

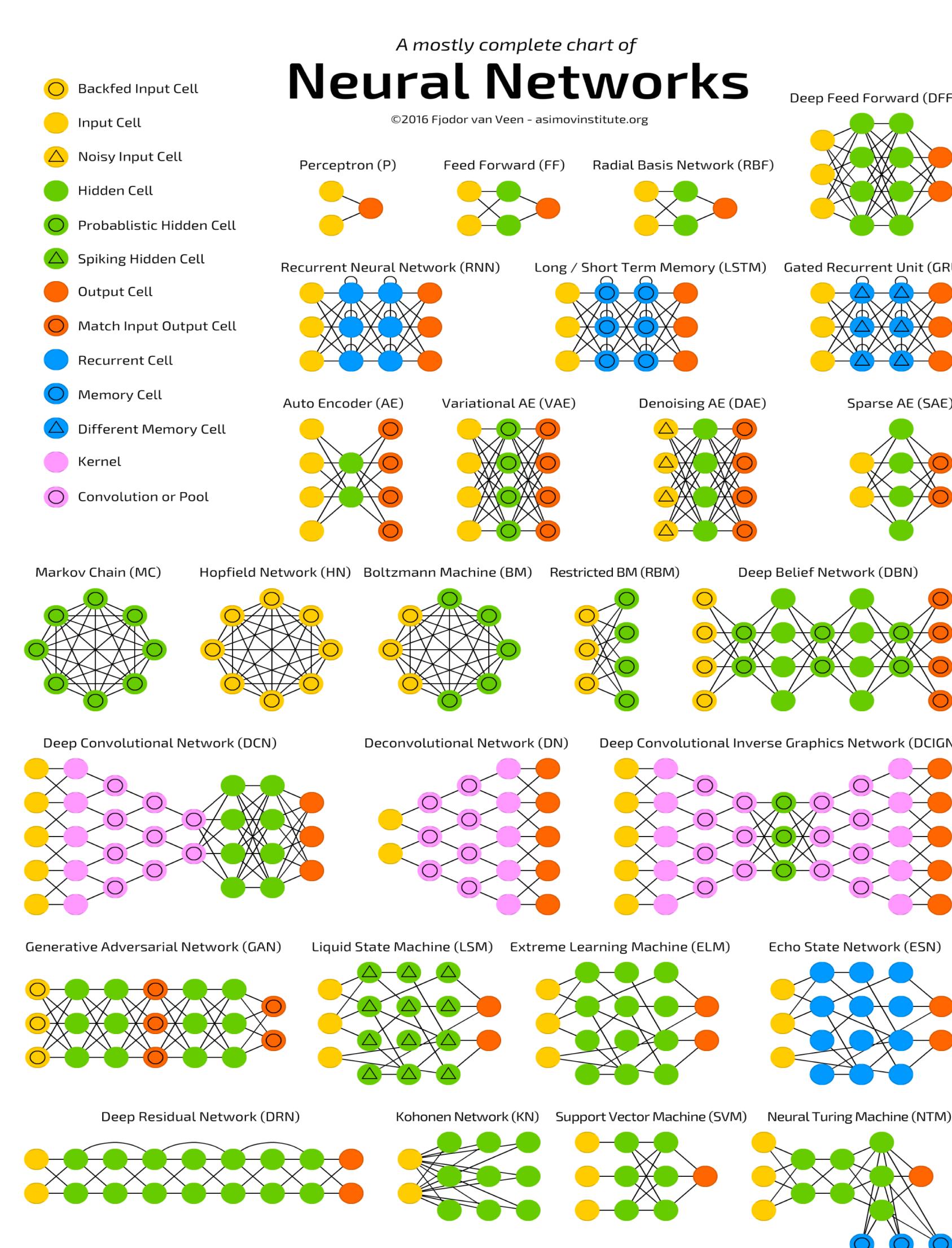
# Convolutional Neural Networks for Pattern Matching in Poker-Type Games

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## Introduction

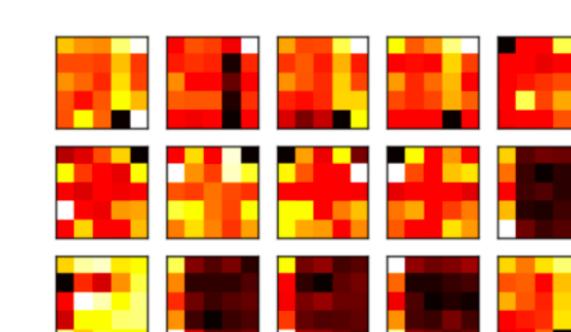
- A novel representation for poker games, extendable to different poker variations
- A convolutional Neural Network (CNN) based learning model that can effectively learn the patterns in three different games.
- A self-trained system that significantly beats the heuristic-based program on which it is trained, and our system is competitive against human expert players.
- Single player video poker
- Two-player Limit Texas Hold'em
- Two-player 2-7 triple draw

## Convolutional Neural Network



### Neural Net Poker

model	negl	tiny	small	big	huge
	\$0.005	<\$0.08	<\$0.25	<\$1.0	\$1.0+
heuristic	1610	53	1081	256	23
DNN	2327	348	242	83	23
CNN 5 x 5	2322	413	151	114	8
CNN 3 x 3	2467	353	131	49	8

