

Transformation of PGN format for MBA:

the association rules requires a sparse matrix in order to run to completion.

Install required python libraries

```
In [8]: %pip install mlxtend pandas
```

Collecting mlxtend

Using cached mlxtend-0.23.4-py3-none-any.whl.metadata (7.3 kB)
 Requirement already satisfied: pandas in /opt/anaconda3/lib/python3.12/site-packages (2.2.2)
 Requirement already satisfied: scipy>=1.2.1 in /opt/anaconda3/lib/python3.12/site-packages (from mlxtend) (1.13.1)
 Requirement already satisfied: numpy>=1.16.2 in /opt/anaconda3/lib/python3.12/site-packages (from mlxtend) (1.26.4)
 Requirement already satisfied: scikit-learn>=1.3.1 in /opt/anaconda3/lib/python3.12/site-packages (from mlxtend) (1.5.1)
 Requirement already satisfied: matplotlib>=3.0.0 in /opt/anaconda3/lib/python3.12/site-packages (from mlxtend) (3.9.2)
 Requirement already satisfied: joblib>=0.13.2 in /opt/anaconda3/lib/python3.12/site-packages (from mlxtend) (1.4.2)
 Requirement already satisfied: python-dateutil>=2.8.2 in /opt/anaconda3/lib/python3.12/site-packages (from pandas) (2.9.0.post0)
 Requirement already satisfied: pytz>=2020.1 in /opt/anaconda3/lib/python3.12/site-packages (from pandas) (2024.1)
 Requirement already satisfied: tzdata>=2022.7 in /opt/anaconda3/lib/python3.12/site-packages (from pandas) (2023.3)
 Requirement already satisfied: contourpy>=1.0.1 in /opt/anaconda3/lib/python3.12/site-packages (from matplotlib>=3.0.0->mlxtend) (1.2.0)
 Requirement already satisfied: cycler>=0.10 in /opt/anaconda3/lib/python3.12/site-packages (from matplotlib>=3.0.0->mlxtend) (0.11.0)
 Requirement already satisfied: fonttools>=4.22.0 in /opt/anaconda3/lib/python3.12/site-packages (from matplotlib>=3.0.0->mlxtend) (4.51.0)
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 Requirement already satisfied: six>=1.5 in /opt/anaconda3/lib/python3.12/site-packages (from python-dateutil>=2.8.2->pandas) (1.16.0)
 Requirement already satisfied: threadpoolctl>=3.1.0 in /opt/anaconda3/lib/python3.12/site-packages (from scikit-learn>=1.3.1->mlxtend) (3.5.0)
 Downloading mlxtend-0.23.4-py3-none-any.whl (1.4 MB)

1.4/1.4 MB 4.0 MB/s eta 0:00:00a
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Installing collected packages: mlxtend

Successfully installed mlxtend-0.23.4

Note: you may need to restart the kernel to use updated packages.

Import libraries for required functionality

```
In [73]: import pandas as pd
         from mlxtend.frequent_patterns import apriori, association_rules, fpmax, fpgm
```

```
from mlxtend.preprocessing import TransactionEncoder
```

We need to generalize groups of moves into baskets. Coincidentally, each game of chess breaks up like a story into a beginning or opening, middle and end. These three parts is just one way of breaking up the game, within each of these groups further subdivisions will help to create more sparse transactions. The results of each game maps via association to each layer or grouping.

The edit distance metric via a dynamic programming algorithm assists with generalizing specific moves to a limited set of 384 different possible moves or products for the basket / transactions.

```
In [76]: def edit_distance(predefined_set, actual_move):
    m, n = len(predefined_set), len(actual_move)
    dynamic_programming_table = [[0] * (n + 1) for _ in range(m + 1)]

    # Initialize the dynamic_programming_table
    for i in range(m + 1):
        for j in range(n + 1):
            if i == 0:
                dynamic_programming_table[i][j] = j # Insert characters of
            elif j == 0:
                dynamic_programming_table[i][j] = i # Remove characters of
            elif predefined_set[i - 1] == actual_move[j - 1]:
                dynamic_programming_table[i][j] = dynamic_programming_table[i - 1][j - 1]
            else:
                dynamic_programming_table[i][j] = 1 + min(
                    dynamic_programming_table[i - 1][j - 1],
                    dynamic_programming_table[i][j - 1], #
                    dynamic_programming_table[i - 1][j] #
                )
    return dynamic_programming_table[m][n]
```

Verify or set our expectations of the edit distance metrics:

```
In [79]: possible_chess_moves = "Ba1 Ba2 Ba3 Ba4 Ba5 Ba6 Ba7 Ba8 Bb1 Bb2 Bb3 Bb4 Bb5
possible_chess_moves_w_player = " 1a1 1a2 1a3 1a4 1a5 1a6 1a7 1a8 1b1 1b2 1b3 1b4 1b5
possible_chess_moves_w_captures = "Ba1 Ba2 Ba3 Ba4 Ba5 Ba6 Ba7 Ba8 Bb1 Bb2 Bb3 Bb4 Bb5
possible_chess_moves_w_both = "1a1 1a2 1a3 1a4 1a5 1a6 1a7 1a8 1axb1 1axb2 1axb3 1axb4 1axb5
tests="""1.d4 d5 2.c4 c6 3.Nc3 Nf6 4.e3 a6 5.Bd3 b5 6.cxd5 cxd5 7.Bd2 e6 8.Ne5 Nbd7
9.Ne5 Nbd7 10.f4 Bb7 11.0-0 0-0 12.Rc1 Nb6 13.Qf3 Rc8 14.Nb1 Qe7 15.b3 Nc4
16.Bc3 Na3 17.Bb2 Nxb1 18.Bxb1 Ne4 19.Qe2 f6 20.Nd3 Bb4 1/2-1/2"""
print (tests)
tcs =tests.split()
pcm = possible_chess_moves_w_both.split()
for t in tcs:
    t="2"+t
    if t.find('.')>0:
```

```

t="1"+t.split('.')[1]
min_distance = 100
for p in pcm:
    if edit_distance(p,t) <= min_distance:
        min_distance = edit_distance(p,t)
        print (f"Possible move: {p} - Actual move: {t} - Distance: {edit_distance(p,t)}")

```

1.d4 d5 2.c4 c6 3.Nc3 Nf6 4.e3 a6 5.Bd3 b5 6.cxd5 cxd5 7.Bd2 e6 8.Nf3 Bd6
 9.Ne5 Nbd7 10.f4 Bb7 11.O-O O-O 12.Rc1 Nb6 13.Qf3 Rc8 14.Nb1 Qe7 15.b3 Nc4
 16.Bc3 Na3 17.Bb2 Nxb1 18.Bxb1 Ne4 19.Qe2 f6 20.Nd3 Bb4 1/2-1/2

Possible move: 1a1 - Actual move: 1d4 - Distance: 2
 Possible move: 1a2 - Actual move: 1d4 - Distance: 2
 Possible move: 1a3 - Actual move: 1d4 - Distance: 2
 Possible move: 1a4 - Actual move: 1d4 - Distance: 1
 Possible move: 1b4 - Actual move: 1d4 - Distance: 1
 Possible move: 1Bd4 - Actual move: 1d4 - Distance: 1
 Possible move: 1c4 - Actual move: 1d4 - Distance: 1
 Possible move: 1d1 - Actual move: 1d4 - Distance: 1
 Possible move: 1d2 - Actual move: 1d4 - Distance: 1
 Possible move: 1d3 - Actual move: 1d4 - Distance: 1
 Possible move: 1d4 - Actual move: 1d4 - Distance: 0
 Possible move: 1a1 - Actual move: 2d5 - Distance: 3
 Possible move: 1a2 - Actual move: 2d5 - Distance: 3
 Possible move: 1a3 - Actual move: 2d5 - Distance: 3
 Possible move: 1a4 - Actual move: 2d5 - Distance: 3
 Possible move: 1a5 - Actual move: 2d5 - Distance: 2
 Possible move: 1b5 - Actual move: 2d5 - Distance: 2
 Possible move: 1Bd5 - Actual move: 2d5 - Distance: 2
 Possible move: 1c5 - Actual move: 2d5 - Distance: 2
 Possible move: 1d1 - Actual move: 2d5 - Distance: 2
 Possible move: 1d2 - Actual move: 2d5 - Distance: 2
 Possible move: 1d3 - Actual move: 2d5 - Distance: 2
 Possible move: 1d4 - Actual move: 2d5 - Distance: 2
 Possible move: 1d5 - Actual move: 2d5 - Distance: 1
 Possible move: 2a5 - Actual move: 2d5 - Distance: 1
 Possible move: 2b5 - Actual move: 2d5 - Distance: 1
 Possible move: 2Bd5 - Actual move: 2d5 - Distance: 1
 Possible move: 2c5 - Actual move: 2d5 - Distance: 1
 Possible move: 2d1 - Actual move: 2d5 - Distance: 1
 Possible move: 2d2 - Actual move: 2d5 - Distance: 1
 Possible move: 2d3 - Actual move: 2d5 - Distance: 1
 Possible move: 2d4 - Actual move: 2d5 - Distance: 1
 Possible move: 2d5 - Actual move: 2d5 - Distance: 0
 Possible move: 1a1 - Actual move: 1c4 - Distance: 2
 Possible move: 1a2 - Actual move: 1c4 - Distance: 2
 Possible move: 1a3 - Actual move: 1c4 - Distance: 2
 Possible move: 1a4 - Actual move: 1c4 - Distance: 1
 Possible move: 1b4 - Actual move: 1c4 - Distance: 1
 Possible move: 1Bc4 - Actual move: 1c4 - Distance: 1
 Possible move: 1c1 - Actual move: 1c4 - Distance: 1

Possible move: 1c2 - Actual move: 1c4 - Distance: 1
Possible move: 1c3 - Actual move: 1c4 - Distance: 1
Possible move: 1c4 - Actual move: 1c4 - Distance: 0
Possible move: 1a1 - Actual move: 2c6 - Distance: 3
Possible move: 1a2 - Actual move: 2c6 - Distance: 3
Possible move: 1a3 - Actual move: 2c6 - Distance: 3
Possible move: 1a4 - Actual move: 2c6 - Distance: 3
Possible move: 1a5 - Actual move: 2c6 - Distance: 3
Possible move: 1a6 - Actual move: 2c6 - Distance: 2
Possible move: 1b6 - Actual move: 2c6 - Distance: 2
Possible move: 1Bc6 - Actual move: 2c6 - Distance: 2
Possible move: 1c1 - Actual move: 2c6 - Distance: 2
Possible move: 1c2 - Actual move: 2c6 - Distance: 2
Possible move: 1c3 - Actual move: 2c6 - Distance: 2
Possible move: 1c4 - Actual move: 2c6 - Distance: 2
Possible move: 1c5 - Actual move: 2c6 - Distance: 2
Possible move: 1c6 - Actual move: 2c6 - Distance: 1
Possible move: 2a6 - Actual move: 2c6 - Distance: 1
Possible move: 2b6 - Actual move: 2c6 - Distance: 1
Possible move: 2Bc6 - Actual move: 2c6 - Distance: 1
Possible move: 2c1 - Actual move: 2c6 - Distance: 1
Possible move: 2c2 - Actual move: 2c6 - Distance: 1
Possible move: 2c3 - Actual move: 2c6 - Distance: 1
Possible move: 2c4 - Actual move: 2c6 - Distance: 1
Possible move: 2c5 - Actual move: 2c6 - Distance: 1
Possible move: 2c6 - Actual move: 2c6 - Distance: 0
Possible move: 1a1 - Actual move: 1Nc3 - Distance: 3
Possible move: 1a2 - Actual move: 1Nc3 - Distance: 3
Possible move: 1a3 - Actual move: 1Nc3 - Distance: 2
Possible move: 1b3 - Actual move: 1Nc3 - Distance: 2
Possible move: 1Ba3 - Actual move: 1Nc3 - Distance: 2
Possible move: 1Bb3 - Actual move: 1Nc3 - Distance: 2
Possible move: 1Bc1 - Actual move: 1Nc3 - Distance: 2
Possible move: 1Bc2 - Actual move: 1Nc3 - Distance: 2
Possible move: 1Bc3 - Actual move: 1Nc3 - Distance: 1
Possible move: 1c3 - Actual move: 1Nc3 - Distance: 1
Possible move: 1Kc3 - Actual move: 1Nc3 - Distance: 1
Possible move: 1Na3 - Actual move: 1Nc3 - Distance: 1
Possible move: 1Nb3 - Actual move: 1Nc3 - Distance: 1
Possible move: 1Nc1 - Actual move: 1Nc3 - Distance: 1
Possible move: 1Nc2 - Actual move: 1Nc3 - Distance: 1
Possible move: 1Nc3 - Actual move: 1Nc3 - Distance: 0
Possible move: 1a1 - Actual move: 2Nf6 - Distance: 4
Possible move: 1a2 - Actual move: 2Nf6 - Distance: 4
Possible move: 1a3 - Actual move: 2Nf6 - Distance: 4
Possible move: 1a4 - Actual move: 2Nf6 - Distance: 4
Possible move: 1a5 - Actual move: 2Nf6 - Distance: 4
Possible move: 1a6 - Actual move: 2Nf6 - Distance: 3
Possible move: 1b6 - Actual move: 2Nf6 - Distance: 3
Possible move: 1Ba6 - Actual move: 2Nf6 - Distance: 3

