Seminarski rad

Pronalazak najkraćeg puta algoritmom A*

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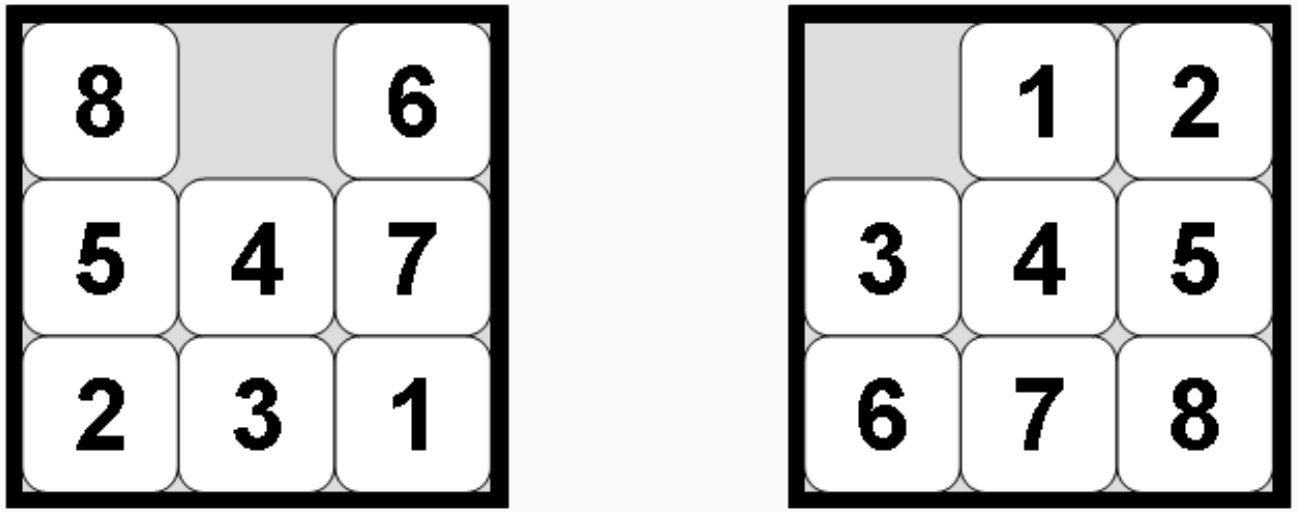
Zagreb, 3. lipnja 2019.

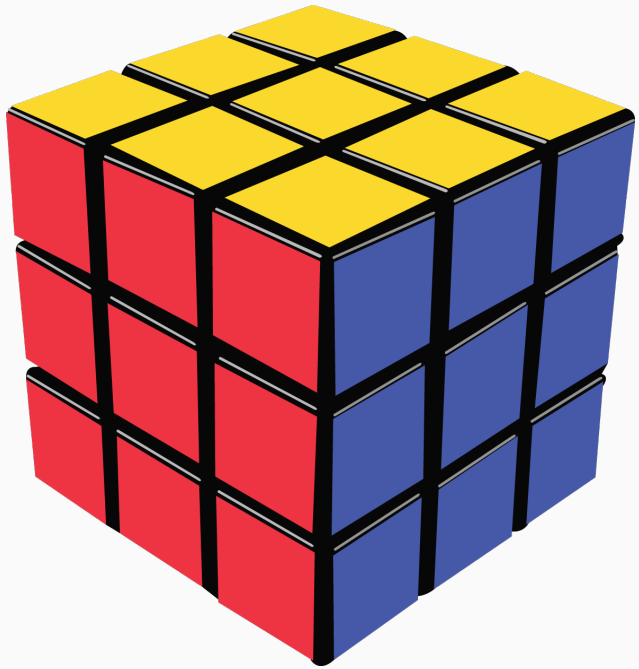
Fakultet elektrotehnike i računarstva

Motivacija - Razne slagalice



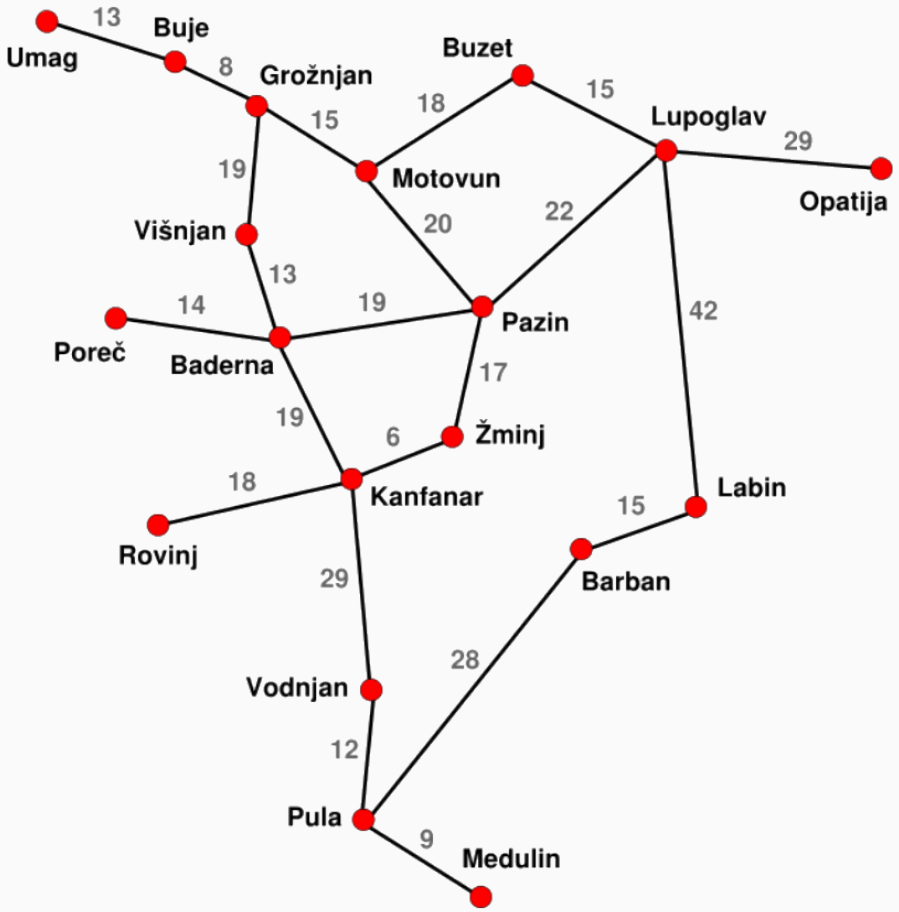
Slika 1: Slika preuzeta s http://www.aiai.ed.ac.uk/~gwickler/eightpuzzle-uninf.html

Motivacija - Rubikova kocka



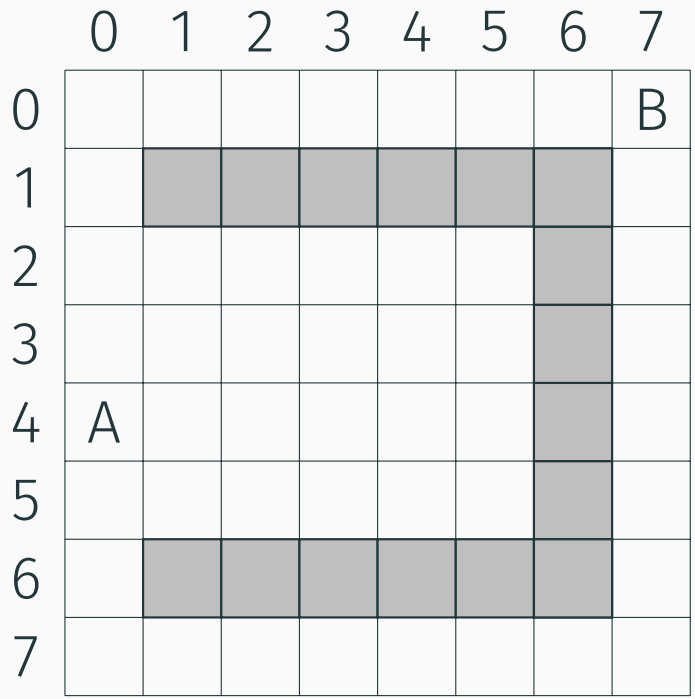
Slika 2: Slika preuzeta s http://pngimg.com/imgs/objects/rubik_cube/

Motivacija - Putovanje po Istri

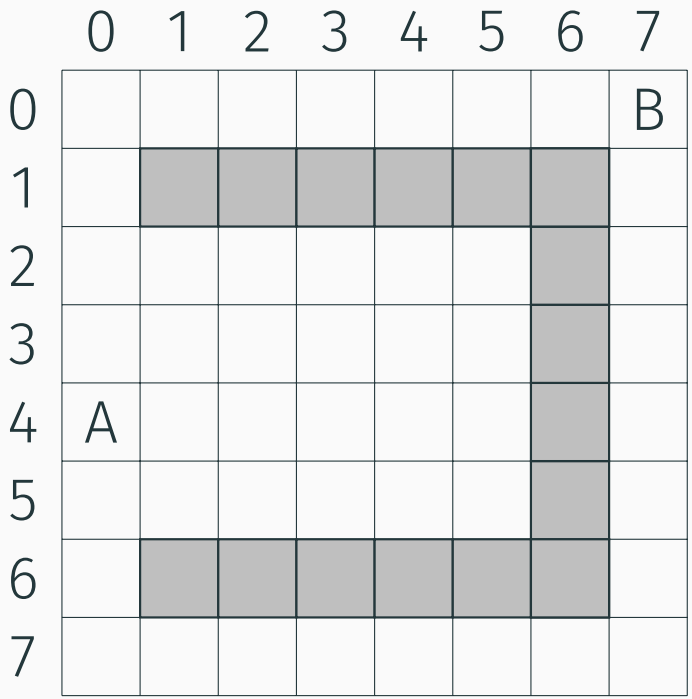


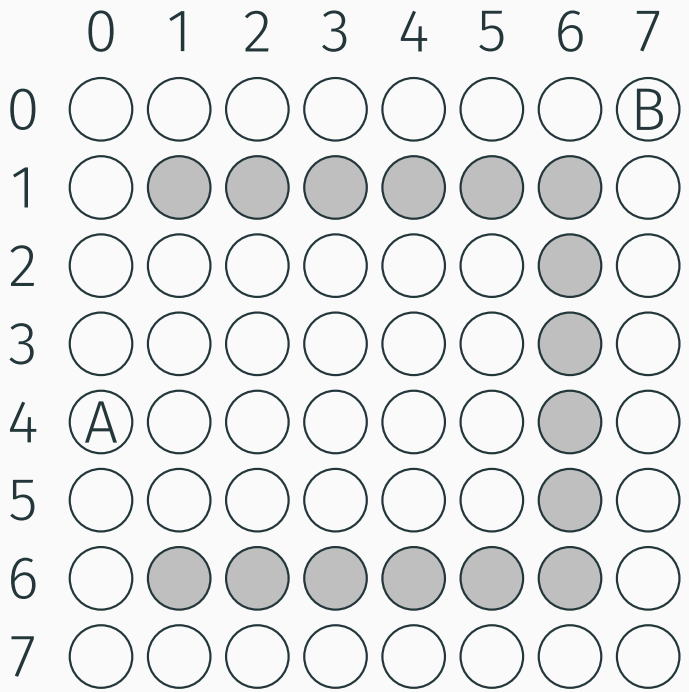
Slika 3: Slika preuzeta s https://www.fer.unizg.hr/_download/repository/UI-3-HeuristickoPretrazivanje.pdf

