Adaptive Parsing

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Harvey Mudd College

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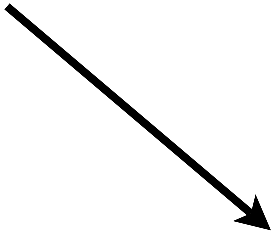
CS152, Fall 2007; Professor Robert Keller

Parsing

Flat text

```
<hwlist>
<name>Problem Set #1</name><due>09/11/2007</due>
<name>Problem Set #2</name><due>09/18/2007</due>
<name>Problem Set #3</name><due>09/25/2007</due>
<name>Problem Set #4</name><due>10/02/2007</due>
<name>Problem Set #5</name><due>10/18/2007</due>
<name>Problem Set #6</name><due>10/30/2007</due>
<name>Problem Set #7</name><due>11/06/2007</due>
<name>Problem Set #8</name><due>11/20/2007</due>
<name>Problem Set #9</name><due>11/27/2007</due>
<name>Problem Set #10</name><due>12/04/2007</due>
</hwlist>
```



Data structure

```
[['1', '09/11'], ['2', '09/18'], ['3',
'09/25'], ['4', '10/02'], ['5', '10/18'],
['6', '10/30'], ['7', '11/06'], ['8',
'11/20'], ['9', '11/27'], ['10', '12/04']]
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(minimal syntax information)

Data structure

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['6', '10/30'], ['7', '11/06'], ['8',
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Neural Problem

Find patterns in text representing delimiters

$\Rightarrow$ Cluster substrings

$\Rightarrow$ Vector quantization (strings are vectors)

$\Rightarrow$ Competitive learning algorithm

Substrings Are Input Vectors

```
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</hwlist>
```

$$\xrightarrow{\quad w \quad}$$

$$\overbrace{\qquad\qquad}^{w}$$

