

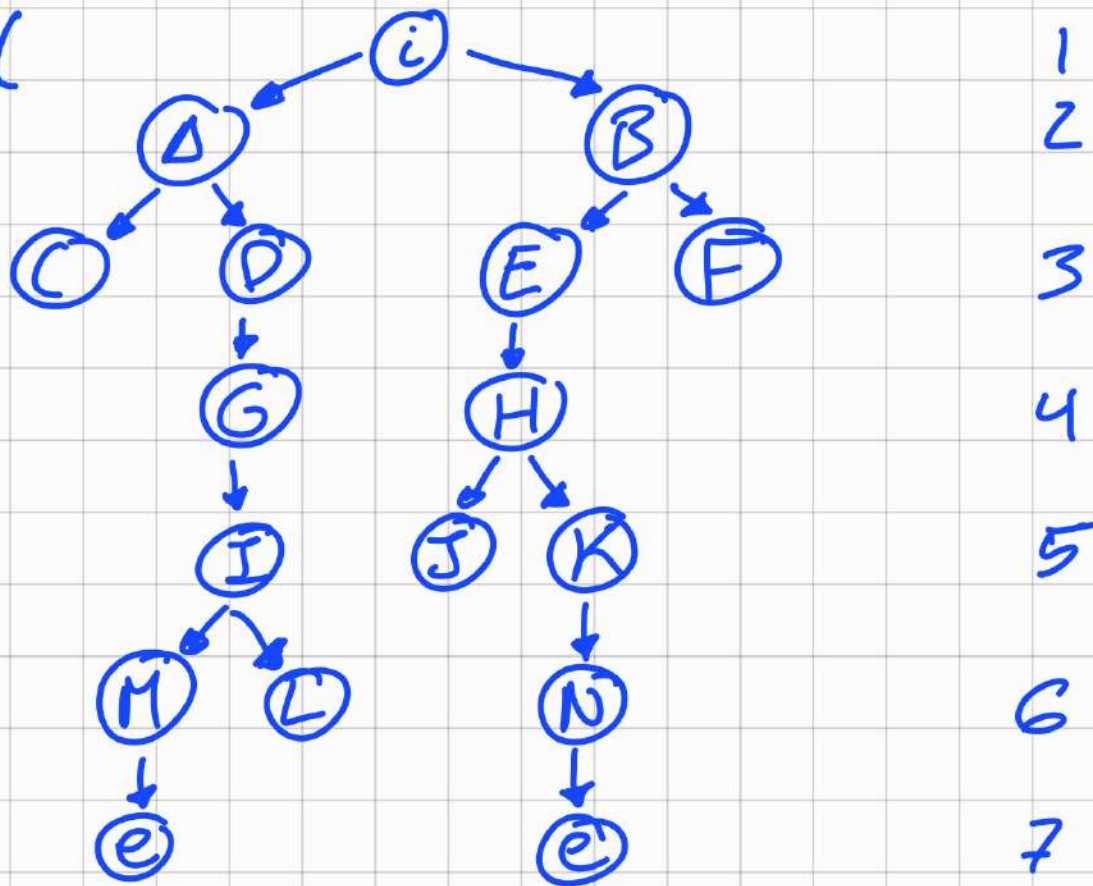
		P	O	L
		e	M	H
				G
e		C	A	D
N	J		i	
K	H	E	B	F