Cjelobrojna rešetka

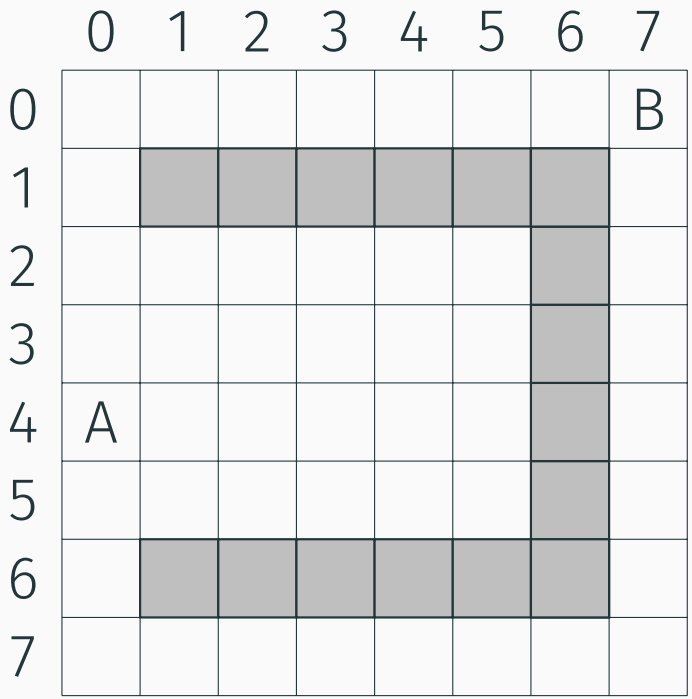


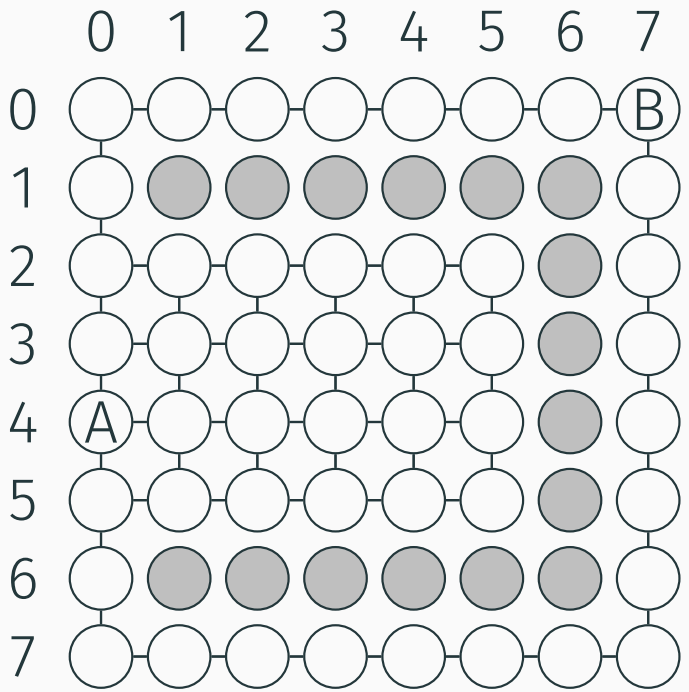
Prostor stanja - stanja





Prostor stanja - prijelazi



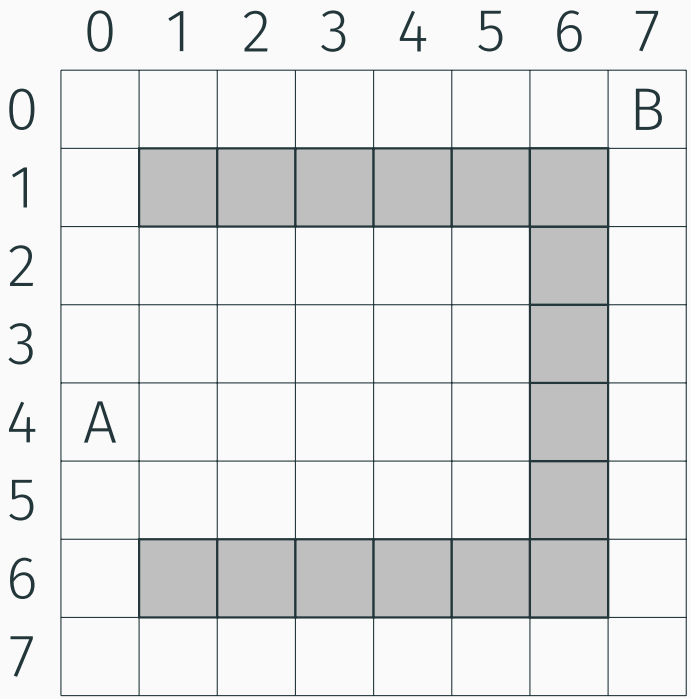


Općenit algoritam pretraživanja

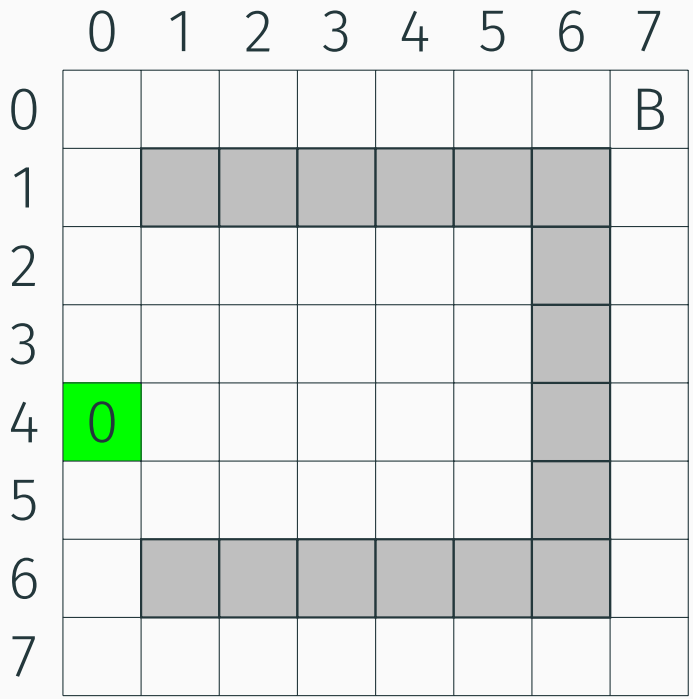
```
fronta = prioritetni red
ubaci u frontu početno stanje i cijenu 0

dok fronta nije prazna
    uzmi prvo stanje i cijenu iz fronte
    obradi to stanje i cijenu
kraj
```

Općenit algoritam pretraživanja



Općenit algoritam pretraživanja



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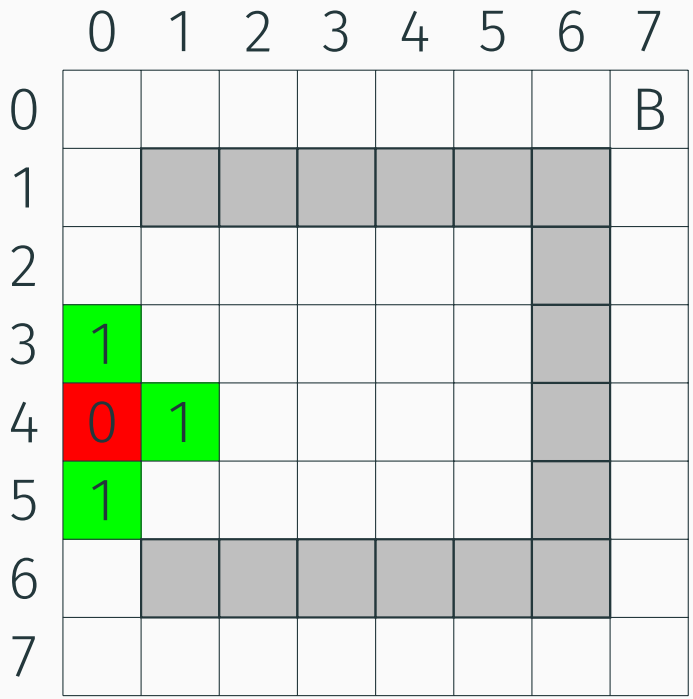

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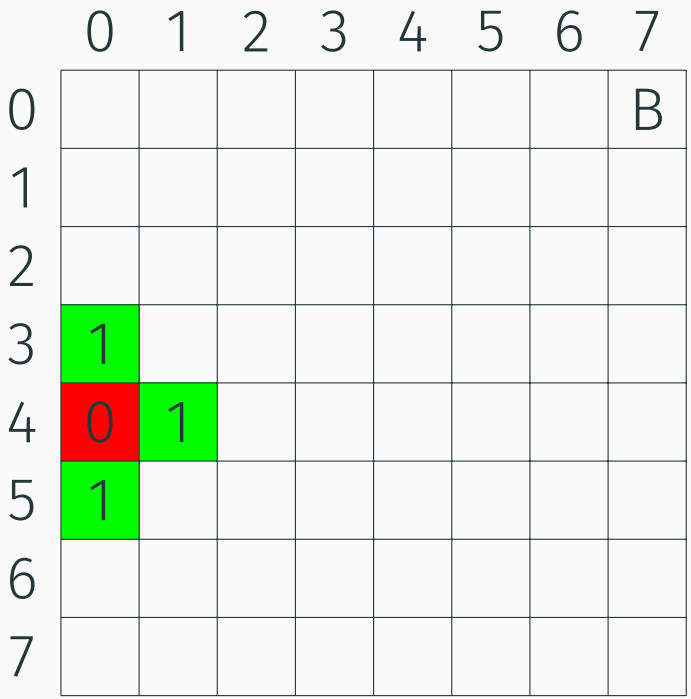

