Problem Set 7

OUT: 8 NOVEMBER, 1994
DUE: 22 NOVEMBER, 1994

Goals

Practice with self-balancing tree.

Reading Assignment

For this homework, you should have read all chapters in *Condensed Pascal* up to 18. Please also read Chapter 18, in order to follow this week's class discussion.

Programming Assignment

Write a 2-4 tree program. It should take keyboard input, break it into words, and insert new words into your 2-4 tree. Repeated words will increment a count associated with each word. You will be able to use large amounts of your previously written code. In particular, MyString software is relevant to the current project. However, MyString software must be modified to a NuString, which is a pointer to a MyString. This is generally how data is passed in working programs — using pointers to data rather than actual copies of the data.
EXTRA CREDIT: Write Delete and Pretty-Print for your 2-4 tree program.

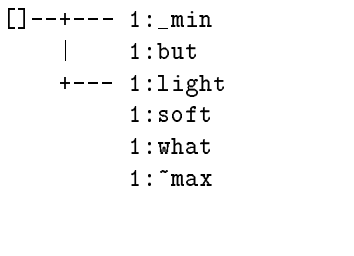
Example Output

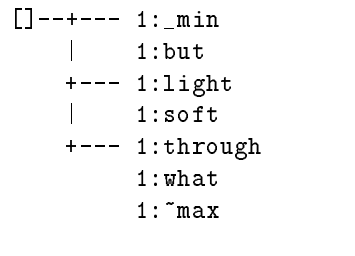
```
Input: ROMEO AND JULIET, ACT II, SCENE II.
[JULIET appears above at a window.]
      But, soft! what light through yonder window breaks?
      It is the east, and Juliet is the sun!-
      Arise, fair sun, and kill the envious moon,
      Who is already sick and pale with grief,
      That thou her maid art far more fair than she:
```

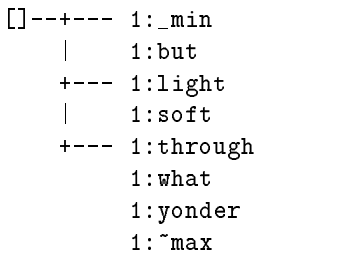
```
[]-- 1:_min
     1:but
     1:~max
```

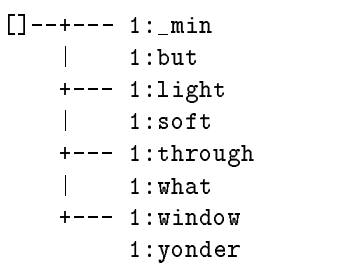
```
[]-- 1:_min
     1:but
     1:soft
     1:~max
```

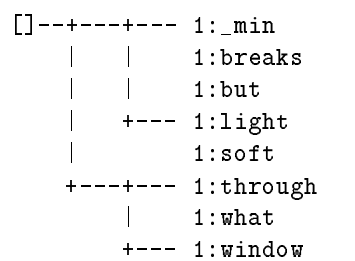
```
[]--+--- 1:_min
    |    1:but
    +--- 1:soft
         1:what
         1:~max
```

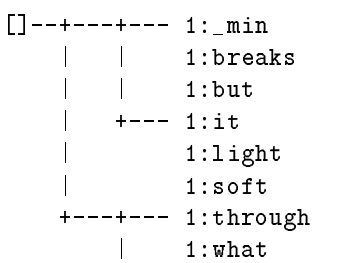

[]--+--- 1:_min
| 1:but
+--- 1:light
1:soft
1:what
1:~max

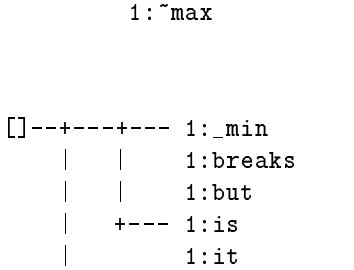

[]--+--- 1:_min
| 1:but
+--- 1:light
| 1:soft
+--- 1:through
1:what
1:~max

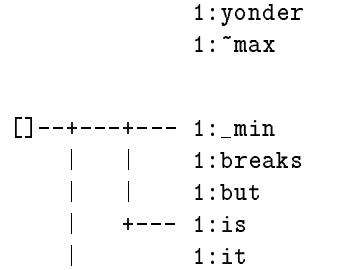

[]--+--- 1:_min
| 1:but
+--- 1:light
| 1:soft
+--- 1:through
1:what
1:yonder
1:~max

