

# Results ( Parameters used, time taken and Output)

## KOS

K=1500, F=4

**(Runtime: 0.0s)**

```
length of F1 item set 3
length of F2 item set 0
length of F3 item set 0
length of F4 item set 0
Frequent 1-itemsets: [['general'], ['bush'], ['kerry']]
Frequent 2-itemsets: []
Frequent 3-itemsets: []
Frequent 4-itemsets: []
```

K=1000, F=4

**(Runtime: 0.3s)**

```
length of F1 item set 12
length of F2 item set 3
length of F3 item set 0
length of F4 item set 0
Frequent 1-itemsets: [['war'], ['general'], ['bush'], ['kerry'],
['house'], ['poll'], ['republicans'], ['democratic'], ['democrats'],
['media'], ['election'], ['time']]
Frequent 2-itemsets: [['general', 'kerry'], ['bush', 'general'], ['bush',
'kerry']]
Frequent 3-itemsets: []
Frequent 4-itemsets: []
```

K=500, F=4

**(Runtime: 18.9s)**

```
length of F1 item set 50
length of F2 item set 101
length of F3 item set 47
length of F4 item set 5
Frequent 1-itemsets: [['vote'], ['voters'], ['war'], ['news'],
['republican'], ['general'], ['administration'], ['november'],
['president'], ['iraq'], ['john'], ['bush'], ['kerry'], ['house'],
['lead'], ['campaign'], ['poll'], ['polls'], ['republicans'],
```

['democratic'], ['win'], ['democrats'], ['primary'], ['governor'],  
['media'], ['race'], ['races'], ['senate'], ['economy'], ['election'],  
['time'], ['elections'], ['year'], ['american'], ['bushs'], ['candidate'],  
['people'], ['running'], ['numbers'], ['candidates'], ['years'],  
['state'], ['states'], ['party'], ['country'], ['oct'], ['gop'],  
['political'], ['national'], ['dean']]

Frequent 2-itemsets: [['bush', 'republican'], ['democratic', 'vote'],  
['bush', 'political'], ['bush', 'election'], ['general', 'house'],  
['media', 'poll'], ['democratic', 'democrats'], ['bush', 'senate'],  
['bush', 'media'], ['bush', 'primary'], ['bush', 'polls'], ['poll',  
'senate'], ['media', 'war'], ['john', 'kerry'], ['poll', 'primary'],  
['poll', 'polls'], ['bush', 'bushs'], ['house', 'republicans'],  
['democrats', 'house'], ['bush', 'time'], ['bush', 'states'],  
['democrats', 'war'], ['campaign', 'kerry'], ['general', 'republicans'],  
['bush', 'kerry'], ['bush', 'state'], ['republicans', 'senate'], ['bush',  
'vote'], ['house', 'poll'], ['polls', 'primary'], ['election', 'kerry'],  
['kerry', 'president'], ['general', 'poll'], ['house', 'war'], ['general',  
'president'], ['kerry', 'war'], ['bush', 'democrats'], ['bush', 'house'],  
['general', 'war'], ['democratic', 'house'], ['democrats', 'republicans'],  
['democratic', 'war'], ['bush', 'campaign'], ['election', 'house'],  
['bush', 'john'], ['democrats', 'poll'], ['campaign', 'democratic'],  
['kerry', 'republicans'], ['democrats', 'election'], ['bush', 'people'],  
['democratic', 'republicans'], ['democrats', 'senate'], ['democrats',  
'media'], ['democrats', 'primary'], ['poll', 'republicans'], ['democrats',  
'general'], ['general', 'vote'], ['kerry', 'poll'], ['bush', 'national'],  
['bush', 'november'], ['bush', 'poll'], ['democratic', 'poll'], ['bush',  
'president'], ['house', 'senate'], ['house', 'media'], ['bush', 'war'],  
['kerry', 'senate'], ['election', 'poll'], ['kerry', 'media'],  
['democratic', 'election'], ['kerry', 'primary'], ['general', 'senate'],  
['kerry', 'polls'], ['general', 'media'], ['poll', 'war'], ['general',  
'primary'], ['democrats', 'kerry'], ['democratic', 'senate'], ['campaign',  
'general'], ['general', 'polls'], ['election', 'war'], ['democratic',  
'media'], ['democratic', 'primary'], ['bush', 'general'], ['democratic',  
'general'], ['democratic', 'polls'], ['bush', 'iraq'], ['election',  
'general'], ['bush', 'democratic'], ['kerry', 'time'], ['house', 'kerry'],  
['general', 'time'], ['bush', 'republicans'], ['republicans', 'war'],  
['iraq', 'war'], ['general', 'kerry'], ['kerry', 'vote'], ['bush',  
'news'], ['election', 'republicans'], ['administration', 'bush'],  
['democratic', 'kerry']]

Frequent 3-itemsets: [['democratic', 'kerry', 'poll'], ['bush',  
'democratic', 'poll'], ['bush', 'democratic', 'war'], ['bush', 'house',  
'kerry'], ['bush', 'democratic', 'general'], ['general', 'poll', 'polls'],  
['general', 'kerry', 'poll'], ['bush', 'kerry', 'media'], ['bush',  
'kerry', 'polls'], ['bush', 'democrats', 'kerry'], ['general', 'kerry',  
'war'], ['bush', 'general', 'media'], ['election', 'general', 'kerry'],  
['bush', 'election', 'general'], ['bush', 'general', 'polls'], ['bush',  
'democratic', 'election'], ['kerry', 'poll', 'primary'], ['bush',

```

'democrats', 'house'], ['democratic', 'kerry', 'primary'], ['bush',
'democratic', 'primary'], ['democratic', 'kerry', 'polls'], ['democratic',
'democrats', 'kerry'], ['general', 'kerry', 'republicans'], ['bush',
'general', 'kerry'], ['bush', 'house', 'war'], ['democratic', 'democrats',
'house'], ['bush', 'democratic', 'kerry'], ['bush', 'democrats',
'republicans'], ['democratic', 'poll', 'primary'], ['bush', 'general',
'house'], ['general', 'kerry', 'polls'], ['bush', 'house', 'republicans'],
['bush', 'democratic', 'democrats'], ['bush', 'democratic', 'house'],
['democratic', 'general', 'kerry'], ['bush', 'kerry', 'republicans'],
['kerry', 'poll', 'polls'], ['bush', 'poll', 'polls'], ['democratic',
'democrats', 'republicans'], ['bush', 'democrats', 'general'], ['bush',
'election', 'kerry'], ['bush', 'general', 'republicans'], ['bush',
'kerry', 'poll'], ['bush', 'kerry', 'war'], ['bush', 'democratic',
'republicans'], ['bush', 'general', 'poll'], ['bush', 'general', 'war']]
Frequent 4-itemsets: [['bush', 'general', 'kerry', 'war'], ['bush',
'general', 'kerry', 'poll'], ['democratic', 'kerry', 'poll', 'primary'],
['bush', 'general', 'kerry', 'polls'], ['bush', 'democratic', 'general',
'kerry']]