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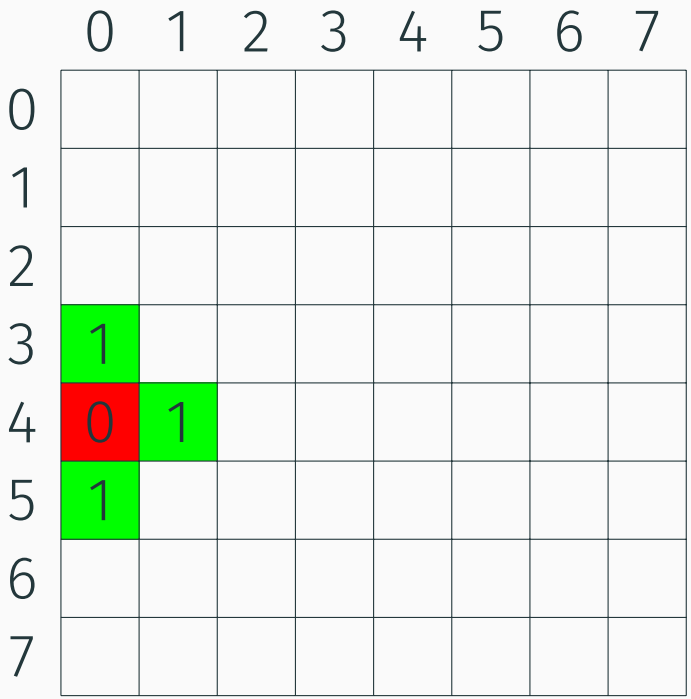


Evaluacijska funkcija

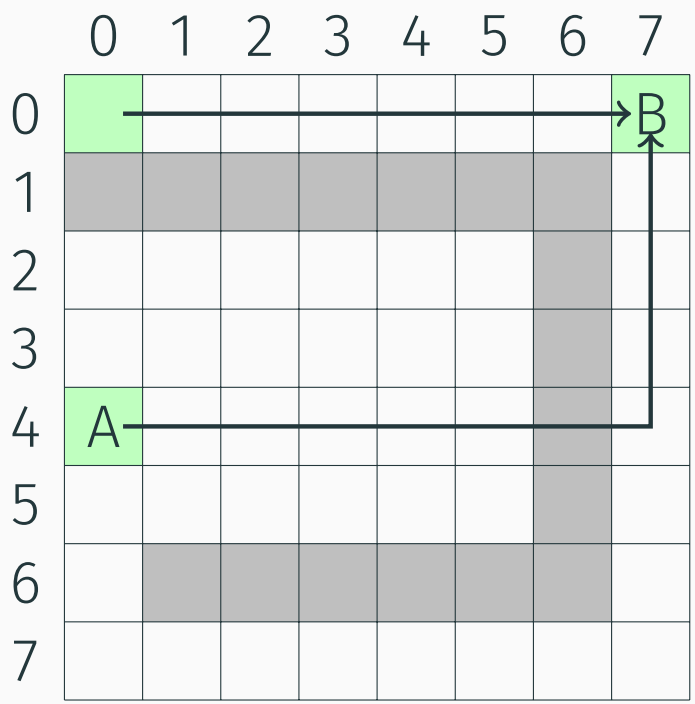
- Evaluacijska funkcija $f(n)$ svakom stanju n pridodaje numeričku vrijednost koja predstavlja prioritet pri pretraživanju
- Manja vrijednost funkcije predstavlja veći prioritet, odnosno manju ”cijenu”

Pomoćne funkcije

- *Cijena puta* ($g(n)$) predstavlja **izračunatu** cijenu puta od početnog stanja do stanja n

- *Heuristička funkcija* ($h(n)$) predstavlja **aproksimaciju** najmanje cijene puta od stanja n do cilja

Heuristička funkcija - primjer



- Jednostavna heuristika za cjelobrojnu rešetku je Manhattan udaljenost između stanja

$$h(\textsc{Stanje}(x, y)) = |x - x_B| + |y - y_B|$$

$$h(\textsc{Stanje}(0, 0)) = 7$$

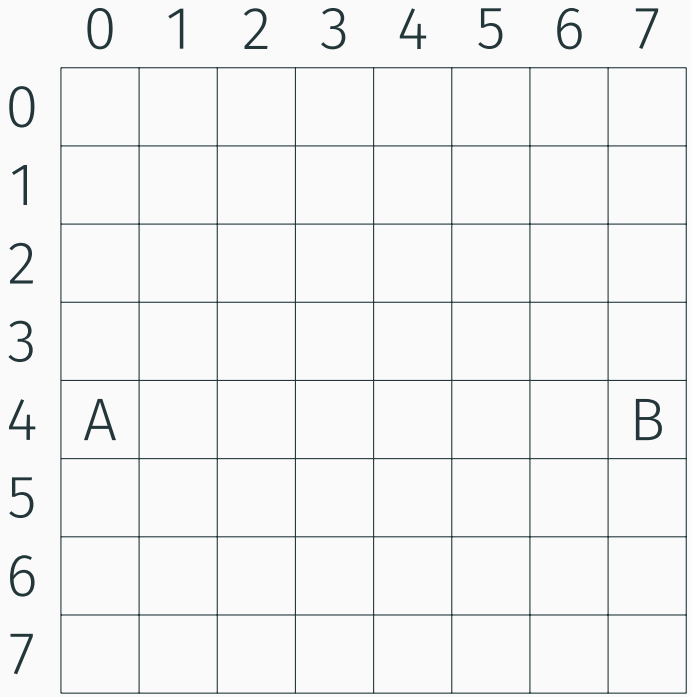
$$h(\textsc{Stanje}(4, 0)) = 11$$

Algoritmi pretraživanja prostora stanja

- Naivni (neinformirani) algoritmi
  - Pretraživanje u širinu
  - Pretraživanje u dubinu
  - Pretraživanje s jednolikom cijenom
- Informirani algoritmi
  - Pretraživanje ”prvi najbolji”
  - Algoritam A*

Pretraživanje s jednolikom cijenom

$$f(n) = g(n)$$



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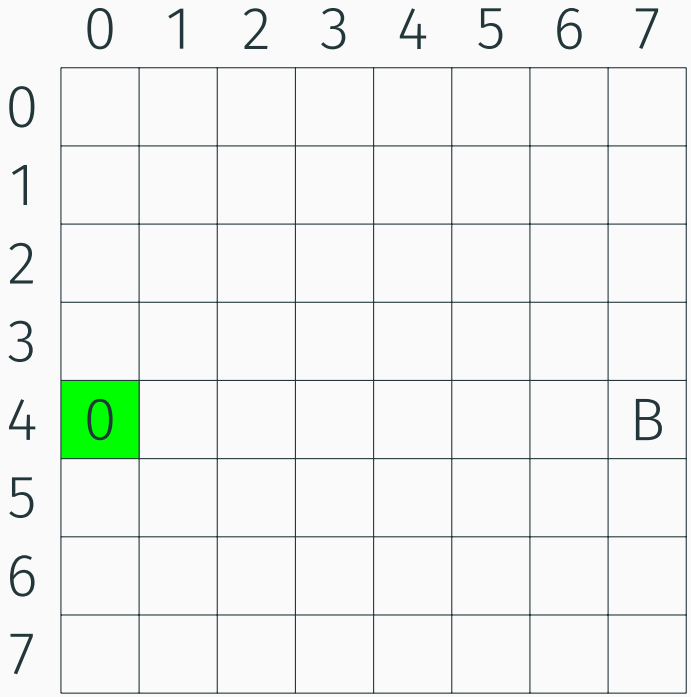

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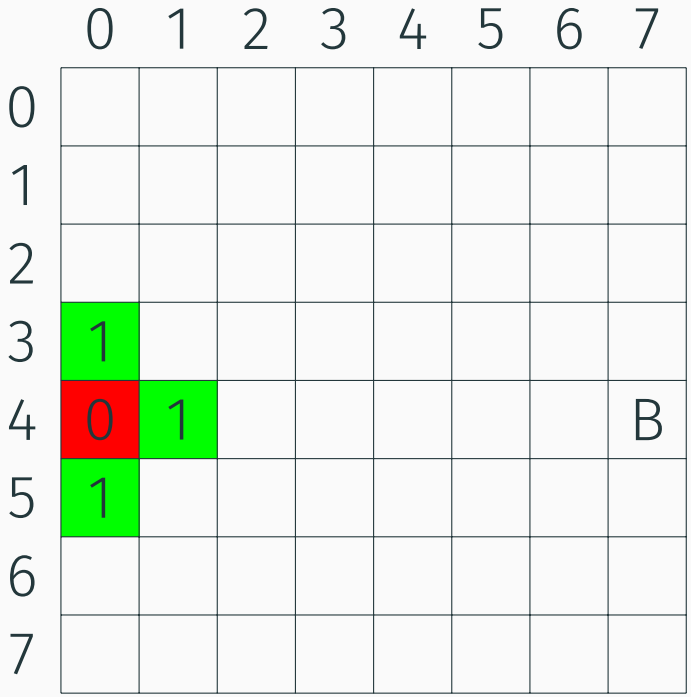

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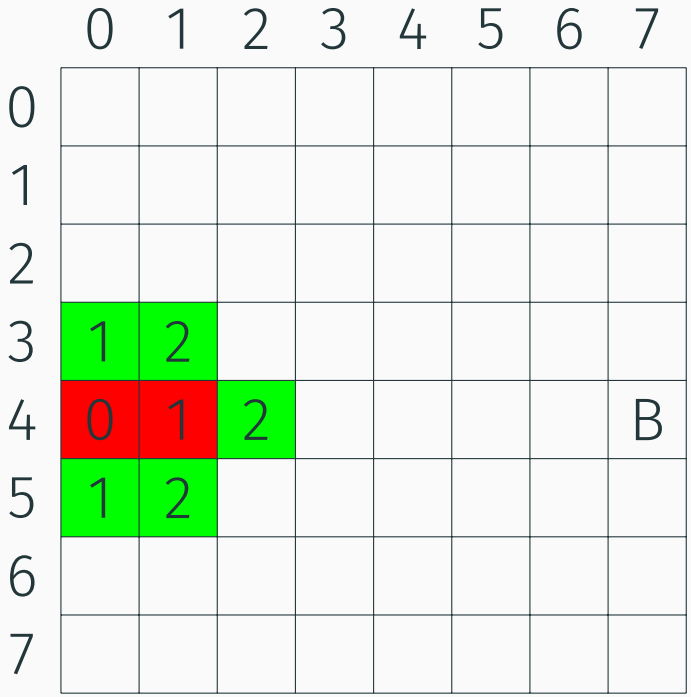

