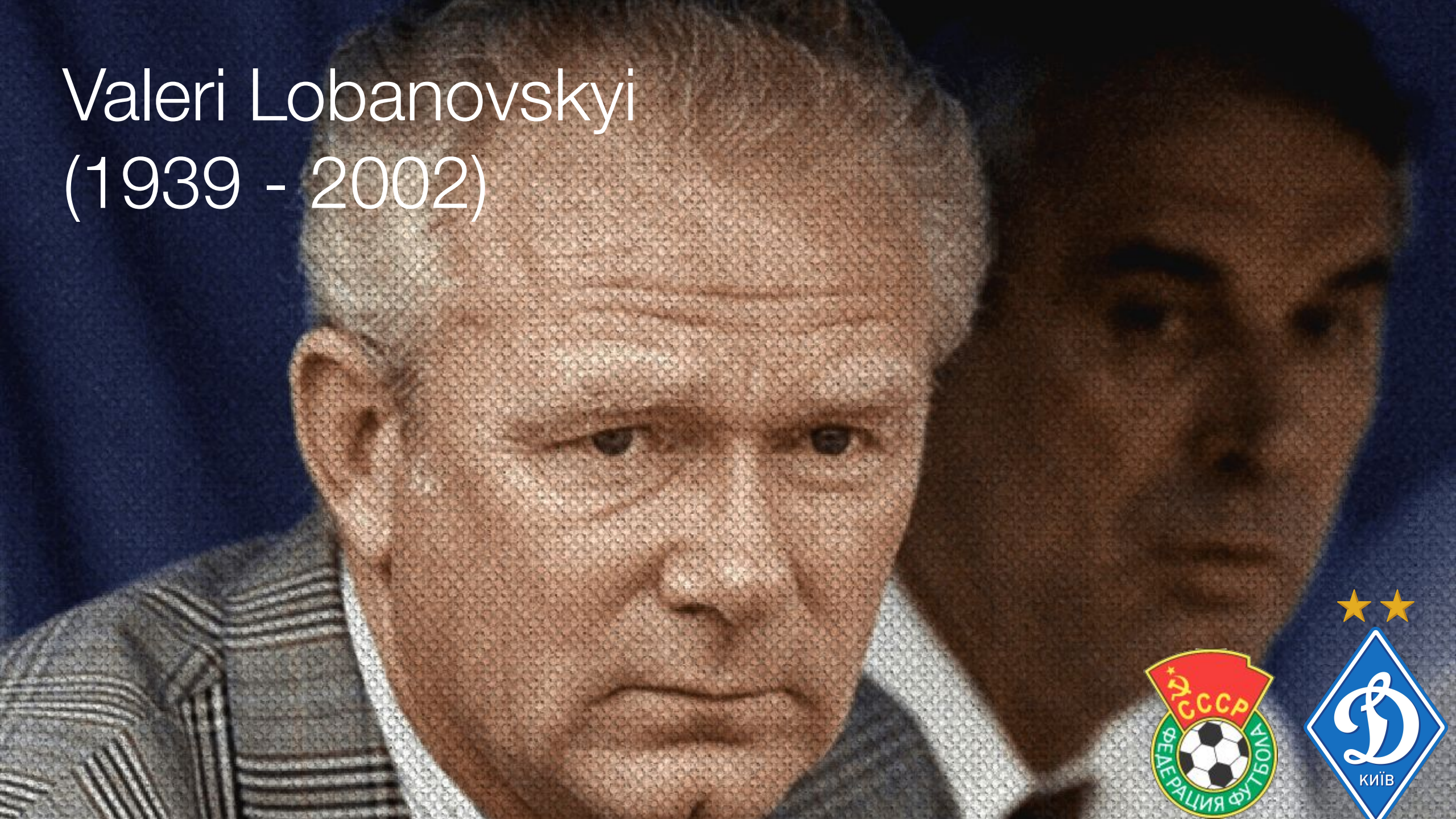
Soccer Analytics

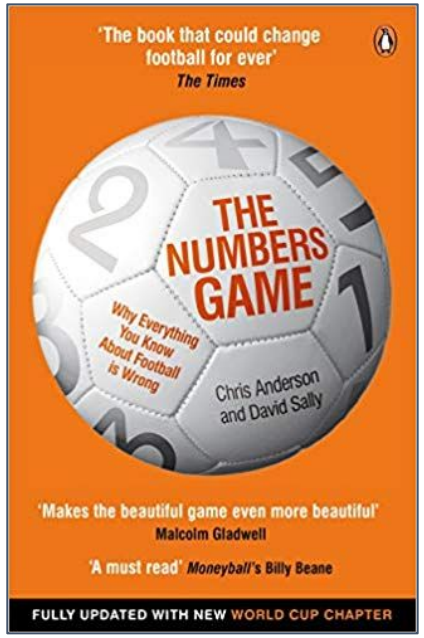
when Data Science takes the field

Charles Reep
(1904 - 2002)


