



INFO 6205 Ranking System Project Report

Team Members:

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Aim of the Project:

- Develop ranking systems for football teams playing in EPL season 2019-20
- Predict the outcome of remaining matches and rank the teams based on the total points they have earned after playing the entire season.
- Design a flexible prediction model which can be used for any football league

Dataset used for the project:

- 288 matches played in the season 2019-20. Data used from each match outcome is home team, away team, goals scored by home team, goals scored by away team

HomeTeam	AwayTeam	HomeGoals	AwayGoals
Liverpool	Norwich	4	1
West Ham	Man City	0	5
Bournemouth	Sheffield Unit	1	1
Burnley	Southampton	3	0
Crystal Palace	Everton	0	0
Watford	Brighton	0	3
Tottenham	Aston Villa	3	1
Leicester	Wolves	0	0
Newcastle	Arsenal	0	1
Man United	Chelsea	4	0
Arsenal	Burnley	2	1
Aston Villa	Bournemouth	1	2
Brighton	West Ham	1	1
Everton	Watford	1	0
Norwich	Newcastle	3	1
Southampton	Liverpool	1	2
Man City	Tottenham	2	2
Sheffield United	Crystal Palace	1	0
Chelsea	Leicester	1	1

Figure 1.1 Dataset Screenshot

Project Description:

Probability of any team scoring the specific number of goals is calculated using Poisson distribution.

What is Poisson distribution?

Poisson distribution is discrete probability distribution function which can be used to calculate the number of events or occurrences over a specified interval (time, length, distance)

Characteristic of Poisson Distribution:

- Discrete outcomes (In our case number of goals $g = 0,1,2,3$)
- Each event is independent of other events
- Expected number of occurrences $E(X)$ are assumed to be constant throughout the experiment
- Describes the distribution of infrequent events
- The number of occurrences in each interval can range from 0 to infinity (theoretically)
- Describes discrete events over an interval (time, distance etc.)

In this case football goals x is a Poisson random variable and distribution of x is termed as Poisson distribution. In this case we assume that each goal scored is independent of other

Probability of occurrence of x goals is given by following formulae:

$$P(x) = \frac{\lambda^x e^{-\lambda}}{x!}$$

Where λ – average goals number of goals expected from the team

x – probability of x goals in the match

Algorithm Design:

- The basic idea is to take previous data and compute following parameters:
 - Total goal scored by team during away matches
 - Total goal scored by team during home matches
 - Total goals conceded by team during home matches
 - Totals goals conceded by team during away matches

Following table shows the performance of 20 team when it plays at **home** ground:

Team	Games Played	Goal For	Average Goals For	Goals Against	Average Goals Against
Liverpool	15	40	2.666666667	12	0.8
Brighton	14	17	1.214285714	15	1.071428571
Norwich	14	19	1.357142857	26	1.857142857
Sheffield United	15	17	1.133333333	13	0.866666667
Aston Villa	13	18	1.384615385	24	1.846153846
West Ham	14	23	1.642857143	26	1.857142857
Newcastle	14	12	0.857142857	12	0.857142857
Leicester	15	30	2	15	1
Burnley	15	20	1.333333333	19	1.266666667
Tottenham	14	27	1.928571429	15	1.071428571
Bournemouth	14	17	1.214285714	21	1.5
Man United	15	29	1.933333333	12	0.8
Crystal Palace	15	12	0.8	13	0.866666667
Southampton	15	16	1.066666667	31	2.066666667
Watford	14	16	1.142857143	17	1.214285714
Wolves	15	21	1.4	17	1.133333333
Arsenal	15	26	1.733333333	20	1.333333333
Chelsea	15	22	1.466666667	15	1
Everton	14	19	1.357142857	15	1.071428571
Man City	13	33	2.538461538	12	0.923076923

Figure 1.1 Home Team Statistics

Following table shows the performance of 20 teams when it plays at **away** ground:

