

CrazyAra

Deep Learning for Crazyhouse Chess



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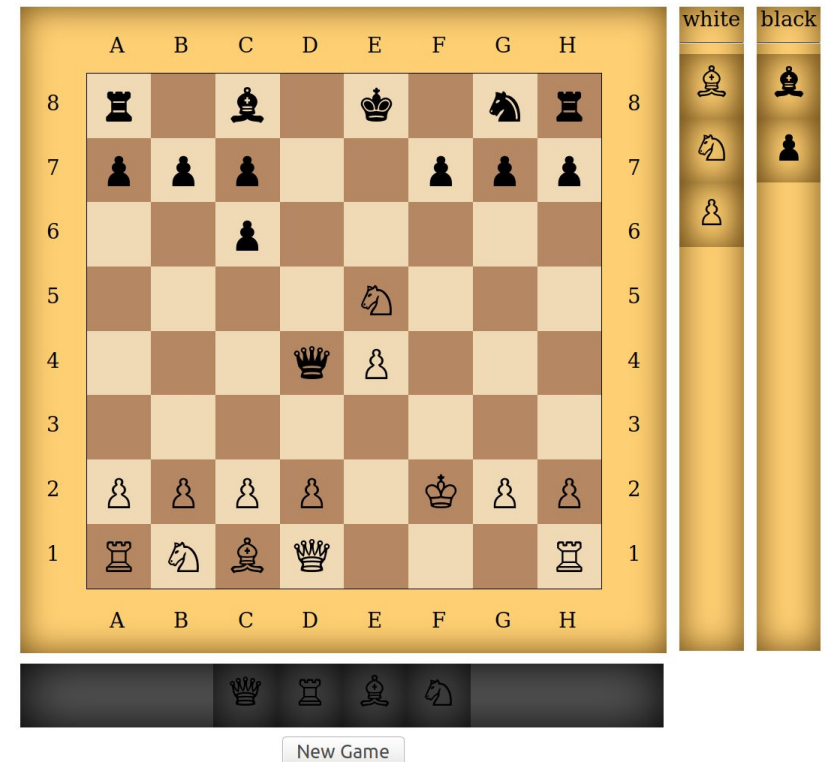
Johannes Czech, Alena Beyer, Moritz Willig

Crazyhouse?! - Rules Overview



Normal chess rules

- Introduction of pockets
- Introduction of piece drops!
- Complex situations
- More focused on tactics
- Higher number of critical situations
- Usually faster games
- Less drawing ($< 1\%$)



Boardstate of a Crazyhouse game

CrazyAra - Milestones



Adapt Alpha(Zero)Chess to Crazyhouse

$$(\mathbf{p}, v) = f_{\theta}(s) \text{ and } l = (z - v)^2 - \boldsymbol{\pi}^T \log \mathbf{p} + c \|\boldsymbol{\theta}\|^2$$

- Add pockets & piece drops

Training procedure

- Supervised learning on human games
- Reinforcement learning using self-play

Evaluate performance

- 1,000 test- and 1,000 validation-games (lichess.org)
- Mate-in-one-Benchmark test
- Test against humans

Description:

l : Loss term

s : Game state

p : Predicted policy

π : True policy

v : Predicted value

z : True value

c : Regularization constant

θ : Weights

CrazyAra - Milestones



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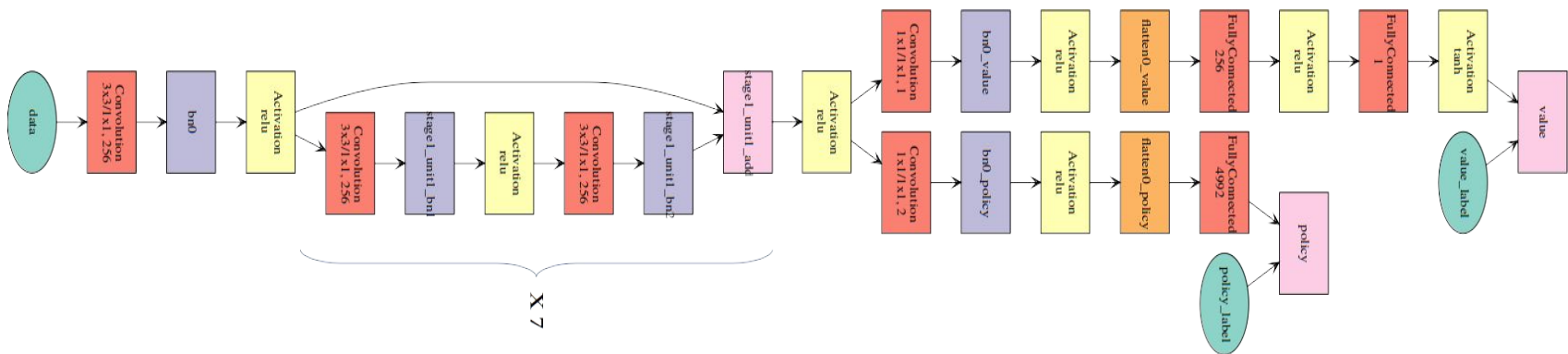


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Model-Architecture - Overview