Valeri Lobanovskyi
(1939 - 2002)
СССР
ФЕДЕРАЦИЯ ФУТБОЛА
КИЇВ

"The greatest mistake of my life"
Sir Alex Ferguson


The Maldini principle:
the better a defender
the fewer the tackles



The numbers game: why everything you know about football is wrong

C. Anderson, D. Sally

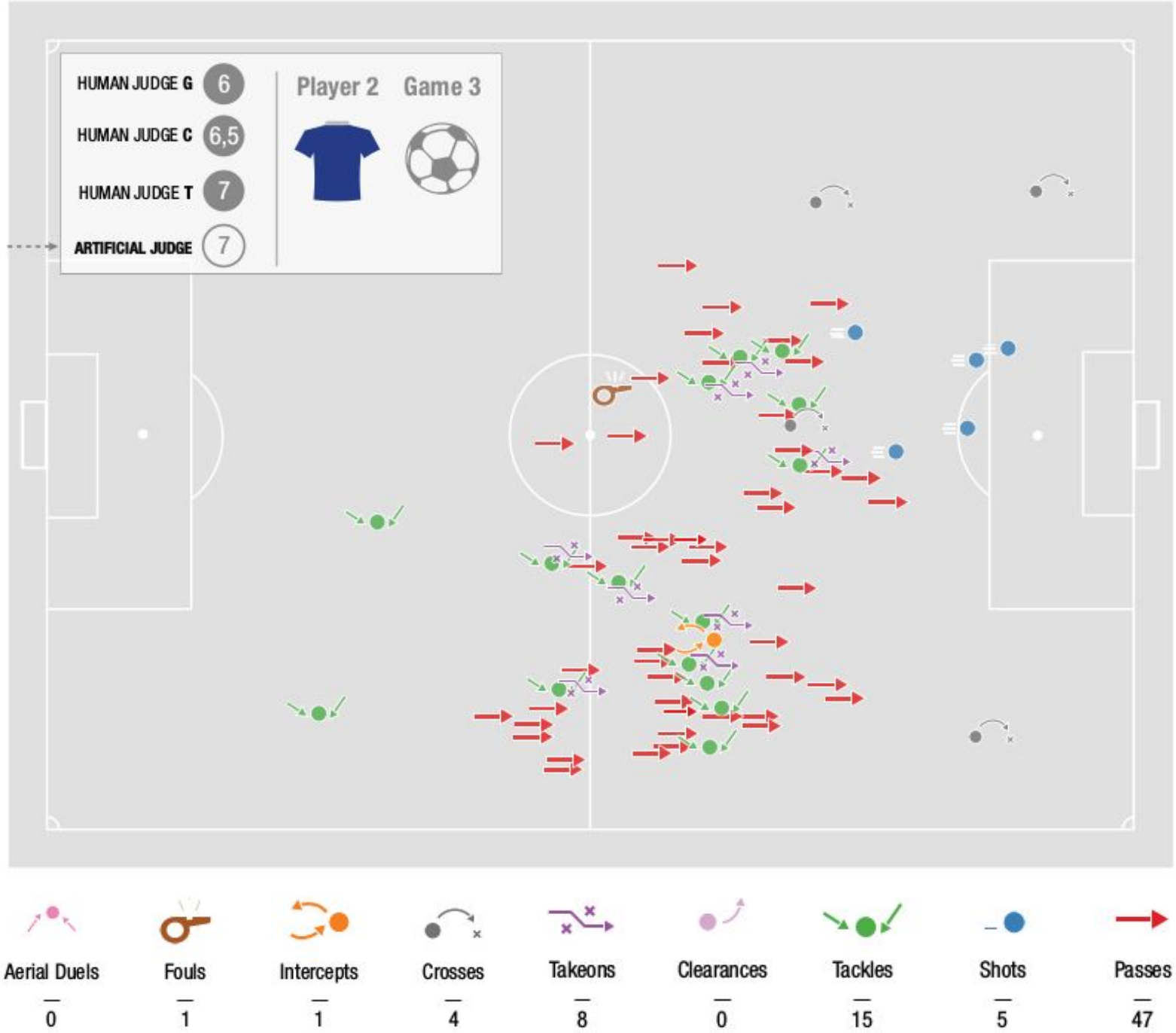
Soccer analytics: Unravelling the complexity of "the beautiful game"

Luke Bornn, Dan Cervone, Javier Fernandez

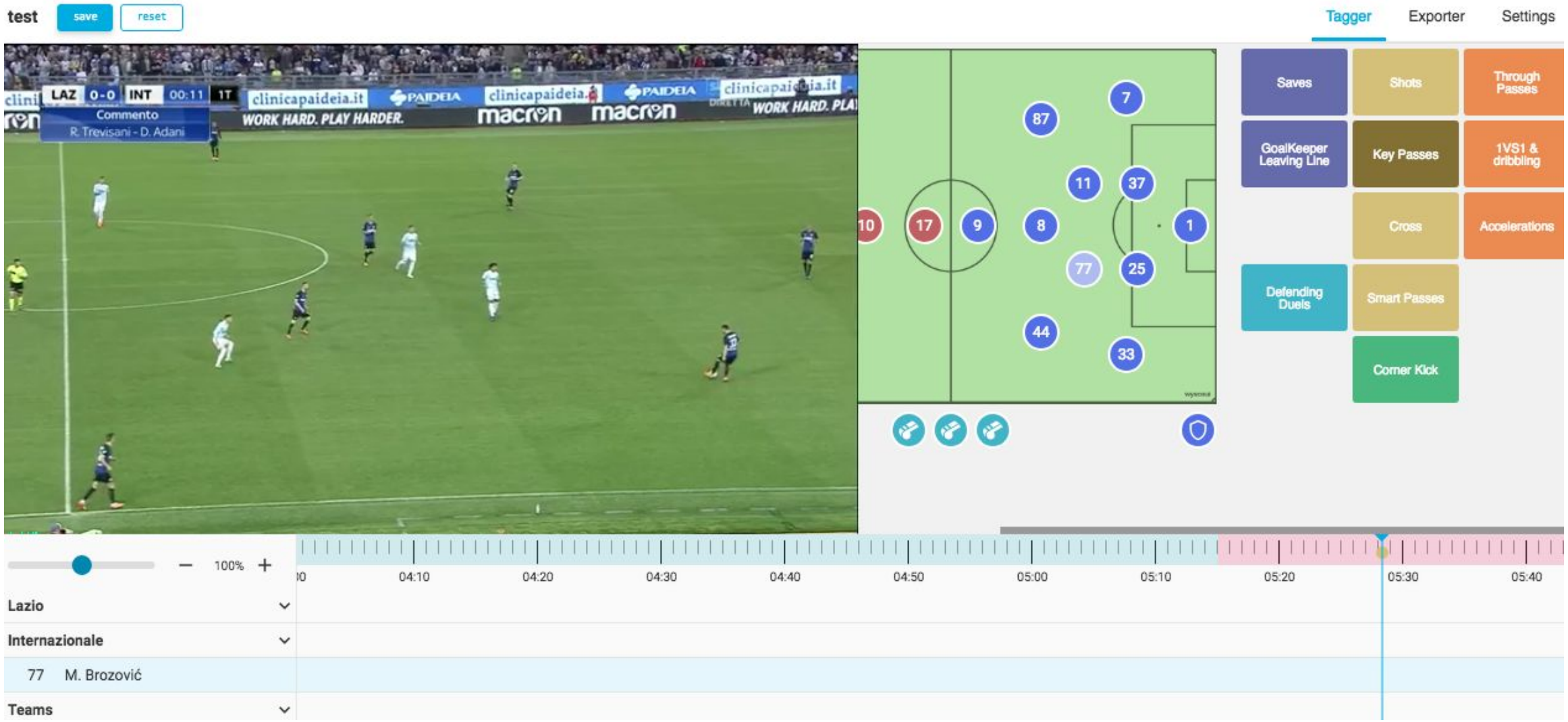
First published: 29 May 2018 | https://doi.org/10.1111/j.1740-9713.2018.01146.x

Soccer-logs

- events involving the ball occurring during a game
- player, team, position, time, outcome
- semi-automatic collection