```

**K=300, F=3**

**(Runtime: 14m 50s)**

```

length of F1 item set 186
length of F2 item set 3226
length of F3 item set 73625
( Output Too big )

```

**NIPS**

**K=1400, F=4**

**(Runtime: 0.1s)**

```

length of F1 item set 3
length of F2 item set 1
length of F3 item set 0
length of F4 item set 0
Frequent 1-itemsets: [['abstract'], ['references'], ['result']]
Frequent 2-itemsets: [['abstract', 'references']]
Frequent 3-itemsets: []
Frequent 4-itemsets: []

```

**K=1200, F=4**

**(Runtime: 2.5s)**

```

length of F1 item set 14
length of F2 item set 38
length of F3 item set 36

```

length of F4 item set 7

Frequent 1-itemsets: [['abstract'], ['function'], ['problem'], ['system'], ['model'], ['references'], ['result'], ['network'], ['neural'], ['input'], ['number'], ['introduction'], ['set'], ['information']]

Frequent 2-itemsets: [['abstract', 'set'], ['abstract', 'result'], ['introduction', 'neural'], ['number', 'references'], ['model', 'references'], ['introduction', 'references'], ['function', 'system'], ['network', 'neural'], ['network', 'references'], ['abstract', 'system'], ['abstract', 'neural'], ['abstract', 'model'], ['function', 'set'], ['function', 'result'], ['abstract', 'references'], ['abstract', 'network'], ['neural', 'system'], ['abstract', 'function'], ['function', 'neural'], ['neural', 'result'], ['neural', 'set'], ['set', 'system'], ['function', 'references'], ['function', 'network'], ['function', 'introduction'], ['function', 'number'], ['abstract', 'introduction'], ['neural', 'references'], ['abstract', 'number'], ['references', 'result'], ['result', 'set'], ['references', 'system'], ['number', 'result'], ['model', 'result'], ['introduction', 'result'], ['references', 'set'], ['result', 'system'], ['network', 'result']]

Frequent 3-itemsets: [['abstract', 'number', 'result'], ['abstract', 'introduction', 'result'], ['function', 'neural', 'result'], ['function', 'references', 'system'], ['abstract', 'network', 'result'], ['network', 'neural', 'result'], ['function', 'references', 'set'], ['abstract', 'references', 'set'], ['abstract', 'references', 'result'], ['abstract', 'number', 'references'], ['abstract', 'result', 'set'], ['abstract', 'model', 'references'], ['abstract', 'introduction', 'references'], ['abstract', 'network', 'neural'], ['abstract', 'references', 'system'], ['abstract', 'network', 'references'], ['network', 'neural', 'references'], ['abstract', 'result', 'system'], ['introduction', 'references', 'result'], ['network', 'references', 'result'], ['function', 'neural', 'references'], ['abstract', 'neural', 'set'], ['abstract', 'neural', 'result'], ['references', 'result', 'set'], ['abstract', 'function', 'set'], ['abstract', 'function', 'result'], ['neural', 'references', 'result'], ['abstract', 'neural', 'system'], ['references', 'result', 'system'], ['abstract', 'neural', 'references'], ['abstract', 'function', 'system'], ['abstract', 'function', 'neural'], ['abstract', 'function', 'references'], ['abstract', 'set', 'system'], ['function', 'references', 'result'], ['neural', 'references', 'system']]

Frequent 4-itemsets: [['abstract', 'function', 'references', 'result'], ['abstract', 'function', 'references', 'set'], ['abstract', 'references', 'result', 'set'], ['abstract', 'neural', 'references', 'system'], ['abstract', 'function', 'neural', 'references'], ['abstract', 'references', 'result', 'system'], ['abstract', 'neural', 'references', 'result']]

K=1000, F=4

(Runtime: 37.9s)

length of F1 item set 34  
length of F2 item set 179  
length of F3 item set 354  
length of F4 item set 362

(Big output)

Frequent 1-itemsets: [['abstract'], ['form'], ['small'], ['function'],  
['point'], ['algorithm'], ['problem'], ['data'], ['system'], ['model'],  
['term'], ['references'], ['result'], ['network'], ['neural'], ['input'],  
['number'], ['introduction'], ['case'], ['university'], ['order'],  
['output'], ['paper'], ['set'], ['parameter'], ['large'], ['simple'],  
['learning'], ['mean'], ['method'], ['information'], ['values'],  
['single'], ['processing']]

