INTERPRETABLE PREDICTION OF GOALS IN SOCCER

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HTTPS://DTAI.CS.KULEUVEN.BE/SPORTS/

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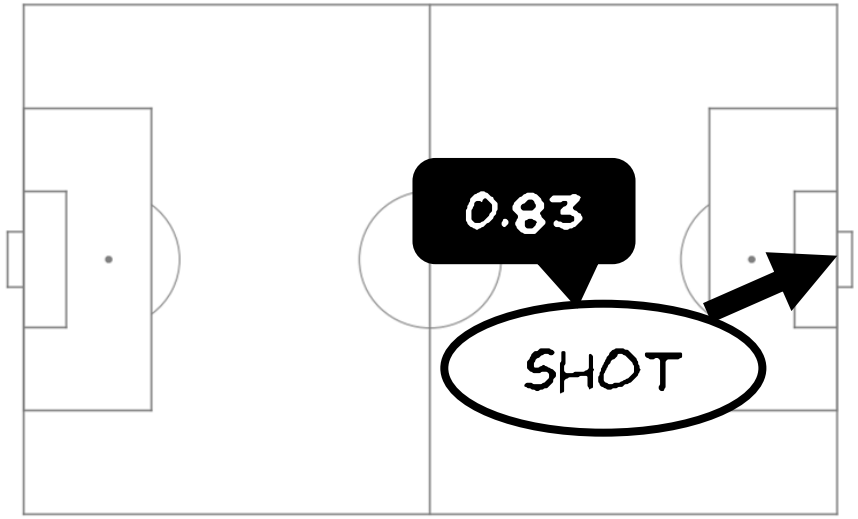
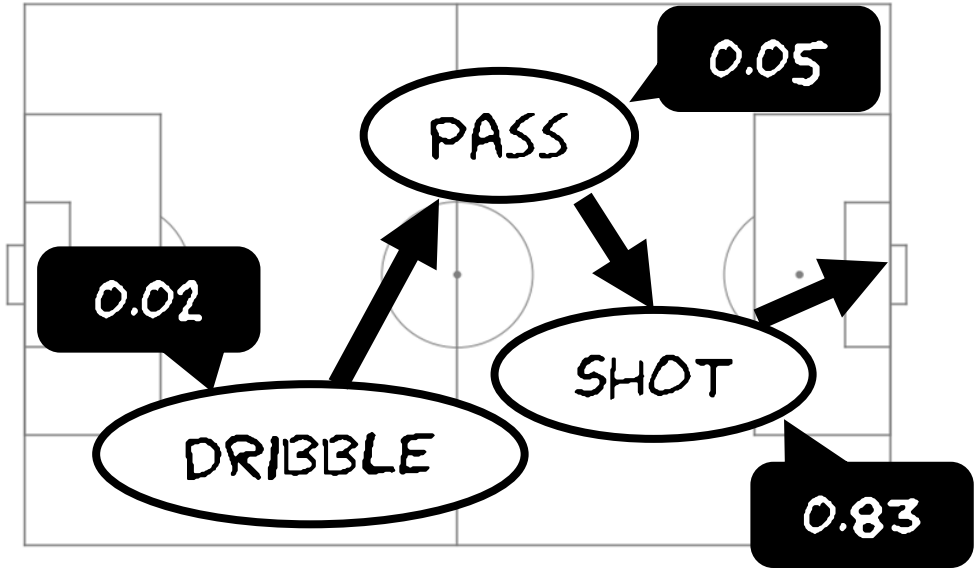
Declarative Languages & Artificial Intelligence

KEY SOCCER ANALYTICS TASK: VALUING ACTIONS

MOST EXISTING SOCCER STATISTICS VALUE ONLY ONE TYPE OF ACTION



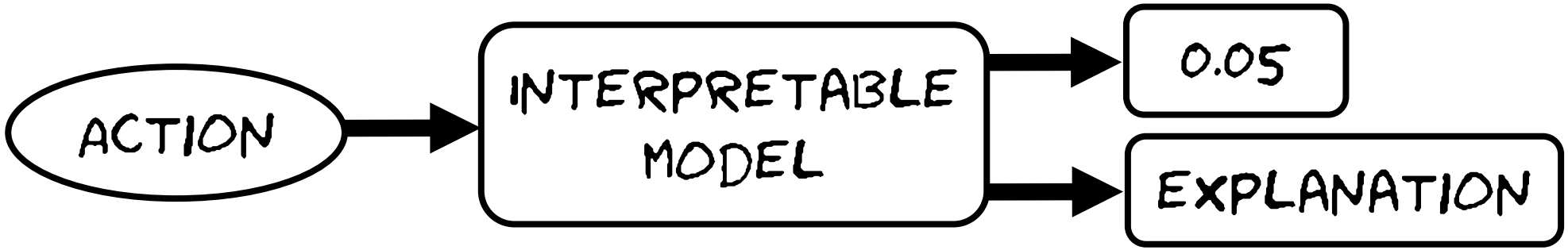


OUR VAEP FRAMEWORK VALUES ALL ON-THE-BALL ACTIONS

KEY SOCCER ANALYTICS TASK: VALUING ACTIONS

VAEP CURRENTLY USES BLACK BOX PREDICTIVE MODELS

THIS TALK: USING INTERPRETABLE PREDICTIVE MODELS



OUTLINE

1. VALUING ACTIONS WITH SPADL AND VAEP

2. ESTIMATING GOAL-SCORING PROBABILITIES

3. EXPERIMENT

(EXTRA: EVALUATION IN SOCCER ANALYTICS)

OUTLINE

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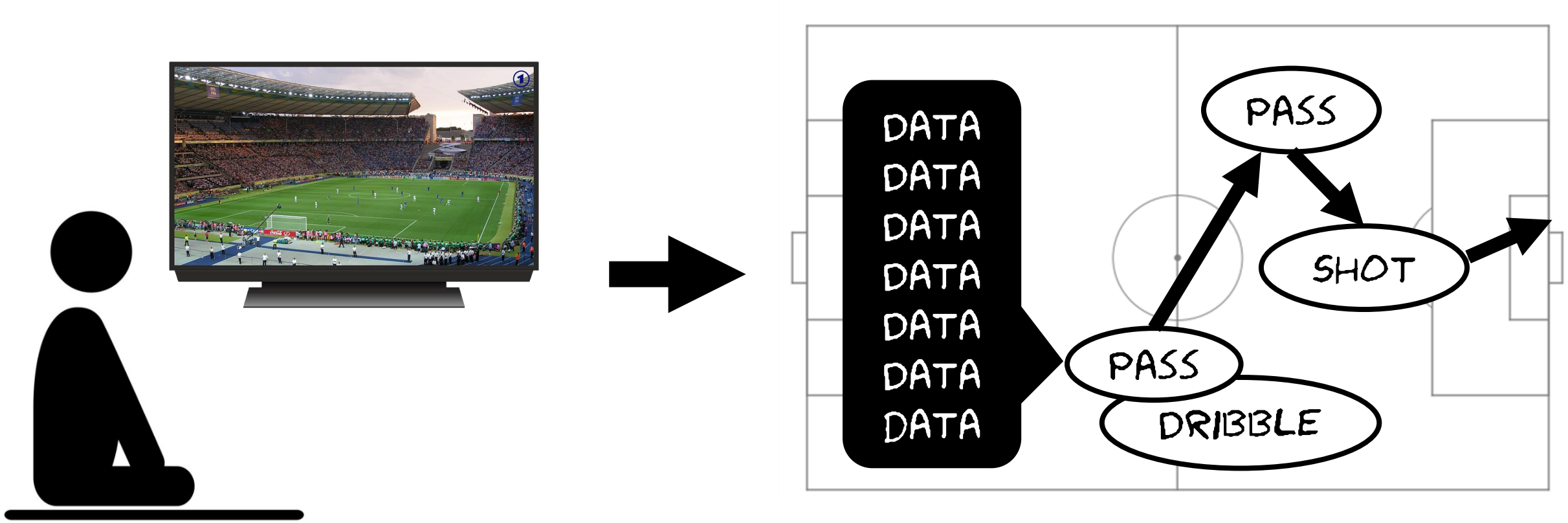
(EXTRA: EVALUATION IN SOCCER ANALYTICS)

PROFESSIONAL ANNOTATORS PRODUCE EVENT STREAM DATA OF SOCCER GAMES



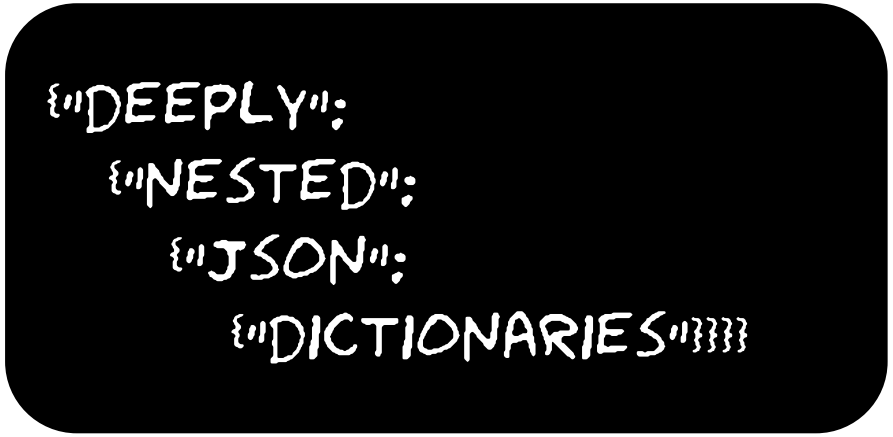
CHALLENGE:

EVENT STREAM DATA IS HARD TO ANALYZE

- VENDOR-SPECIFIC TERMINOLOGY

- USELESS EVENTS

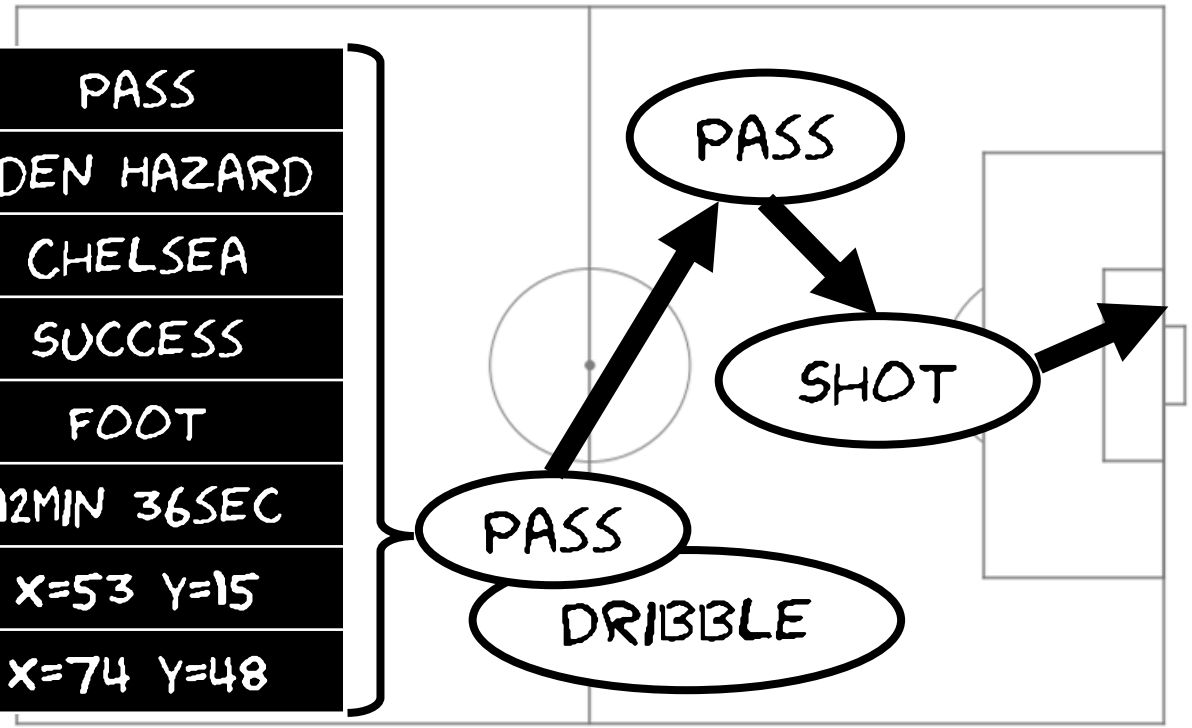
- DYNAMIC INFORMATION SNIPPETS



SPADL IS AN EVENT STREAM DATA FORMAT DESIGNED TO FACILITATE DATA ANALYSIS

- UNIFIES EVENT DATA FROM VARIOUS VENDORS
- ON-THE-BALL ACTIONS
- FIXED ATTRIBUTES

TYPE:	PASS
PLAYER:	EDEN HAZARD
TEAM:	CHELSEA
RESULT:	SUCCESS
BODYPART:	FOOT
TIME:	12MIN 36SEC
START:	X=53 Y=15
END:	X=74 Y=48