Soccer-logs collection system



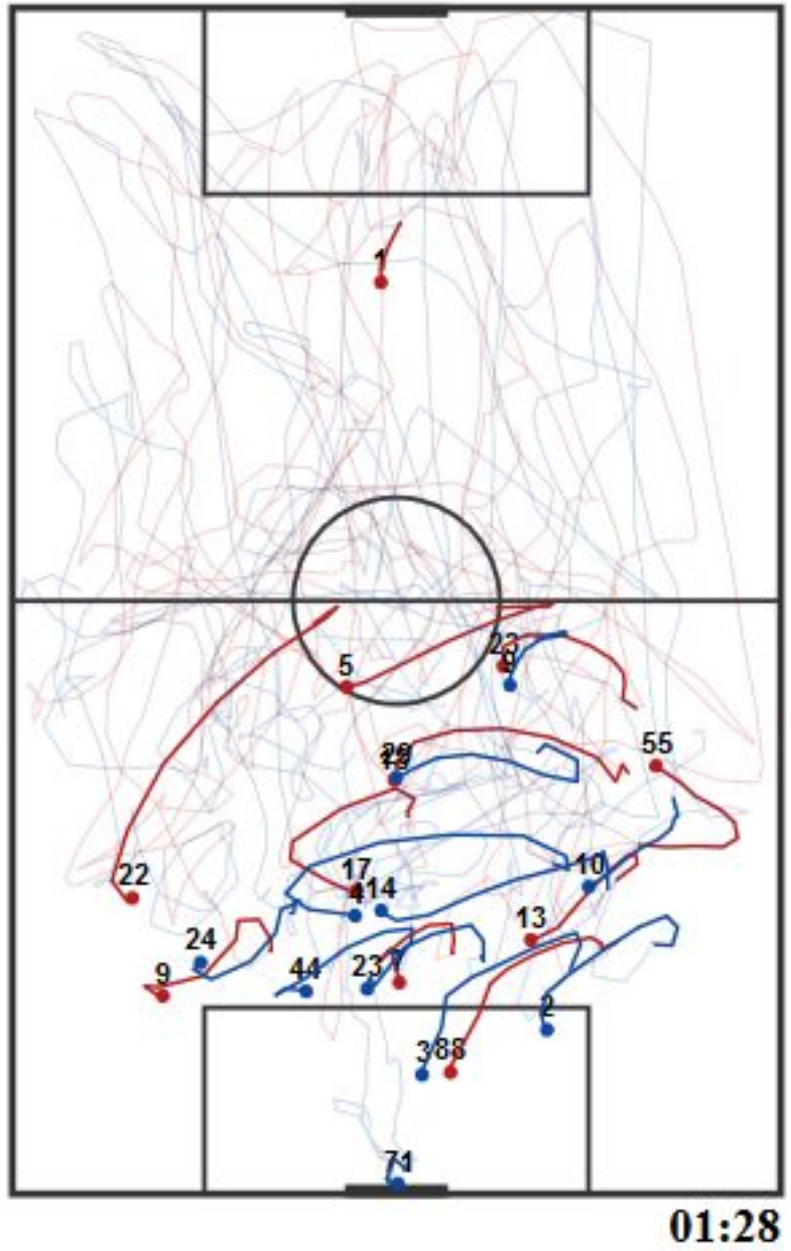
```
{'eventName': 8,
  'eventSec': 8.221464,
  'id': 217097515,
  'matchId': 2576132,
  'matchPeriod': '1H',
  'playerId': 8306,
  'positions': [{'x': 42, 'y': 14}, {'x': 74, 'y':
33}],
  'subEventName': 83,
  'tags': [{'id': 1801}],
  'teamId': 3158}
```

1700 events per match (in average)

powered by wyscout

Video tracking

- video-cameras are installed in stadiums
- each player identified
- trajectory of the player is inferred

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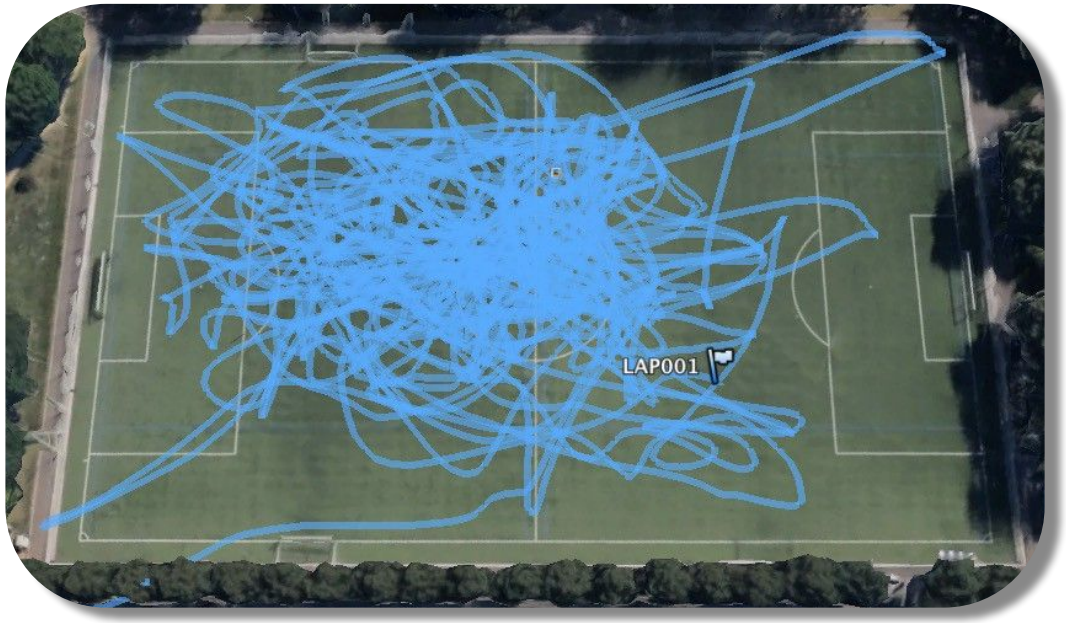


GPS devices track training sessions

Prediction

is better than cure

using AI to predict injuries of soccer players

Sochi, Russia

2

1

FIFA WORLD CUP
RUSSIA 2018

Sochi, Russia

2

1

FIFA WORLD CUP
RUSSIA 2018

188M €

in Spain

16%

days absence

Economic costs estimation of soccer injuries in first and second spanish division professional teams
http://bit.ly/cost_injuries_soccer


High Speed Running
Metabolic Distance
Accelerations
Decelerations
Dynamic stress load
Total distance
Fatigue index
High Metabolic
Load Distance
age, role, height
weight, **injuries**