Team	Games Played	Goal For	Average Goals For	Goals Against	Average Goals Against
Liverpool	14	26	1.857142857	9	0.642857143
Brighton	15	15	1	25	1.666666667
Norwich	15	6	0.4	26	1.733333333
Sheffield United	13	13	1	12	0.923076923
Aston Villa	15	16	1.066666667	32	2.133333333
West Ham	15	12	0.8	24	1.6
Newcastle	15	13	0.866666667	29	1.933333333
Leicester	14	28	2	13	0.928571429
Burnley	14	14	1	21	1.5
Tottenham	15	20	1.333333333	25	1.666666667
Bournemouth	15	12	0.8	26	1.733333333
Man United	14	15	1.071428571	18	1.285714286
Crystal Palace	14	14	1	19	1.357142857
Southampton	14	19	1.357142857	21	1.5
Watford	15	11	0.733333333	27	1.8
Wolves	14	20	1.428571429	17	1.214285714
Arsenal	13	14	1.076923077	16	1.230769231
Chelsea	14	29	2.071428571	24	1.714285714
Everton	15	18	1.2	31	2.066666667
Man City	15	35	2.333333333	19	1.266666667

Figure 1.1 Away Team Statistics

- In the next step we compute to league average for home teams and away teams.

For example, if total home goals scored by all the 20 teams = 200

Total home matches played = 98

League average for home teams = $200/98 = 2.04$

Similarly, league average for away teams

= total goals scored by away teams / total away matches played

- Individual team averages are compared to league average which are used to create values for attacking and defensive strength for every team

Attacking Strength of home team =

Home team's average goals per home game / average home league goals per game

Defensive Strength of home team =

Home team's average goals conceded per home game / average home league goals per game

Attacking Strength of away team =

Away team's average goals per home game / average away league goals per game

Defensive Strength of away team =

Away team's average goals conceded per home game / average away league goals per game

Following table shows computed attacking and defensive strength:

Team	Home Attack Strength	Home Defense Strength	Away Attack Strength	Away Defense Strength
Liverpool	1.769585253	0.658285714	1.528163265	0.426596445
Brighton	0.805793285	0.881632653	0.822857143	1.105990783
Norwich	0.900592495	1.528163265	0.329142857	1.150230415
Sheffield United	0.752073733	0.713142857	0.822857143	0.612548742
Aston Villa	0.918823112	1.519120879	0.877714286	1.415668203
West Ham	1.090190915	1.528163265	0.658285714	1.061751152
Newcastle	0.56879526	0.705306122	0.713142857	1.282949309
Leicester	1.32718894	0.822857143	1.645714286	0.616194865
Burnley	0.884792627	1.042285714	0.822857143	0.995391705
Tottenham	1.279789335	0.881632653	1.097142857	1.105990783
Bournemouth	0.805793285	1.234285714	0.658285714	1.150230415
Man United	1.282949309	0.658285714	0.881632653	0.85319289
Crystal Palace	0.530875576	0.713142857	0.822857143	0.900592495
Southampton	0.707834101	1.700571429	1.116734694	0.995391705
Watford	0.75839368	0.999183673	0.603428571	1.194470046
Wolves	0.929032258	0.932571429	1.175510204	0.805793285
Arsenal	1.150230415	1.097142857	0.886153846	0.816731655
Chelsea	0.973271889	0.822857143	1.704489796	1.13759052
Everton	0.900592495	0.881632653	0.987428571	1.371428571
Man City	1.684509039	0.75956044	1.92	0.840552995

- Attacking and defensive strengths are used to calculate goal expectancy of home team and away team

Goal expectancy of home team =

Attack strength of home team * defensive strength of away team * average home goals of league

Goal expectancy of away team =

Attack strength of away team * defensive strength of home team * average away goals of league

- This metric is put into Poisson distribution formulae which calculates the probability of every result when two teams face each other

Steps for calculating probability matrix:

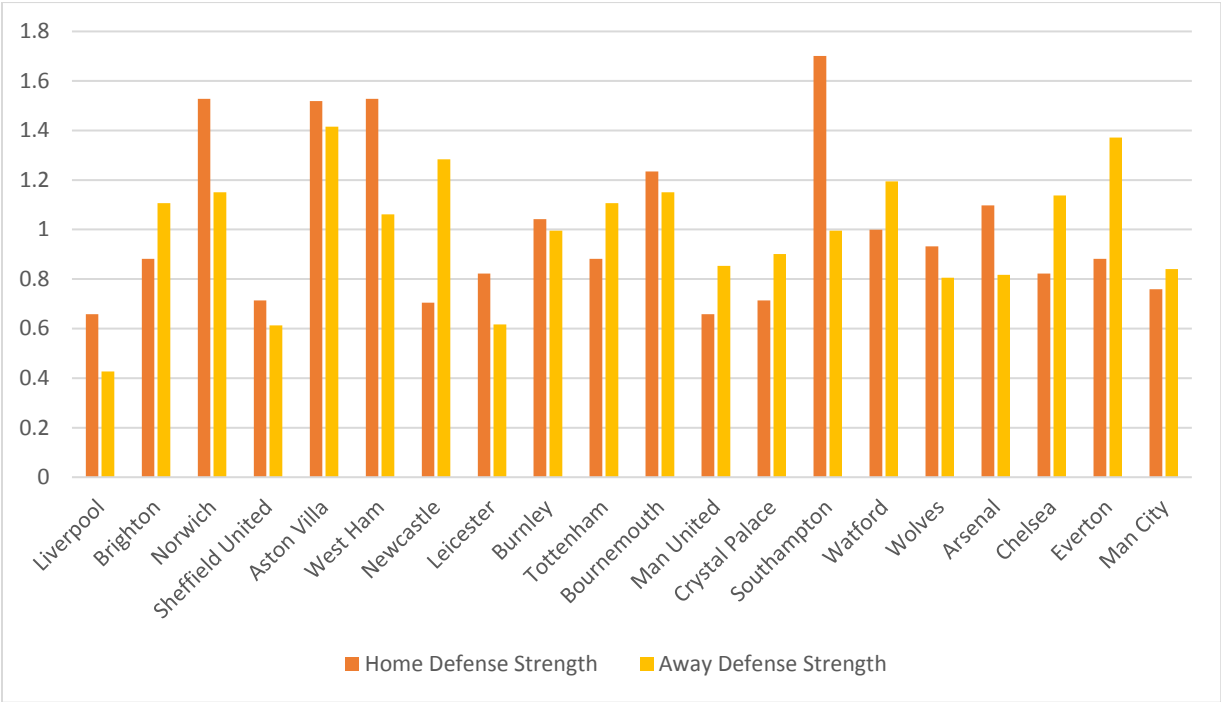
Example: West Ham vs Aston Villa

1. Projected goal expectancy of home team West Ham = 2.085
2. Projected goal expectancy of away team Aston Villa = 1.093
3. Initialize the constructor with expected home and away team average
PoissonDistribution poissonDistHomeObj = new PoissonDistribution (2.085);
PoissonDistribution poissonDistAwayObj = new PoissonDistribution (1.093);
4. Calculate the probability of 0-0 goals by giving input as 0 to
poissonDistAwayObj and 0 to poissonDistHomeObj
`poissonDistAwayObj.probability(0) * poissonDistHomeObj.probability(0) * 100;`
Similarly calculate the probability for all goal scoring outcomes by creating a matrix given below
5. From the matrix it can be concluded that probability of West Ham scoring 2 goals and Aston Villa scoring 1 goal is highest. Based on this result model decides the winning team.
6. 3 points are added to winning team. Losing team gets 0 points and if probability of both the teams scoring same goals is highest then both the teams get 1-1 point.