Possible move: 1Bb6 – Actual move: 2Nf6 – Distance: 3
Possible move: 1Bc6 – Actual move: 2Nf6 – Distance: 3
Possible move: 1Bd6 – Actual move: 2Nf6 – Distance: 3
Possible move: 1Be6 – Actual move: 2Nf6 – Distance: 3
Possible move: 1Bf1 – Actual move: 2Nf6 – Distance: 3
Possible move: 1Bf2 – Actual move: 2Nf6 – Distance: 3
Possible move: 1Bf3 – Actual move: 2Nf6 – Distance: 3
Possible move: 1Bf4 – Actual move: 2Nf6 – Distance: 3
Possible move: 1Bf5 – Actual move: 2Nf6 – Distance: 3
Possible move: 1Bf6 – Actual move: 2Nf6 – Distance: 2
Possible move: 1f6 – Actual move: 2Nf6 – Distance: 2
Possible move: 1Kf6 – Actual move: 2Nf6 – Distance: 2
Possible move: 1Na6 – Actual move: 2Nf6 – Distance: 2
Possible move: 1Nb6 – Actual move: 2Nf6 – Distance: 2
Possible move: 1Nc6 – Actual move: 2Nf6 – Distance: 2
Possible move: 1Nd6 – Actual move: 2Nf6 – Distance: 2
Possible move: 1Ne6 – Actual move: 2Nf6 – Distance: 2
Possible move: 1Nf1 – Actual move: 2Nf6 – Distance: 2
Possible move: 1Nf2 – Actual move: 2Nf6 – Distance: 2
Possible move: 1Nf3 – Actual move: 2Nf6 – Distance: 2
Possible move: 1Nf4 – Actual move: 2Nf6 – Distance: 2
Possible move: 1Nf5 – Actual move: 2Nf6 – Distance: 2
Possible move: 1Nf6 – Actual move: 2Nf6 – Distance: 1
Possible move: 2Bf6 – Actual move: 2Nf6 – Distance: 1
Possible move: 2f6 – Actual move: 2Nf6 – Distance: 1
Possible move: 2Kf6 – Actual move: 2Nf6 – Distance: 1
Possible move: 2Na6 – Actual move: 2Nf6 – Distance: 1
Possible move: 2Nb6 – Actual move: 2Nf6 – Distance: 1
Possible move: 2Nc6 – Actual move: 2Nf6 – Distance: 1
Possible move: 2Nd6 – Actual move: 2Nf6 – Distance: 1
Possible move: 2Ne6 – Actual move: 2Nf6 – Distance: 1
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Possible move: 2Nf2 – Actual move: 2Nf6 – Distance: 1
Possible move: 2Nf3 – Actual move: 2Nf6 – Distance: 1
Possible move: 2Nf4 – Actual move: 2Nf6 – Distance: 1
Possible move: 2Nf5 – Actual move: 2Nf6 – Distance: 1
Possible move: 2Nf6 – Actual move: 2Nf6 – Distance: 0
Possible move: 1a1 – Actual move: 1e3 – Distance: 2
Possible move: 1a2 – Actual move: 1e3 – Distance: 2
Possible move: 1a3 – Actual move: 1e3 – Distance: 1
Possible move: 1b3 – Actual move: 1e3 – Distance: 1
Possible move: 1Be3 – Actual move: 1e3 – Distance: 1
Possible move: 1c3 – Actual move: 1e3 – Distance: 1
Possible move: 1d3 – Actual move: 1e3 – Distance: 1
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Possible move: 1e3 – Actual move: 1e3 – Distance: 0
Possible move: 1a1 – Actual move: 2a6 – Distance: 2
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Possible move: 1Ba1 – Actual move: 1Bd3 – Distance: 2
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Possible move: 1a1 – Actual move: 1cxd5 – Distance: 4
Possible move: 1a2 – Actual move: 1cxd5 – Distance: 4
Possible move: 1a3 – Actual move: 1cxd5 – Distance: 4
Possible move: 1a4 – Actual move: 1cxd5 – Distance: 4
Possible move: 1a5 – Actual move: 1cxd5 – Distance: 3
Possible move: 1axb1 – Actual move: 1cxd5 – Distance: 3
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Possible move: 1axb3 – Actual move: 1cxd5 – Distance: 3
Possible move: 1axb4 – Actual move: 1cxd5 – Distance: 3
Possible move: 1axb5 – Actual move: 1cxd5 – Distance: 2
Possible move: 1Bd5 – Actual move: 1cxd5 – Distance: 2
Possible move: 1bxa5 – Actual move: 1cxd5 – Distance: 2
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Possible move: 1cxd5 – Actual move: 1cxd5 – Distance: 0
Possible move: 1a1 – Actual move: 2cxd5 – Distance: 5
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Possible move: 1a3 – Actual move: 2cxd5 – Distance: 5
Possible move: 1a4 – Actual move: 2cxd5 – Distance: 5
Possible move: 1a5 – Actual move: 2cxd5 – Distance: 4
Possible move: 1axb1 – Actual move: 2cxd5 – Distance: 4
Possible move: 1axb2 – Actual move: 2cxd5 – Distance: 4
Possible move: 1axb3 – Actual move: 2cxd5 – Distance: 4
Possible move: 1axb4 – Actual move: 2cxd5 – Distance: 4
Possible move: 1axb5 – Actual move: 2cxd5 – Distance: 3
Possible move: 1Bd5 – Actual move: 2cxd5 – Distance: 3
Possible move: 1bxa5 – Actual move: 2cxd5 – Distance: 3
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Possible move: 1cxd4 – Actual move: 2cxd5 – Distance: 2
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Possible move: 2Bxd5 – Actual move: 2cxd5 – Distance: 1
Possible move: 2cxd1 – Actual move: 2cxd5 – Distance: 1
Possible move: 2cxd2 – Actual move: 2cxd5 – Distance: 1
Possible move: 2cxd3 – Actual move: 2cxd5 – Distance: 1
Possible move: 2cxd4 – Actual move: 2cxd5 – Distance: 1
Possible move: 2cxd5 – Actual move: 2cxd5 – Distance: 0
Possible move: 1a1 – Actual move: 1Bd2 – Distance: 3
Possible move: 1a2 – Actual move: 1Bd2 – Distance: 2
Possible move: 1b2 – Actual move: 1Bd2 – Distance: 2

Possible move: 1Ba1 – Actual move: 1Bd2 – Distance: 2
Possible move: 1Ba2 – Actual move: 1Bd2 – Distance: 1
Possible move: 1Bb2 – Actual move: 1Bd2 – Distance: 1
Possible move: 1Bc2 – Actual move: 1Bd2 – Distance: 1
Possible move: 1Bd1 – Actual move: 1Bd2 – Distance: 1
Possible move: 1Bd2 – Actual move: 1Bd2 – Distance: 0
Possible move: 1a1 – Actual move: 2e6 – Distance: 3
Possible move: 1a2 – Actual move: 2e6 – Distance: 3
Possible move: 1a3 – Actual move: 2e6 – Distance: 3
Possible move: 1a4 – Actual move: 2e6 – Distance: 3
Possible move: 1a5 – Actual move: 2e6 – Distance: 3
Possible move: 1a6 – Actual move: 2e6 – Distance: 2
Possible move: 1b6 – Actual move: 2e6 – Distance: 2
Possible move: 1Be6 – Actual move: 2e6 – Distance: 2
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Possible move: 1e1 – Actual move: 2e6 – Distance: 2
Possible move: 1e2 – Actual move: 2e6 – Distance: 2
Possible move: 1e3 – Actual move: 2e6 – Distance: 2
Possible move: 1e4 – Actual move: 2e6 – Distance: 2
Possible move: 1e5 – Actual move: 2e6 – Distance: 2
Possible move: 1e6 – Actual move: 2e6 – Distance: 1
Possible move: 2a6 – Actual move: 2e6 – Distance: 1
Possible move: 2b6 – Actual move: 2e6 – Distance: 1
Possible move: 2Be6 – Actual move: 2e6 – Distance: 1
Possible move: 2c6 – Actual move: 2e6 – Distance: 1
Possible move: 2d6 – Actual move: 2e6 – Distance: 1
Possible move: 2e1 – Actual move: 2e6 – Distance: 1
Possible move: 2e2 – Actual move: 2e6 – Distance: 1
Possible move: 2e3 – Actual move: 2e6 – Distance: 1
Possible move: 2e4 – Actual move: 2e6 – Distance: 1
Possible move: 2e5 – Actual move: 2e6 – Distance: 1
Possible move: 2e6 – Actual move: 2e6 – Distance: 0
Possible move: 1a1 – Actual move: 1Nf3 – Distance: 3
Possible move: 1a2 – Actual move: 1Nf3 – Distance: 3
Possible move: 1a3 – Actual move: 1Nf3 – Distance: 2
Possible move: 1b3 – Actual move: 1Nf3 – Distance: 2
Possible move: 1Ba3 – Actual move: 1Nf3 – Distance: 2
Possible move: 1Bb3 – Actual move: 1Nf3 – Distance: 2
Possible move: 1Bc3 – Actual move: 1Nf3 – Distance: 2
Possible move: 1Bd3 – Actual move: 1Nf3 – Distance: 2
Possible move: 1Be3 – Actual move: 1Nf3 – Distance: 2
Possible move: 1Bf1 – Actual move: 1Nf3 – Distance: 2
Possible move: 1Bf2 – Actual move: 1Nf3 – Distance: 2
Possible move: 1Bf3 – Actual move: 1Nf3 – Distance: 1
Possible move: 1f3 – Actual move: 1Nf3 – Distance: 1
Possible move: 1Kf3 – Actual move: 1Nf3 – Distance: 1
Possible move: 1Na3 – Actual move: 1Nf3 – Distance: 1
Possible move: 1Nb3 – Actual move: 1Nf3 – Distance: 1
Possible move: 1Nc3 – Actual move: 1Nf3 – Distance: 1

