STARSS: A Spatio-Temporal Action Rating System for Soccer

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Soccer analytics attempts to quantify and explain soccer

Ronaldo or Messi, who is the better player?

What are the odds that my team will win?

What is the best strategy for our team?

Should this player have scored his shot?

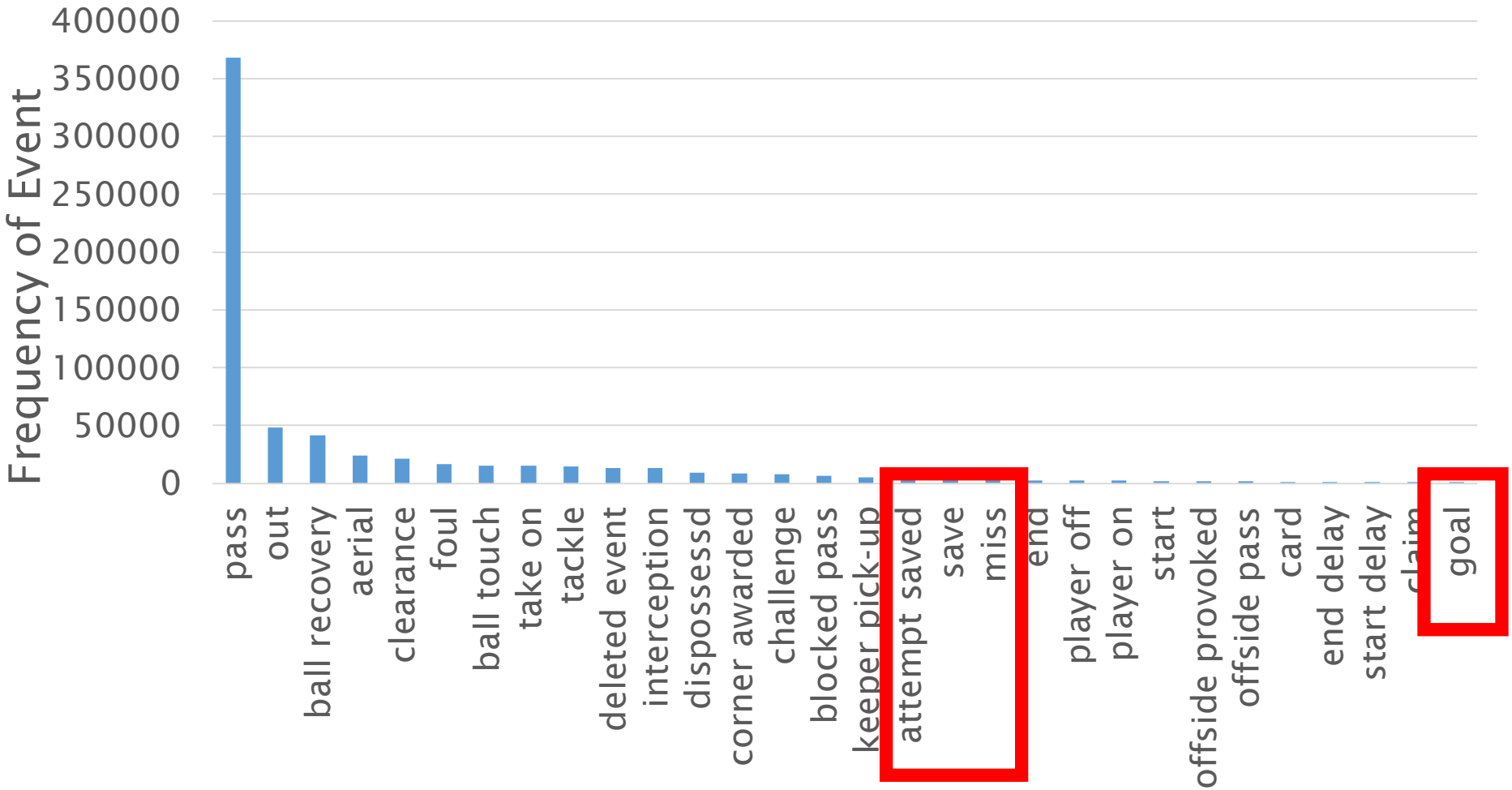
Some shots are better than others

Expected goals (xG) models quantify the value of a shot.

.16

.09

Shots are rare actions;
xG models ignore most gameplay



Some actions are better than others

Can we quantify the value of any action?

Shot

.12

Pass

.04

Ball recovery

.01

Overview

Data
Action streams

STARSS
Our approach for rating actions

Experiments
Identifying top players

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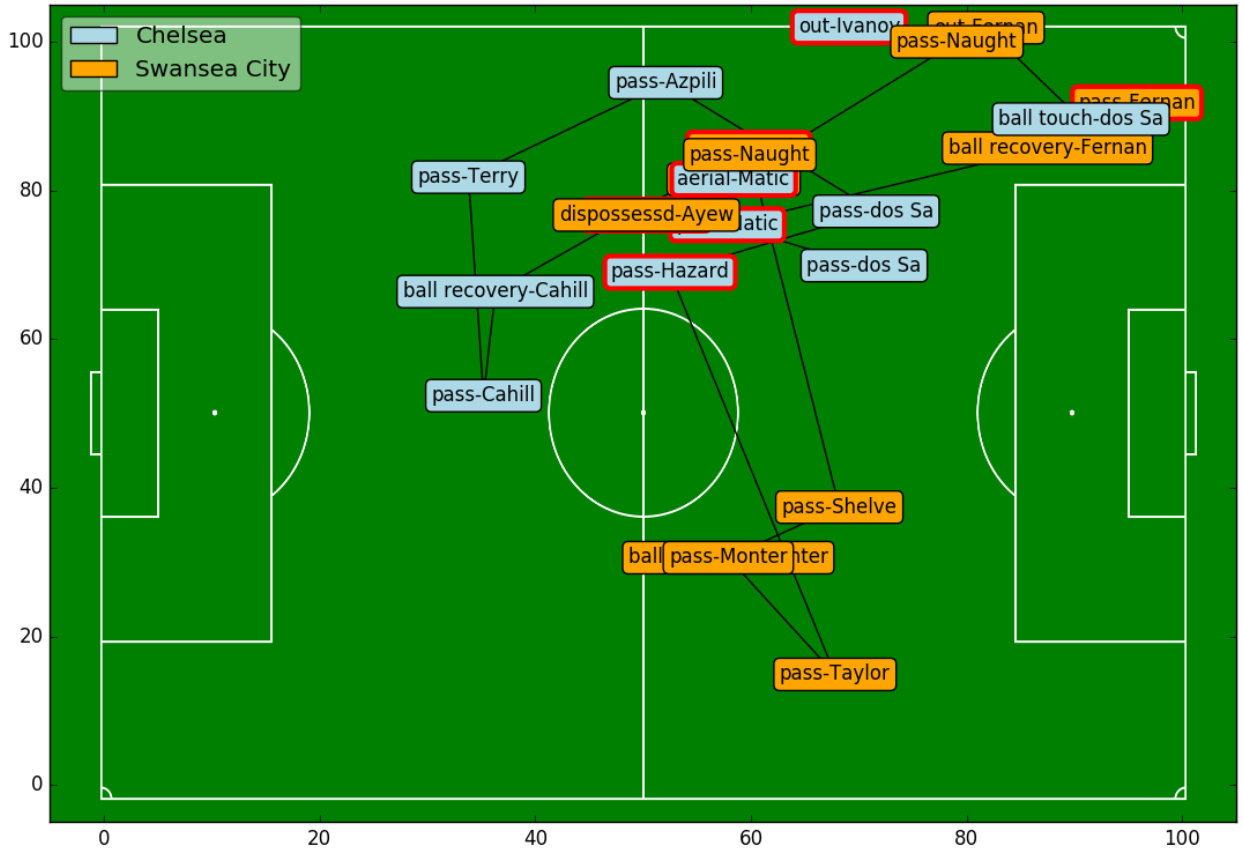
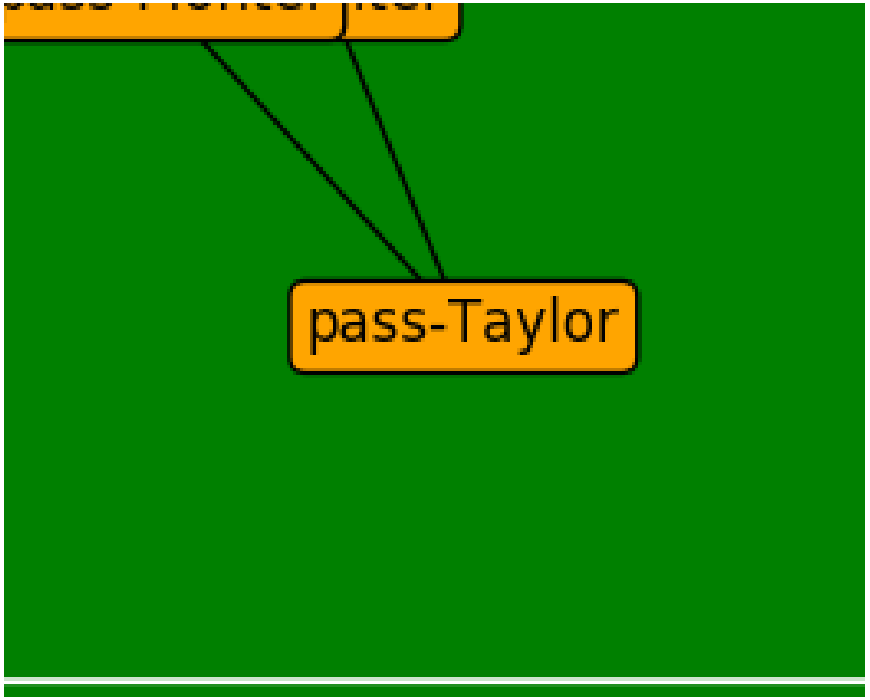
A soccer match is described by a stream of ±1750 on-the-ball actions