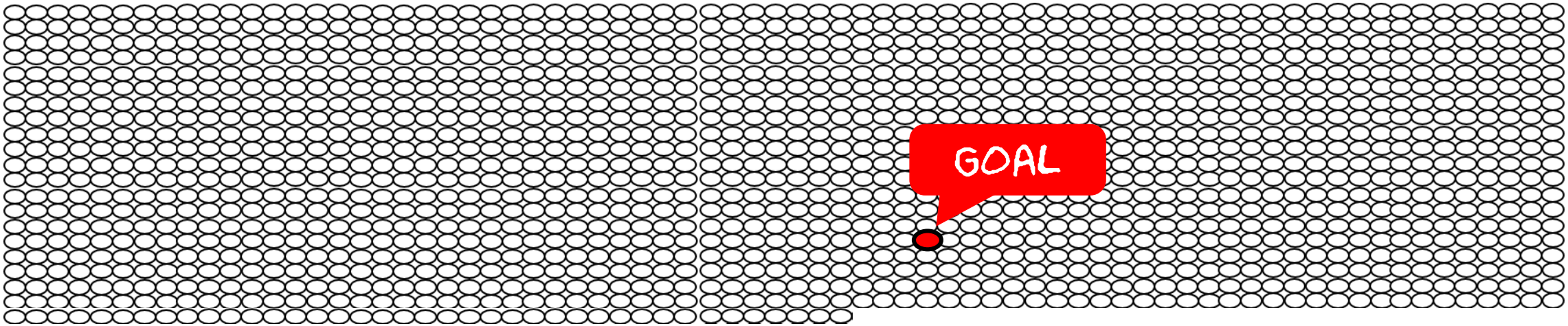
wyscout
STATSBOMB
opta

CONVERTERS AVAILABLE AT:
HTTPS://GITHUB.COM/ML-KULEUVEN/SOCCERACTION/

CHALLENGE: VALUING ACTIONS THAT DO NOT DIRECTLY AFFECT THE SCORE

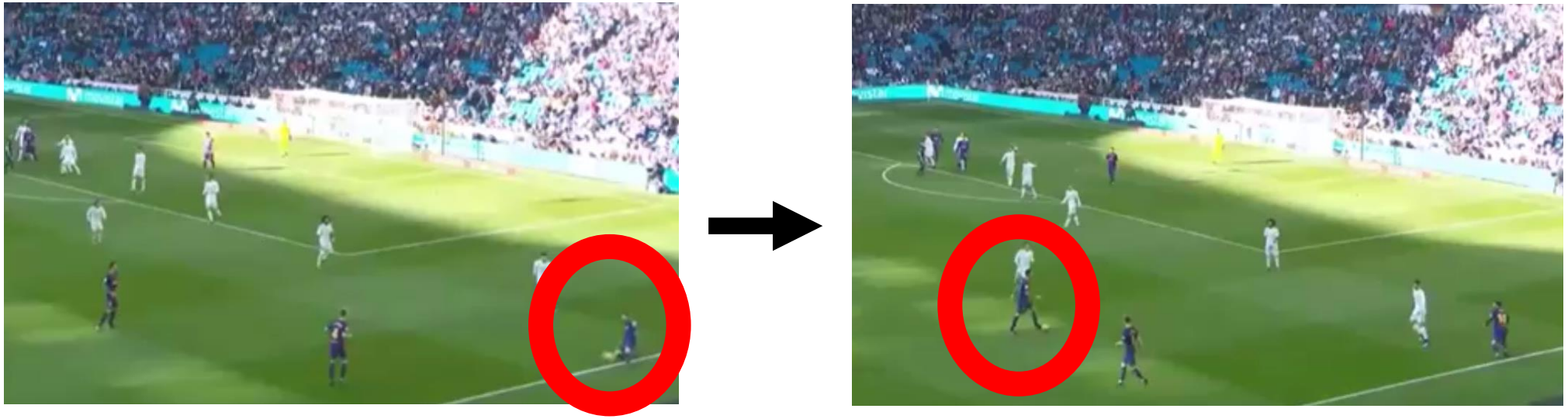
+- 1600 ACTIONS IN A GAME

MOST COMMON FINAL SCORE: 1 - 0



EXAMPLE NON-SCORING ACTION:
PASS FROM MESSI TO BUSQUETS

ACTION a_i MOVES THE GAME FROM STATE S_{i-1} TO STATE S_i



$$V(a_i) = V(S_i) - V(S_{i-1})$$

VALUING ACTIONS BY ESTIMATING PROBABILITIES

A GAME STATE S IS GOOD FOR TEAM T IF IT HAS

(1) A HIGH SHORT-TERM PROBABILITY OF TEAM T SCORING

(2) A LOW SHORT-TERM PROBABILITY OF TEAM T CONCEDING

$$V(S) = P_{scores}(S, T) - P_{concedes}(S, T)$$

$$V(a_i) = V(S_i) - V(S_{i-1})$$

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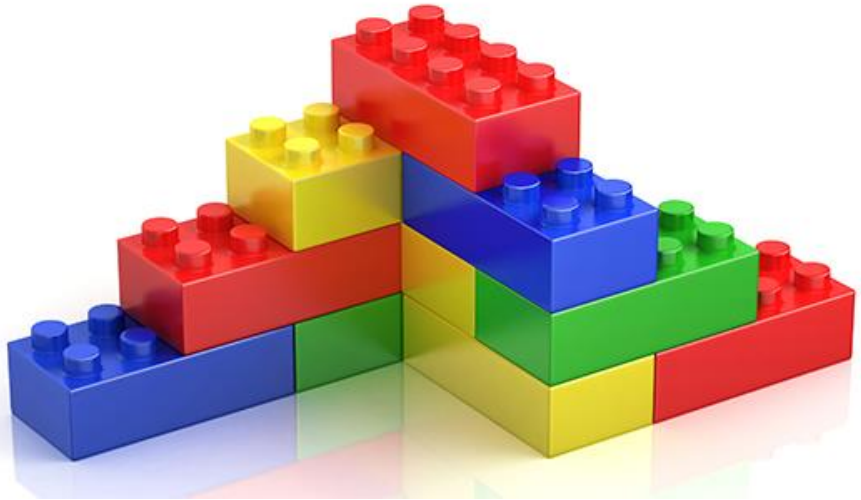
TASK: ESTIMATE THE PROBABILITY OF TEAM T SCORING AFTER GAME STATE S



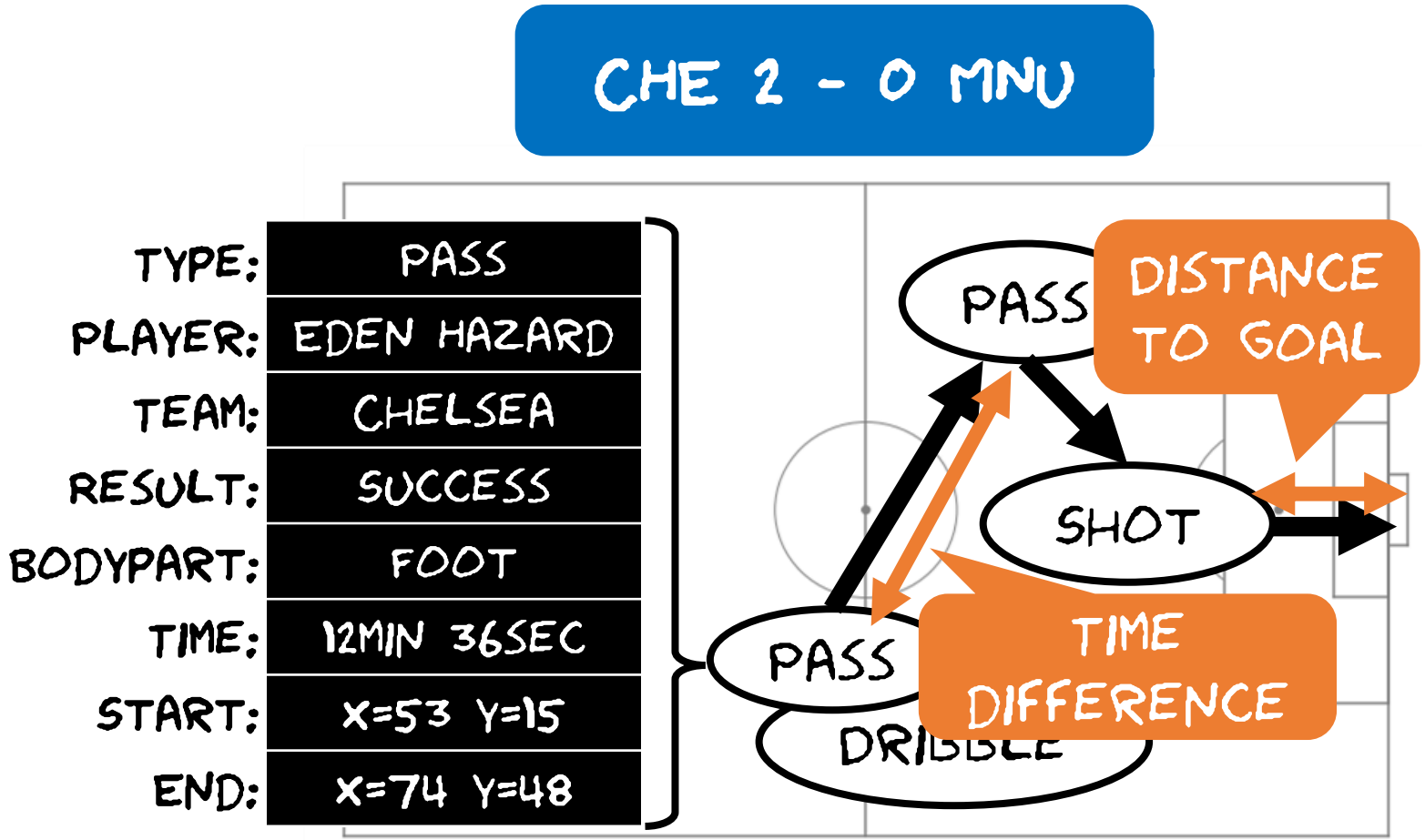
1. FEATURES
2. LABELS
3. PROBABILISTIC CLASSIFIER

FEATURES THAT DESCRIBE GAME STATE S

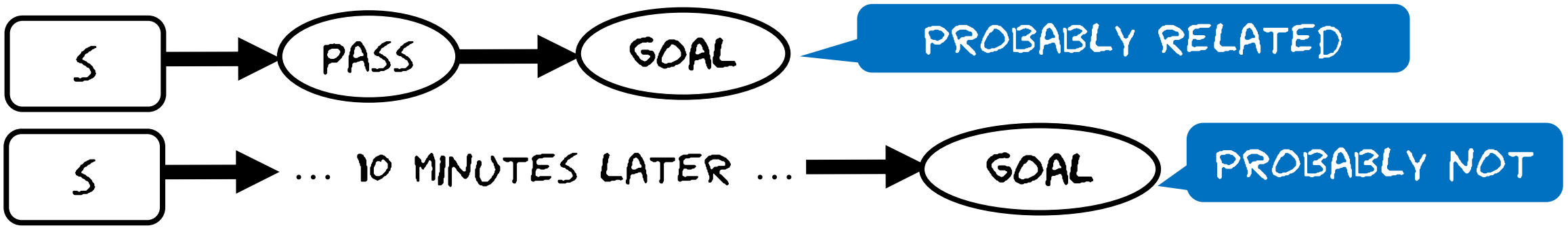
A) SIMPLE FEATURES
- ACTION TYPE
- RESULT
- ...