Training features (GPS)

- Total Distance
- High Speed Running (>19.8 km/h)
- Metabolic Distance (>20W/kg)
- High Metabolic Load Distance (>25.5 W/Kg)
- High Metabolic Load Distance Per Minute
- Explosive Distance (>25 W/kg <19.8 Km/h)
- Accelerations >2m/s^2
- Accelerations >3m/s^2
- Decelerations >2m/s^2
- Decelerations >3m/s^2
- Dynamic Stress Load (>2g)
- Fatigue Index (Dynamic Stress Load/Speed Intensity)

Players' features

- Age
- Height
- Weight
- Role
- Previous injuries

Number of injuries that players had occurred before each training session

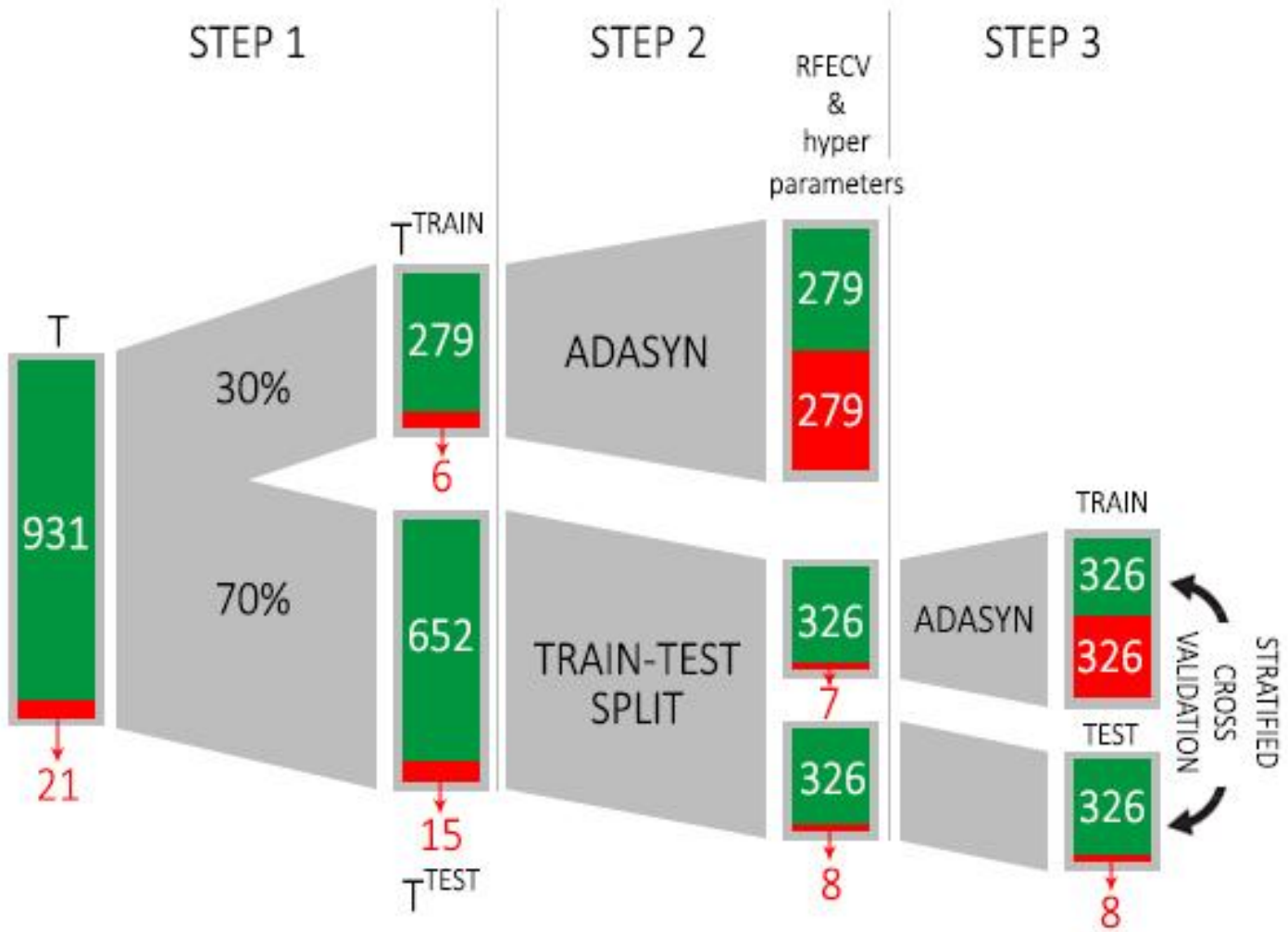
a classification problem

	d_{TOT}	d_{EXP}	...	ACC_3	label
s_1	4,018.19	426.42	...	16.99	**0**
s_2	3,465.81	326.41	...	16.91	**0**
s_3	3,227.15	256.85	...	18.25	**1**
	⋮	⋮	⋮	⋮	⋮
s_n	3,199.58	273.69	...	19.64	**1**

injury examples are very **rare**

(just 2% of the examples)

