Deep reinforcement learning

Michal CHOVANEC, PhD.

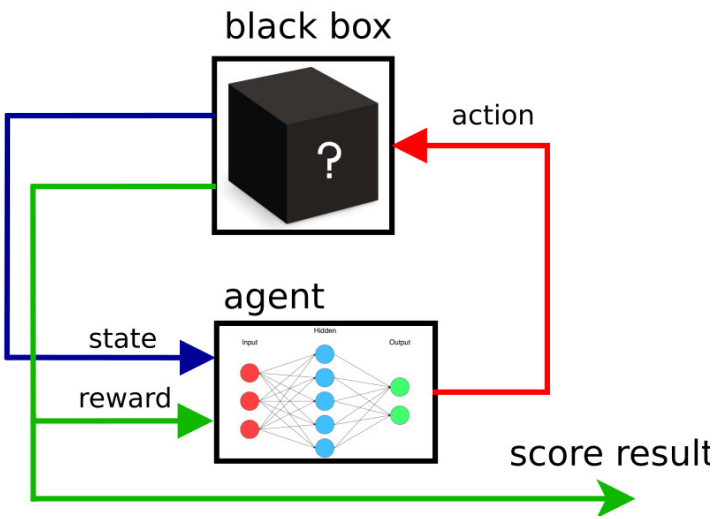
May 2018

Faculty of Management Science and Informatics

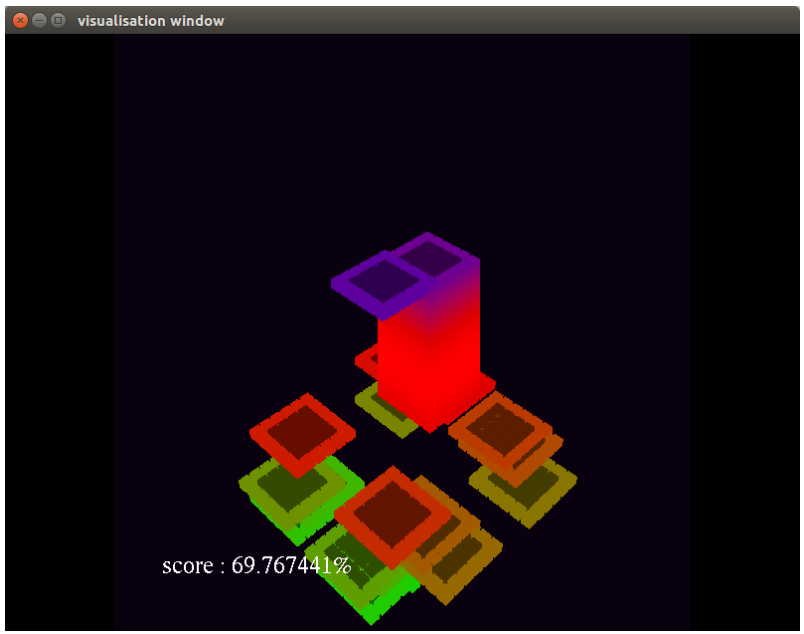
Problem definition

- learn to play game with unknow rules
- input : state and reward
- output : action and total score
- $Q(s, a)$: learn Q function

agent never sees required value (required action)



Stack game



- build stack tower
- **state** : last + actual floor image [20x20x2]
- **reward** : alignment rate $\langle 0, 1 \rangle$

