RESULTS

Part 1

Earphone
Cross Validation 1 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 60.0)
('MNB_classifier accuracy percent:', 63.07692307692307)
('BernoulliNB_classifier accuracy percent:', 61.53846153846154)
('LogisticRegression_classifier accuracy percent:', 69.23076923076923)
('LinearSVC_classifier accuracy percent:', 70.76923076923077)
('voted_classifier accuracy percent:', 63.07692307692307)
Cross Validation 2 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 74.60317460317461)
('MNB_classifier accuracy percent:', 73.01587301587301)
('BernoulliNB_classifier accuracy percent:', 76.19047619047619)
('LogisticRegression_classifier accuracy percent:', 66.66666666666666)
('LinearSVC_classifier accuracy percent:', 66.66666666666666)
('voted_classifier accuracy percent:', 73.01587301587301)
Cross Validation 3 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 58.06451612903226)
('MNB_classifier accuracy percent:', 56.451612903225815)
('BernoulliNB_classifier accuracy percent:', 56.451612903225815)
('LogisticRegression_classifier accuracy percent:', 62.903225806451616)
('LinearSVC_classifier accuracy percent:', 56.451612903225815)
('voted_classifier accuracy percent:', 56.451612903225815)
Cross Validation 4 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 68.75)
('MNB_classifier accuracy percent:', 68.75)
('BernoulliNB_classifier accuracy percent:', 67.1875)
('LogisticRegression_classifier accuracy percent:', 64.0625)
('LinearSVC_classifier accuracy percent:', 67.1875)
('voted_classifier accuracy percent:', 68.75)
Cross Validation 5 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 63.63636363636363)
('MNB_classifier accuracy percent:', 59.09090909090909)
('BernoulliNB_classifier accuracy percent:', 59.09090909090909)
('LogisticRegression_classifier accuracy percent:', 60.60606060606061)
('LinearSVC_classifier accuracy percent:', 59.09090909090909)
('voted_classifier accuracy percent:', 62.121212121212125)
Cross Validation 6 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 61.53846153846154)
('MNB_classifier accuracy percent:', 64.61538461538461)
('BernoulliNB_classifier accuracy percent:', 63.07692307692307)
('LogisticRegression_classifier accuracy percent:', 64.61538461538461)
('LinearSVC_classifier accuracy percent:', 70.76923076923077)
('voted_classifier accuracy percent:', 66.15384615384615)
Cross Validation 7 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 53.96825396825397)
('MNB_classifier accuracy percent:', 53.96825396825397)

('BernoulliNB_classifier accuracy percent:', 52.38095238095239)
('LogisticRegression_classifier accuracy percent:', 57.14285714285714)
('LinearSVC_classifier accuracy percent:', 52.38095238095239)
('voted_classifier accuracy percent:', 52.38095238095239)
Cross Validation 8 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 56.060606060606055)
('MNB_classifier accuracy percent:', 59.09090909090909)
('BernoulliNB_classifier accuracy percent:', 60.60606060606061)
('LogisticRegression_classifier accuracy percent:', 63.63636363636363)
('LinearSVC_classifier accuracy percent:', 66.66666666666666)
('voted_classifier accuracy percent:', 59.09090909090909)
Cross Validation 9 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 66.15384615384615)
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('LinearSVC_classifier accuracy percent:', 55.38461538461539)
('voted_classifier accuracy percent:', 63.07692307692307)
Cross Validation 10 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 69.6969696969697)
('MNB_classifier accuracy percent:', 68.18181818181817)
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('LogisticRegression_classifier accuracy percent:', 59.09090909090909)
('LinearSVC_classifier accuracy percent:', 62.121212121212125)
('voted_classifier accuracy percent:', 63.63636363636363)
('Average Original Naive Bayes Algo accuracy percent using high frequency words:', 63.2472191786708)
('Average MNB_classifier accuracy percent:', 63.085706855868146)
('Average BernoulliNB_classifier accuracy percent:', 62.01592594233724)
('Average LogisticRegression_classifier accuracy percent:', 62.64162752570011)
('Average LinearSVC_classifier accuracy percent:', 62.748859675270964)
('Average voted_classifier accuracy percent:', 62.77546154562284)

GPS
Cross Validation 1 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 72.08121827411168)
('MNB_classifier accuracy percent:', 77.15736040609137)
('BernoulliNB_classifier accuracy percent:', 75.63451776649747)
('LogisticRegression_classifier accuracy percent:', 80.20304568527918)
('LinearSVC_classifier accuracy percent:', 77.66497461928934)
('voted_classifier accuracy percent:', 77.66497461928934)
Cross Validation 2 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 77.61194029850746)
('MNB_classifier accuracy percent:', 75.62189054726367)
('BernoulliNB_classifier accuracy percent:', 74.12935323383084)
('LogisticRegression_classifier accuracy percent:', 83.08457711442786)
('LinearSVC_classifier accuracy percent:', 78.60696517412936)
('voted_classifier accuracy percent:', 80.09950248756219)
Cross Validation 3 / 10