= 1 minute of gameplay

An action has attributes such as type, timestamp, location, team, player, …



Action
Pass
12min 36sec
X: 32.2, Y: 85.1
Neil Taylor
Swansea
…

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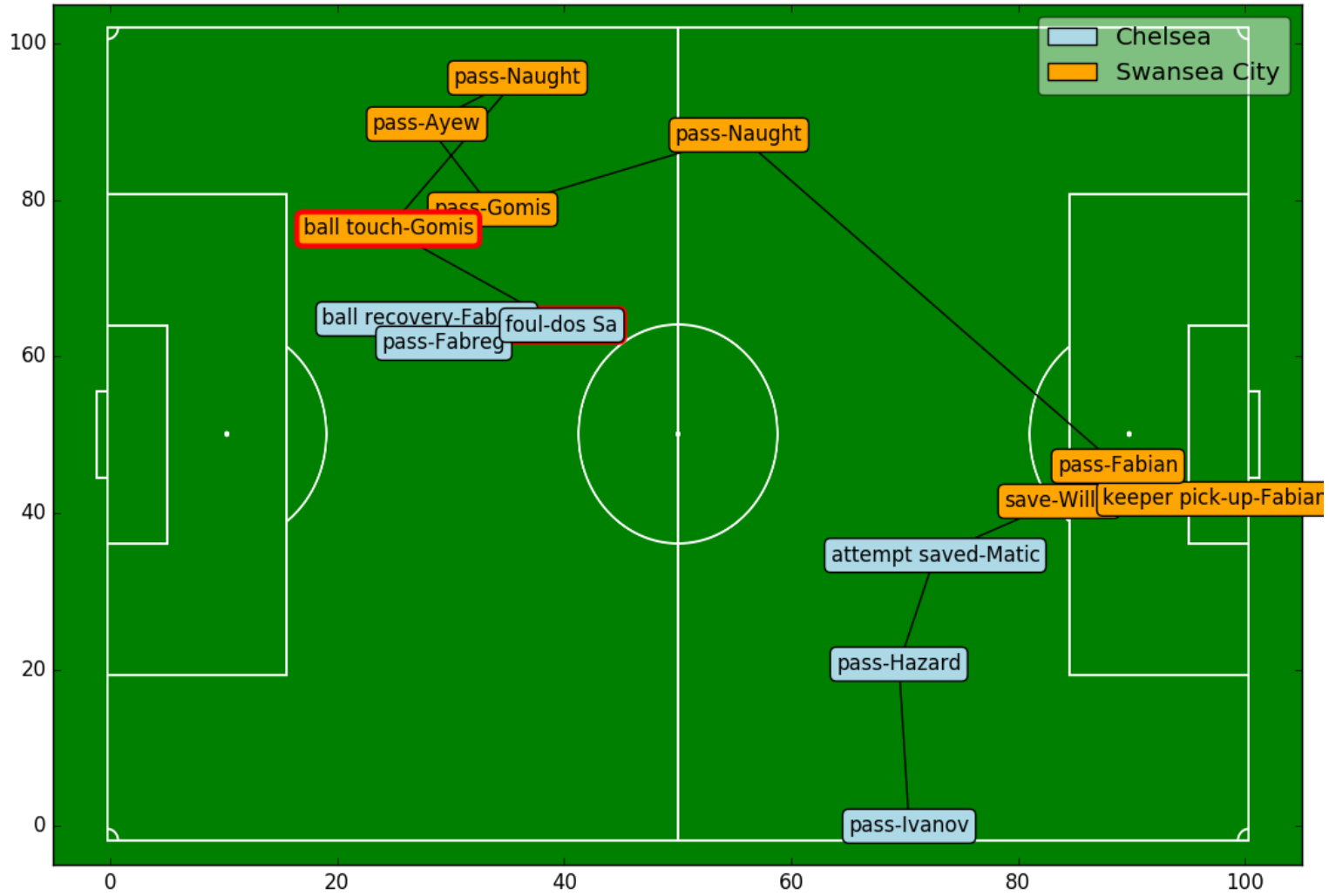
STARSS rates actions using 3 simple steps