Frequent 2-itemsets: [['learning', 'neural'], ['parameter', 'result'],  
['data', 'neural'], ['introduction', 'system'], ['processing',  
'references'], ['abstract', 'values'], ['input', 'system'], ['function',  
'system'], ['introduction', 'network'], ['problem', 'system'],  
['function', 'parameter'], ['references', 'single'], ['network',  
'neural'], ['data', 'introduction'], ['abstract', 'simple'], ['input',  
'result'], ['function', 'result'], ['abstract', 'references'], ['form',  
'references'], ['abstract', 'data'], ['algorithm', 'result'], ['abstract',  
'university'], ['information', 'system'], ['set', 'system'],  
['information', 'network'], ['learning', 'number'], ['abstract', 'form'],  
['point', 'result'], ['function', 'information'], ['introduction',  
'problem'], ['algorithm', 'set'], ['processing', 'result'], ['algorithm',  
'function'], ['network', 'number'], ['function', 'problem'],  
['references', 'result'], ['references', 'small'], ['abstract', 'mean'],  
['data', 'system'], ['function', 'paper'], ['large', 'references'],  
['abstract', 'method'], ['learning', 'result'], ['introduction',  
'learning'], ['neural', 'output'], ['number', 'result'], ['data',  
'result'], ['information', 'problem'], ['function', 'learning'],  
['references', 'set'], ['network', 'result'], ['abstract', 'set'],  
['model', 'system'], ['abstract', 'algorithm'], ['introduction',  
'references'], ['model', 'network'], ['abstract', 'neural'],  
['information', 'references'], ['input', 'network'], ['function',  
'network'], ['abstract', 'processing'], ['order', 'result'], ['abstract',  
'single'], ['function', 'input'], ['result', 'small'], ['model',  
'problem'], ['neural', 'processing'], ['output', 'result'],  
['information', 'number'], ['abstract', 'point'], ['neural',  
'references'], ['abstract', 'number'], ['input', 'output'], ['order',  
'set'], ['large', 'neural'], ['processing', 'system'], ['neural',  
'number'], ['result', 'set'], ['references', 'system'], ['introduction',  
'set'], ['case', 'references'], ['abstract', 'parameter'], ['method',  
'references'], ['learning', 'system'], ['abstract', 'result'], ['number',  
'system'], ['paper', 'references'], ['abstract', 'small'], ['form',  
'result'], ['introduction', 'neural'], ['case', 'number'], ['learning',  
'network'], ['model', 'references'], ['data', 'network'], ['information',

'model'], ['network', 'system'], ['abstract', 'model'], ['information', 'set'], ['abstract', 'function'], ['form', 'function'], ['information', 'neural'], ['neural', 'set'], ['function', 'processing'], ['case', 'result'], ['input', 'references'], ['function', 'references'], ['problem', 'references'], ['introduction', 'number'], ['function', 'point'], ['information', 'introduction'], ['number', 'problem'], ['large', 'result'], ['input', 'number'], ['function', 'number'], ['abstract', 'introduction'], ['abstract', 'order'], ['order', 'system'], ['network', 'problem'], ['case', 'set'], ['point', 'references'], ['case', 'function'], ['neural', 'order'], ['references', 'values'], ['paper', 'set'], ['case', 'neural'], ['model', 'set'], ['introduction', 'result'], ['problem', 'result'], ['abstract', 'large'], ['case', 'introduction'], ['abstract', 'case'], ['learning', 'references'], ['model', 'neural'], ['introduction', 'model'], ['number', 'references'], ['data', 'references'], ['input', 'model'], ['function', 'model'], ['abstract', 'system'], ['network', 'references'], ['information', 'result'], ['input', 'set'], ['function', 'set'], ['problem', 'set'], ['data', 'number'], ['abstract', 'network'], ['neural', 'system'], ['abstract', 'input'], ['input', 'neural'], ['function', 'neural'], ['neural', 'result'], ['parameter', 'references'], ['abstract', 'output'], ['algorithm', 'neural'], ['model', 'number'], ['input', 'introduction'], ['function', 'introduction'], ['function', 'order'], ['abstract', 'information'], ['case', 'system'], ['result', 'values'], ['order', 'references'], ['abstract', 'problem'], ['paper', 'system'], ['output', 'references'], ['algorithm', 'references'], ['neural', 'problem'], ['paper', 'result'], ['learning', 'set'], ['abstract', 'paper'], ['number', 'set'], ['data', 'set'], ['model', 'result'], ['data', 'function'], ['function', 'large'], ['neural', 'paper'], ['result', 'system'], ['abstract', 'learning'], ['network', 'set']]

Frequent 3-itemsets: [['paper', 'references', 'result'], ['learning', 'references', 'set'], ['function', 'model', 'references'], ['data', 'result', 'set'], ['neural', 'references', 'set'], ['abstract', 'introduction', 'set'], ['abstract', 'case', 'references'], ['network', 'neural', 'system'], ['function', 'input', 'neural'], ['function', 'neural', 'result'], ['function', 'references', 'system'], ['model', 'number', 'result'], ['order', 'references', 'result'], ['information', 'result', 'system'], ['function', 'information', 'set'], ['network', 'neural', 'result'], ['abstract', 'references', 'result'], ['abstract', 'references', 'small'], ['abstract', 'number', 'system'], ['abstract', 'order', 'set'], ['model', 'network', 'result'], ['abstract', 'introduction', 'neural'], ['function', 'result', 'set'], ['abstract', 'result', 'set'], ['abstract', 'model', 'references'], ['function', 'paper', 'references'], ['abstract', 'form', 'result'], ['introduction', 'number', 'result'], ['information', 'network', 'neural'], ['abstract', 'network', 'system'], ['function', 'information', 'neural'], ['function', 'neural', 'set'], ['information', 'set', 'system'], ['abstract', 'function', 'problem'], ['function', 'input', 'references'], ['function',