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

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

Árbol



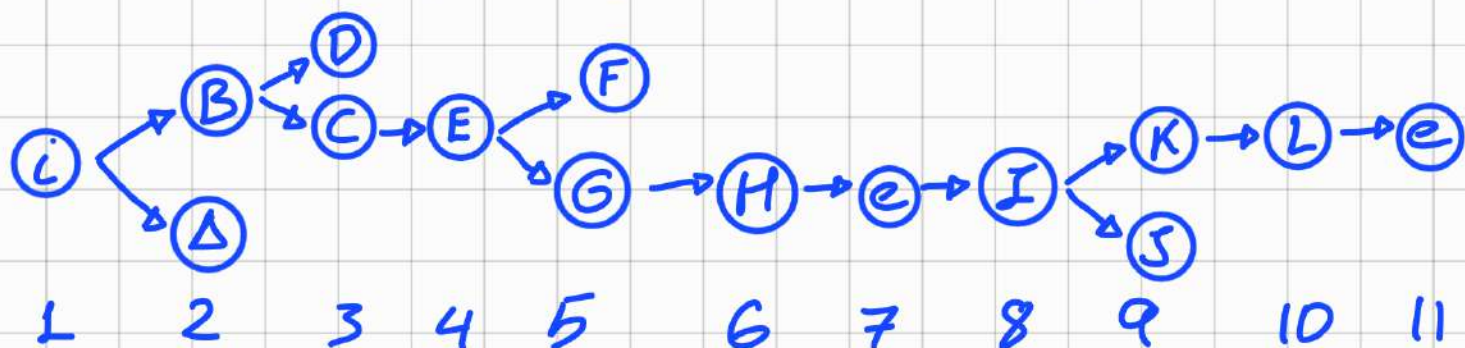
Solución búsqueda por anchura:

$e \rightarrow i, \Delta(i), D(\Delta), G(D), I(G), M(I), e(M)$
 $e \rightarrow i, B(i), E(B), H(E), K(H), N(K), e(N)$

				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); $C = \{i, B, D, C, E, G, H, e, I, K, L, e\}$; $\Delta = \{\Delta, F, J\}$

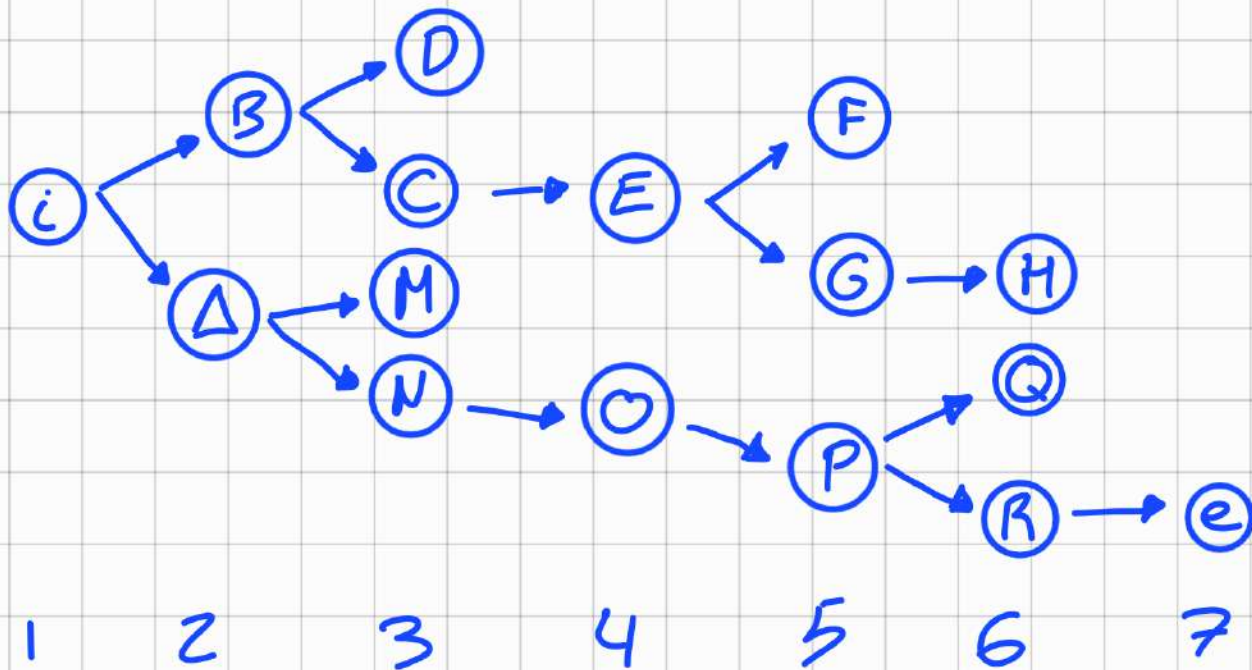


Solución búsqueda en profundidad sin límite:

$e \rightarrow i, B(i), C(B), E(C), G(E), H(G), e(H), I(e), K(I), L(K), e(L).$

- 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(Δ); $C = \{i, B, D, C, E, G, H, \Delta\}$; $\Delta = \{M, N\}$
- 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



Solución búsqueda de profundidad con límite 5:

$e \rightarrow i, \Delta(i), N(\Delta), O(N), P(O), R(P), e(R)$

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

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

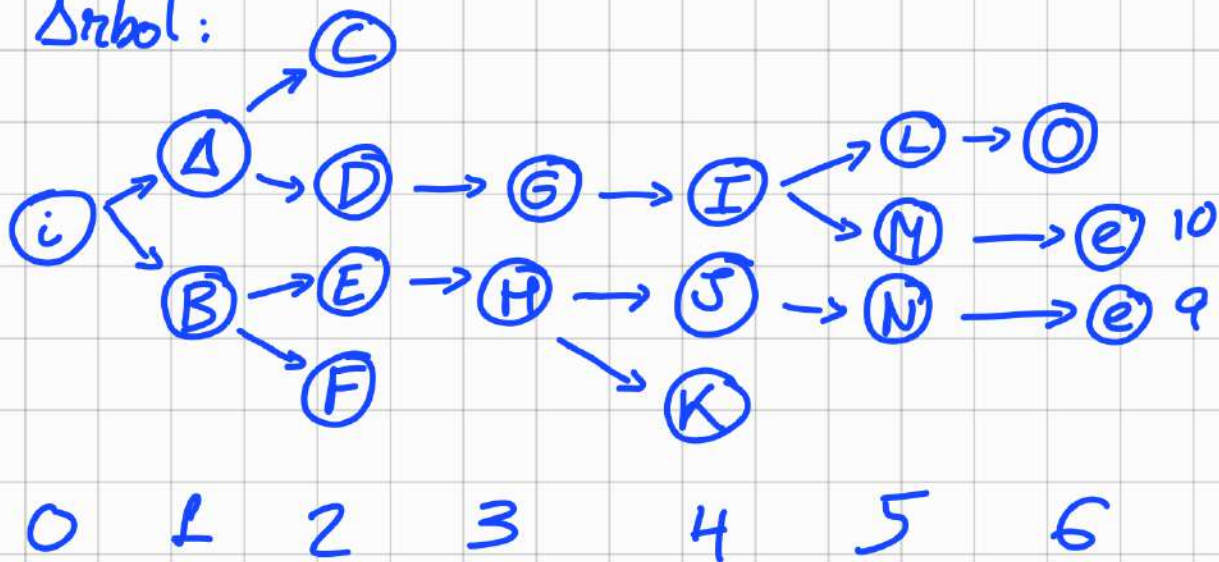
- 1 Test(i); $C = \{i^0\}$; $\Delta = \{\Delta^1(i), B^1(i)\}$
- 2 Test(A); $C = \{i^0, \Delta^1(i)\}$; $\Delta = \{B^1(i), C^3(A), D^3(A)\}$
- 3 Test(B); $C = \{i^0, \Delta^1(i), B^1(i)\}$;
 $\Delta = \{C^3(A), D^3(A), E^3(B), F^3(B)\}$
- 4 Test(C); $C = \{i^0, \Delta^1(i), B^1(i), C^3(A)\}$;
 $\Delta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

Solución búsqueda por coste uniforme:

$e^1 \rightarrow i^0, \Delta^1(i), D^3(\Delta), G^4(D), I^6(G), M^8(I), e^{10}(M)$ → coste
 $e^2 \rightarrow i^0, B^1(i), E^3(B), H^5(E), J^6(H), N^8(J), e^9(N)$

Árbol:



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

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

- 1 Test(i); $C = \{\emptyset i_4^4\}$; $\Delta = \{1 \Delta_3^4(i), 1 B_5^6(i)\}$
- 2 Test(Δ); $C = \{\emptyset i_4^4, 1 \Delta_3^4(i)\}$; $\Delta = \{1 B_5^6(i), 3 C_2^5(\Delta), 3 D_4^7(\Delta)\}$
- 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); $C = \{\emptyset i_4^4, {}_1\Delta_3^4(i), {}_3C_2^5(\Delta), {}_1B_5^6(i), {}_3D_4^7(\Delta), {}_3E_4^7(B), {}_4G_3^7(D)\}$; $\Delta = \{{}_3F_6^9(B), {}_5H_5^{10}(E), {}_5I_2^7(G)\}$

