Text Processing in Linux
A Tutorial for NLP (CSE 562/662)

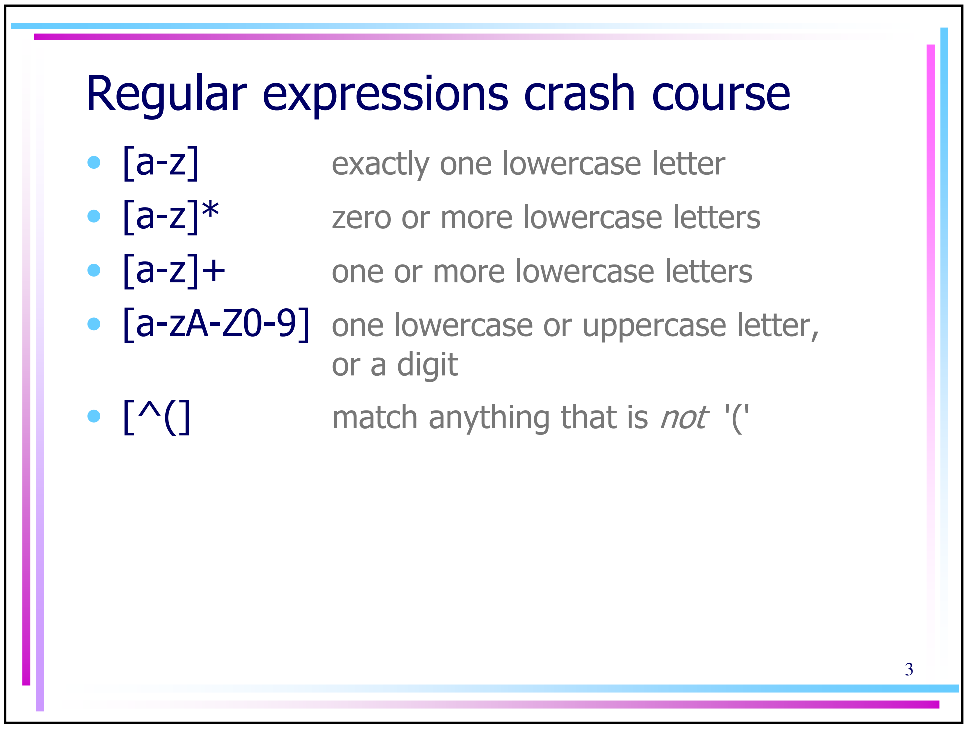
Kristy Hollingshead
Winter 2007

`www.cslu.ogi.edu/~hollingk/NLP_tutorial.html`

Overview

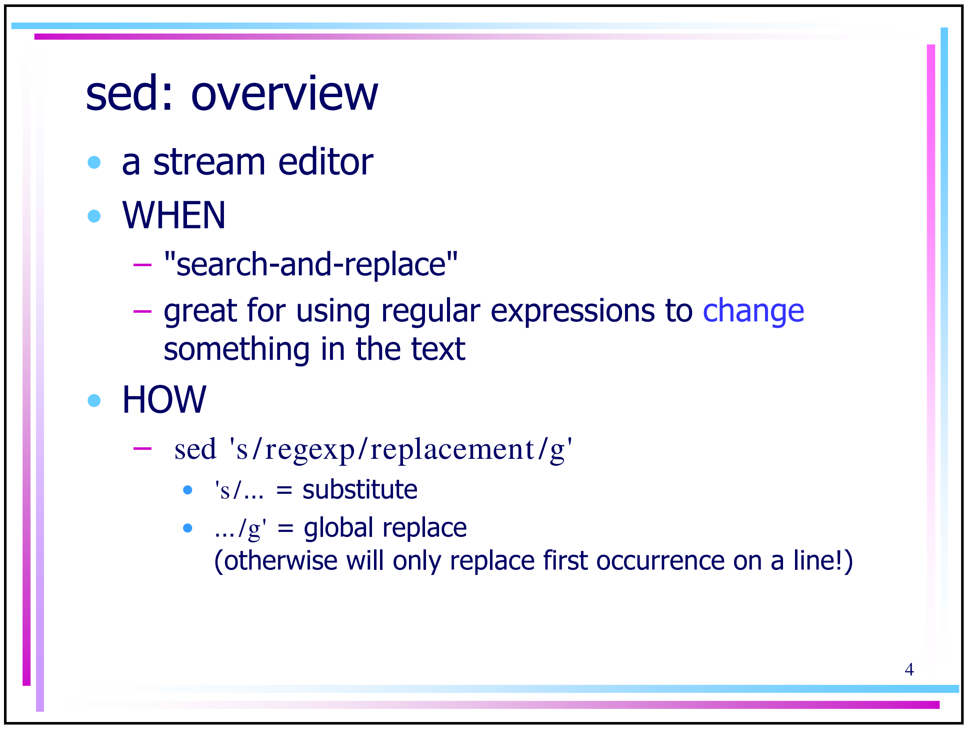
- The goal here is to make your lives easier!
- NLP is very text-intensive
- Simple tools for text-manipulation
  - `sed`
  - `awk`
  - `bash/tcsh`
  - `split`
  - `sort`
  - `head, tail`
- When & how to use each of these tools