Possible move: 1Nd3 – Actual move: 1Nf3 – Distance: 1
Possible move: 1Ne3 – Actual move: 1Nf3 – Distance: 1
Possible move: 1Nf1 – Actual move: 1Nf3 – Distance: 1
Possible move: 1Nf2 – Actual move: 1Nf3 – Distance: 1
Possible move: 1Nf3 – Actual move: 1Nf3 – Distance: 0
Possible move: 1a1 – Actual move: 2Bd6 – Distance: 4
Possible move: 1a2 – Actual move: 2Bd6 – Distance: 4
Possible move: 1a3 – Actual move: 2Bd6 – Distance: 4
Possible move: 1a4 – Actual move: 2Bd6 – Distance: 4
Possible move: 1a5 – Actual move: 2Bd6 – Distance: 4
Possible move: 1a6 – Actual move: 2Bd6 – Distance: 3
Possible move: 1b6 – Actual move: 2Bd6 – Distance: 3
Possible move: 1Ba1 – Actual move: 2Bd6 – Distance: 3
Possible move: 1Ba2 – Actual move: 2Bd6 – Distance: 3
Possible move: 1Ba3 – Actual move: 2Bd6 – Distance: 3
Possible move: 1Ba4 – Actual move: 2Bd6 – Distance: 3
Possible move: 1Ba5 – Actual move: 2Bd6 – Distance: 3
Possible move: 1Ba6 – Actual move: 2Bd6 – Distance: 2
Possible move: 1Bb6 – Actual move: 2Bd6 – Distance: 2
Possible move: 1Bc6 – Actual move: 2Bd6 – Distance: 2
Possible move: 1Bd1 – Actual move: 2Bd6 – Distance: 2
Possible move: 1Bd2 – Actual move: 2Bd6 – Distance: 2
Possible move: 1Bd3 – Actual move: 2Bd6 – Distance: 2
Possible move: 1Bd4 – Actual move: 2Bd6 – Distance: 2
Possible move: 1Bd5 – Actual move: 2Bd6 – Distance: 2
Possible move: 1Bd6 – Actual move: 2Bd6 – Distance: 1
Possible move: 2Ba6 – Actual move: 2Bd6 – Distance: 1
Possible move: 2Bb6 – Actual move: 2Bd6 – Distance: 1
Possible move: 2Bc6 – Actual move: 2Bd6 – Distance: 1
Possible move: 2Bd1 – Actual move: 2Bd6 – Distance: 1
Possible move: 2Bd2 – Actual move: 2Bd6 – Distance: 1
Possible move: 2Bd3 – Actual move: 2Bd6 – Distance: 1
Possible move: 2Bd4 – Actual move: 2Bd6 – Distance: 1
Possible move: 2Bd5 – Actual move: 2Bd6 – Distance: 1
Possible move: 2Bd6 – Actual move: 2Bd6 – Distance: 0
Possible move: 1a1 – Actual move: 1Ne5 – Distance: 3
Possible move: 1a2 – Actual move: 1Ne5 – Distance: 3
Possible move: 1a3 – Actual move: 1Ne5 – Distance: 3
Possible move: 1a4 – Actual move: 1Ne5 – Distance: 3
Possible move: 1a5 – Actual move: 1Ne5 – Distance: 2
Possible move: 1b5 – Actual move: 1Ne5 – Distance: 2
Possible move: 1Ba5 – Actual move: 1Ne5 – Distance: 2
Possible move: 1Bb5 – Actual move: 1Ne5 – Distance: 2
Possible move: 1Bc5 – Actual move: 1Ne5 – Distance: 2
Possible move: 1Bd5 – Actual move: 1Ne5 – Distance: 2
Possible move: 1Be1 – Actual move: 1Ne5 – Distance: 2
Possible move: 1Be2 – Actual move: 1Ne5 – Distance: 2
Possible move: 1Be3 – Actual move: 1Ne5 – Distance: 2
Possible move: 1Be4 – Actual move: 1Ne5 – Distance: 2
Possible move: 1Be5 – Actual move: 1Ne5 – Distance: 1

Possible move: 1e5 - Actual move: 1Ne5 - Distance: 1
Possible move: 1Ke5 - Actual move: 1Ne5 - Distance: 1
Possible move: 1Na5 - Actual move: 1Ne5 - Distance: 1
Possible move: 1Nb5 - Actual move: 1Ne5 - Distance: 1
Possible move: 1Nc5 - Actual move: 1Ne5 - Distance: 1
Possible move: 1Nd5 - Actual move: 1Ne5 - Distance: 1
Possible move: 1Ne1 - Actual move: 1Ne5 - Distance: 1
Possible move: 1Ne2 - Actual move: 1Ne5 - Distance: 1
Possible move: 1Ne3 - Actual move: 1Ne5 - Distance: 1
Possible move: 1Ne4 - Actual move: 1Ne5 - Distance: 1
Possible move: 1Ne5 - Actual move: 1Ne5 - Distance: 0
Possible move: 1a1 - Actual move: 2Nbd7 - Distance: 5
Possible move: 1a2 - Actual move: 2Nbd7 - Distance: 5
Possible move: 1a3 - Actual move: 2Nbd7 - Distance: 5
Possible move: 1a4 - Actual move: 2Nbd7 - Distance: 5
Possible move: 1a5 - Actual move: 2Nbd7 - Distance: 5
Possible move: 1a6 - Actual move: 2Nbd7 - Distance: 5
Possible move: 1a7 - Actual move: 2Nbd7 - Distance: 4
Possible move: 1axb7 - Actual move: 2Nbd7 - Distance: 4
Possible move: 1b1 - Actual move: 2Nbd7 - Distance: 4
Possible move: 1b2 - Actual move: 2Nbd7 - Distance: 4
Possible move: 1b3 - Actual move: 2Nbd7 - Distance: 4
Possible move: 1b4 - Actual move: 2Nbd7 - Distance: 4
Possible move: 1b5 - Actual move: 2Nbd7 - Distance: 4
Possible move: 1b6 - Actual move: 2Nbd7 - Distance: 4
Possible move: 1b7 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1Bb7 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1Bd7 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1Bxd7 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1cxd7 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1d7 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1exd7 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1Kb7 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1Kd7 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1Kxd7 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1Na7 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1Nb1 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1Nb2 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1Nb3 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1Nb4 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1Nb5 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1Nb6 - Actual move: 2Nbd7 - Distance: 3
Possible move: 1Nb7 - Actual move: 2Nbd7 - Distance: 2
Possible move: 1Nd7 - Actual move: 2Nbd7 - Distance: 2
Possible move: 1Nxd7 - Actual move: 2Nbd7 - Distance: 2
Possible move: 2b7 - Actual move: 2Nbd7 - Distance: 2
Possible move: 2Bb7 - Actual move: 2Nbd7 - Distance: 2
Possible move: 2Bd7 - Actual move: 2Nbd7 - Distance: 2
Possible move: 2Bxd7 - Actual move: 2Nbd7 - Distance: 2
Possible move: 2cxd7 - Actual move: 2Nbd7 - Distance: 2

Possible move: 2d7 - Actual move: 2Nbd7 - Distance: 2
Possible move: 2Kb7 - Actual move: 2Nbd7 - Distance: 2
Possible move: 2Kd7 - Actual move: 2Nbd7 - Distance: 2
Possible move: 2Kxd7 - Actual move: 2Nbd7 - Distance: 2
Possible move: 2Na7 - Actual move: 2Nbd7 - Distance: 2
Possible move: 2Nb1 - Actual move: 2Nbd7 - Distance: 2
Possible move: 2Nb2 - Actual move: 2Nbd7 - Distance: 2
Possible move: 2Nb3 - Actual move: 2Nbd7 - Distance: 2
Possible move: 2Nb4 - Actual move: 2Nbd7 - Distance: 2
Possible move: 2Nb5 - Actual move: 2Nbd7 - Distance: 2
Possible move: 2Nb6 - Actual move: 2Nbd7 - Distance: 2
Possible move: 2Nb7 - Actual move: 2Nbd7 - Distance: 1
Possible move: 2Nd7 - Actual move: 2Nbd7 - Distance: 1
Possible move: 2Nxd7 - Actual move: 2Nbd7 - Distance: 1
Possible move: 1a1 - Actual move: 1f4 - Distance: 2
Possible move: 1a2 - Actual move: 1f4 - Distance: 2
Possible move: 1a3 - Actual move: 1f4 - Distance: 2
Possible move: 1a4 - Actual move: 1f4 - Distance: 1
Possible move: 1b4 - Actual move: 1f4 - Distance: 1
Possible move: 1Bf4 - Actual move: 1f4 - Distance: 1
Possible move: 1c4 - Actual move: 1f4 - Distance: 1
Possible move: 1d4 - Actual move: 1f4 - Distance: 1
Possible move: 1e4 - Actual move: 1f4 - Distance: 1
Possible move: 1f1 - Actual move: 1f4 - Distance: 1
Possible move: 1f2 - Actual move: 1f4 - Distance: 1
Possible move: 1f3 - Actual move: 1f4 - Distance: 1
Possible move: 1f4 - Actual move: 1f4 - Distance: 0
Possible move: 1a1 - Actual move: 2Bb7 - Distance: 4
Possible move: 1a2 - Actual move: 2Bb7 - Distance: 4
Possible move: 1a3 - Actual move: 2Bb7 - Distance: 4
Possible move: 1a4 - Actual move: 2Bb7 - Distance: 4
Possible move: 1a5 - Actual move: 2Bb7 - Distance: 4
Possible move: 1a6 - Actual move: 2Bb7 - Distance: 4
Possible move: 1a7 - Actual move: 2Bb7 - Distance: 3
Possible move: 1axb7 - Actual move: 2Bb7 - Distance: 3
Possible move: 1b1 - Actual move: 2Bb7 - Distance: 3
Possible move: 1b2 - Actual move: 2Bb7 - Distance: 3
Possible move: 1b3 - Actual move: 2Bb7 - Distance: 3
Possible move: 1b4 - Actual move: 2Bb7 - Distance: 3
Possible move: 1b5 - Actual move: 2Bb7 - Distance: 3
Possible move: 1b6 - Actual move: 2Bb7 - Distance: 3
Possible move: 1b7 - Actual move: 2Bb7 - Distance: 2
Possible move: 1Ba7 - Actual move: 2Bb7 - Distance: 2
Possible move: 1Bb1 - Actual move: 2Bb7 - Distance: 2
Possible move: 1Bb2 - Actual move: 2Bb7 - Distance: 2
Possible move: 1Bb3 - Actual move: 2Bb7 - Distance: 2
Possible move: 1Bb4 - Actual move: 2Bb7 - Distance: 2
Possible move: 1Bb5 - Actual move: 2Bb7 - Distance: 2
Possible move: 1Bb6 - Actual move: 2Bb7 - Distance: 2
Possible move: 1Bb7 - Actual move: 2Bb7 - Distance: 1

Possible move: 2b7 - Actual move: 2Bb7 - Distance: 1
Possible move: 2Ba7 - Actual move: 2Bb7 - Distance: 1
Possible move: 2Bb1 - Actual move: 2Bb7 - Distance: 1
Possible move: 2Bb2 - Actual move: 2Bb7 - Distance: 1
Possible move: 2Bb3 - Actual move: 2Bb7 - Distance: 1
Possible move: 2Bb4 - Actual move: 2Bb7 - Distance: 1
Possible move: 2Bb5 - Actual move: 2Bb7 - Distance: 1
Possible move: 2Bb6 - Actual move: 2Bb7 - Distance: 1
Possible move: 2Bb7 - Actual move: 2Bb7 - Distance: 0
Possible move: 1a1 - Actual move: 10-0 - Distance: 3
Possible move: 1a2 - Actual move: 10-0 - Distance: 3
Possible move: 1a3 - Actual move: 10-0 - Distance: 3
Possible move: 1a4 - Actual move: 10-0 - Distance: 3
Possible move: 1a5 - Actual move: 10-0 - Distance: 3
Possible move: 1a6 - Actual move: 10-0 - Distance: 3
Possible move: 1a7 - Actual move: 10-0 - Distance: 3
Possible move: 1a8 - Actual move: 10-0 - Distance: 3
Possible move: 1b1 - Actual move: 10-0 - Distance: 3
Possible move: 1b2 - Actual move: 10-0 - Distance: 3
Possible move: 1b3 - Actual move: 10-0 - Distance: 3
Possible move: 1b4 - Actual move: 10-0 - Distance: 3
Possible move: 1b5 - Actual move: 10-0 - Distance: 3
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Possible move: 1b7 - Actual move: 10-0 - Distance: 3
Possible move: 1b8 - Actual move: 10-0 - Distance: 3
Possible move: 1Ba1 - Actual move: 10-0 - Distance: 3
Possible move: 1Ba2 - Actual move: 10-0 - Distance: 3
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Possible move: 1Ba4 - Actual move: 10-0 - Distance: 3
Possible move: 1Ba5 - Actual move: 10-0 - Distance: 3
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Possible move: 1Ba7 - Actual move: 10-0 - Distance: 3
Possible move: 1Ba8 - Actual move: 10-0 - Distance: 3
Possible move: 1Bb1 - Actual move: 10-0 - Distance: 3
Possible move: 1Bb2 - Actual move: 10-0 - Distance: 3
Possible move: 1Bb3 - Actual move: 10-0 - Distance: 3
Possible move: 1Bb4 - Actual move: 10-0 - Distance: 3
Possible move: 1Bb5 - Actual move: 10-0 - Distance: 3
Possible move: 1Bb6 - Actual move: 10-0 - Distance: 3
Possible move: 1Bb7 - Actual move: 10-0 - Distance: 3
Possible move: 1Bb8 - Actual move: 10-0 - Distance: 3
Possible move: 1Bc1 - Actual move: 10-0 - Distance: 3
Possible move: 1Bc2 - Actual move: 10-0 - Distance: 3
Possible move: 1Bc3 - Actual move: 10-0 - Distance: 3
Possible move: 1Bc4 - Actual move: 10-0 - Distance: 3
Possible move: 1Bc5 - Actual move: 10-0 - Distance: 3
Possible move: 1Bc6 - Actual move: 10-0 - Distance: 3
Possible move: 1Bc7 - Actual move: 10-0 - Distance: 3
Possible move: 1Bc8 - Actual move: 10-0 - Distance: 3
Possible move: 1Bd1 - Actual move: 10-0 - Distance: 3