1. Split action stream in phases
   Temporal aspect + expert knowledge

2. Rate phases
   Spatio-Temporal Nearest Neighbours

3. Distribute phase rating over individual actions
   Exponential decay

Action streams are split in phases based on time and change of possession



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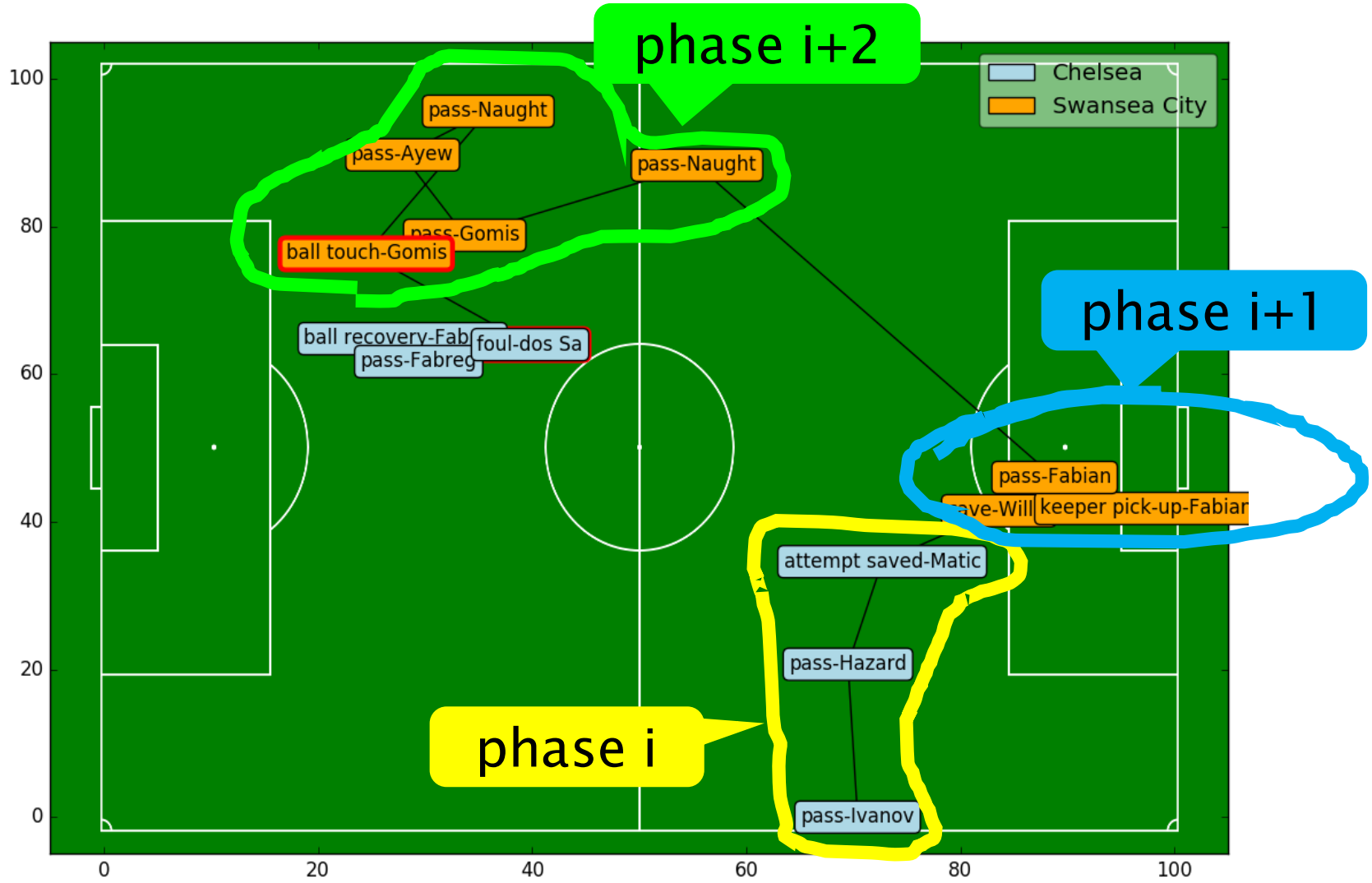