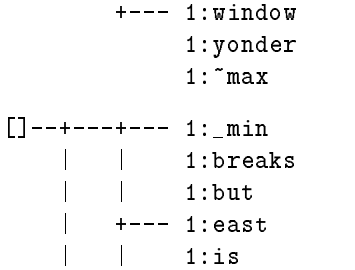

[]--+--- 1:_min
| 1:but
+--- 1:light
| 1:soft
+--- 1:through
| 1:what
+--- 1:window
1:yonder
1:~max

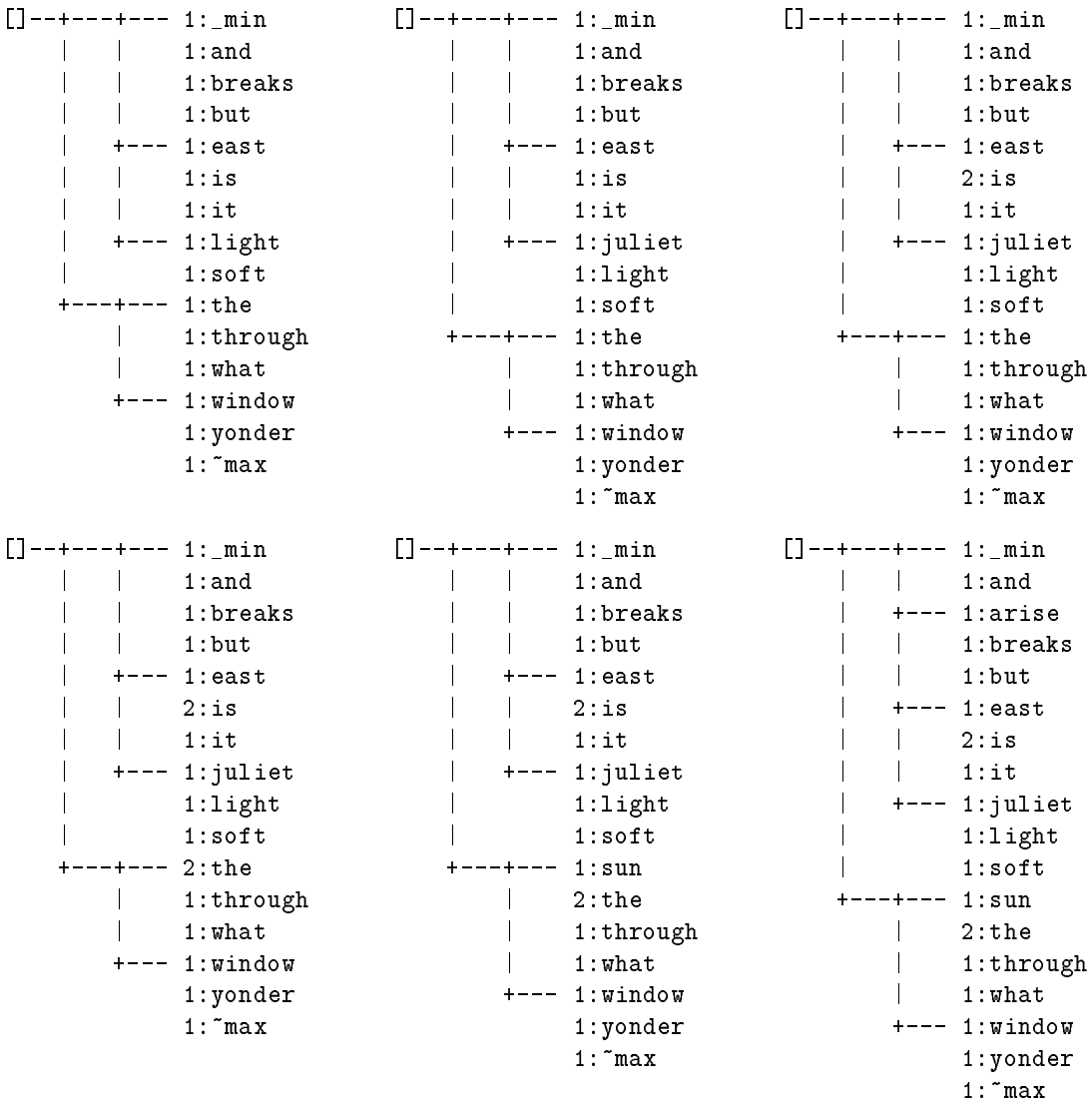

[]--+---+--- 1:_min
| | 1:breaks
| | 1:but
| +--- 1:light
| 1:soft
+---+--- 1:through
| 1:what
+--- 1:window
1:yonder
1:~max