2



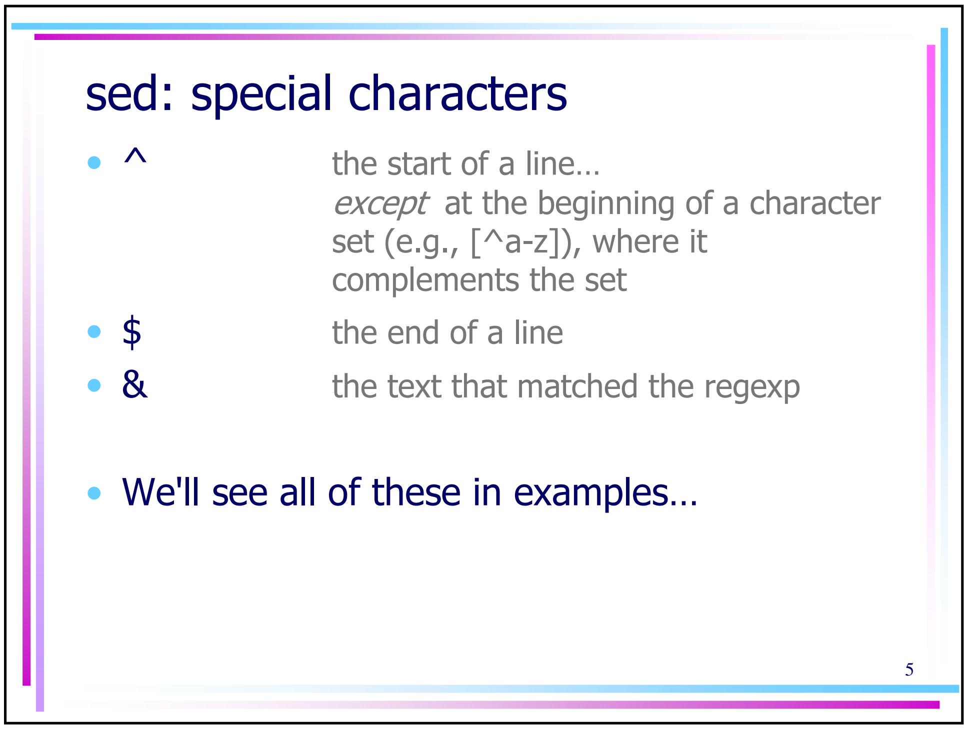
Regular expressions crash course

[a-z]	exactly one lowercase letter
[a-z]*	zero or more lowercase letters
[a-z]+	one or more lowercase letters
[a-zA-Z0-9]	one lowercase or uppercase letter, or a digit
[^(]	match anything that is *not* '('



sed: overview

- a stream editor
- WHEN
  - "search-and-replace"
  - great for using regular expressions to change something in the text
- HOW
  - sed 's/regexp/replacement/g'
    - 's/... = substitute
    - .../g' = global replace
      (otherwise will only replace first occurrence on a line!)

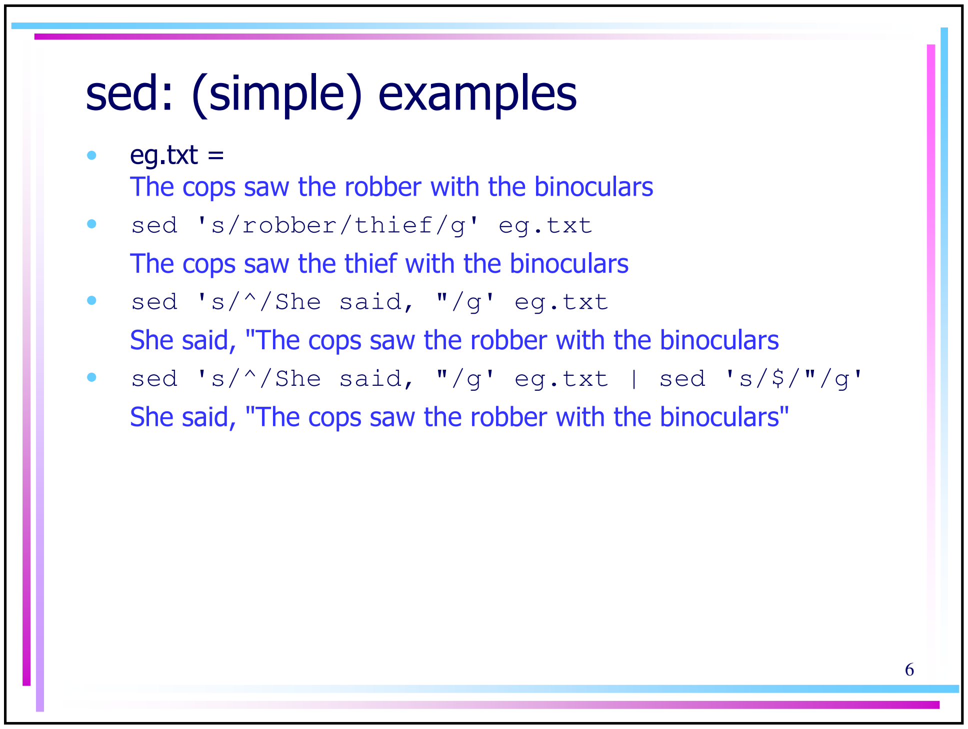


sed: special characters

^	the start of a line… *except* at the beginning of a character set (e.g., [^a-z]), where it complements the set
$	the end of a line
&	the text that matched the regexp

- We'll see all of these in examples…

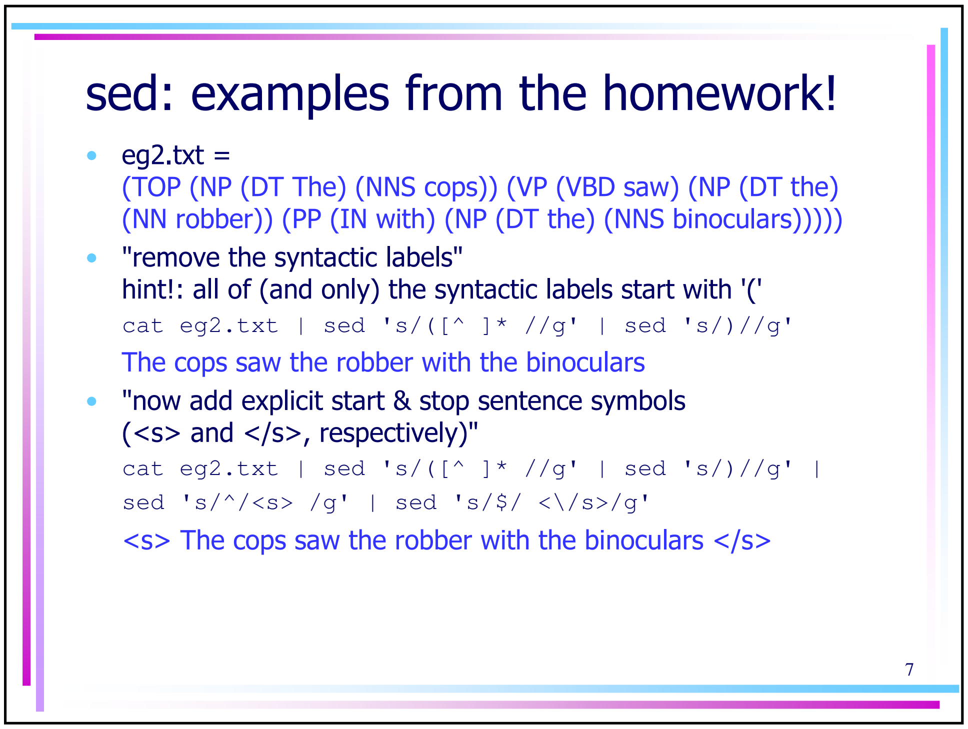
5



sed: (simple) examples

- eg.txt =
  The cops saw the robber with the binoculars
- `sed 's/robber/thief/g' eg.txt`
  The cops saw the thief with the binoculars
- `sed 's/^/She said, "/g' eg.txt`
  She said, "The cops saw the robber with the binoculars
- `sed 's/^/She said, "/g' eg.txt | sed 's/$/"/g'`
  She said, "The cops saw the robber with the binoculars"

6



sed: examples from the homework!