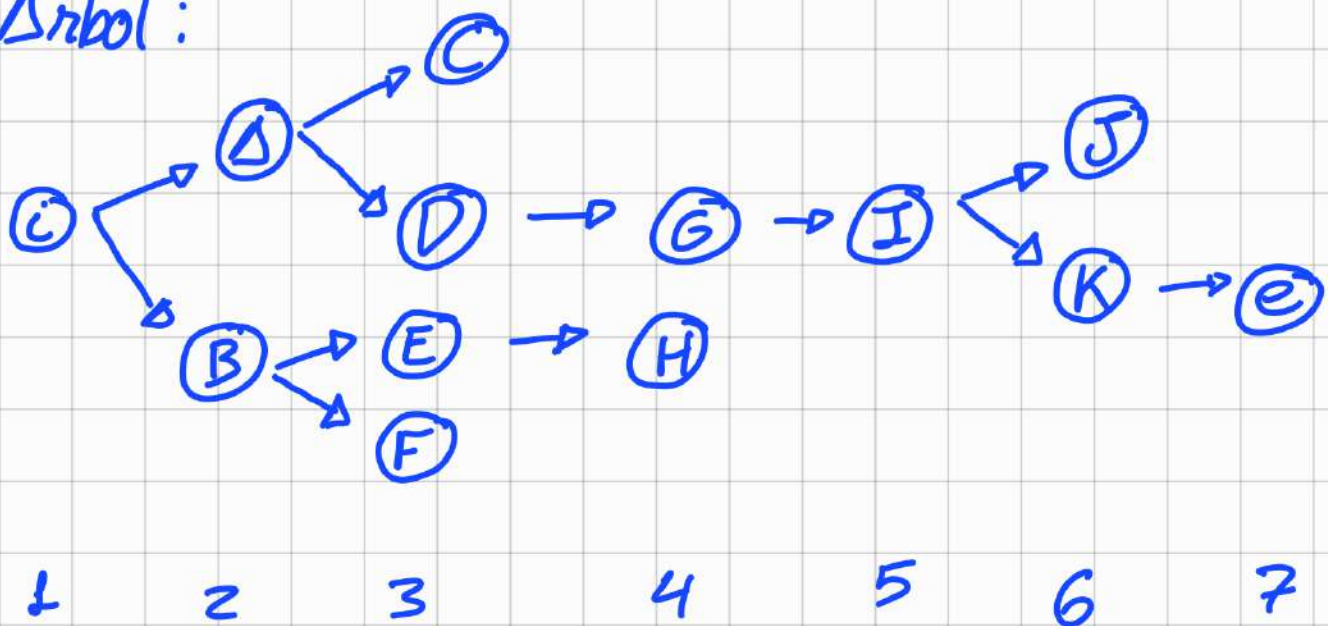
8 Test(I); $C = \{\emptyset i_4^4, {}_1\Delta_3^4(i), {}_3C_2^5(\Delta), {}_1B_5^6(i), {}_3D_4^7(\Delta), {}_3E_4^7(B), {}_4G_3^7(D), {}_5I_2^7(G)\}$; $\Delta = \{{}_3F_6^9(B), {}_5H_5^{10}(E), {}_6J_3^9(I), {}_7K_1^8(I)\}$