('Original Naive Bayes Algo accuracy percent using high frequency words:', 76.80412371134021)
('MNB_classifier accuracy percent:', 73.19587628865979)
('BernoulliNB_classifier accuracy percent:', 70.10309278350515)
('LogisticRegression_classifier accuracy percent:', 80.9278350515464)
('LinearSVC_classifier accuracy percent:', 82.4742268041237)
('voted_classifier accuracy percent:', 77.31958762886599)
Cross Validation 4 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 77.41935483870968)
('MNB_classifier accuracy percent:', 80.64516129032258)
('BernoulliNB_classifier accuracy percent:', 79.56989247311827)
('LogisticRegression_classifier accuracy percent:', 87.09677419354838)
('LinearSVC_classifier accuracy percent:', 87.09677419354838)
('voted_classifier accuracy percent:', 83.33333333333334)
Cross Validation 5 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 81.91489361702128)
('MNB_classifier accuracy percent:', 82.97872340425532)
('BernoulliNB_classifier accuracy percent:', 81.91489361702128)
('LogisticRegression_classifier accuracy percent:', 85.63829787234043)
('LinearSVC_classifier accuracy percent:', 82.97872340425532)
('voted_classifier accuracy percent:', 85.1063829787234)
Cross Validation 6 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 74.73684210526315)
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('BernoulliNB_classifier accuracy percent:', 75.26315789473685)
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('LinearSVC_classifier accuracy percent:', 78.94736842105263)
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Cross Validation 7 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 72.91666666666666)
('MNB_classifier accuracy percent:', 79.16666666666666)
('BernoulliNB_classifier accuracy percent:', 76.5625)
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('LinearSVC_classifier accuracy percent:', 79.16666666666666)
('voted_classifier accuracy percent:', 77.08333333333334)
Cross Validation 8 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 74.27184466019418)
('MNB_classifier accuracy percent:', 80.58252427184466)
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Cross Validation 9 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 75.26315789473685)
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Cross Validation 10 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 67.95580110497238)
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('Average Original Naive Bayes Algo accuracy percent using high frequency words:', 75.09758431715235)
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('Average BernoulliNB_classifier accuracy percent:', 75.46449262672573)
('Average LogisticRegression_classifier accuracy percent:', 81.60204594495099)
('Average LinearSVC_classifier accuracy percent:', 79.93414279747995)
('Average voted_classifier accuracy percent:', 78.93024621481543)

Keyboard

python Part1.py
Cross Validation 1 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 65.94202898550725)
('MNB_classifier accuracy percent:', 66.66666666666666)
('BernoulliNB_classifier accuracy percent:', 64.4927536231884)
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('LinearSVC_classifier accuracy percent:', 72.46376811594203)
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Cross Validation 2 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 71.73913043478261)
('MNB_classifier accuracy percent:', 71.01449275362319)
('BernoulliNB_classifier accuracy percent:', 71.01449275362319)
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Cross Validation 3 / 10
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Cross Validation 4 / 10
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Cross Validation 5 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 73.91304347826086)
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('BernoulliNB_classifier accuracy percent:', 73.91304347826086)
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('voted_classifier accuracy percent:', 73.91304347826086)
Cross Validation 6 / 10
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('LogisticRegression_classifier accuracy percent:', 66.38655462184873)
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Cross Validation 7 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 67.6056338028169)
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('LogisticRegression_classifier accuracy percent:', 66.19718309859155)
('LinearSVC_classifier accuracy percent:', 64.7887323943662)
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Cross Validation 8 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 68.11594202898551)
('MNB_classifier accuracy percent:', 68.11594202898551)
('BernoulliNB_classifier accuracy percent:', 66.66666666666666)
('LogisticRegression_classifier accuracy percent:', 73.91304347826086)
('LinearSVC_classifier accuracy percent:', 71.01449275362319)
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Cross Validation 9 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 70.0)
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Cross Validation 10 / 10
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('voted_classifier accuracy percent:', 71.01449275362319)
('Average Original Naive Bayes Algo accuracy percent using high frequency words:', 69.03414044042977)
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('Average BernoulliNB_classifier accuracy percent:', 67.99847473150112)
('Average LogisticRegression_classifier accuracy percent:', 72.0180967980364)
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Mouse

Cross Validation 1 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 72.58064516129032)
('MNB_classifier accuracy percent:', 82.66129032258065)

('BernoulliNB_classifier accuracy percent:', 83.06451612903226)
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Cross Validation 2 / 10
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Cross Validation 3 / 10
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Cross Validation 4 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 81.78137651821862)
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Cross Validation 5 / 10
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Cross Validation 6 / 10
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Cross Validation 7 / 10
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Cross Validation 8 / 10
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Cross Validation 9 / 10
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Cross Validation 10 / 10
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MP3 Player

Cross Validation 1 / 10
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Cross Validation 2 / 10
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('LogisticRegression_classifier accuracy percent:', 79.41176470588235)
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Cross Validation 3 / 10
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Cross Validation 4 / 10
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Cross Validation 5 / 10
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Cross Validation 6 / 10
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Cross Validation 7 / 10
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Cross Validation 8 / 10
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Cross Validation 9 / 10
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Cross Validation 10 / 10
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('LinearSVC_classifier accuracy percent:', 56.25)
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('Average LinearSVC_classifier accuracy percent:', 63.66908530274279)
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Router

