Reinforcement Learning For Sports Analytics

Oliver Schulte

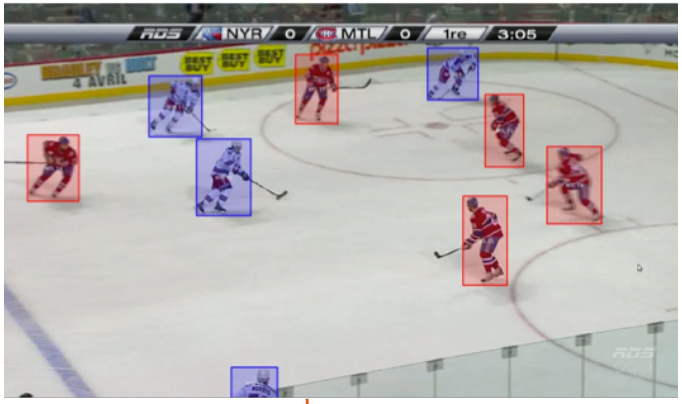
School of Computing Science

Simon Fraser University

Vancouver, Canada

Sports Analytics and Reinforcement Learning

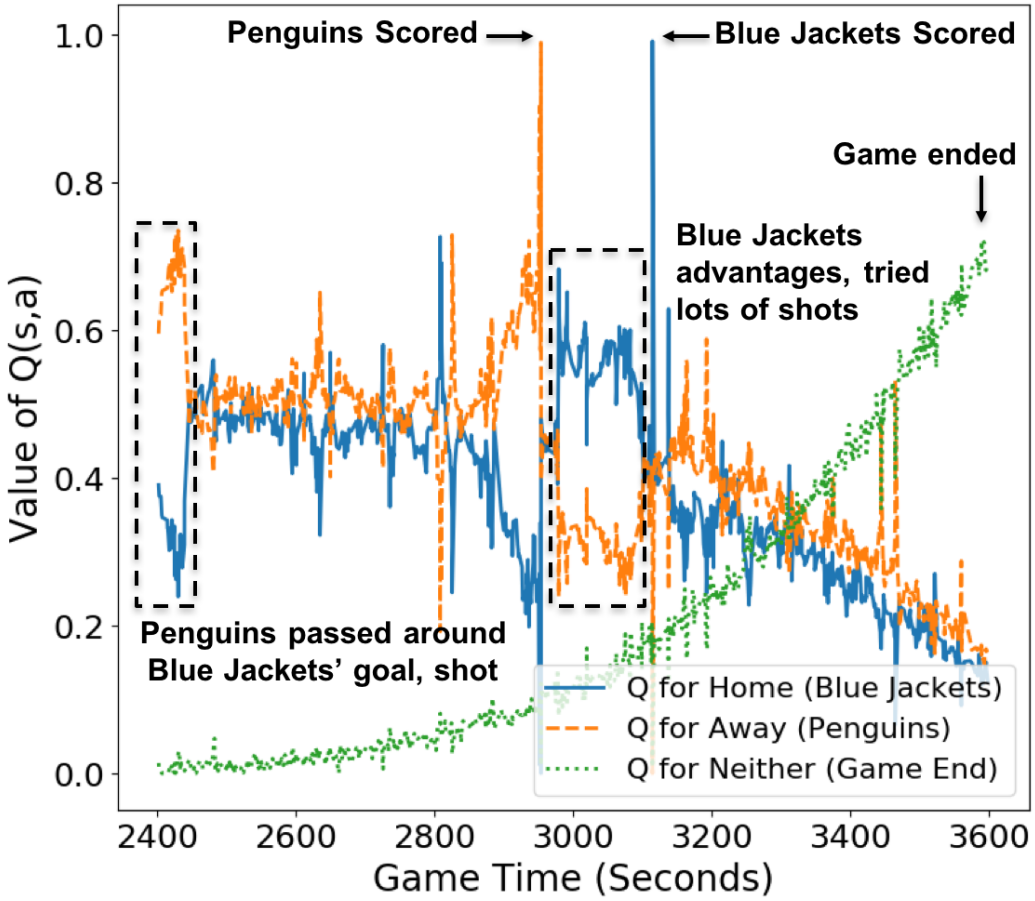
- Sports represents many issues in complex *multi-agent* scenarios
  - competition
  - cooperation
  - contribution of individual to group outcomes



Q = 0.2

- Fundamental Question: What contributes to winning?
- Can be answered by learning a value function
  $Q(s,a)$ = expected reward given match state s and action a
- Reward = win/goal
- RL is used to *evaluate the behaviour of real human agents*

Value Ticker and Action Impact



- Value Q function represented by LSTM
- Learned on NHL dataset from SportlogiQ
- 2015-2016, > 3M events
- Q = chance of scoring the next goal
- Blue Jackets vs. Penguins Nov 17, 2015

Schulte, O.; Zhao, Z.; Javan, M. & Desaulniers, P. (2017), Apples-to-Apples: Clustering and Ranking NHL Players Using Location Information and Scoring Impact, *in 'Proceedings MIT Sloan Sports Analytics Conference'*.