B) COMPLEX FEATURES
- DISTANCE TO GOAL
- TIME BETWEEN ACTIONS
- ...

C) CONTEXT FEATURES
- GOAL DIFFERENCE
(E.G., +2, -1)



LABELS THAT CAPTURE THE LIMITED TEMPORAL INFLUENCE OF GAME STATE S



$$Scores(S,T) = \begin{cases} 1 \text{ IF TEAM T SCORES IN THE NEXT 10 ACTIONS} \\ 0 \text{ OTHERWISE} \end{cases}$$

A SIMPLIFIED SUMMARY OF PROBABILISTIC CLASSIFIERS

	INTERPRETABLE	NON-LINEAR RELATIONSHIPS
LOGISTIC REGRESSION	✓	✗
XGBOOST	✗	✓

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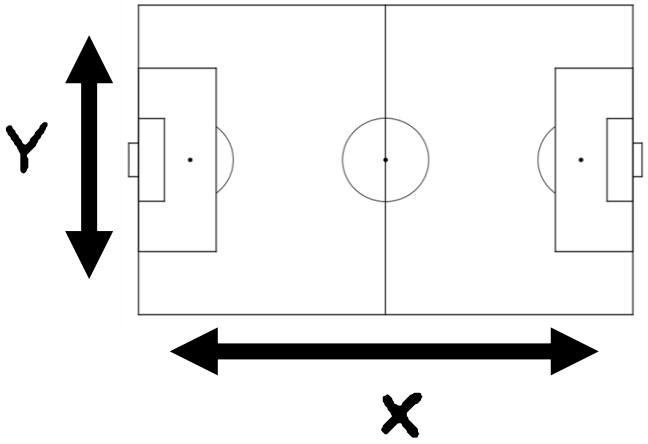
	INTERPRETABLE	NON-LINEAR RELATIONSHIPS
LOGISTIC REGRESSION	✓	✗
XGBOOST	✗	✓
GENERALIZED ADDITIVE MODELS	✓	✓

GENERALIZED ADDITIVE MODELS ARE A GENERALIZATION OF LOGISTIC REGRESSION

TASK: PREDICT GOAL CHANCE USING X,Y-LOCATION



LOGISTIC REGRESSION:

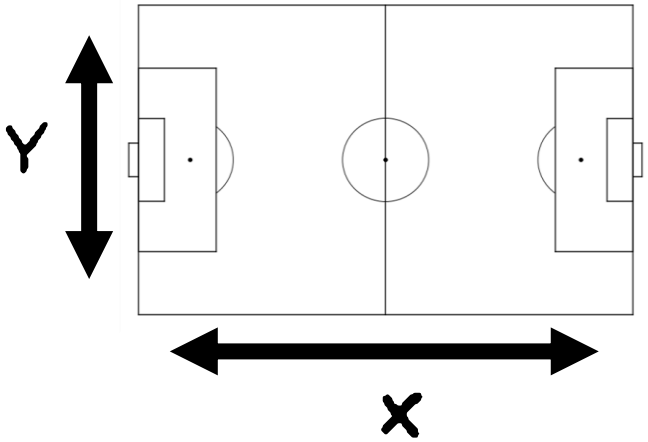
G(E(SCORES)) = 0.04*X + 0*Y + C

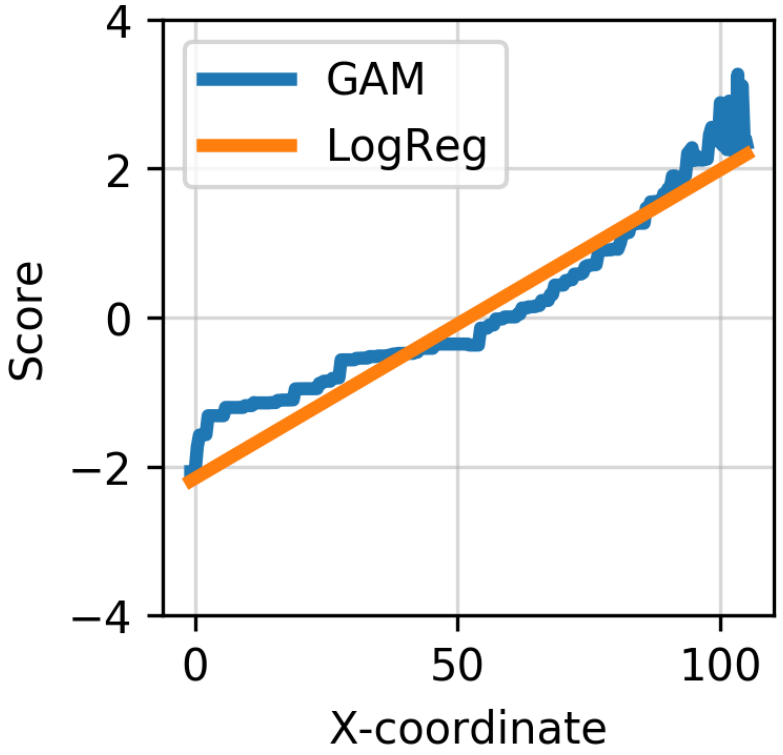
GENERALIZED ADDITIVE MODEL:

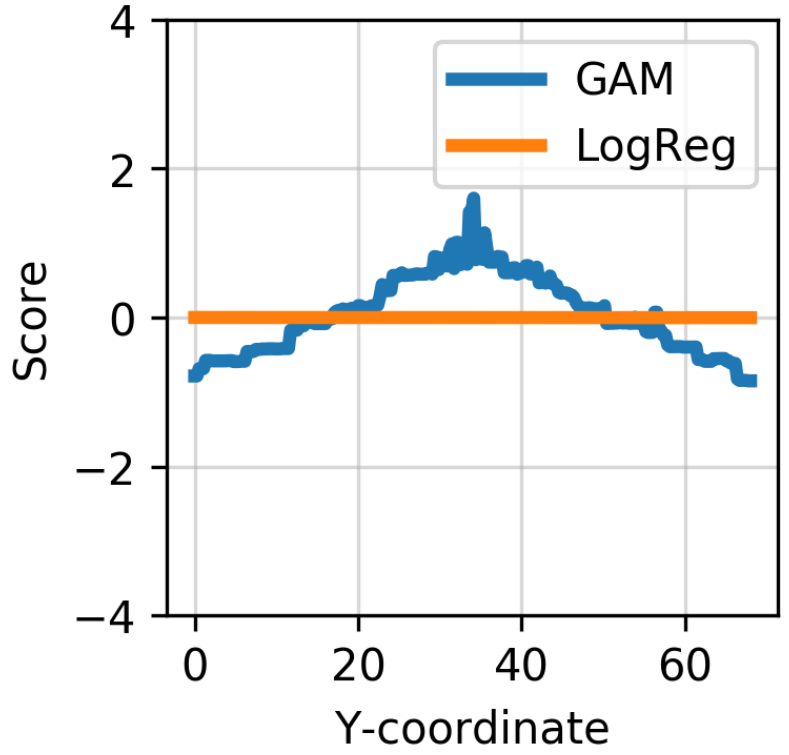
G(E(SCORES)) = F1(X) + F2(Y) + C

GENERALIZED ADDITIVE MODELS ARE A GENERALIZATION OF LOGISTIC REGRESSION

TASK: PREDICT GOAL CHANCE USING X,Y-LOCATION







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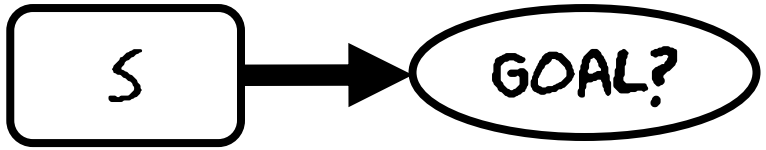
EXPERIMENTAL SETUP (1/2)

TASK: PREDICT CHANCE OF SCORING A GOAL AFTER GAME STATE S



DATA: PREMIER LEAGUE 2017/18 (TRAIN)
PREMIER LEAGUE 2018/19 (TEST)

STATSBOMB

EVALUATION METRIC: NORMALIZED BRIER SCORE

EXPERIMENTAL SETUP (2/2)

CANDIDATE PROBABILISTIC CLASSIFIERS:

1. LOGISTIC REGRESSION
2. GENERALIZED ADDITIVE MODELS
3. XGBOOST

INTERPRETABLE

COMPLEX

CANDIDATE FEATURE SETS:

1. X,Y (LOCATION ONLY)
2. TOP-10 BEST FEATURES
3. 151 FEATURES (ORIGINAL VAEP PAPER)

INTERPRETABLE

COMPLEX

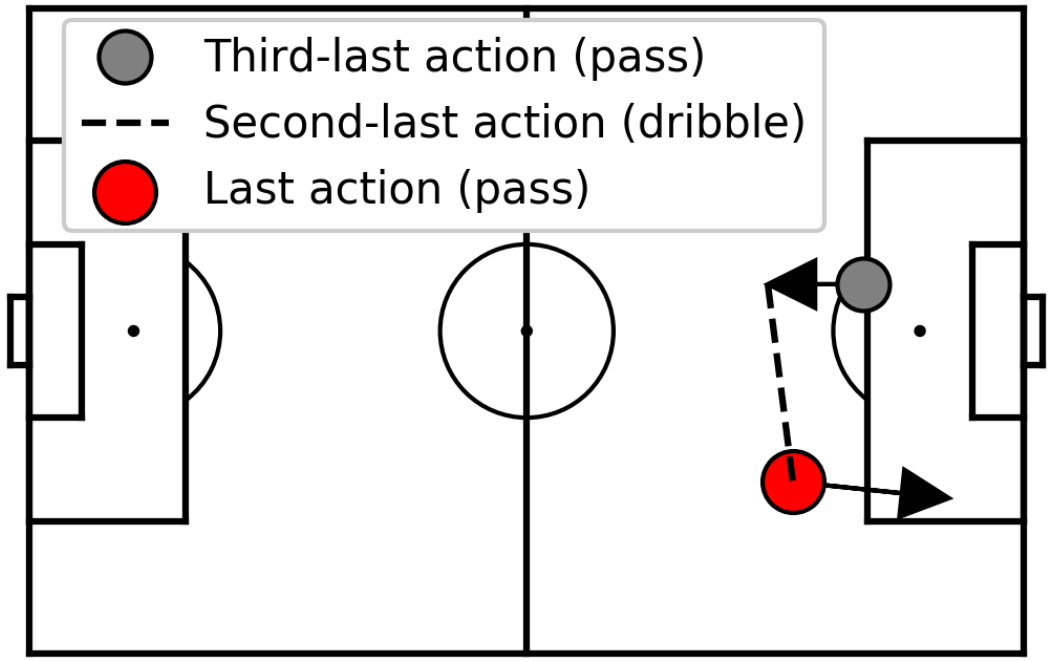
NORMALIZED BRIER SCORE PER <CLASSIFIER, FEATURE SET>-COMBINATION

	X,Y	TOP-10	151 FEATURES
LOGISTIC REGRESSION	0.986	0.912	0.895
GENERALIZED ADDITIVE MODELS	0.964	0.861	0.858
XGBOOST	0.964	0.860	0.856