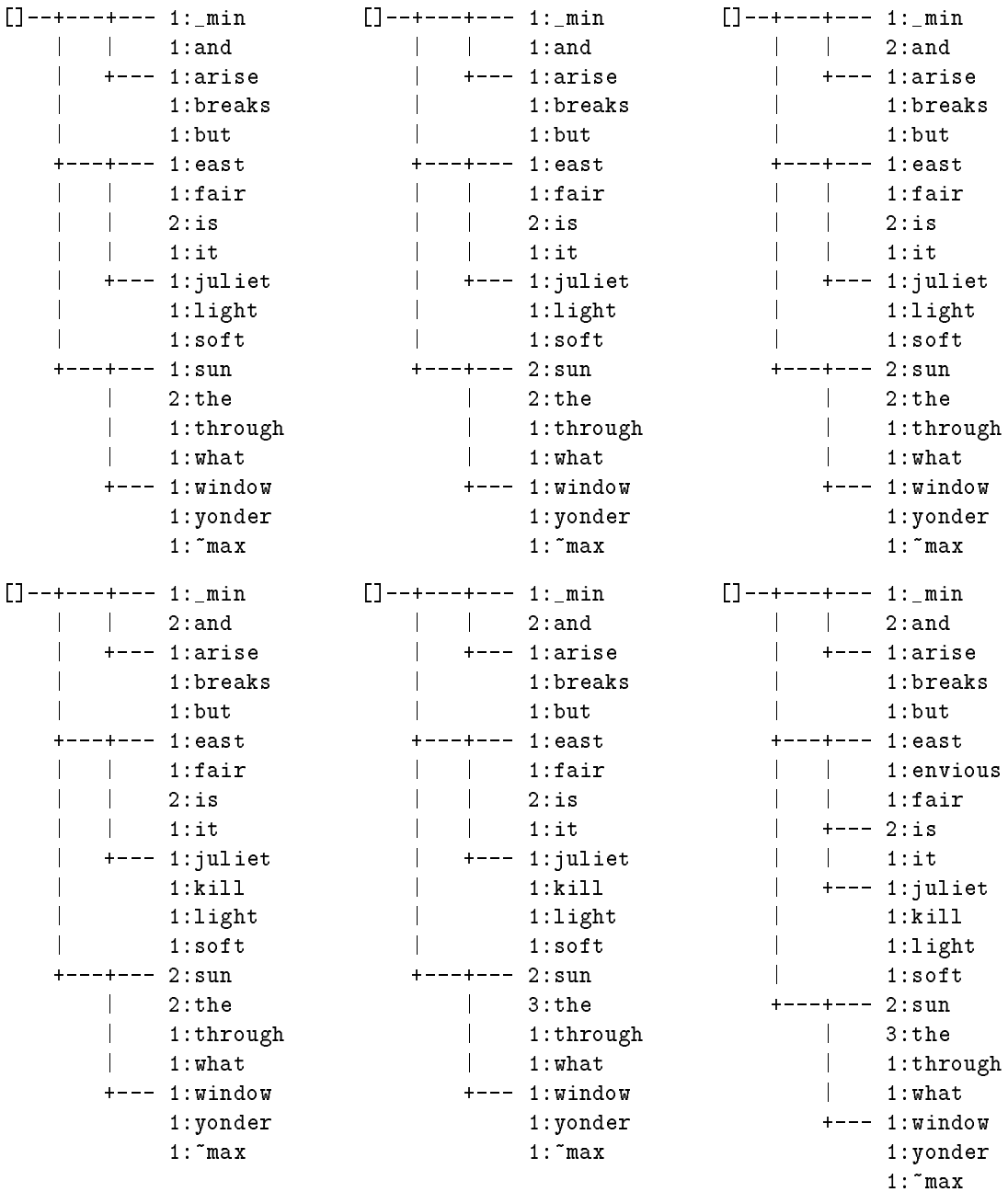

[]--+---+--- 1:_min
| | 1:breaks
| | 1:but
| +--- 1:it
| 1:light
| 1:soft
+---+--- 1:through
| 1:what
+--- 1:window
1:yonder
1:~max