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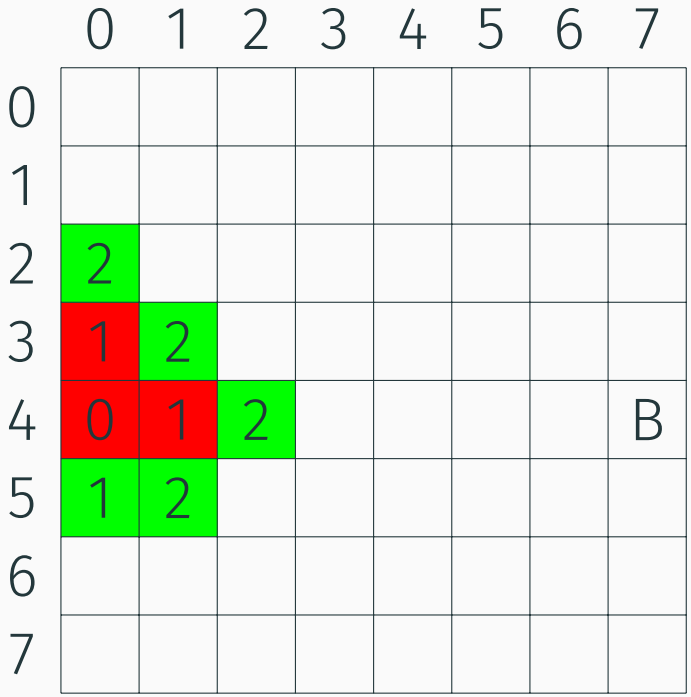

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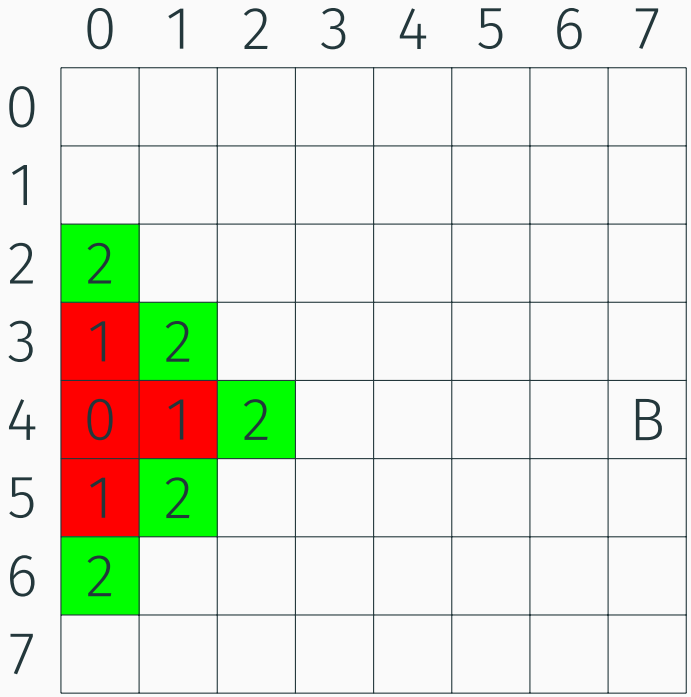

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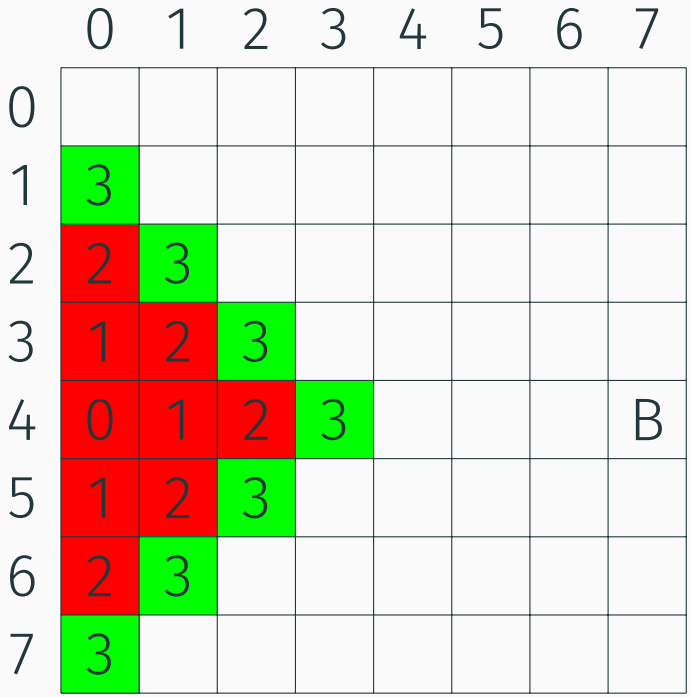
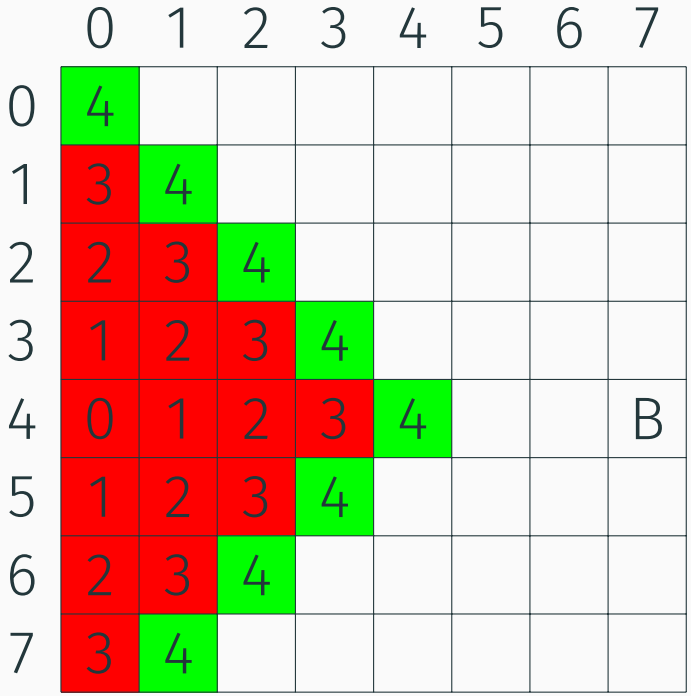


Pretraživanje s jednolikom cijenom

$$f(n) = g(n)$$



Pretraživanje s jednolikom cijenom

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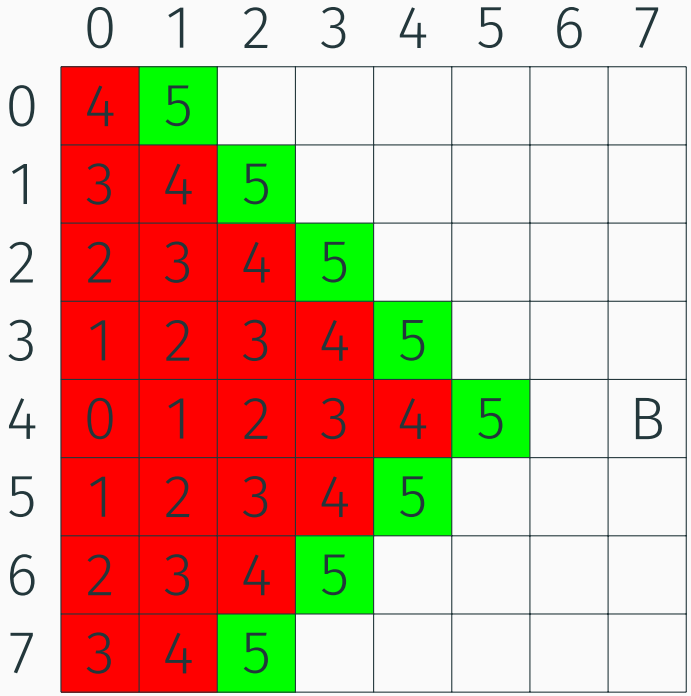

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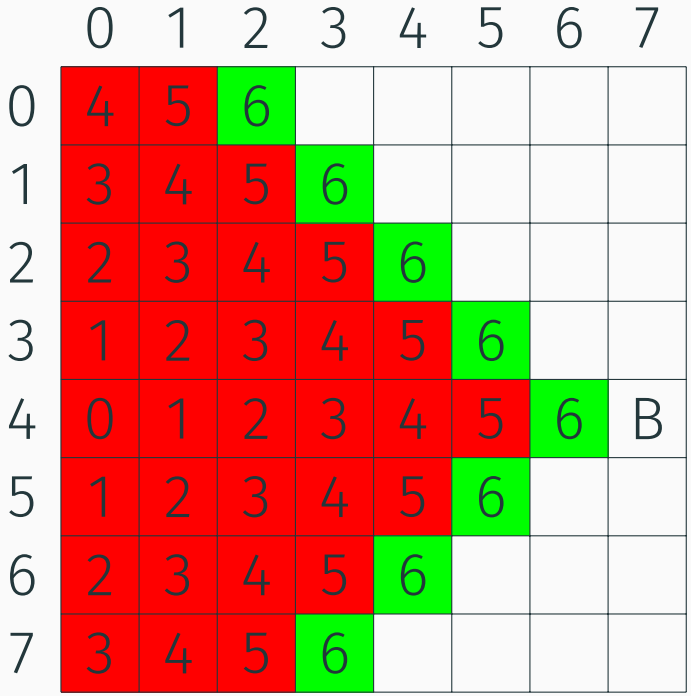
$$f(n) = g(n)$$



Pretraživanje s jednolikom cijenom

$$f(n) = g(n)$$

	0	1	2	3	4	5	6	7
0	4	5	6	7				
1	3	4	5	6	7			
2	2	3	4	5	6	7		
3	1	2	3	4	5	6	7	
4	0	1	2	3	4	5	6	7
5	1	2	3	4	5	6	7	
6	2	3	4	5	6	7		
7	3	4	5	6	7			

