



Igrač šaha

Vedran Brkić
Željko Kraljević

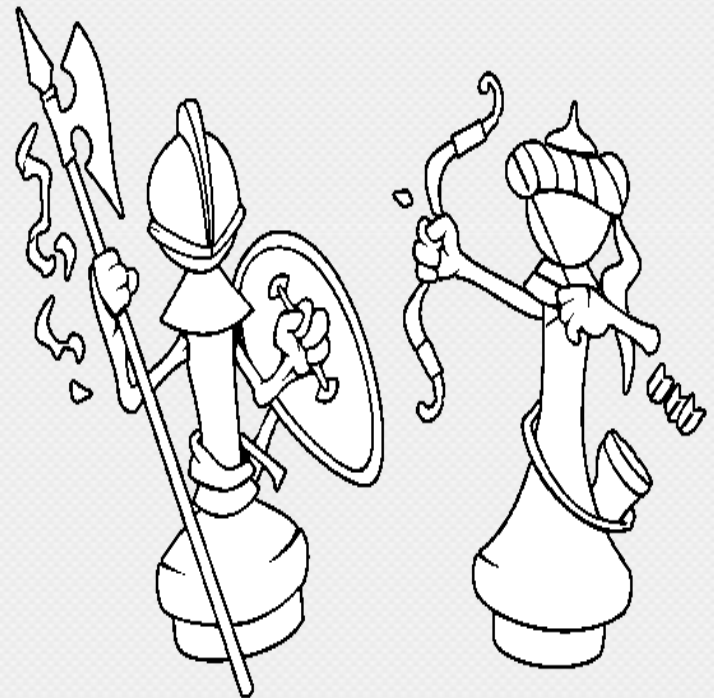
Cilj Projekta

- Razviti ekspertni sustav za igranje šaha u programskom jeziku LISP, zasnovan na heurističkom znanju šahovskih eksperata u kombinaciji s pretraživanjem mogućih poteza i predikcijom budućih poteza.

