B), G^4(D), H^5(E), I^6(G), J^6(H), L^7(I), M^8(I), N^8(J)\}; \Delta = \{e^{10}(M), e^9(N)\};$

$e^1 \rightarrow i^\emptyset, \Delta^1(i), D^3(\Delta), G^4(D), I^6(G), M^8(I), e^{10}(M)$  → cost 10  
 $e^2 \rightarrow i^\emptyset, B^1(i), E^3(B), H^5(E), J^6(H), N^8(J), e^9(N)$

Symbol:



0 1 2 3 4 5 6

				J
		e	K	I
				G
		C	A	D
			i	
	H	E	B	F

Búsqueda de  $\Delta^*$   $f(n) = g(n) + h(n)$   $N \rightarrow \text{noob}$   
 $N \begin{matrix} f \\ n \end{matrix} \begin{matrix} 1^o > f \\ 2^o FZF \cup \end{matrix}$   $h \rightarrow \text{heurística}$   
 $f = g + h$   
 $g \rightarrow \text{coste}$

- 1 Test(i);  $C = \{\emptyset i_4^4\}$ ;  $\Delta = \{1 \Delta_3^4(i), 1 B_5^6(i)\}$
- 2 Test( $\Delta$ );  $C = \{\emptyset i_4^4, 1 \Delta_3^4(i)\}$ ;  $\Delta = \{1 B_5^6(i), 3 C_2^5(\Delta), 3 D_4^7(\Delta)\}$
- 3 Test(C);  $C = \{\emptyset i_4^4, 1 \Delta_3^4(i), 3 C_2^5(\Delta)\}$ ;  $\Delta = \{1 B_5^6(i), 3 D_4^7(\Delta)\}$
- 4 Test(B);  $C = \{\emptyset i_4^4, 1 \Delta_3^4(i), 3 C_2^5(\Delta), 1 B_5^6(i)\}$ ;  
 $\Delta = \{3 D_4^7(\Delta), 3 E_4^7(B), 3 F_6^9(B)\}$
- 5 Test(D);  $C = \{\emptyset i_4^4, 1 \Delta_3^4(i), 3 C_2^5(\Delta), 1 B_5^6(i), 3 D_4^7(\Delta)\}$ ;  
 $\Delta = \{3 E_4^7(B), 3 F_6^9(B), 4 G_3^7(D)\}$
- 6 Test(E);  $C = \{\emptyset i_4^4, 1 \Delta_3^4(i), 3 C_2^5(\Delta), 1 B_5^6(i), 3 D_4^7(\Delta),$   
 $3 E_4^7(B)\}$ ;  $\Delta = \{3 F_6^9(B), 5 H_5^{10}(E)\}$

