Impasse – Game and AI – i6306739 – Amit K. Jadhav

Individual Project for Intelligent Search and Games Course – Sept Oct 2022

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Outline

- Impasse Game in Ludii
- Evaluation Function
- Functionalities Implemented
- Playable AIs

Impasse Game in Ludii

- Play rules – Priority for each piece to move
  - 3 Basic Moves (Single Slide, Double Slide, Transpose)
  - 2 Special Moves (Crown, Bear Off)
- Impasse Move → if no moves for any piece
- Boundary conditions – 2 crownable pieces, Compound moves (Slide + Bear Off + Crown, Impasse + Crown)

Evaluation Function

- Material Score (#Opponent Pieces – #Own Pieces)
- Position Score *(ref supporting material – slides 9 to 11)*
- Blocking Score *(ref supporting material – slides 9 to 11)*
- Random Element
- Player-To-Move Score

(supporting material here)

Functionalities & Enhancements Implemented

- Minimax *(not Negamax)*
- Alpha Beta Pruning
- Iterative Deepening
- Move Ordering
- Transposition Table (using the existing Data structure from Ludii AI Resources)
- Adaptive Time Control
- Enhanced Evaluation
- Aspiration Window

Playable AIs

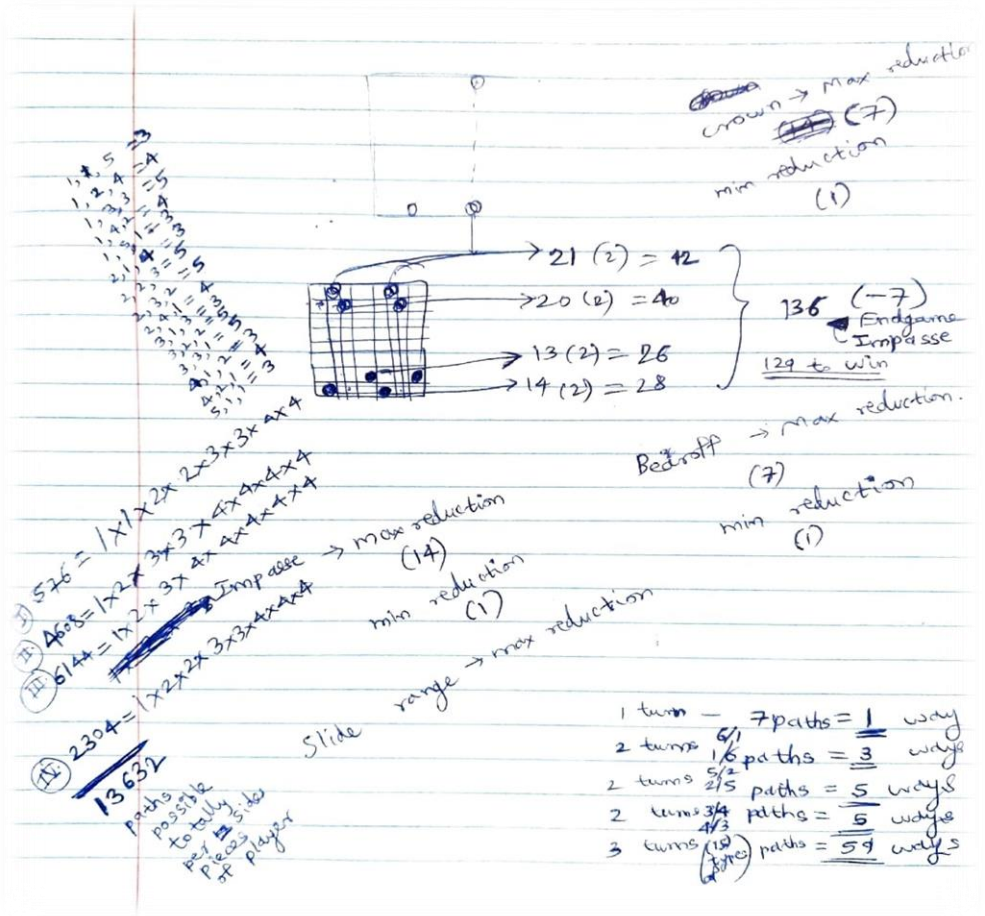
- **AI1** – **(Minimax + AB)**
- **AI2** – AI1 + **(Iterative Deepening + Move Ordering + Transposition Table + Enhanced Evaluation)**
- **AI3** – AI2 + **(Adaptive Time Control for Iterative Deepening)**
- **AI4** – AI3 + (Aspiration Window)