Cross Validation 1 / 10
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Cross Validation 2 / 10
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Cross Validation 3 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 82.25806451612904)
('MNB_classifier accuracy percent:', 85.08064516129032)
('BernoulliNB_classifier accuracy percent:', 83.87096774193549)
('LogisticRegression_classifier accuracy percent:', 86.69354838709677)
('LinearSVC_classifier accuracy percent:', 83.46774193548387)
('voted_classifier accuracy percent:', 85.08064516129032)
Cross Validation 4 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 84.50704225352112)
('MNB_classifier accuracy percent:', 85.91549295774648)
('BernoulliNB_classifier accuracy percent:', 85.91549295774648)
('LogisticRegression_classifier accuracy percent:', 86.31790744466801)
('LinearSVC_classifier accuracy percent:', 83.90342052313883)
('voted_classifier accuracy percent:', 86.31790744466801)
Cross Validation 5 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 57.31462925851704)
('MNB_classifier accuracy percent:', 65.13026052104209)
('BernoulliNB_classifier accuracy percent:', 66.33266533066133)
('LogisticRegression_classifier accuracy percent:', 58.717434869739485)
('LinearSVC_classifier accuracy percent:', 59.118236472945895)
('voted_classifier accuracy percent:', 62.32464929859719)
Cross Validation 6 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 81.17408906882592)
('MNB_classifier accuracy percent:', 81.37651821862349)
('BernoulliNB_classifier accuracy percent:', 80.5668016194332)
('LogisticRegression_classifier accuracy percent:', 81.9838056680162)
('LinearSVC_classifier accuracy percent:', 80.97165991902834)
('voted_classifier accuracy percent:', 83.19838056680162)
Cross Validation 7 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 80.28169014084507)
('MNB_classifier accuracy percent:', 79.47686116700201)

('BernoulliNB_classifier accuracy percent:', 78.4708249496982)
('LogisticRegression_classifier accuracy percent:', 79.67806841046277)
('LinearSVC_classifier accuracy percent:', 79.27565392354124)
('voted_classifier accuracy percent:', 79.67806841046277)
Cross Validation 8 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 81.83673469387756)
('MNB_classifier accuracy percent:', 81.22448979591836)
('BernoulliNB_classifier accuracy percent:', 80.61224489795919)
('LogisticRegression_classifier accuracy percent:', 82.85714285714286)
('LinearSVC_classifier accuracy percent:', 81.0204081632653)
('voted_classifier accuracy percent:', 81.63265306122449)
Cross Validation 9 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 82.07739307535643)
('MNB_classifier accuracy percent:', 82.07739307535643)
('BernoulliNB_classifier accuracy percent:', 80.04073319755601)
('LogisticRegression_classifier accuracy percent:', 84.72505091649694)
('LinearSVC_classifier accuracy percent:', 82.89205702647658)
('voted_classifier accuracy percent:', 82.68839103869654)
Cross Validation 10 / 10
('Original Naive Bayes Algo accuracy percent using high frequency words:', 82.897384305835)
('MNB_classifier accuracy percent:', 82.09255533199196)
('BernoulliNB_classifier accuracy percent:', 80.48289738430584)
('LogisticRegression_classifier accuracy percent:', 80.88531187122736)
('LinearSVC_classifier accuracy percent:', 82.09255533199196)
('voted_classifier accuracy percent:', 82.09255533199196)
('Average Original Naive Bayes Algo accuracy percent using high frequency words:',
77.32660353369552)
('Average MNB_classifier accuracy percent:', 79.79611514951868)
('Average BernoulliNB_classifier accuracy percent:', 79.18787552842927)
('Average LogisticRegression_classifier accuracy percent:', 80.16632852527736)
('Average LinearSVC_classifier accuracy percent:', 79.17382828744681)
('Average voted_classifier accuracy percent:', 80.0812253166189)

Accuracy Part1

Algorithm\Product	Earphone	GPS	Keyboard	Mouse	MP3 Player	Router
Naive Bayes	63.24	75.097	69.034	76.095	68.79	77.32
MNB_classifier	63.085	77.101	68.69	82.87	67.84	79.76
BernoulliNB	62.015	75.46	67.99	82.31	67.82	79.18
LogisticRegression	62.64	81.60	72.01	84.69	65.45	80.16
LinearSVC	62.74	79.93	70.99	81.99	63.66	79.17
voted_classifier	62.77	78.93	69.03	83.67	67.55	80.081

Part 2

Earphone
L-BFGS with L1/L2 regularization
Holdout group: 1
***** Iteration #250 *****
Loss: 115.723560
Feature norm: 8.089360
Error norm: 0.611706
Active features: 1781192
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 1.410
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1836, 1943, 1844) (0.9449, 0.9957, 0.9696)
   B: (11, 13, 37) (0.8462, 0.2973, 0.4400)
   I: (35, 41, 116) (0.8537, 0.3017, 0.4459)
Macro-average precision, recall, F1: (0.881581, 0.531561, 0.618498)
Item accuracy: 1882 / 1997 (0.9424)
Instance accuracy: 40 / 68 (0.5882)

Holdout group: 2
***** Iteration #246 *****
Loss: 111.532077
Feature norm: 8.100101
Error norm: 0.459563
Active features: 1770844
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 0.949
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1827, 1919, 1856) (0.9521, 0.9844, 0.9679)
   B: (12, 17, 34) (0.7059, 0.3529, 0.4706)
   I: (44, 69, 115) (0.6377, 0.3826, 0.4783)
Macro-average precision, recall, F1: (0.765207, 0.573308, 0.638932)
Item accuracy: 1883 / 2005 (0.9392)
Instance accuracy: 41 / 68 (0.6029)