Pretraživanje s jednolikom cijenom

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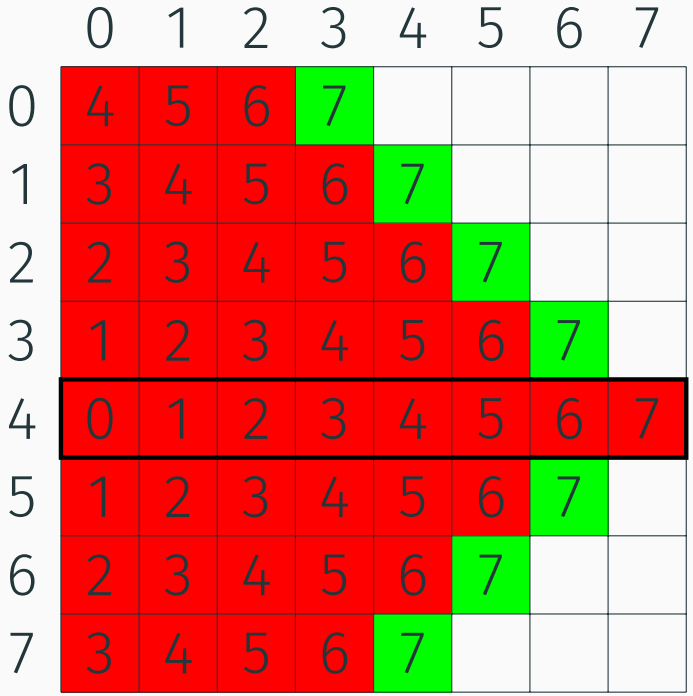
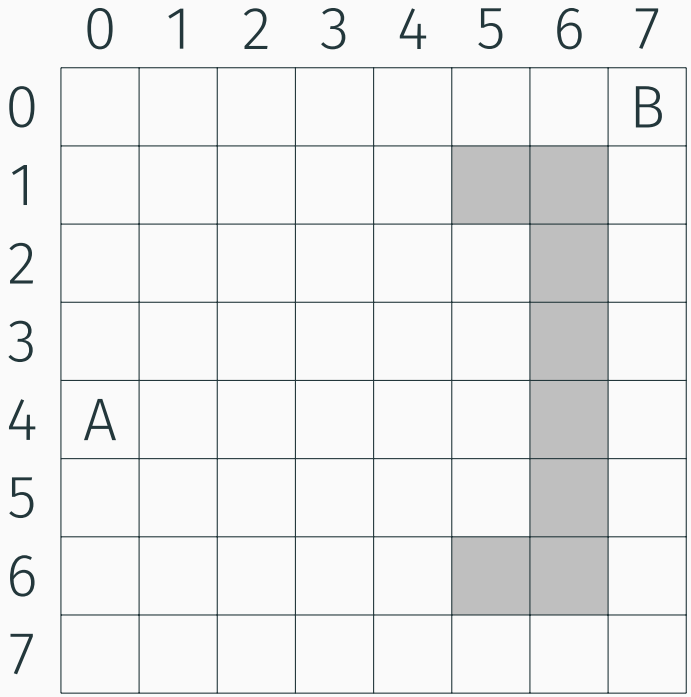


Pretraživanje ”prvi najbolji”

$$f(n) = h(n)$$



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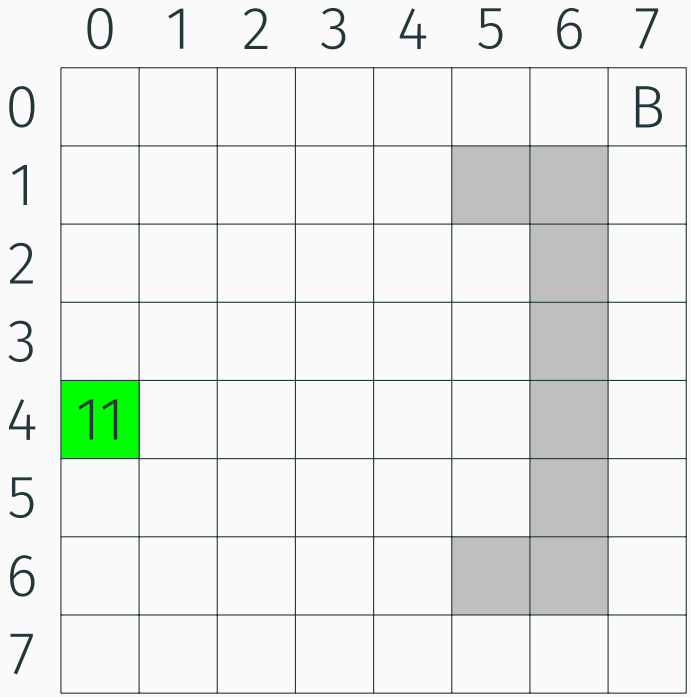
$$f(n) = h(n)$$



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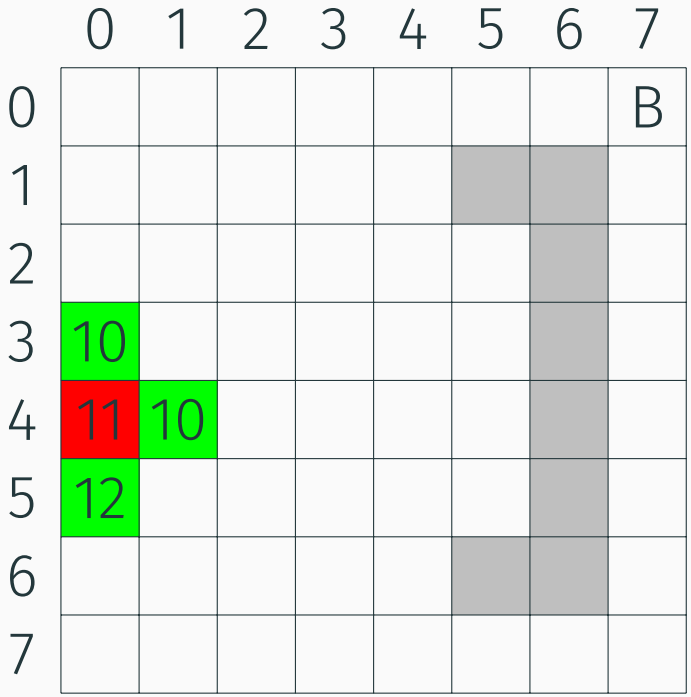
$$f(n) = h(n)$$



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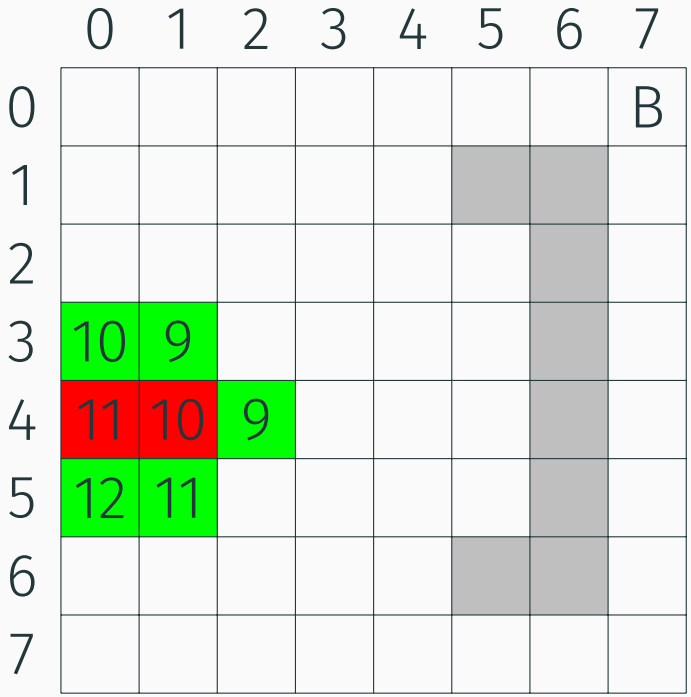

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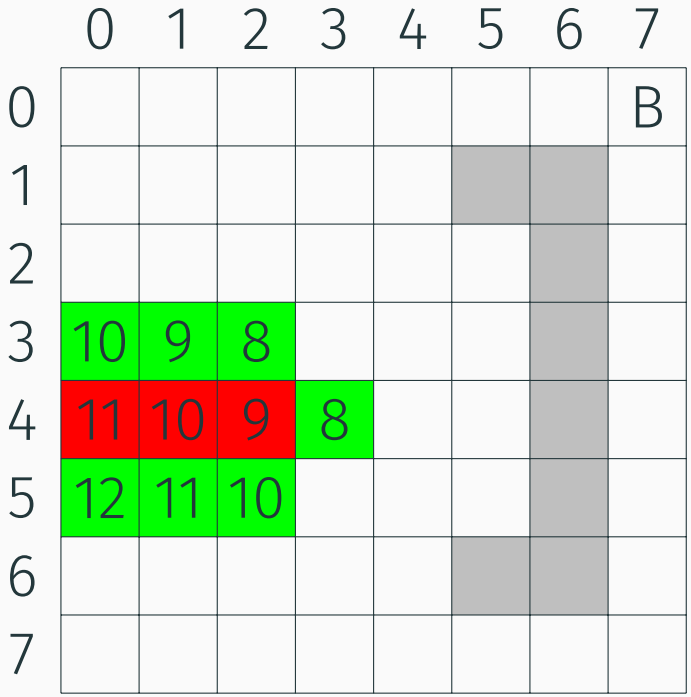

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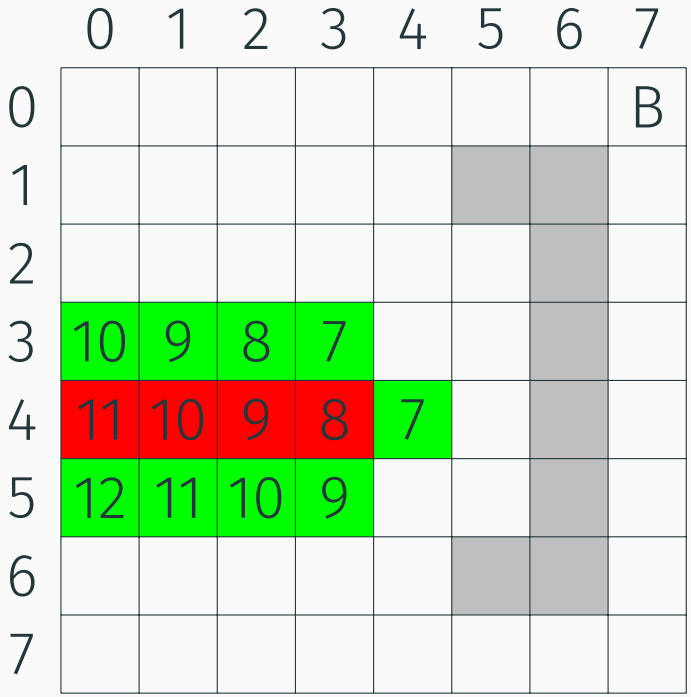