Re-balancing the dataset



ADASYN:
a technique to rebalance the dataset

It generates synthetic examples of the minority class

State of the art

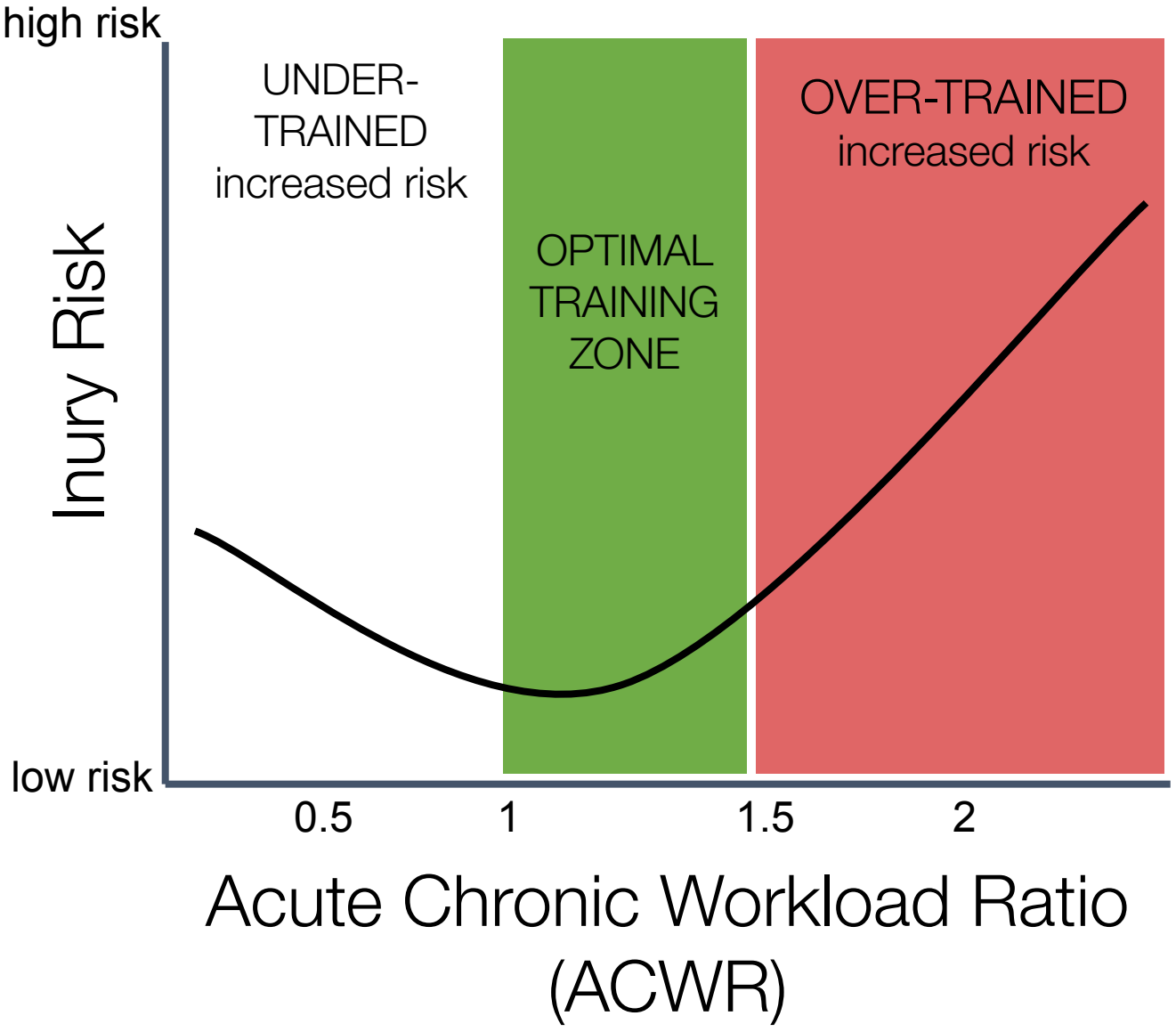
$$ACWR = \frac{\text{acute workload (7 days)}}{\text{chronic workload (28 days)}}$$

Pro:

- simple to compute
- high recall

Cons:

- monodimensional
- low precision
- many false alarms



high recall

> 90

low precision

< 4%

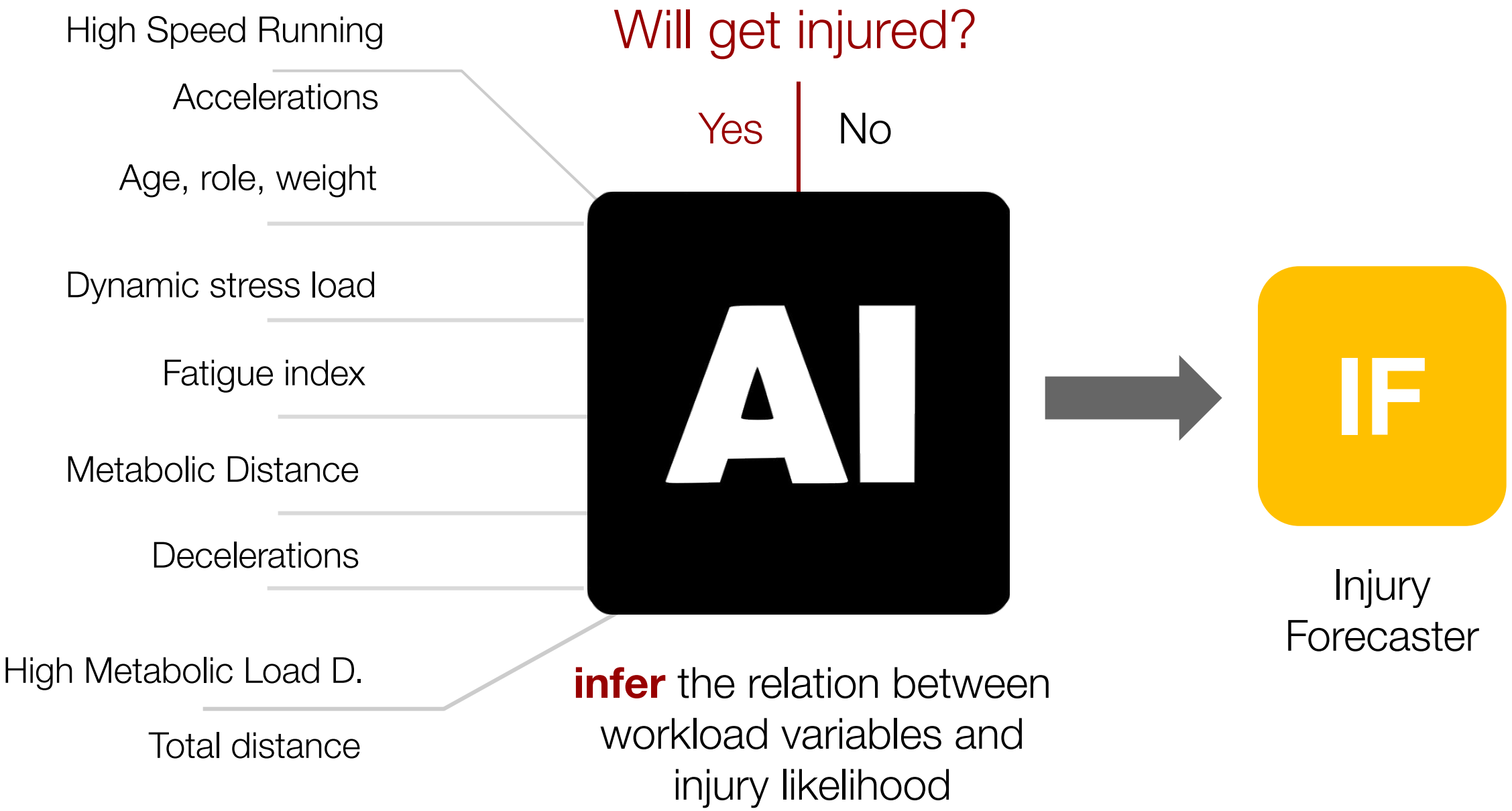
	class	prec	rec	F1	AUC
ACWR	0	1.00	0.43	0.60	0.67
	1	0.04	0.91	0.07	
Null model	0	0.98	0.98	0.98	0.51
	1	0.06	0.05	0.05	

