HW5
Aarshay Jain (aj2713)

1 Markov Chain

1.1 Top 25 teams

The top 25 teams and their corresponding weights for different iterations are shown in Figure 1.

ranks	t_10	t_100	t_1000	t_10000
1	('Mary Hardin-Baylor', '0.015')	('NW Missouri St', '0.038')	('Alabama', '0.061')	('Alabama', '0.067')
2	('NW Missouri St', '0.013')	('Alabama', '0.033')	('Clemson', '0.060')	('Clemson', '0.067')
3	('Alabama', '0.012')	('Clemson', '0.033')	('NW Missouri St', '0.030')	('Florida St', '0.021')
4	('Clemson', '0.011')	('Mary Hardin-Baylor', '0.031')	('Florida St', '0.019')	('Ohio State', '0.020')
5	('UW-Oshkosh', '0.010')	('UW-Oshkosh', '0.017')	('Ohio State', '0.018')	('Washington', '0.018')
6	('St Thomas', '0.008')	('UW-Whitewater', '0.012')	('Washington', '0.016')	('Virginia Tech', '0.018')
7	('UW-Whitewater', '0.008')	('Florida St', '0.010')	('Virginia Tech', '0.016')	('Michigan', '0.016')
8	('St Francis IN', '0.008')	('Grand Valley St', '0.010')	('Michigan', '0.015')	('NW Missouri St', '0.016')
9	('Mount Union', '0.008')	('John Carroll', '0.010')	('Pittsburgh', '0.015')	('Pittsburgh', '0.016')
10	('James Madison', '0.007')	('Ohio State', '0.010')	('Oklahoma', '0.014')	('Oklahoma', '0.016')
11	('Reinhardt', '0.007')	('Ferris St', '0.009')	('Penn State', '0.014')	('Penn State', '0.015')
12	('John Carroll', '0.007')	('St Thomas', '0.009')	('Wisconsin', '0.013')	('Wisconsin', '0.014')
13	('Shepherd', '0.007')	('Washington', '0.009')	('Louisville', '0.013')	('Louisville', '0.014')
14	('California PA', '0.007')	('Virginia Tech', '0.009')	('Miami FL', '0.012')	('Miami FL', '0.014')
15	('North Dakota St', '0.007')	('Mount Union', '0.009')	('Southern Cal', '0.012')	('Southern Cal', '0.013')
16	('Baker', '0.006')	('Michigan', '0.008')	('North Carolina', '0.011')	('North Carolina', '0.013')
17	('Alfred', '0.006')	('Pittsburgh', '0.008')	('Oklahoma St', '0.011')	('Oklahoma St', '0.012')
18	('Grand Valley St', '0.006')	('Oklahoma', '0.008')	('Florida', '0.011')	('Florida', '0.012')
19	('North Alabama', '0.006')	('Emporia St', '0.008')	('Tennessee', '0.011')	('Tennessee', '0.012')
20	('Harding', '0.006')	('Penn State', '0.008')	('Auburn', '0.011')	('Auburn', '0.012')
21	('Marian IN', '0.006')	('Wisconsin', '0.007')	('Georgia Tech', '0.010')	('Georgia Tech', '0.011')
22	('North Central', '0.006')	('Louisville', '0.007')	('LSU', '0.010')	('LSU', '0.011')
23	('Trinity CT', '0.005')	('Miami FL', '0.007')	('Western Michigan', '0.010')	('Western Michigan', '0.011')
24	('Wheaton', '0.005')	('North Carolina', '0.007')	('Stanford', '0.010')	('Stanford', '0.011')
25	('Morningside', '0.005')	('Southern Cal', '0.006')	('James Madison', '0.009')	('Texas A&M', '0.010')