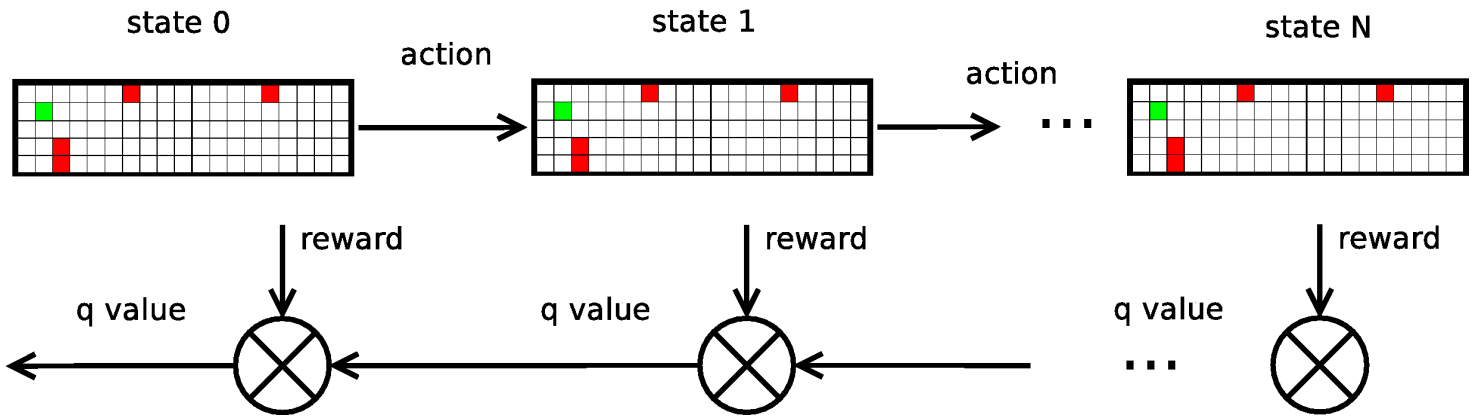
Storing Q values

- table
- linear combination of basis function (handmade features)
- Kenerva's sparse encoding
- neural network

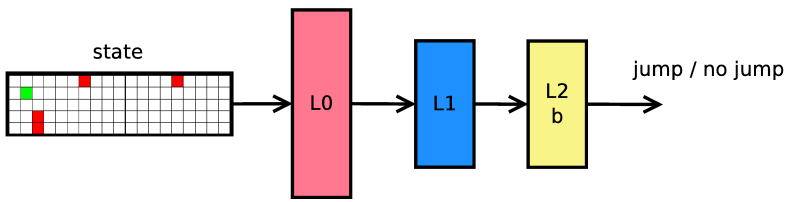
problems

- state correlations
- nonstationary Q values
- convergence to optimal strategy

Neural network approximator - deep reinforcement learning

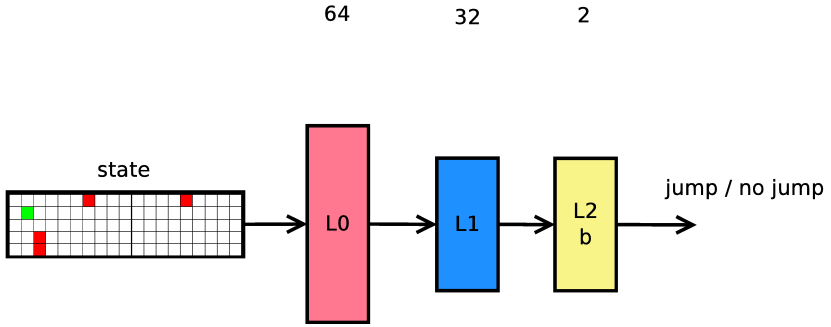


64 32 2

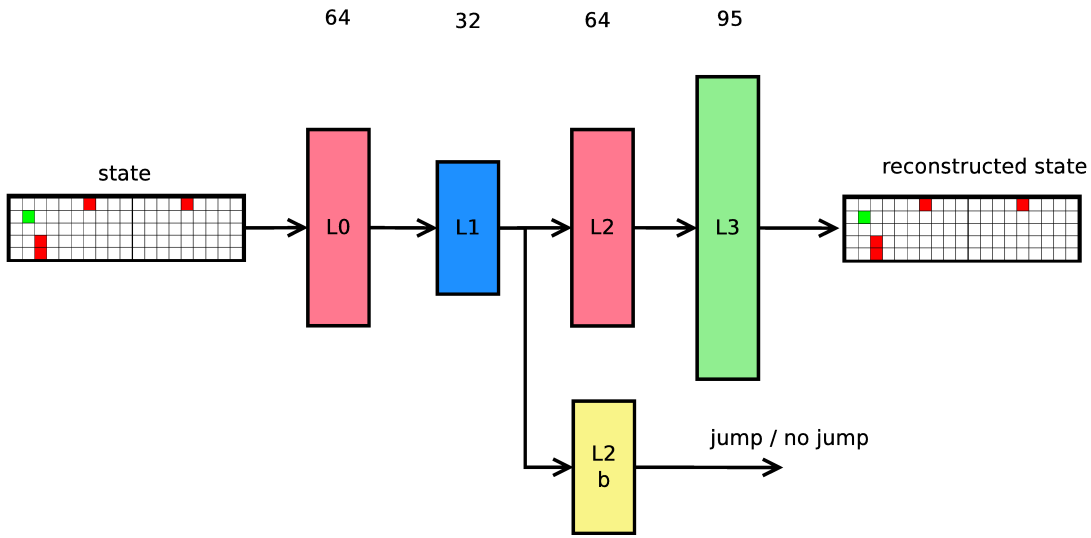



```
layer IO                : [  20   20    2] [   1    1    1] [  20   20    2] [    0    0]
layer AV POOLING        : [  20   20    2] [   2    2    1] [  10   10    2] [    0    0]
layer FC                : [   1    1  200] [   1    1   64] [   1    1   64] [12800   64]
layer RELU              : [   1    1   64] [   1    1    1] [   1    1   64] [    0    0]
layer FC                : [   1    1   64] [   1    1    8] [   1    1    8] [  512    8]
layer RELU              : [   1    1    8] [   1    1    1] [   1    1    8] [    0    0]
layer FC                : [   1    1    8] [   1    1    2] [   1    1    2] [   16    2]
layer IO                : [   1    1    2] [   1    1    1] [   1    1    2] [    0    0]
```