- eg2.txt =
  (TOP (NP (DT The) (NNS cops)) (VP (VBD saw) (NP (DT the) (NN robber)) (PP (IN with) (NP (DT the) (NNS binoculars)))))
- "remove the syntactic labels"
  hint!: all of (and only) the syntactic labels start with '('

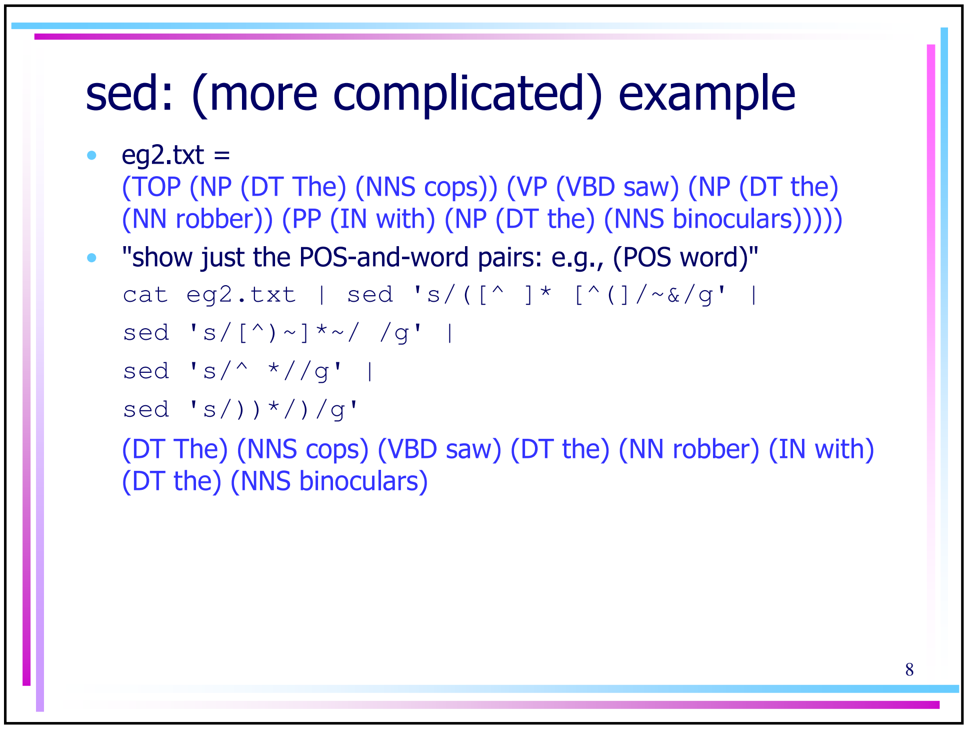
```
cat eg2.txt | sed 's/([^ ]* //g' | sed 's/)//g'
```

  The cops saw the robber with the binoculars
- "now add explicit start & stop sentence symbols (<s> and </s>, respectively)"

```
cat eg2.txt | sed 's/([^ ]* //g' | sed 's/)//g' |
sed 's/^/<s> /g' | sed 's/$/ <\/s>/g'
```

  <s> The cops saw the robber with the binoculars </s>

7



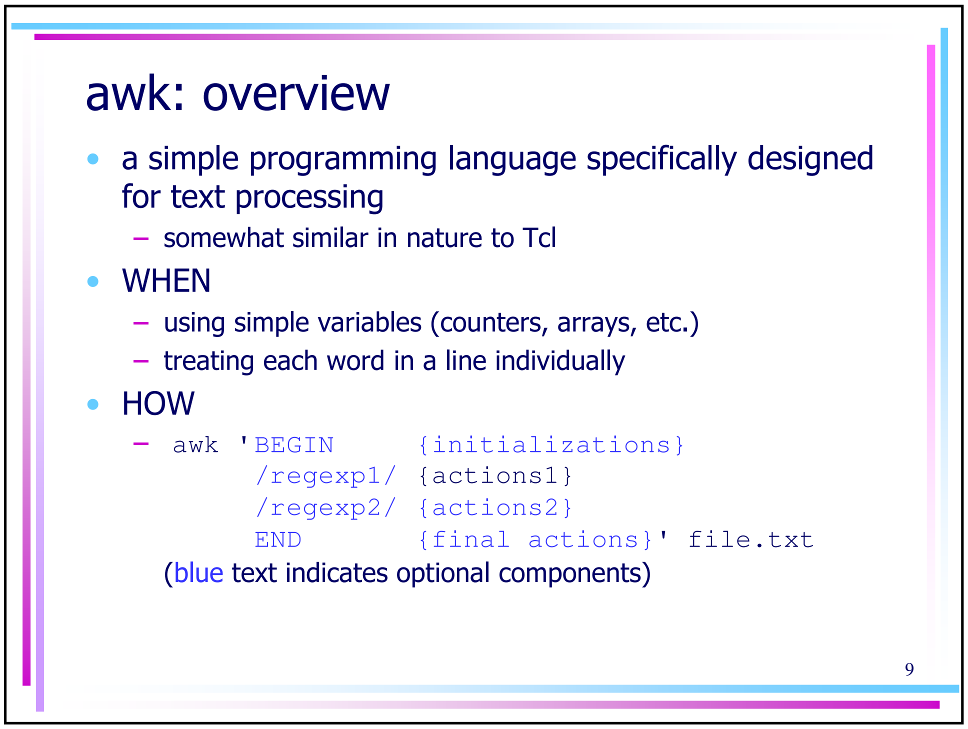
sed: (more complicated) example

- eg2.txt =
  (TOP (NP (DT The) (NNS cops)) (VP (VBD saw) (NP (DT the) (NN robber)) (PP (IN with) (NP (DT the) (NNS binoculars)))))
- "show just the POS-and-word pairs: e.g., (POS word)"

```
cat eg2.txt | sed 's/([^ ]* [^(]/~&/g' |
sed 's/[^)~]*~/ /g' |
sed 's/^ *//g' |
sed 's/))*/)/g'
```