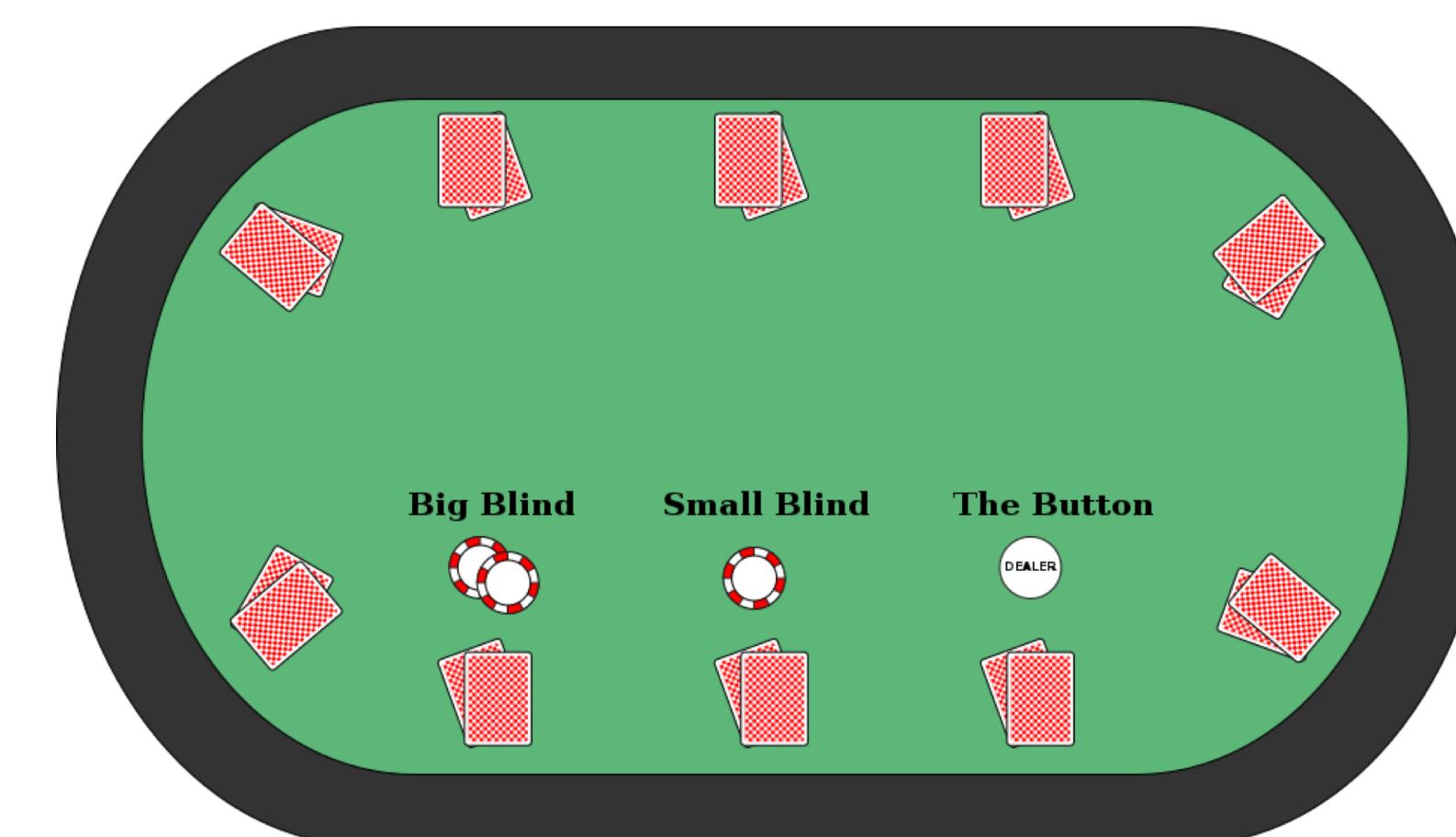


## Video Poker



The objective of Video Poker is simple: match the best possible hand of five cards. Given 32 possible choices, based on the players, final 5 cards where payout is calculated by a table of matches.

## Texas Hold'em (Heads-Up Limit)



Both players have a fixed amount of money known as stack size at the start of each game. An ante is required to start every game and is considered the first round of Private and public cards are dealt and if the players make it through 3 more rounds a showdown will take place which is where both players end up showing each other their hands where there is only one winner.