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Possible move: 1d4 - Actual move: 10-0 - Distance: 3
Possible move: 1d5 - Actual move: 10-0 - Distance: 3
Possible move: 1d6 - Actual move: 10-0 - Distance: 3
Possible move: 1d7 - Actual move: 10-0 - Distance: 3
Possible move: 1d8 - Actual move: 10-0 - Distance: 3
Possible move: 1e1 - Actual move: 10-0 - Distance: 3
Possible move: 1e2 - Actual move: 10-0 - Distance: 3
Possible move: 1e3 - Actual move: 10-0 - Distance: 3
Possible move: 1e4 - Actual move: 10-0 - Distance: 3
Possible move: 1e5 - Actual move: 10-0 - Distance: 3
Possible move: 1e6 - Actual move: 10-0 - Distance: 3
Possible move: 1e7 - Actual move: 10-0 - Distance: 3
Possible move: 1e8 - Actual move: 10-0 - Distance: 3
Possible move: 1f1 - Actual move: 10-0 - Distance: 3
Possible move: 1f2 - Actual move: 10-0 - Distance: 3
Possible move: 1f3 - Actual move: 10-0 - Distance: 3
Possible move: 1f4 - Actual move: 10-0 - Distance: 3
Possible move: 1f5 - Actual move: 10-0 - Distance: 3
Possible move: 1f6 - Actual move: 10-0 - Distance: 3
Possible move: 1f7 - Actual move: 10-0 - Distance: 3
Possible move: 1f8 - Actual move: 10-0 - Distance: 3
Possible move: 1g1 - Actual move: 10-0 - Distance: 3
Possible move: 1g2 - Actual move: 10-0 - Distance: 3
Possible move: 1g3 - Actual move: 10-0 - Distance: 3
Possible move: 1g4 - Actual move: 10-0 - Distance: 3
Possible move: 1g5 - Actual move: 10-0 - Distance: 3
Possible move: 1g6 - Actual move: 10-0 - Distance: 3
Possible move: 1g7 - Actual move: 10-0 - Distance: 3
Possible move: 1g8 - Actual move: 10-0 - Distance: 3
Possible move: 1h1 - Actual move: 10-0 - Distance: 3
Possible move: 1h2 - Actual move: 10-0 - Distance: 3
Possible move: 1h3 - Actual move: 10-0 - Distance: 3
Possible move: 1h4 - Actual move: 10-0 - Distance: 3
Possible move: 1h5 - Actual move: 10-0 - Distance: 3
Possible move: 1h6 - Actual move: 10-0 - Distance: 3
Possible move: 1h7 - Actual move: 10-0 - Distance: 3
Possible move: 1h8 - Actual move: 10-0 - Distance: 3
Possible move: 1Ka1 - Actual move: 10-0 - Distance: 3
Possible move: 1Ka2 - Actual move: 10-0 - Distance: 3
Possible move: 1Ka3 - Actual move: 10-0 - Distance: 3
Possible move: 1Ka4 - Actual move: 10-0 - Distance: 3
Possible move: 1Ka5 - Actual move: 10-0 - Distance: 3
Possible move: 1Ka6 - Actual move: 10-0 - Distance: 3
Possible move: 1Ka7 - Actual move: 10-0 - Distance: 3
Possible move: 1Ka8 - Actual move: 10-0 - Distance: 3
Possible move: 1Kb1 - Actual move: 10-0 - Distance: 3
Possible move: 1Kb2 - Actual move: 10-0 - Distance: 3
Possible move: 1Kb3 - Actual move: 10-0 - Distance: 3
Possible move: 1Kb4 - Actual move: 10-0 - Distance: 3
Possible move: 1Kb5 - Actual move: 10-0 - Distance: 3

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Possible move: 1a8 - Actual move: 20-0 - Distance: 4
Possible move: 1b1 - Actual move: 20-0 - Distance: 4
Possible move: 1b2 - Actual move: 20-0 - Distance: 4
Possible move: 1b3 - Actual move: 20-0 - Distance: 4
Possible move: 1b4 - Actual move: 20-0 - Distance: 4
Possible move: 1b5 - Actual move: 20-0 - Distance: 4
Possible move: 1b6 - Actual move: 20-0 - Distance: 4
Possible move: 1b7 - Actual move: 20-0 - Distance: 4
Possible move: 1b8 - Actual move: 20-0 - Distance: 4
Possible move: 1Ba1 - Actual move: 20-0 - Distance: 4
Possible move: 1Ba2 - Actual move: 20-0 - Distance: 4
Possible move: 1Ba3 - Actual move: 20-0 - Distance: 4
Possible move: 1Ba4 - Actual move: 20-0 - Distance: 4
Possible move: 1Ba5 - Actual move: 20-0 - Distance: 4
Possible move: 1Ba6 - Actual move: 20-0 - Distance: 4
Possible move: 1Ba7 - Actual move: 20-0 - Distance: 4
Possible move: 1Ba8 - Actual move: 20-0 - Distance: 4
Possible move: 1Bb1 - Actual move: 20-0 - Distance: 4
Possible move: 1Bb2 - Actual move: 20-0 - Distance: 4
Possible move: 1Bb3 - Actual move: 20-0 - Distance: 4
Possible move: 1Bb4 - Actual move: 20-0 - Distance: 4
Possible move: 1Bb5 - Actual move: 20-0 - Distance: 4
Possible move: 1Bb6 - Actual move: 20-0 - Distance: 4
Possible move: 1Bb7 - Actual move: 20-0 - Distance: 4
Possible move: 1Bb8 - Actual move: 20-0 - Distance: 4
Possible move: 1Bc1 - Actual move: 20-0 - Distance: 4
Possible move: 1Bc2 - Actual move: 20-0 - Distance: 4
Possible move: 1Bc3 - Actual move: 20-0 - Distance: 4
Possible move: 1Bc4 - Actual move: 20-0 - Distance: 4
Possible move: 1Bc5 - Actual move: 20-0 - Distance: 4
Possible move: 1Bc6 - Actual move: 20-0 - Distance: 4
Possible move: 1Bc7 - Actual move: 20-0 - Distance: 4
Possible move: 1Bc8 - Actual move: 20-0 - Distance: 4
Possible move: 1Bd1 - Actual move: 20-0 - Distance: 4
Possible move: 1Bd2 - Actual move: 20-0 - Distance: 4
Possible move: 1Bd3 - Actual move: 20-0 - Distance: 4
Possible move: 1Bd4 - Actual move: 20-0 - Distance: 4
Possible move: 1Bd5 - Actual move: 20-0 - Distance: 4
Possible move: 1Bd6 - Actual move: 20-0 - Distance: 4
Possible move: 1Bd7 - Actual move: 20-0 - Distance: 4
Possible move: 1Bd8 - Actual move: 20-0 - Distance: 4
Possible move: 1Be1 - Actual move: 20-0 - Distance: 4
Possible move: 1Be2 - Actual move: 20-0 - Distance: 4
Possible move: 1Be3 - Actual move: 20-0 - Distance: 4
Possible move: 1Be4 - Actual move: 20-0 - Distance: 4
Possible move: 1Be5 - Actual move: 20-0 - Distance: 4
Possible move: 1Be6 - Actual move: 20-0 - Distance: 4
Possible move: 1Be7 - Actual move: 20-0 - Distance: 4
Possible move: 1Be8 - Actual move: 20-0 - Distance: 4
Possible move: 1Bf1 - Actual move: 20-0 - Distance: 4

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Possible move: 1f4 - Actual move: 20-0 - Distance: 4
Possible move: 1f5 - Actual move: 20-0 - Distance: 4
Possible move: 1f6 - Actual move: 20-0 - Distance: 4
Possible move: 1f7 - Actual move: 20-0 - Distance: 4
Possible move: 1f8 - Actual move: 20-0 - Distance: 4
Possible move: 1g1 - Actual move: 20-0 - Distance: 4
Possible move: 1g2 - Actual move: 20-0 - Distance: 4
Possible move: 1g3 - Actual move: 20-0 - Distance: 4
Possible move: 1g4 - Actual move: 20-0 - Distance: 4
Possible move: 1g5 - Actual move: 20-0 - Distance: 4
Possible move: 1g6 - Actual move: 20-0 - Distance: 4
Possible move: 1g7 - Actual move: 20-0 - Distance: 4
Possible move: 1g8 - Actual move: 20-0 - Distance: 4
Possible move: 1h1 - Actual move: 20-0 - Distance: 4
Possible move: 1h2 - Actual move: 20-0 - Distance: 4
Possible move: 1h3 - Actual move: 20-0 - Distance: 4
Possible move: 1h4 - Actual move: 20-0 - Distance: 4
Possible move: 1h5 - Actual move: 20-0 - Distance: 4
Possible move: 1h6 - Actual move: 20-0 - Distance: 4
Possible move: 1h7 - Actual move: 20-0 - Distance: 4
Possible move: 1h8 - Actual move: 20-0 - Distance: 4
Possible move: 1Ka1 - Actual move: 20-0 - Distance: 4
Possible move: 1Ka2 - Actual move: 20-0 - Distance: 4
Possible move: 1Ka3 - Actual move: 20-0 - Distance: 4
Possible move: 1Ka4 - Actual move: 20-0 - Distance: 4
Possible move: 1Ka5 - Actual move: 20-0 - Distance: 4
Possible move: 1Ka6 - Actual move: 20-0 - Distance: 4
Possible move: 1Ka7 - Actual move: 20-0 - Distance: 4
Possible move: 1Ka8 - Actual move: 20-0 - Distance: 4
Possible move: 1Kb1 - Actual move: 20-0 - Distance: 4
Possible move: 1Kb2 - Actual move: 20-0 - Distance: 4
Possible move: 1Kb3 - Actual move: 20-0 - Distance: 4
Possible move: 1Kb4 - Actual move: 20-0 - Distance: 4
Possible move: 1Kb5 - Actual move: 20-0 - Distance: 4
Possible move: 1Kb6 - Actual move: 20-0 - Distance: 4
Possible move: 1Kb7 - Actual move: 20-0 - Distance: 4
Possible move: 1Kb8 - Actual move: 20-0 - Distance: 4
Possible move: 1Kc1 - Actual move: 20-0 - Distance: 4
Possible move: 1Kc2 - Actual move: 20-0 - Distance: 4
Possible move: 1Kc3 - Actual move: 20-0 - Distance: 4
Possible move: 1Kc4 - Actual move: 20-0 - Distance: 4
Possible move: 1Kc5 - Actual move: 20-0 - Distance: 4
Possible move: 1Kc6 - Actual move: 20-0 - Distance: 4
Possible move: 1Kc7 - Actual move: 20-0 - Distance: 4
Possible move: 1Kc8 - Actual move: 20-0 - Distance: 4
Possible move: 1Kd1 - Actual move: 20-0 - Distance: 4
Possible move: 1Kd2 - Actual move: 20-0 - Distance: 4
Possible move: 1Kd3 - Actual move: 20-0 - Distance: 4
Possible move: 1Kd4 - Actual move: 20-0 - Distance: 4
Possible move: 1Kd5 - Actual move: 20-0 - Distance: 4