```
<hwlis
hwlist
wlist>
list>¬
ist>¬<
st>¬<n
t>¬<na
>¬<nam
¬<name
<name>
name>P
ame>Pr
me>Pro
e>Prob
>Probl
Proble
```

$$\vdots$$

Euclidean Distance of Byte Strings

aaa
$(97, 97, 97)$

aba
$(97, 98, 97)$

aza
$(97, 122, 97)$

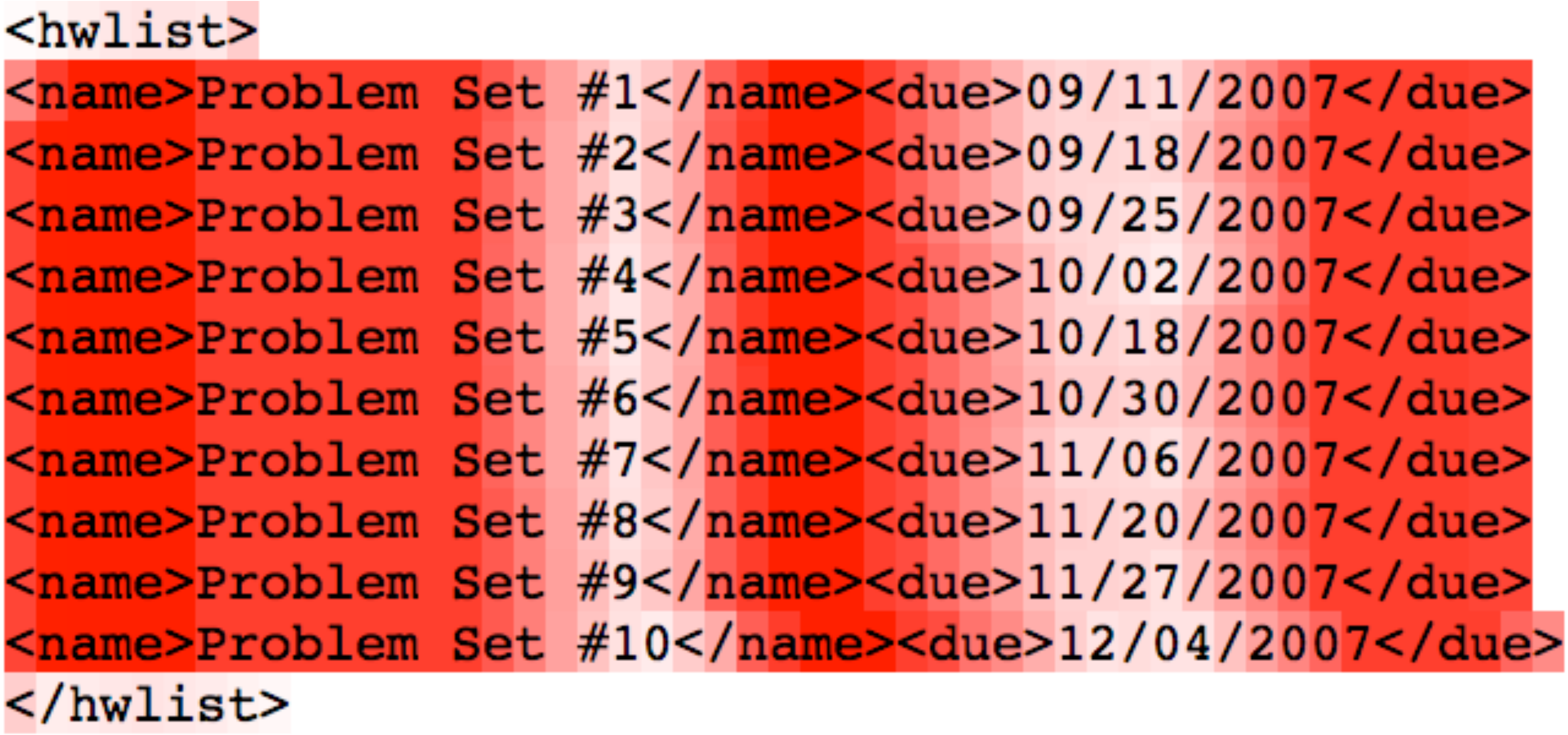
Euclidean Distance of One-Hot Strings

aaa

aza

aba

$$(0, 0, 0, 0, 0, 0, 0, \ldots, 0, 1, 0, \ldots, 0, 0, 0)$$



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</hwlist>