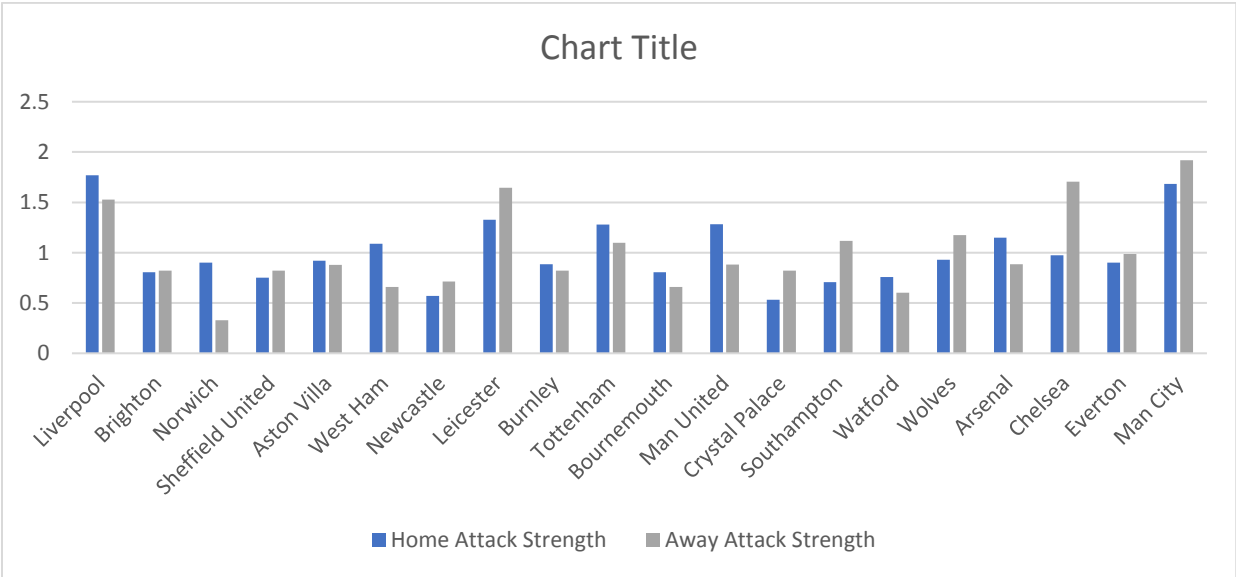
Probability Matrix:

	Home team goals	0	1	2	3	4
Away team goals	Poisson prob for number of goals per team	12.353	25.767	26.865	18.681	9.732
0	31.444	4.159	8.675	9.04	6.290	3.280
1	34.399	4.550	9.491	9.898	6.88	3.58
2	18.82	2.489	5.191	5.414	3.764	1.962
3	6.861	0.907	1.893	1.974	1.372	0.715
4	1.874	0.248	0.517	0.539	0.375	0.195

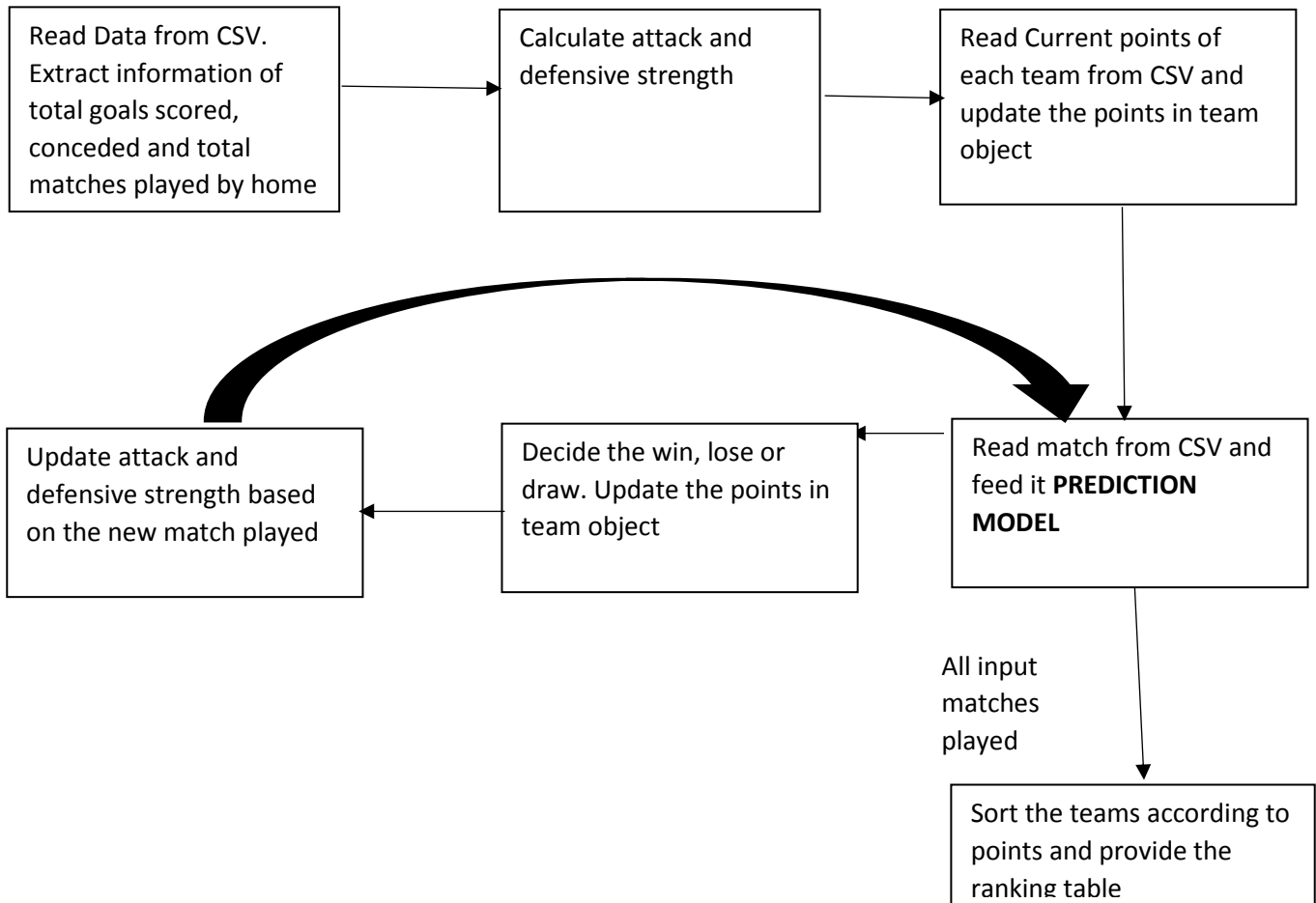
Home Defense Strength Vs Away Defense Strength