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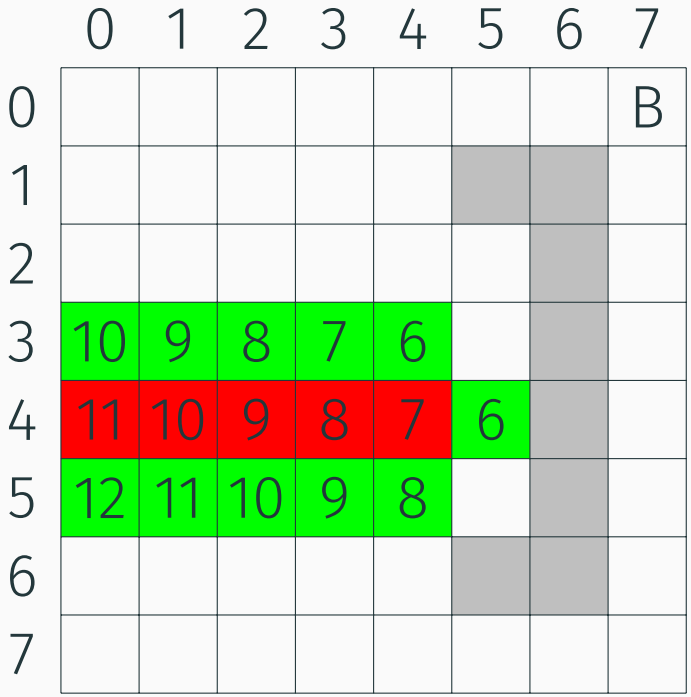

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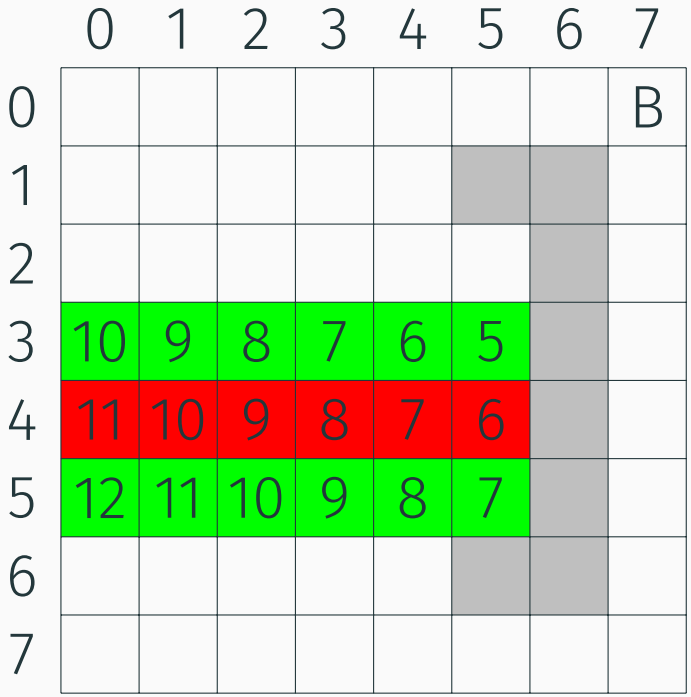

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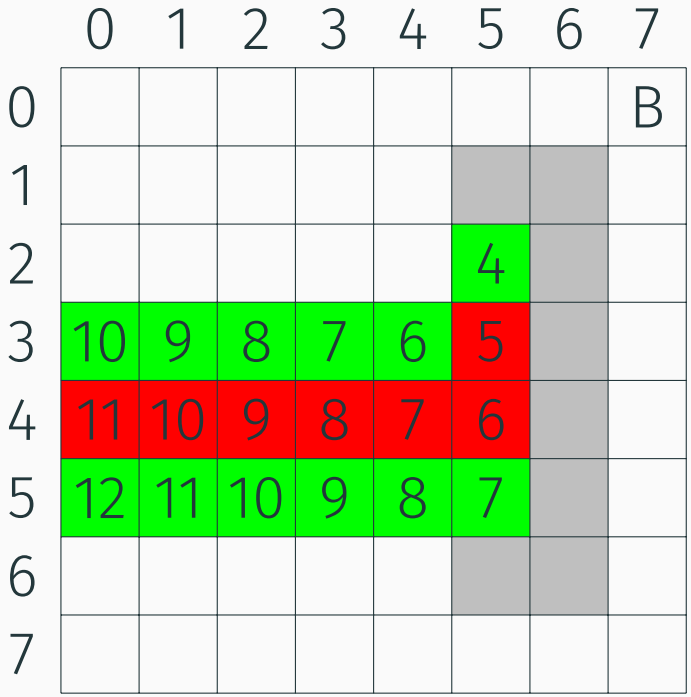

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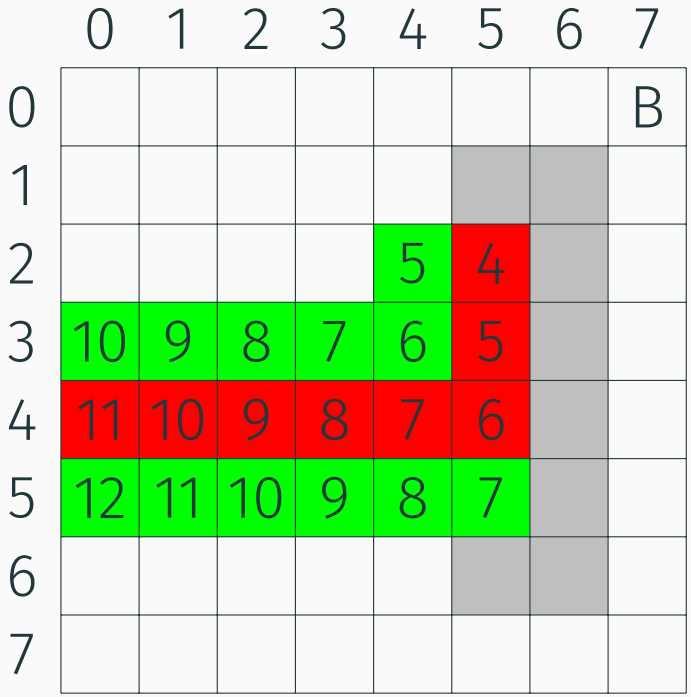

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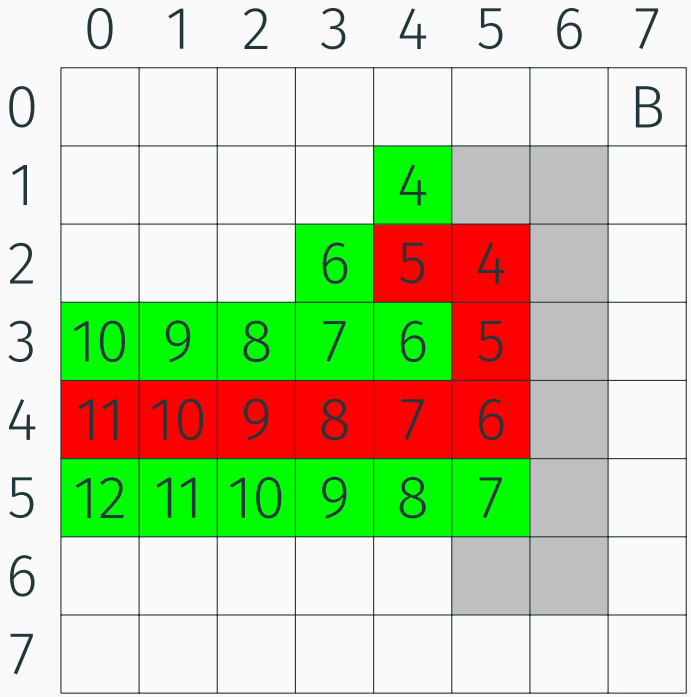

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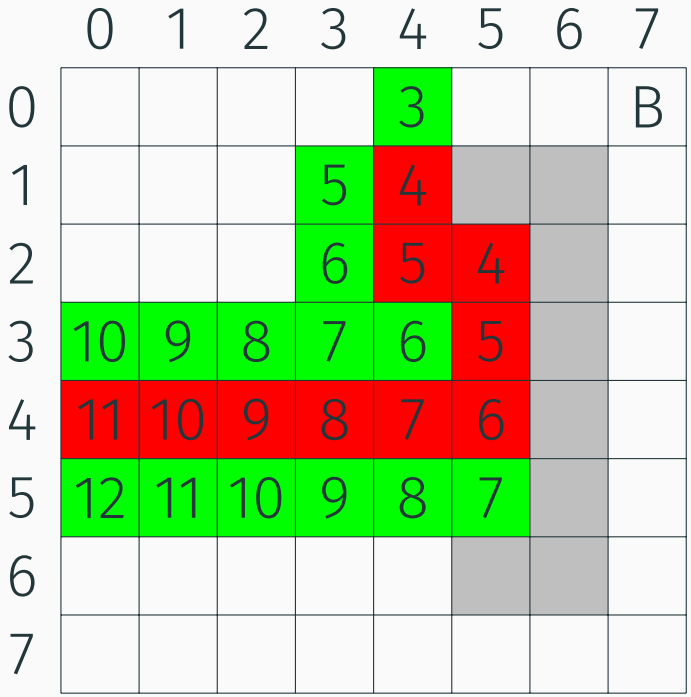

Pretraživanje ”prvi najbolji”

$$f(n) = h(n)$$

	0	1	2	3	4	5	6	7
0				4	3	2		B
1				5	4			
2				6	5	4		
3	10	9	8	7	6	5		
4	11	10	9	8	7	6		
5	12	11	10	9	8	7		
6								
7								

Pretraživanje ”prvi najbolji”

$$f(n) = h(n)$$

	0	1	2	3	4	5	6	7
0				4	3	2	1	B
1				5	4			
2				6	5	4		
3	10	9	8	7	6	5		
4	11	10	9	8	7	6		
5	12	11	10	9	8	7		
6								
7								

Pretraživanje ”prvi najbolji”

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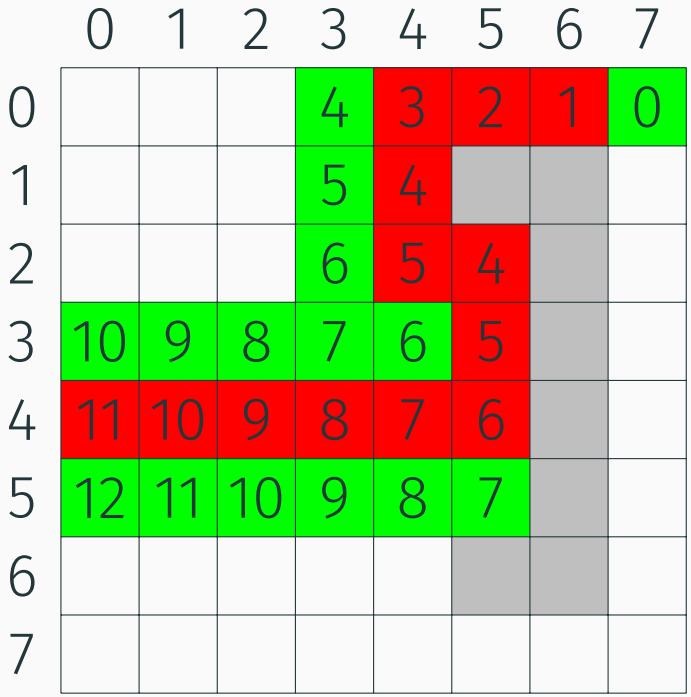