Application: Player Ranking

- Action Goal Impact = Change in Goal Scoring Chance
- Player Goal Impact Metric:= add up goal impact of player's actions

Name	GIM	Goals	Points	Team	Salary
Taylor Hall	96.40	26	65	EDM	$6M
Joe Pavelski	94.56	38	78	SJS	$6M
Johnny Gaudreau	94.51	30	78	CGY	**$9.25K**
Anze Kopitar	94.10	25	74	LAK	$7.7M
Erik Karlsson	92.41	25	74	OTT	$7M

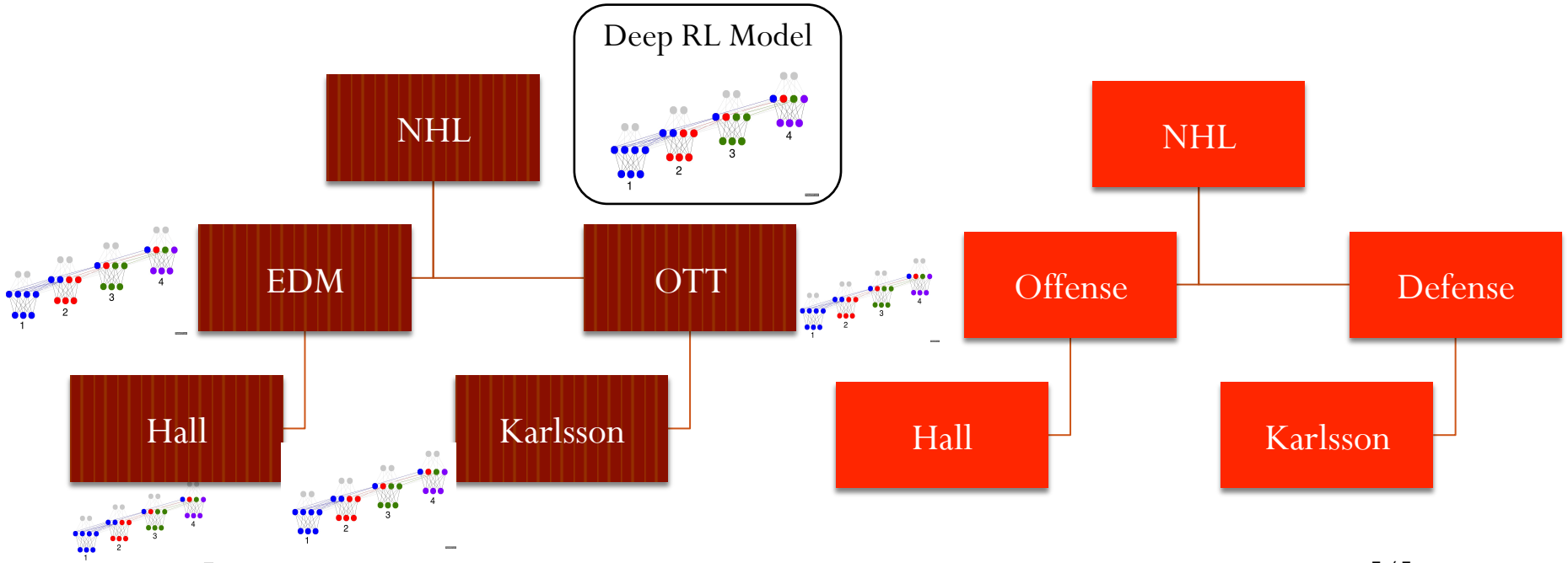
Correlation Goal Impact Metric with other performance measures

Points	Salary Season +1	Salary Season +2
0.93	0.66	0.76

Routley, K. & Schulte, O. (2015), A Markov Game Model for Valuing Player Actions in Ice Hockey, *in 'Uncertainty in Artificial Intelligence (UAI)', pp. 782--791.*

Multi-Level/Precision Sports Analytics

- Identify what is common and what is special for leagues, teams, players
- Shrinkage/multi-level model for recurrent NNs representing value functions



Gelman, A. & Hill, J. (2007), *Data analysis using regression and multilevel/hierarchical models, Cambridge University Press.*

Multi-Level/Precision Reproductive Dynamics

Hormone Levels	1.05, 480, 2.3, 4.5	2.05, 360, 2.2, 4.7	...	0.98, 350, 2.7, 5.1
Ovulation?	no	no		yes
Day	1	2	…	120

- Goal: predict reproductive events (e.g. ovulation, pregnancy, miscarriage).
- Interdisciplinary SFU team (health science, engineering, biology, CS).
- Datasets: time series of 4 hormone levels (e.g. estrogen).