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

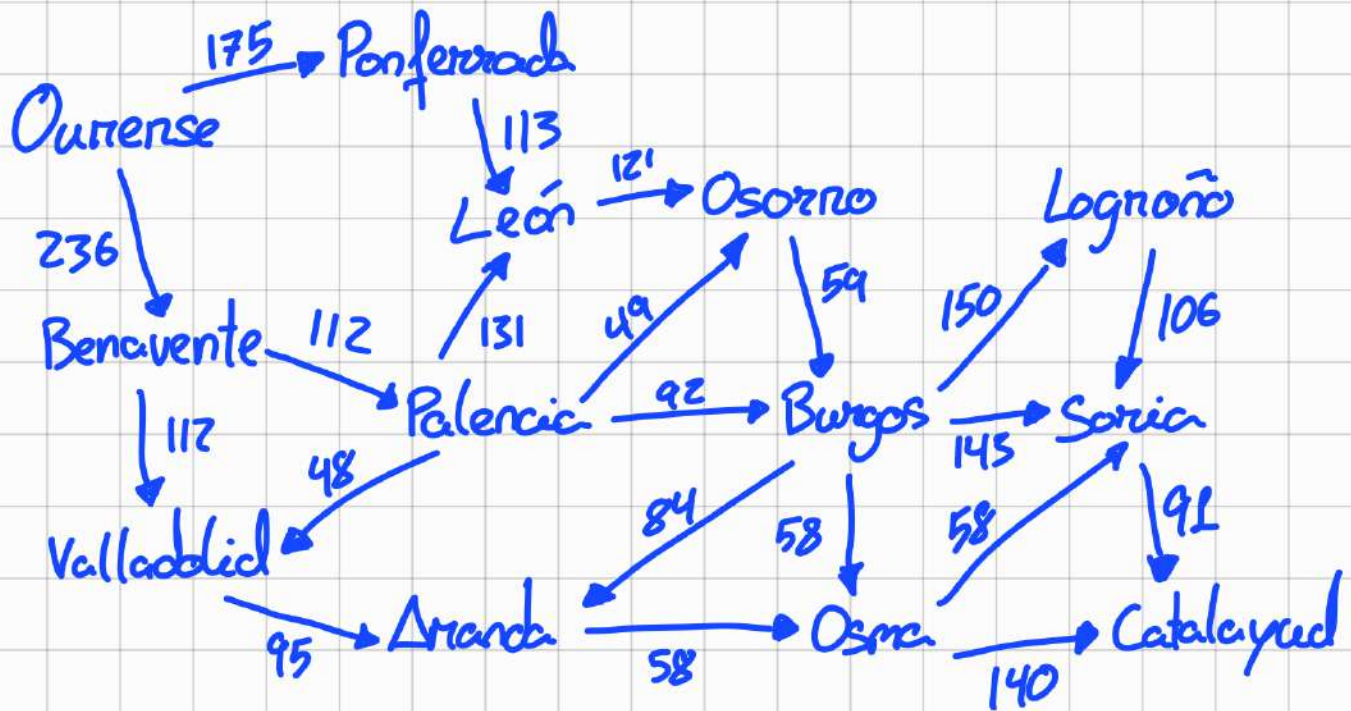
Solución búsqueda por Δ^* :

$e \rightarrow \emptyset i_4^4, {}_1\Delta_3^4(i), {}_3D_4^7(\Delta), {}_4G_3^7(D), {}_5I_2^7(G), {}_7K_1^8(I), {}_9e(K)_\emptyset^9$

Árbol:



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); $C = \{Ourense^0, Ponferrada^{175}(Ourense), Benavente^{236}(Ourense), León^{288}(Ponferrada), Palencia^{348}(Benavente)\}$

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

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

$\Delta = \{ \text{Soria}^{583} (\text{Burgos}), \text{Osma}^{501} (\text{Aranda}), \text{Soria}^{696} (\text{Logroño}) \}$

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

$\Delta = \{ \text{Osma}^{501} (\text{Aranda}), \text{Osma}^{691} (\text{Soria}), \text{Atalayud}^{674} (\text{Soria}) \}$

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

$\Delta = \{ \text{Osma}^{501} (\text{Aranda}), \text{Osma}^{691} (\text{Soria}), \text{Atalayud}^{674} (\text{Soria}) \}$

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

$\Delta = \{ \text{Atalayud}^{674} (\text{Soria}), \text{Atalayud}^{1641} (\text{Osma}) \}$

Solución: Ourense⁰, Benavente²³⁶ (Ourense),
Valladolid³⁴⁸ (Benavente), Ávila⁴⁴³ (Valladolid),
Osma⁵⁰¹ (Ávila), Calatayud⁶⁴¹ (Osma)

Árbol