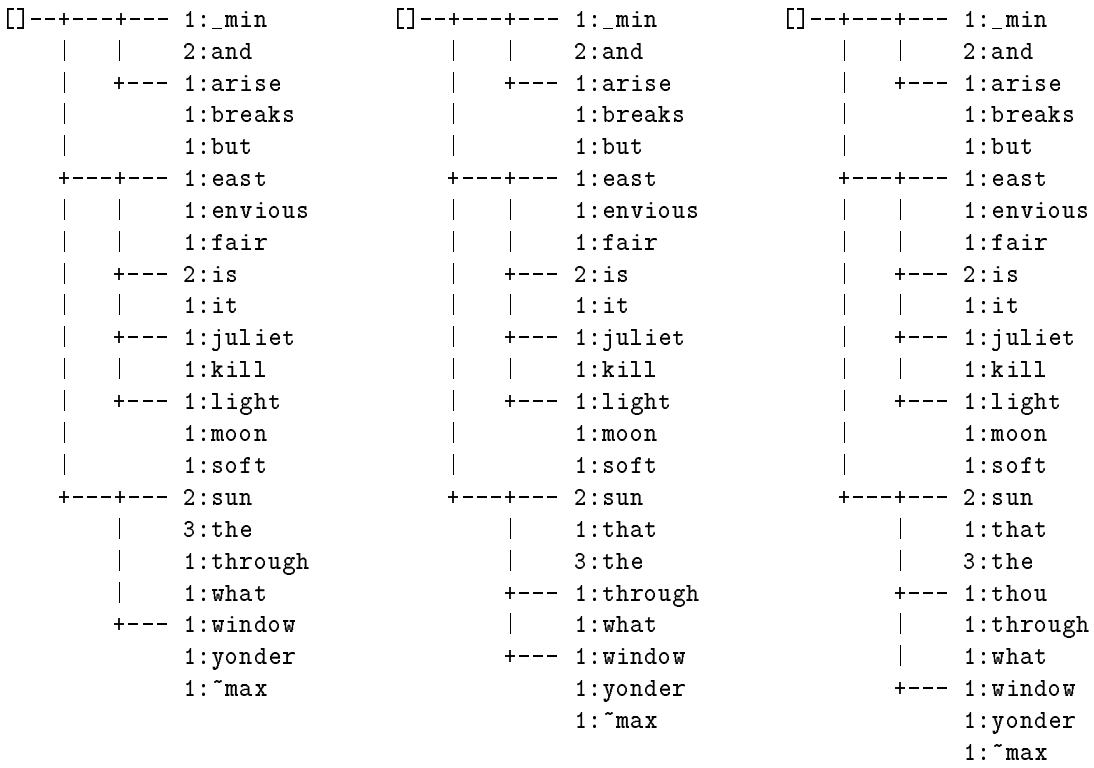

[]--+---+--- 1:_min
| | 1:breaks
| | 1:but
| +--- 1:is
| 1:it
| 1:light
| 1:soft
+---+--- 1:through
| 1:what
+--- 1:window
1:yonder
1:~max


[]--+---+--- 1:_min
| | 1:breaks
| | 1:but
| +--- 1:is
| 1:it
| 1:light
| 1:soft
+---+--- 1:the
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max


[]--+---+--- 1:_min
| | 1:breaks
| | 1:but
| +--- 1:east
| | 1:is
| | 1:it
| +--- 1:light
| 1:soft
+---+--- 1:the
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max


[]--+---+--- 1:_min
| | 1:and
| | 1:breaks
| | 1:but
| +--- 1:east
| | 1:is
| | 1:it
| +--- 1:light
| 1:soft
+---+--- 1:the
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max
[]--+---+--- 1:_min
| | 1:and
| | 1:breaks
| | 1:but
| +--- 1:east
| | 1:is
| | 1:it
| +--- 1:juliet
| 1:light
| 1:soft
+---+--- 1:the
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max
[]--+---+--- 1:_min
| | 1:and
| | 1:breaks
| | 1:but
| +--- 1:east
| | 2:is
| | 1:it
| +--- 1:juliet
| 1:light
| 1:soft
+---+--- 1:the
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max
[]--+---+--- 1:_min
| | 1:and
| | 1:breaks
| | 1:but
| +--- 1:east
| | 2:is
| | 1:it
| +--- 1:juliet
| 1:light
| 1:soft
+---+--- 2:the
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max
[]--+---+--- 1:_min
| | 1:and
| | 1:breaks
| | 1:but
| +--- 1:east
| | 2:is
| | 1:it
| +--- 1:juliet
| 1:light
| 1:soft
+---+--- 1:sun
| 2:the
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max
[]--+---+--- 1:_min
| | 1:and
| +--- 1:arise
| | 1:breaks
| | 1:but
| +--- 1:east
| | 2:is
| | 1:it
| +--- 1:juliet
| 1:light
| 1:soft
+---+--- 1:sun
| 2:the
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max