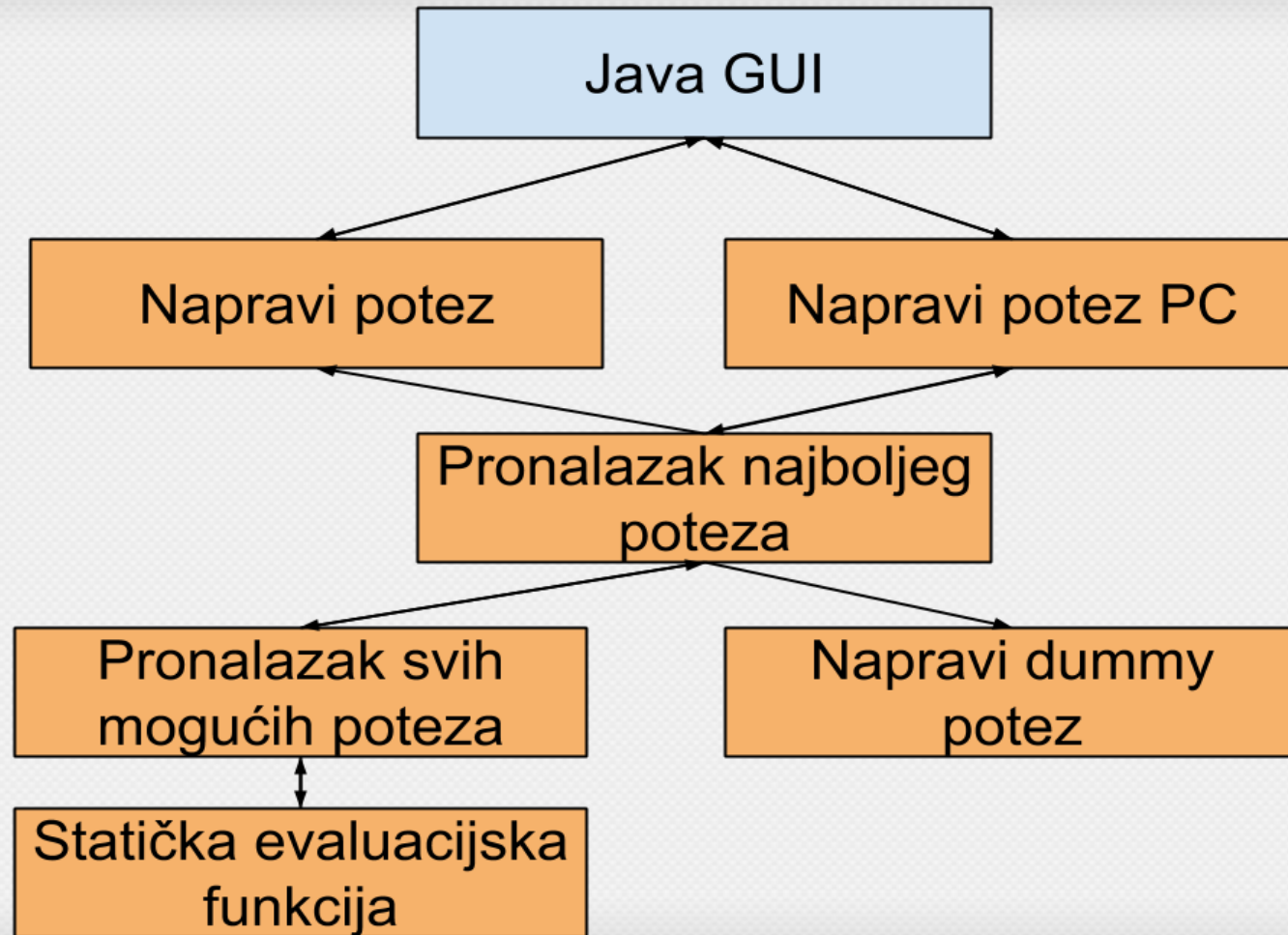


Gdje je problem

- 20 mogućih početnih poteza
- Oko 40 mogućih poteza u prosjeku
- 197 281 mogućih pozicija nakon po dva poteza
- 7^{13} pozicija nakon po 5 poteza
- Eksponencijalna složenost



Struktura sustava



Statička evaluacijska funkcija

- Procjenjuje povoljnost trenutnog stanja na ploči za svakog igrača
 - Vraća pozitivnu vrijednost ako je stanje povoljno za PC ili negativnu ako je povoljno za čovjeka
- Statička evaluacijska funkcije koristi niz heuristike



Heuristika – Ukupna vrijednost preostalih figura



Heuristika – Ukupna vrijednost preostalih figura

- White

$$6 * 1$$

$$1 * 5$$

$$1 * 9$$

$$1 * 25$$

$$= 45$$

- Black

$$5 * 1$$

$$1 * 5$$

$$1 * 9$$

$$1 * 25$$

$$= 44$$

dfa vs fdaf x +

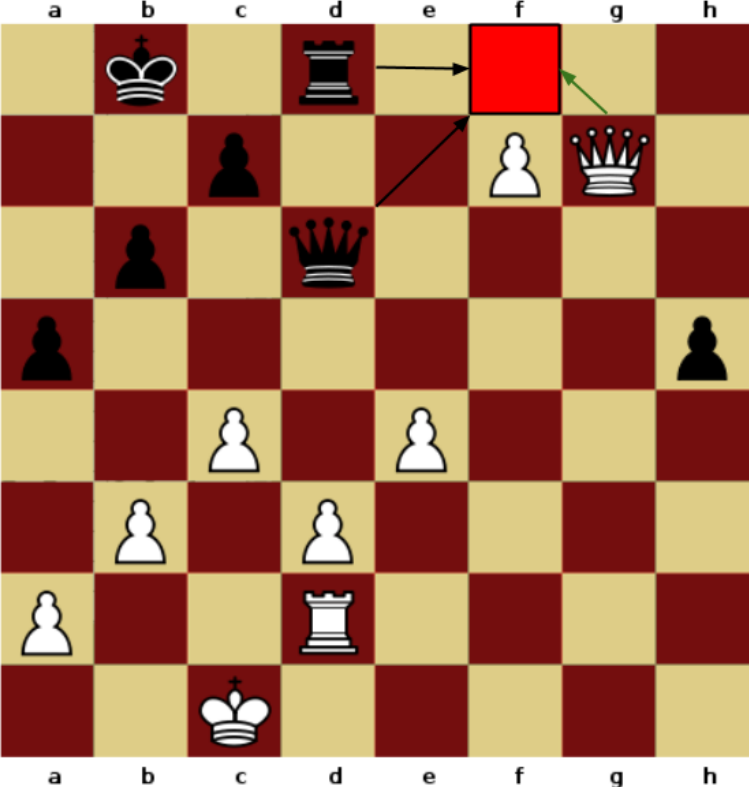
fdaf	dfa
00:00	00:00

White	Black
Bh3-e6	Ba6-b5
Qh4xf6	Bb5-c6
Be6-d5	Qd8-e7
Bd5xc6	O-O-O
Bc6xd7+	Qe7xd7
Qf6xq6	Nd4-e6
Qq6xe6	a7-a5
Qe6-h6	Qd7-h3
f2-f4	Qh3xq3
f4-f5	Qq3xh2
f5-f6	Qh2xq1
f6-f7	Qq1xh1
Qh6xh8	Qh1-f3
Qh8-q8	Qf3-f4+
Rd1-d2	Qf4-f3
Qq8-q7	Kc8-b8
Qq7-h7	Qf3-q3
Qh7-q7	Qq3-q6
Qq7xe5	Qq6-d6
Qe5-q7	Qd6-q3