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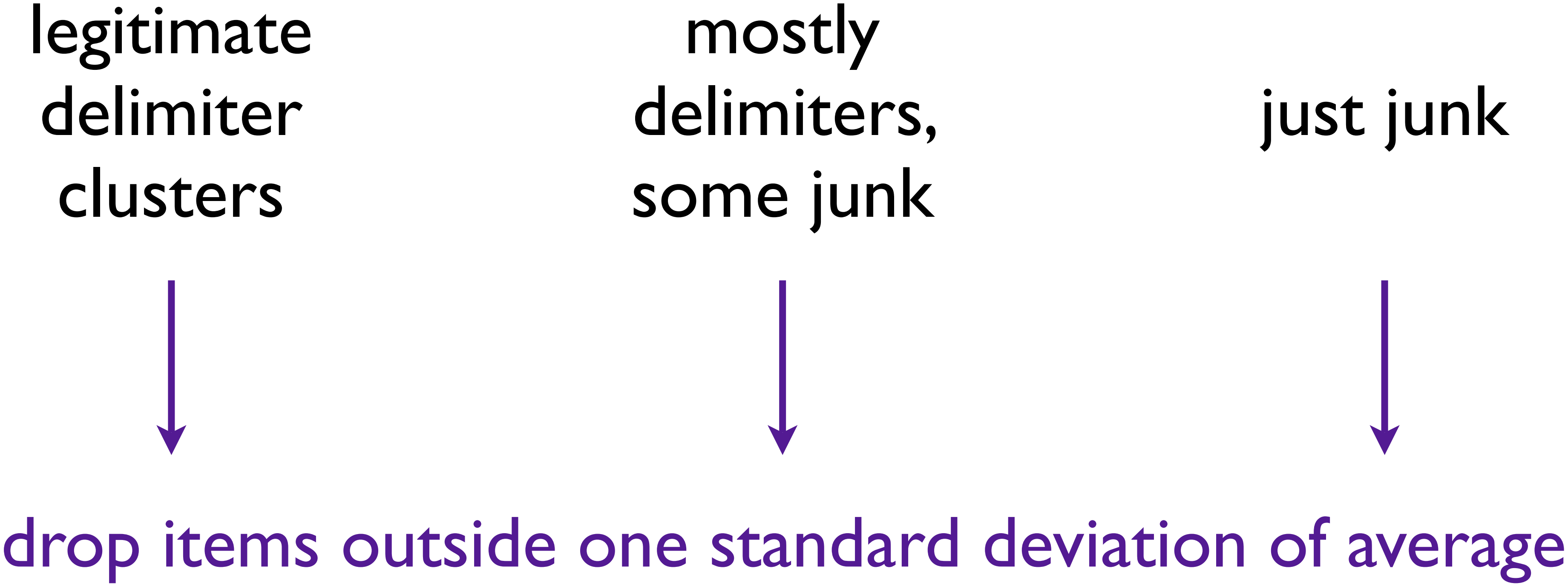
Filtering Output



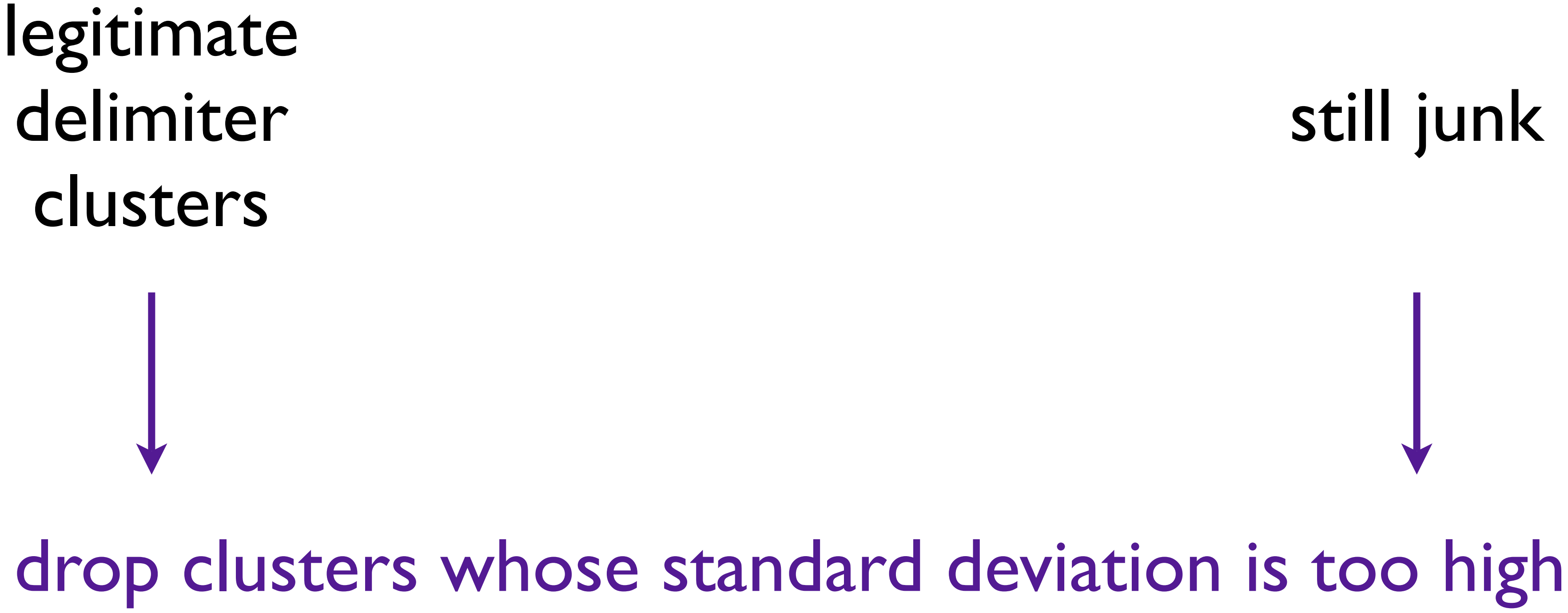
legitimate delimiter clusters

mostly delimiters, some junk

just junk

drop items outside one standard deviation of average

Filtering Output



legitimate delimiter clusters

still junk

drop clusters whose standard deviation is too high