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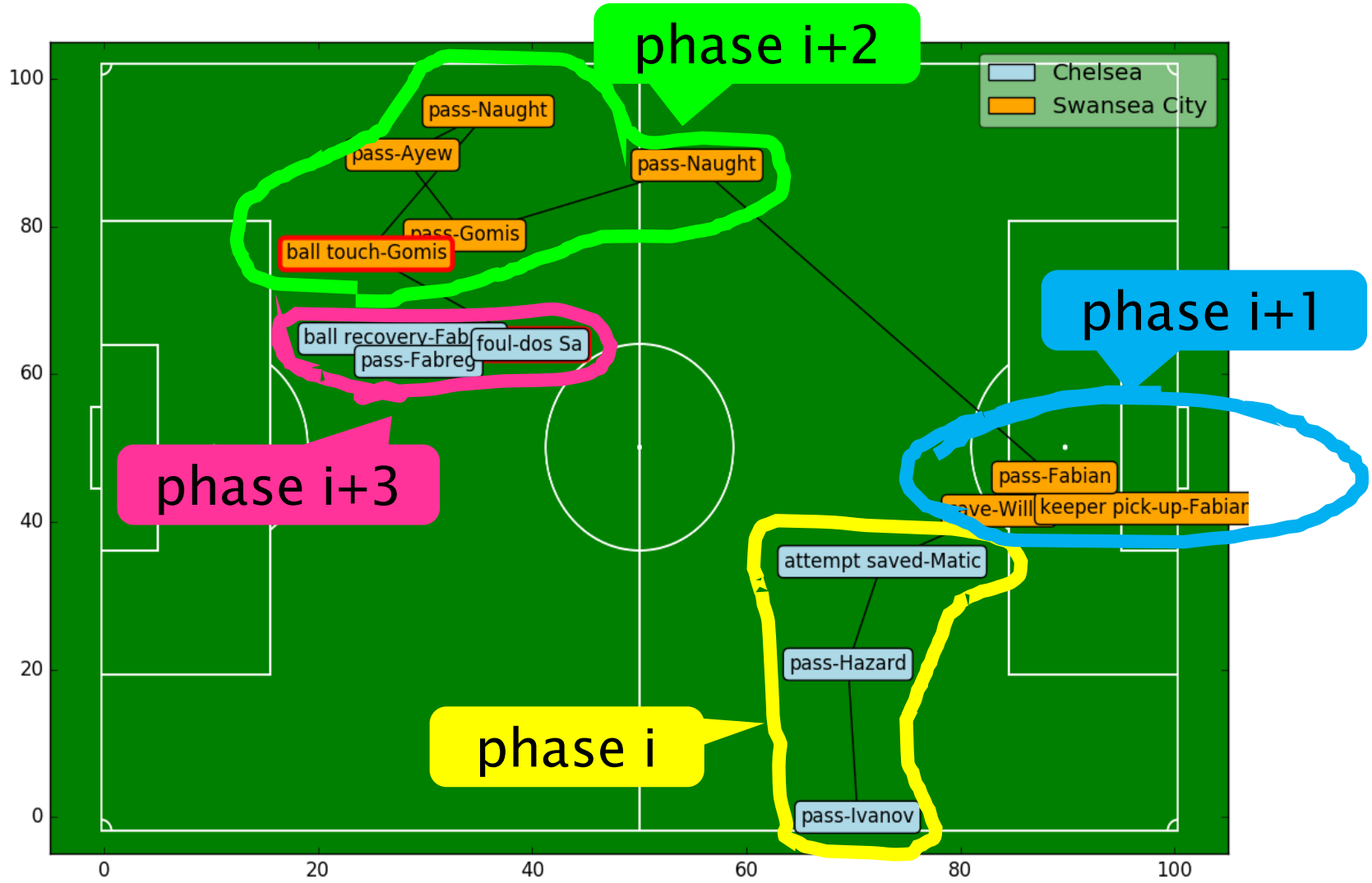
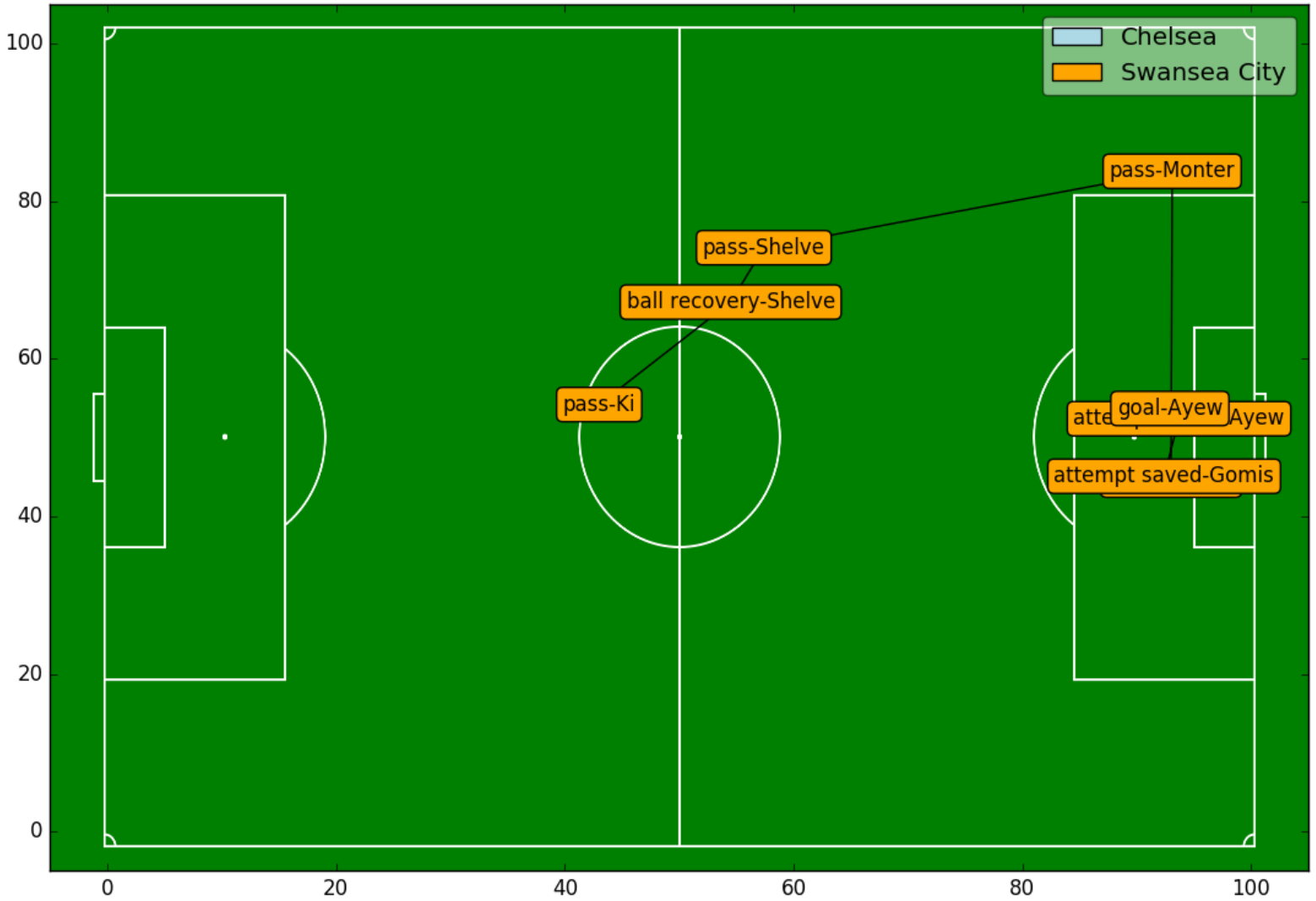
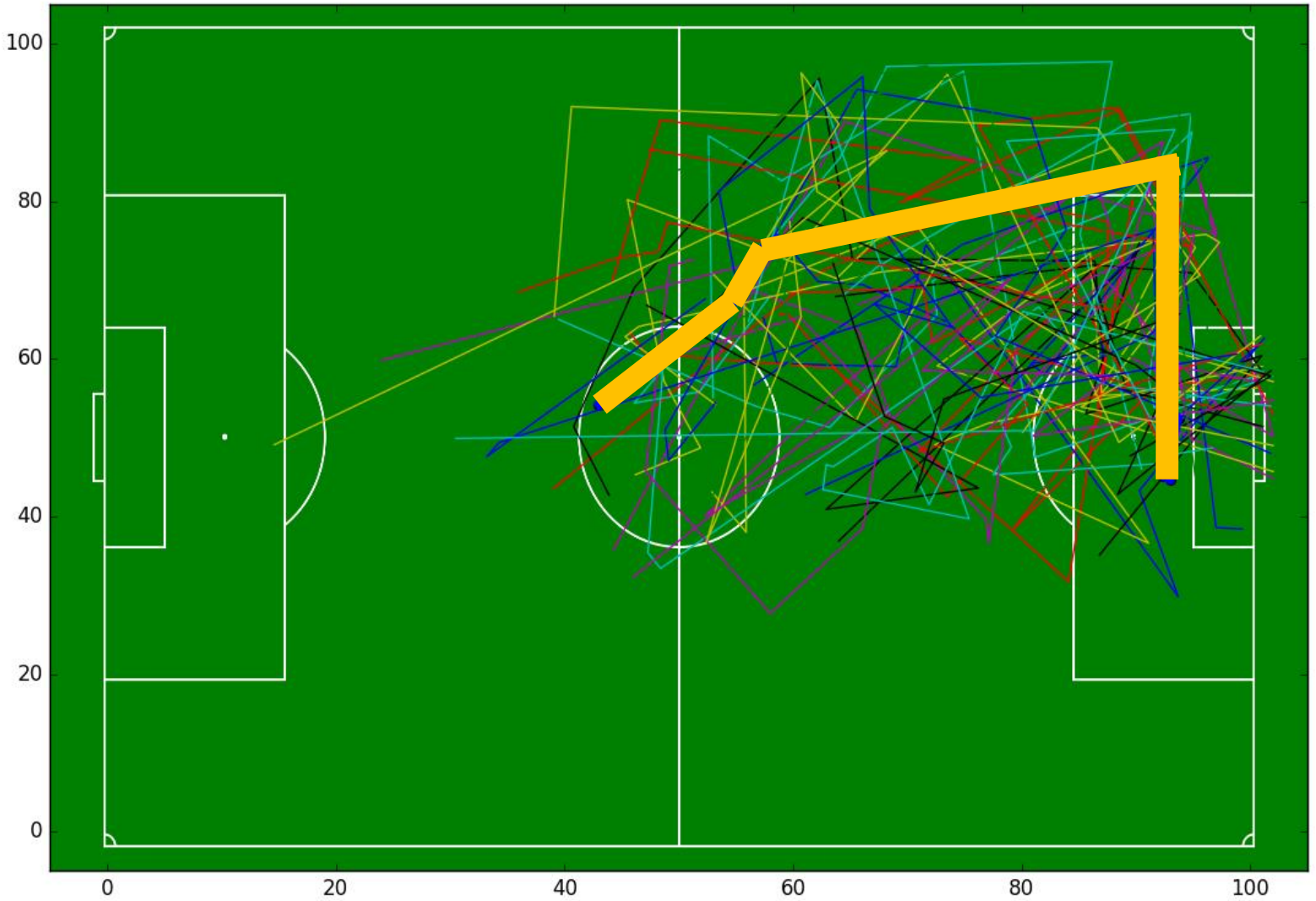


How good is this phase?