  (DT The) (NNS cops) (VBD saw) (DT the) (NN robber) (IN with) (DT the) (NNS binoculars)

8

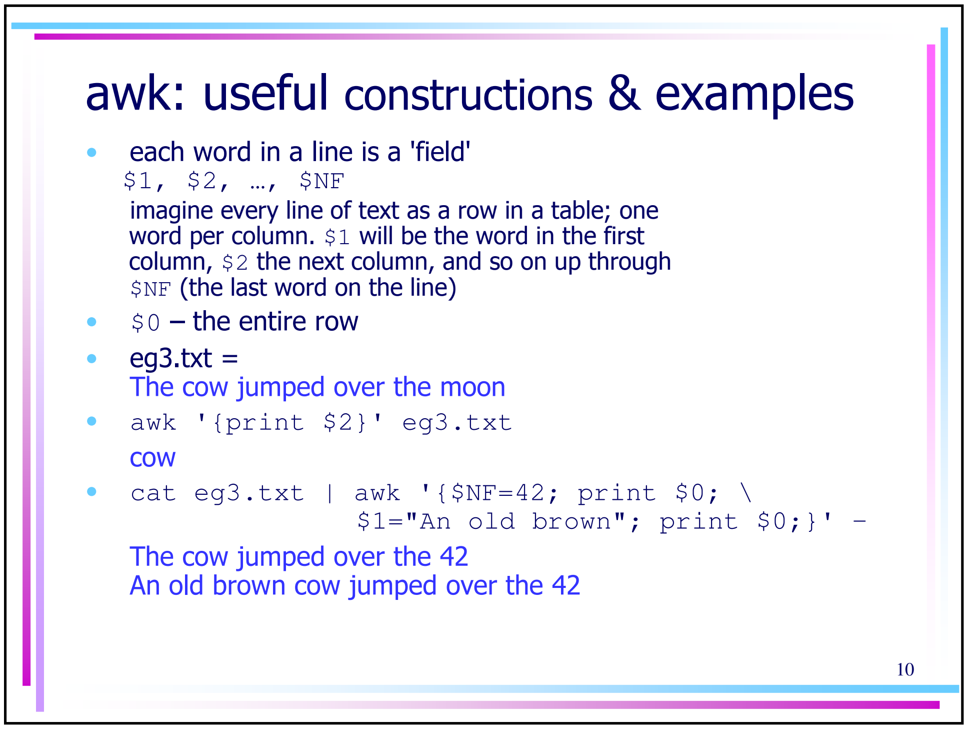


awk: overview

- a simple programming language specifically designed for text processing
  - somewhat similar in nature to Tcl
- WHEN
  - using simple variables (counters, arrays, etc.)
  - treating each word in a line individually
- HOW

  -
    ```
    awk 'BEGIN     {initializations}
         /regexp1/ {actions1}
         /regexp2/ {actions2}
         END       {final actions}' file.txt
    ```
    (blue text indicates optional components)

9

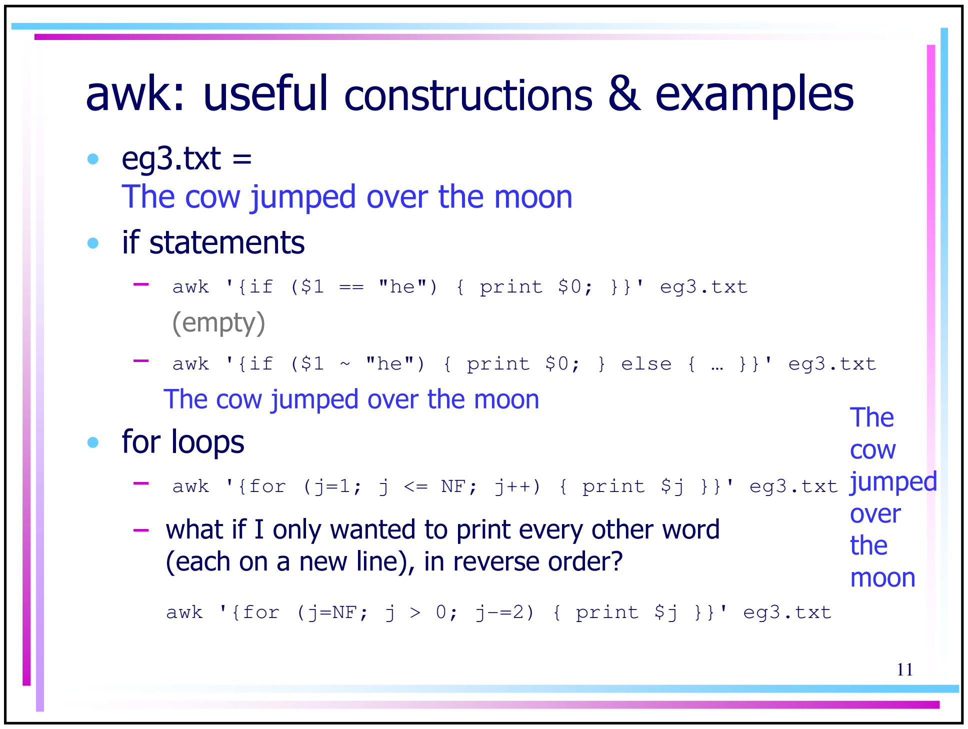


awk: useful constructions & examples

- each word in a line is a 'field'
  `$1, $2, …, $NF`
  imagine every line of text as a row in a table; one word per column. `$1` will be the word in the first column, `$2` the next column, and so on up through `$NF` (the last word on the line)
- `$0` – the entire row
- eg3.txt =
  The cow jumped over the moon
- `awk '{print $2}' eg3.txt`
  cow

