

# Deep Learning for Adaptive Playing Strength in Computer Games

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**Abstract.** In this abstract we present our initial results on the first successful attempt to train computer chess programs to realistically exhibit different playing strengths.

While the main target of research in computer chess has always been achieving stronger playing strength, the seemingly easier task of creating *realistically weaker* programs remains challenging. Nowadays human chess players from novice to grandmaster are easily defeated by state-of-the-art chess programs, and thus gain little enjoyment or experience by playing against such an overwhelmingly superior opponent. As a result, commercial chess programs have always tried to allow the human user to adjust their strength to best match theirs. Previous attempts used by commercial chess programs involved either limiting the amount of time or search depth used by the program, or randomly playing inferior moves with some probability. All these methods have resulted in unrealistic playing style, which yields little benefit and enjoyment for the human opponents (i.e., the computer program does not pass a Turing test).

In our work, we train the chess program to exhibit a targeted playing strength realistically, without any artificial handicap. To do so, we build on our previous DeepChess [1] work which allowed us to train an end-to-end neural network from scratch, achieving a state-of-the-art chess program.

Here, instead of training the deep neural network on datasets of grandmaster chess players only, we train two separate neural networks using DeepChess architecture. Using the ChessBase Mega Database, we extract two hundred thousand positions from games where both players were rated above 2500 Elo, and train the first neural network (to which we refer as DEEPCHESSTRONG). Similarly, we train a second neural network that using two hundred thousand positions from games where both players were rated below 2300 (to which we refer as DEEPCHESWEAK).

To compare the performance of these two chess programs, we conducted 100 games at a time control of 30 min per game for each side. The result was DEEPCHESSTRONG defeating DEEPCHESWEAK by of 78.5% to 21.5%, corresponding to a rating difference of 225 Elo in favor of DEEPCHESSTRONG.

These results present the first successful attempt at adaptive adjustment of playing strength in computer chess, while producing realistic playing style. This method can be extended to additional games in order to achieve realistic playing style at different playing strength levels.

## Reference

1. David, O.E., Netanyahu, N.S., Wolf, L.: DeepChess: End-to-end deep neural network for automatic learning in Chess. In: Villa, A.E.P., Masulli, P., Pons Rivero, A.J. (eds.) ICANN 2016. LNCS, vol. 9887, pp. 88–96. Springer, Cham (2016). doi:[10.1007/978-3-319-44781-0\\_11](https://doi.org/10.1007/978-3-319-44781-0_11)