Data Mining I: Basic Methods and Techniques
Laboratory Assignment #4:
Due 11/06/2017

John M. Warlop

1 Describe the Classification Rule method.

This type of classifier uses If...then... based rules to classify. This type of classifier uses the covering approach. This method works chooses the attribute-value pair that maximizes the probability of a desired classification. Thus, the goal is maximum accuracy. If t is the total number of instances covered by rule and p is positive examples covered by rule. The classifier chooses a rule that maximizes p/t. This occurs when p/t == 1 or set of instances cannot be split anymore.

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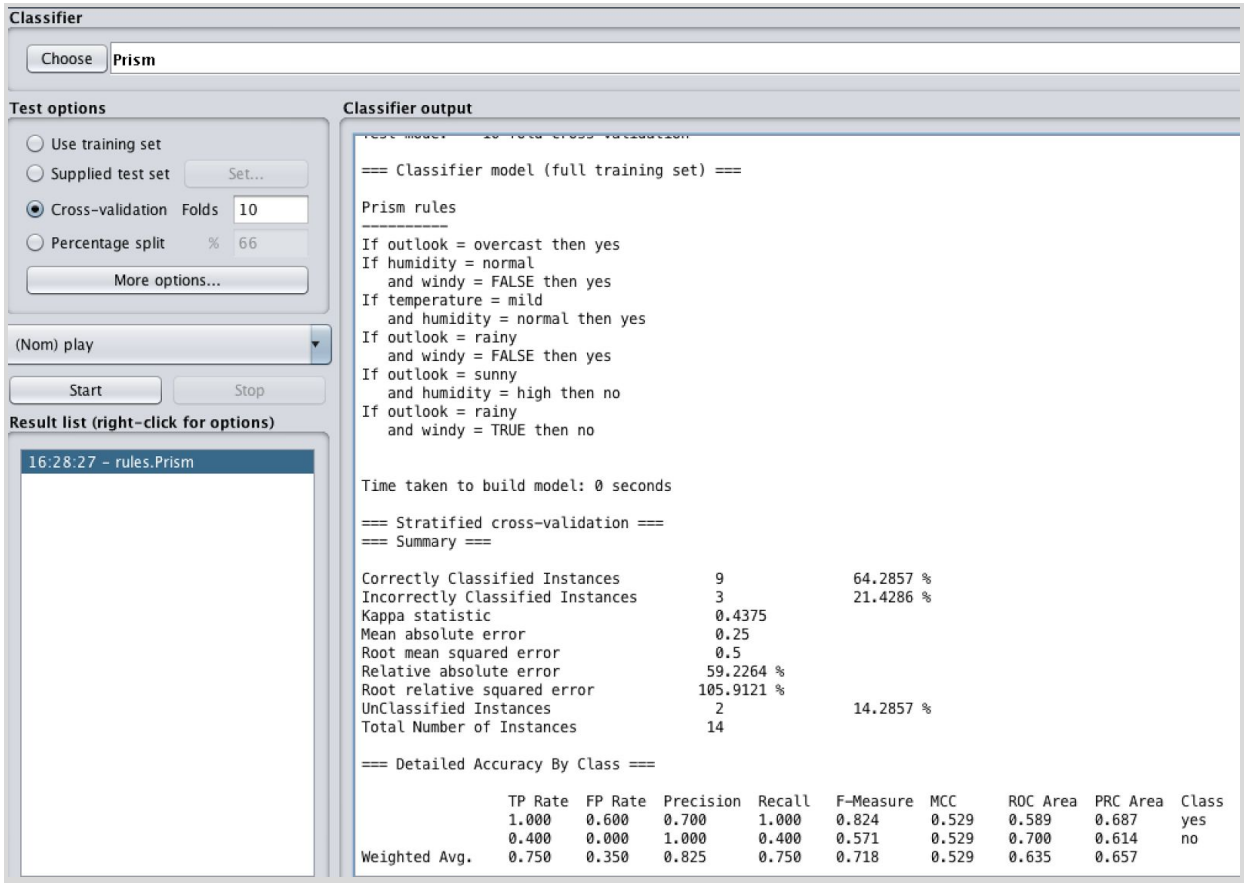
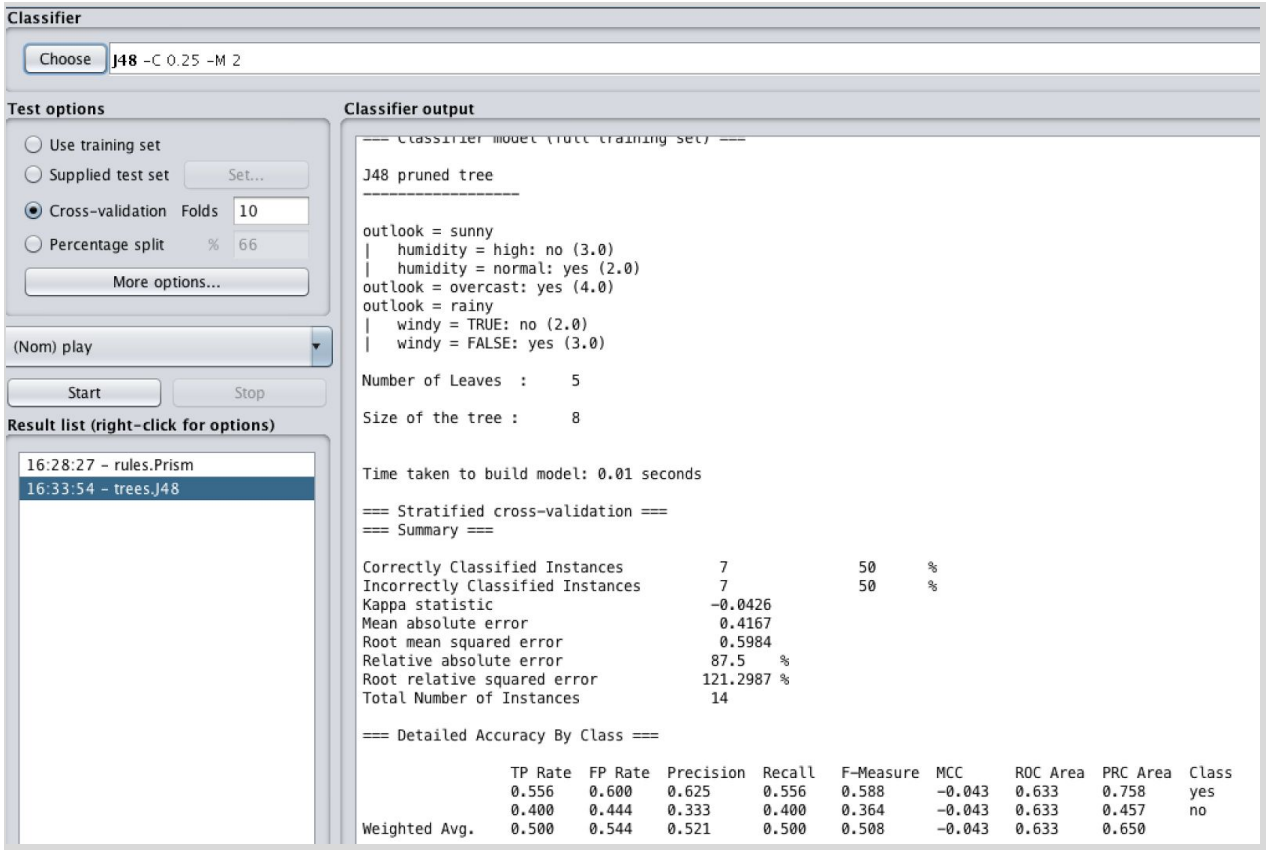
2 Use the Classification rule production method PRISM (weka.classifiers.Prism) on the Weather.nominal data set. How many rules did it produce? Compare this to the Decision tree produced on the same data. What is the difference between the two models?