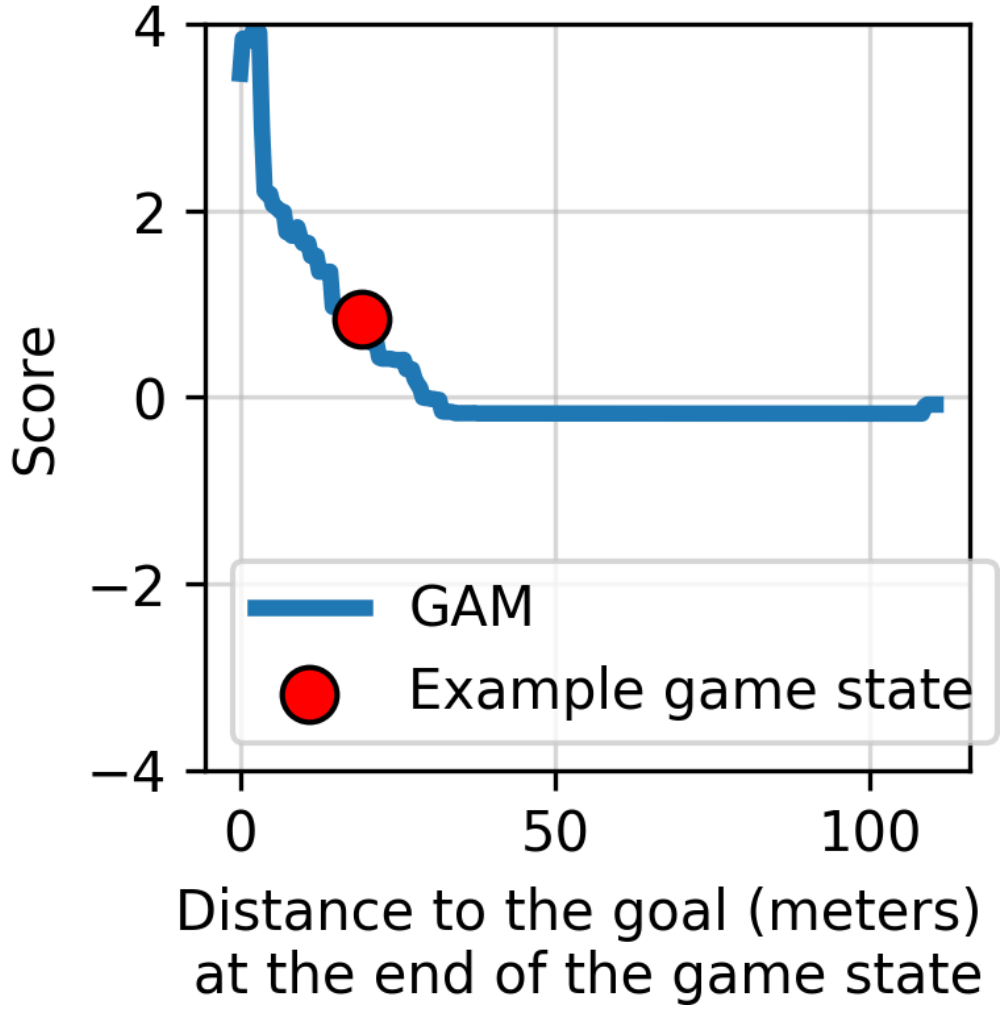
OUR PREDICTIVE MODEL SHOULD BE INTERPRETABLE AND PERFORMANT

	X,Y	TOP-10	151 FEATURES
LOGISTIC REGRESSION	0.986	0.912	0.895
GENERALIZED ADDITIVE MODELS	0.964	0.861	0.858
XGBOOST	0.964	0.860	0.856

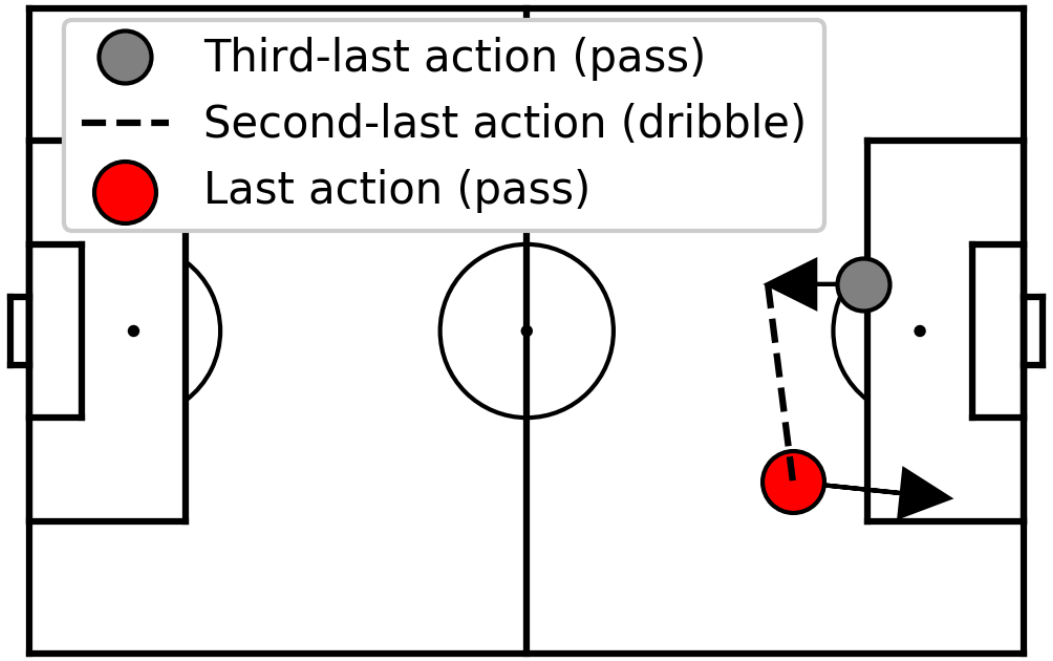
INSPECTING OUR PREDICTIVE MODEL WITH AN EXAMPLE GAME STATE (1/10)



P(SCORES) = 0.049



INSPECTING OUR PREDICTIVE MODEL WITH AN EXAMPLE GAME STATE (2/10)



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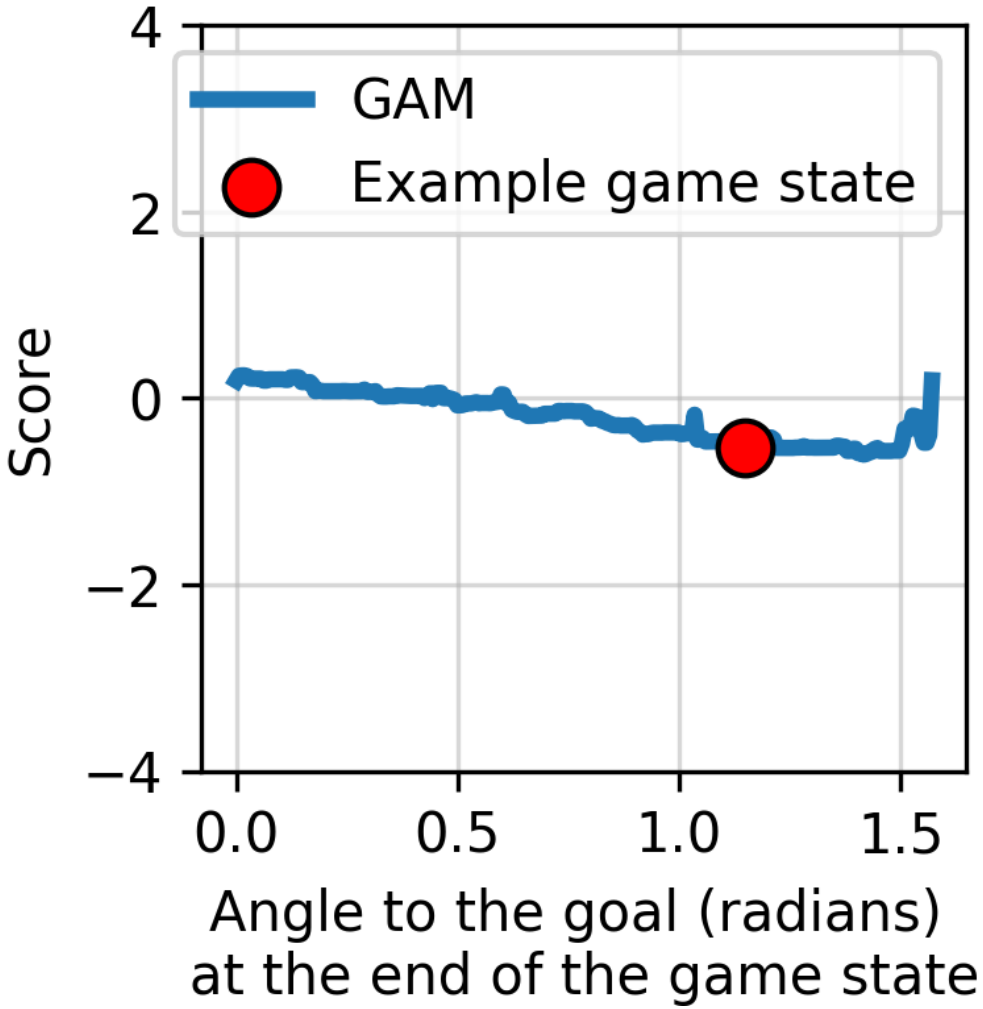
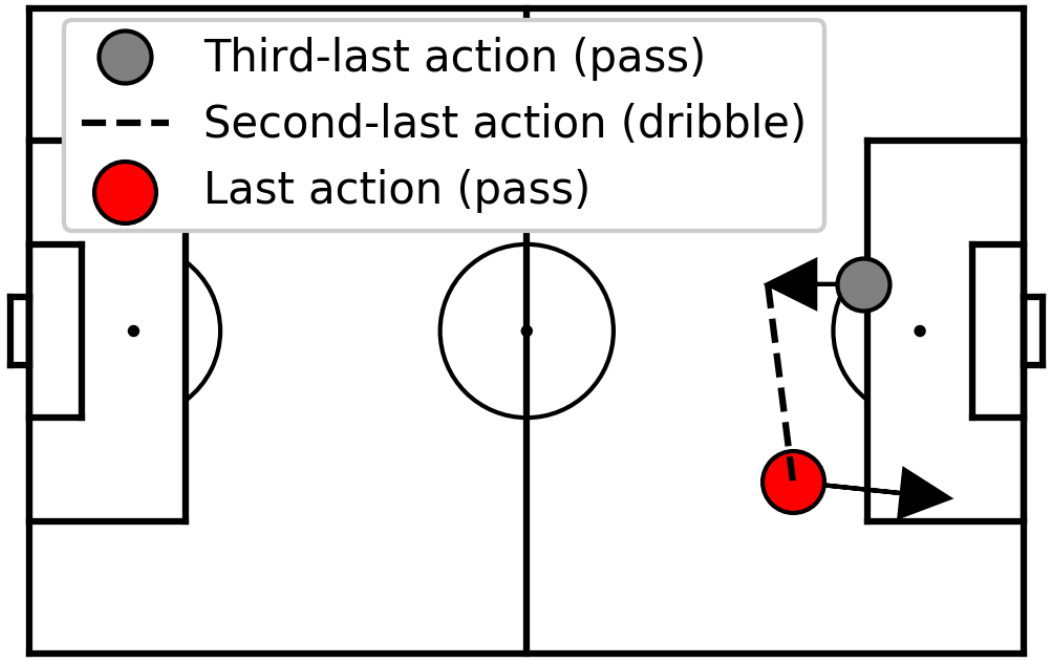
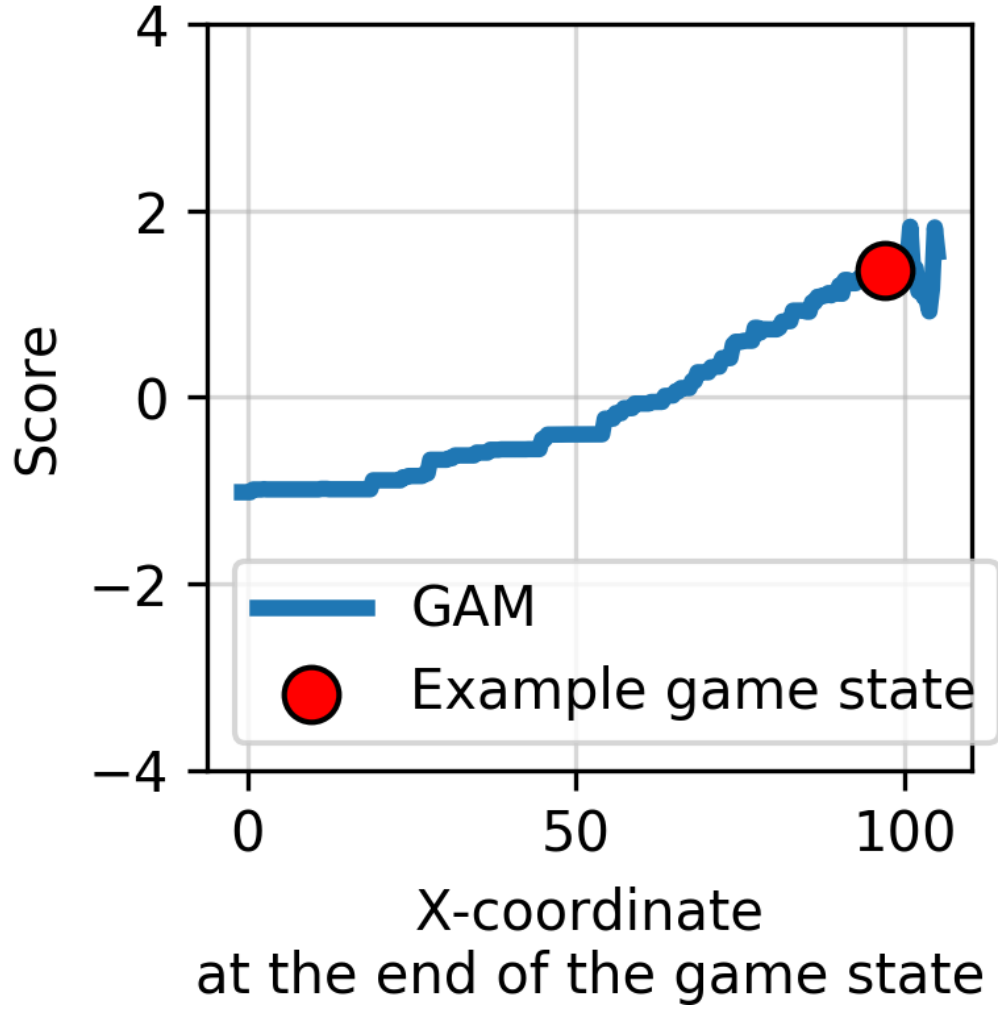