Holdout group: 3
***** Iteration #274 *****
Loss: 117.496869
Feature norm: 8.074770
Error norm: 0.799070
Active features: 1801077
Line search trials: 2
Line search step: 0.447981
Seconds required for this iteration: 2.261
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1484, 1571, 1492) (0.9446, 0.9946, 0.9690)
   B: (13, 15, 32) (0.8667, 0.4062, 0.5532)

I: (32, 38, 100) (0.8421, 0.3200, 0.4638)
Macro-average precision, recall, F1: (0.884464, 0.573629, 0.661981)
Item accuracy: 1529 / 1624 (0.9415)
Instance accuracy: 45 / 68 (0.6618)

Holdout group: 4
***** Iteration #243 *****
Loss: 110.051090
Feature norm: 8.106986
Error norm: 0.556050
Active features: 1784417
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 1.286
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1678, 1785, 1695) (0.9401, 0.9900, 0.9644)
   B: (7, 10, 34) (0.7000, 0.2059, 0.3182)
   I: (19, 34, 100) (0.5588, 0.1900, 0.2836)
Macro-average precision, recall, F1: (0.732960, 0.461951, 0.522044)
Item accuracy: 1704 / 1829 (0.9317)
Instance accuracy: 38 / 68 (0.5588)

Holdout group: 5
***** Iteration #279 *****
Loss: 115.075727
Feature norm: 8.096623
Error norm: 1.576471
Active features: 1780801
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 1.530
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1712, 1825, 1726) (0.9381, 0.9919, 0.9642)
   B: (4, 7, 33) (0.5714, 0.1212, 0.2000)
   I: (12, 23, 96) (0.5217, 0.1250, 0.2017)
Macro-average precision, recall, F1: (0.677083, 0.412700, 0.455305)
Item accuracy: 1728 / 1855 (0.9315)
Instance accuracy: 35 / 68 (0.5147)

Holdout group: 6
***** Iteration #266 *****
Loss: 108.541841
Feature norm: 8.086395
Error norm: 1.178635
Active features: 1795870
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 1.631
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1666, 1775, 1705) (0.9386, 0.9771, 0.9575)

   B: (12, 22, 37) (0.5455, 0.3243, 0.4068)
   I: (42, 73, 128) (0.5753, 0.3281, 0.4179)
Macro-average precision, recall, F1: (0.686463, 0.543192, 0.594054)
Item accuracy: 1720 / 1870 (0.9198)
Instance accuracy: 39 / 68 (0.5735)

Holdout group: 7
***** Iteration #277 *****
Loss: 114.238202
Feature norm: 8.131193
Error norm: 1.154696
Active features: 1790273
Line search trials: 2
Line search step: 0.234060
Seconds required for this iteration: 3.058
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1642, 1712, 1652) (0.9591, 0.9939, 0.9762)
   B: (10, 14, 29) (0.7143, 0.3448, 0.4651)
   I: (33, 41, 86) (0.8049, 0.3837, 0.5197)
Macro-average precision, recall, F1: (0.826092, 0.574165, 0.653673)
Item accuracy: 1685 / 1767 (0.9536)
Instance accuracy: 44 / 67 (0.6567)

Holdout group: 8
***** Iteration #248 *****
Loss: 107.064829
Feature norm: 8.031242
Error norm: 1.855535
Active features: 1783298
Line search trials: 2
Line search step: 0.218725
Seconds required for this iteration: 3.409
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1678, 1781, 1694) (0.9422, 0.9906, 0.9658)
   B: (12, 17, 38) (0.7059, 0.3158, 0.4364)
   I: (37, 49, 115) (0.7551, 0.3217, 0.4512)
Macro-average precision, recall, F1: (0.801051, 0.542695, 0.617780)
Item accuracy: 1727 / 1847 (0.9350)
Instance accuracy: 36 / 67 (0.5373)

Holdout group: 9
***** Iteration #246 *****
Loss: 102.637964
Feature norm: 7.991669
Error norm: 0.441777
Active features: 1782260
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 1.840
Performance by label (#match, #model, #ref) (precision, recall, F1):

O: (1673, 1812, 1689) (0.9233, 0.9905, 0.9557)
  B: (12, 16, 44) (0.7500, 0.2727, 0.4000)
  I: (36, 50, 145) (0.7200, 0.2483, 0.3692)
Macro-average precision, recall, F1: (0.797763, 0.503843, 0.574986)
Item accuracy: 1721 / 1878 (0.9164)
Instance accuracy: 32 / 67 (0.4776)

Holdout group: 10
***** Iteration #295 *****
Loss: 116.176030
Feature norm: 8.079505
Error norm: 1.216295
Active features: 1786872
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 1.783
Performance by label (#match, #model, #ref) (precision, recall, F1):
  O: (1541, 1660, 1545) (0.9283, 0.9974, 0.9616)
  B: (10, 12, 42) (0.8333, 0.2381, 0.3704)
  I: (32, 36, 121) (0.8889, 0.2645, 0.4076)
Macro-average precision, recall, F1: (0.883512, 0.499990, 0.579879)
Item accuracy: 1583 / 1708 (0.9268)
Instance accuracy: 34 / 67 (0.5075)