PRISM & Weather



J48 & Weather



64.3% vs 50% performance difference. Neither one very good.

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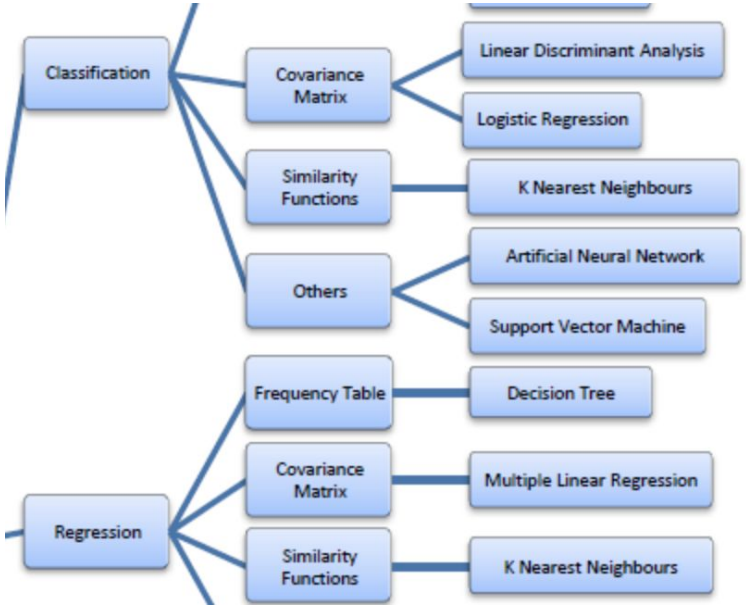
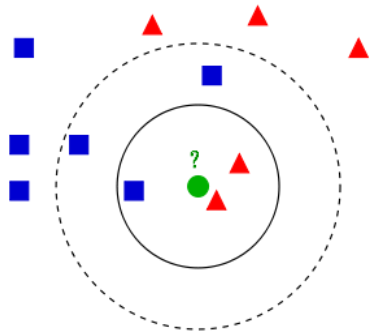
3 Describe the K-nearest neighbor method.



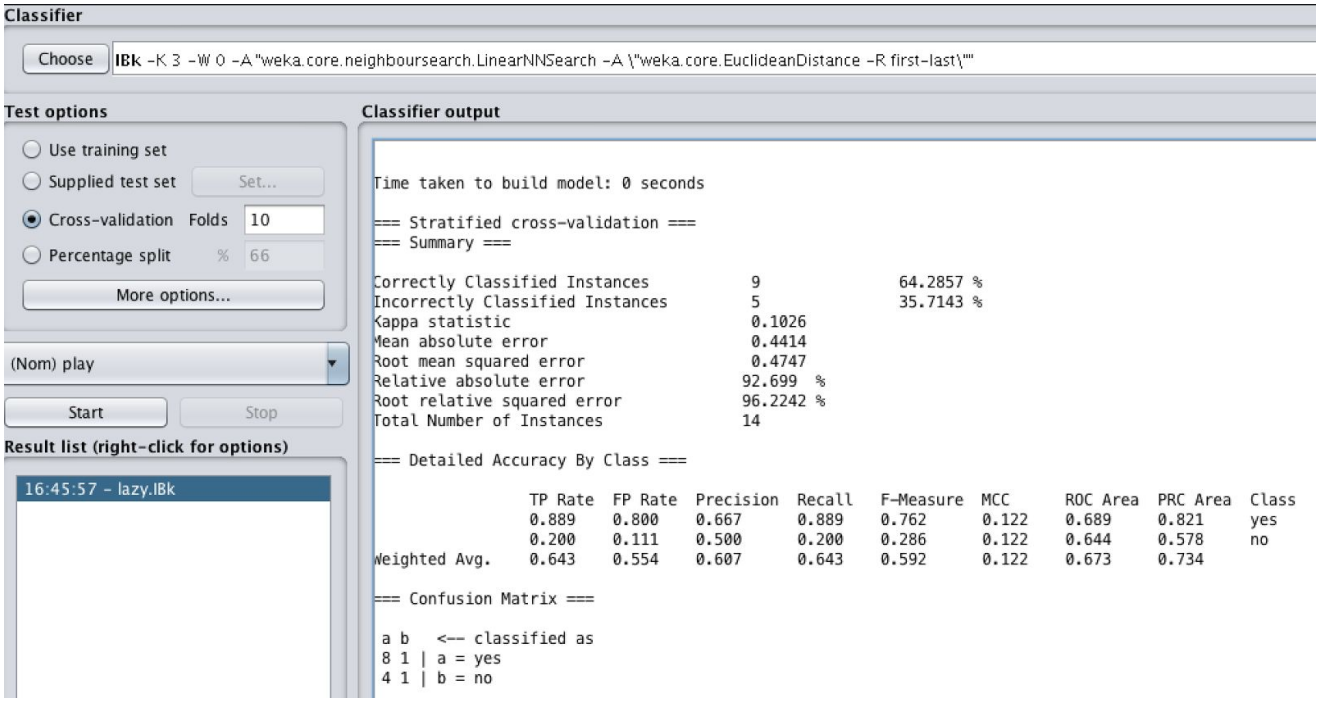
K nearest neighbors method is used in classification and regression. This method assumes the data under consideration does not have known probability distributions.