Figure 1: Top 25 Teams

1.2   Plot of $||w_t - w_\infty||_1$ by iterations
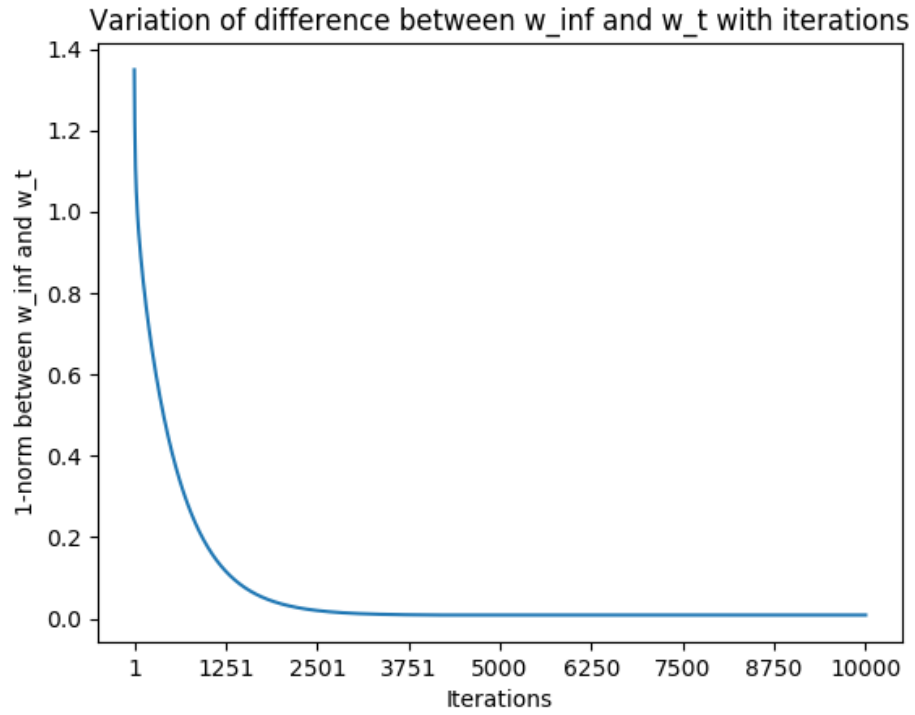
The required plot is shown in Figure 2