[]--+---+--- 1:_min
| | 1:and
| +--- 1:arise
| 1:breaks
| 1:but
+---+--- 1:east
| | 1:fair
| | 2:is
| | 1:it
| +--- 1:juliet
| 1:light
| 1:soft
+---+--- 1:sun
| 2:the
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max
[]--+---+--- 1:_min
| | 1:and
| +--- 1:arise
| 1:breaks
| 1:but
+---+--- 1:east
| | 1:fair
| | 2:is
| | 1:it
| +--- 1:juliet
| 1:light
| 1:soft
+---+--- 2:sun
| 2:the
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max
[]--+---+--- 1:_min
| | 2:and
| +--- 1:arise
| 1:breaks
| 1:but
+---+--- 1:east
| | 1:fair
| | 2:is
| | 1:it
| +--- 1:juliet
| 1:light
| 1:soft
+---+--- 2:sun
| 2:the
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max
[]--+---+--- 1:_min
| | 2:and
| +--- 1:arise
| 1:breaks
| 1:but
+---+--- 1:east
| | 1:fair
| | 2:is
| | 1:it
| +--- 1:juliet
| 1:kill
| 1:light
| 1:soft
+---+--- 2:sun
| 2:the
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max
[]--+---+--- 1:_min
| | 2:and
| +--- 1:arise
| 1:breaks
| 1:but
+---+--- 1:east
| | 1:fair
| | 2:is
| | 1:it
| +--- 1:juliet
| 1:kill
| 1:light
| 1:soft
+---+--- 2:sun
| 3:the
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max
[]--+---+--- 1:_min
| | 2:and
| +--- 1:arise
| 1:breaks
| 1:but
+---+--- 1:east
| | 1:envious
| | 1:fair
| +--- 2:is
| | 1:it
| +--- 1:juliet
| 1:kill
| 1:light
| 1:soft
+---+--- 2:sun
| 3:the
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max