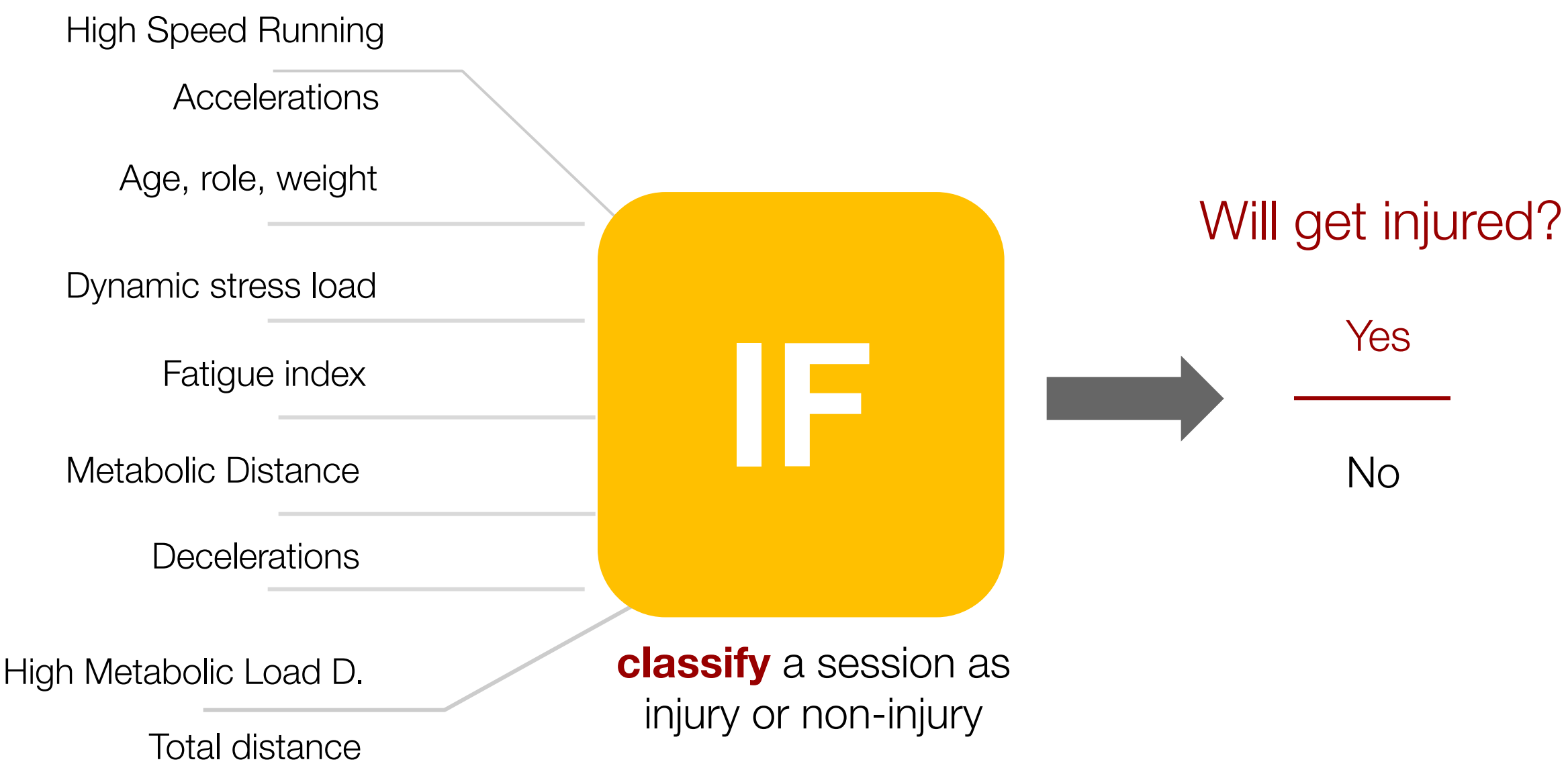
high recall

> 90

low precision

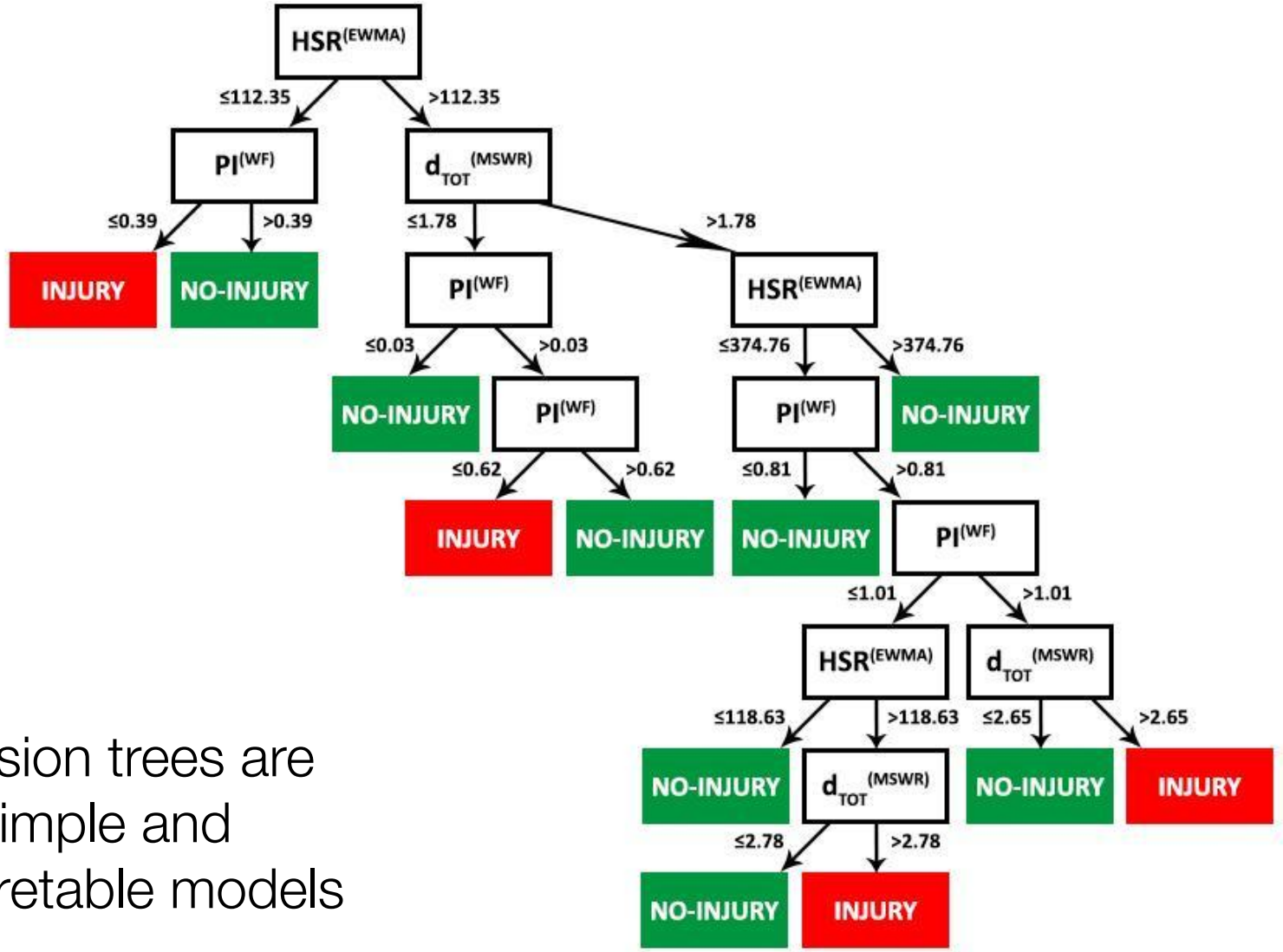
< 4%


High Speed Running
Accelerations
Age, role, weight
Dynamic stress load
Fatigue index
Metabolic Distance
Decelerations
High Metabolic Load D.
Total distance
Will get injured?
Yes
No
AI
IF
Injury Forecaster