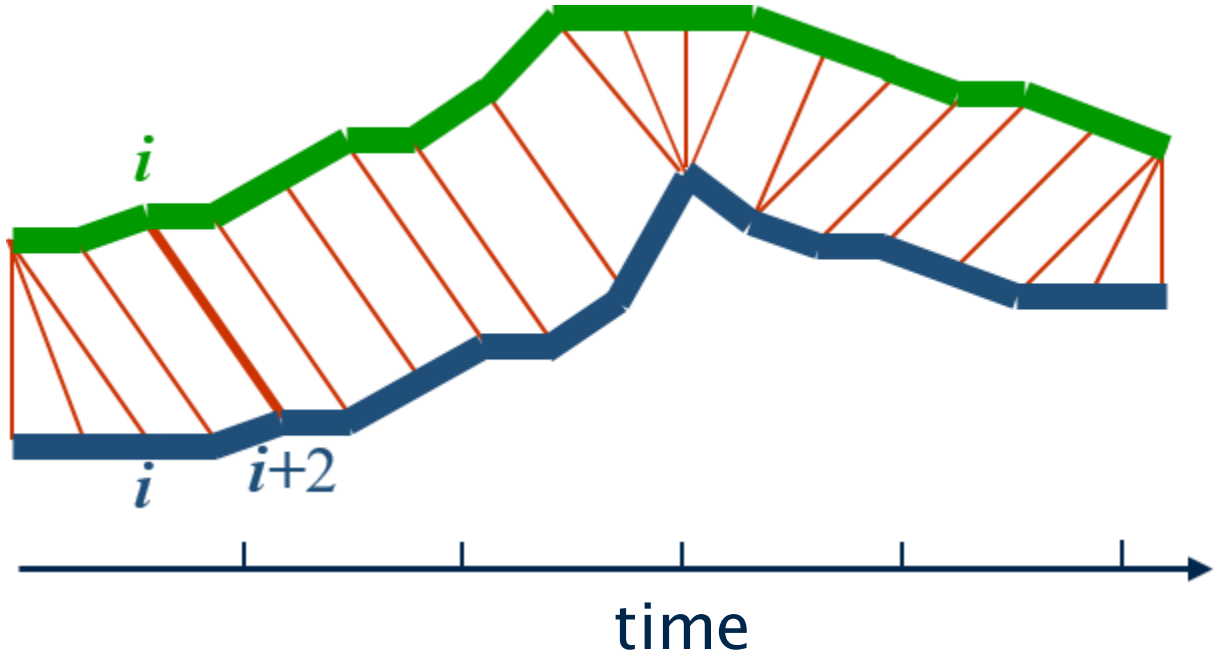


How good is this phase?
Let's look at what happened in similar phases



Dynamic Time Warping (DTW) is a great distance measure for phases

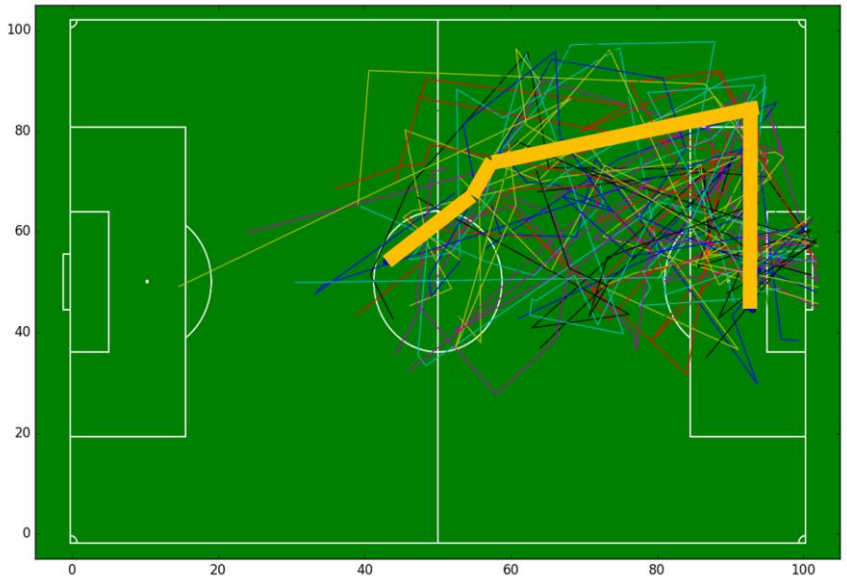
Similar shapes are matched,
even if not synced on the time axis



https://www.psb.ugent.be/cbd/papers/gentxwarper/DTWalgorithm.htm

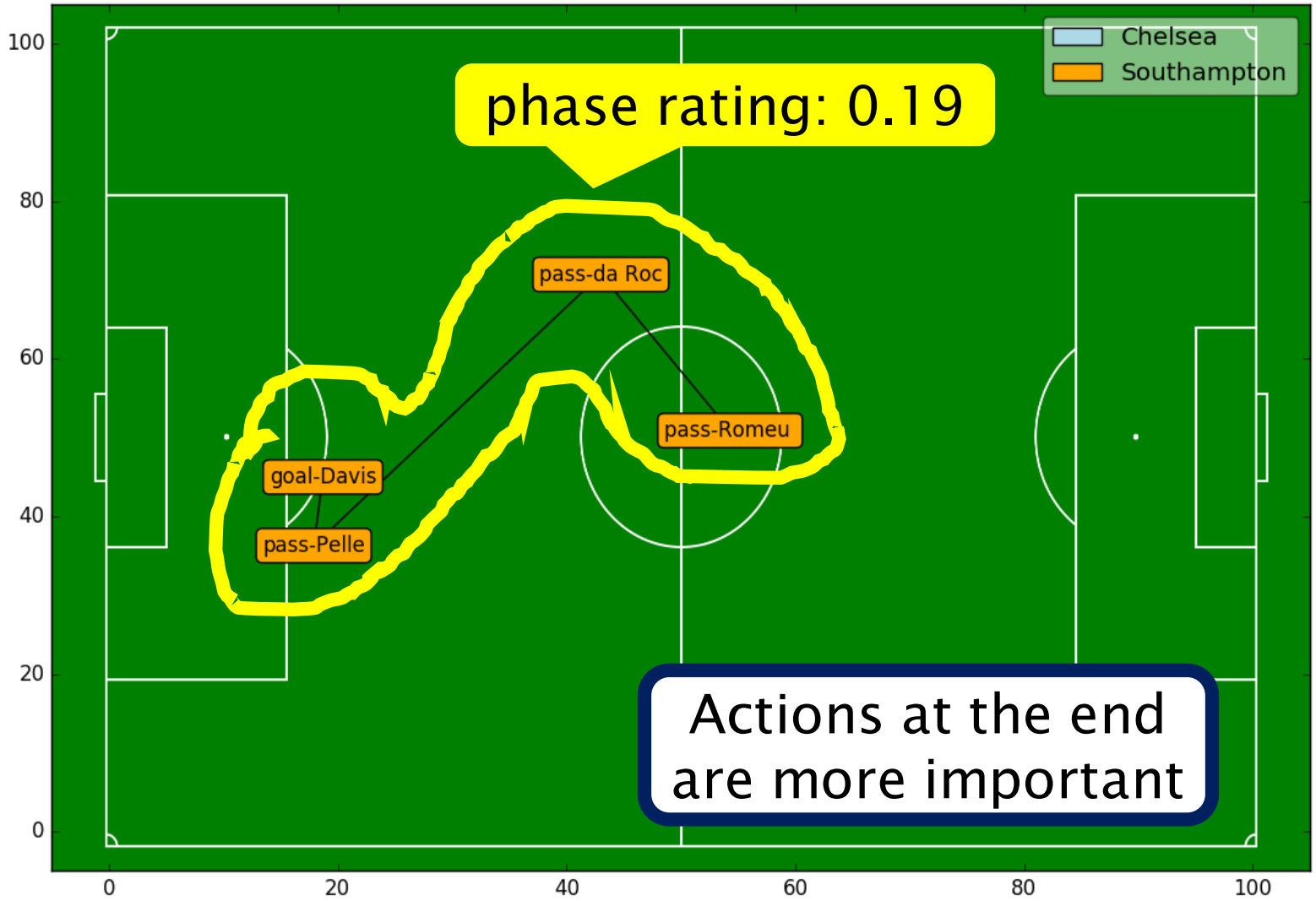
Phases are rated using a *k*-nearest neighbors approach