'problem', 'references'], ['introduction', 'network', 'result'],  
['introduction', 'references', 'set'], ['abstract', 'learning', 'system'],  
['case', 'neural', 'result'], ['problem', 'set', 'system'],  
['introduction', 'model', 'system'], ['data', 'function', 'references'],  
['function', 'introduction', 'number'], ['abstract', 'paper',  
'references'], ['abstract', 'data', 'system'], ['function', 'number',  
'problem'], ['number', 'references', 'set'], ['information', 'neural',  
'system'], ['abstract', 'large', 'references'], ['abstract', 'learning',  
'network'], ['introduction', 'number', 'set'], ['network', 'number',  
'set'], ['problem', 'result', 'set'], ['abstract', 'case', 'result'],  
['network', 'neural', 'problem'], ['abstract', 'problem', 'references'],  
['model', 'neural', 'references'], ['abstract', 'function', 'learning'],  
['abstract', 'neural', 'set'], ['references', 'result', 'set'],  
['abstract', 'input', 'references'], ['input', 'introduction', 'result'],  
['abstract', 'information', 'set'], ['learning', 'neural', 'references'],  
['abstract', 'introduction', 'number'], ['input', 'result', 'system'],  
['abstract', 'number', 'problem'], ['problem', 'references', 'result'],  
['model', 'neural', 'number'], ['introduction', 'neural', 'references'],  
['information', 'number', 'result'], ['function', 'model', 'set'],  
['abstract', 'network', 'problem'], ['function', 'introduction',  
'result'], ['neural', 'number', 'system'], ['abstract', 'case', 'set'],  
['model', 'references', 'system'], ['introduction', 'set', 'system'],  
['input', 'number', 'references'], ['abstract', 'case', 'function'],  
['abstract', 'function', 'references'], ['information', 'references',  
'set'], ['input', 'network', 'neural'], ['function', 'input', 'result'],  
['function', 'problem', 'result'], ['neural', 'references', 'system'],  
['function', 'model', 'neural'], ['abstract', 'references', 'values'],  
['model', 'result', 'set'], ['abstract', 'case', 'neural'], ['function',  
'number', 'references'], ['function', 'introduction', 'model'],  
['learning', 'references', 'result'], ['abstract', 'large', 'result'],  
['abstract', 'model', 'set'], ['abstract', 'introduction', 'result'],  
['abstract', 'neural', 'processing'], ['learning', 'result', 'set'],  
['input', 'neural', 'system'], ['neural', 'result', 'set'], ['abstract',  
'order', 'system'], ['abstract', 'problem', 'result'], ['data', 'neural',  
'result'], ['function', 'result', 'system'], ['information', 'network',  
'result'], ['data', 'references', 'system'], ['abstract', 'case',  
'introduction'], ['function', 'information', 'result'], ['function',  
'input', 'set'], ['function', 'problem', 'set'], ['network', 'set',  
'system'], ['abstract', 'order', 'result'], ['introduction', 'result',  
'set'], ['number', 'set', 'system'], ['abstract', 'model', 'neural'],  
['abstract', 'introduction', 'model'], ['abstract', 'number',  
'references'], ['function', 'neural', 'system'], ['model', 'number',  
'system'], ['function', 'learning', 'references'], ['abstract', 'neural',  
'number'], ['case', 'function', 'result'], ['abstract', 'paper', 'set'],  
['abstract', 'information', 'number'], ['abstract', 'references',  
'system'], ['function', 'network', 'references'], ['abstract', 'network',  
'references'], ['model', 'network', 'system'], ['model', 'neural', 'set'],

['abstract', 'problem', 'set'], ['introduction', 'references', 'result'],  
['introduction', 'number', 'system'], ['abstract', 'input', 'set'],  
['function', 'model', 'number'], ['network', 'references', 'result'],  
['learning', 'neural', 'set'], ['input', 'references', 'set'], ['network',  
'number', 'system'], ['number', 'references', 'result'], ['abstract',  
'learning', 'references'], ['introduction', 'model', 'references'],  
['function', 'network', 'number'], ['abstract', 'data', 'references'],  
['information', 'neural', 'references'], ['number', 'result', 'set'],  
['introduction', 'network', 'system'], ['network', 'number', 'result'],  
['introduction', 'neural', 'set'], ['abstract', 'function', 'model'],  
['abstract', 'input', 'neural'], ['abstract', 'neural', 'result'],  
['function', 'order', 'references'], ['result', 'set', 'system'],  
['abstract', 'information', 'result'], ['abstract', 'function', 'set'],  
['abstract', 'model', 'number'], ['abstract', 'parameter', 'references'],  
['input', 'network', 'result'], ['network', 'references', 'set'], ['case',  
'references', 'result'], ['abstract', 'case', 'system'], ['function',  
'neural', 'problem'], ['neural', 'problem', 'result'], ['algorithm',  
'references', 'result'], ['information', 'references', 'system'],  
['function', 'number', 'set'], ['function', 'model', 'result'],  
['introduction', 'problem', 'references'], ['abstract', 'function',  
'neural'], ['abstract', 'information', 'model'], ['neural', 'number',  
'references'], ['network', 'problem', 'references'], ['information',  
'references', 'result'], ['problem', 'references', 'system'], ['number',  
'problem', 'references'], ['model', 'result', 'system'], ['information',  
'result', 'set'], ['input', 'network', 'set'], ['abstract', 'function',  
'introduction'], ['case', 'references', 'set'], ['neural', 'result',  
'system'], ['function', 'introduction', 'system'], ['abstract', 'output',  
'references'], ['abstract', 'number', 'set'], ['neural', 'problem',  
'set'], ['abstract', 'algorithm', 'references'], ['abstract', 'model',  
'result'], ['function', 'learning', 'set'], ['abstract', 'result',  
'values'], ['function', 'input', 'system'], ['function', 'introduction',  
'network'], ['function', 'problem', 'system'], ['abstract', 'input',  
'number'], ['input', 'neural', 'references'], ['function', 'network',  
'set'], ['abstract', 'network', 'set'], ['function', 'input', 'network'],  
['input', 'set', 'system'], ['learning', 'references', 'system'],  
['abstract', 'information', 'neural'], ['abstract', 'introduction',  
'system'], ['abstract', 'neural', 'order'], ['function', 'learning',  
'neural'], ['introduction', 'neural', 'number'], ['abstract',  
'processing', 'references'], ['abstract', 'function', 'point'],  
['abstract', 'information', 'introduction'], ['data', 'function',  
'result'], ['abstract', 'paper', 'result'], ['abstract', 'introduction',  
'network'], ['model', 'number', 'references'], ['information',  
'introduction', 'references'], ['abstract', 'problem', 'system'],  
['abstract', 'function', 'number'], ['abstract', 'data', 'set'],  
['function', 'network', 'neural'], ['abstract', 'network', 'neural'],  
['function', 'information', 'system'], ['information', 'neural', 'set'],  
['network', 'neural', 'references'], ['model', 'neural', 'result'],