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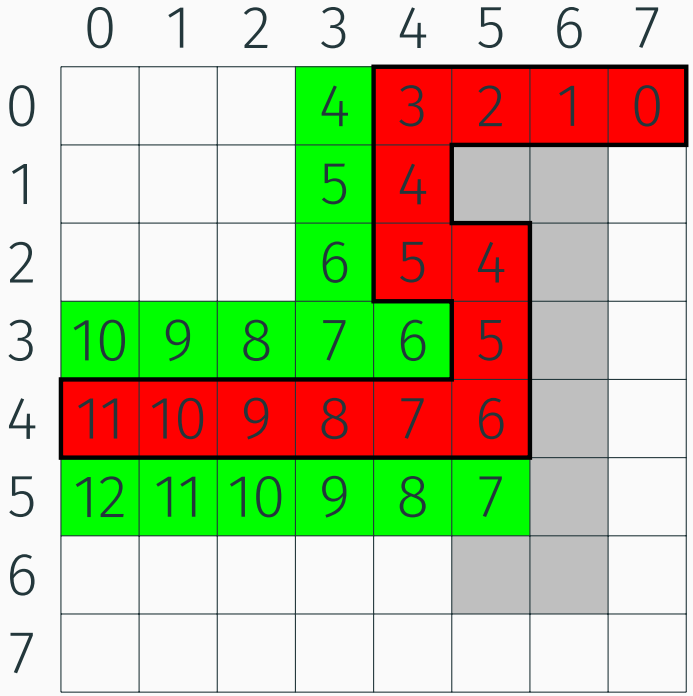
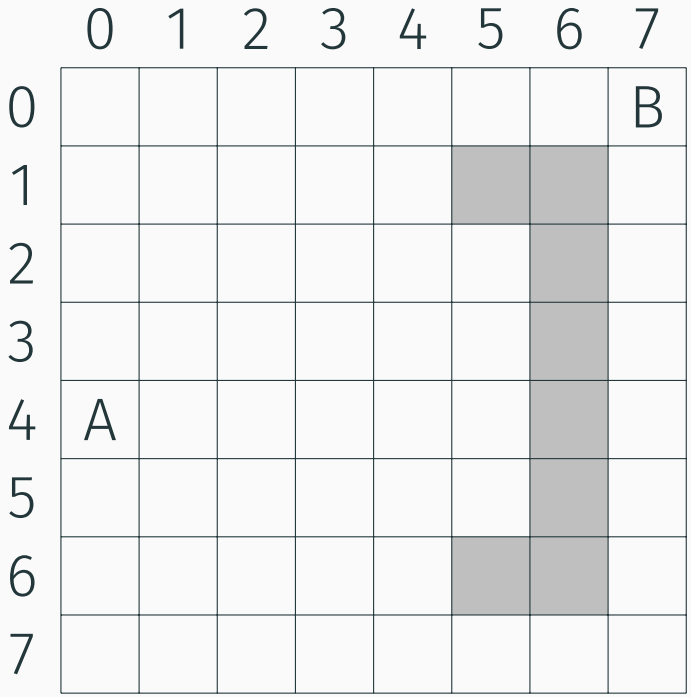


Algoritam A*

$$f(n) = g(n) + h(n)$$



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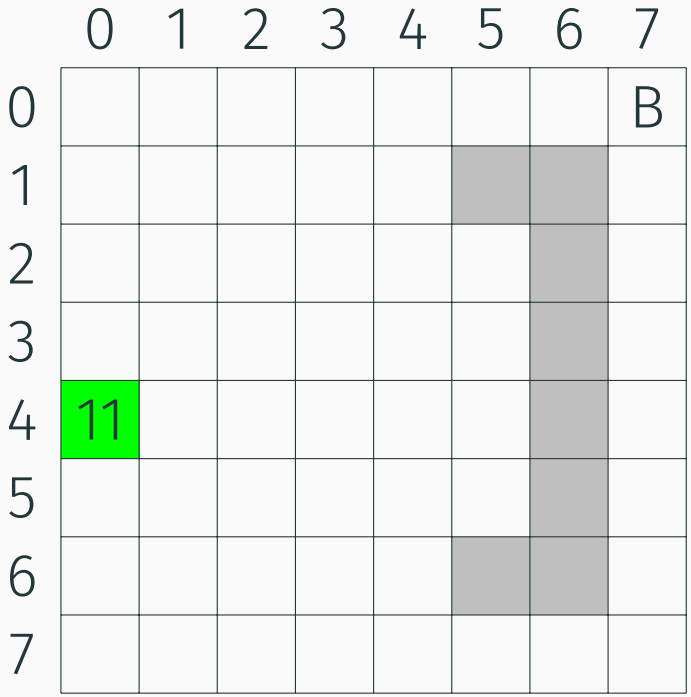

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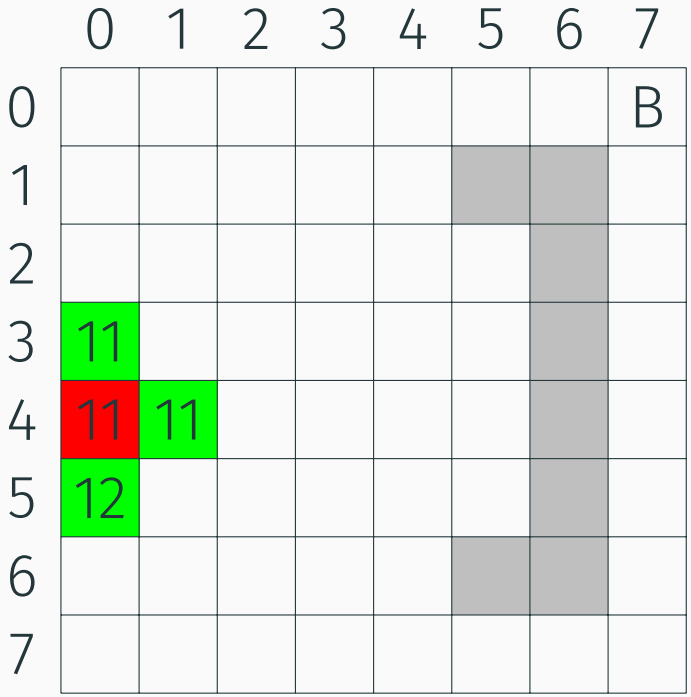

Algoritam A*

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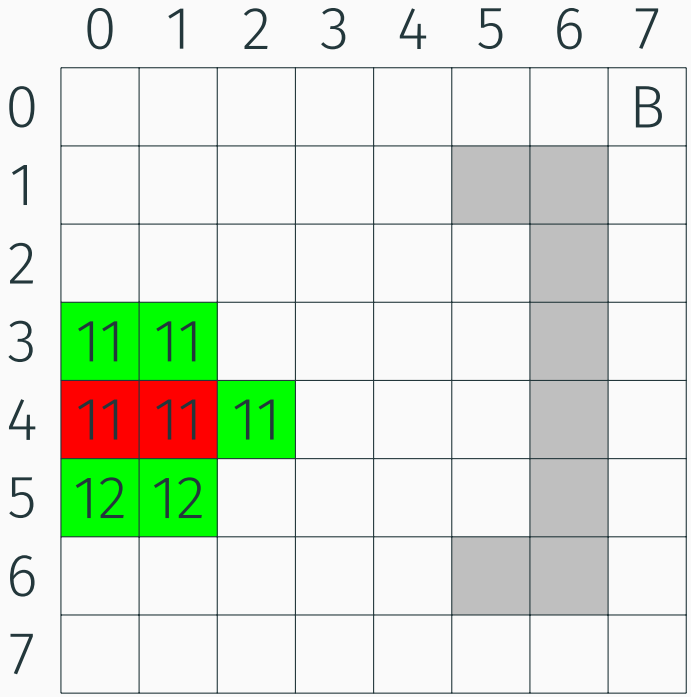

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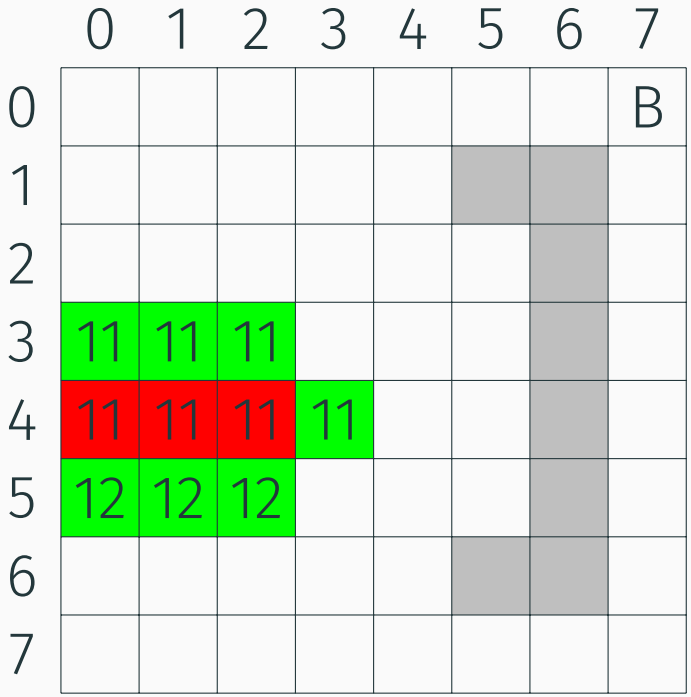