SGD with L2-regularization

Holdout group: 1
***** Epoch #30 *****
Loss: 178.853454
Improvement ratio: -0.028070
Feature L2-norm: 6.482796
Learning rate (eta): 0.001429
Total number of feature updates: 9690
Seconds required for this iteration: 0.735
Performance by label (#match, #model, #ref) (precision, recall, F1):
  O: (745, 832, 756) (0.8954, 0.9854, 0.9383)
  B: (17, 21, 36) (0.8095, 0.4722, 0.5965)
  I: (49, 58, 119) (0.8448, 0.4118, 0.5537)
Macro-average precision, recall, F1: (0.849928, 0.623146, 0.696150)
Item accuracy: 811 / 911 (0.8902)
Instance accuracy: 14 / 36 (0.3889)

Holdout group: 2
***** Epoch #30 *****
Loss: 178.853454
Improvement ratio: -0.028070
Feature L2-norm: 6.482796
Learning rate (eta): 0.001429
Total number of feature updates: 9690
Seconds required for this iteration: 0.735
Performance by label (#match, #model, #ref) (precision, recall, F1):

O: (745, 832, 756) (0.8954, 0.9854, 0.9383)
B: (17, 21, 36) (0.8095, 0.4722, 0.5965)
I: (49, 58, 119) (0.8448, 0.4118, 0.5537)
Macro-average precision, recall, F1: (0.849928, 0.623146, 0.696150)
Item accuracy: 811 / 911 (0.8902)
Instance accuracy: 14 / 36 (0.3889)

Holdout group: 3
***** Epoch #30 *****
Loss: 158.230295
Improvement ratio: -0.053860
Feature L2-norm: 6.459961
Learning rate (eta): 0.001429
Total number of feature updates: 9690
Seconds required for this iteration: 0.636
Performance by label (#match, #model, #ref) (precision, recall, F1):
O: (884, 924, 907) (0.9567, 0.9746, 0.9656)
B: (25, 29, 36) (0.8621, 0.6944, 0.7692)
I: (69, 90, 100) (0.7667, 0.6900, 0.7263)
Macro-average precision, recall, F1: (0.861815, 0.786362, 0.820380)
Item accuracy: 978 / 1043 (0.9377)
Instance accuracy: 18 / 36 (0.5000)

Holdout group: 4
***** Epoch #34 *****
Loss: 186.919494
Improvement ratio: -0.012375
Feature L2-norm: 6.614265
Learning rate (eta): 0.001412
Total number of feature updates: 10982
Seconds required for this iteration: 0.755
Performance by label (#match, #model, #ref) (precision, recall, F1):
O: (739, 814, 753) (0.9079, 0.9814, 0.9432)
B: (20, 26, 36) (0.7692, 0.5556, 0.6452)
I: (50, 62, 113) (0.8065, 0.4425, 0.5714)
Macro-average precision, recall, F1: (0.827848, 0.659814, 0.719931)
Item accuracy: 809 / 902 (0.8969)
Instance accuracy: 11 / 36 (0.3056)

Holdout group: 5
***** Epoch #29 *****
Loss: 173.937732
Improvement ratio: -0.006542
Feature L2-norm: 6.438555
Learning rate (eta): 0.001433
Total number of feature updates: 9367
Seconds required for this iteration: 0.452
Performance by label (#match, #model, #ref) (precision, recall, F1):
O: (900, 975, 915) (0.9231, 0.9836, 0.9524)
B: (16, 23, 36) (0.6957, 0.4444, 0.5424)
I: (48, 61, 108) (0.7869, 0.4444, 0.5680)

Macro-average precision, recall, F1: (0.801871, 0.624165, 0.687600)
Item accuracy: 964 / 1059 (0.9103)
Instance accuracy: 11 / 36 (0.3056)

Holdout group: 6
***** Epoch #35 *****
Loss: 162.389107
Improvement ratio: -0.022369
Feature L2-norm: 6.594273
Learning rate (eta): 0.001408
Total number of feature updates: 11305
Seconds required for this iteration: 0.657
Performance by label (#match, #model, #ref) (precision, recall, F1):
    O: (768, 853, 785) (0.9004, 0.9783, 0.9377)
    B: (15, 20, 36) (0.7500, 0.4167, 0.5357)
    I: (46, 60, 112) (0.7667, 0.4107, 0.5349)
Macro-average precision, recall, F1: (0.805673, 0.601908, 0.669442)
Item accuracy: 829 / 933 (0.8885)
Instance accuracy: 11 / 36 (0.3056)

Holdout group: 7
***** Epoch #33 *****
Loss: 159.726563
Improvement ratio: -0.027089
Feature L2-norm: 6.604374
Learning rate (eta): 0.001416
Total number of feature updates: 10659
Seconds required for this iteration: 0.860
Performance by label (#match, #model, #ref) (precision, recall, F1):
    O: (767, 821, 784) (0.9342, 0.9783, 0.9558)
    B: (26, 29, 36) (0.8966, 0.7222, 0.8000)
    I: (61, 78, 108) (0.7821, 0.5648, 0.6559)
Macro-average precision, recall, F1: (0.870943, 0.755118, 0.803892)
Item accuracy: 854 / 928 (0.9203)
Instance accuracy: 18 / 36 (0.5000)