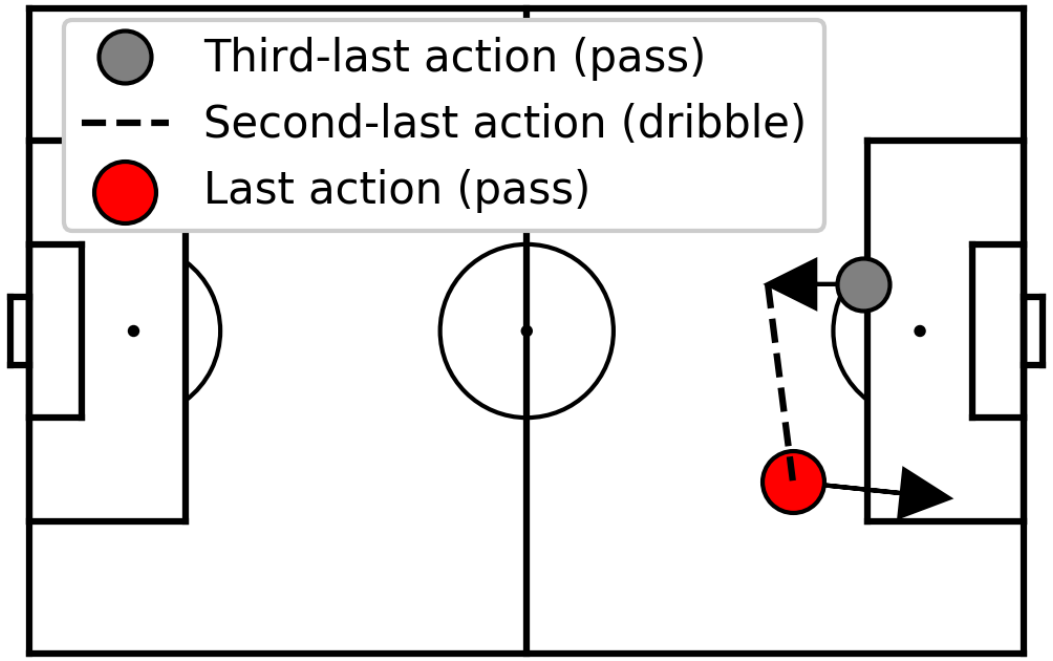
INSPECTING OUR PREDICTIVE MODEL WITH AN EXAMPLE GAME STATE (3/10)



P(SCORES) = 0.049



INSPECTING OUR PREDICTIVE MODEL WITH AN EXAMPLE GAME STATE (4/10)



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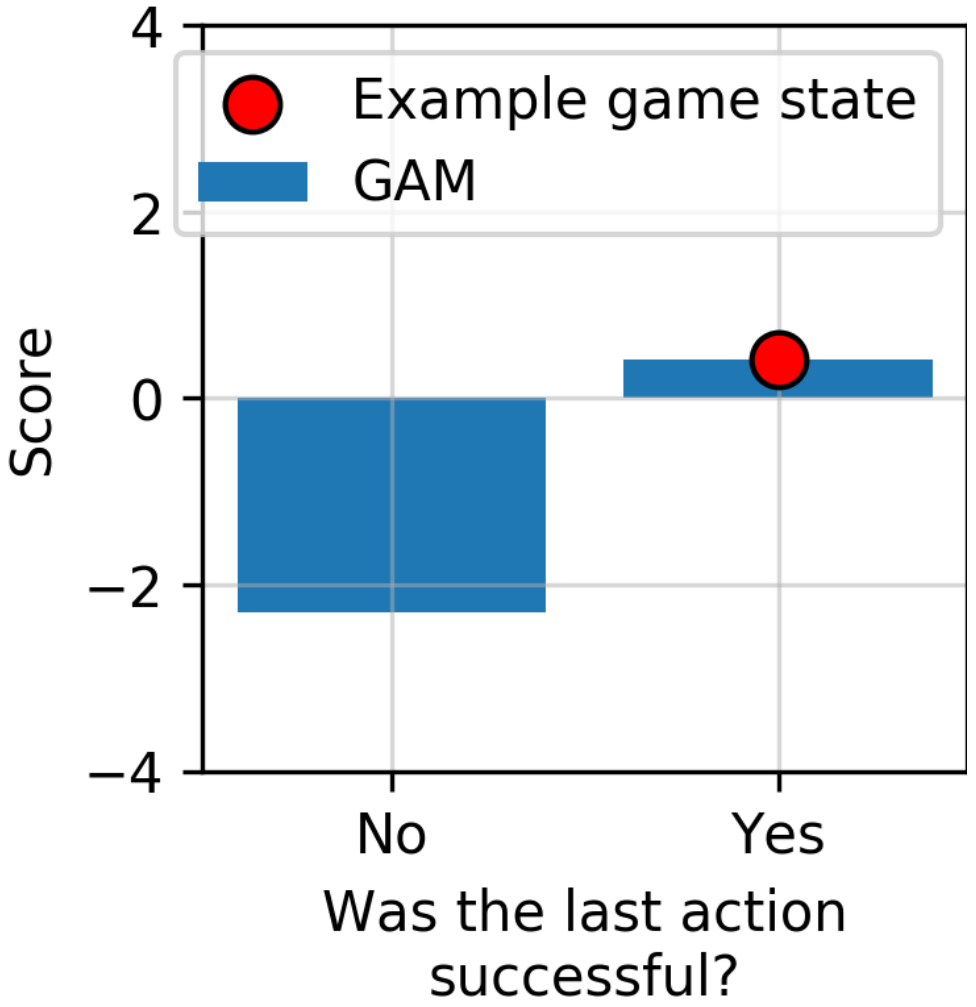
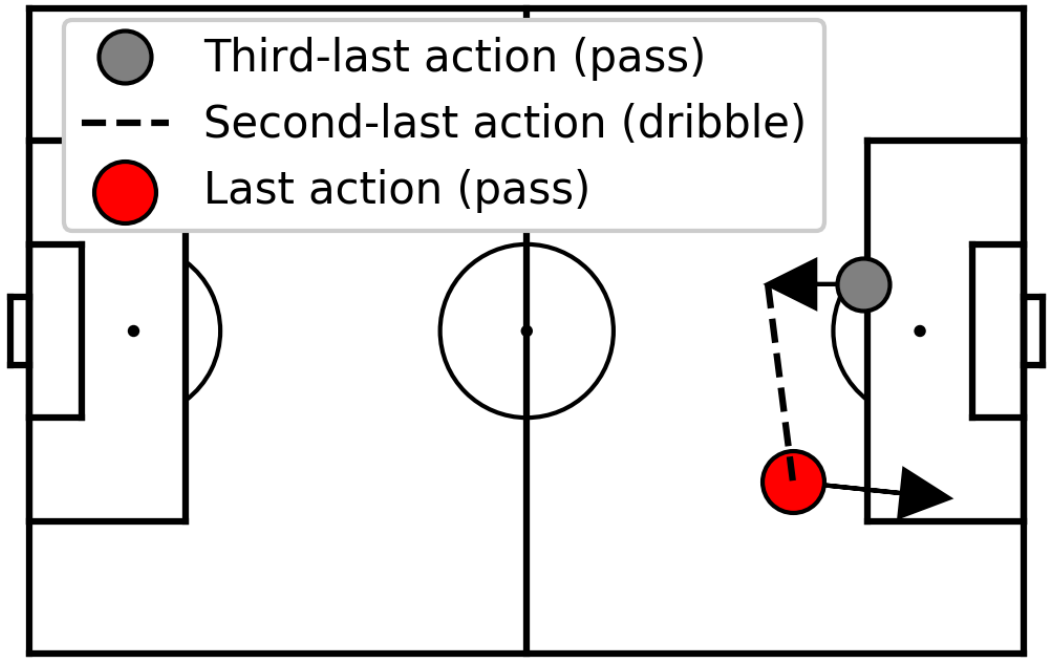


INSPECTING OUR PREDICTIVE MODEL WITH AN EXAMPLE GAME STATE (5/10)