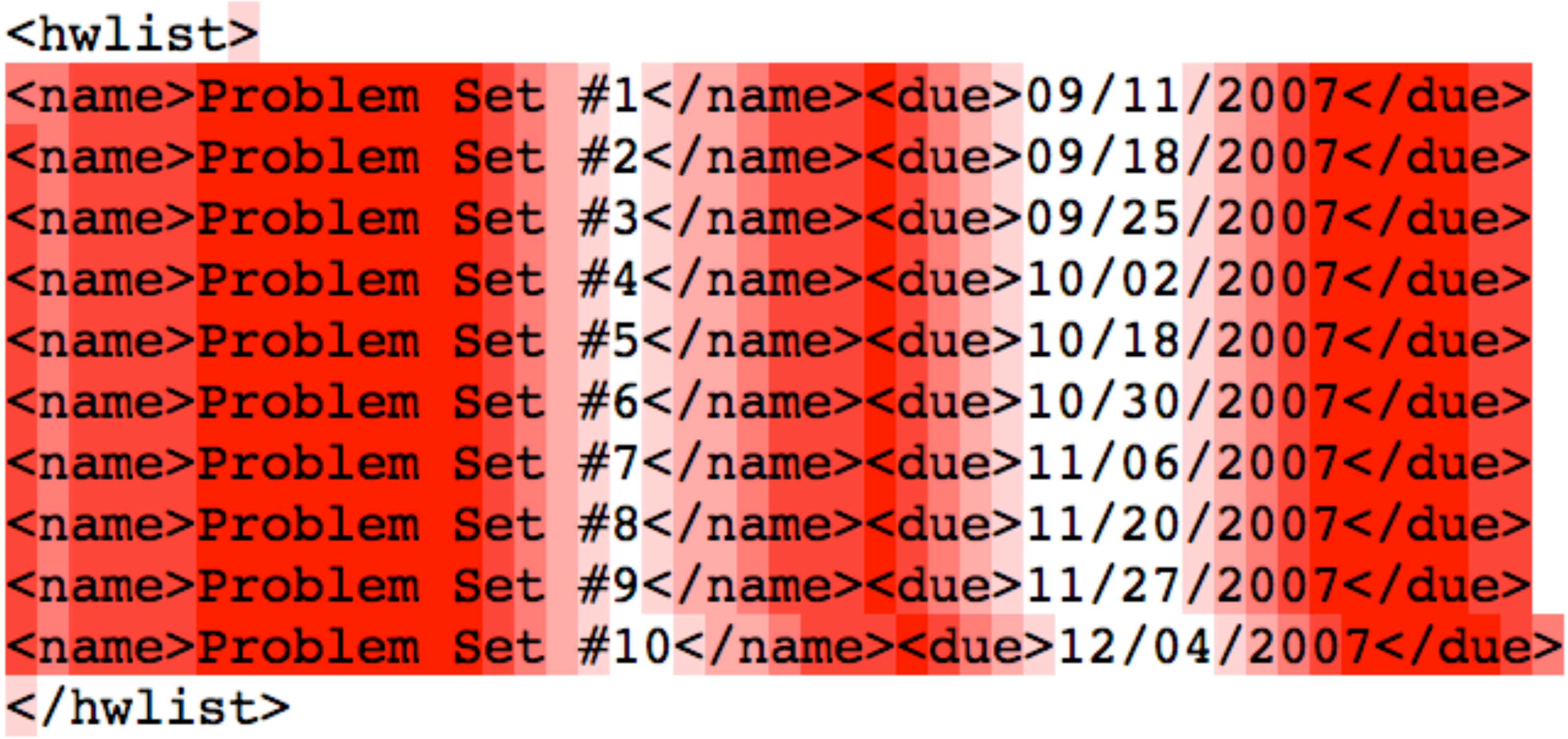
Filtering Output

legitimate
delimiter
clusters

Shifting Output

Delimiters will repeat n times where n is the number of vectors

$\Rightarrow$ Prefer vectors whose popularity is *uniform*



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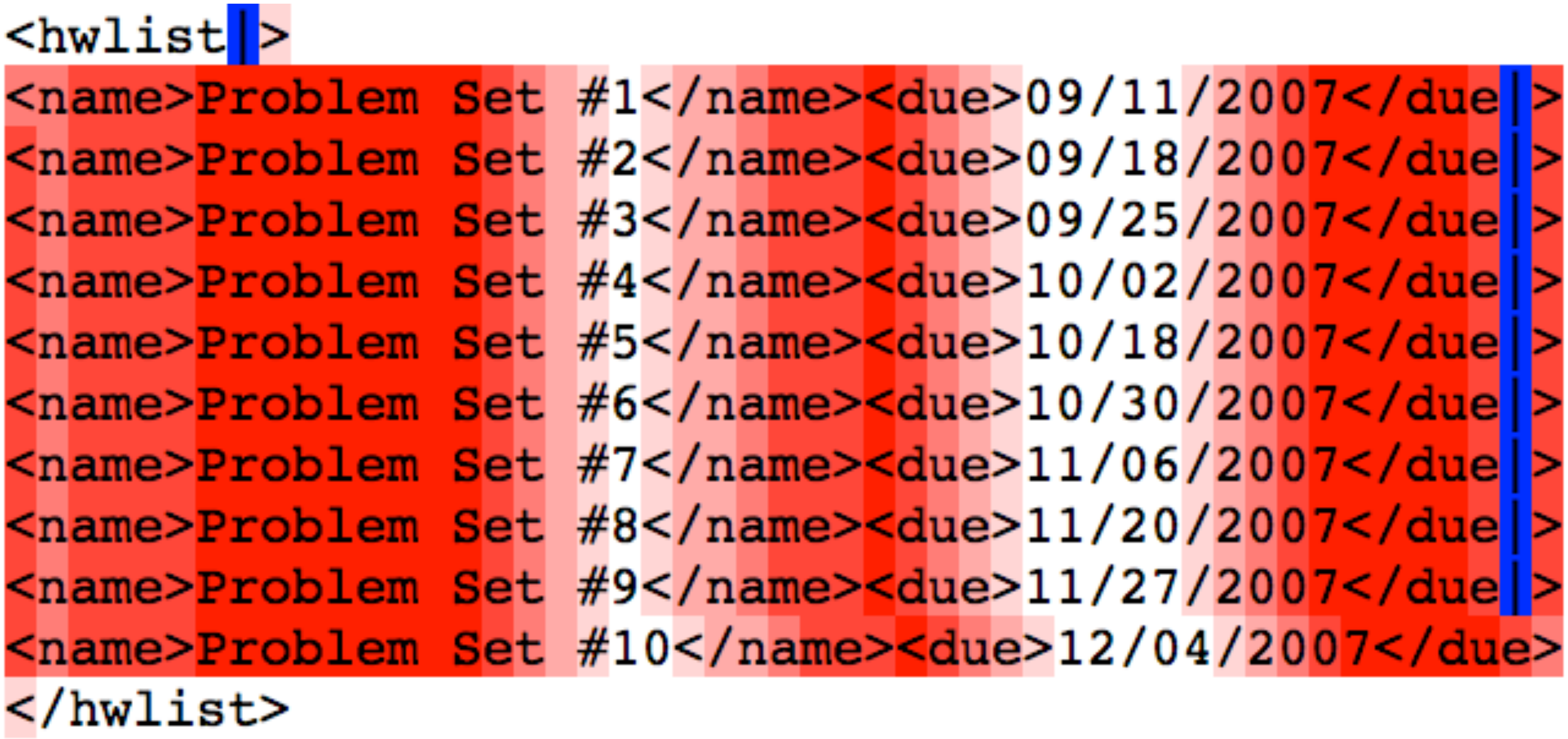
Delimiting Records

- Find first contiguous sequence of delimiters
  - Collect sequence of cluster IDs