With this method, the parameters are determined by the data that is used to train the model.

Below is an example of how algorithm works for classification. The red triangles are class "A" and the blue squares are class "B". The green dot(GD) is the test case(which class should GD be in?). Using Eucleadean distance, if k is 3 then the circle engulfs 2 "A"'s and 1 "B", but if K is 5, the circle engulfs 3 "B''s and 2 "A"'s. So, given values of K give different classifications.



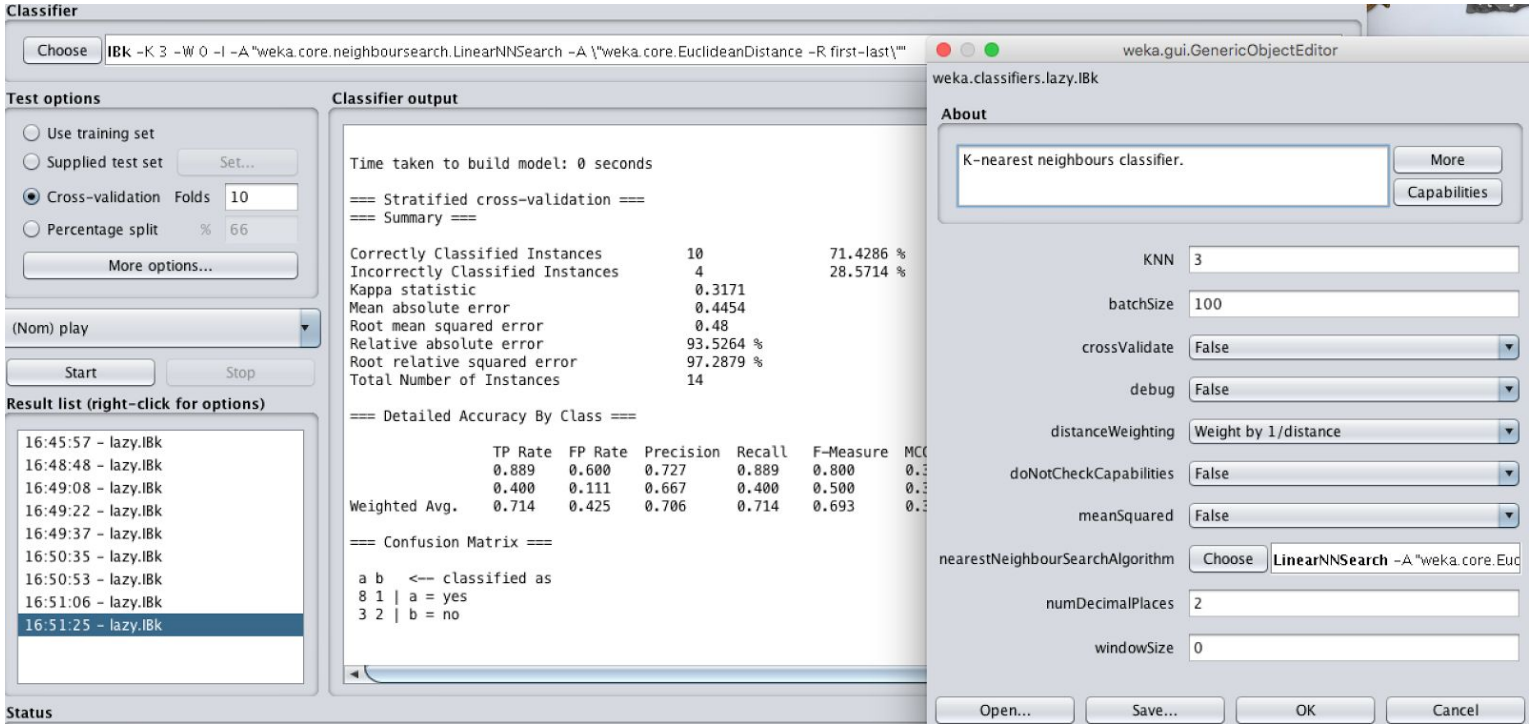
4 Produce a K-NN model (classifiers.lazy.IBk) for Weather data set.
The standard K-nearest neighbor method can be found in the 'lazy' submenu of the list presented when you click 'Choose' in Explorer's Classify window. It is called 'IBk'. Select this and then click on IBk so you can modify the parameters. The default value of k is 1. Set it to 3 (or other value of your preference) and then click Start to run the programs.
What is the output? How many instances did it classify correctly and how many incorrectly?
As seen below, 9 out of 14 were classified correctly. Whereas 5 out of 14 were classified incorrectly.



=> Try changing the parameter K – the number of neighbors. Did that influence the model's performance?

