

Investment Vs. reward in competitive games

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We investigate the balance between the costs of training larger deep learning models compared to the advantage they provide in solving general problems. Defining advantage as the performance relative to competitors, two competitive games are used as test cases. The first is a two-player game based on the knapsack problem where two opponents compete over shared resources, with the goal of collecting more resources than the opponent. The second is the popular game Connect Four. In both cases neural nets of varying sizes are trained using a variant of the AlphaZero algorithm. A surprisingly simple relation is found for the relative win rate of a net against another, depending on their sizes. Success increases linearly with investments in additional resources when the networks sizes are comparable in size, with returns diminishing when both networks are very different.