Assessing Game Balance with AlphaZero

https://deepmind.com/research/publications/Assessing-Game-Balance-with-AlphaZero-Exploring-Alternative-Rule-Sets-in-Chess

Cameron Browne: Automatic Generation and Evaluation of Recombination Games

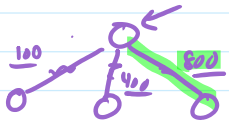
Decisiveness: how often/quickly a player with a large lead wins the game

Clarity: how clear it is which moves are most promising

high variance - low clarity

low variance - high clarity

Chess: Grandmasters draw ≥ 90% (expected - people think chess is a draw theoretically)
games end in "home preparation" too often



AlphaZero: Deep RL + MCTS

let AlphaZero play chess variants!

encourage exploration by adding noise
- add noise to move probabilities from NN
- after MCTS, pick move randomly biased by evaluation counts

1st 15 moves per player (30 plies)

do this for 1st 20 plies

then play 10K @ 1/sec per move
1K @ 1/min per move

Entropy

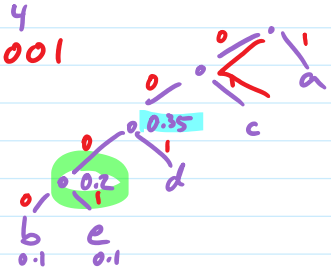
a	b	c	d	e
0.4	0.1	0.25	0.15	0.1
1	4	2	3	4
1	0000	01	001	0001

2.15 bits/character

256 chars
2^8 sequences of 8 bits

00000000 a
11111111 z

$\log_2 5 = 2.32$



$$\text{entropy} = H(X) = -\sum_{i=1}^{n} P(x_i) \cdot \log P(x_i) \approx 2.104$$

apply this to output of neural network

output 0 0 0 1 0 0 0

entropy = 0

1/7 1/7 - - - - - 1/7

~~0.01~~ ~~0.02~~ . . . . . 0.3 0.4 ~~0.01~~

estimated # moves considered $e^{H(s)}$