1. Search *k* similar phases using DTW (e.g., 100)
2. Count number of phases that end in a goal (e.g., 6)

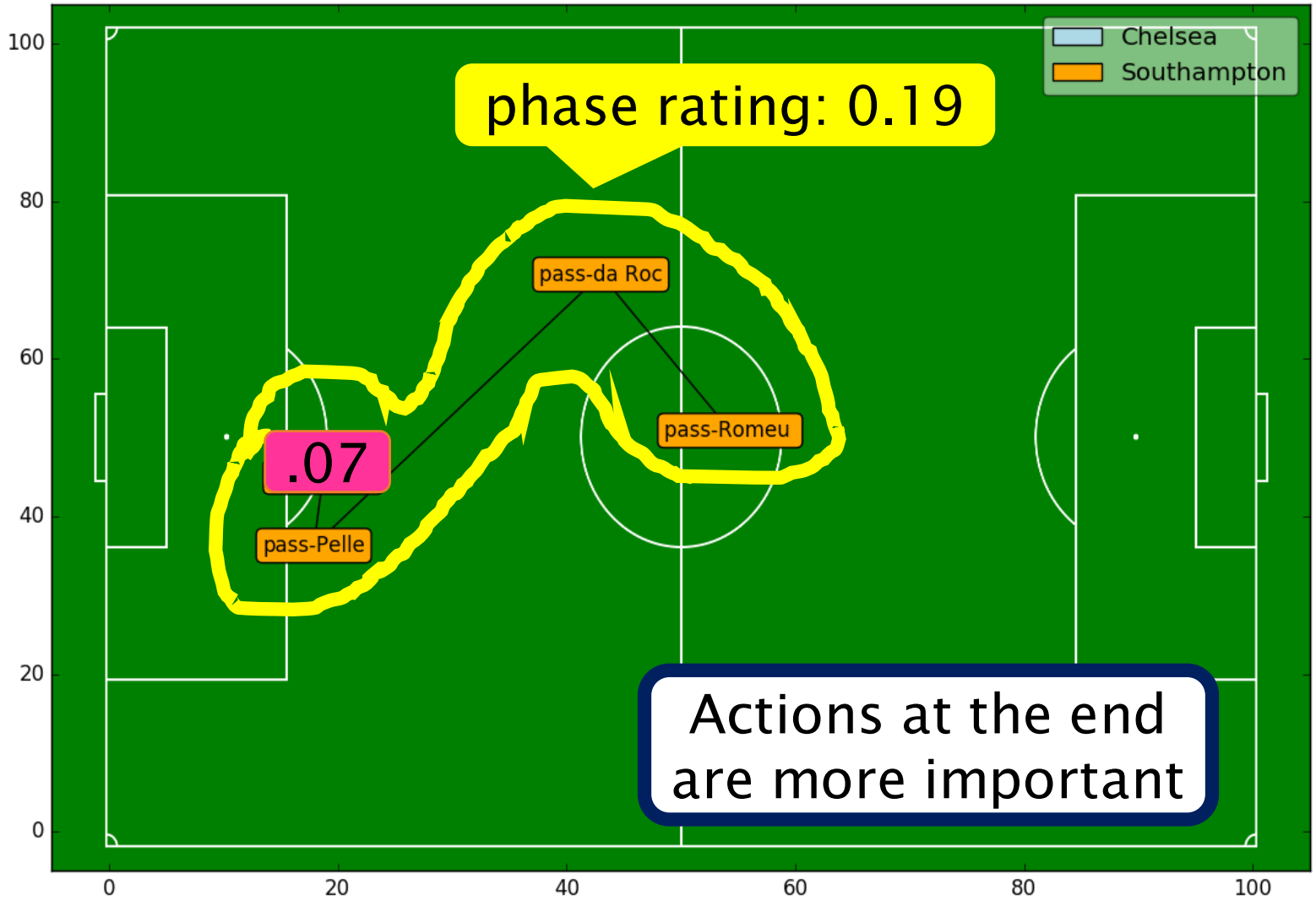


$$Rating(phase) = \frac{6\ goals}{100\ similar\ phases} = 0.06$$

The phase rating is distributed over its individual actions using exponential decay



The phase rating is distributed over its individual actions using exponential decay



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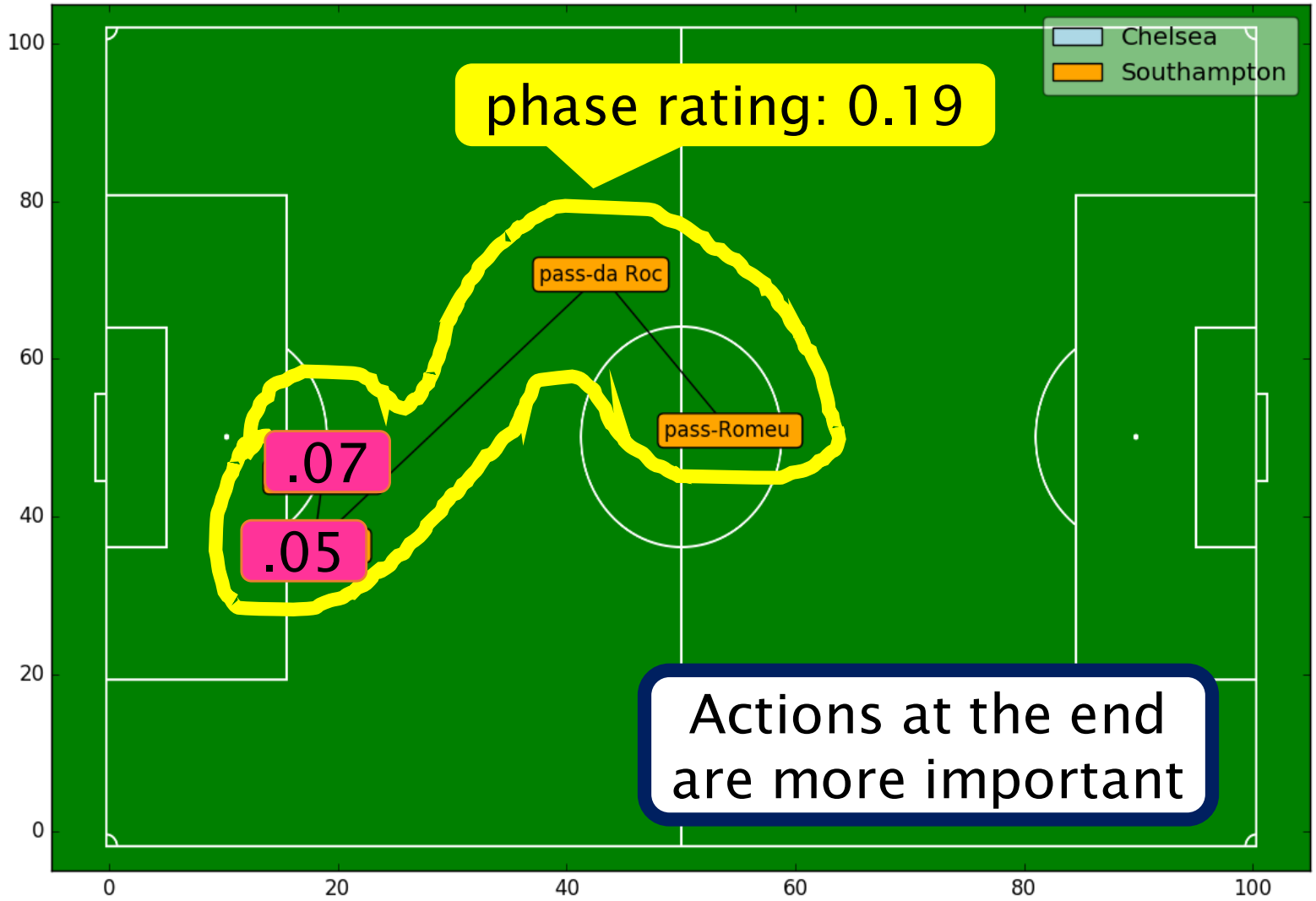