```
<name,  name>,  ame>P,  me>Pr,  ...
```

- Search for delimiter sequences whose IDs match this sequence



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<hwlist>
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</hwlist>
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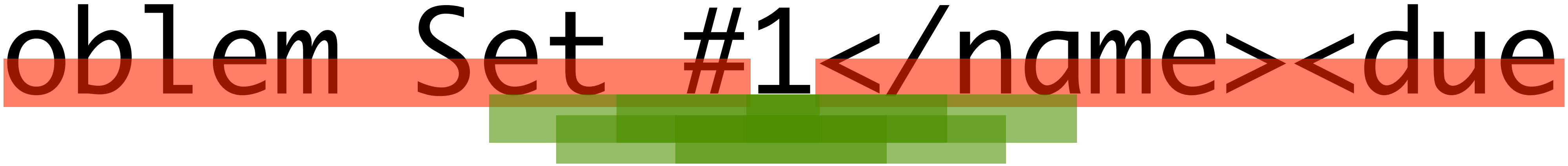
Finding Fields

$$w = 5$$



```
oblem Set #1</name><due
```

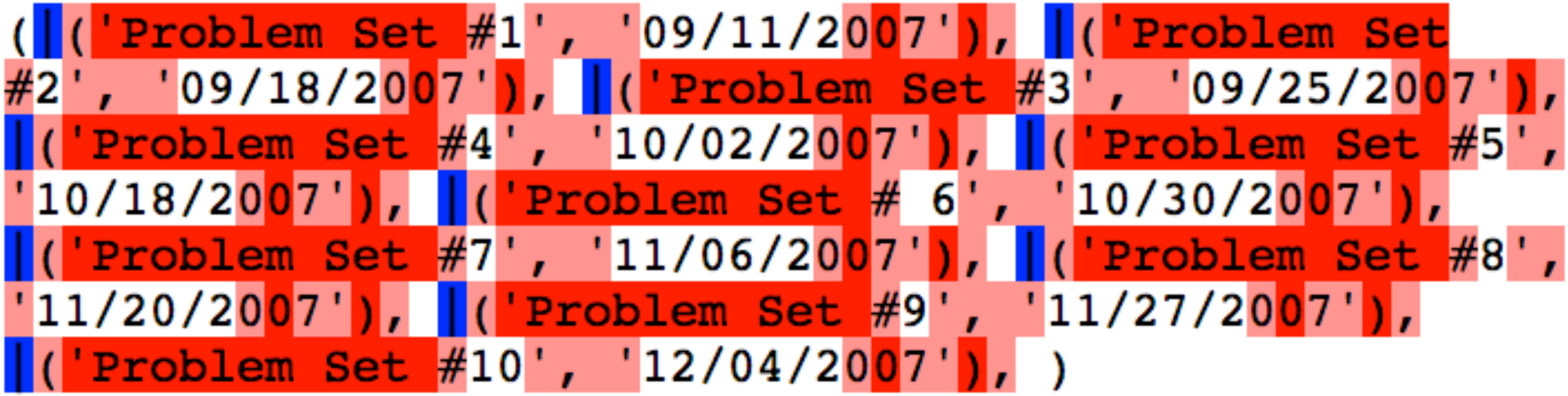
w vectors on left and w vectors on right of each field are unpopular

$\Rightarrow$ fields marked by w contiguous unpopular vectors