Figure 2: Variation of $||w_t - w_\infty||_1$ by iterations

2 Nonnegative Matrix Factorization

2.1 Objective per iteration

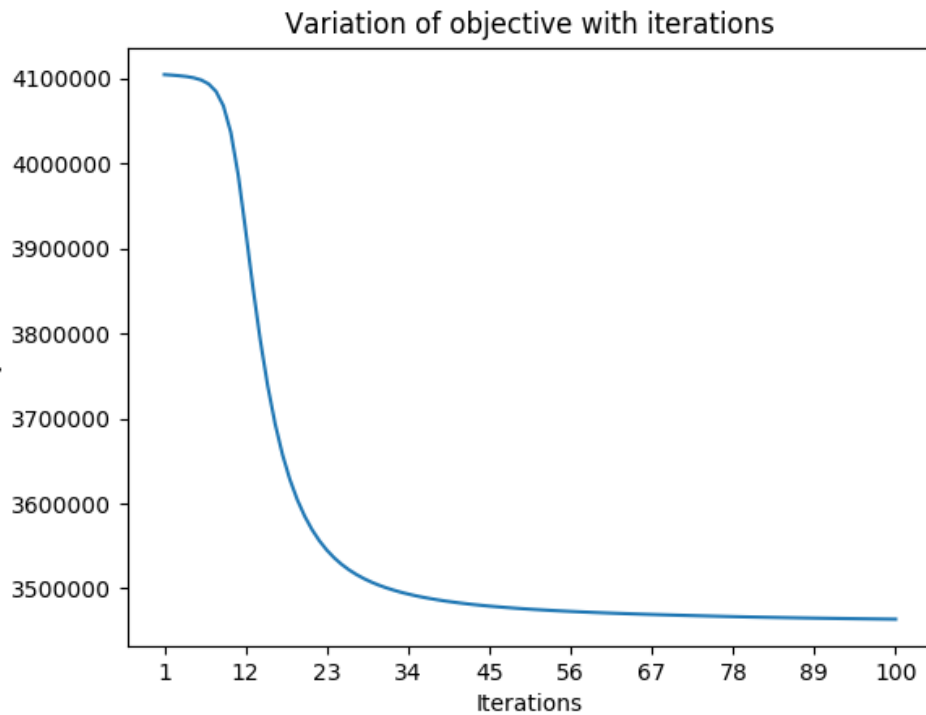The required plot is shown in Figure 3

Figure 3: Variation of objective by iterations

2.2 Objective per iteration

The words and their weights in each topic are shown in Figure 4

Topic_1	Topic_2	Topic_3	Topic_4	Topic_5
('0.012', 'food')	('0.044', 'president')	('0.017', 'health')	('0.009', 'problem')	('0.014', 'government')
('0.009', 'serve')	('0.033', 'mrs')	('0.016', 'drug')	('0.009', 'question')	('0.013', 'states')
('0.008', 'restaurant')	('0.032', 'father')	('0.014', 'doctor')	('0.008', 'important')	('0.012', 'country')
('0.008', 'taste')	('0.030', 'graduate')	('0.013', 'medical')	('0.007', 'far')	('0.012', 'leader')
('0.007', 'fresh')	('0.028', 'retire')	('0.012', 'study')	('0.007', 'change')	('0.011', 'american')
('0.007', 'dry')	('0.026', 'son')	('0.012', 'patient')	('0.006', 'reason')	('0.011', 'official')
('0.007', 'eat')	('0.025', 'yesterday')	('0.011', 'treatment')	('0.006', 'view')	('0.010', 'political')
('0.007', 'add')	('0.025', 'director')	('0.010', 'cause')	('0.006', 'approach')	('0.008', 'meeting')
('0.007', 'fish')	('0.024', 'vice')	('0.009', 'care')	('0.006', 'mean')	('0.008', 'war')
('0.007', 'water')	('0.023', 'executive')	('0.009', 'research')	('0.006', 'thing')	('0.007', 'military')
Topic_6	**Topic_7**	**Topic_8**	**Topic_9**	**Topic_10**
('0.034', 'store')	('0.021', 'industry')	('0.026', 'company')	('0.017', 'vote')	('0.023', 'computer')
('0.033', 'sell')	('0.017', 'product')	('0.018', 'pay')	('0.014', 'campaign')	('0.016', 'technology')
('0.028', 'buy')	('0.015', 'executive')	('0.014', 'financial')	('0.014', 'state')	('0.014', 'information')
('0.023', 'sale')	('0.015', 'company')	('0.012', 'money')	('0.013', 'political')	('0.014', 'system')
('0.021', 'owner')	('0.015', 'market')	('0.012', 'business')	('0.012', 'republican')	('0.013', 'network')
('0.020', 'car')	('0.013', 'business')	('0.011', 'executive')	('0.011', 'candidate')	('0.013', 'company')
('0.016', 'company')	('0.013', 'president')	('0.010', 'deal')	('0.011', 'election')	('0.011', 'television')
('0.015', 'price')	('0.012', 'advertising')	('0.010', 'bank')	('0.010', 'party')	('0.010', 'internet')
('0.014', 'business')	('0.010', 'commercial')	('0.010', 'share')	('0.009', 'democratic')	('0.010', 'service')
('0.013', 'customer')	('0.009', 'cost')	('0.008', 'investment')	('0.009', 'bill')	('0.010', 'site')
Topic_11	**Topic_12**	**Topic_13**	**Topic_14**	**Topic_15**
('0.017', 'art')	('0.019', 'music')	('0.033', 'city')	('0.036', 'child')	('0.019', 'official')
('0.012', 'artist')	('0.018', 'play')	('0.021', 'building')	('0.036', 'family')	('0.014', 'agency')
('0.011', 'design')	('0.014', 'film')	('0.017', 'resident')	('0.027', 'woman')	('0.012', 'plan')