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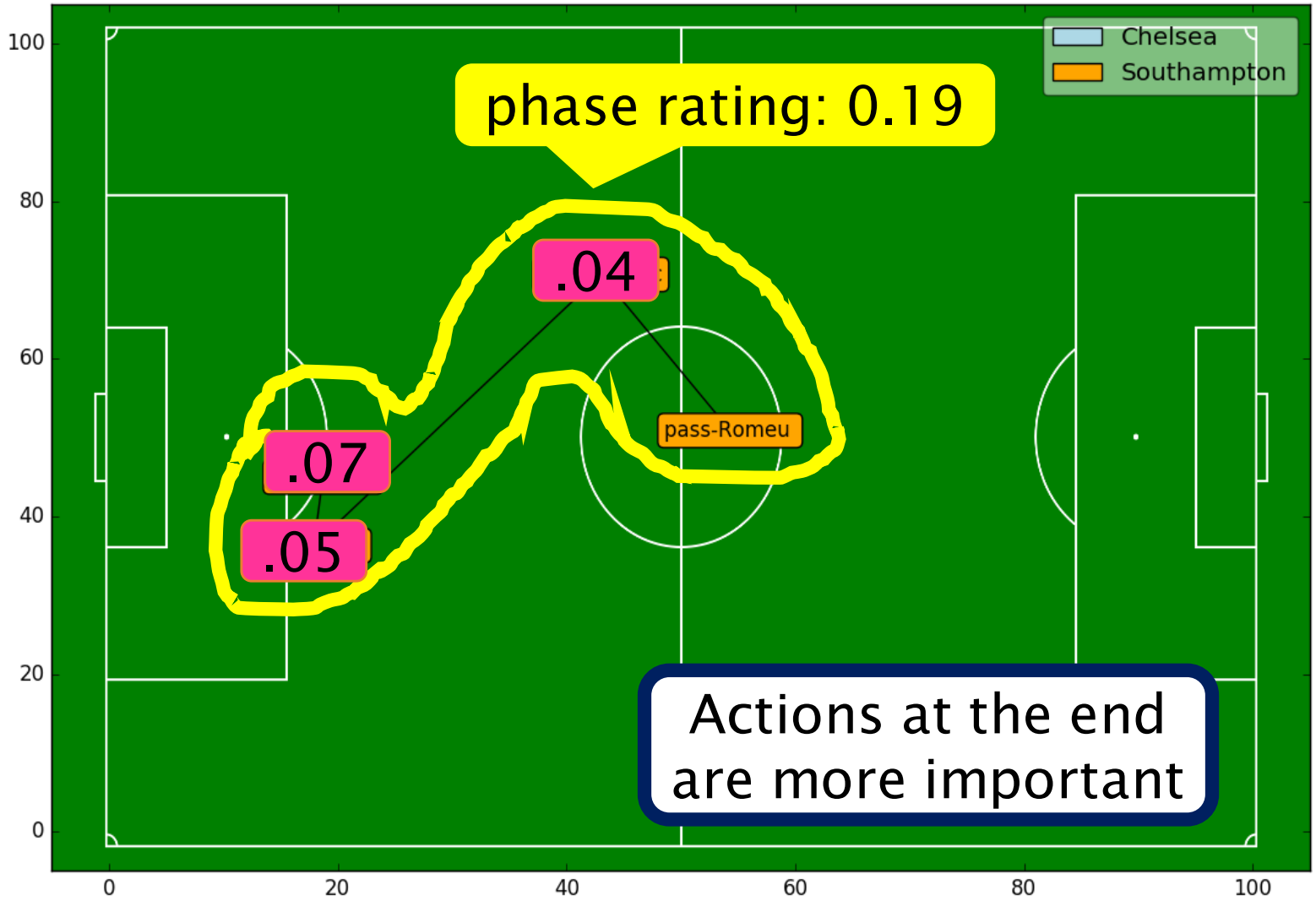