Speed up learning

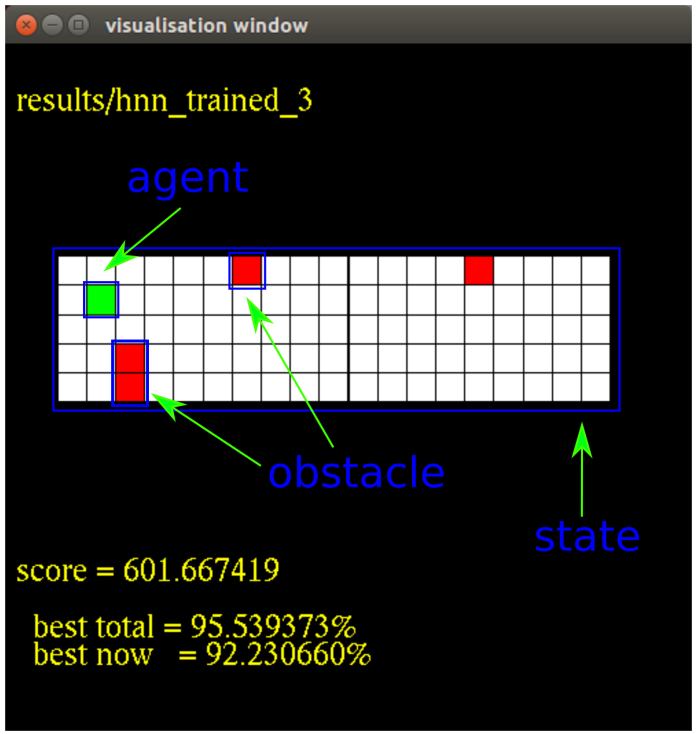


common feed forward neural network



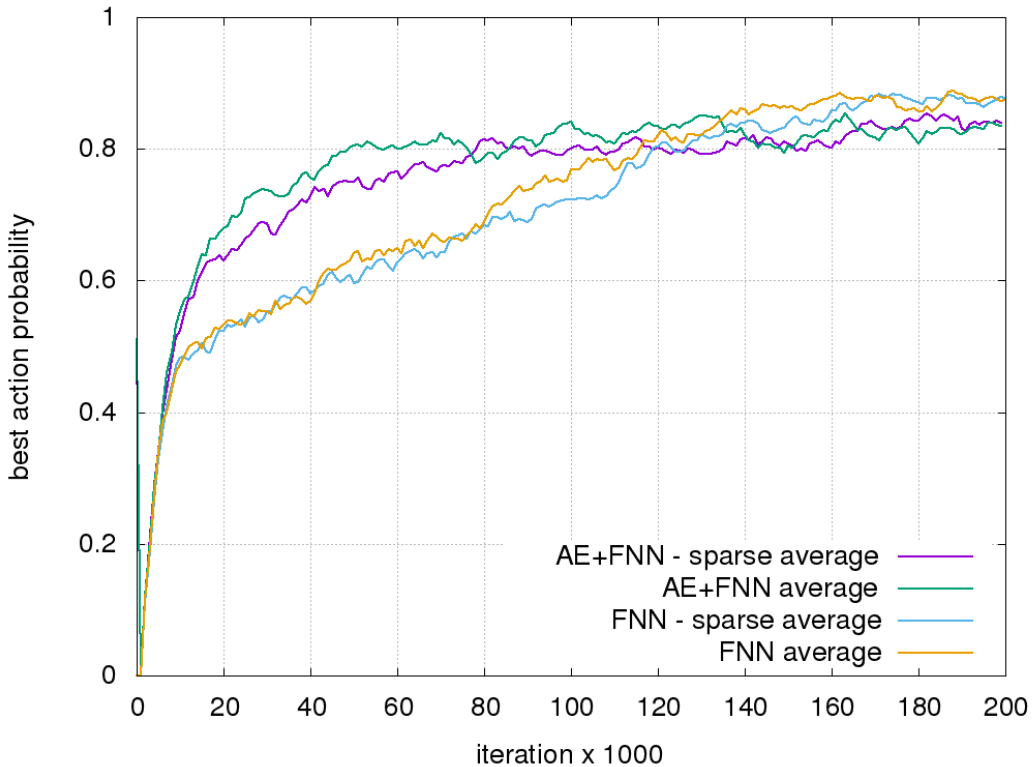
stacked autoencoder + feed forward neural network