Heuristika – Kontrola svakog polja na ploči

dfa vs fdaf x +



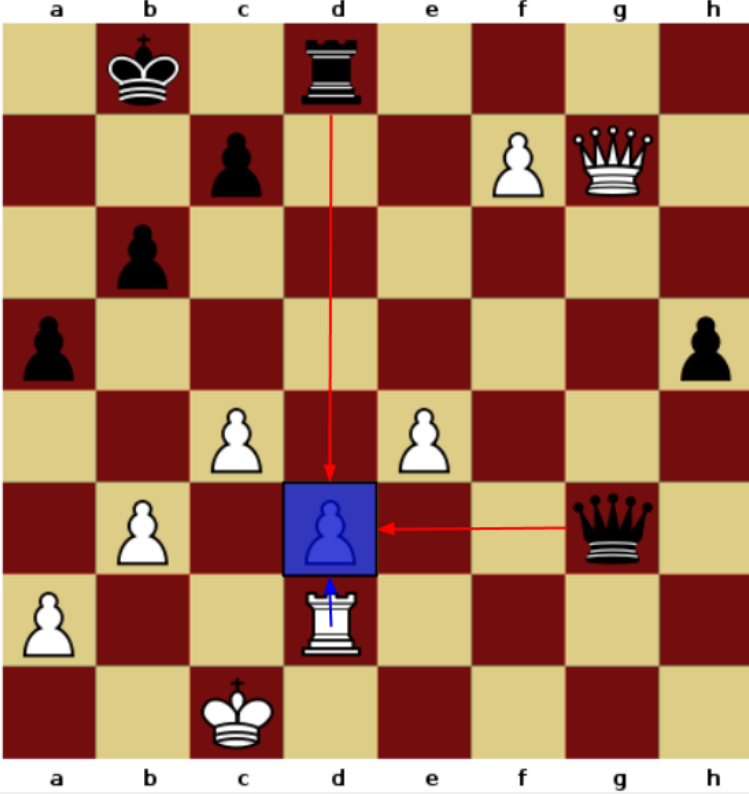
Chessboard diagram showing a game state. The board is labeled with files a-h and ranks 1-8. White pieces are on b8, d8, f7, g7, f4, e4, b3, d3, a2, and c1. Black pieces are on b8, d8, f7, g7, f4, e4, b3, d3, a2, and c1. The square f8 is highlighted in red. Arrows indicate potential moves from d8 to f8 and from f7 to f8.

fdaf	dfa
00:00	00:00

White	Black
Be6-d5	Qd8-e7
Bd5xc6	O-O-O
Bc6xd7+	Qe7xd7
Qf6xq6	Nd4-e6
Qq6xe6	a7-a5
Qe6-h6	Qd7-h3
f2-f4	Qh3xq3
f4-f5	Qq3xh2
f5-f6	Qh2xq1
f6-f7	Qq1xh1
Qh6xh8	Qh1-f3
Qh8-q8	Qf3-f4+
Rd1-d2	Qf4-f3
Qq8-q7	Kc8-b8
Qq7-h7	Qf3-q3
Qh7-q7	Qq3-q6
Qq7xe5	Qq6-d6
Qe5-q7	Qd6-q3
Qq7-h7	Qq3-d6
Qh7-q7	

Heuristika – Zaštićenost i napadnutost figura

dfa vs fdaf x +



Chessboard diagram showing a game state. The board is labeled with files a-h and ranks 1-8. White pieces are on b8, d8, f7, g7, d4, e4, b3, d3, a2, and c1. Black pieces are on c8, c7, c6, c5, h5, d3, and c1. A blue square highlights the d3 square, and a red arrow points from the black king on g7 to it. A blue arrow points from the white king on b8 to the d3 square.

White	Black
Bh3-e6	Ba6-b5
Qh4xf6	Bb5-c6
Be6-d5	Qd8-e7
Bd5xc6	O-O-O
Bc6xd7+	Qe7xd7
Qf6xq6	Nd4-e6
Qq6xe6	a7-a5
Qe6-h6	Qd7-h3
f2-f4	Qh3xq3
f4-f5	Qq3xh2
f5-f6	Qh2xq1
f6-f7	Qq1xh1
Qh6xh8	Qh1-f3
Qh8-q8	Qf3-f4+
Rd1-d2	Qf4-f3
Qq8-q7	Kc8-b8
Qq7-h7	Qf3-q3
Qh7-q7	Qq3-q6
Qq7xe5	Qq6-d6
Qe5-q7	Qd6-q3