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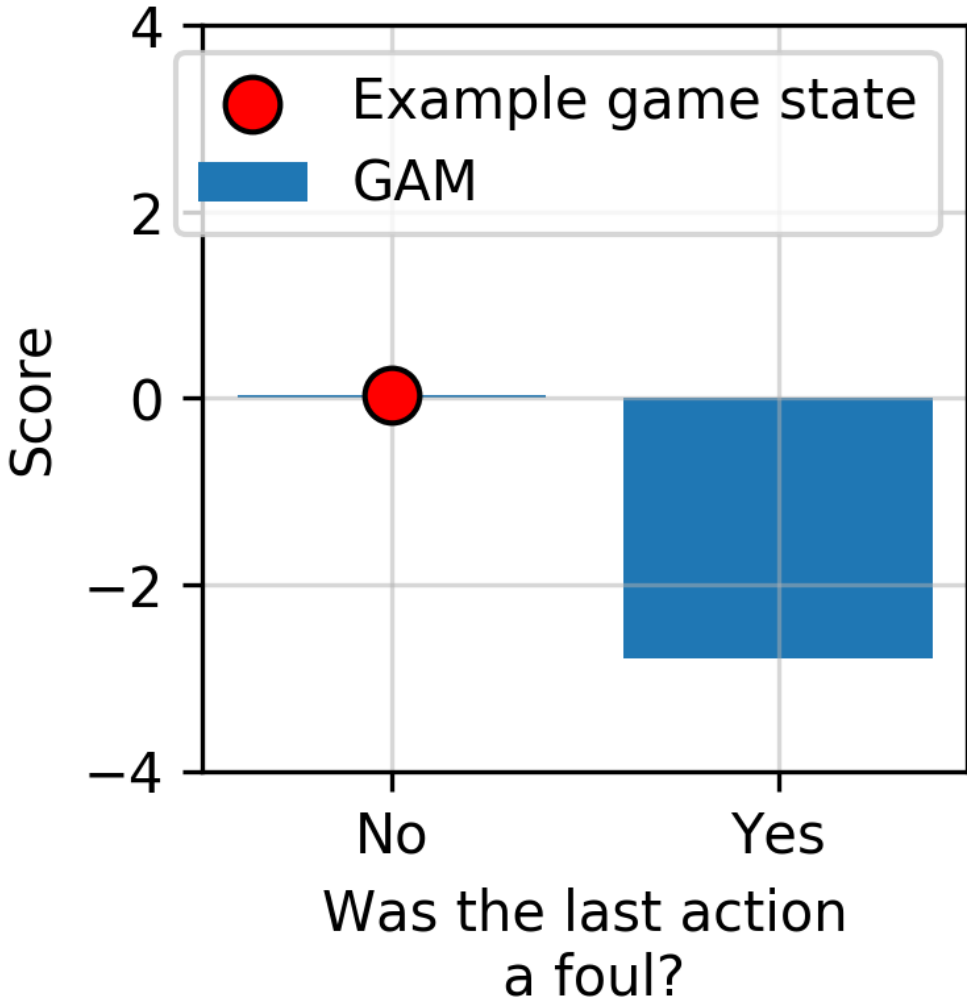
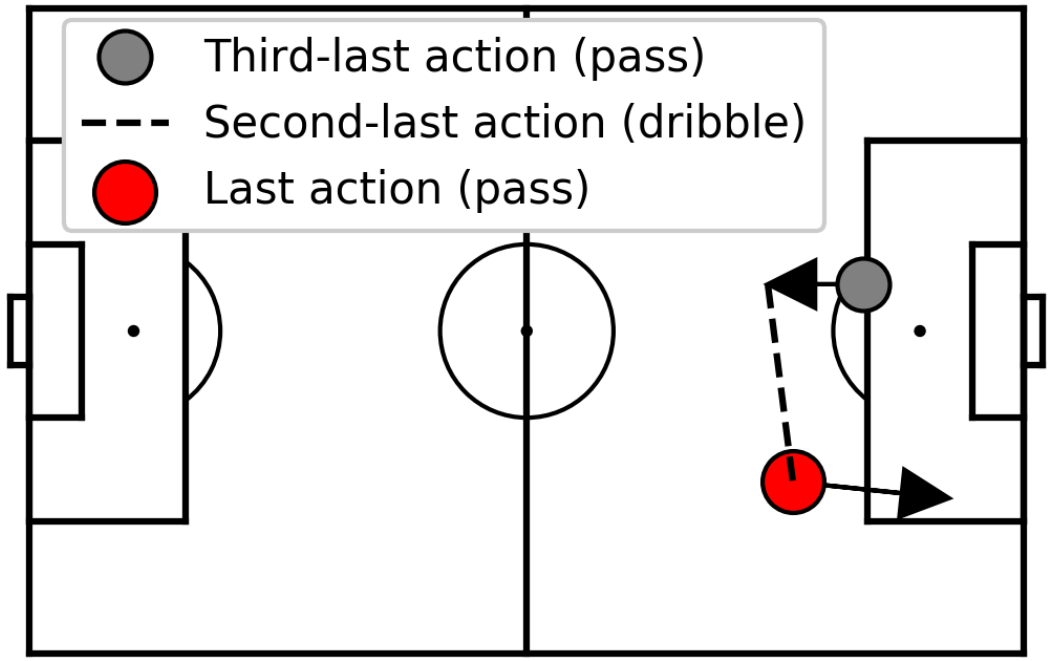


INSPECTING OUR PREDICTIVE MODEL WITH AN EXAMPLE GAME STATE (6/10)



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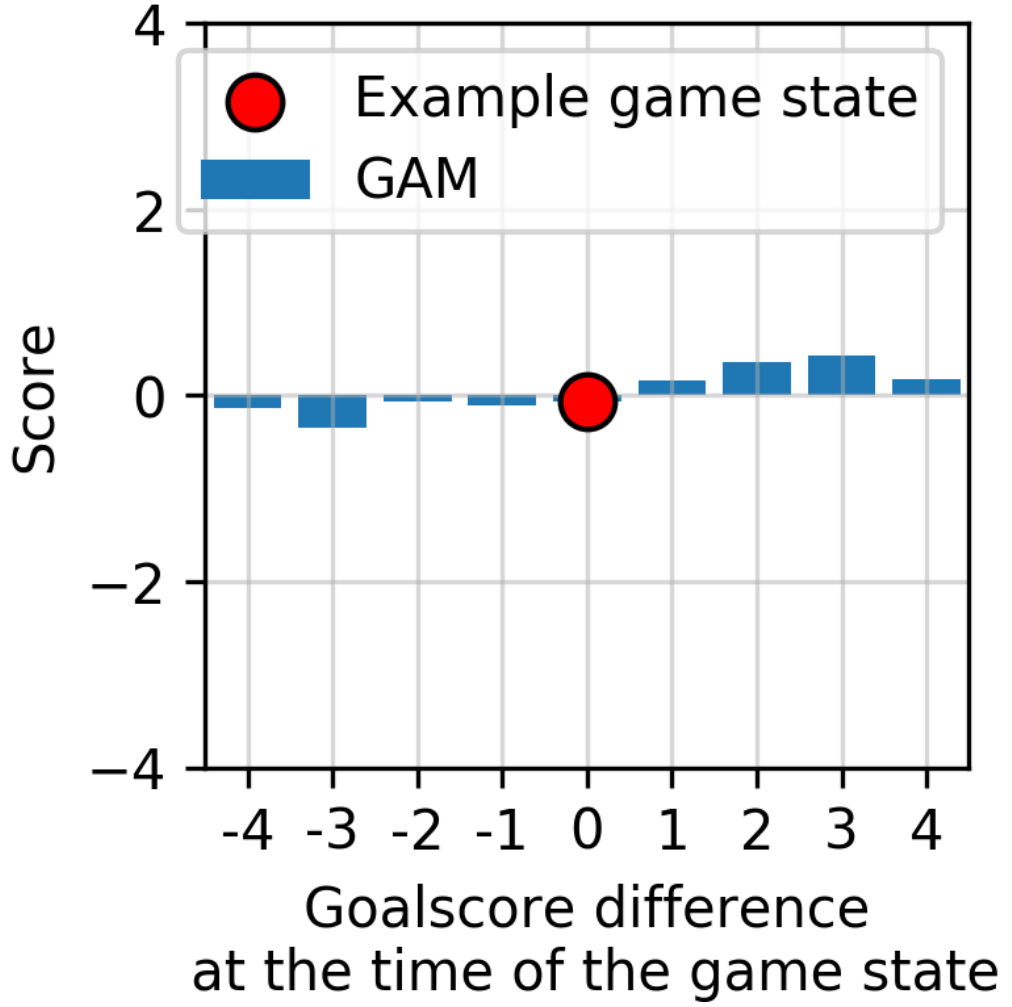
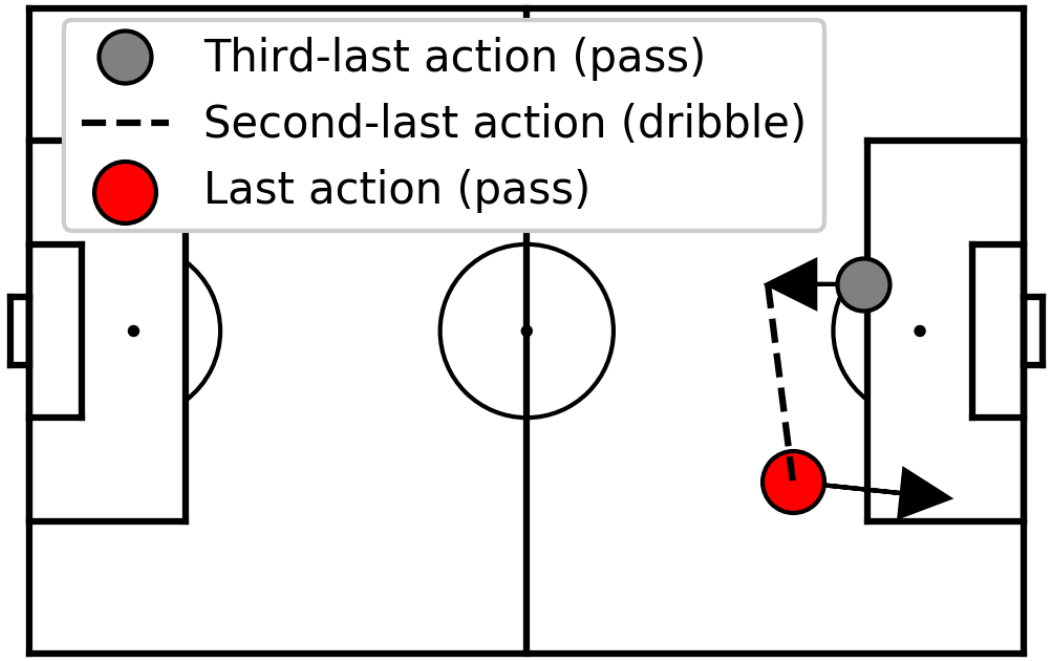


INSPECTING OUR PREDICTIVE MODEL WITH AN EXAMPLE GAME STATE (7/10)