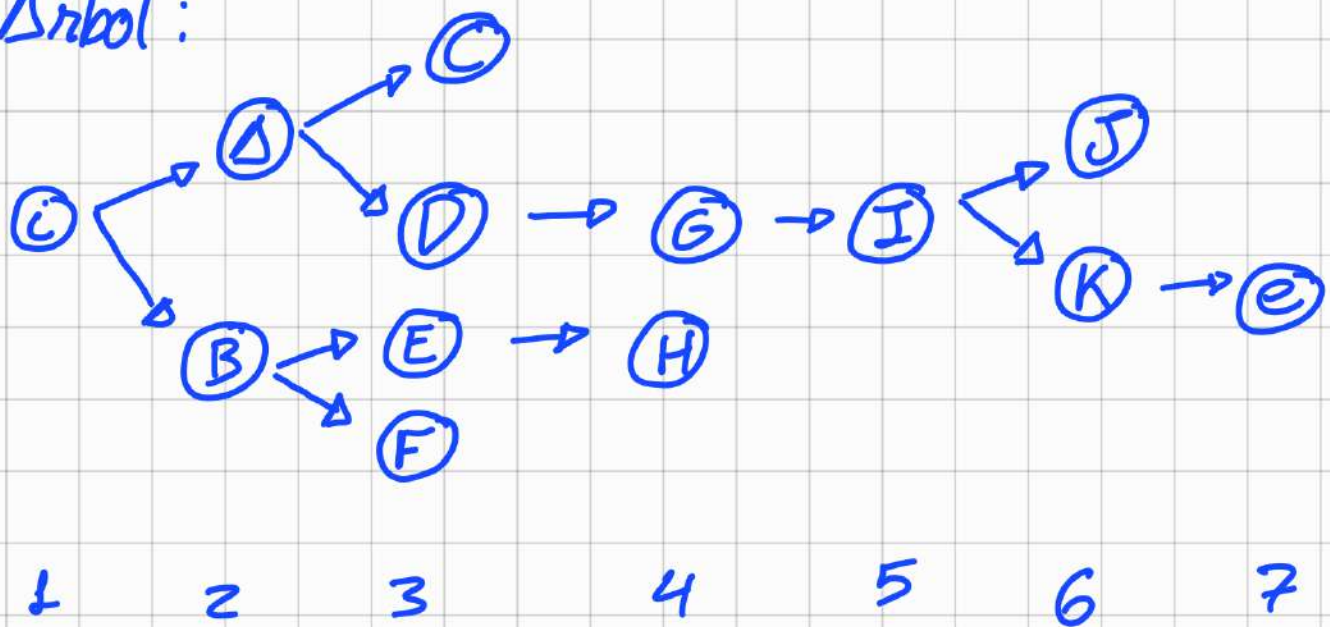


7 Test(G);  $C = \{\emptyset i_4^4, {}_1\Delta_3^4(i), {}_3C_2^5(\Delta), {}_1B_5^6(i), {}_3D_4^7(\Delta), {}_3E_4^7(B), {}_4G_3^7(D)\}$ ;  $\Delta = \{{}_3F_6^9(B), {}_5H_5^{10}(E), {}_5I_2^7(G)\}$

8 Test(I);  $C = \{\emptyset i_4^4, {}_1\Delta_3^4(i), {}_3C_2^5(\Delta), {}_1B_5^6(i), {}_3D_4^7(\Delta), {}_3E_4^7(B), {}_4G_3^7(D), {}_5I_2^7(G)\}$ ;  $\Delta = \{{}_3F_6^9(B), {}_5H_5^{10}(E), {}_6J_3^9(I), {}_7K_1^8(I)\}$

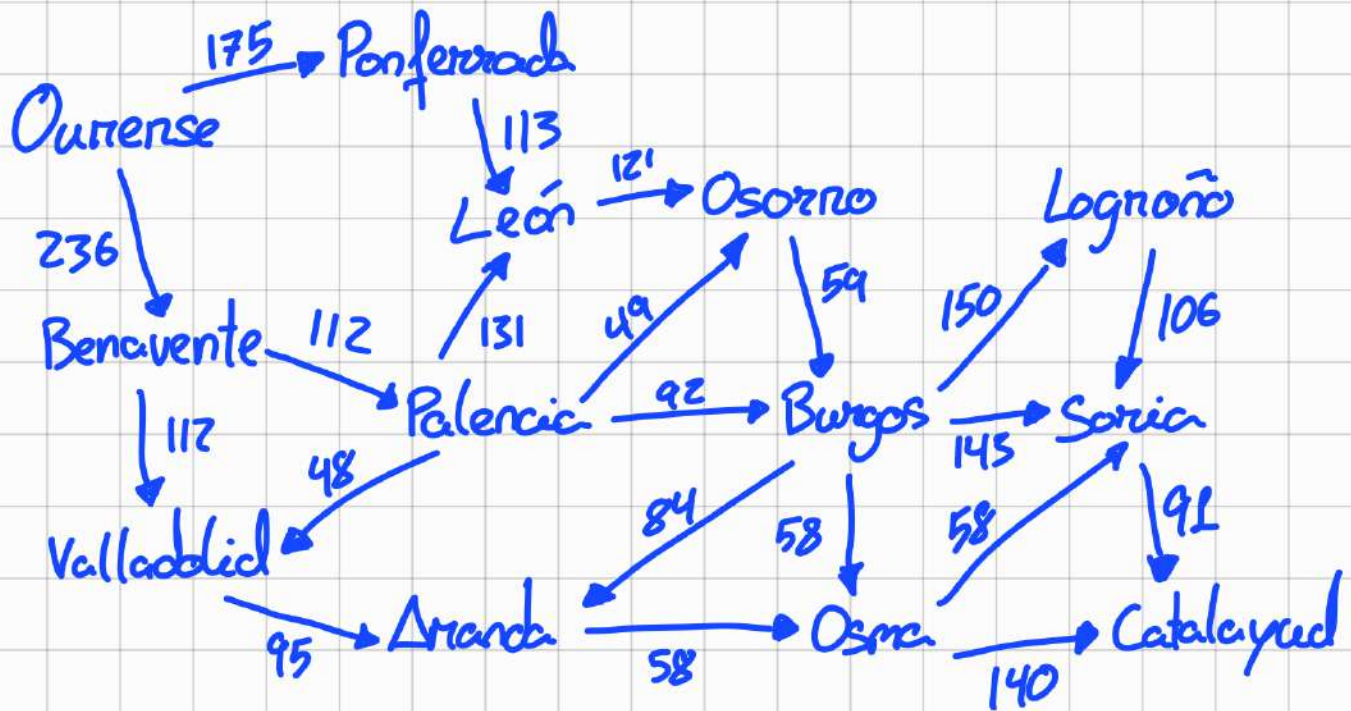
9 Test(K);  $C = \{\emptyset i_4^4, {}_1\Delta_3^4(i), {}_3C_2^5(\Delta), {}_1B_5^6(i), {}_3D_4^7(\Delta), {}_3E_4^7(B), {}_4G_3^7(D), {}_5I_2^7(G), {}_7K_1^8(I)\}$ ;  $\Delta = \{{}_3F_6^9(B), {}_5H_5^{10}(E), {}_6J_3^9(I), {}_9e_\emptyset^9\}$