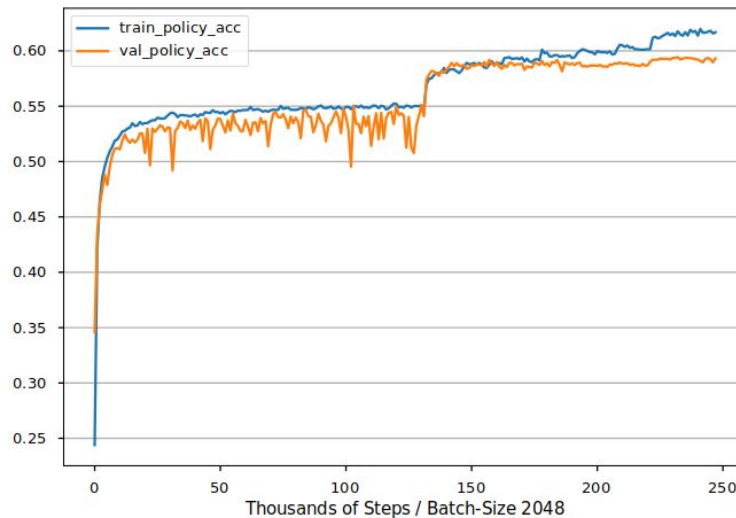


- **Input dimension:** 34x8x8 (no board history!)
- **Output dimension:** [1, 4992] (value, policy)
- **Structure:** Input - 1 CNN-Layer - 7 residual blocks - value head & policy head
- **Reweighting** of the gradients (to avoid overfitting - Mastering the game of Go without human knowledge, David Silver et al.)
 - 0.01 value loss gradient
 - 0.99 policy loss gradient
- **Normalization** of the inputs to the numerical range [0.0f, 1.0f]

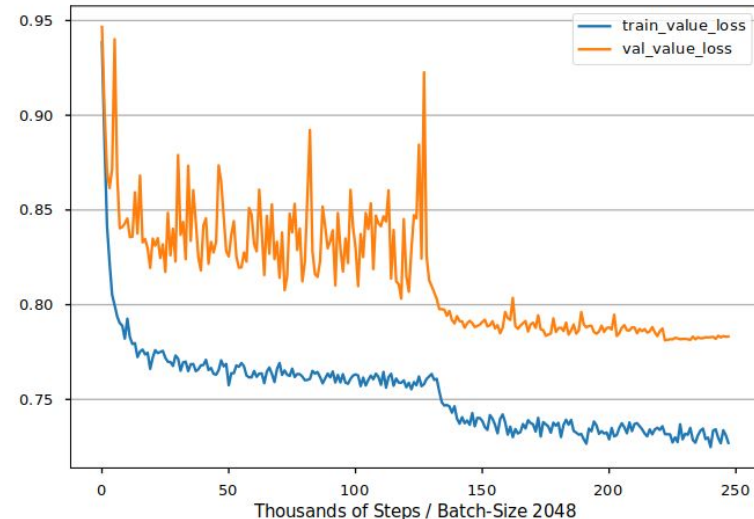
Training Results - Summary



Prediction on professional moves (%)



MSE of professional game outcomes



Trained for ~40 hours on 569,537 human games

- All time controls (including Bullet) with elo $\geq 2,000$

Move prediction accuracy

- 61.2% train - 59.3% validation - 58.9% test

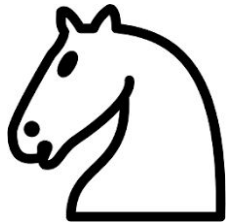
Learning rate schedule using NAG (Nesterov Accelerated Gradient)

- Dropping of lr two times - [0.1, 0.01, 0.001]

Performance on 1,000 mate-in-one positions

- 93.9% top-1-Acc - 99.7% top-5-Acc:

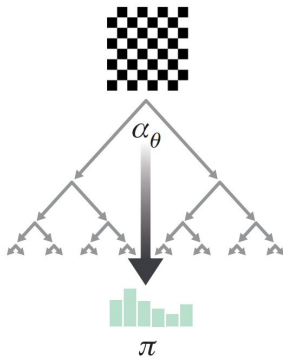
Achievements - Summary



Integration to **lichess.org**

BOT CrazyAra: <https://lichess.org/@/CrazyAra>

- Played > 100 games against humans
- Final rating: **2298.44** +/- 79.3.
- Better than [98.2% of Crazyhouse players.](#)
- The source code will be hosted at:
 - <https://github.com/QueensGambit/CrazyAra>



Integration of **Monte Carlo Tree Search**

References

- Mastering the game of Go with deep neural networks and tree search, David Silver et al.
- Mastering the game of Go without human knowledge, David Silver et al.
- Mastering Chess and Shogi by Self-Play with a General Reinforcement Learning Algorithm, David Silver et al.
- <https://github.com/careless25/lichess-bot>
- <https://github.com/Zeta36/chess-alpha-zero>
- <https://github.com/benediamond/chess-alpha-zero>
- <https://github.com/glinnscott/leela-chess>

Live Match with Audience - Volunteer?



The screenshot displays a chess match interface. On the left is a chessboard with files a-h and ranks 1-8. White pieces are on the bottom half, and Black pieces are on the top half. The king is on e8, and the queen is on d8. The board shows a complex position with many pieces.

On the right is a panel showing the match progress. At the top, it says "#1" and "Stockfish 9+ WASM in local browser". Below this is a list of moves:

Move	Move
13 bxc3	13 ♔xf3
14 ♖xf3	14 @e4
15 ♖g3	15 @e5
16 @e6	16 exd4
17 exf7+	17 ♔xf7
18 @e6+	18 ♔xe6
19 ♔@h3+	19 ♔e7
20 ♖xg7+	20 ♔f8
21 ♔@h6	21 dxe3
22 ♖xd7+	22 ♔e8 #1
23 ?	

At the bottom of the panel, it says "1-0" and "Checkmate, White is victorious".

Thank you!



<https://wallpercave.com/w/LPXTLA7>