Arcade game experiment



	FNN sparse	FNN no sparse	AE+FNN sparse	AE+FNN no sparse
unsupervised iterations	0	0	100000	100000
supervised iterations	200000	200000	200000	200000
iterations per slice	0	0	50000	50000
learning rate	0.0005	0.0005	0.0005	0.0005
init weight range	0.1	0.1	0.1	0.1
dropout	0	0	0	0
lambda	0.00000001	0	0.00000001	0

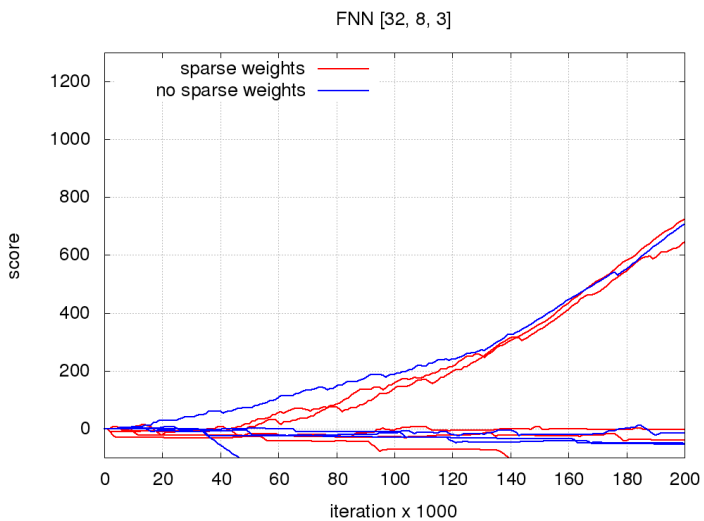
Results



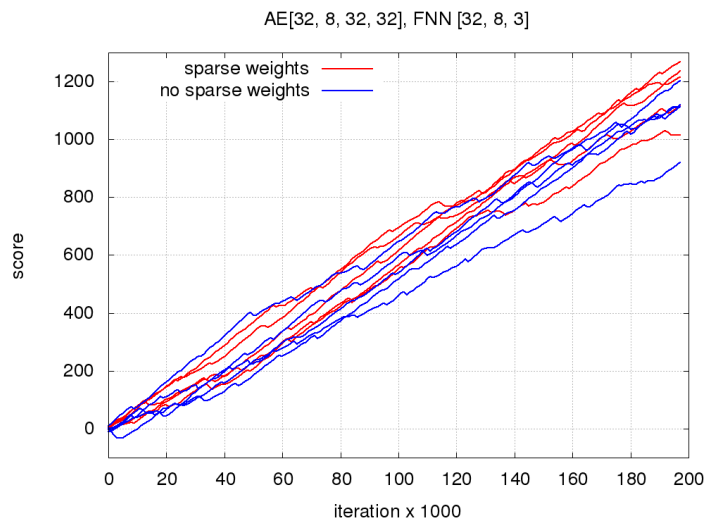
Average training progress comparison

	average score	best score	worst score	average best action probability [%
FNN sparse weights	957.31	978.3	927.31	94.04
FNN nosparse weights	951.5	959.3	942.644	95.95
AE+FNN sparse weights	763.58	942.97	618.66	88.16
AE+FNN no sparse weights	737.78	884.98	618.99	87.19

Snake game experiment



FNN score progress comparison



AE+FNN score progress comparison

Q&A

https://github.com/michalnand/robotics
https://github.com/michalnand/machine_learning

michal.nand@gmail.com