Δnbol:





# EJERCICIO 3: Búsqueda de coste uniforme:



- 1 Test (Ourense);  $C = \{Ourense^0\}$ ;  $\Delta = \{Ponferrada^{175}(Ourense), Benavente^{236}(Ourense)\}$
- 2 Test (Ponferrada);  $C = \{Ourense^0, Ponferrada^{175}(Ourense)\}$   
 $\Delta = \{Benavente^{236}(Ourense), León^{288}(Ponferrada)\}$
- 3 Test (Benavente);  $C = \{Ourense^0, Ponferrada^{175}(Ourense), Benavente^{236}(Ourense)\}$   
 $\Delta = \{León^{288}(Ponferrada), Palencia^{348}(Benavente), Valladolid^{348}(Benavente)\}$
- 4 Test (León);  $C = \{Ourense^0, Ponferrada^{175}(Ourense), Benavente^{236}(Ourense), León^{288}(Ponferrada)\}$   
 $\Delta = \{Palencia^{348}(Benavente), Valladolid^{348}(Benavente), ~~Palencia^{419}(León)~~, Osorno^{409}(León)\}$
- 5 Test (Palencia);  $C = \{Ourense^0, Ponferrada^{175}(Ourense), Benavente^{236}(Ourense), León^{288}(Ponferrada), Palencia^{348}(Benavente)\}$



$\Delta = \{ \text{Valladolid}^{348} (\text{Berauente}), \text{Osorno}^{409} (\text{Aron}), \text{León}^{474} (\text{Palencia}), \text{Osorno}^{397} (\text{Palencia}), \text{Burgos}^{440} (\text{Palencia}), \text{Valladolid}^{348} (\text{Palencia}) \}$

6 Test (Valladolid);  $C = \{ \text{Ourense}^0, \text{Ponferrada}^{175} (\text{Ourense}), \text{Berauente}^{236} (\text{Ourense}), \text{León}^{288} (\text{Ponferrada}), \text{Palencia}^{348} (\text{Berauente}), \text{Valladolid}^{348} (\text{Berauente}) \}$

$\Delta = \{ \text{Osorno}^{397} (\text{Palencia}), \text{Burgos}^{440} (\text{Palencia}), \text{Aranda}^{443} (\text{Valladolid}) \}$

7 Test (Osorno);  $C = \{ \text{Ourense}^0, \text{Ponferrada}^{175} (\text{Ourense}), \text{Berauente}^{236} (\text{Ourense}), \text{León}^{288} (\text{Ponferrada}), \text{Palencia}^{348} (\text{Berauente}), \text{Valladolid}^{348} (\text{Berauente}), \text{Osorno}^{397} (\text{Palencia}) \}$

$\Delta = \{ \text{Burgos}^{440} (\text{Palencia}), \text{Aranda}^{443} (\text{Valladolid}), \text{Burgos}^{456} (\text{Osorno}) \}$