Referred Material

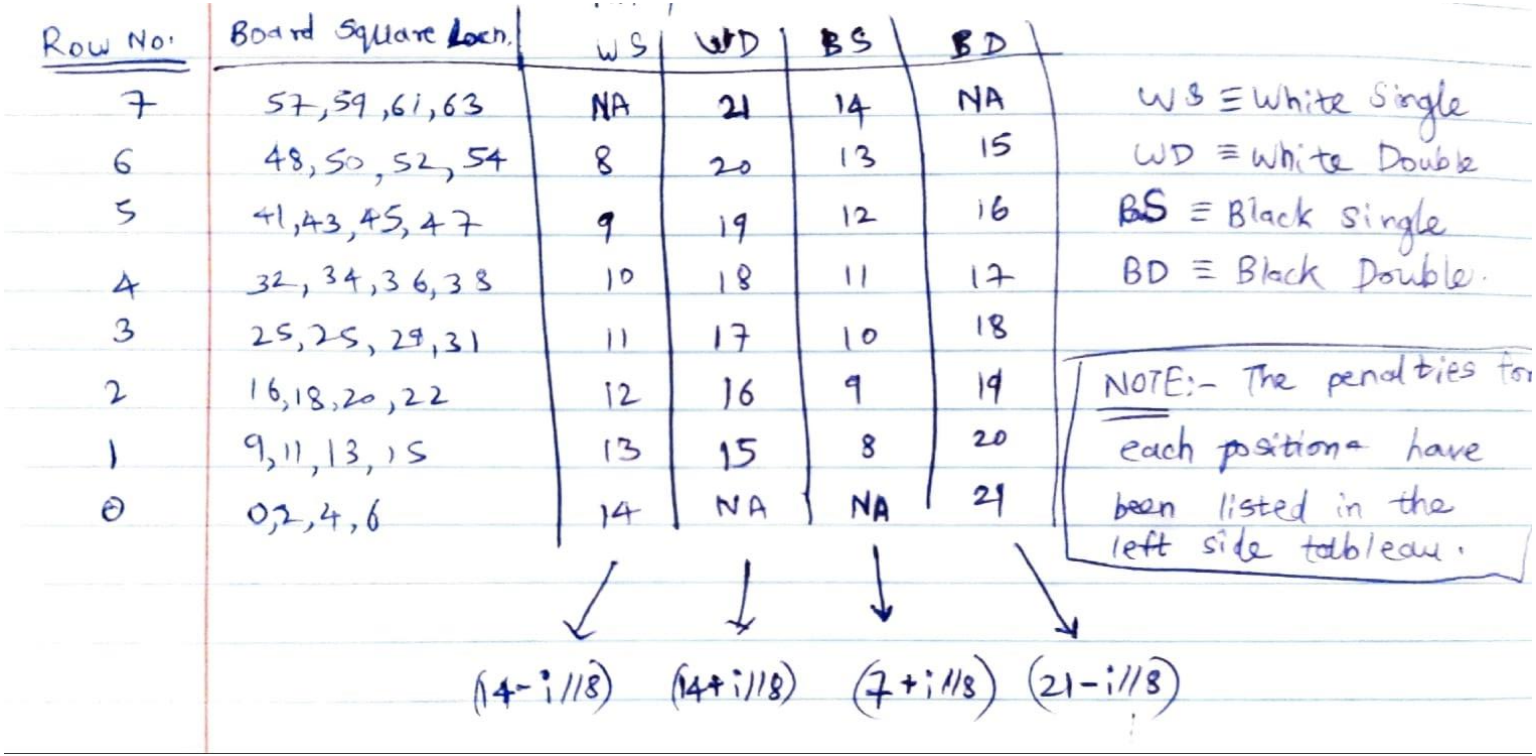
- T. Marsland 1986 (A review of Game tree Prunings)
- Ludii & LudiiAI Github repositories by Eric/Dennis
- Impasse Game by Mark Steere (https://www.marksteeregames.com/Impasse_rules.pdf)
- Ludii Portal (https://ludii.games/)