Holdout group: 8
***** Epoch #33 *****
Loss: 153.632690
Improvement ratio: -0.010469
Feature L2-norm: 6.519886
Learning rate (eta): 0.001416
Total number of feature updates: 10659
Seconds required for this iteration: 0.531
Performance by label (#match, #model, #ref) (precision, recall, F1):
    O: (747, 828, 769) (0.9022, 0.9714, 0.9355)
    B: (15, 21, 36) (0.7143, 0.4167, 0.5263)
    I: (46, 66, 110) (0.6970, 0.4182, 0.5227)
Macro-average precision, recall, F1: (0.771143, 0.602080, 0.661516)
Item accuracy: 808 / 915 (0.8831)
Instance accuracy: 10 / 36 (0.2778)

Holdout group: 9
***** Epoch #32 *****
Loss: 175.712285
Improvement ratio: -0.055231
Feature L2-norm: 6.520308
Learning rate (eta): 0.001420
Total number of feature updates: 10336
Seconds required for this iteration: 0.808
Performance by label (#match, #model, #ref) (precision, recall, F1):
    O: (750, 808, 761) (0.9282, 0.9855, 0.9560)
    B: (21, 23, 36) (0.9130, 0.5833, 0.7119)
    I: (68, 79, 113) (0.8608, 0.6018, 0.7083)
Macro-average precision, recall, F1: (0.900674, 0.723550, 0.792074)
Item accuracy: 839 / 910 (0.9220)
Instance accuracy: 18 / 36 (0.5000)

Holdout group: 10
***** Epoch #30 *****
Loss: 171.742210
Improvement ratio: -0.019729
Feature L2-norm: 6.449046
Learning rate (eta): 0.001429
Total number of feature updates: 9720
Seconds required for this iteration: 0.639
Performance by label (#match, #model, #ref) (precision, recall, F1):
    O: (794, 877, 821) (0.9054, 0.9671, 0.9352)
    B: (14, 24, 35) (0.5833, 0.4000, 0.4746)
    I: (50, 76, 121) (0.6579, 0.4132, 0.5076)
Macro-average precision, recall, F1: (0.715529, 0.593445, 0.639136)
Item accuracy: 858 / 977 (0.8782)
Instance accuracy: 11 / 35 (0.3143)

GPS
L-BFGS with L1/L2 regularization
Holdout group: 1
***** Iteration #205 *****
Loss: 115.429655
Feature norm: 8.546305
Error norm: 0.489915
Active features: 1846694
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 1.222

Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1594, 1705, 1623) (0.9349, 0.9821, 0.9579)
   B: (40, 50, 63) (0.8000, 0.6349, 0.7080)
   I: (104, 125, 194) (0.8320, 0.5361, 0.6520)
Macro-average precision, recall, F1: (0.855632, 0.717712, 0.772645)
Item accuracy: 1738 / 1880 (0.9245)
Instance accuracy: 32 / 63 (0.5079)

Holdout group: 2
***** Iteration #215 *****
Loss: 115.429655
Feature norm: 8.546305
Error norm: 0.489915
Active features: 1846694
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 1.222
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1594, 1705, 1623) (0.9349, 0.9821, 0.9579)
   B: (40, 50, 63) (0.8000, 0.6349, 0.7080)
   I: (104, 125, 194) (0.8320, 0.5361, 0.6520)
Macro-average precision, recall, F1: (0.855632, 0.717712, 0.772645)
Item accuracy: 1738 / 1880 (0.9245)
Instance accuracy: 32 / 63 (0.5079)

Holdout group: 3
***** Iteration #224 *****
Loss: 120.226247
Feature norm: 8.575585
Error norm: 0.540260
Active features: 1886225
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 1.372
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1202, 1281, 1215) (0.9383, 0.9893, 0.9631)
   B: (41, 46, 63) (0.8913, 0.6508, 0.7523)
   I: (111, 122, 171) (0.9098, 0.6491, 0.7577)
Macro-average precision, recall, F1: (0.913157, 0.763072, 0.824371)
Item accuracy: 1354 / 1449 (0.9344)
Instance accuracy: 38 / 63 (0.6032)

Holdout group: 4
***** Iteration #220 *****
Loss: 116.520967
Feature norm: 8.531810
Error norm: 0.480556
Active features: 1857624
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 1.417

Performance by label (#match, #model, #ref) (precision, recall, F1):
    O: (1429, 1536, 1443) (0.9303, 0.9903, 0.9594)
    B: (39, 42, 63) (0.9286, 0.6190, 0.7429)
    I: (86, 99, 171) (0.8687, 0.5029, 0.6370)
Macro-average precision, recall, F1: (0.909199, 0.704090, 0.779759)
Item accuracy: 1554 / 1677 (0.9267)
Instance accuracy: 30 / 63 (0.4762)

Holdout group: 5
***** Iteration #212 *****
Loss: 113.829497
Feature norm: 8.537515
Error norm: 0.507378
Active features: 1876876
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 1.247
Performance by label (#match, #model, #ref) (precision, recall, F1):
    O: (1291, 1444, 1306) (0.8940, 0.9885, 0.9389)
    B: (31, 37, 63) (0.8378, 0.4921, 0.6200)
    I: (77, 88, 200) (0.8750, 0.3850, 0.5347)
Macro-average precision, recall, F1: (0.868961, 0.621859, 0.697877)
Item accuracy: 1399 / 1569 (0.8917)
Instance accuracy: 26 / 63 (0.4127)