-
  ```
  cat eg3.txt | awk '{$NF=42; print $0; \
                $1="An old brown"; print $0;}' -
  ```
  The cow jumped over the 42
  An old brown cow jumped over the 42

10

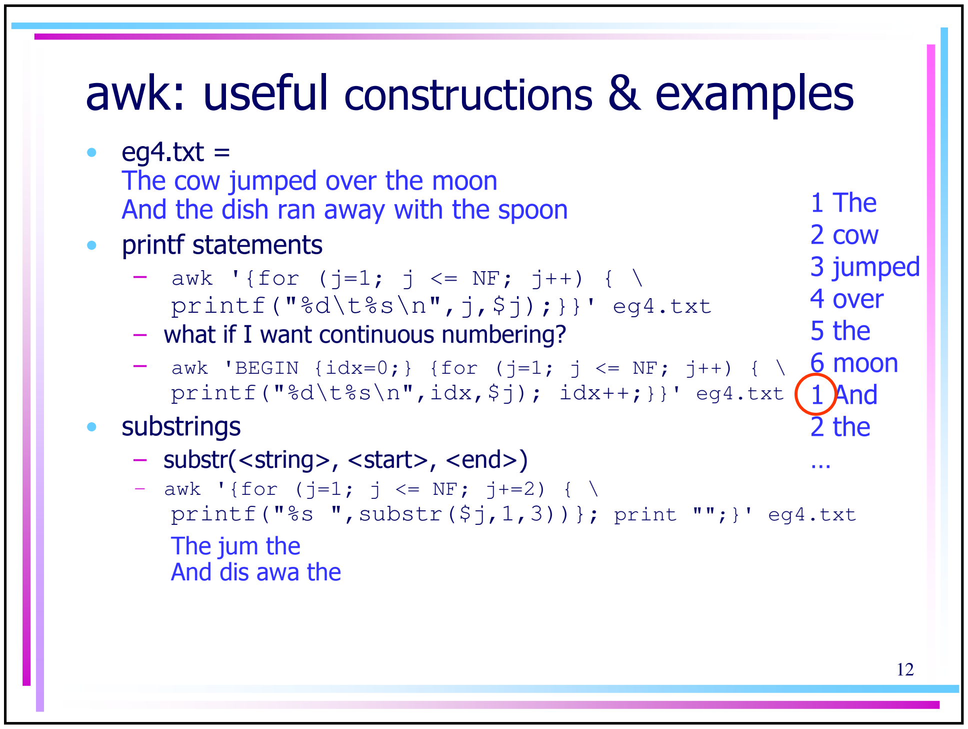


awk: useful constructions & examples

- eg3.txt =
  The cow jumped over the moon
- if statements
  - `awk '{if ($1 == "he") { print $0; }}' eg3.txt`
    (empty)
  - `awk '{if ($1 ~ "he") { print $0; } else { … }}' eg3.txt`
    ```
    The cow jumped over the moon
    ```
- for loops
  - `awk '{for (j=1; j <= NF; j++) { print $j }}' eg3.txt`
    ```
    The
    cow
    jumped
    over
    the
    moon
    ```
  - what if I only wanted to print every other word (each on a new line), in reverse order?

    `awk '{for (j=NF; j > 0; j-=2) { print $j }}' eg3.txt`

11



awk: useful constructions & examples

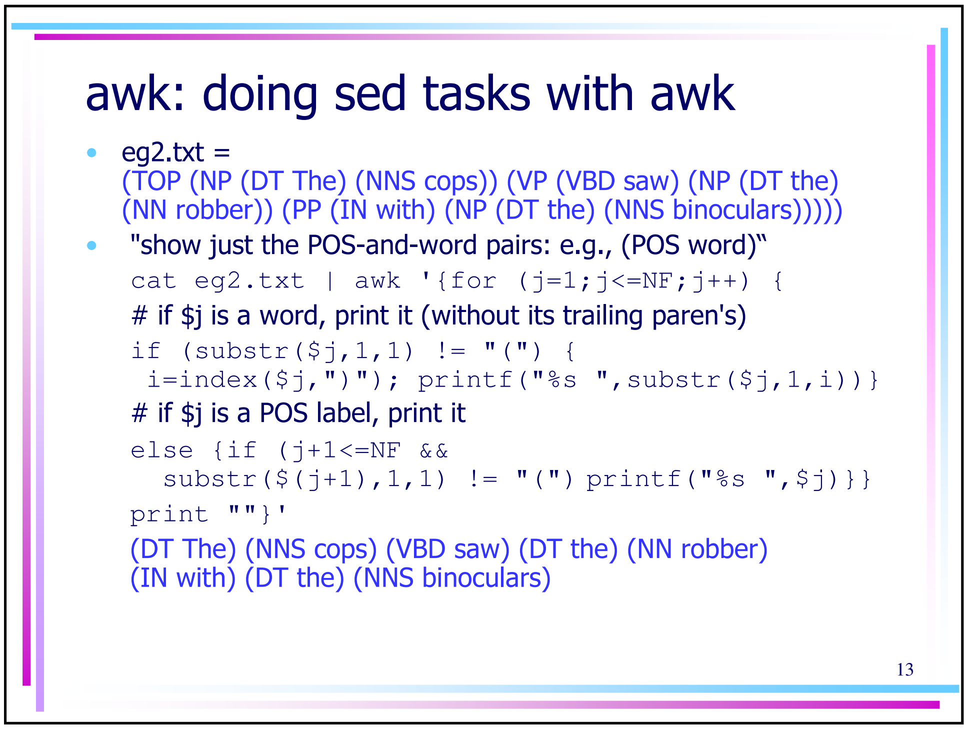
- eg4.txt =
  The cow jumped over the moon
  And the dish ran away with the spoon
- printf statements

  -
    ```
    awk '{for (j=1; j <= NF; j++) { \
    printf("%d\t%s\n",j,$j);}}' eg4.txt
    ```
    ```
    1 The
    2 cow
    3 jumped
    4 over
    5 the
    6 moon
    1 And
    2 the
    …
    ```
  - what if I want continuous numbering?

  -
    ```
    awk 'BEGIN {idx=0;} {for (j=1; j <= NF; j++) { \
    printf("%d\t%s\n",idx,$j); idx++;}}' eg4.txt
    ```
- substrings
  - substr(<string>, <start>, <end>)

  -
    ```
    awk '{for (j=1; j <= NF; j+=2) { \
    printf("%s ",substr($j,1,3))}; print "";}' eg4.txt
    ```
    ```
    The jum the
    And dis awa the
    ```

12



awk: doing sed tasks with awk

- eg2.txt =
  (TOP (NP (DT The) (NNS cops)) (VP (VBD saw) (NP (DT the) (NN robber)) (PP (IN with) (NP (DT the) (NNS binoculars)))))
- "show just the POS-and-word pairs: e.g., (POS word)"

```
cat eg2.txt | awk '{for (j=1;j<=NF;j++) {
```

if $j is a word, print it (without its trailing paren's)