THANK YOU

My Evaluation Logic

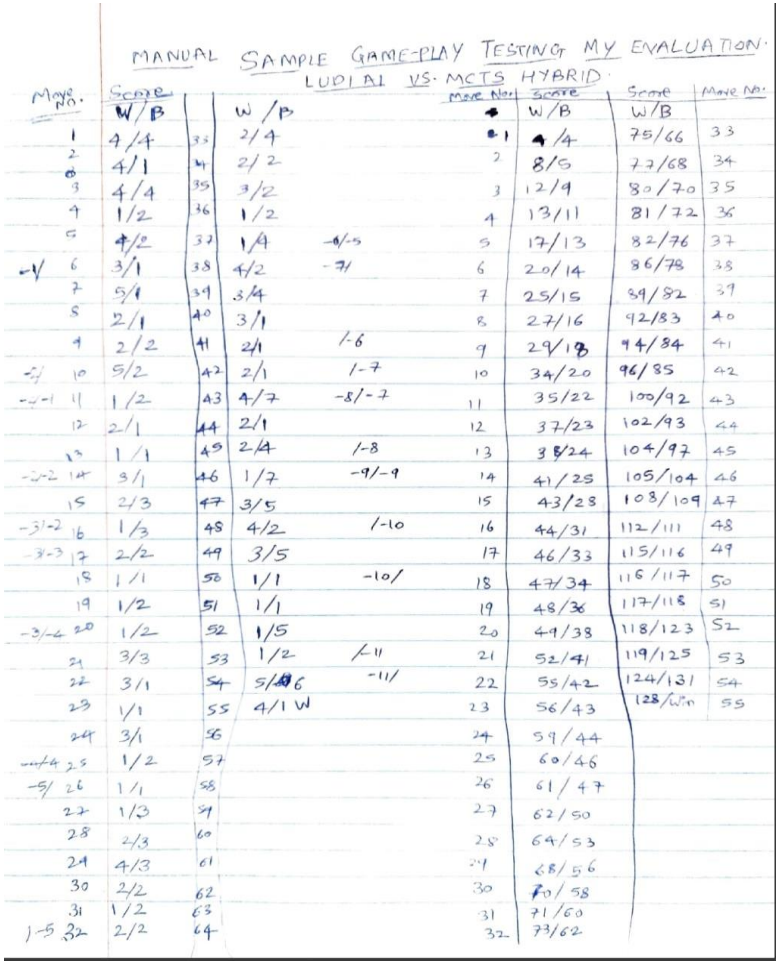


Positional Penalties per Piece Type



Row No.	Board Square Loc.	WS	WD	BS	BD
7	57, 59, 61, 63	NA	21	14	NA
6	48, 50, 52, 54	8	20	13	15
5	41, 43, 45, 47	9	19	12	16
4	32, 34, 36, 38	10	18	11	17
3	25, 25, 29, 31	11	17	10	18
2	16, 18, 20, 22	12	16	9	19
1	9, 11, 13, 15	13	15	8	20
0	0, 2, 4, 6	14	NA	NA	21

1 Sample Manually Scored Game – Ludi AI Vs. MCTS Hybrid



MANUAL SAMPLE GAME-PLAY TESTING MY EVALUATION.
LUDI AI VS. MCTS HYBRID.

Move No.	Score W/B		W/B		Move No.	Score W/B	Score W/B	Move No.
1	4/4	33	2/4		1	4/4	75/66	33
2	4/1	34	2/2		2	8/5	77/68	34
3	4/4	35	3/2		3	12/9	80/70	35
4	1/2	36	1/2		4	13/11	81/72	36
5	4/2	37	1/4	-4/-5	5	17/13	82/76	37
-1 6	3/1	38	4/2	-7/	6	20/14	86/78	38
7	5/1	39	3/4		7	25/15	89/82	39
8	2/1	40	3/1		8	27/16	92/83	40
9	2/2	41	2/1	/-6	9	29/18	94/84	41
-2/ 10	5/2	42	2/1	/-7	10	34/20	96/85	42
-2-1 11	1/2	43	4/7	-8/-7	11	35/22	100/92	43
12	2/1	44	2/1		12	37/23	102/93	44
13	1/1	45	2/4	/-8	13	38/24	104/97	45
-2-2 14	3/1	46	1/7	-9/-9	14	41/25	105/104	46
15	2/3	47	3/5		15	43/28	108/109	47
-3/-2 16	1/3	48	4/2	/-10	16	44/31	112/111	48
-3-3 17	2/2	49	3/5		17	46/33	115/116	49
18	1/1	50	1/1	-10/	18	47/34	116/117	50
19	1/2	51	1/1		19	48/36	117/118	51
-3/-4 20	1/2	52	1/5		20	49/38	118/123	52
21	3/3	53	1/2	/-11	21	52/41	119/125	53
22	3/1	54	5/6	-11/	22	55/42	124/131	54
23	1/1	55	4/1 W		23	56/43	128/Win	55
24	3/1	56			24	59/44		
-4/-4 25	1/2	57			25	60/46		
-5/ 26	1/1	58			26	61/47		
27	1/3	59			27	62/50		
28	2/3	60			28	64/53		
29	4/3	61			29	68/56		
30	2/2	62			30	70/58		
31	1/2	63			31	71/60		
-5 32	2/2	64			32	73/62		