('0.010', 'collection')	('0.011', 'performance')	('0.015', 'area')	('0.024', 'life')	('0.011', 'require')
('0.010', 'museum')	('0.010', 'audience')	('0.014', 'build')	('0.019', 'wife')	('0.010', 'worker')
('0.008', 'exhibition')	('0.009', 'movie')	('0.013', 'community')	('0.019', 'friend')	('0.009', 'state')
('0.008', 'photograph')	('0.008', 'stage')	('0.012', 'local')	('0.018', 'young')	('0.009', 'union')
('0.007', 'painting')	('0.008', 'theater')	('0.011', 'house')	('0.017', 'live')	('0.009', 'system')
('0.007', 'open')	('0.008', 'production')	('0.011', 'live')	('0.017', 'mother')	('0.008', 'program')
('0.007', 'color')	('0.008', 'dance')	('0.010', 'property')	('0.016', 'man')	('0.007', 'cost')
Topic_16	**Topic_17**	**Topic_18**	**Topic_19**	**Topic_20**
('0.023', 'police')	('0.040', 'percent')	('0.033', 'team')	('0.025', 'win')	('0.017', 'book')
('0.019', 'kill')	('0.021', 'rate')	('0.031', 'game')	('0.022', 'second')	('0.017', 'write')
('0.015', 'attack')	('0.018', 'rise')	('0.024', 'play')	('0.019', 'third')	('0.014', 'editor')
('0.013', 'officer')	('0.017', 'market')	('0.023', 'player')	('0.015', 'hit')	('0.010', 'writer')
('0.012', 'man')	('0.015', 'price')	('0.020', 'season')	('0.013', 'race')	('0.009', 'life')
('0.011', 'force')	('0.013', 'increase')	('0.013', 'coach')	('0.011', 'victory')	('0.008', 'world')
('0.010', 'official')	('0.012', 'fall')	('0.010', 'point')	('0.011', 'finish')	('0.008', 'story')
('0.010', 'fire')	('0.012', 'report')	('0.009', 'win')	('0.010', 'start')	('0.007', 'author')
('0.010', 'military')	('0.011', 'economy')	('0.009', 'league')	('0.010', 'fourth')	('0.007', 'page')
('0.008', 'report')	('0.011', 'low')	('0.008', 'second')	('0.009', 'lose')	('0.007', 'history')
Topic_21	**Topic_22**	**Topic_23**	**Topic_24**	**Topic_25**
('0.025', 'states')	('0.020', 'thing')	('0.040', 'school')	('0.020', 'case')	('0.010', 'wear')
('0.021', 'country')	('0.019', 'tell')	('0.030', 'student')	('0.017', 'lawyer')	('0.008', 'night')
('0.021', 'american')	('0.017', 'ask')	('0.019', 'program')	('0.016', 'court')	('0.007', 'walk')
('0.015', 'world')	('0.015', 'feel')	('0.014', 'education')	('0.016', 'charge')	('0.007', 'trip')
('0.014', 'oil')	('0.012', 'really')	('0.014', 'class')	('0.014', 'law')	('0.006', 'foot')
('0.013', 'plant')	('0.011', 'lot')	('0.013', 'college')	('0.011', 'judge')	('0.006', 'drive')
('0.012', 'japanese')	('0.009', 'happen')	('0.011', 'teacher')	('0.009', 'legal')	('0.006', 'hour')
('0.011', 'energy')	('0.008', 'talk')	('0.011', 'child')	('0.009', 'investigation')	('0.006', 'place')
('0.010', 'production')	('0.008', 'little')	('0.010', 'group')	('0.008', 'trial')	('0.006', 'ride')
('0.009', 'produce')	('0.007', 'put')	('0.008', 'university')	('0.007', 'file')	('0.006', 'mile')

Figure 4: Words in Topics