['model', 'network', 'references'], ['abstract', 'point', 'references'],  
['abstract', 'result', 'system'], ['abstract', 'learning', 'neural'],  
['abstract', 'input', 'result'], ['introduction', 'model', 'neural'],  
['learning', 'neural', 'result'], ['input', 'references', 'result'],  
['introduction', 'number', 'references'], ['abstract', 'data', 'neural'],  
['input', 'result', 'set'], ['network', 'neural', 'number'],  
['introduction', 'neural', 'result'], ['introduction', 'references',  
'system'], ['introduction', 'network', 'references'], ['abstract',  
'function', 'parameter'], ['network', 'references', 'system'],  
['abstract', 'data', 'introduction'], ['function', 'set', 'system'],  
['abstract', 'input', 'model'], ['input', 'number', 'result'], ['case',  
'neural', 'references'], ['number', 'references', 'system'], ['neural',  
'number', 'set'], ['abstract', 'function', 'result'], ['number',  
'problem', 'set'], ['abstract', 'introduction', 'problem'], ['problem',  
'result', 'system'], ['abstract', 'processing', 'result'], ['network',  
'result', 'set'], ['abstract', 'network', 'number'], ['abstract',  
'neural', 'system'], ['function', 'number', 'result'], ['references',  
'result', 'system'], ['abstract', 'algorithm', 'set'], ['information',  
'introduction', 'result'], ['abstract', 'information', 'system'], ['case',  
'result', 'set'], ['input', 'introduction', 'references'], ['input',  
'network', 'system'], ['abstract', 'information', 'network'], ['abstract',  
'learning', 'number'], ['function', 'references', 'result'], ['input',  
'neural', 'set'], ['neural', 'problem', 'system'], ['abstract', 'point',  
'result'], ['abstract', 'function', 'information'], ['data', 'references',  
'set'], ['abstract', 'introduction', 'learning'], ['function', 'model',  
'system'], ['information', 'number', 'references'], ['abstract', 'number',  
'result'], ['abstract', 'input', 'introduction'], ['function',  
'introduction', 'references'], ['function', 'network', 'system'],  
['function', 'learning', 'result'], ['function', 'model', 'network'],  
['model', 'number', 'set'], ['function', 'network', 'result'],  
['abstract', 'network', 'result'], ['network', 'neural', 'set'],  
['function', 'references', 'set'], ['abstract', 'references', 'set'],  
['model', 'network', 'set'], ['abstract', 'model', 'system'], ['abstract',  
'function', 'paper'], ['abstract', 'introduction', 'references'],  
['references', 'set', 'system'], ['abstract', 'function', 'order'],  
['abstract', 'learning', 'result'], ['abstract', 'model', 'network'],  
['introduction', 'model', 'result'], ['abstract', 'neural', 'problem'],  
['abstract', 'data', 'result'], ['information', 'neural', 'result'],  
['data', 'neural', 'references'], ['information', 'network',  
'references'], ['model', 'network', 'neural'], ['function', 'information',  
'references'], ['introduction', 'result', 'system'], ['introduction',  
'network', 'set'], ['model', 'set', 'system'], ['abstract', 'order',  
'references'], ['abstract', 'paper', 'system'], ['processing',  
'references', 'system'], ['abstract', 'neural', 'paper'], ['case',  
'function', 'references'], ['neural', 'set', 'system'], ['abstract',  
'parameter', 'result'], ['abstract', 'learning', 'set'], ['introduction',  
'model', 'set'], ['function', 'neural', 'references'], ['model', 'neural',

```

'system'], ['introduction', 'network', 'neural'], ['abstract', 'data',
'function'], ['abstract', 'function', 'large'], ['abstract', 'input',
'system'], ['large', 'references', 'result'], ['input', 'references',
'system'], ['introduction', 'problem', 'result'], ['neural', 'number',
'result'], ['network', 'problem', 'result'], ['network', 'result',
'system'], ['model', 'references', 'result'], ['abstract', 'input',
'network'], ['number', 'problem', 'result'], ['number', 'result',
'system'], ['function', 'neural', 'number'], ['abstract', 'model',
'problem'], ['problem', 'references', 'set'], ['abstract', 'form',
'references'], ['introduction', 'neural', 'system'], ['neural',
'references', 'result'], ['network', 'number', 'references'], ['abstract',
'output', 'result'], ['abstract', 'algorithm', 'result'], ['function',
'introduction', 'set'], ['abstract', 'neural', 'references'], ['abstract',
'function', 'system'], ['input', 'introduction', 'neural'], ['abstract',
'information', 'references'], ['abstract', 'set', 'system'], ['abstract',
'function', 'network'], ['input', 'neural', 'result'], ['abstract',
'processing', 'system'], ['input', 'network', 'references'], ['abstract',
'function', 'input'], ['model', 'references', 'set'], ['function',
'number', 'system'], ['neural', 'problem', 'references'], ['data',
'references', 'result'], ['function', 'introduction', 'neural']]
Frequent 4-itemsets: [['abstract', 'input', 'number', 'references'],
['abstract', 'neural', 'result', 'set'], ['information', 'references',
'result', 'system'], ['function', 'network', 'neural', 'number'],
['input', 'network', 'neural', 'system'], ['abstract', 'model', 'network',
'neural'], ['abstract', 'function', 'introduction', 'number'],
['abstract', 'introduction', 'problem', 'references'], ['network',
'neural', 'set', 'system'], ['network', 'number', 'references', 'set'],
['function', 'network', 'references', 'system'], ['abstract', 'network',
'problem', 'references'], ['abstract', 'information', 'neural', 'system'],
['abstract', 'input', 'references', 'system'], ['abstract', 'input',
'network', 'references'], ['abstract', 'number', 'problem', 'references'],
['abstract', 'model', 'result', 'system'], ['function', 'information',
'references', 'system'], ['input', 'references', 'result', 'set'],
['input', 'neural', 'references', 'system'], ['abstract', 'model',
'number', 'references'], ['function', 'input', 'neural', 'references'],
['function', 'model', 'result', 'system'], ['abstract', 'neural',
'number', 'system'], ['introduction', 'neural', 'number', 'result'],
['network', 'neural', 'number', 'result'], ['function', 'neural', 'set',
'system'], ['abstract', 'data', 'function', 'references'], ['abstract',
'learning', 'neural', 'references'], ['model', 'network', 'neural',
'result'], ['abstract', 'model', 'network', 'references'], ['network',
'neural', 'references', 'result'], ['function', 'references', 'result',
'set'], ['function', 'network', 'neural', 'result'], ['abstract',
'neural', 'problem', 'references'], ['abstract', 'input', 'neural',
'result'], ['introduction', 'neural', 'references', 'set'], ['abstract',
'function', 'model', 'set'], ['abstract', 'function', 'introduction',
'result'], ['function', 'introduction', 'result', 'system'], ['abstract',