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Possible move: 1Re6 – Actual move: 20-0 – Distance: 4
Possible move: 1Re7 – Actual move: 20-0 – Distance: 4
Possible move: 1Re8 – Actual move: 20-0 – Distance: 4
Possible move: 1Rf1 – Actual move: 20-0 – Distance: 4
Possible move: 1Rf2 – Actual move: 20-0 – Distance: 4
Possible move: 1Rf3 – Actual move: 20-0 – Distance: 4
Possible move: 1Rf4 – Actual move: 20-0 – Distance: 4
Possible move: 1Rf5 – Actual move: 20-0 – Distance: 4
Possible move: 1Rf6 – Actual move: 20-0 – Distance: 4
Possible move: 1Rf7 – Actual move: 20-0 – Distance: 4
Possible move: 1Rf8 – Actual move: 20-0 – Distance: 4
Possible move: 1Rg1 – Actual move: 20-0 – Distance: 4
Possible move: 1Rg2 – Actual move: 20-0 – Distance: 4
Possible move: 1Rg3 – Actual move: 20-0 – Distance: 4
Possible move: 1Rg4 – Actual move: 20-0 – Distance: 4
Possible move: 1Rg5 – Actual move: 20-0 – Distance: 4
Possible move: 1Rg6 – Actual move: 20-0 – Distance: 4
Possible move: 1Rg7 – Actual move: 20-0 – Distance: 4
Possible move: 1Rg8 – Actual move: 20-0 – Distance: 4
Possible move: 1Rh1 – Actual move: 20-0 – Distance: 4
Possible move: 1Rh2 – Actual move: 20-0 – Distance: 4
Possible move: 1Rh3 – Actual move: 20-0 – Distance: 4
Possible move: 1Rh4 – Actual move: 20-0 – Distance: 4
Possible move: 1Rh5 – Actual move: 20-0 – Distance: 4
Possible move: 1Rh6 – Actual move: 20-0 – Distance: 4
Possible move: 1Rh7 – Actual move: 20-0 – Distance: 4
Possible move: 1Rh8 – Actual move: 20-0 – Distance: 4
Possible move: 2a1 – Actual move: 20-0 – Distance: 3
Possible move: 2a2 – Actual move: 20-0 – Distance: 3
Possible move: 2a3 – Actual move: 20-0 – Distance: 3
Possible move: 2a4 – Actual move: 20-0 – Distance: 3
Possible move: 2a5 – Actual move: 20-0 – Distance: 3
Possible move: 2a6 – Actual move: 20-0 – Distance: 3
Possible move: 2a7 – Actual move: 20-0 – Distance: 3
Possible move: 2a8 – Actual move: 20-0 – Distance: 3
Possible move: 2b1 – Actual move: 20-0 – Distance: 3
Possible move: 2b2 – Actual move: 20-0 – Distance: 3
Possible move: 2b3 – Actual move: 20-0 – Distance: 3
Possible move: 2b4 – Actual move: 20-0 – Distance: 3
Possible move: 2b5 – Actual move: 20-0 – Distance: 3
Possible move: 2b6 – Actual move: 20-0 – Distance: 3
Possible move: 2b7 – Actual move: 20-0 – Distance: 3
Possible move: 2b8 – Actual move: 20-0 – Distance: 3
Possible move: 2Ba1 – Actual move: 20-0 – Distance: 3
Possible move: 2Ba2 – Actual move: 20-0 – Distance: 3
Possible move: 2Ba3 – Actual move: 20-0 – Distance: 3
Possible move: 2Ba4 – Actual move: 20-0 – Distance: 3
Possible move: 2Ba5 – Actual move: 20-0 – Distance: 3
Possible move: 2Ba6 – Actual move: 20-0 – Distance: 3
Possible move: 2Ba7 – Actual move: 20-0 – Distance: 3

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Possible move: 2Rg6 – Actual move: 20–0 – Distance: 3
Possible move: 2Rg7 – Actual move: 20–0 – Distance: 3
Possible move: 2Rg8 – Actual move: 20–0 – Distance: 3
Possible move: 2Rh1 – Actual move: 20–0 – Distance: 3
Possible move: 2Rh2 – Actual move: 20–0 – Distance: 3
Possible move: 2Rh3 – Actual move: 20–0 – Distance: 3
Possible move: 2Rh4 – Actual move: 20–0 – Distance: 3
Possible move: 2Rh5 – Actual move: 20–0 – Distance: 3
Possible move: 2Rh6 – Actual move: 20–0 – Distance: 3
Possible move: 2Rh7 – Actual move: 20–0 – Distance: 3
Possible move: 2Rh8 – Actual move: 20–0 – Distance: 3
Possible move: 1a1 – Actual move: 1Rc1 – Distance: 2
Possible move: 1b1 – Actual move: 1Rc1 – Distance: 2
Possible move: 1Ba1 – Actual move: 1Rc1 – Distance: 2
Possible move: 1Bb1 – Actual move: 1Rc1 – Distance: 2
Possible move: 1Bc1 – Actual move: 1Rc1 – Distance: 1
Possible move: 1c1 – Actual move: 1Rc1 – Distance: 1
Possible move: 1Kc1 – Actual move: 1Rc1 – Distance: 1
Possible move: 1Nc1 – Actual move: 1Rc1 – Distance: 1
Possible move: 1Qc1 – Actual move: 1Rc1 – Distance: 1
Possible move: 1Ra1 – Actual move: 1Rc1 – Distance: 1
Possible move: 1Rb1 – Actual move: 1Rc1 – Distance: 1
Possible move: 1Rc1 – Actual move: 1Rc1 – Distance: 0
Possible move: 1a1 – Actual move: 2Nb6 – Distance: 4
Possible move: 1a2 – Actual move: 2Nb6 – Distance: 4
Possible move: 1a3 – Actual move: 2Nb6 – Distance: 4
Possible move: 1a4 – Actual move: 2Nb6 – Distance: 4
Possible move: 1a5 – Actual move: 2Nb6 – Distance: 4
Possible move: 1a6 – Actual move: 2Nb6 – Distance: 3
Possible move: 1axb6 – Actual move: 2Nb6 – Distance: 3
Possible move: 1b1 – Actual move: 2Nb6 – Distance: 3
Possible move: 1b2 – Actual move: 2Nb6 – Distance: 3
Possible move: 1b3 – Actual move: 2Nb6 – Distance: 3
Possible move: 1b4 – Actual move: 2Nb6 – Distance: 3
Possible move: 1b5 – Actual move: 2Nb6 – Distance: 3
Possible move: 1b6 – Actual move: 2Nb6 – Distance: 2
Possible move: 1Bb6 – Actual move: 2Nb6 – Distance: 2
Possible move: 1Kb6 – Actual move: 2Nb6 – Distance: 2
Possible move: 1Na6 – Actual move: 2Nb6 – Distance: 2
Possible move: 1Nb1 – Actual move: 2Nb6 – Distance: 2
Possible move: 1Nb2 – Actual move: 2Nb6 – Distance: 2
Possible move: 1Nb3 – Actual move: 2Nb6 – Distance: 2
Possible move: 1Nb4 – Actual move: 2Nb6 – Distance: 2
Possible move: 1Nb5 – Actual move: 2Nb6 – Distance: 2
Possible move: 1Nb6 – Actual move: 2Nb6 – Distance: 1
Possible move: 2b6 – Actual move: 2Nb6 – Distance: 1
Possible move: 2Bb6 – Actual move: 2Nb6 – Distance: 1
Possible move: 2Kb6 – Actual move: 2Nb6 – Distance: 1
Possible move: 2Na6 – Actual move: 2Nb6 – Distance: 1
Possible move: 2Nb1 – Actual move: 2Nb6 – Distance: 1

Possible move: 2Nb2 – Actual move: 2Nb6 – Distance: 1
Possible move: 2Nb3 – Actual move: 2Nb6 – Distance: 1
Possible move: 2Nb4 – Actual move: 2Nb6 – Distance: 1
Possible move: 2Nb5 – Actual move: 2Nb6 – Distance: 1
Possible move: 2Nb6 – Actual move: 2Nb6 – Distance: 0
Possible move: 1a1 – Actual move: 1Qf3 – Distance: 3
Possible move: 1a2 – Actual move: 1Qf3 – Distance: 3
Possible move: 1a3 – Actual move: 1Qf3 – Distance: 2
Possible move: 1b3 – Actual move: 1Qf3 – Distance: 2
Possible move: 1Ba3 – Actual move: 1Qf3 – Distance: 2
Possible move: 1Bb3 – Actual move: 1Qf3 – Distance: 2
Possible move: 1Bc3 – Actual move: 1Qf3 – Distance: 2
Possible move: 1Bd3 – Actual move: 1Qf3 – Distance: 2
Possible move: 1Be3 – Actual move: 1Qf3 – Distance: 2
Possible move: 1Bf1 – Actual move: 1Qf3 – Distance: 2
Possible move: 1Bf2 – Actual move: 1Qf3 – Distance: 2
Possible move: 1Bf3 – Actual move: 1Qf3 – Distance: 1
Possible move: 1f3 – Actual move: 1Qf3 – Distance: 1
Possible move: 1Kf3 – Actual move: 1Qf3 – Distance: 1
Possible move: 1Nf3 – Actual move: 1Qf3 – Distance: 1
Possible move: 1Qa3 – Actual move: 1Qf3 – Distance: 1
Possible move: 1Qb3 – Actual move: 1Qf3 – Distance: 1
Possible move: 1Qc3 – Actual move: 1Qf3 – Distance: 1
Possible move: 1Qd3 – Actual move: 1Qf3 – Distance: 1
Possible move: 1Qe3 – Actual move: 1Qf3 – Distance: 1
Possible move: 1Qf1 – Actual move: 1Qf3 – Distance: 1
Possible move: 1Qf2 – Actual move: 1Qf3 – Distance: 1
Possible move: 1Qf3 – Actual move: 1Qf3 – Distance: 0
Possible move: 1a1 – Actual move: 2Rc8 – Distance: 4
Possible move: 1a2 – Actual move: 2Rc8 – Distance: 4
Possible move: 1a3 – Actual move: 2Rc8 – Distance: 4
Possible move: 1a4 – Actual move: 2Rc8 – Distance: 4
Possible move: 1a5 – Actual move: 2Rc8 – Distance: 4
Possible move: 1a6 – Actual move: 2Rc8 – Distance: 4
Possible move: 1a7 – Actual move: 2Rc8 – Distance: 4
Possible move: 1a8 – Actual move: 2Rc8 – Distance: 3
Possible move: 1b8 – Actual move: 2Rc8 – Distance: 3
Possible move: 1Ba8 – Actual move: 2Rc8 – Distance: 3
Possible move: 1Bb8 – Actual move: 2Rc8 – Distance: 3
Possible move: 1Bc1 – Actual move: 2Rc8 – Distance: 3
Possible move: 1Bc2 – Actual move: 2Rc8 – Distance: 3
Possible move: 1Bc3 – Actual move: 2Rc8 – Distance: 3
Possible move: 1Bc4 – Actual move: 2Rc8 – Distance: 3
Possible move: 1Bc5 – Actual move: 2Rc8 – Distance: 3
Possible move: 1Bc6 – Actual move: 2Rc8 – Distance: 3
Possible move: 1Bc7 – Actual move: 2Rc8 – Distance: 3
Possible move: 1Bc8 – Actual move: 2Rc8 – Distance: 2
Possible move: 1c8 – Actual move: 2Rc8 – Distance: 2
Possible move: 1Kc8 – Actual move: 2Rc8 – Distance: 2
Possible move: 1Nc8 – Actual move: 2Rc8 – Distance: 2