infer the relation between workload variables and injury likelihood

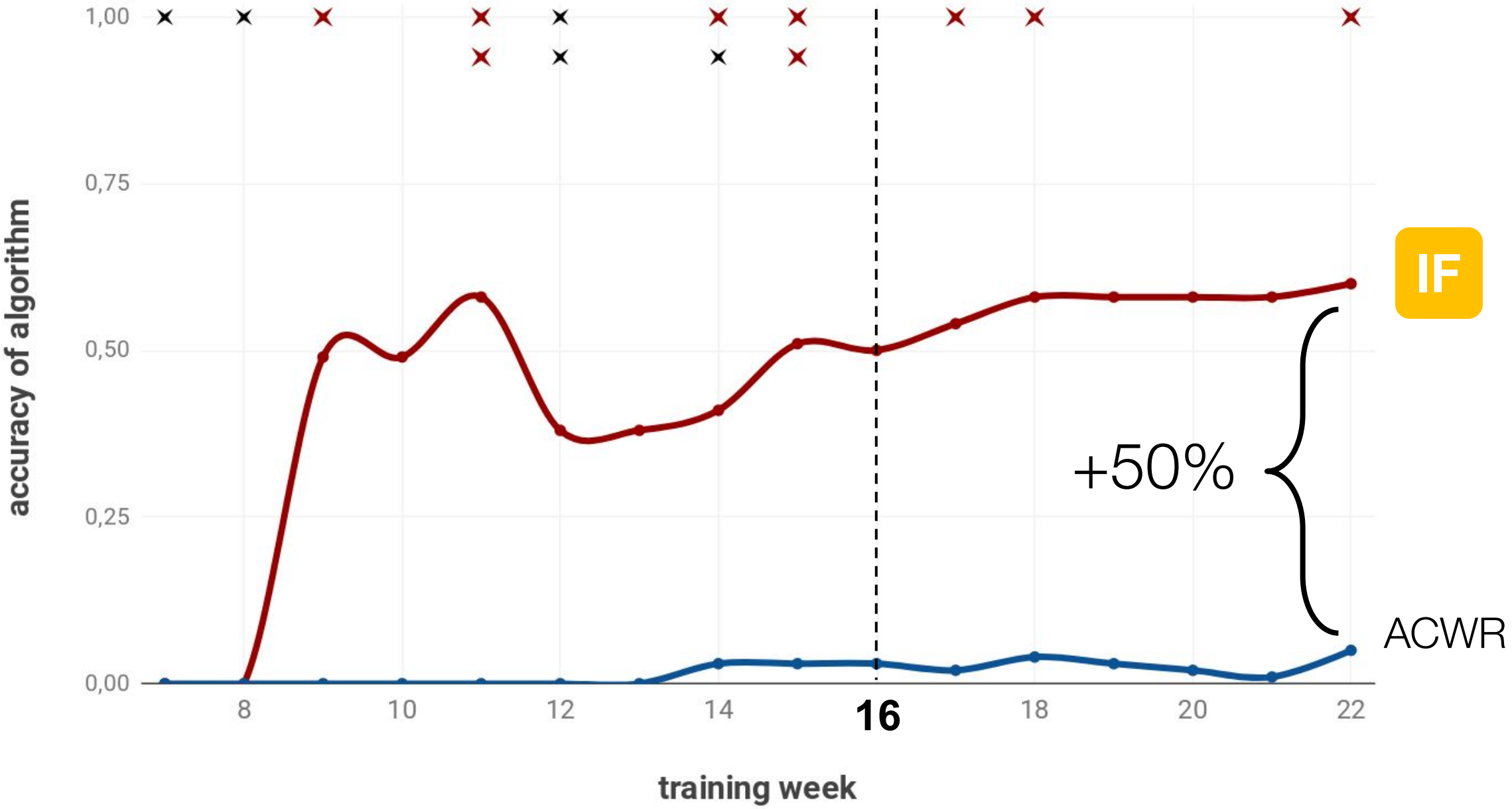

High Speed Running
Accelerations
Age, role, weight
Dynamic stress load
Fatigue index
Metabolic Distance
Decelerations
High Metabolic Load D.
Total distance
IF
classify a session as injury or non-injury
Will get injured?
Yes
No

How IF is made?