Heuristika – Relativna mobilnost figura

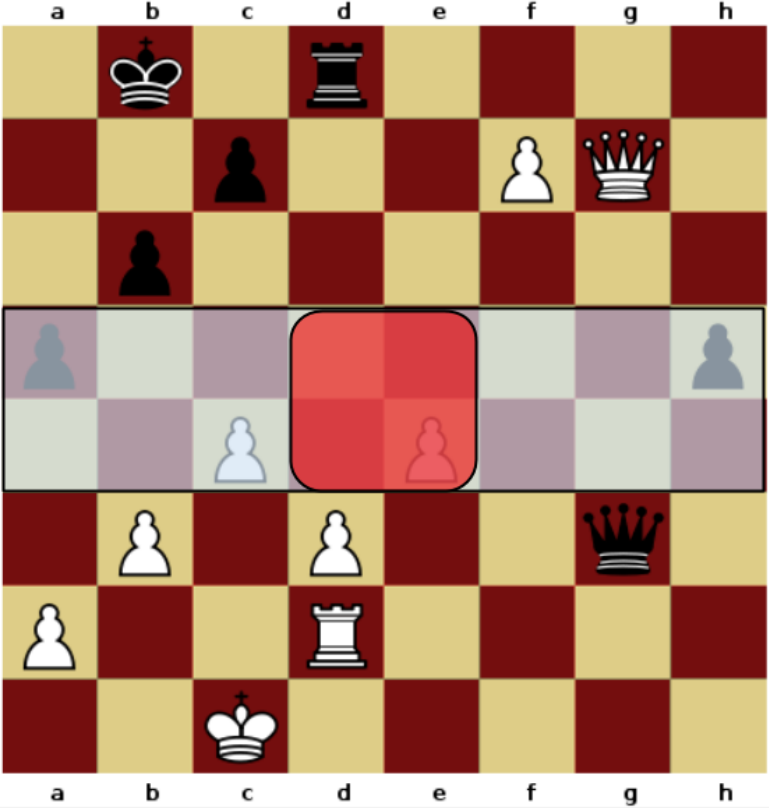
- $\text{vri_fig} * (\text{t_mob_fig} / \text{max_mob_fig})$
 - $5 * (4 / 14)$

dfa vs fdaf x +

White	Black
Bh3-e6	Ba6-b5
Qh4xf6	Bb5-c6
Be6-d5	Qd8-e7
Bd5xc6	O-O-O
Bc6xd7+	Qe7xd7
Qf6xq6	Nd4-e6
Qq6xe6	a7-a5
Qe6-h6	Qd7-h3
f2-f4	Qh3xq3
f4-f5	Qq3xh2
f5-f6	Qh2xq1
f6-f7	Qq1xh1
Qh6xh8	Qh1-f3
Qh8-q8	Qf3-f4+
Rd1-d2	Qf4-f3
Qq8-q7	Kc8-b8
Qq7-h7	Qf3-q3
Qh7-q7	Qq3-q6
Qq7xe5	Qq6-d6
Qe5-q7	Qd6-q3

Heuristika – Kontroliranost središnjih polja pijunima

dfa vs fdaf x +



Chessboard diagram showing a game state. White pieces are on b2, c3, d3, f7, g7, and h5. Black pieces are on b6, c7, d8, e7, and g3. A red highlight is on the d5-e5 squares. The board is labeled with files a-h and ranks 1-8.

White	Black
Bh3-e6	Ba6-b5
Qh4xf6	Bb5-c6
Be6-d5	Qd8-e7
Bd5xc6	O-O-O
Bc6xd7+	Qe7xd7
Qf6xq6	Nd4-e6
Qq6xe6	a7-a5
Qe6-h6	Qd7-h3
f2-f4	Qh3xq3
f4-f5	Qq3xh2
f5-f6	Qh2xq1
f6-f7	Qq1xh1
Qh6xh8	Qh1-f3
Qh8-q8	Qf3-f4+
Rd1-d2	Qf4-f3
Qq8-q7	Kc8-b8
Qq7-h7	Qf3-q3
Qh7-q7	Qq3-q6
Qq7xe5	Qq6-d6
Qe5-q7	Qd6-q3

Ostale heuristike

- Sporedne heuristike
 - Poredak pijuna – loše ako je jedan za drugim
 - Napadnutost jačih figura slabijima
 - Zaštićenost polja oko kralja
 -



Pronalazak najboljeg poteza

- Funkcija koja gleda N poteza unaprijed te bira najbolji.
- Varijacija min-max funkcije
 - Maksimalan dobitak uz minimalan gubitak



Pronalazak najboljeg poteza

Pronađi 10 najboljih poteza koje možeš napraviti s trenutnim stanjem na ploči

1	2	3	4	5	6	7	8	9	10
55	54	47	36	23	22	21	11	7	5

Napravi potez

Pronađi 3 najbolja protivnikova poteza

$((\text{Najbolji_protivnikov_potez} * 3) + \text{ostala dva poteza}) / 3$



Demo