8 Test (Burgos);  $C = \{ \text{Ourense}^0, \text{Ponferrada}^{175} (\text{Ourense}), \text{Berauente}^{236} (\text{Ourense}), \text{León}^{288} (\text{Ponferrada}), \text{Palencia}^{348} (\text{Berauente}), \text{Valladolid}^{348} (\text{Berauente}), \text{Osorno}^{397} (\text{Palencia}), \text{Burgos}^{440} (\text{Palencia}) \}$

$\Delta = \{ \text{Aranda}^{443} (\text{Valladolid}), \text{Logroño}^{590} (\text{Burgos}), \text{Soria}^{583} (\text{Burgos}), \text{Aranda}^{524} (\text{Burgos}) \}$

9 Test (Aranda);  $C = \{ \text{Ourense}^0, \text{Ponferrada}^{175} (\text{Ourense}), \text{Berauente}^{236} (\text{Ourense}), \text{León}^{288} (\text{Ponferrada}), \text{Palencia}^{348} (\text{Berauente}), \text{Valladolid}^{348} (\text{Berauente}), \text{Osorno}^{397} (\text{Palencia}), \text{Burgos}^{440} (\text{Palencia}), \text{Aranda}^{443} (\text{Valladolid}) \}$

$\Delta = \{ \text{Logroño}^{590} (\text{Burgos}), \text{Soria}^{583} (\text{Burgos}), \text{Osma}^{501} (\text{Aranda}) \}$

10 Test (Logroño);  $C = \{ \text{Ourense}^0, \text{Ponferrada}^{175} (\text{Ourense}), \text{Berauente}^{236} (\text{Ourense}), \text{León}^{288} (\text{Ponferrada}), \text{Palencia}^{348} (\text{Berauente}), \text{Valladolid}^{348} (\text{Berauente}), \text{Osorno}^{397} (\text{Palencia}), \text{Burgos}^{440} (\text{Palencia}), \text{Aranda}^{443} (\text{Valladolid}), \text{Logroño}^{590} (\text{Burgos}) \}$

$\Delta = \{ \text{Soria}^{583} (\text{Burgos}), \text{Osma}^{501} (\text{Aranda}), \text{Soria}^{646} (\text{Logroño}) \}$

11 Test (Soria);  $C = \{ \text{Ourense}^0, \text{Ponferrada}^{175} (\text{Ourense}), \text{Berauente}^{236} (\text{Ourense}), \text{León}^{288} (\text{Ponferrada}), \text{Palencia}^{348} (\text{Berauente}), \text{Valladolid}^{348} (\text{Berauente}), \text{Osorno}^{397} (\text{Palencia}), \text{Burgos}^{440} (\text{Palencia}), \text{Aranda}^{443} (\text{Valladolid}), \text{Logroño}^{590} (\text{Burgos}), \text{Soria}^{583} (\text{Burgos}) \}$

$\Delta = \{ \text{Osma}^{501} (\text{Aranda}), \text{Osma}^{641} (\text{Soria}), \text{Atalayud}^{674} (\text{Soria}) \}$

12 Test (Soria);  $C = \{ \text{Ourense}^0, \text{Ponferrada}^{175} (\text{Ourense}), \text{Berauente}^{236} (\text{Ourense}), \text{León}^{288} (\text{Ponferrada}), \text{Palencia}^{348} (\text{Berauente}), \text{Valladolid}^{348} (\text{Berauente}), \text{Osorno}^{397} (\text{Palencia}), \text{Burgos}^{440} (\text{Palencia}), \text{Aranda}^{443} (\text{Valladolid}), \text{Logroño}^{590} (\text{Burgos}), \text{Soria}^{583} (\text{Burgos}) \}$

$\Delta = \{ \text{Osma}^{501} (\text{Aranda}), \text{Osma}^{641} (\text{Soria}), \text{Atalayud}^{674} (\text{Soria}) \}$

12 Test (Osma);  $C = \{ \text{Ourense}^0, \dots, \text{Soria}^{583} (\text{Burgos}), \text{Osma}^{501} (\text{Aranda}) \}$

$\Delta = \{ \text{Atalayud}^{674} (\text{Soria}), \text{Atalayud}^{641} (\text{Osma}) \}$



Solución: Ourense<sup>0</sup>, Benavente<sup>236</sup> (Ourense),  
Valladolid<sup>348</sup> (Benavente), Ávila<sup>443</sup> (Valladolid),  
Osma<sup>501</sup> (Ávila), Calatayud<sup>641</sup> (Osma)

Árbol