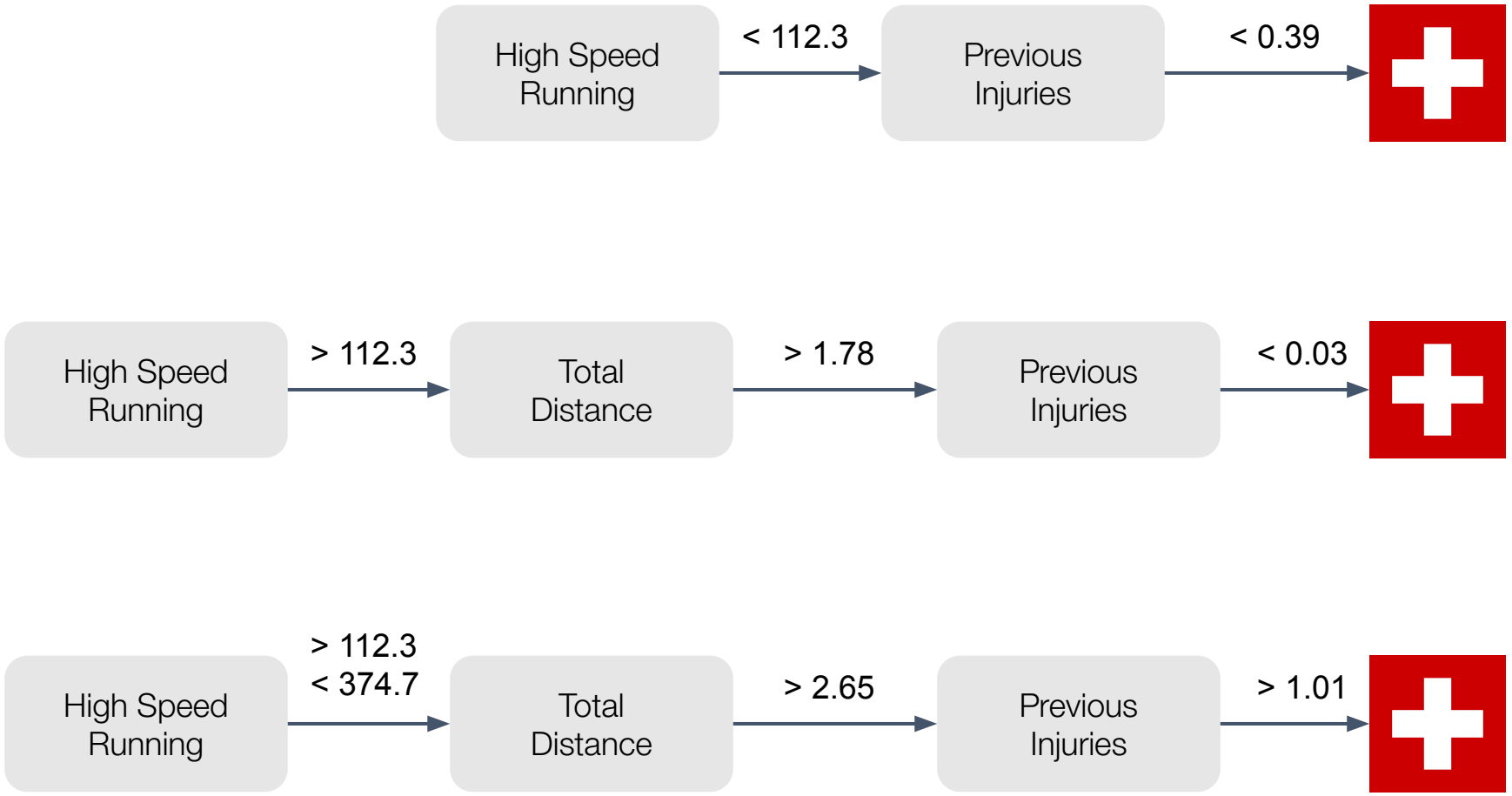
IF



Decision trees are simple and interpretable models


1,00
0,75
0,50
0,25
0,00
accuracy of algorithm
8
10
12
14
16
18
20
22
training week
IF
+50%
ACWR

How IF is made?

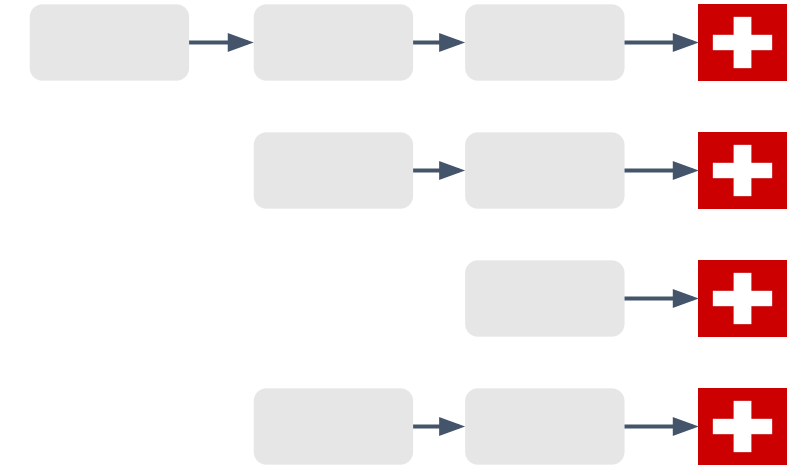


Specialized IF

JUVENTUS

IF
Juventus

IF
Inter



Personalized IF

IF
Ronaldo

IF
Icardi

EL PAÍS

Un algoritmo para saber cuándo se va a lesionar un jugador

Los especialistas afirman que las soluciones tecnológicas para evitar daños en los atletas profesionales están todavía en fase embrionaria

NewScientist

DAILY NEWS 3 August 2018

Football teams secretly using AI to predict injuries before they occur

Stop agli infortuni e mercato al top Con due algoritmi cambia il futuro

● Cnr e Università di Pisa hanno creato due sistemi di intelligenza artificiale

La Gazzetta dello Sport

WIRED

L'intelligenza artificiale aiuta i calciatori a evitare gli infortuni

Un algoritmo calcola con una precisione del 50% il rischio per il singolo calciatore di farsi male nell'allenamento successivo. Le stime attuali hanno una precisione solo del 4%. Alla ricerca partecipano Università di Pisa, Cnr e Università di Milano, nonché alcuni calciatori

Il Sole 24 ORE

SPORT E DATA ANALYTICS

Infortuni previsti con precisione: arriva la manutenzione predittiva del calciatore

PLOS ONE

Effective injury forecasting in soccer with GPS training data and machine learning

http://bit.ly/plosone_injury

Phases of the project

1. **Motivate your proposal:** find material demonstrating the importance of your proposal;
2. **State of the art:** search for existing solutions
3. **Define:** formalize your problem in terms of predictive task
4. **Extract information** extract meaningful features
5. **Implement:** realize your solution using the most suitable technique
6. **Evaluate:** evaluate the quality of your solution
7. **Interpret:** interpret your model to extract new knowledge