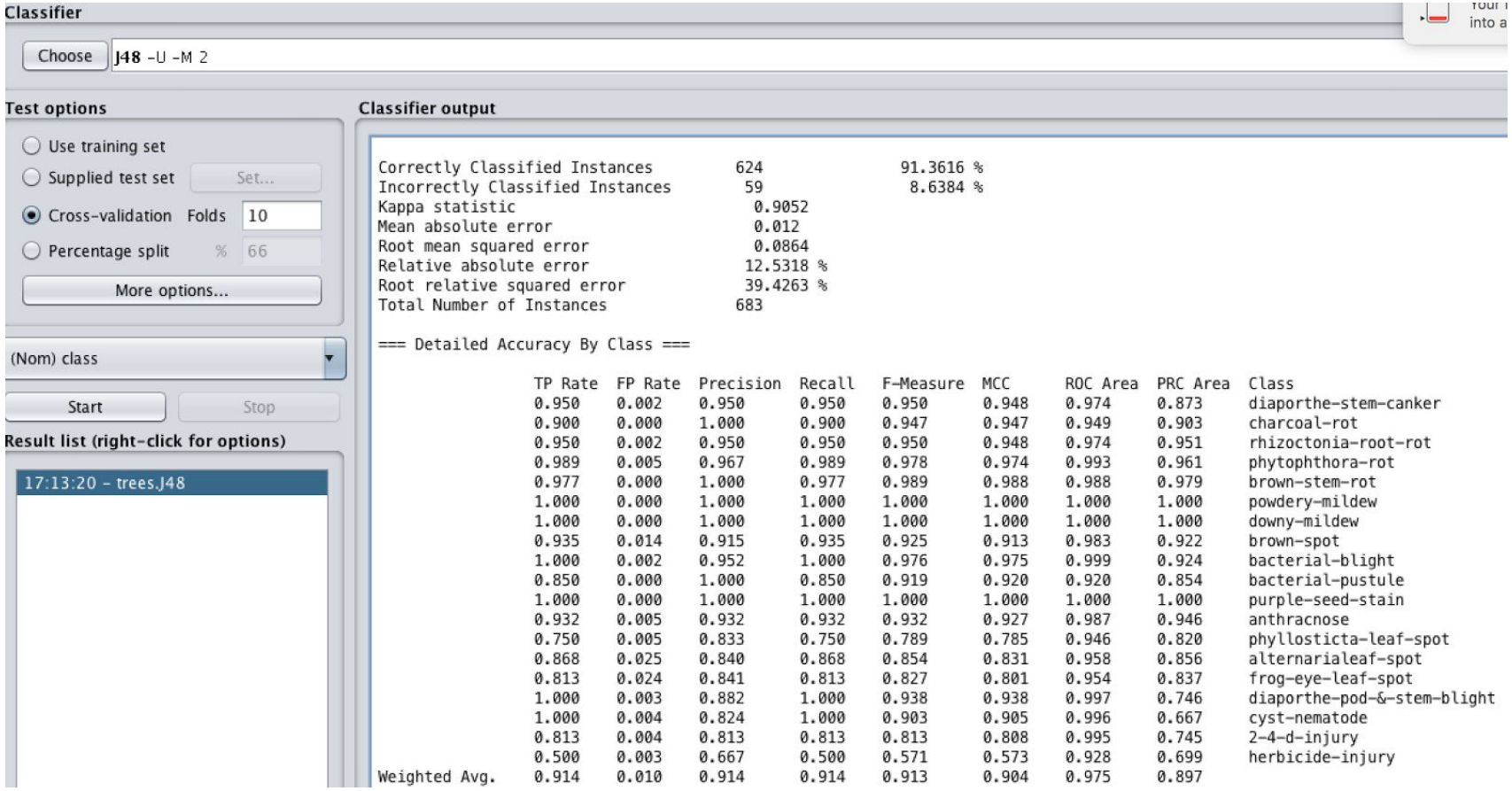
No, I tried several values of K, but it did not change performance. This may be due to the low number of instances.

=> Try using different weighting schemes. Did does this change influence the model's performance?
As seen below, when I use the distanceWeight, the performance improves to 71.4%, while leaving KNN @ 3 The weight parameter gives more weight to closer instances.



5 Upload the soybean.arff data set. Before running Weka, it is worth having a brief look at the data file under the Preprocess tab click Edit button. Alternatively, you can take a look at the data file using a text editor (Notepad or WordPad would work). Lines beginning with % are comments. Typically the beginning of the file provides background information on the data set. This includes details of the data itself and references to previous work using the data. The Soybean file contains 683 examples, each of which has 35 attributes plus the class attribute. The task is to assign examples to one of 19 disease classes. Apply the k-nearest neighbor classifier to the soybean data set.