[]--+---+--- 1:_min
| | 2:and
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| 1:breaks
| 1:but
+---+--- 1:east
| | 1:envious
| | 1:fair
| +--- 2:is
| | 1:it
| +--- 1:juliet
| | 1:kill
| +--- 1:light
| 1:moon
| 1:soft
+---+--- 2:sun
| 3:the
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max
[]--+---+--- 1:_min
| | 2:and
| +--- 1:arise
| 1:breaks
| 1:but
+---+--- 1:east
| | 1:envious
| | 1:fair
| +--- 2:is
| | 1:it
| +--- 1:juliet
| | 1:kill
| +--- 1:light
| 1:moon
| 1:soft
+---+--- 2:sun
| 1:that
| 3:the
+--- 1:through
| 1:what
+--- 1:window
1:yonder
1:~max
[]--+---+--- 1:_min
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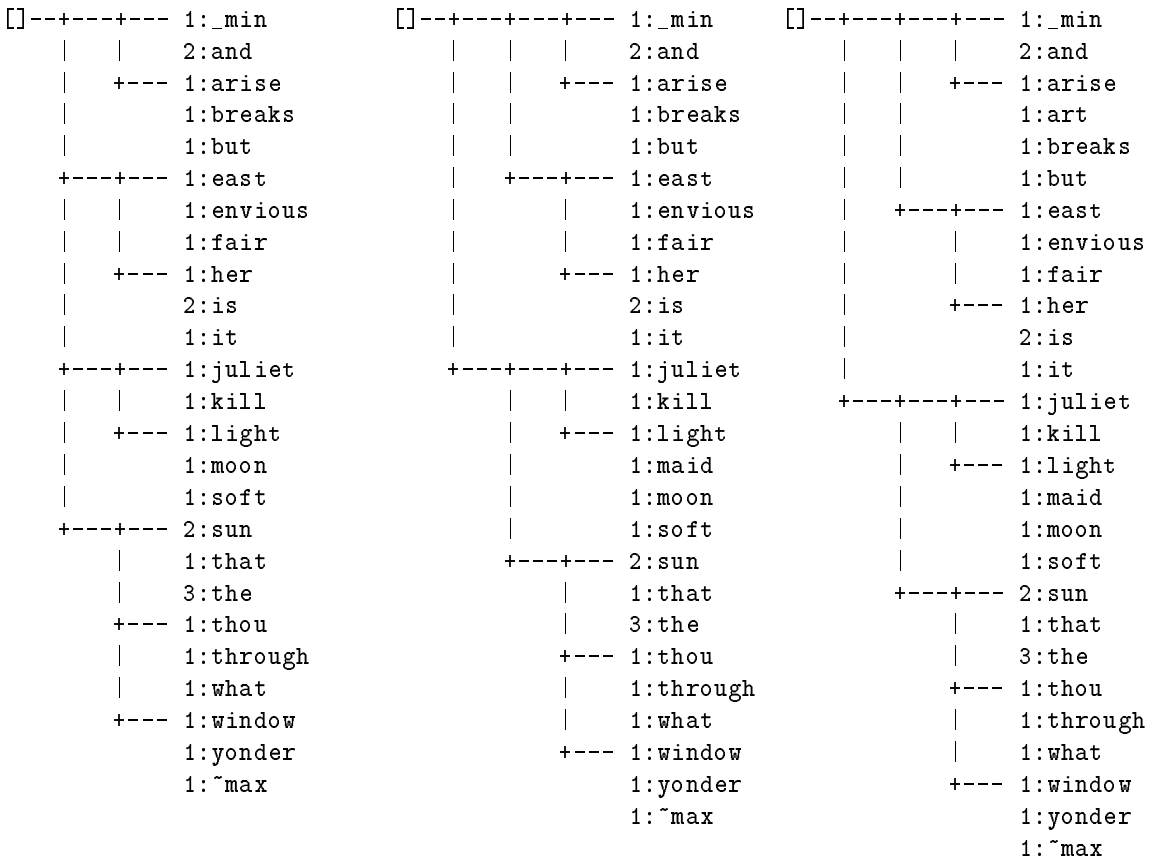
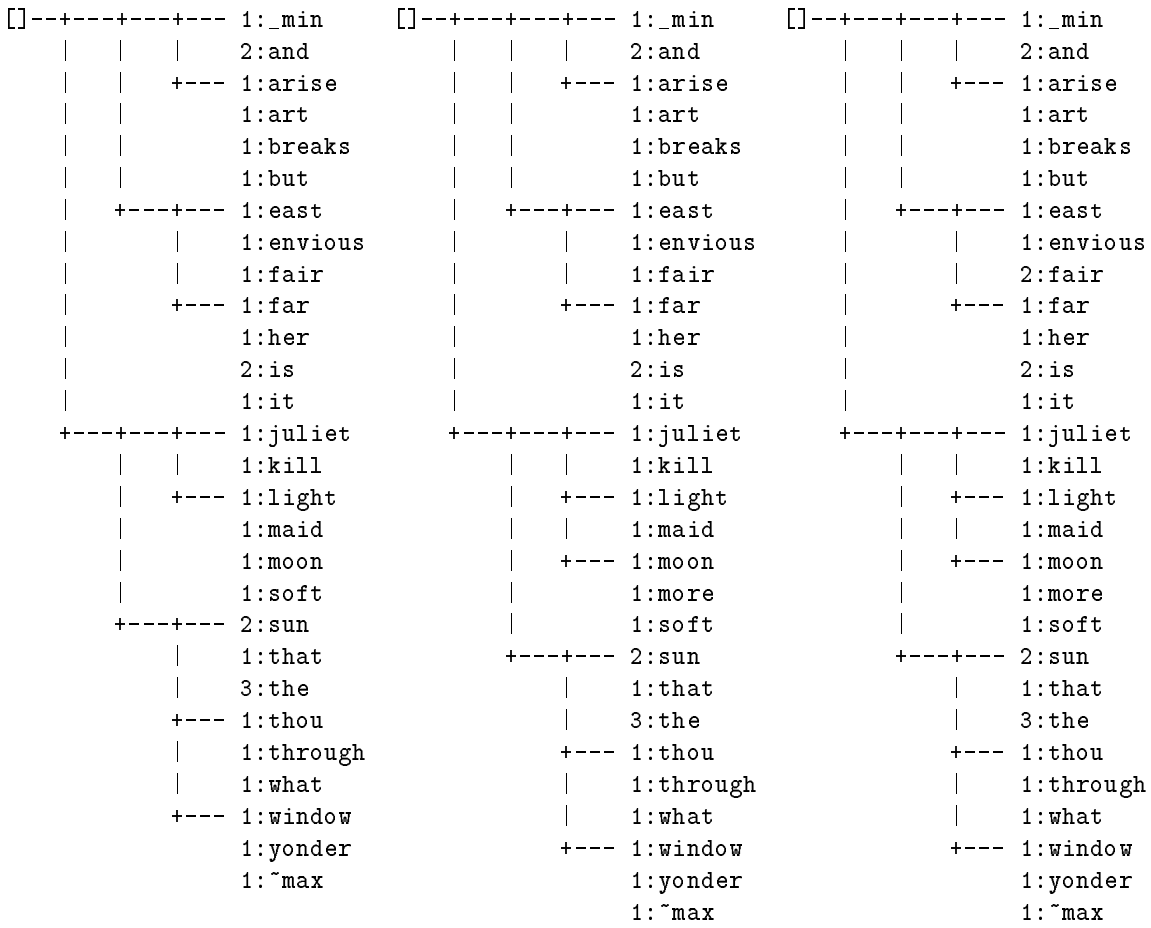
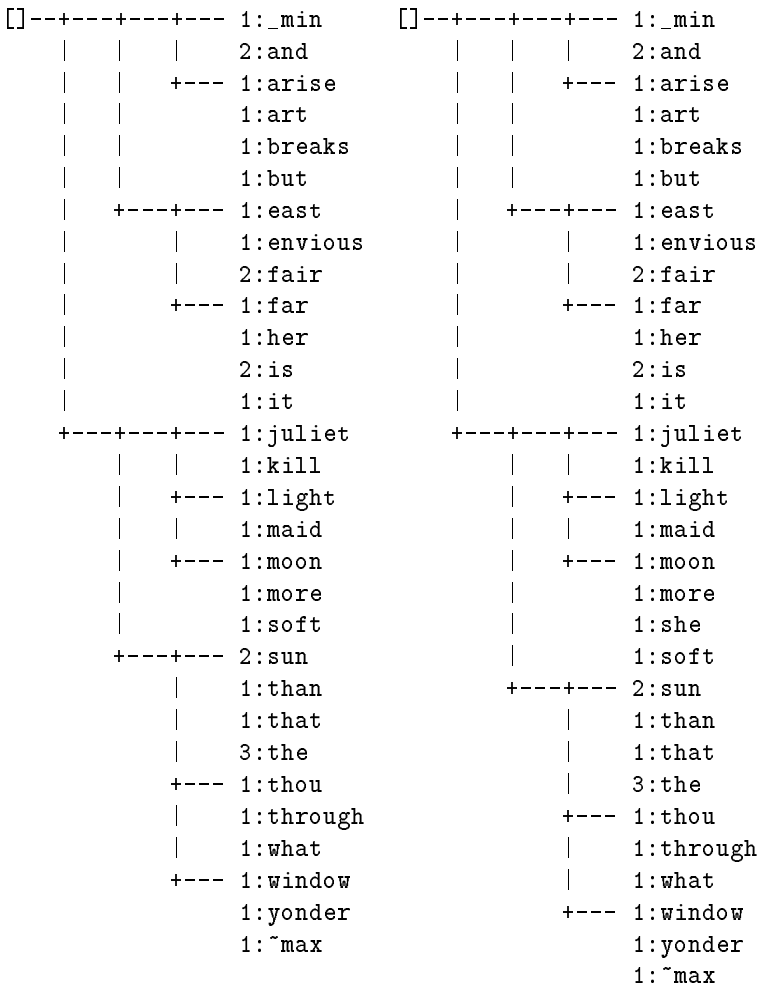
| +--- 1:arise
| 1:breaks
| 1:but
+---+--- 1:east
| | 1:envious
| | 1:fair
| +--- 2:is
| | 1:it
| +--- 1:juliet
| | 1:kill
| +--- 1:light
| 1:moon
| 1:soft
+---+--- 2:sun
| 1:that
| 3:the
+--- 1:thou
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max