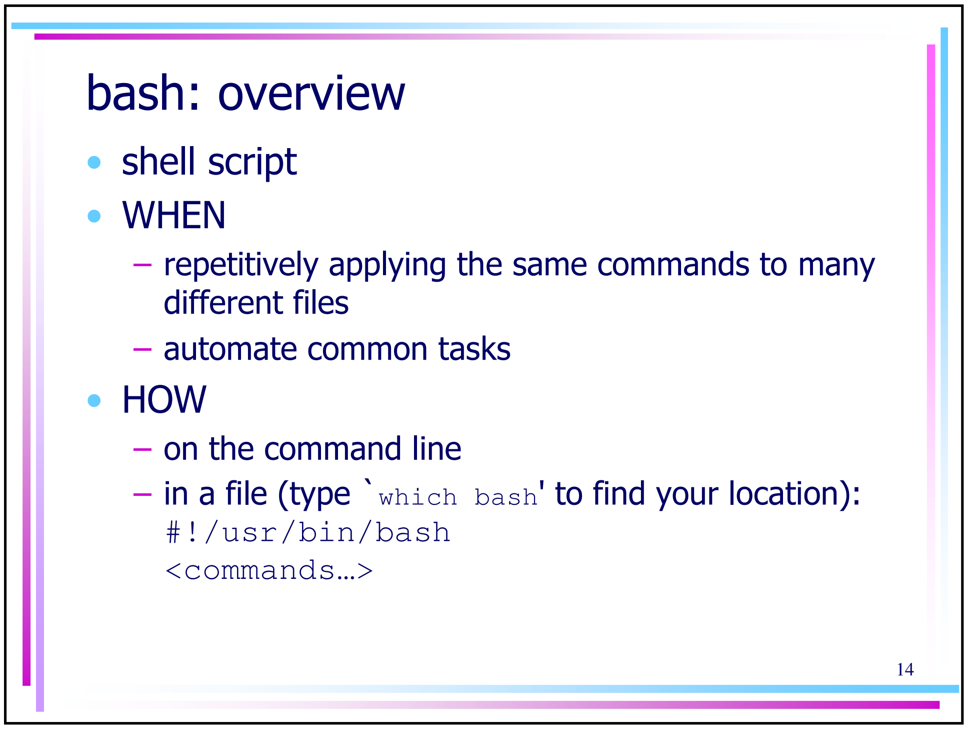
```
if (substr($j,1,1) != "(") {
 i=index($j,")"); printf("%s ",substr($j,1,i))}
```

if $j is a POS label, print it

```
else {if (j+1<=NF &&
  substr($(j+1),1,1) != "(") printf("%s ",$j)}}
print ""}'
```

(DT The) (NNS cops) (VBD saw) (DT the) (NN robber)
(IN with) (DT the) (NNS binoculars)

13



bash: overview

- shell script
- WHEN
  - repetitively applying the same commands to many different files
  - automate common tasks
- HOW
  - on the command line
  - in a file (type `` `which bash' `` to find your location):

```
#!/usr/bin/bash
<commands…>
```

14

bash: examples

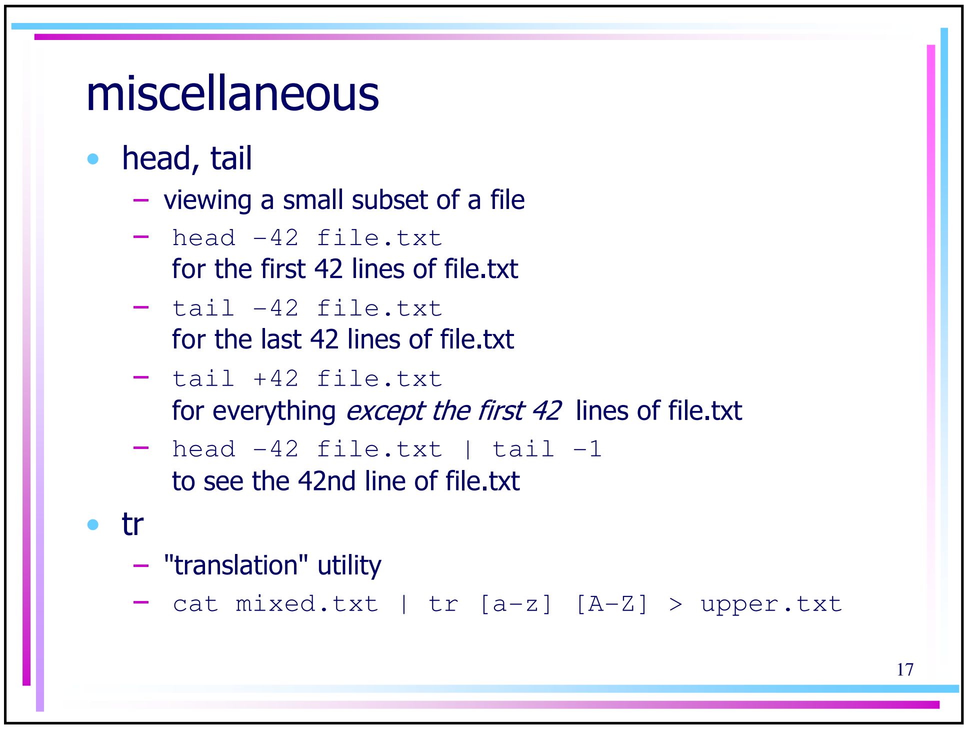
-
  ```
  for f in *.txt; do
    echo $f;
    tail -1 $f >> txt.tails;
  done
  ```

-
  ```
  for (( j=0; j < 4; j++ )); do
    cat part$j.txt >> parts0-3.txt;
  done
  ```

-
  ```
  for f in hw1.*; do
    mv $f ${f//hw1/hw2};
  done
  ```