J48 Unpruned & Soybean.arff



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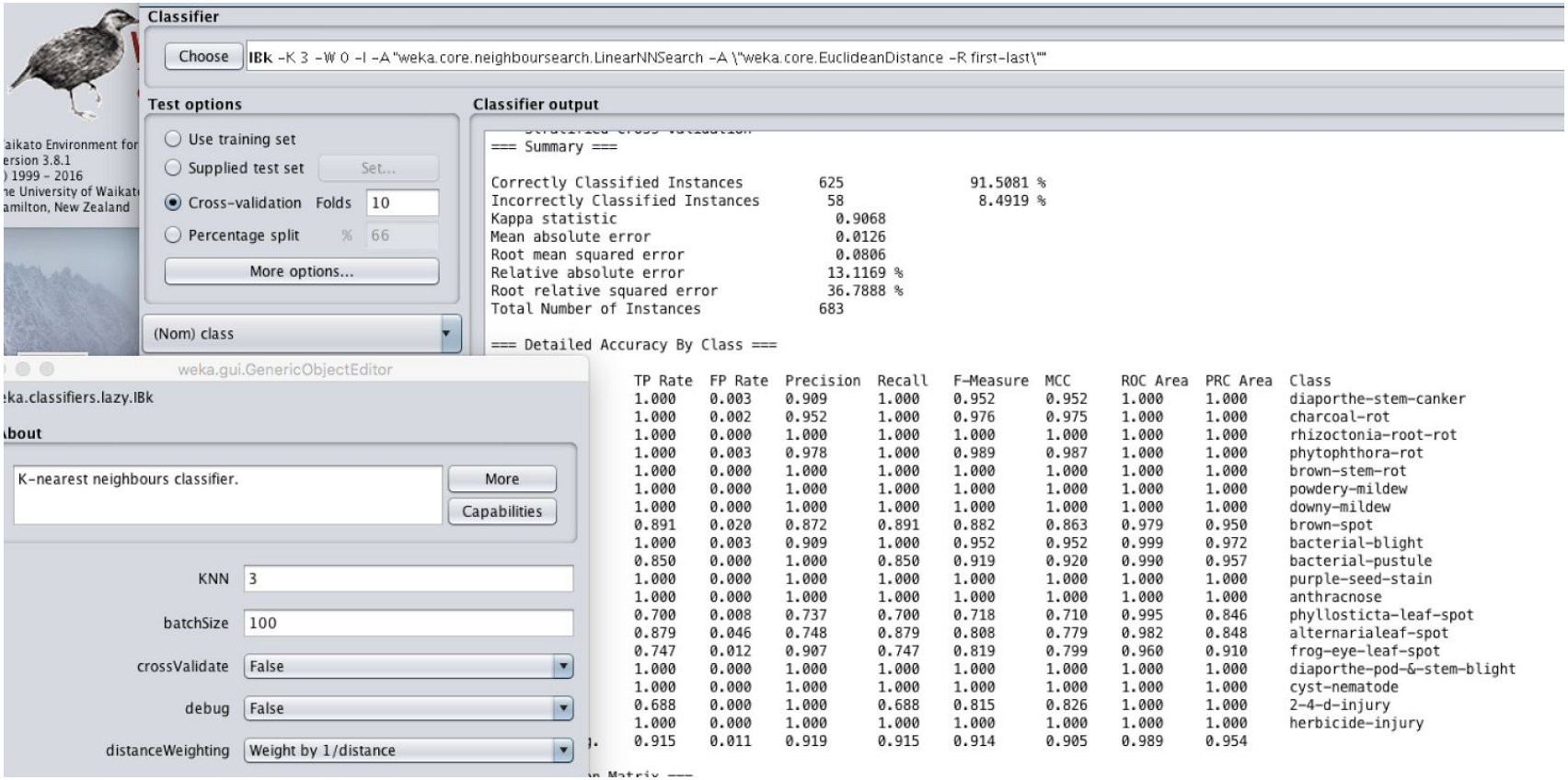
IBk & Soybeans.arff



What % of examples are correctly classified? Compare the result to the same result of the unpruned decision tree procedure. Try investigating the effect of repeating the run with different values for k. Compare and contrast the 2 methods and their outputs.

On first inspection, these to classifieres have similar performance. The unpruned tree @ 91.4% and IBk @ 91.6%.