[]--+---+--- 1:_min
| | 2:and
| +--- 1:arise
| 1:breaks
| 1:but
+---+--- 1:east
| | 1:envious
| | 1:fair
| +--- 1:her
| 2:is
| 1:it
+---+--- 1:juliet
| | 1:kill
| +--- 1:light
| 1:moon
| 1:soft
+---+--- 2:sun
| 1:that
| 3:the
+--- 1:thou
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max
[]--+---+---+--- 1:_min
| | | 2:and
| | +--- 1:arise
| | 1:breaks
| | 1:but
| +---+--- 1:east
| | 1:envious
| | 1:fair
| +--- 1:her
| 2:is
| 1:it
+---+---+--- 1:juliet
| | 1:kill
| +--- 1:light
| 1:maid
| 1:moon
| 1:soft
+---+--- 2:sun
| 1:that
| 3:the
+--- 1:thou
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max
[]--+---+---+--- 1:_min
| | | 2:and
| | +--- 1:arise
| | 1:art
| | 1:breaks
| | 1:but
| +---+--- 1:east
| | 1:envious
| | 1:fair
| +--- 1:her
| 2:is
| 1:it
+---+---+--- 1:juliet
| | 1:kill
| +--- 1:light
| 1:maid
| 1:moon
| 1:soft
+---+--- 2:sun
| 1:that
| 3:the
+--- 1:thou
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max