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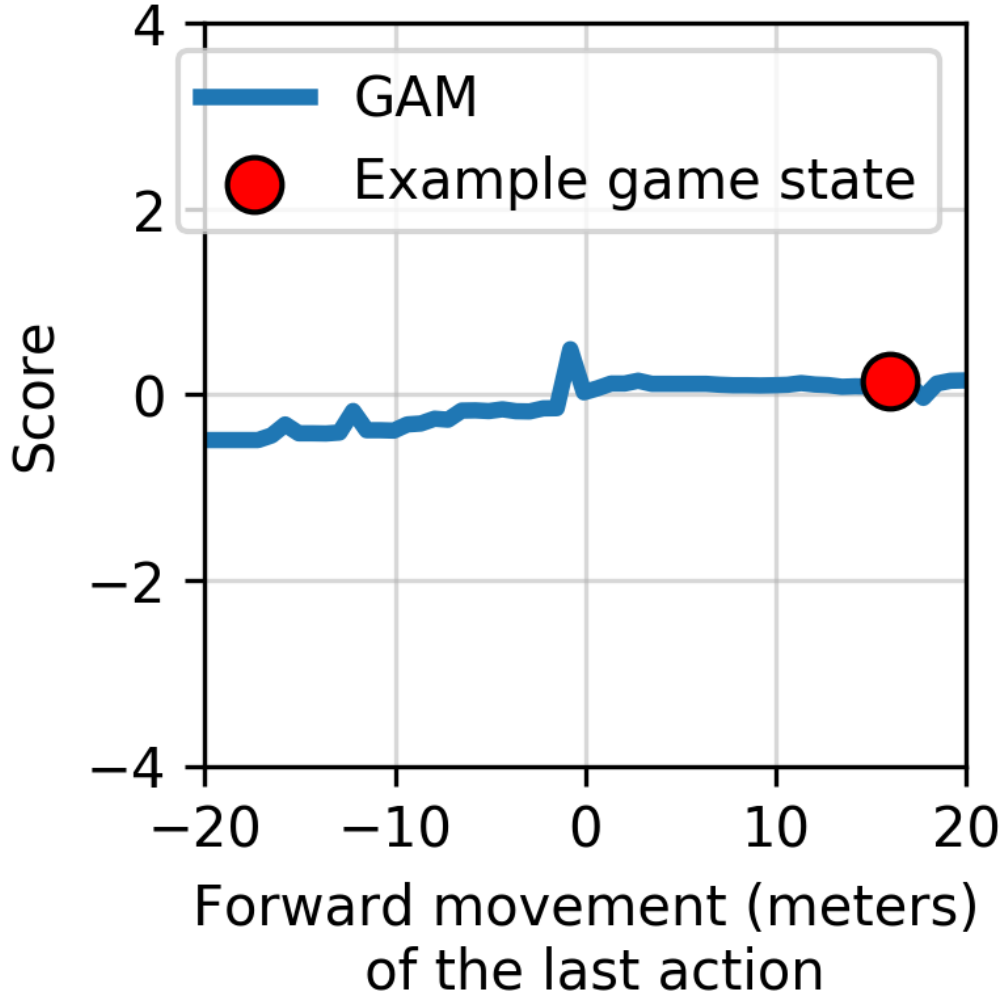

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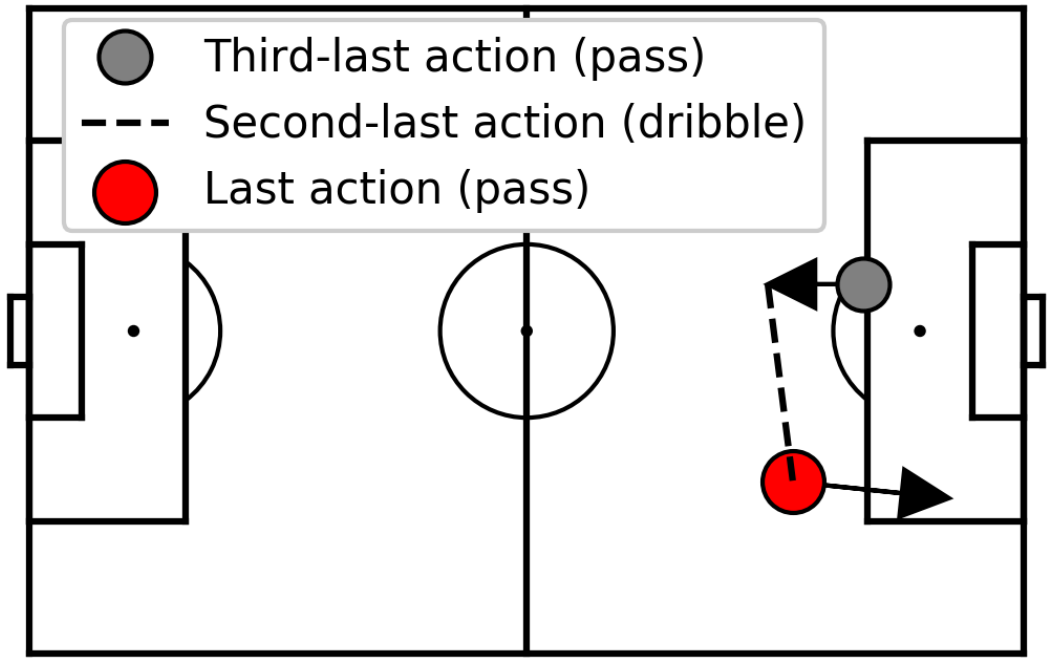

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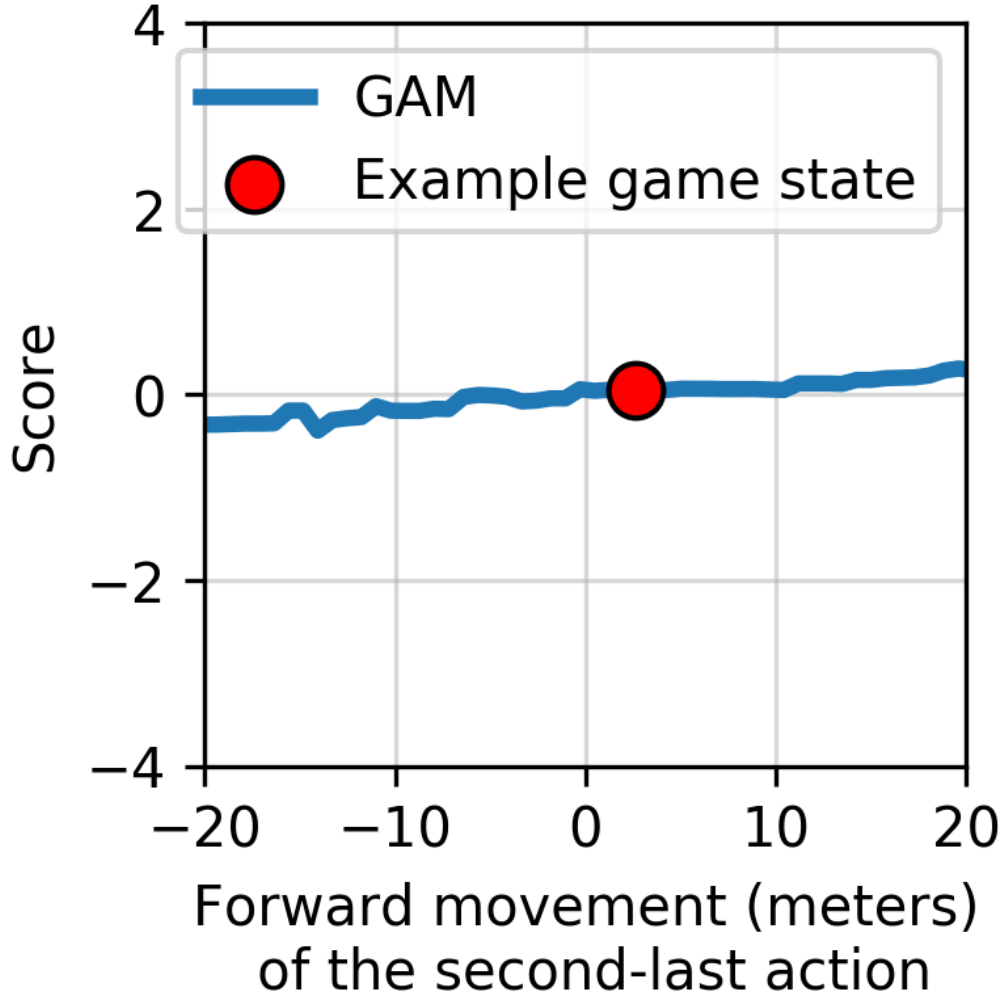
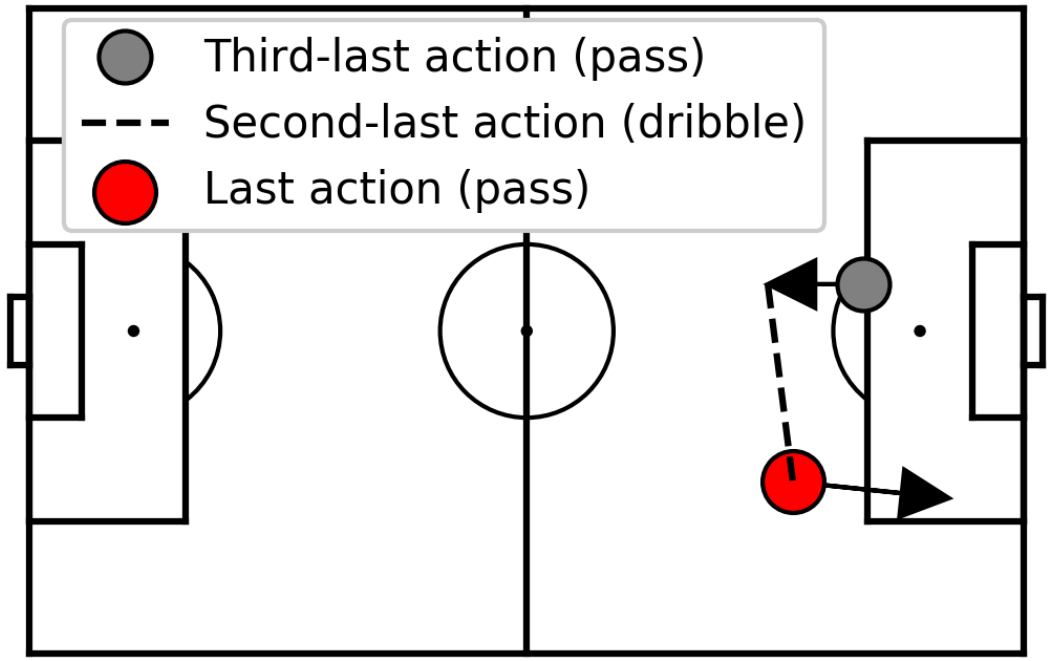


INSPECTING OUR PREDICTIVE MODEL WITH AN EXAMPLE GAME STATE (9/10)