Appendix

Soybeans.arff Header & Meta Info

```
%
% Notes: The large soybean database (soybean-large-data.arff) and it's
%        corresponding test database (soybean-large-test.arff) combined
%        into a single file (soybean-large.arff).
%
% 1. Title: Large Soybean Database
%
% 2. Sources:
%      (a) R.S. Michalski and R.L. Chilausky "Learning by Being Told and
%          Learning from Examples: An Experimental Comparison of the Two
%       Methods of Knowledge Acquisition in the Context of Developing
%       an Expert System for Soybean Disease Diagnosis", International
%       Journal of Policy Analysis and Information Systems, Vol. 4,
%       No. 2, 1980.
%      (b) Donor: Ming Tan & Jeff Schlimmer (Jeff.Schlimmer%cs.cmu.edu)
%      (c) Date: 11 July 1988
%
% 3. Past Usage:
%     1. See above.
%     2. Tan, M., & Eshelman, L. (1988). Using weighted networks to represent
%        classification knowledge in noisy domains.  Proceedings of the Fifth
%        International Conference on Machine Learning (pp. 121-134). Ann Arbor,
%         Michigan: Morgan Kaufmann.
%         -- IWN recorded a 97.1% classification accuracy
%            -- 290 training and 340 test instances
%      3. Fisher,D.H. & Schlimmer,J.C. (1988). Concept Simplification and
%         Predictive Accuracy. Proceedings of the Fifth
%         International Conference on Machine Learning (pp. 22-28). Ann Arbor,
%         Michigan: Morgan Kaufmann.
%         -- Notes why this database is highly predictable
%
% 4. Relevant Information Paragraph:
%     There are 19 classes, only the first 15 of which have been used in prior
```

```
%     work.  The folklore seems to be that the last four classes are
%     unjustified by the data since they have so few examples.
%     There are 35 categorical attributes, some nominal and some ordered.  The
%     value ``dna'' means does not apply.  The values for attributes are
%     encoded numerically, with the first value encoded as ``0,'' the second as
%     ``1,'' and so forth.  An unknown values is encoded as ``?''.
%
% 5. Number of Instances: 683
%
% 6. Number of Attributes: 35 (all have been nominalized)
%
% 7. Attribute Information:
%    -- 19 Classes
%     diaporthe-stem-canker, charcoal-rot, rhizoctonia-root-rot,
%     phytophthora-rot, brown-stem-rot, powdery-mildew,
%     downy-mildew, brown-spot, bacterial-blight,
%     bacterial-pustule, purple-seed-stain, anthracnose,
%     phyllosticta-leaf-spot, alternarialeaf-spot,
%     frog-eye-leaf-spot, diaporthe-pod-&-stem-blight,
%     cyst-nematode, 2-4-d-injury, herbicide-injury.
%
%    1. date:       april,may,june,july,august,september,october,?.
%    2. plant-stand:      normal,lt-normal,?.
%    3. precip:           lt-norm,norm,gt-norm,?.
%    4. temp:       lt-norm,norm,gt-norm,?.
%    5. hail:       yes,no,?.
%    6. crop-hist:  diff-lst-year,same-lst-yr,same-lst-two-yrs,
%                        same-lst-sev-yrs,?.
%    7. area-damaged:     scattered,low-areas,upper-areas,whole-field,?.
%    8. severity:   minor,pot-severe,severe,?.
%    9. seed-tmt:   none,fungicide,other,?.
%   10. germination:      '90-100%','80-89%','lt-80%',?.
%   11. plant-growth:     norm,abnorm,?.
%   12. leaves:           norm,abnorm.
%   13. leafspots-halo:   absent,yellow-halos,no-yellow-halos,?.
%   14. leafspots-marg:   w-s-marg,no-w-s-marg,dna,?.
%   15. leafspot-size:    lt-1/8,gt-1/8,dna,?.
%   16. leaf-shread:      absent,present,?.
%   17. leaf-malf:  absent,present,?.
```

```
%   18. leaf-mild:  absent,upper-surf,lower-surf,?.
%   19. stem:       norm,abnorm,?.
%   20. lodging:          yes,no,?.
%   21. stem-cankers:     absent,below-soil,above-soil,above-sec-nde,?.
%   22. canker-lesion:    dna,brown,dk-brown-blk,tan,?.
%   23. fruiting-bodies:  absent,present,?.
%   24. external decay:   absent,firm-and-dry,watery,?.
%   25. mycelium:   absent,present,?.
%   26. int-discolor:     none,brown,black,?.
%   27. sclerotia:  absent,present,?.
%   28. fruit-pods: norm,diseased,few-present,dna,?.
%   29. fruit spots:      absent,colored,brown-w/blk-specks,distort,dna,?.
%   30. seed:       norm,abnorm,?.
%   31. mold-growth:      absent,present,?.
%   32. seed-discolor:    absent,present,?.
%   33. seed-size:  norm,lt-norm,?.
%   34. shriveling: absent,present,?.
%   35. roots:            norm,rotted,galls-cysts,?.

@RELATION soybean

@ATTRIBUTE date                 {april,may,june,july,august,september,october}
@ATTRIBUTE plant-stand          {normal,lt-normal}
@ATTRIBUTE precip         {lt-norm,norm,gt-norm}
@ATTRIBUTE temp           {lt-norm,norm,gt-norm}
@ATTRIBUTE hail           {yes,no}
@ATTRIBUTE crop-hist            {diff-lst-year,same-lst-yr,same-lst-two-yrs, same-lst-sev-yrs}
@ATTRIBUTE area-damaged         {scattered,low-areas,upper-areas,whole-field}
@ATTRIBUTE severity             {minor,pot-severe,severe}
@ATTRIBUTE seed-tmt             {none,fungicide,other}
@ATTRIBUTE germination          {90-100,80-89,lt-80}
@ATTRIBUTE plant-growth         {norm,abnorm}
@ATTRIBUTE leaves         {norm,abnorm}
@ATTRIBUTE leafspots-halo {absent,yellow-halos,no-yellow-halos}
@ATTRIBUTE leafspots-marg {w-s-marg,no-w-s-marg,dna}
@ATTRIBUTE leafspot-size  {lt-1/8,gt-1/8,dna}
@ATTRIBUTE leaf-shread          {absent,present}
@ATTRIBUTE leaf-malf            {absent,present}
@ATTRIBUTE leaf-mild            {absent,upper-surf,lower-surf}
```

```
@ATTRIBUTE stem           {norm,abnorm}
@ATTRIBUTE lodging        {yes,no}
@ATTRIBUTE stem-cankers   {absent,below-soil,above-soil,above-sec-nde}
@ATTRIBUTE canker-lesion  {dna,brown,dk-brown-blk,tan}
@ATTRIBUTE fruiting-bodies       {absent,present}
@ATTRIBUTE external-decay {absent,firm-and-dry,watery}
@ATTRIBUTE mycelium              {absent,present}
@ATTRIBUTE int-discolor   {none,brown,black}
@ATTRIBUTE sclerotia             {absent,present}
@ATTRIBUTE fruit-pods             {norm,diseased,few-present,dna}
@ATTRIBUTE fruit-spots            {absent,colored,brown-w/blk-specks,distort,dna}
@ATTRIBUTE seed           {norm,abnorm}
@ATTRIBUTE mold-growth            {absent,present}
@ATTRIBUTE seed-discolor  {absent,present}
@ATTRIBUTE seed-size              {norm,lt-norm}
@ATTRIBUTE shriveling             {absent,present}
@ATTRIBUTE roots          {norm,rotted,galls-cysts}
@ATTRIBUTE class          {diaporthe-stem-canker, charcoal-rot, rhizoctonia-root-rot, phytophthora-rot,
brown-stem-rot, powdery-mildew, downy-mildew, brown-spot, bacterial-blight, bacterial-pustule, purple-seed-stain,
anthracnose, phyllosticta-leaf-spot, alternarialeaf-spot, frog-eye-leaf-spot, diaporthe-pod-&-stem-blight,
cyst-nematode, 2-4-d-injury, herbicide-injury}
```