```
[['1', '09/11'], ['2', '09/18'],
['3', '09/25'], ['4', '10/02'],
['5', '10/18'], ['6', '10/30'],
['7', '11/06'], ['8', '11/20'],
['9', '11/27'], ['10', '12/04']]
```

Awesome!

Another Example



```
( ('Problem Set #1', '09/11/2007'),  ('Problem Set
#2', '09/18/2007'),  ('Problem Set #3', '09/25/2007'),
('Problem Set #4', '10/02/2007'),  ('Problem Set #5',
'10/18/2007'),  ('Problem Set # 6', '10/30/2007'),
('Problem Set #7', '11/06/2007'),  ('Problem Set #8',
'11/20/2007'),  ('Problem Set #9', '11/27/2007'),
('Problem Set #10', '12/04/2007'), )
```

```
[['1', '09/11/2', ' '],
 ['2', '09/18/2', ' '],
 ['3', '09/25/2', ' '],
 ['4', '10/02/2', ' '],
 ['5', '10/18/2', ' '],
 [' 6', '10/30/2', ' '],
 ['7', '11/06/2', ' '],
 ['8', '11/20/2', ' '],
 ['9', '11/27/2', ' '],
 ['10', '12/04/2']]
```

Observations

- Choosing w is the hardest (least automatable) task
- Delicate balance: tolerance to noise vs. sensitivity to fields

Future Work

- Implement competitive learning myself
    - Use distance metric that incorporates insertions & deletions

… faster than one-hot strings?

Future Work

- Use sequence clustering work from bioinformatics

Future Work

- Runtime
    - Keep “training” to parse future modifications/additions to document easily