Holdout group: 6
***** Iteration #209 *****
Loss: 113.346588
Feature norm: 8.524242
Error norm: 0.546057
Active features: 1870199
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 1.589
Performance by label (#match, #model, #ref) (precision, recall, F1):
    O: (1441, 1561, 1455) (0.9231, 0.9904, 0.9556)
    B: (33, 38, 63) (0.8684, 0.5238, 0.6535)
    I: (87, 99, 180) (0.8788, 0.4833, 0.6237)
Macro-average precision, recall, F1: (0.890112, 0.665840, 0.744231)
Item accuracy: 1561 / 1698 (0.9193)
Instance accuracy: 27 / 63 (0.4286)

Holdout group: 7
***** Iteration #239 *****
Loss: 119.861275
Feature norm: 8.560310
Error norm: 0.585614
Active features: 1887071
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 1.514

Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1248, 1363, 1262) (0.9156, 0.9889, 0.9509)
   B: (38, 41, 63) (0.9268, 0.6032, 0.7308)
   I: (87, 99, 178) (0.8788, 0.4888, 0.6282)
Macro-average precision, recall, F1: (0.907081, 0.693615, 0.769928)
Item accuracy: 1373 / 1503 (0.9135)
Instance accuracy: 30 / 63 (0.4762)

Holdout group: 8
***** Iteration #228 *****
Loss: 117.363029
Feature norm: 8.569084
Error norm: 0.506768
Active features: 1891933
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 1.058
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1175, 1305, 1193) (0.9004, 0.9849, 0.9408)
   B: (35, 41, 63) (0.8537, 0.5556, 0.6731)
   I: (96, 111, 201) (0.8649, 0.4776, 0.6154)
Macro-average precision, recall, F1: (0.872969, 0.672693, 0.743071)
Item accuracy: 1306 / 1457 (0.8964)
Instance accuracy: 33 / 63 (0.5238)

Holdout group: 9
Loss: 114.056984
Feature norm: 8.556239
Error norm: 0.428754
Active features: 1875342
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 1.119
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1362, 1471, 1403) (0.9259, 0.9708, 0.9478)
   B: (36, 48, 63) (0.7500, 0.5714, 0.6486)
   I: (106, 136, 189) (0.7794, 0.5608, 0.6523)
Macro-average precision, recall, F1: (0.818438, 0.701017, 0.749588)
Item accuracy: 1504 / 1655 (0.9088)
Instance accuracy: 28 / 63 (0.4444)

Holdout group: 10
Loss: 112.372808
Feature norm: 8.558586
Error norm: 0.356299
Active features: 1915285
Line search trials: 1
Line search step: 1.000000
Seconds required for this iteration: 1.405

Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1128, 1214, 1147) (0.9292, 0.9834, 0.9555)
   B: (41, 48, 63) (0.8542, 0.6508, 0.7387)
   I: (99, 114, 166) (0.8684, 0.5964, 0.7071)
Macro-average precision, recall, F1: (0.883916, 0.743538, 0.800470)
Item accuracy: 1268 / 1376 (0.9215)
Instance accuracy: 36 / 63 (0.5714)

SGD with L2-regularization
Holdout group: 1
***** Epoch #38 *****
Loss: 188.822380
Improvement ratio: -0.004369
Feature L2-norm: 7.751698
Learning rate (eta): 0.001397
Total number of feature updates: 21546
Seconds required for this iteration: 1.286
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1587, 1700, 1623) (0.9335, 0.9778, 0.9552)
   B: (40, 52, 63) (0.7692, 0.6349, 0.6957)
   I: (102, 128, 194) (0.7969, 0.5258, 0.6335)
Macro-average precision, recall, F1: (0.833212, 0.712838, 0.761451)
Item accuracy: 1729 / 1880 (0.9197)
Instance accuracy: 29 / 63 (0.4603)

Holdout group: 2
***** Epoch #45 *****
Loss: 204.710611
Improvement ratio: -0.043242
Feature L2-norm: 7.972495
Learning rate (eta): 0.001370
Total number of feature updates: 25515
Seconds required for this iteration: 1.295
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1185, 1242, 1215) (0.9541, 0.9753, 0.9646)
   B: (47, 56, 63) (0.8393, 0.7460, 0.7899)
   I: (124, 151, 171) (0.8212, 0.7251, 0.7702)
Macro-average precision, recall, F1: (0.871528, 0.815496, 0.841564)
Item accuracy: 1356 / 1449 (0.9358)
Instance accuracy: 41 / 63 (0.6508)

Holdout group: 3
***** Epoch #31 *****
Loss: 195.275022
Improvement ratio: -0.000257
Feature L2-norm: 7.542005
Learning rate (eta): 0.001425

Total number of feature updates: 17577
Seconds required for this iteration: 1.114
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1424, 1525, 1443) (0.9338, 0.9868, 0.9596)
   B: (40, 46, 63) (0.8696, 0.6349, 0.7339)
   I: (90, 106, 171) (0.8491, 0.5263, 0.6498)
Macro-average precision, recall, F1: (0.884131, 0.716023, 0.781111)
Item accuracy: 1554 / 1677 (0.9267)
Instance accuracy: 29 / 63 (0.4603)