## 2-7 Triple Draw (Lowball)



Multiple rounds of betting but in this game you can also choose to trash some number of your cards or keep them. Low card is high, in other words a low card straight would be the best hand

## Results

### Video Poker Results

model	average return
perfect player	\$1.000
professional player	\$0.98 to \$0.99
heuristic player	\$0.916 ± 0.002
random action player	\$0.339 ± 0.003
Fully connected network	\$0.960 ± 0.002
CNN with 5 x 5 filters	\$0.967 ± 0.002
CNN with 3 x 3 filters	\$0.977 ± 0.002

### Texas Hold'em Results

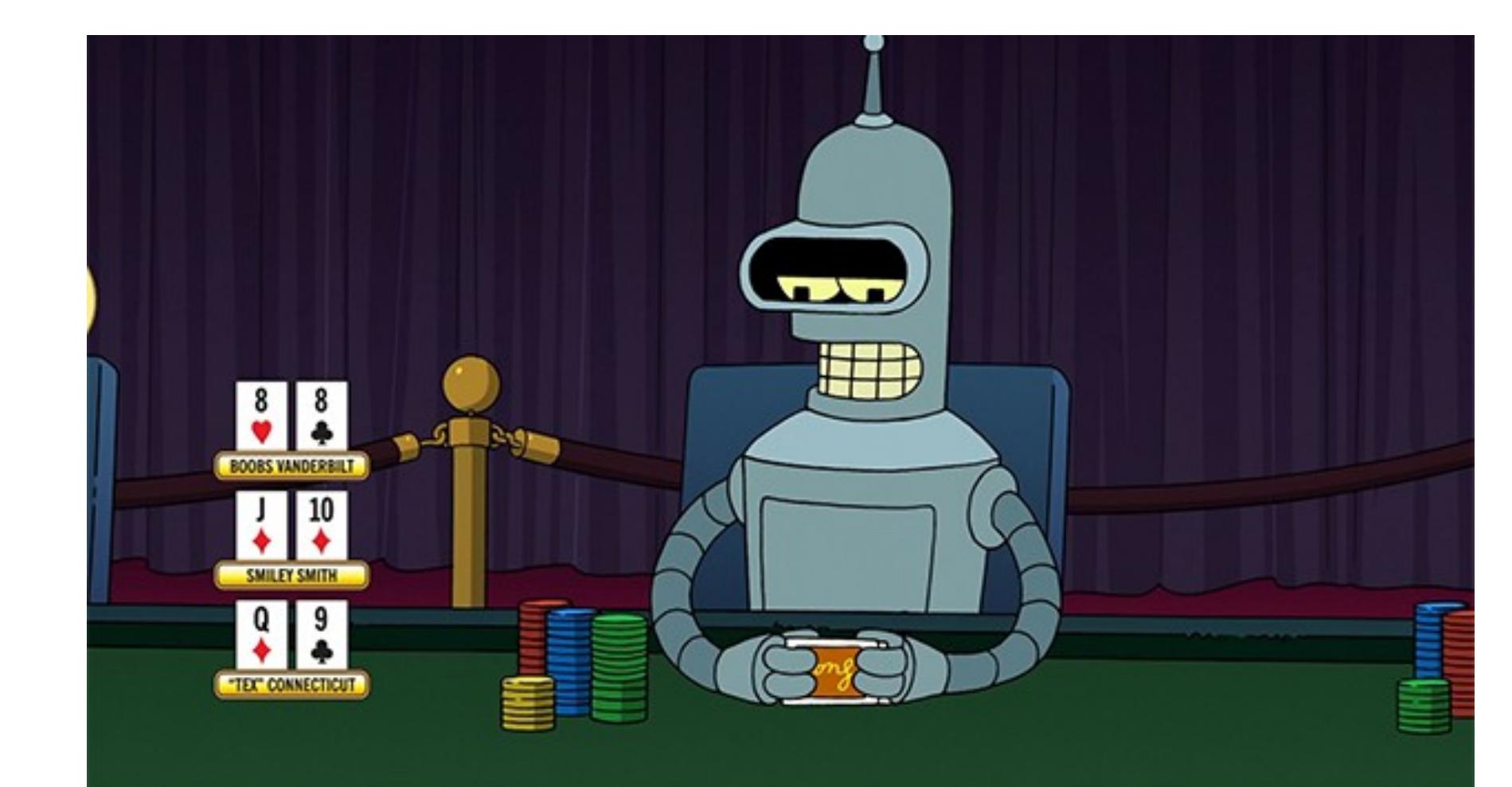
Player	Player earnings	# hands
ACPC sample player	-\$90.9 ± 7.0	10000
Heuristic player	-\$29.3 ± 5.6	10785
CFR-1	-\$93.2 ± 7.0	10000
Professional human player	+\$21.1 ± 30.5	527

### 2-7 Triple Draw (lowball)

model	heuristic	CNN-1	Pok-CNN	DNN
Heuristic	0	-\$99.5	-\$61.7	-\$29.4
CNN-1	+\$99.5	0	-\$73.3	-\$54.9
Pok-CNN	+\$61.7	+\$73.3	0	+\$66.2
DNN	+\$29.4	+\$54.9	-\$66.2	0

## Conclusion

For a heuristic trained agent, this really showed how a **generalized self-learning model** has room for improvement and could excel in all forms of this immensely large game state, given a Convolutional Neural Network.



## Picture Reference websites

<http://www.pokerstars.net/poker/games/>,  
<http://www.asimovinstitute.org/neural-network-zoo/>,  
<https://www.videopoker.com/>,  
<https://www.geek.com/news/ai-solves-texas-hold-em-poker-and-becomes-unbeatable-161309/>