J48 Unpruned & Soybean.arff

```
=== Classifier model (full training set) ===

J48 unpruned tree
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leafspot-size = lt-1/8
|   canker-lesion = dna
|   |   leafspots-marg = w-s-marg
|   |   |   seed-size = norm: bacterial-blight (21.0/1.0)
```

```
|   |   |   seed-size = lt-norm: bacterial-pustule (3.23/1.23)
|   |   leafspots-marg = no-w-s-marg
|   |   |   seed-size = norm: bacterial-pustule (12.0)
|   |   |   seed-size = lt-norm
|   |   |   |   roots = norm: bacterial-pustule (2.2/0.2)
|   |   |   |   roots = rotted: bacterial-pustule (3.3/0.3)
|   |   |   |   roots = galls-cysts: cyst-nematode (0.4/0.04)
|   |   leafspots-marg = dna: bacterial-blight (0.0)
|   canker-lesion = brown: bacterial-blight (0.0)
|   canker-lesion = dk-brown-blk: phytophthora-rot (4.78/0.1)
|   canker-lesion = tan
|   |   fruit-pods = norm: purple-seed-stain (2.0)
|   |   fruit-pods = diseased: purple-seed-stain (9.0)
|   |   fruit-pods = few-present: cyst-nematode (0.23)
|   |   fruit-pods = dna: purple-seed-stain (0.0)
leafspot-size = gt-1/8
|   roots = norm
|   |   mold-growth = absent
|   |   |   fruit-spots = absent
|   |   |   |   leaf-malf = absent
|   |   |   |   |   fruiting-bodies = absent
|   |   |   |   |   |   date = april: brown-spot (5.0)
|   |   |   |   |   |   date = may: brown-spot (24.0/1.0)
|   |   |   |   |   |   date = june
|   |   |   |   |   |   |   precip = lt-norm: phyllosticta-leaf-spot (4.0)
|   |   |   |   |   |   |   precip = norm
|   |   |   |   |   |   |   |   area-damaged = scattered: brown-spot (2.0/1.0)
|   |   |   |   |   |   |   |   area-damaged = low-areas: brown-spot (0.0)
|   |   |   |   |   |   |   |   area-damaged = upper-areas: brown-spot (2.0)
|   |   |   |   |   |   |   |   area-damaged = whole-field: phyllosticta-leaf-spot (1.0)
|   |   |   |   |   |   |   precip = gt-norm: brown-spot (21.0)
|   |   |   |   |   |   date = july
|   |   |   |   |   |   |   precip = lt-norm: phyllosticta-leaf-spot (1.0)
|   |   |   |   |   |   |   precip = norm: phyllosticta-leaf-spot (2.0)
|   |   |   |   |   |   |   precip = gt-norm
|   |   |   |   |   |   |   |   area-damaged = scattered: frog-eye-leaf-spot (6.0/2.0)
|   |   |   |   |   |   |   |   area-damaged = low-areas: brown-spot (2.0/1.0)
|   |   |   |   |   |   |   |   area-damaged = upper-areas: frog-eye-leaf-spot (2.0)
|   |   |   |   |   |   |   |   area-damaged = whole-field: brown-spot (1.0)
```

```
|   |   |   |   |   |   date = august
|   |   |   |   |   |   |   plant-growth = norm
|   |   |   |   |   |   |   |   seed = norm
|   |   |   |   |   |   |   |   |   hail = yes
|   |   |   |   |   |   |   |   |   |   leaf-shread = absent
|   |   |   |   |   |   |   |   |   |   |   seed-tmt = none
|   |   |   |   |   |   |   |   |   |   |   |   area-damaged = scattered: frog-eye-leaf-spot (3.0/1.0)
|   |   |   |   |   |   |   |   |   |   |   |   area-damaged = low-areas: alternarialeaf-spot (1.0)
|   |   |   |   |   |   |   |   |   |   |   |   area-damaged = upper-areas: alternarialeaf-spot (5.0/1.0)
|   |   |   |   |   |   |   |   |   |   |   |   area-damaged = whole-field: alternarialeaf-spot (3.0)
|   |   |   |   |   |   |   |   |   |   |   seed-tmt = fungicide
|   |   |   |   |   |   |   |   |   |   |   |   plant-stand = normal: frog-eye-leaf-spot (5.0)
|   |   |   |   |   |   |   |   |   |   |   |   plant-stand = lt-normal: alternarialeaf-spot (5.0/1.0)
|   |   |   |   |   |   |   |   |   |   |   seed-tmt = other: alternarialeaf-spot (0.0)
|   |   |   |   |   |   |   |   |   |   leaf-shread = present: alternarialeaf-spot (2.0)
|   |   |   |   |   |   |   |   |   hail = no: frog-eye-leaf-spot (3.0)
|   |   |   |   |   |   |   |   seed = abnorm: alternarialeaf-spot (3.0)
|   |   |   |   |   |   |   plant-growth = abnorm: frog-eye-leaf-spot (2.0)
|   |   |   |   |   |   date = september
|   |   |   |   |   |   |   stem = norm
|   |   |   |   |   |   |   |   temp = lt-norm: alternarialeaf-spot (0.0)
|   |   |   |   |   |   |   |   temp = norm
|   |   |   |   |   |   |   |   |   leaf-shread = absent
|   |   |   |   |   |   |   |   |   |   crop-hist = diff-lst-year: alternarialeaf-spot (3.0)
|   |   |   |   |   |   |   |   |   |   crop-hist = same-lst-yr: frog-eye-leaf-spot (3.0/1.0)
|   |   |   |   |   |   |   |   |   |   crop-hist = same-lst-two-yrs: alternarialeaf-spot (3.0)
|   |   |   |   |   |   |   |   |   |   crop-hist = same-lst-sev-yrs: frog-eye-leaf-spot (2.0)
|   |   |   |   |   |   |   |   |   leaf-shread = present: alternarialeaf-spot (5.0)
|   |   |   |   |   |   |   |   temp = gt-norm: alternarialeaf-spot (28.0)
|   |   |   |   |   |   |   stem = abnorm: frog-eye-leaf-spot (2.0)
|   |   |   |   |   |   date = october: alternarialeaf-spot (31.0/1.0)
|   |   |   |   |   fruiting-bodies = present: brown-spot (34.0)
|   |   |   |   leaf-malf = present: phyllosticta-leaf-spot (10.0)
|   |   |   fruit-spots = colored
|   |   |   |   fruit-pods = norm: brown-spot (2.0)
|   |   |   |   fruit-pods = diseased: frog-eye-leaf-spot (62.0)
|   |   |   |   fruit-pods = few-present: frog-eye-leaf-spot (0.0)
|   |   |   |   fruit-pods = dna: frog-eye-leaf-spot (0.0)