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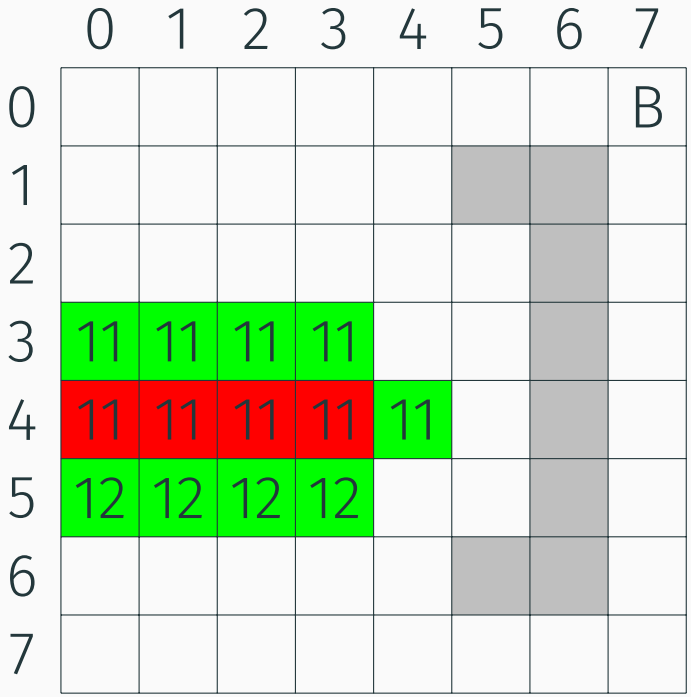

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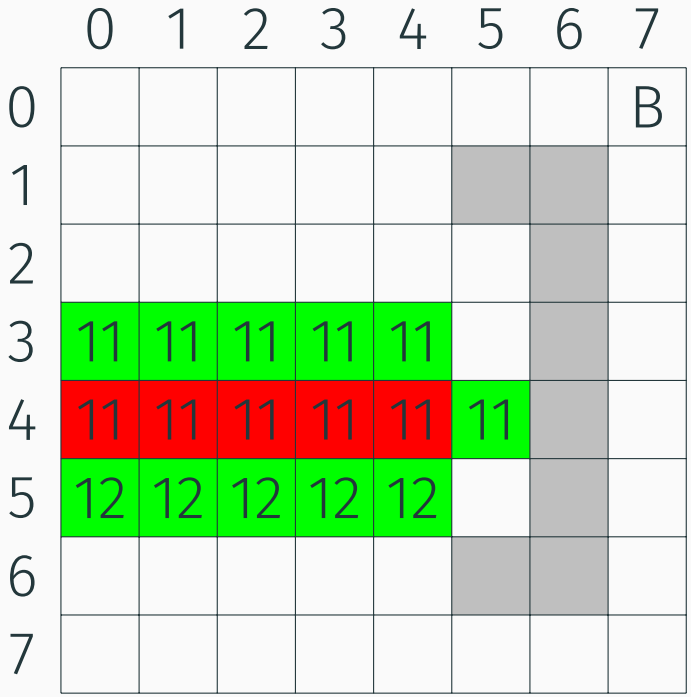


Algoritam A*

$$f(n) = g(n) + h(n)$$

	0	1	2	3	4	5	6	7
0								B
1								
2								
3	11	11	11	11	11	11		
4	11	11	11	11	11	11		
5	12	12	12	12	12	12		
6								
7								

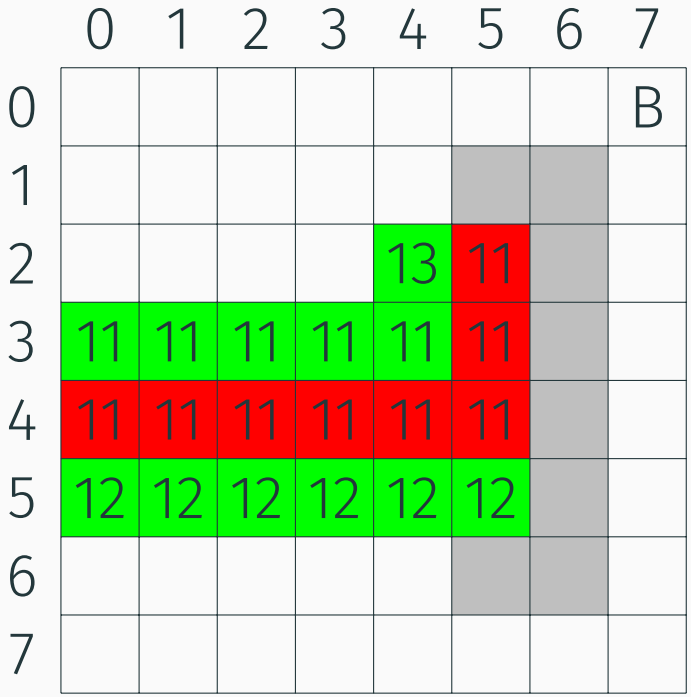
Algoritam A*

$$f(n) = g(n) + h(n)$$

	0	1	2	3	4	5	6	7
0								B
1								
2						11		
3	11	11	11	11	11	11		
4	11	11	11	11	11	11		
5	12	12	12	12	12	12		
6								
7								

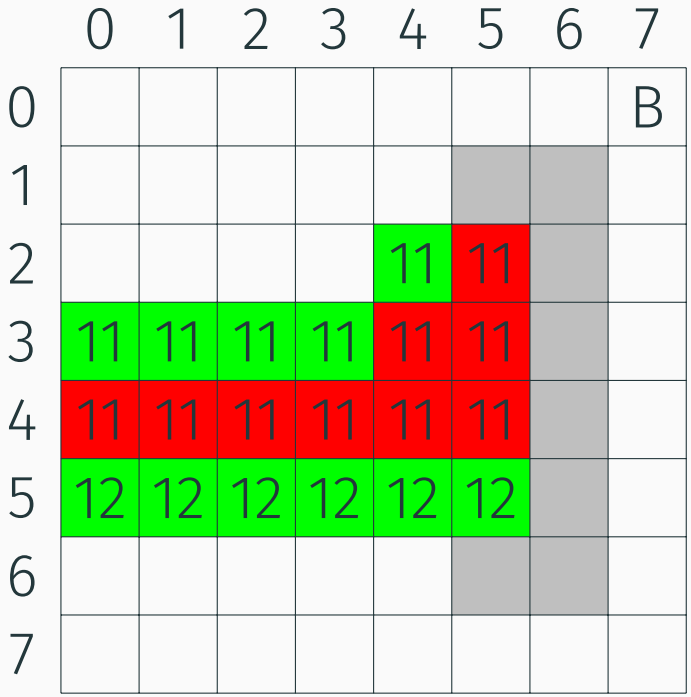
Algoritam A*

$$f(n) = g(n) + h(n)$$



Algoritam A*

$$f(n) = g(n) + h(n)$$



Algoritam A*

$$f(n) = g(n) + h(n)$$

	0	1	2	3	4	5	6	7
0								B
1					11			
2				13	11	11		
3	11	11	11	11	11	11		
4	11	11	11	11	11	11		
5	12	12	12	12	12	12		
6								
7								

Algoritam A*

$$f(n) = g(n) + h(n)$$

	0	1	2	3	4	5	6	7
0					11			B
1				13	11			
2				13	11	11		
3	11	11	11	11	11	11		
4	11	11	11	11	11	11		
5	12	12	12	12	12	12		
6								
7								

Algoritam A*

$$f(n) = g(n) + h(n)$$

	0	1	2	3	4	5	6	7
0				13	11	11		B
1				13	11			
2				13	11	11		
3	11	11	11	11	11	11		
4	11	11	11	11	11	11		
5	12	12	12	12	12	12		
6								
7								

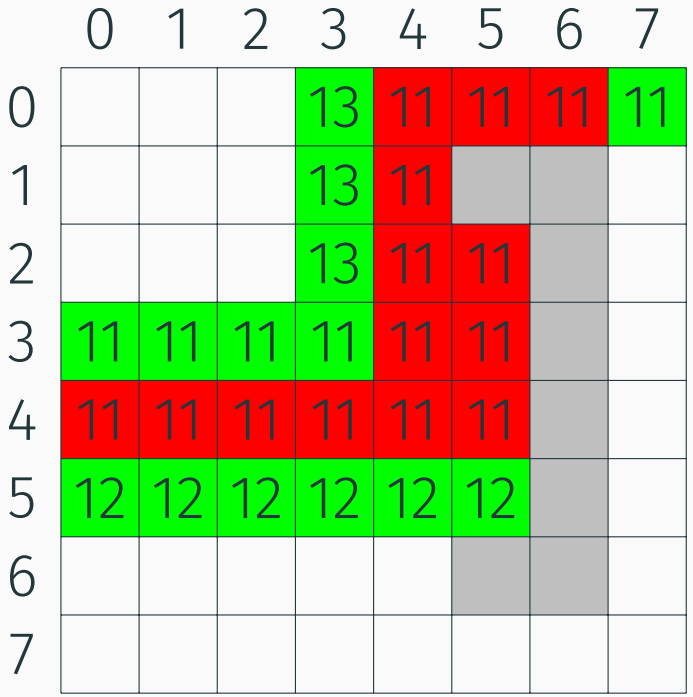
Algoritam A*

$$f(n) = g(n) + h(n)$$

	0	1	2	3	4	5	6	7
0				13	11	11	11	B
1				13	11			
2				13	11	11		
3	11	11	11	11	11	11		
4	11	11	11	11	11	11		
5	12	12	12	12	12	12		
6								
7								

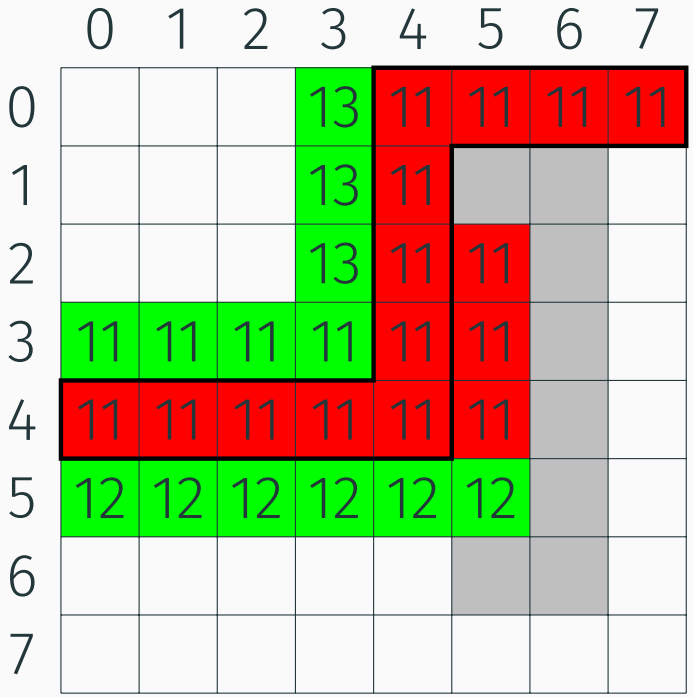
Algoritam A*

$$f(n) = g(n) + h(n)$$



Algoritam A*

$$f(n) = g(n) + h(n)$$



Demonstracija programa

Hvala na pažnji!

Pitanja?