[]--+---+---+--- 1:_min
| | | 2:and
| | +--- 1:arise
| | 1:art
| | 1:breaks
| | 1:but
| +---+--- 1:east
| | 1:envious
| | 1:fair
| +--- 1:far
| 1:her
| 2:is
| 1:it
+---+---+--- 1:juliet
| | 1:kill
| +--- 1:light
| 1:maid
| 1:moon
| 1:soft
+---+--- 2:sun
| 1:that
| 3:the
+--- 1:thou
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max
[]--+---+---+--- 1:_min
| | | 2:and
| | +--- 1:arise
| | 1:art
| | 1:breaks
| | 1:but
| +---+--- 1:east
| | 1:envious
| | 1:fair
| +--- 1:far
| 1:her
| 2:is
| 1:it
+---+---+--- 1:juliet
| | 1:kill
| +--- 1:light
| | 1:maid
| +--- 1:moon
| 1:more
| 1:soft
+---+--- 2:sun
| 1:that
| 3:the
+--- 1:thou
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max
[]--+---+---+--- 1:_min
| | | 2:and
| | +--- 1:arise
| | 1:art
| | 1:breaks
| | 1:but
| +---+--- 1:east
| | 1:envious
| | 2:fair
| +--- 1:far
| 1:her
| 2:is
| 1:it
+---+---+--- 1:juliet
| | 1:kill
| +--- 1:light
| | 1:maid
| +--- 1:moon
| 1:more
| 1:soft
+---+--- 2:sun
| 1:that
| 3:the
+--- 1:thou
| 1:through
| 1:what
+--- 1:window
1:yonder
1:~max


[]--+---+---+--- 1:_min
| | | 2:and
| | +--- 1:arise
| | 1:art
| | 1:breaks
| | 1:but
| +---+--- 1:east
| | 1:envious
| | 2:fair
| +--- 1:far
| 1:her
| 2:is
| 1:it
+---+---+--- 1:juliet
| | | 1:kill
| | +--- 1:light
| | | 1:maid
| | +--- 1:moon
| | 1:more
| | 1:soft
| +---+--- 2:sun
| | 1:than
| | 1:that
| | 3:the
| +--- 1:thou
| | 1:through
| | 1:what
| +--- 1:window
| 1:yonder
| 1:~max
[]--+---+---+--- 1:_min
| | | 2:and
| | +--- 1:arise
| | 1:art
| | 1:breaks
| | 1:but
| +---+--- 1:east
| | 1:envious
| | 2:fair
| +--- 1:far
| 1:her
| 2:is
| 1:it
+---+---+--- 1:juliet
| | | 1:kill
| | +--- 1:light
| | | 1:maid
| | +--- 1:moon
| | 1:more
| | 1:she
| | 1:soft
| +---+--- 2:sun
| | 1:than
| | 1:that
| | 3:the
| +--- 1:thou
| | 1:through
| | 1:what
| +--- 1:window
| 1:yonder
| 1:~max