Possible move: 1Qc8 – Actual move: 2Rc8 – Distance: 2
Possible move: 1Ra8 – Actual move: 2Rc8 – Distance: 2
Possible move: 1Rb8 – Actual move: 2Rc8 – Distance: 2
Possible move: 1Rc1 – Actual move: 2Rc8 – Distance: 2
Possible move: 1Rc2 – Actual move: 2Rc8 – Distance: 2
Possible move: 1Rc3 – Actual move: 2Rc8 – Distance: 2
Possible move: 1Rc4 – Actual move: 2Rc8 – Distance: 2
Possible move: 1Rc5 – Actual move: 2Rc8 – Distance: 2
Possible move: 1Rc6 – Actual move: 2Rc8 – Distance: 2
Possible move: 1Rc7 – Actual move: 2Rc8 – Distance: 2
Possible move: 1Rc8 – Actual move: 2Rc8 – Distance: 1
Possible move: 2Bc8 – Actual move: 2Rc8 – Distance: 1
Possible move: 2c8 – Actual move: 2Rc8 – Distance: 1
Possible move: 2Kc8 – Actual move: 2Rc8 – Distance: 1
Possible move: 2Nc8 – Actual move: 2Rc8 – Distance: 1
Possible move: 2Qc8 – Actual move: 2Rc8 – Distance: 1
Possible move: 2Ra8 – Actual move: 2Rc8 – Distance: 1
Possible move: 2Rb8 – Actual move: 2Rc8 – Distance: 1
Possible move: 2Rc1 – Actual move: 2Rc8 – Distance: 1
Possible move: 2Rc2 – Actual move: 2Rc8 – Distance: 1
Possible move: 2Rc3 – Actual move: 2Rc8 – Distance: 1
Possible move: 2Rc4 – Actual move: 2Rc8 – Distance: 1
Possible move: 2Rc5 – Actual move: 2Rc8 – Distance: 1
Possible move: 2Rc6 – Actual move: 2Rc8 – Distance: 1
Possible move: 2Rc7 – Actual move: 2Rc8 – Distance: 1
Possible move: 2Rc8 – Actual move: 2Rc8 – Distance: 0
Possible move: 1a1 – Actual move: 1Nb1 – Distance: 2
Possible move: 1axb1 – Actual move: 1Nb1 – Distance: 2
Possible move: 1b1 – Actual move: 1Nb1 – Distance: 1
Possible move: 1Bb1 – Actual move: 1Nb1 – Distance: 1
Possible move: 1Kb1 – Actual move: 1Nb1 – Distance: 1
Possible move: 1Na1 – Actual move: 1Nb1 – Distance: 1
Possible move: 1Nb1 – Actual move: 1Nb1 – Distance: 0
Possible move: 1a1 – Actual move: 2Qe7 – Distance: 4
Possible move: 1a2 – Actual move: 2Qe7 – Distance: 4
Possible move: 1a3 – Actual move: 2Qe7 – Distance: 4
Possible move: 1a4 – Actual move: 2Qe7 – Distance: 4
Possible move: 1a5 – Actual move: 2Qe7 – Distance: 4
Possible move: 1a6 – Actual move: 2Qe7 – Distance: 4
Possible move: 1a7 – Actual move: 2Qe7 – Distance: 3
Possible move: 1b7 – Actual move: 2Qe7 – Distance: 3
Possible move: 1Ba7 – Actual move: 2Qe7 – Distance: 3
Possible move: 1Bb7 – Actual move: 2Qe7 – Distance: 3
Possible move: 1Bc7 – Actual move: 2Qe7 – Distance: 3
Possible move: 1Bd7 – Actual move: 2Qe7 – Distance: 3
Possible move: 1Be1 – Actual move: 2Qe7 – Distance: 3
Possible move: 1Be2 – Actual move: 2Qe7 – Distance: 3
Possible move: 1Be3 – Actual move: 2Qe7 – Distance: 3
Possible move: 1Be4 – Actual move: 2Qe7 – Distance: 3
Possible move: 1Be5 – Actual move: 2Qe7 – Distance: 3

Possible move: 1Be6 – Actual move: 2Qe7 – Distance: 3
Possible move: 1Be7 – Actual move: 2Qe7 – Distance: 2
Possible move: 1e7 – Actual move: 2Qe7 – Distance: 2
Possible move: 1Ke7 – Actual move: 2Qe7 – Distance: 2
Possible move: 1Ne7 – Actual move: 2Qe7 – Distance: 2
Possible move: 1Qa7 – Actual move: 2Qe7 – Distance: 2
Possible move: 1Qb7 – Actual move: 2Qe7 – Distance: 2
Possible move: 1Qc7 – Actual move: 2Qe7 – Distance: 2
Possible move: 1Qd7 – Actual move: 2Qe7 – Distance: 2
Possible move: 1Qe1 – Actual move: 2Qe7 – Distance: 2
Possible move: 1Qe2 – Actual move: 2Qe7 – Distance: 2
Possible move: 1Qe3 – Actual move: 2Qe7 – Distance: 2
Possible move: 1Qe4 – Actual move: 2Qe7 – Distance: 2
Possible move: 1Qe5 – Actual move: 2Qe7 – Distance: 2
Possible move: 1Qe6 – Actual move: 2Qe7 – Distance: 2
Possible move: 1Qe7 – Actual move: 2Qe7 – Distance: 1
Possible move: 2Be7 – Actual move: 2Qe7 – Distance: 1
Possible move: 2e7 – Actual move: 2Qe7 – Distance: 1
Possible move: 2Ke7 – Actual move: 2Qe7 – Distance: 1
Possible move: 2Ne7 – Actual move: 2Qe7 – Distance: 1
Possible move: 2Qa7 – Actual move: 2Qe7 – Distance: 1
Possible move: 2Qb7 – Actual move: 2Qe7 – Distance: 1
Possible move: 2Qc7 – Actual move: 2Qe7 – Distance: 1
Possible move: 2Qd7 – Actual move: 2Qe7 – Distance: 1
Possible move: 2Qe1 – Actual move: 2Qe7 – Distance: 1
Possible move: 2Qe2 – Actual move: 2Qe7 – Distance: 1
Possible move: 2Qe3 – Actual move: 2Qe7 – Distance: 1
Possible move: 2Qe4 – Actual move: 2Qe7 – Distance: 1
Possible move: 2Qe5 – Actual move: 2Qe7 – Distance: 1
Possible move: 2Qe6 – Actual move: 2Qe7 – Distance: 1
Possible move: 2Qe7 – Actual move: 2Qe7 – Distance: 0
Possible move: 1a1 – Actual move: 1b3 – Distance: 2
Possible move: 1a2 – Actual move: 1b3 – Distance: 2
Possible move: 1a3 – Actual move: 1b3 – Distance: 1
Possible move: 1b1 – Actual move: 1b3 – Distance: 1
Possible move: 1b2 – Actual move: 1b3 – Distance: 1
Possible move: 1b3 – Actual move: 1b3 – Distance: 0
Possible move: 1a1 – Actual move: 2Nc4 – Distance: 4
Possible move: 1a2 – Actual move: 2Nc4 – Distance: 4
Possible move: 1a3 – Actual move: 2Nc4 – Distance: 4
Possible move: 1a4 – Actual move: 2Nc4 – Distance: 3
Possible move: 1b4 – Actual move: 2Nc4 – Distance: 3
Possible move: 1Ba4 – Actual move: 2Nc4 – Distance: 3
Possible move: 1Bb4 – Actual move: 2Nc4 – Distance: 3
Possible move: 1Bc1 – Actual move: 2Nc4 – Distance: 3
Possible move: 1Bc2 – Actual move: 2Nc4 – Distance: 3
Possible move: 1Bc3 – Actual move: 2Nc4 – Distance: 3
Possible move: 1Bc4 – Actual move: 2Nc4 – Distance: 2
Possible move: 1c4 – Actual move: 2Nc4 – Distance: 2
Possible move: 1Kc4 – Actual move: 2Nc4 – Distance: 2

Possible move: 1Na4 – Actual move: 2Nc4 – Distance: 2
Possible move: 1Nb4 – Actual move: 2Nc4 – Distance: 2
Possible move: 1Nc1 – Actual move: 2Nc4 – Distance: 2
Possible move: 1Nc2 – Actual move: 2Nc4 – Distance: 2
Possible move: 1Nc3 – Actual move: 2Nc4 – Distance: 2
Possible move: 1Nc4 – Actual move: 2Nc4 – Distance: 1
Possible move: 2Bc4 – Actual move: 2Nc4 – Distance: 1
Possible move: 2c4 – Actual move: 2Nc4 – Distance: 1
Possible move: 2Kc4 – Actual move: 2Nc4 – Distance: 1
Possible move: 2Na4 – Actual move: 2Nc4 – Distance: 1
Possible move: 2Nb4 – Actual move: 2Nc4 – Distance: 1
Possible move: 2Nc1 – Actual move: 2Nc4 – Distance: 1
Possible move: 2Nc2 – Actual move: 2Nc4 – Distance: 1
Possible move: 2Nc3 – Actual move: 2Nc4 – Distance: 1
Possible move: 2Nc4 – Actual move: 2Nc4 – Distance: 0
Possible move: 1a1 – Actual move: 1Bc3 – Distance: 3
Possible move: 1a2 – Actual move: 1Bc3 – Distance: 3
Possible move: 1a3 – Actual move: 1Bc3 – Distance: 2
Possible move: 1b3 – Actual move: 1Bc3 – Distance: 2
Possible move: 1Ba1 – Actual move: 1Bc3 – Distance: 2
Possible move: 1Ba2 – Actual move: 1Bc3 – Distance: 2
Possible move: 1Ba3 – Actual move: 1Bc3 – Distance: 1
Possible move: 1Bb3 – Actual move: 1Bc3 – Distance: 1
Possible move: 1Bc1 – Actual move: 1Bc3 – Distance: 1
Possible move: 1Bc2 – Actual move: 1Bc3 – Distance: 1
Possible move: 1Bc3 – Actual move: 1Bc3 – Distance: 0
Possible move: 1a1 – Actual move: 2Na3 – Distance: 3
Possible move: 1a2 – Actual move: 2Na3 – Distance: 3
Possible move: 1a3 – Actual move: 2Na3 – Distance: 2
Possible move: 1Ba3 – Actual move: 2Na3 – Distance: 2
Possible move: 1Ka3 – Actual move: 2Na3 – Distance: 2
Possible move: 1Na1 – Actual move: 2Na3 – Distance: 2
Possible move: 1Na2 – Actual move: 2Na3 – Distance: 2
Possible move: 1Na3 – Actual move: 2Na3 – Distance: 1
Possible move: 2a3 – Actual move: 2Na3 – Distance: 1
Possible move: 2Ba3 – Actual move: 2Na3 – Distance: 1
Possible move: 2Ka3 – Actual move: 2Na3 – Distance: 1
Possible move: 2Na1 – Actual move: 2Na3 – Distance: 1
Possible move: 2Na2 – Actual move: 2Na3 – Distance: 1
Possible move: 2Na3 – Actual move: 2Na3 – Distance: 0
Possible move: 1a1 – Actual move: 1Bb2 – Distance: 3
Possible move: 1a2 – Actual move: 1Bb2 – Distance: 2
Possible move: 1axb2 – Actual move: 1Bb2 – Distance: 2
Possible move: 1b1 – Actual move: 1Bb2 – Distance: 2
Possible move: 1b2 – Actual move: 1Bb2 – Distance: 1
Possible move: 1Ba2 – Actual move: 1Bb2 – Distance: 1
Possible move: 1Bb1 – Actual move: 1Bb2 – Distance: 1
Possible move: 1Bb2 – Actual move: 1Bb2 – Distance: 0
Possible move: 1a1 – Actual move: 2Nxb1 – Distance: 4
Possible move: 1axb1 – Actual move: 2Nxb1 – Distance: 2