Holdout group: 4
***** Epoch #39 *****
Loss: 180.954788
Improvement ratio: -0.000366
Feature L2-norm: 7.792776
Learning rate (eta): 0.001393
Total number of feature updates: 22113
Seconds required for this iteration: 0.890
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1281, 1411, 1306) (0.9079, 0.9809, 0.9430)
   B: (36, 44, 63) (0.8182, 0.5714, 0.6729)
   I: (91, 114, 200) (0.7982, 0.4550, 0.5796)
Macro-average precision, recall, F1: (0.841431, 0.669095, 0.731822)
Item accuracy: 1408 / 1569 (0.8974)
Instance accuracy: 26 / 63 (0.4127)

Holdout group: 5
***** Epoch #77 *****
Loss: 139.829466
Improvement ratio: -0.007117
Feature L2-norm: 7.628442
Learning rate (eta): 0.000697
Total number of feature updates: 43659
Seconds required for this iteration: 1.383
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1365, 1451, 1392) (0.9407, 0.9806, 0.9603)
   B: (40, 51, 63) (0.7843, 0.6349, 0.7018)
   I: (106, 127, 174) (0.8346, 0.6092, 0.7043)
Macro-average precision, recall, F1: (0.853230, 0.741573, 0.788776)
Item accuracy: 1511 / 1629 (0.9276)
Instance accuracy: 33 / 63 (0.5238)

Holdout group: 6
***** Epoch #38 *****
Loss: 186.408629
Improvement ratio: -0.005748
Feature L2-norm: 7.769552
Learning rate (eta): 0.001397
Total number of feature updates: 21546
Seconds required for this iteration: 1.682
Performance by label (#match, #model, #ref) (precision, recall, F1):

   O: (1439, 1570, 1455) (0.9166, 0.9890, 0.9514)
   B: (31, 36, 63) (0.8611, 0.4921, 0.6263)
   I: (78, 92, 180) (0.8478, 0.4333, 0.5735)
Macro-average precision, recall, F1: (0.875166, 0.638133, 0.717066)
Item accuracy: 1548 / 1698 (0.9117)
Instance accuracy: 26 / 63 (0.4127)

Holdout group: 7
***** Epoch #38 *****
Loss: 196.471012
Improvement ratio: -0.094236
Feature L2-norm: 7.805161
Learning rate (eta): 0.001397
Total number of feature updates: 21546
Seconds required for this iteration: 1.510
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1250, 1353, 1262) (0.9239, 0.9905, 0.9560)
   B: (40, 43, 63) (0.9302, 0.6349, 0.7547)
   I: (95, 107, 178) (0.8879, 0.5337, 0.6667)
Macro-average precision, recall, F1: (0.913985, 0.719707, 0.792469)
Item accuracy: 1385 / 1503 (0.9215)
Instance accuracy: 32 / 63 (0.5079)

Holdout group: 8
***** Epoch #34 *****
Loss: 197.471731
Improvement ratio: -0.060050
Feature L2-norm: 7.684714
Learning rate (eta): 0.001412
Total number of feature updates: 19278
Seconds required for this iteration: 1.437
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1175, 1295, 1193) (0.9073, 0.9849, 0.9445)
   B: (37, 43, 63) (0.8605, 0.5873, 0.6981)
   I: (104, 119, 201) (0.8739, 0.5174, 0.6500)
Macro-average precision, recall, F1: (0.880584, 0.696542, 0.764216)
Item accuracy: 1316 / 1457 (0.9032)
Instance accuracy: 35 / 63 (0.5556)

Holdout group: 9
***** Epoch #44 *****
Loss: 155.443668
Improvement ratio: -0.016611
Feature L2-norm: 7.850781
Learning rate (eta): 0.001374
Total number of feature updates: 24948
Seconds required for this iteration: 1.707
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1362, 1473, 1403) (0.9246, 0.9708, 0.9471)

B: (35, 48, 63) (0.7292, 0.5556, 0.6306)
   I: (104, 134, 189) (0.7761, 0.5503, 0.6440)
Macro-average precision, recall, F1: (0.809977, 0.692199, 0.740581)
Item accuracy: 1501 / 1655 (0.9069)
Instance accuracy: 27 / 63 (0.4286)

Holdout group: 10
***** Epoch #93 *****
Loss: 132.267344
Improvement ratio: -0.001363
Feature L2-norm: 7.810223
Learning rate (eta): 0.000682
Total number of feature updates: 52731
Seconds required for this iteration: 1.371
Performance by label (#match, #model, #ref) (precision, recall, F1):
   O: (1122, 1201, 1147) (0.9342, 0.9782, 0.9557)
   B: (44, 53, 63) (0.8302, 0.6984, 0.7586)
   I: (103, 122, 166) (0.8443, 0.6205, 0.7153)
Macro-average precision, recall, F1: (0.869557, 0.765700, 0.809868)
Item accuracy: 1269 / 1376 (0.9222)
Instance accuracy: 38 / 63 (0.6032)

(Precision, Recall, F1)

Algorithm\Product	Earphone	GPS
L-BFGS with L1/L2 regularization	(0.787, 0.519, 0.589)	(0.87, 0.696, 0.76)
SGD with L2-regularization	(0.82, 0.65, 0.714)	(0.86, 0.714, 0.77)