```

'introduction', 'neural', 'number'], ['neural', 'number', 'set',  
'system'], ['abstract', 'introduction', 'model', 'set'], ['function',  
'number', 'result', 'system'], ['abstract', 'function', 'input',  
'result'], ['abstract', 'model', 'neural', 'system'], ['function',  
'result', 'set', 'system'], ['abstract', 'learning', 'references',  
'system'], ['abstract', 'function', 'model', 'neural'], ['abstract',  
'model', 'neural', 'result'], ['abstract', 'information', 'number',  
'result'], ['abstract', 'learning', 'references', 'result'], ['network',  
'neural', 'references', 'set'], ['function', 'model', 'neural', 'system'],  
'abstract', 'function', 'network', 'neural'], ['abstract', 'function',  
'information', 'system'], ['abstract', 'introduction', 'model', 'neural'],  
'abstract', 'learning', 'result', 'set'], ['abstract', 'introduction',  
'number', 'references'], ['function', 'input', 'references', 'system'],  
'abstract', 'function', 'problem', 'result'], ['neural', 'number',  
'references', 'result'], ['abstract', 'network', 'number', 'references'],  
'abstract', 'function', 'result', 'system'], ['introduction', 'network',  
'result', 'system'], ['introduction', 'model', 'references', 'result'],  
'abstract', 'information', 'network', 'result'], ['function', 'neural',  
'number', 'result'], ['abstract', 'network', 'neural', 'number'],  
'abstract', 'function', 'information', 'result'], ['abstract',  
'function', 'input', 'set'], ['abstract', 'information', 'references',  
'set'], ['neural', 'number', 'result', 'set'], ['introduction',  
'references', 'result', 'system'], ['abstract', 'introduction', 'neural',  
'result'], ['abstract', 'introduction', 'network', 'references'],  
'function', 'introduction', 'number', 'references'], ['function',  
'neural', 'references', 'set'], ['function', 'introduction', 'neural',  
'system'], ['abstract', 'function', 'number', 'references'], ['abstract',  
'function', 'neural', 'system'], ['abstract', 'network', 'references',  
'system'], ['abstract', 'information', 'introduction', 'references'],  
'introduction', 'network', 'neural', 'system'], ['abstract', 'model',  
'network', 'result'], ['abstract', 'number', 'references', 'system'],  
'abstract', 'input', 'network', 'set'], ['function', 'introduction',  
'neural', 'result'], ['function', 'introduction', 'network',  
'references'], ['abstract', 'function', 'network', 'references'],  
'abstract', 'problem', 'result', 'system'], ['network', 'number',  
'references', 'system'], ['function', 'neural', 'number', 'set'],  
'function', 'model', 'references', 'set'], ['input', 'references',  
'result', 'system'], ['model', 'neural', 'references', 'set'], ['number',  
'references', 'result', 'set'], ['input', 'network', 'neural',  
'references'], ['abstract', 'input', 'network', 'neural'], ['abstract',  
'function', 'learning', 'references'], ['abstract', 'function', 'network',  
'number'], ['abstract', 'neural', 'references', 'system'], ['abstract',  
'network', 'neural', 'result'], ['abstract', 'information', 'neural',  
'references'], ['network', 'number', 'result', 'set'], ['function',  
'network', 'result', 'system'], ['abstract', 'neural', 'problem', 'set'],  
'abstract', 'input', 'result', 'system'], ['network', 'references',  
'result', 'set'], ['abstract', 'result', 'set', 'system'], ['input',

'neural', 'result', 'system'], ['function', 'references', 'result', 'system'], ['number', 'result', 'set', 'system'], ['neural', 'references', 'result', 'set'], ['introduction', 'neural', 'references', 'system'], ['function', 'network', 'number', 'references'], ['abstract', 'function', 'neural', 'problem'], ['abstract', 'network', 'neural', 'set'], ['network', 'result', 'set', 'system'], ['network', 'neural', 'result', 'set'], ['abstract', 'problem', 'set', 'system'], ['input', 'network', 'references', 'result'], ['introduction', 'neural', 'references', 'result'], ['abstract', 'function', 'model', 'result'], ['network', 'neural', 'number', 'system'], ['introduction', 'neural', 'result', 'set'], ['abstract', 'function', 'network', 'result'], ['abstract', 'introduction', 'number', 'set'], ['abstract', 'introduction', 'model', 'result'], ['introduction', 'network', 'references', 'set'], ['network', 'neural', 'references', 'system'], ['model', 'references', 'set', 'system'], ['function', 'network', 'neural', 'system'], ['introduction', 'number', 'references', 'set'], ['abstract', 'information', 'result', 'set'], ['abstract', 'input', 'neural', 'system'], ['abstract', 'introduction', 'result', 'system'], ['abstract', 'function', 'introduction', 'system'], ['abstract', 'introduction', 'network', 'set'], ['abstract', 'model', 'set', 'system'], ['abstract', 'function', 'number', 'set'], ['model', 'references', 'result', 'set'], ['function', 'neural', 'result', 'set'], ['abstract', 'function', 'input', 'system'], ['abstract', 'function', 'introduction', 'network'], ['function', 'model', 'neural', 'references'], ['abstract', 'case', 'function', 'references'], ['neural', 'result', 'set', 'system'], ['function', 'neural', 'references', 'system'], ['abstract', 'function', 'network', 'set'], ['abstract', 'function', 'input', 'network'], ['function', 'input', 'network', 'references'], ['abstract', 'information', 'references', 'result'], ['abstract', 'introduction', 'network', 'neural'], ['function', 'problem', 'references', 'result'], ['abstract', 'introduction', 'set', 'system'], ['function', 'neural', 'references', 'result'], ['information', 'references', 'result', 'set'], ['abstract', 'introduction', 'problem', 'result'], ['abstract', 'function', 'learning', 'set'], ['introduction', 'network', 'neural', 'references'], ['abstract', 'network', 'problem', 'result'], ['abstract', 'function', 'problem', 'system'], ['neural', 'number', 'references', 'system'], ['abstract', 'model', 'references', 'result'], ['function', 'introduction', 'network', 'neural'], ['abstract', 'network', 'result', 'system'], ['abstract', 'number', 'problem', 'result'], ['abstract', 'input', 'network', 'result'], ['function', 'neural', 'number', 'system'], ['function', 'network', 'references', 'set'], ['abstract', 'number', 'result', 'system'], ['abstract', 'information', 'neural', 'set'], ['function', 'introduction', 'set', 'system'], ['abstract', 'input', 'references', 'set'], ['abstract', 'problem', 'references', 'set'], ['abstract', 'references', 'result', 'system'], ['number', 'references', 'result', 'system'], ['abstract', 'introduction', 'neural', 'system'], ['function', 'number', 'set', 'system'], ['abstract', 'model', 'number', 'result'], ['abstract',