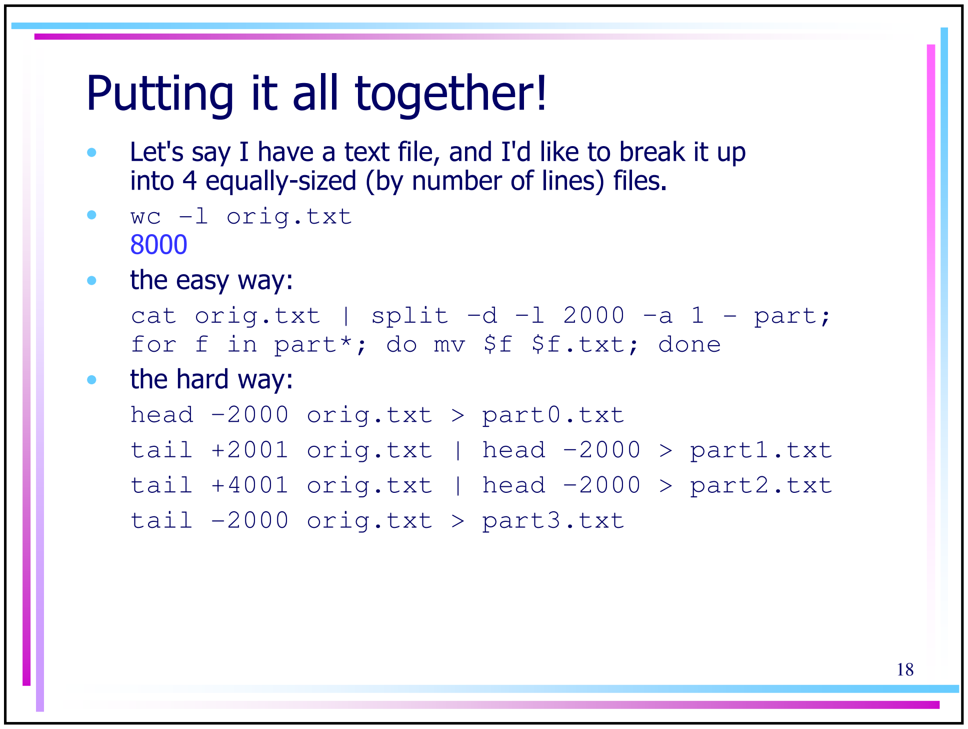
miscellaneous

- sort
  - `sort -u file.txt`
    for a uniquely-sorted list of each line in the file
- split
  - `cat file.txt | split -l 20 -d fold`
    divide file.txt into files of 20 lines apiece, using "fold" as the prefix and with numeric suffixes
- wc
  - a counting utility
  - `wc -[l|c|w] file.txt`
    counts number of lines, characters, or words in a file



miscellaneous

- head, tail
  - viewing a small subset of a file
  - `head -42 file.txt`
    for the first 42 lines of file.txt
  - `tail -42 file.txt`
    for the last 42 lines of file.txt
  - `tail +42 file.txt`
    for everything *except the first 42* lines of file.txt
  - `head -42 file.txt | tail -1`
    to see the 42nd line of file.txt
- tr
  - "translation" utility
  - `cat mixed.txt | tr [a-z] [A-Z] > upper.txt`



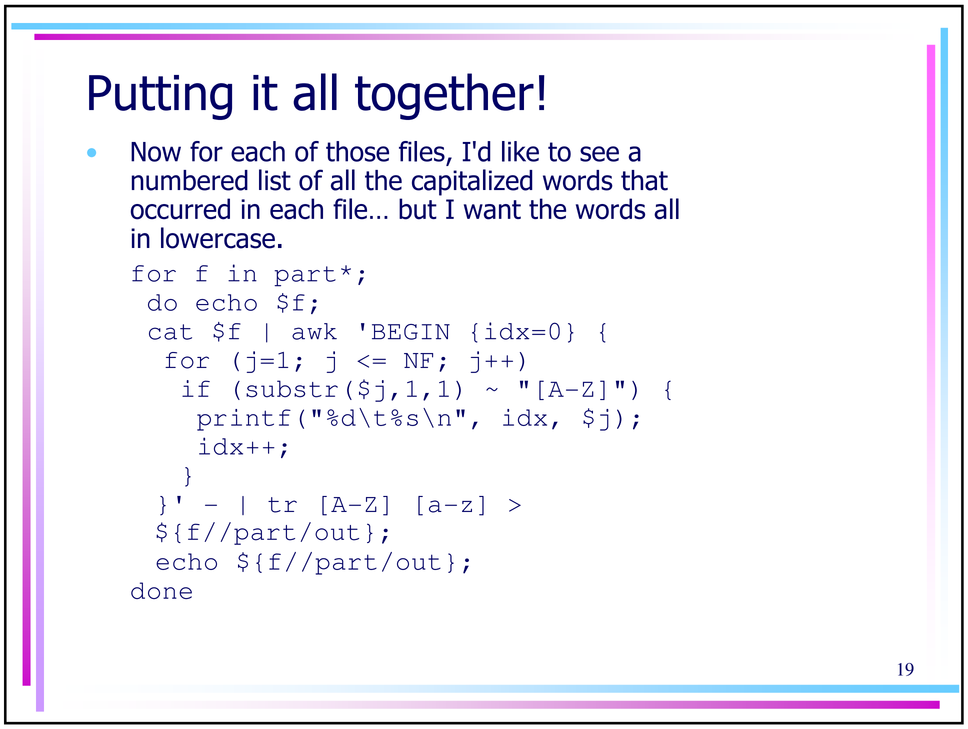
Putting it all together!

- Let's say I have a text file, and I'd like to break it up into 4 equally-sized (by number of lines) files.
- `wc -l orig.txt`
  8000
- the easy way:

```
cat orig.txt | split -d -l 2000 -a 1 - part;
for f in part*; do mv $f $f.txt; done
```

- the hard way:

```
head -2000 orig.txt > part0.txt
tail +2001 orig.txt | head -2000 > part1.txt
tail +4001 orig.txt | head -2000 > part2.txt
tail -2000 orig.txt > part3.txt
```