Possible move: 1Bxb1 – Actual move: 2Nxb1 – Distance: 2
Possible move: 1cxb1 – Actual move: 2Nxb1 – Distance: 2
Possible move: 1Kxb1 – Actual move: 2Nxb1 – Distance: 2
Possible move: 1Nb1 – Actual move: 2Nxb1 – Distance: 2
Possible move: 1Nxa1 – Actual move: 2Nxb1 – Distance: 2
Possible move: 1Nxb1 – Actual move: 2Nxb1 – Distance: 1
Possible move: 2axb1 – Actual move: 2Nxb1 – Distance: 1
Possible move: 2Bxb1 – Actual move: 2Nxb1 – Distance: 1
Possible move: 2Kxb1 – Actual move: 2Nxb1 – Distance: 1
Possible move: 2Nb1 – Actual move: 2Nxb1 – Distance: 1
Possible move: 2Nxa1 – Actual move: 2Nxb1 – Distance: 1
Possible move: 2Nxb1 – Actual move: 2Nxb1 – Distance: 0
Possible move: 1a1 – Actual move: 1Bxb1 – Distance: 3
Possible move: 1axb1 – Actual move: 1Bxb1 – Distance: 1
Possible move: 1Bb1 – Actual move: 1Bxb1 – Distance: 1
Possible move: 1Bxa1 – Actual move: 1Bxb1 – Distance: 1
Possible move: 1Bxb1 – Actual move: 1Bxb1 – Distance: 0
Possible move: 1a1 – Actual move: 2Ne4 – Distance: 4
Possible move: 1a2 – Actual move: 2Ne4 – Distance: 4
Possible move: 1a3 – Actual move: 2Ne4 – Distance: 4
Possible move: 1a4 – Actual move: 2Ne4 – Distance: 3
Possible move: 1b4 – Actual move: 2Ne4 – Distance: 3
Possible move: 1Ba4 – Actual move: 2Ne4 – Distance: 3
Possible move: 1Bb4 – Actual move: 2Ne4 – Distance: 3
Possible move: 1Bc4 – Actual move: 2Ne4 – Distance: 3
Possible move: 1Bd4 – Actual move: 2Ne4 – Distance: 3
Possible move: 1Be1 – Actual move: 2Ne4 – Distance: 3
Possible move: 1Be2 – Actual move: 2Ne4 – Distance: 3
Possible move: 1Be3 – Actual move: 2Ne4 – Distance: 3
Possible move: 1Be4 – Actual move: 2Ne4 – Distance: 2
Possible move: 1e4 – Actual move: 2Ne4 – Distance: 2
Possible move: 1Ke4 – Actual move: 2Ne4 – Distance: 2
Possible move: 1Na4 – Actual move: 2Ne4 – Distance: 2
Possible move: 1Nb4 – Actual move: 2Ne4 – Distance: 2
Possible move: 1Nc4 – Actual move: 2Ne4 – Distance: 2
Possible move: 1Nd4 – Actual move: 2Ne4 – Distance: 2
Possible move: 1Ne1 – Actual move: 2Ne4 – Distance: 2
Possible move: 1Ne2 – Actual move: 2Ne4 – Distance: 2
Possible move: 1Ne3 – Actual move: 2Ne4 – Distance: 2
Possible move: 1Ne4 – Actual move: 2Ne4 – Distance: 1
Possible move: 2Be4 – Actual move: 2Ne4 – Distance: 1
Possible move: 2e4 – Actual move: 2Ne4 – Distance: 1
Possible move: 2Ke4 – Actual move: 2Ne4 – Distance: 1
Possible move: 2Na4 – Actual move: 2Ne4 – Distance: 1
Possible move: 2Nb4 – Actual move: 2Ne4 – Distance: 1
Possible move: 2Nc4 – Actual move: 2Ne4 – Distance: 1
Possible move: 2Nd4 – Actual move: 2Ne4 – Distance: 1
Possible move: 2Ne1 – Actual move: 2Ne4 – Distance: 1
Possible move: 2Ne2 – Actual move: 2Ne4 – Distance: 1
Possible move: 2Ne3 – Actual move: 2Ne4 – Distance: 1

Possible move: 2Ne4 – Actual move: 2Ne4 – Distance: 0
Possible move: 1a1 – Actual move: 1Qe2 – Distance: 3
Possible move: 1a2 – Actual move: 1Qe2 – Distance: 2
Possible move: 1b2 – Actual move: 1Qe2 – Distance: 2
Possible move: 1Ba2 – Actual move: 1Qe2 – Distance: 2
Possible move: 1Bb2 – Actual move: 1Qe2 – Distance: 2
Possible move: 1Bc2 – Actual move: 1Qe2 – Distance: 2
Possible move: 1Bd2 – Actual move: 1Qe2 – Distance: 2
Possible move: 1Be1 – Actual move: 1Qe2 – Distance: 2
Possible move: 1Be2 – Actual move: 1Qe2 – Distance: 1
Possible move: 1e2 – Actual move: 1Qe2 – Distance: 1
Possible move: 1Ke2 – Actual move: 1Qe2 – Distance: 1
Possible move: 1Ne2 – Actual move: 1Qe2 – Distance: 1
Possible move: 1Qa2 – Actual move: 1Qe2 – Distance: 1
Possible move: 1Qb2 – Actual move: 1Qe2 – Distance: 1
Possible move: 1Qc2 – Actual move: 1Qe2 – Distance: 1
Possible move: 1Qd2 – Actual move: 1Qe2 – Distance: 1
Possible move: 1Qe1 – Actual move: 1Qe2 – Distance: 1
Possible move: 1Qe2 – Actual move: 1Qe2 – Distance: 0
Possible move: 1a1 – Actual move: 2f6 – Distance: 3
Possible move: 1a2 – Actual move: 2f6 – Distance: 3
Possible move: 1a3 – Actual move: 2f6 – Distance: 3
Possible move: 1a4 – Actual move: 2f6 – Distance: 3
Possible move: 1a5 – Actual move: 2f6 – Distance: 3
Possible move: 1a6 – Actual move: 2f6 – Distance: 2
Possible move: 1b6 – Actual move: 2f6 – Distance: 2
Possible move: 1Bf6 – Actual move: 2f6 – Distance: 2
Possible move: 1c6 – Actual move: 2f6 – Distance: 2
Possible move: 1d6 – Actual move: 2f6 – Distance: 2
Possible move: 1e6 – Actual move: 2f6 – Distance: 2
Possible move: 1f1 – Actual move: 2f6 – Distance: 2
Possible move: 1f2 – Actual move: 2f6 – Distance: 2
Possible move: 1f3 – Actual move: 2f6 – Distance: 2
Possible move: 1f4 – Actual move: 2f6 – Distance: 2
Possible move: 1f5 – Actual move: 2f6 – Distance: 2
Possible move: 1f6 – Actual move: 2f6 – Distance: 1
Possible move: 2a6 – Actual move: 2f6 – Distance: 1
Possible move: 2b6 – Actual move: 2f6 – Distance: 1
Possible move: 2Bf6 – Actual move: 2f6 – Distance: 1
Possible move: 2c6 – Actual move: 2f6 – Distance: 1
Possible move: 2d6 – Actual move: 2f6 – Distance: 1
Possible move: 2e6 – Actual move: 2f6 – Distance: 1
Possible move: 2f1 – Actual move: 2f6 – Distance: 1
Possible move: 2f2 – Actual move: 2f6 – Distance: 1
Possible move: 2f3 – Actual move: 2f6 – Distance: 1
Possible move: 2f4 – Actual move: 2f6 – Distance: 1
Possible move: 2f5 – Actual move: 2f6 – Distance: 1
Possible move: 2f6 – Actual move: 2f6 – Distance: 0
Possible move: 1a1 – Actual move: 1Nd3 – Distance: 3
Possible move: 1a2 – Actual move: 1Nd3 – Distance: 3

Possible move: 1a3 – Actual move: 1Nd3 – Distance: 2
Possible move: 1b3 – Actual move: 1Nd3 – Distance: 2
Possible move: 1Ba3 – Actual move: 1Nd3 – Distance: 2
Possible move: 1Bb3 – Actual move: 1Nd3 – Distance: 2
Possible move: 1Bc3 – Actual move: 1Nd3 – Distance: 2
Possible move: 1Bd1 – Actual move: 1Nd3 – Distance: 2
Possible move: 1Bd2 – Actual move: 1Nd3 – Distance: 2
Possible move: 1Bd3 – Actual move: 1Nd3 – Distance: 1
Possible move: 1d3 – Actual move: 1Nd3 – Distance: 1
Possible move: 1Kd3 – Actual move: 1Nd3 – Distance: 1
Possible move: 1Na3 – Actual move: 1Nd3 – Distance: 1
Possible move: 1Nb3 – Actual move: 1Nd3 – Distance: 1
Possible move: 1Nc3 – Actual move: 1Nd3 – Distance: 1
Possible move: 1Nd1 – Actual move: 1Nd3 – Distance: 1
Possible move: 1Nd2 – Actual move: 1Nd3 – Distance: 1
Possible move: 1Nd3 – Actual move: 1Nd3 – Distance: 0
Possible move: 1a1 – Actual move: 2Bb4 – Distance: 4
Possible move: 1a2 – Actual move: 2Bb4 – Distance: 4
Possible move: 1a3 – Actual move: 2Bb4 – Distance: 4
Possible move: 1a4 – Actual move: 2Bb4 – Distance: 3
Possible move: 1axb4 – Actual move: 2Bb4 – Distance: 3
Possible move: 1b1 – Actual move: 2Bb4 – Distance: 3
Possible move: 1b2 – Actual move: 2Bb4 – Distance: 3
Possible move: 1b3 – Actual move: 2Bb4 – Distance: 3
Possible move: 1b4 – Actual move: 2Bb4 – Distance: 2
Possible move: 1Ba4 – Actual move: 2Bb4 – Distance: 2
Possible move: 1Bb1 – Actual move: 2Bb4 – Distance: 2
Possible move: 1Bb2 – Actual move: 2Bb4 – Distance: 2
Possible move: 1Bb3 – Actual move: 2Bb4 – Distance: 2
Possible move: 1Bb4 – Actual move: 2Bb4 – Distance: 1
Possible move: 2b4 – Actual move: 2Bb4 – Distance: 1
Possible move: 2Ba4 – Actual move: 2Bb4 – Distance: 1
Possible move: 2Bb1 – Actual move: 2Bb4 – Distance: 1
Possible move: 2Bb2 – Actual move: 2Bb4 – Distance: 1
Possible move: 2Bb3 – Actual move: 2Bb4 – Distance: 1
Possible move: 2Bb4 – Actual move: 2Bb4 – Distance: 0
Possible move: 1a1 – Actual move: 21/2-1/2 – Distance: 6
Possible move: 1a2 – Actual move: 21/2-1/2 – Distance: 6
Possible move: 1axb1 – Actual move: 21/2-1/2 – Distance: 6
Possible move: 1axb2 – Actual move: 21/2-1/2 – Distance: 6
Possible move: 1b1 – Actual move: 21/2-1/2 – Distance: 6
Possible move: 1b2 – Actual move: 21/2-1/2 – Distance: 6
Possible move: 1Ba1 – Actual move: 21/2-1/2 – Distance: 6
Possible move: 1Ba2 – Actual move: 21/2-1/2 – Distance: 6
Possible move: 1Bb1 – Actual move: 21/2-1/2 – Distance: 6
Possible move: 1Bb2 – Actual move: 21/2-1/2 – Distance: 6
Possible move: 1Bc1 – Actual move: 21/2-1/2 – Distance: 6
Possible move: 1Bc2 – Actual move: 21/2-1/2 – Distance: 6
Possible move: 1Bd1 – Actual move: 21/2-1/2 – Distance: 6
Possible move: 1Bd2 – Actual move: 21/2-1/2 – Distance: 6

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Possible move: 2Ra1 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Ra2 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rb1 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rb2 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rc1 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rc2 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rd1 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rd2 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Re1 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Re2 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rf1 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rf2 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rg1 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rg2 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rh1 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rh2 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rxa1 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rxa2 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rxb1 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rxb2 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rxc1 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rxc2 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rxd1 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rxd2 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rxe1 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rxe2 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rxf1 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rxf2 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Ryg1 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Ryg2 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rxh1 – Actual move: 21/2–1/2 – Distance: 6
 Possible move: 2Rxh2 – Actual move: 21/2–1/2 – Distance: 6

This test reveals that we need to further split on the dot of the move number and add the three possible results to our list of possible chess moves.