Home Attack Strength Vs Away Attack Strength



Software Design:



Software Design:

- **Data Structure:**

HashMap is used where key – Team Name, Value – Team object

```
private static HashMap<String, Team> teamData = new  
HashMap<String,Team>();
```

- Used factory design pattern to create team objects
- Provided modularity and abstraction using team interface which is implemented by teamRecord class

OUTPUT SCREENSHOT:

2019-20 Premier League Standings											
Ranking	Premier ...	GP	PTS	W	D	L	GF	GA	GD	HOME	AWAY
1	Liverpool	38	100	32	4	2	76	22	54	19-0-0	13-4-2
2	Man City	38	83	26	5	7	83	32	51	15-2-2	11-3-5
3	Leicester	38	72	22	6	10	65	30	35	13-3-3	9-3-7
4	Chelsea	38	67	20	7	11	61	45	16	10-4-5	10-3-6
5	Sheffiel...	38	61	16	13	9	36	27	9	10-4-5	6-9-4
6	Man Uni...	38	60	16	12	10	50	33	17	12-5-2	4-7-8
7	Wolves	38	59	14	17	7	49	39	10	7-9-3	7-8-4
8	Tottenh...	38	58	16	10	12	53	43	10	13-2-4	3-8-8
9	Arsenal	38	54	12	18	8	46	42	4	9-7-3	3-11-5
10	Everton	38	48	13	9	16	42	52	-10	10-5-4	3-4-12
11	Burnley	38	47	12	11	15	37	47	-10	8-5-6	4-6-9
12	Crystal ...	38	45	10	15	13	29	39	-10	6-7-6	4-8-7
13	Newcas...	38	43	10	13	15	27	47	-20	6-10-3	4-3-12
14	Brighton	38	40	8	16	14	37	46	-9	5-9-5	3-7-9
15	Southa...	38	38	11	5	22	39	62	-23	4-2-13	7-3-9
16	Watford	38	37	8	13	17	32	50	-18	6-7-6	2-6-11
17	Bourne...	38	35	9	8	21	33	56	-23	6-7-6	3-1-15
18	West Ha...	38	33	8	9	21	41	60	-19	5-5-9	3-4-12
19	Norwich	38	29	7	8	23	30	61	-31	6-5-8	1-3-15
20	Aston Vil...	38	28	7	7	24	40	73	-33	5-5-9	2-2-15