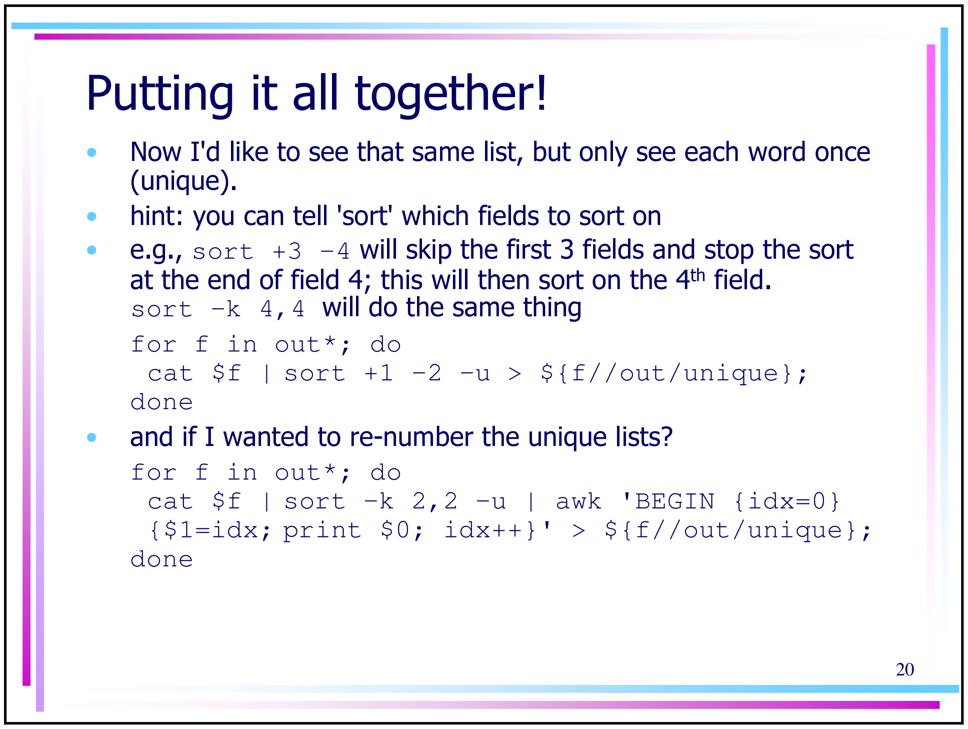


Putting it all together!

- Now for each of those files, I'd like to see a numbered list of all the capitalized words that occurred in each file… but I want the words all in lowercase.

```
for f in part*;
 do echo $f;
 cat $f | awk 'BEGIN {idx=0} {
  for (j=1; j <= NF; j++)
   if (substr($j,1,1) ~ "[A-Z]") {
    printf("%d\t%s\n", idx, $j);
    idx++;
   }
  }' - | tr [A-Z] [a-z] >
  ${f//part/out};
  echo ${f//part/out};
done
```

19



Putting it all together!

- Now I'd like to see that same list, but only see each word once (unique).
- hint: you can tell 'sort' which fields to sort on
- e.g., `sort +3 -4` will skip the first 3 fields and stop the sort at the end of field 4; this will then sort on the 4th field.
  `sort -k 4,4` will do the same thing

```
for f in out*; do
 cat $f | sort +1 -2 -u > ${f//out/unique};
done
```

- and if I wanted to re-number the unique lists?

```
for f in out*; do
 cat $f | sort -k 2,2 -u | awk 'BEGIN {idx=0}
 {$1=idx; print $0; idx++}' > ${f//out/unique};
done
```

20

Putting it all together!

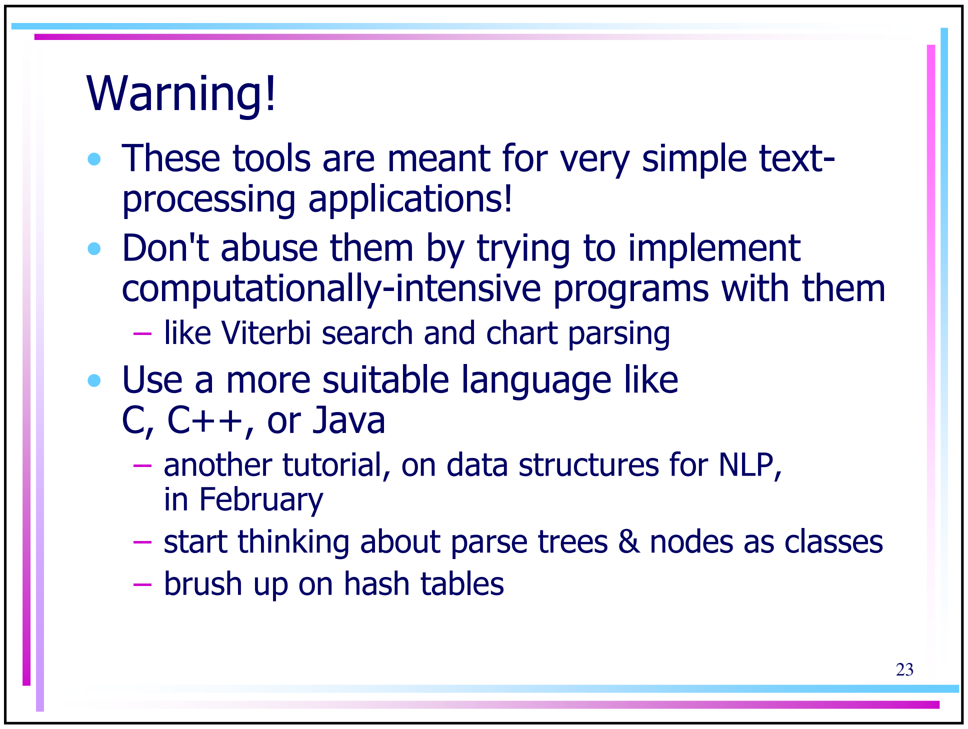
- And finally, I'd like to see the first 5 & the last 5 words in each list, but I already have a list of these first-and-lasts started, so I just want to add onto it instead of creating a new one.

```
for f in unique*; do
 head -5 $f >> top-and-bottom-5;
 tail -5 $f >> top-and-bottom-5; done
```

- (and of course, I could then re-number top-and-bottom-5 if I were so inclined)

Resources

- You can always look at the man page for help on any of these tools!
  - i.e.: `` `man sed' ``, or `` `man tail' ``
- My favorite online resources:
  - sed: www.grymoire.com/Unix/Sed.html
  - awk: www.vectorsite.net/tsawk.html
  - bash: www.tldp.org/LDP/abs/html/ (particularly section 9.2 on string manipulation)
- Google it. ☺



Warning!

- These tools are meant for very simple text-processing applications!
- Don't abuse them by trying to implement computationally-intensive programs with them
  - like Viterbi search and chart parsing
- Use a more suitable language like C, C++, or Java
  - another tutorial, on data structures for NLP, in February
  - start thinking about parse trees & nodes as classes
  - brush up on hash tables

23