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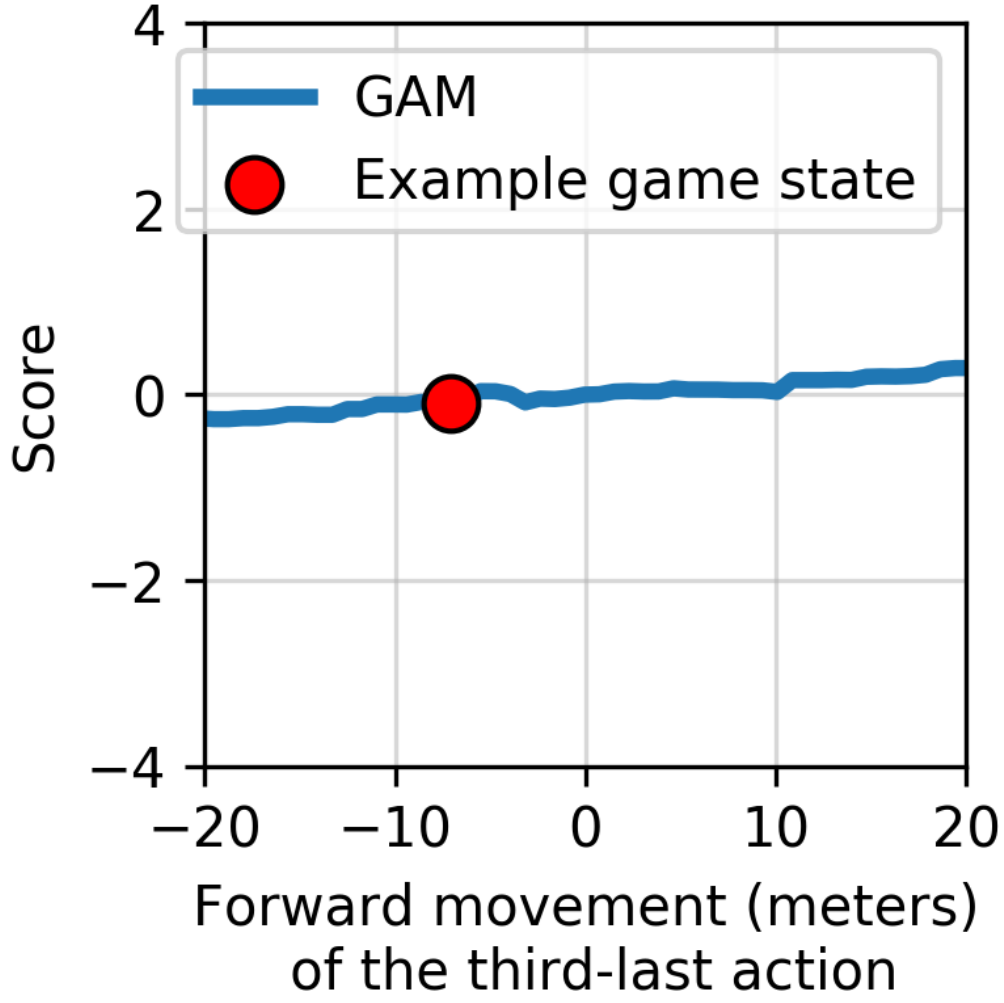
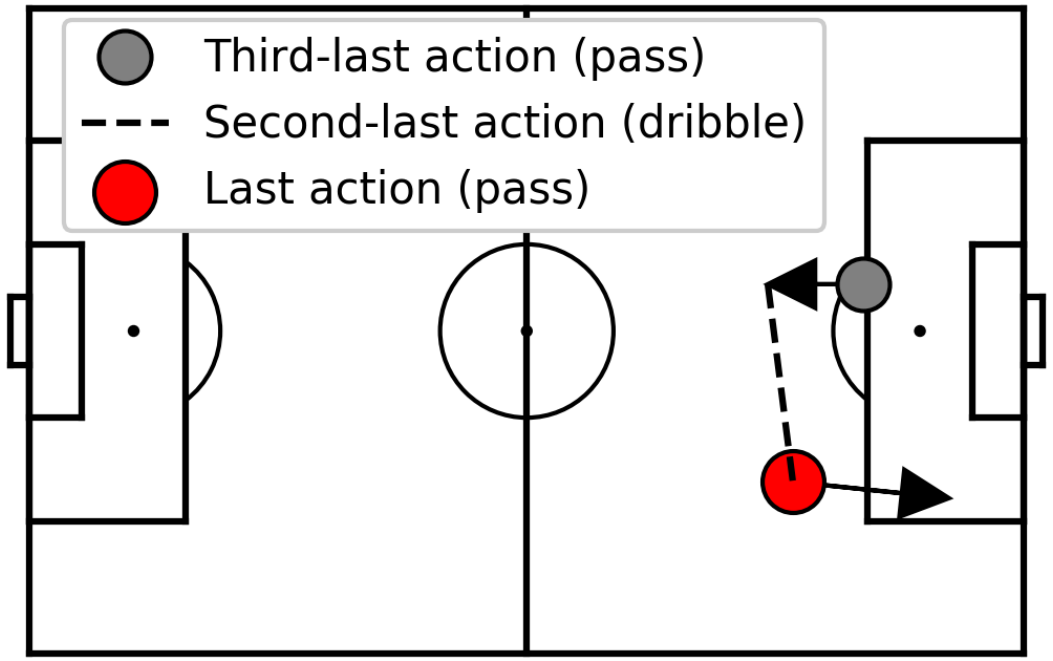


INSPECTING OUR PREDICTIVE MODEL WITH AN EXAMPLE GAME STATE (10/10)



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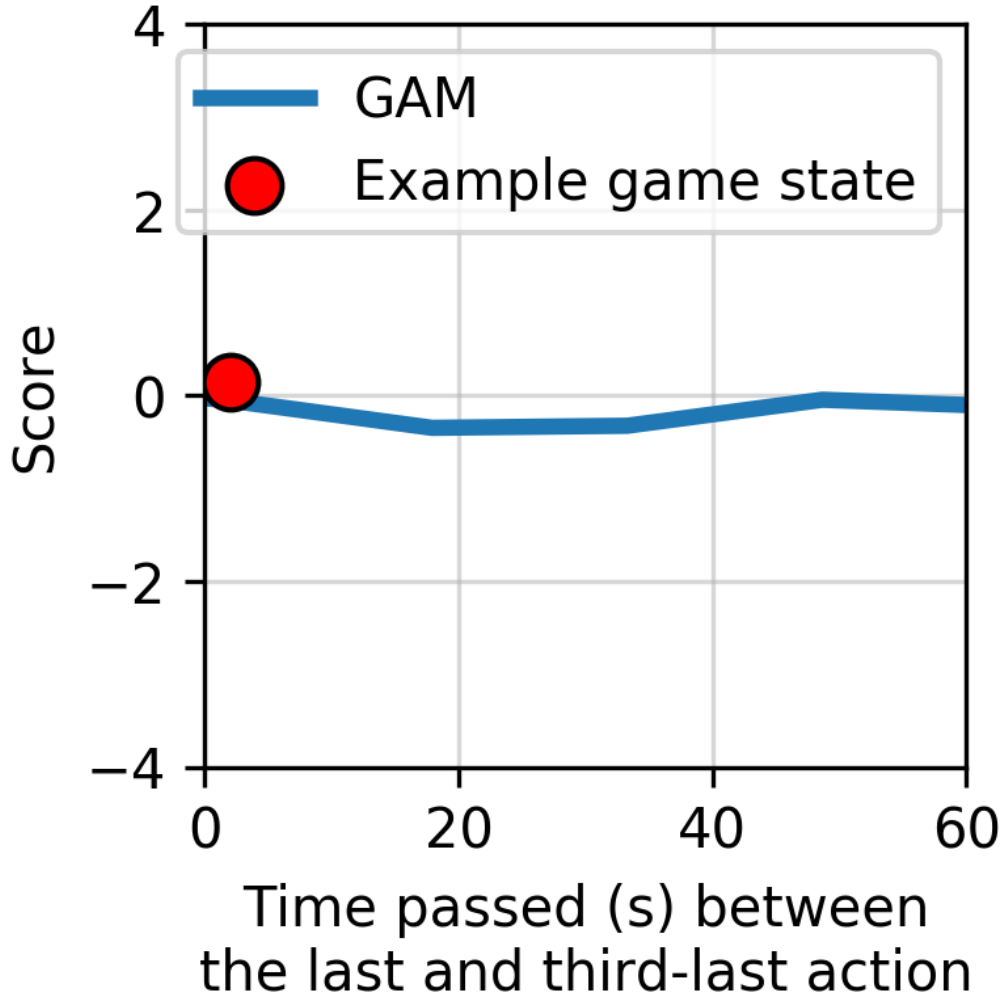

ONLINE RESOURCES

https://github.com/ML-KULeuven/socceraction/

- pip install socceraction
- example notebooks demonstrating SPADL, VAEP, and xT with free statsbomb data

In [2]:
```
import socceraction.spadl as spadl
import socceraction.spadl.statsbomb as statsbomb
```

Set up the statsbombloader

In [3]:
```
# Use this if you only want to use the free public statsbomb data
free_open_data_remote = "https://raw.githubusercontent.com/statsbomb/open-data/master/data/"
SBL = statsbomb.StatsBombLoader(root=free_open_data_remote,getter="remote")

# # Uncomment the code below if you have a local folder on your computer with statsbomb data
# datafolder = "../data/statsbomb-epl-1718" # Example of local folder with statsbomb data
# SBL = StatsBombLoader(root=datafolder,getter="local")
```

Select competitions to load and convert

In [4]:
```
# View all available competitions
competitions = SBL.competitions()
set(competitions.competition_name)
```

Out[4]:
```
{"FA Women's Super League",
 'FIFA World Cup',
 'La Liga',
 'NWSL',
 "Women's World Cup"}
```

In [5]:
```
# Fifa world cup
selected_competitions = competitions[competitions.competition_name=="FIFA World Cup"]

# # Messi data
# selected_competitions = competitions[competitions.competition_name=="La Liga"]

# # FA Women's Super League
# selected_competitions = competitions[competitions.competition_name=="FA Women's Super League"]

selected_competitions
```

Out[5]:

	competition_id	season_id	country_name	competition_name	competition_gender	season_name	match_updat
2	43	3	International	FIFA World Cup	male	2018	2019-12-16T23:09:16.1

https://github.com/microsoft/interpret

- recent implementation of generalized additive models

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(EXTRA: EVALUATION IN SOCCER ANALYTICS)

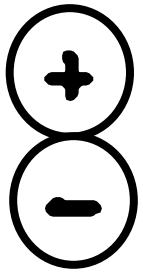
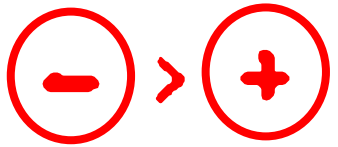
PROPER EVALUATION CAN BE AN AFTERTHOUGHT IN SOCCER ANALYTICS

> "ALL THE MODELS ARE CAREFULLY TUNED AND CALIBRATED."

> "WE FOCUS NOT ON THE TECHNICAL DETAILS, BUT RATHER THE POWER OF ... IN ANSWERING MANY IMPORTANT QUESTIONS IN THE SOCCER ANALYTICS COMMUNITY."

> "WE SET THE PARAMETERS ... BASED ON DOMAIN KNOWLEDGE AND AN EMPIRICAL ANALYSIS OF THE AVAILABLE DATA."

WHICH EVALUATION METRIC SHOULD I USE FOR MY PROBABILISTIC CLASSIFIER?

AUROC:  ->  OR  ?

BRIER SCORE: $$\frac{1}{N}\sum_{i}^{N}(p_i - y_i)^2$$

LOGARITHMIC LOSS: $$\frac{1}{N}\sum_{i}^{N} y_i \log p_i + (1 - y_i) \log(1 - p_i)$$

THE CHOICE OF EVALUATION METRIC DEPENDS ON THE USE CASE FOR THE MODEL OUTPUT

AUROC:
RANKING / CLASSIFYING EXAMPLES

BRIER SCORE:
SUMMING / SUBTRACTING PREDICTED PROBABILITIES

LOGARITHMIC LOSS:
MULTIPLYING / DIVIDING PREDICTED PROBABILITIES

PEOPLE OFTEN GET THIS WRONG!

A BASELINE MAKES AN EVALUATION METRIC MORE INTERPRETABLE

BASELINE AUROC = RANDOM GUESSING (50%)

BASELINE BRIER SCORE = A MODEL THAT ALWAYS PREDICTS THE CLASS DISTRIBUTION

$$\underline{\text{NORMALIZED}}\ \text{BRIER SCORE (MODEL)} = \frac{\text{BRIER SCORE (MODEL)}}{\text{BRIER SCORE (BASELINE)}}$$

CONCLUDING THOUGHTS

BRIDGING THE GAP BETWEEN ACADEMIA AND SOCCER PEOPLE IS NON-TRIVIAL -> INTERPRETABLE MODELS CAN HELP

WHEN ESTIMATING PROBABILITIES:
TRY TO UNDERSTAND WHAT IS HAPPENING UNDER THE HOOD AND TEST YOUR ASSUMPTIONS

WHEN EVALUATING PREDICTIVE MODELS:
BE CAREFUL AND CONSIDER YOUR USE CASE