We now need to build the representation of our Basket:

```
In [96]: class Basket:
    possible_chess_moves = "1a1 1a2 1a3 1a4 1a5 1a6 1a7 1a8 1axb1 1axb2 1axt
    possible_chess_moves_without_player = "Ba1 Ba2 Ba3 Ba4 Ba5 Ba6 Ba7 Ba8 E
    possible_chess_moves_wo_captures = "Ba1 Ba2 Ba3 Ba4 Ba5 Ba6 Ba7 Ba8 Bb1
    hm={}
    pcm = []
    def __init__(self):
        self.pcm = self.possible_chess_moves.split()
        print(f"Length of Products:{len(self.pcm)}")
        for pm in self.pcm:
            self.hm.update({pm: [False]})
```

```

def metric_lookup(self, query):
    min_metric = 10
    for m in self.pcm:
        metric = edit_distance(query,m)
        if metric <= min_metric: # < for the first tie; <= for the last
            min_metric = metric
            s2m = m
    return s2m, min_metric

def update_basket(self, item, move_number=0):
    tempList=self.hm.get(item)
    # detect the result of the move
    temp_list_res01 = self.hm.get(self.pcm[len(self.pcm)-1])
    temp_list_res12 = self.hm.get(self.pcm[len(self.pcm)-2])
    temp_list_res10 = self.hm.get(self.pcm[len(self.pcm)-3])
    if item == self.pcm[len(self.pcm)-1] or item == self.pcm[len(self.pcm)-2] or item == self.pcm[len(self.pcm)-3]:
        tmnr = move_number
        # apply the results across all prior transactions
        while not temp_list_res01[tmnr] and not temp_list_res12[tmnr] and not temp_list_res10[tmnr]:
            tempList[tmnr] = True
            if tmnr > 0:
                tmnr -= 1
    # make room for a new transaction across all products
    while move_number >= len(tempList):
        for pm in self.pcm:
            tl=self.hm.get(pm)
            tl.append(False)
            self.hm.update({pm:tl})
        tempList=self.hm.get(item)
    if not tempList[ move_number ] :
        tempList[ move_number ] =True #1+tempList[ move_number ]
        self.hm.update({item:tempList})

def __str__(self):
    ret = ""
    for k in self.hm.keys():
        d=""
        for elm in self.hm.get(k):
            if elm:
                d+=" "+str(elm)+" "
            else:
                d+=" "+str(elm)
        if 0 < self.hm.get(k).count(True):
            ret+=str(f"{k} [{self.hm.get(k).count(True)}]:{len(self.hm.get(k))}")
    return ret

def analyze_apriori(self):
    df = pd.DataFrame(self.hm)
    # Generate frequent itemsets

```

```
frequent_itemsets = apriori(df, min_support=0.91, use_colnames=True)
# Generate association rules
#rules = association_rules(frequent_itemsets, support_only=True, min_
rules = association_rules(frequent_itemsets, metric='support', min_t
print(rules)
```

We now build out various levels of abstractions via transaction delimiters representative of and according to our notions of chess strategy:

```
In [90]: test1="1.d4 d5 2.c4 c6 3.Nc3 Nf6 4.e3 a6 5.Bd3 b5 6.cxd5 cxd5 7.Bd2 e6 8.Nf3
test2="1.d4 d5 2.c4 c6 3.Nc3 Nf6 4.e3 a6 5.Bd3 b5 6.cxd5 cxd5 7.Bd2 e6 8.Nf3
test3="1.d4 d5 2.c4 c6 3.Nc3 Nf6 4.e3 a6 5.Bd3 b5 6.cxd5 cxd5 7.Bd2 e6 8.Nf3
tests=test1+" "+test2+" "+test3
print (tests)
tcs =tests.split()
class PGN_Parser:
    mba = Basket()
    # control over the relative degree of sparsity in each basket
    move_number=0 # appends to list on each pair of moves
    pawn_move_number=0 # appends to list on each pawn move: a bit more dense t
    king_move_number=0 # appends to list on each king move more sparse at the
    queen_move_number=0 # appends to list on each queen move more sparse in th
    castle_move_number=0 # appends to list splits the opening from the rest of
    def __init__(self, the_chess_string):
        self.tcs = the_chess_string

    def parse_metrics(self):
        for t in self.tcs:
            T=t.split('.')
            s=T[0]
            if len(T) > 1:
                self.move_number+=1 # appends to list
                if s == "1":
                    self.king_move_number+=1 # appends to list
                    self.queen_move_number+=1 # appends to list
                    self.castle_move_number+=1
                    if T[1][2:3].islower():
                        self.pawn_move_number+=1
                    s=T[1]
                if s.startswith('Q'):
                    self.queen_move_number +=1
                elif s.startswith('K'):
                    self.king_move_number +=1
                elif s.startswith('O'):
                    self.castle_move_number +=1
                    self.king_move_number +=1
                if s=="0-0":
                    s="Rf8"
```

```

1.d4 d5 2.c4 c6 3.Nc3 Nf6 4.e3 a5 5.Bd3 b5 6.cxd5 cxd5 7.Bd2 e6 8.Nf3 Bd6 9.
Ne5 Nbd7 10.f4 Bb7 11.0-0 0-0 12.Rc1 Nb6 13.Qf3 Rc8 14.Nb1 Qe7 15.b3 Nc4 16.
Bc3 Na3 17.Bb2 Nxb1 18.Bxb1 Ne4 19.Qe2 f6 20.Nd3 Bb4 1-0 1.d4 d5 2.c4 c6 3.N
c3 Nf6 4.e3 a6 5.Bd3 b5 6.cxd5 cxd5 7.Bd2 e6 8.Nf3 Bd6 9.Ne5 Nbd7 10.f4 Bb7
11.0-0 0-0 12.Rc1 Nb6 13.Qf3 Rc8 14.Nb1 Qe7 15.b3 Nc4 16.Bc3 Na3 17.Bb2 Nxb1
18.Bxb1 Ne4 19.Qe2 f6 20.Nd3 Bb4 1/2-1/2 1.d4 d5 2.c4 c6 3.Nc3 Nf6 4.e3 a6
5.Bd3 b5 6.cxd5 cxd5 7.Bd2 e6 8.Nf3 Bd6 9.Ne5 Nbd7 10.f4 Bb7 11.0-0 0-0 12.R
c1 Nb6 13.Qf3 Rc8 14.Nb1 Qe7 15.b3 Nc4 16.Bc3 Na3 17.Bb2 Nxb1 18.Bxb1 Ne4 1
9.Qe2 f6 20.Nd3 Bb4 0-1
Length of Products:1587
1h1[3:67]: False False False False False False False False False False False
False False False False True False False False False False False False Fals
e False False False False False False False False False False False False Fa
lse True False False False False False False False False False False False
False False False False False False False False False False True False Fals
e False False False False False
1h3[3:67]: False False False False False False False False False False False
False False False False False True False False False False False False Fals
e False False False False False False False False False False False False Fa
lse False True False False False False False False False False False False
False False False False False False False False False False False True Fals
e False False False False False
1h4[3:67]: False False False False False False False False False False False
False False False False False False True False False False False False Fals
e False False False False False False False False False False False False Fa

```

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[illegible]

```

e False False False False True
1/2[29:67]: True True True False False False False False False False False
e False False False False True True True True True True True True False Tr
ue True False False False False False False False False False False False
False True True True True True True True True True True True False Fals
e False False False False False False False False False False True True Tr
ue True True True True False
0-1[37:67]: False False False True True True True True True True True True
True True True True False False False False False False False False Fals
e False True True True True True True True True True True True True Tr
ue False False False False False False False False False False True True
True True True True True True True True True True True False False Fals
e False False False False True

```

```

In [94]: p.mba.analyze_apriori()
# The output of association rules using the apriori algorithm will be printed

```

antecedents			consequents	antecedent support	\	
0	(1h1)		(2Kg8)	0.044776		
1	(2Kg8)		(1h1)	0.044776		
2	(1h1)		(2Nb6)	0.044776		
3	(2Nb6)		(1h1)	0.044776		
4	(1h1)		(2Rf8)	0.044776		
..		
549	(2Bb7)	(0-1, 2Rd7, 2d6, 1-0)		0.044776		
550	(0-1)	(2Bb7, 2Rd7, 2d6, 1-0)		0.552239		
551	(2d6)	(2Bb7, 0-1, 2Rd7, 1-0)		0.044776		
552	(2Rd7)	(2Bb7, 0-1, 2d6, 1-0)		0.044776		
553	(1-0)	(2Bb7, 0-1, 2Rd7, 2d6)		0.089552		
consequent support			support	confidence	lift	representativity
\						
0		0.044776	0.044776	1.000000	22.333333	1.0
1		0.044776	0.044776	1.000000	22.333333	1.0
2		0.044776	0.044776	1.000000	22.333333	1.0
3		0.044776	0.044776	1.000000	22.333333	1.0
4		0.044776	0.044776	1.000000	22.333333	1.0
..	
549		0.044776	0.044776	1.000000	22.333333	1.0
550		0.044776	0.044776	0.081081	1.810811	1.0
551		0.044776	0.044776	1.000000	22.333333	1.0
552		0.044776	0.044776	1.000000	22.333333	1.0
553		0.044776	0.044776	0.500000	11.166667	1.0
leverage		conviction	zhangs_metric	jaccard	certainty	kulczynski
0	0.042771	inf	1.0	1.000000	1.000000	1.000000
1	0.042771	inf	1.0	1.000000	1.000000	1.000000
2	0.042771	inf	1.0	1.000000	1.000000	1.000000
3	0.042771	inf	1.0	1.000000	1.000000	1.000000
4	0.042771	inf	1.0	1.000000	1.000000	1.000000
..
549	0.042771	inf	1.0	1.000000	1.000000	1.000000
550	0.020049	1.039508	1.0	0.081081	0.038007	0.540541
551	0.042771	inf	1.0	1.000000	1.000000	1.000000
552	0.042771	inf	1.0	1.000000	1.000000	1.000000
553	0.040766	1.910448	1.0	0.500000	0.476562	0.750000

[554 rows x 14 columns]

These rules show the time/space-complexity for a very small set of games. We can see that the more densely packed our transactions are the more time and space will be required to compute the associations. We can now move on to applying the pgn transformation over our complete collection of games with greater control over the relative sparseness for the computation of association rules. We have included transaction delimiters that map nicely to our understanding of movement / progress in chess game development from the opening, through the middle and

into the end game. These divisions help to reduce the complexity in the rule building process.

Before we begin running through our collection of games we need to preprocess the files so that the files match our working assumptions of the games:

```
grep -v ^$ twic1450.pgn | grep -v ^"[" | perl -p -e 's/\r\n/ /' | sed 's/ 1. /\n1. /g' >
twic1450.preprocessed.pgn
```

We can get a lot more elaborate, but this will remove all of the comments and whitespace.

```
In [ ]: tcs = ""
pgn_file = "twic1450.preprocessed.pgn"
with open(pgn_file, 'r', encoding='latin-1') as file:
    for line in file:
        tcs = tcs + " " + line

pgn_parser = PGN_Parser(tcs)
pgn_parser.parse_metrics()
p.mba.analyze_apriori()
```

```
In [ ]:
```