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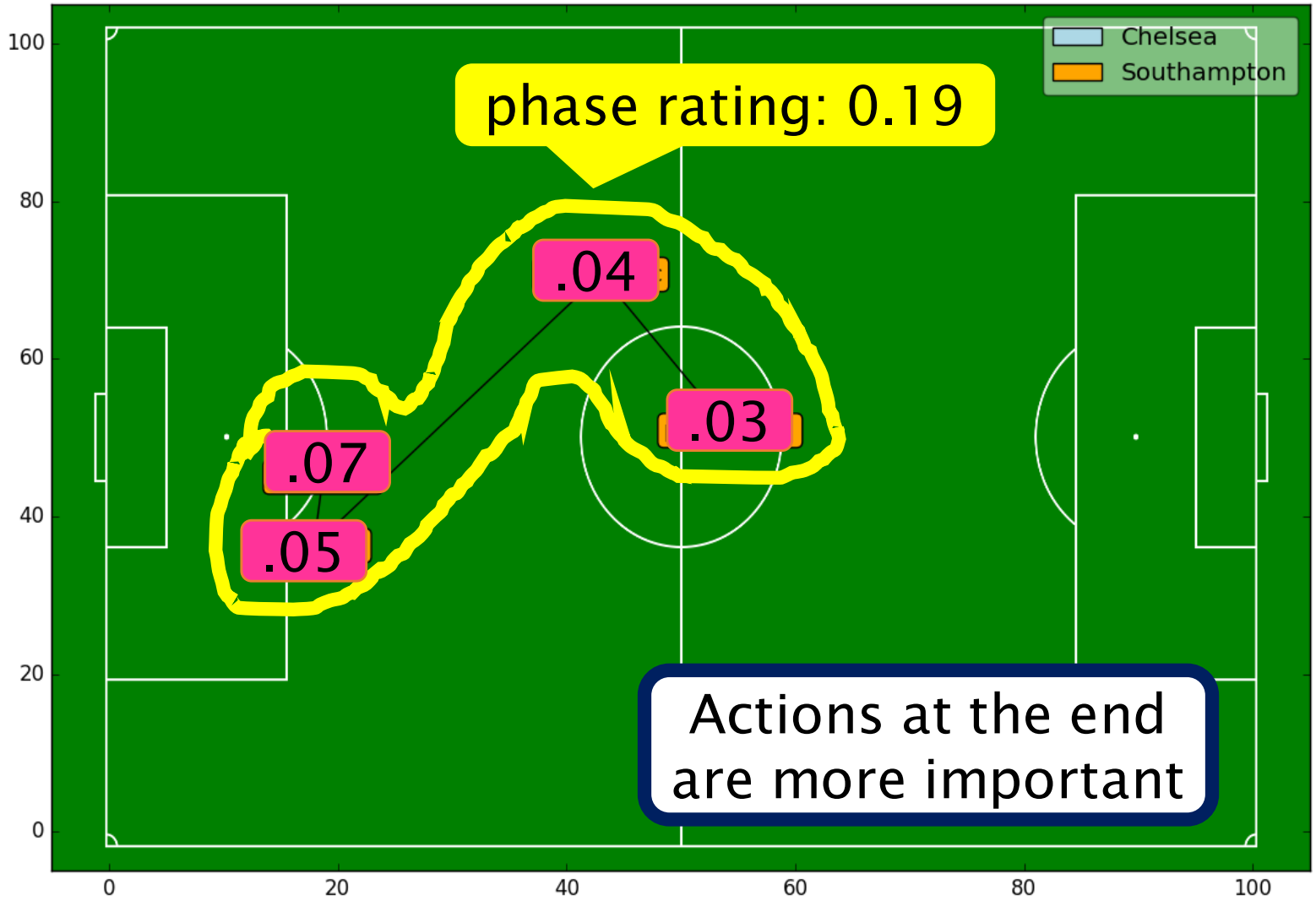

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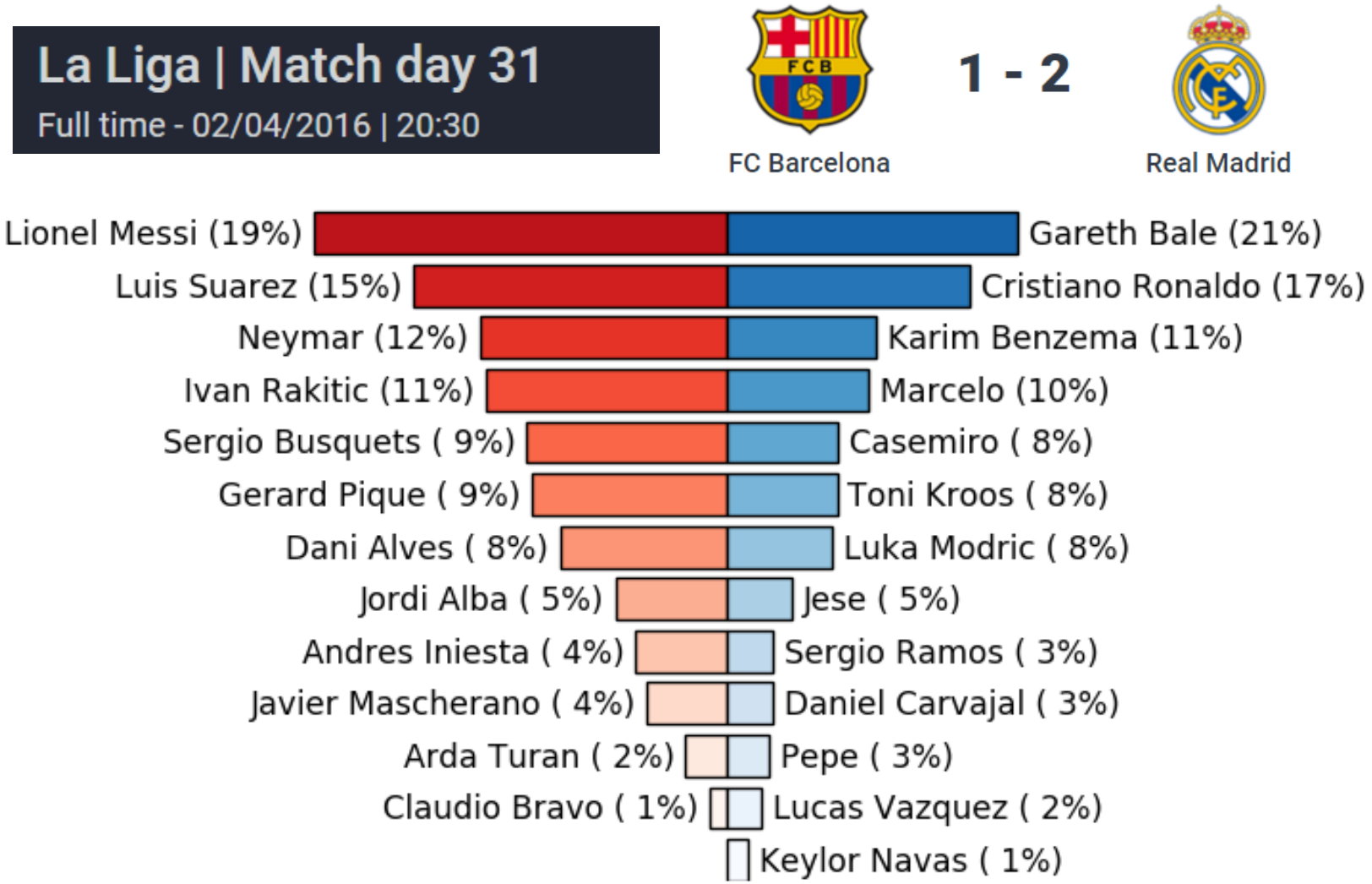
Players can be rated over a season by aggregating their action values

Rank	Team	Player	Rating Per90	Minutes played	Goals Per90	Assists Per90
1	Arsenal	Alexis Sanchez	0.289	2446	0.478	0.147
2	West Ham United	Dimitri Payet	0.279	2571	0.315	0.420
3	West Ham United	Mauro Zarate	0.262	790	0.342	0.000
4	Chelsea	Willian	0.249	2749	0.164	0.196
5	Liverpool	Philippe Coutinho	0.244	2003	0.359	0.225
6	Arsenal	Santi Cazorla	0.240	1292	0.000	0.209
7	Arsenal	Mesut Ozil	0.240	3047	0.177	0.561
8	Sunderland	Wahbi Khazri	0.240	1077	0.167	0.084
9	Aston Villa	Rudy Gestede	0.237	1657	0.272	0.109
10	Manchester City	Kevin De Bruyne	0.233	2003	0.315	0.404
11	Tottenham Hotspur	Christian Eriksen	0.231	2938	0.184	0.398
12	Arsenal	Olivier Giroud	0.231	2424	0.594	0.223
13	Liverpool	Christian Benteke	0.229	1518	0.474	0.178
14	Tottenham Hotspur	Erik Lamela	0.228	2383	0.189	0.340
15	Manchester City	David Silva	0.222	1800	0.100	0.550

Players can be rated over a match by aggregating their action values



Conclusion

STARSS is an approach for automatically rating the actions performed by soccer players.

STARSS accounts for the spatio-temporal context in which actions happened.

STARSS can identify top players
over a season and in an individual match.