'input', 'introduction', 'references'], ['information', 'neural',  
'references', 'result'], ['function', 'model', 'references', 'result'],  
['abstract', 'model', 'network', 'system'], ['function', 'input',  
'neural', 'result'], ['references', 'result', 'set', 'system'], ['model',  
'neural', 'references', 'result'], ['network', 'number', 'result',  
'system'], ['abstract', 'neural', 'problem', 'system'], ['function',  
'problem', 'references', 'set'], ['abstract', 'learning', 'neural',  
'result'], ['function', 'model', 'result', 'set'], ['abstract', 'model',  
'references', 'set'], ['abstract', 'neural', 'problem', 'result'],  
['neural', 'references', 'result', 'system'], ['abstract', 'neural',  
'result', 'system'], ['function', 'introduction', 'references', 'result'],  
['abstract', 'case', 'function', 'result'], ['abstract', 'function',  
'set', 'system'], ['introduction', 'references', 'set', 'system'],  
['abstract', 'network', 'neural', 'system'], ['network', 'neural',  
'result', 'system'], ['function', 'neural', 'problem', 'references'],  
['introduction', 'number', 'result', 'set'], ['abstract', 'introduction',  
'references', 'set'], ['introduction', 'neural', 'result', 'system'],  
['abstract', 'information', 'result', 'system'], ['introduction',  
'neural', 'number', 'references'], ['network', 'neural', 'number',  
'references'], ['function', 'introduction', 'references', 'set'],  
['abstract', 'introduction', 'number', 'result'], ['abstract', 'function',  
'references', 'result'], ['introduction', 'network', 'references',  
'result'], ['abstract', 'network', 'number', 'result'], ['model',  
'network', 'neural', 'references'], ['abstract', 'function', 'number',  
'system'], ['introduction', 'number', 'references', 'result'],  
['abstract', 'neural', 'number', 'references'], ['introduction',  
'network', 'result', 'set'], ['abstract', 'data', 'references', 'set'],  
['input', 'network', 'references', 'system'], ['function', 'network',  
'neural', 'references'], ['abstract', 'function', 'model', 'system'],  
['abstract', 'input', 'neural', 'references'], ['abstract',  
'introduction', 'network', 'result'], ['function', 'introduction',  
'number', 'result'], ['function', 'information', 'neural', 'references'],  
['introduction', 'references', 'result', 'set'], ['abstract', 'function',  
'number', 'result'], ['problem', 'references', 'result', 'set'],  
['abstract', 'function', 'introduction', 'references'], ['abstract',  
'information', 'introduction', 'result'], ['abstract', 'order',  
'references', 'result'], ['function', 'network', 'set', 'system'],  
['abstract', 'function', 'network', 'system'], ['abstract', 'input',  
'set', 'system'], ['abstract', 'function', 'model', 'network'],  
['abstract', 'introduction', 'model', 'system'], ['abstract', 'network',  
'references', 'set'], ['introduction', 'network', 'neural', 'set'],  
['abstract', 'number', 'references', 'set'], ['abstract', 'function',  
'input', 'references'], ['introduction', 'result', 'set', 'system'],  
['model', 'neural', 'result', 'system'], ['function', 'input', 'network',  
'neural'], ['function', 'introduction', 'network', 'result'], ['neural',  
'problem', 'references', 'set'], ['abstract', 'function', 'references',  
'set'], ['abstract', 'network', 'number', 'set'], ['abstract', 'problem',