|   |   |   fruit-spots = brown-w/blk-specks
```

```
|   |   |   |   crop-hist = diff-lst-year: brown-spot (0.0)
|   |   |   |   crop-hist = same-lst-yr: brown-spot (2.0)
|   |   |   |   crop-hist = same-lst-two-yrs: brown-spot (0.0)
|   |   |   |   crop-hist = same-lst-sev-yrs: frog-eye-leaf-spot (2.0)
|   |   |   fruit-spots = distort: brown-spot (0.0)
|   |   |   fruit-spots = dna: brown-stem-rot (9.0)
|   |   mold-growth = present
|   |   |   leaves = norm: diaporthe-pod-&-stem-blight (7.25)
|   |   |   leaves = abnorm: downy-mildew (20.0)
|   roots = rotted
|   |   area-damaged = scattered: herbicide-injury (1.1/0.1)
|   |   area-damaged = low-areas: phytophthora-rot (30.03)
|   |   area-damaged = upper-areas: phytophthora-rot (0.0)
|   |   area-damaged = whole-field: herbicide-injury (3.66/0.66)
|   roots = galls-cysts
|   |   area-damaged = scattered: diaporthe-pod-&-stem-blight (0.02)
|   |   area-damaged = low-areas: cyst-nematode (4.37)
|   |   area-damaged = upper-areas: cyst-nematode (3.28)
|   |   area-damaged = whole-field: diaporthe-pod-&-stem-blight (0.15)
leafspot-size = dna
|   int-discolor = none
|   |   leaves = norm
|   |   |   plant-growth = norm
|   |   |   |   stem-cankers = absent
|   |   |   |   |   canker-lesion = dna: diaporthe-pod-&-stem-blight (5.53)
|   |   |   |   |   canker-lesion = brown: purple-seed-stain (0.0)
|   |   |   |   |   canker-lesion = dk-brown-blk: purple-seed-stain (0.0)
|   |   |   |   |   canker-lesion = tan: purple-seed-stain (9.0)
|   |   |   |   stem-cankers = below-soil: anthracnose (0.0)
|   |   |   |   stem-cankers = above-soil: anthracnose (0.0)
|   |   |   |   stem-cankers = above-sec-nde: anthracnose (24.0)
|   |   |   plant-growth = abnorm: rhizoctonia-root-rot (19.0)
|   |   leaves = abnorm
|   |   |   stem = norm
|   |   |   |   plant-growth = norm
|   |   |   |   |   date = april: 2-4-d-injury (0.38)
|   |   |   |   |   date = may: powdery-mildew (3.27/0.27)
|   |   |   |   |   date = june: powdery-mildew (3.27/0.27)
|   |   |   |   |   date = july: powdery-mildew (2.26/0.26)
```

```
|   |   |   |   |   date = august: powdery-mildew (4.27/0.27)
|   |   |   |   |   date = september: powdery-mildew (4.27/0.27)
|   |   |   |   |   date = october: powdery-mildew (4.27/0.27)
|   |   |   |   plant-growth = abnorm: cyst-nematode (4.3/0.39)
|   |   |   stem = abnorm
|   |   |   |   plant-stand = normal
|   |   |   |   |   leaf-malf = absent
|   |   |   |   |   |   seed = norm: diaporthe-stem-canker (21.0/1.0)
|   |   |   |   |   |   seed = abnorm: anthracnose (9.0)
|   |   |   |   |   leaf-malf = present: 2-4-d-injury (3.0)
|   |   |   |   plant-stand = lt-normal
|   |   |   |   |   area-damaged = scattered
|   |   |   |   |   |   leaf-malf = absent: anthracnose (2.0)
|   |   |   |   |   |   leaf-malf = present: herbicide-injury (3.99/1.72)
|   |   |   |   |   area-damaged = low-areas
|   |   |   |   |   |   fruiting-bodies = absent
|   |   |   |   |   |   |   date = april: phytophthora-rot (6.35/0.04)
|   |   |   |   |   |   |   date = may: phytophthora-rot (11.94/0.43)
|   |   |   |   |   |   |   date = june: phytophthora-rot (14.54/0.45)
|   |   |   |   |   |   |   date = july: phytophthora-rot (14.0/0.08)
|   |   |   |   |   |   |   date = august: phytophthora-rot (1.92/0.01)
|   |   |   |   |   |   |   date = september: 2-4-d-injury (0.37)
|   |   |   |   |   |   |   date = october: 2-4-d-injury (0.37)
|   |   |   |   |   |   fruiting-bodies = present
|   |   |   |   |   |   |   roots = norm: anthracnose (3.11/0.11)
|   |   |   |   |   |   |   roots = rotted: phytophthora-rot (4.7/0.16)
|   |   |   |   |   |   |   roots = galls-cysts: phytophthora-rot (0.0)
|   |   |   |   |   area-damaged = upper-areas: anthracnose (4.71/1.71)
|   |   |   |   |   area-damaged = whole-field
|   |   |   |   |   |   leaf-malf = absent: anthracnose (4.0/1.0)
|   |   |   |   |   |   leaf-malf = present: 2-4-d-injury (2.05/0.76)
|   int-discolor = brown
|   |   leaf-malf = absent: brown-stem-rot (35.73/0.73)
|   |   leaf-malf = present: 2-4-d-injury (3.15/0.68)
|   int-discolor = black
|   |   area-damaged = scattered: 2-4-d-injury (0.62/0.26)
|   |   area-damaged = low-areas: 2-4-d-injury (0.62/0.26)
|   |   area-damaged = upper-areas
|   |   |   date = april: 2-4-d-injury (0.09)
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|   |   |   date = may: charcoal-rot (0.0)
|   |   |   date = june: 2-4-d-injury (0.12/0.03)
|   |   |   date = july: charcoal-rot (3.2/0.2)
|   |   |   date = august: charcoal-rot (1.07/0.07)
|   |   |   date = september: charcoal-rot (5.02/0.02)
|   |   |   date = october: charcoal-rot (1.09/0.09)
|   |   area-damaged = whole-field
|   |   |   date = april: 2-4-d-injury (0.18/0.09)
|   |   |   date = may: charcoal-rot (0.0)
|   |   |   date = june: charcoal-rot (0.0)
|   |   |   date = july: 2-4-d-injury (0.09)
|   |   |   date = august: charcoal-rot (4.1/0.1)
|   |   |   date = september: charcoal-rot (1.0/0.0)
|   |   |   date = october: charcoal-rot (5.02/0.02)

Number of Leaves  :       121

Size of the tree :  175


Time taken to build model: 0.02 seconds
```