'result', 'set'], ['abstract', 'network', 'neural', 'problem'],  
['abstract', 'model', 'neural', 'references'], ['function', 'number',  
'references', 'set'], ['abstract', 'information', 'number', 'references'],  
['abstract', 'problem', 'references', 'system'], ['input', 'network',  
'neural', 'result'], ['abstract', 'function', 'learning', 'result'],  
['model', 'network', 'references', 'result'], ['model', 'number',  
'references', 'result'], ['function', 'problem', 'result', 'set'],  
['function', 'network', 'references', 'result'], ['abstract',  
'information', 'neural', 'result'], ['abstract', 'function', 'problem',  
'references'], ['abstract', 'information', 'references', 'system'],  
['abstract', 'input', 'references', 'result'], ['abstract', 'data',  
'neural', 'references'], ['abstract', 'case', 'references', 'set'],  
['abstract', 'problem', 'references', 'result'], ['abstract',  
'information', 'network', 'references'], ['neural', 'number', 'result',  
'system'], ['function', 'information', 'references', 'result'],  
['function', 'neural', 'number', 'references'], ['abstract', 'neural',  
'references', 'set'], ['abstract', 'function', 'information',  
'references'], ['function', 'references', 'set', 'system'], ['function',  
'network', 'result', 'set'], ['abstract', 'input', 'result', 'set'],  
['abstract', 'introduction', 'neural', 'references'], ['input', 'neural',  
'references', 'result'], ['abstract', 'model', 'references', 'system'],  
['abstract', 'input', 'network', 'system'], ['abstract', 'neural',  
'number', 'result'], ['function', 'network', 'number', 'result'],  
['function', 'introduction', 'neural', 'references'], ['abstract',  
'function', 'neural', 'references'], ['information', 'neural',  
'references', 'system'], ['function', 'model', 'references', 'system'],  
['model', 'neural', 'references', 'system'], ['abstract', 'model',  
'result', 'set'], ['network', 'neural', 'number', 'set'], ['abstract',  
'introduction', 'references', 'system'], ['input', 'neural', 'references',  
'set'], ['abstract', 'function', 'neural', 'number'], ['abstract', 'case',  
'neural', 'references'], ['abstract', 'network', 'neural', 'references'],  
['abstract', 'neural', 'number', 'set'], ['abstract', 'function',  
'introduction', 'model'], ['abstract', 'introduction', 'references',  
'result'], ['function', 'network', 'neural', 'set'], ['abstract', 'input',  
'neural', 'set'], ['function', 'introduction', 'references', 'system'],  
['abstract', 'network', 'set', 'system'], ['network', 'references',  
'result', 'system'], ['abstract', 'introduction', 'result', 'set'],  
['abstract', 'number', 'set', 'system'], ['abstract', 'function',  
'introduction', 'set'], ['abstract', 'references', 'set', 'system'],  
['number', 'references', 'set', 'system'], ['function', 'model', 'neural',  
'result'], ['problem', 'references', 'result', 'system'], ['function',  
'introduction', 'result', 'set'], ['function', 'input', 'references',  
'result'], ['abstract', 'data', 'references', 'result'], ['abstract',  
'function', 'introduction', 'neural'], ['function', 'number', 'result',  
'set'], ['abstract', 'model', 'neural', 'set'], ['abstract', 'paper',  
'references', 'result'], ['abstract', 'learning', 'references', 'set'],  
['abstract', 'function', 'model', 'references'], ['abstract', 'data',

```

'result', 'set'], ['abstract', 'introduction', 'number', 'system'],
['abstract', 'neural', 'set', 'system'], ['abstract', 'function', 'input',
'neural'], ['abstract', 'function', 'neural', 'result'], ['abstract',
'network', 'references', 'result'], ['abstract', 'function', 'references',
'system'], ['introduction', 'network', 'references', 'system'],
['introduction', 'network', 'neural', 'result'], ['abstract', 'network',
'number', 'system'], ['abstract', 'number', 'references', 'result'],
['introduction', 'number', 'references', 'system'], ['abstract',
'introduction', 'model', 'references'], ['abstract', 'function',
'problem', 'set'], ['function', 'number', 'references', 'system'],
['neural', 'number', 'references', 'set'], ['abstract', 'network',
'result', 'set'], ['neural', 'problem', 'references', 'result'],
['abstract', 'function', 'information', 'set'], ['abstract', 'number',
'result', 'set'], ['abstract', 'introduction', 'network', 'system'],
['abstract', 'references', 'result', 'set'], ['abstract', 'function',
'model', 'number'], ['abstract', 'introduction', 'neural', 'set'],
['abstract', 'input', 'introduction', 'result'], ['function', 'number',
'references', 'result'], ['model', 'references', 'result', 'system'],
['function', 'neural', 'result', 'system'], ['function', 'introduction',
'model', 'references'], ['abstract', 'function', 'result', 'set'],
['network', 'number', 'references', 'result'], ['network', 'references',
'set', 'system'], ['abstract', 'function', 'paper', 'references'],
['introduction', 'neural', 'set', 'system'], ['neural', 'references',
'set', 'system'], ['abstract', 'information', 'network', 'neural'],
['function', 'introduction', 'neural', 'set'], ['abstract', 'function',
'information', 'neural'], ['abstract', 'function', 'neural', 'set'],
['abstract', 'information', 'set', 'system'], ['abstract', 'case',
'references', 'result'], ['abstract', 'neural', 'references', 'result']]

```

**K=500, F=3**

**(Runtime: 88m 33.7s before KEYBOARD INTERRUPT)**

**ENRON**

**K=8000, F=4**

**(Runtime: 0.5s)**

```

length of F1 item set 0
length of F2 item set 0
length of F3 item set 0
length of F4 item set 0

```

```

Frequent 1-itemsets: []
Frequent 2-itemsets: []
Frequent 3-itemsets: []
Frequent 4-itemsets: []

```

**K=4000, F=4**

**(Runtime: 1m 41.5s)**

length of F1 item set 48  
length of F2 item set 0  
length of F3 item set 0  
length of F4 item set 0

Frequent 1-itemsets: [['contract'], ['power'], ['price'], ['office'],  
['houston'], ['comment'], ['market'], ['cost'], ['point'], ['attached'],  
['energy'], ['offer'], ['help'], ['list'], ['team'], ['california'],  
['month'], ['meeting'], ['process'], ['sure'], ['issues'], ['review'],  
['think'], ['plan'], ['friday'], ['going'], ['look'], ['end'], ['free'],  
['report'], ['company'], ['number'], ['received'], ['send'], ['forward'],  
['monday'], ['deal'], ['group'], ['order'], ['date'], ['find'],  
['message'], ['service'], ['provide'], ['give'], ['receive'],  
['business'], ['customer']]  
Frequent 2-itemsets: []  
Frequent 3-itemsets: []  
Frequent 4-itemsets: []

**K=3000, F=4**

**(Runtime: 6m 49.2s)**

length of F1 item set 100  
length of F2 item set 0  
length of F3 item set 0  
length of F4 item set 0

Frequent 1-itemsets: [['additional'], ['contract'], ['note'], ['access'],  
['power'], ['based'], ['agreement'], ['price'], ['able'], ['office'],  
['houston'], ['comment'], ['high'], ['discuss'], ['support'], ['market'],  
['cost'], ['conference'], ['point'], ['attached'], ['energy'],  
['working'], ['offer'], ['problem'], ['thought'], ['help'], ['list'],  
['meet'], ['team'], ['issue'], ['california'], ['soon'], ['month'],  
['put'], ['prices'], ['file'], ['thing'], ['meeting'], ['process'],  
['sure'], ['issues'], ['review'], ['think'], ['plan'], ['asked'],  
['friday'], ['hope'], ['position'], ['result'], ['going'], ['look'],  
['end'], ['free'], ['report'], ['wednesday'], ['company'], ['tuesday'],  
['set'], ['hour'], ['regarding'], ['due'], ['place'], ['jeff'],  
['change'], ['number'], ['received'], ['start'], ['send'], ['gas'],  
['forward'], ['ill'], ['monday'], ['deal'], ['request'], ['include'],  
['group'], ['current'], ['part'], ['order'], ['future'], ['fax'],  
['thursday'], ['phone'], ['data'], ['date'], ['services'], ['find'],  
['message'], ['service'], ['including'], ['address'], ['provide'],  
['member'], ['give'], ['receive'], ['detail'], ['corp'], ['business'],  
['customer'], ['bill']]  
Frequent 2-itemsets: []



Frequent 3-itemsets: []  
Frequent 4-itemsets: []

**K=2000, F=3**

**(Runtime: 55m 14.5s before keyboard interrupt)**