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Kelas : IF 3A Reguler

Tugas Besar Data Mining Klasifikasi C5.0

Tujuan:

- ✓ Menerapkan algoritma C5.0 Alat:
- ✓ R dan R Studio

Deskripsi:

Pada tugas besar ini kelompok kami menggunakan metode klasifikasi C5.0 dan memakai dataset Cryotherapy Dataset yang memiliki Kumpulan data memberikan informasi yang berkaitan dengan pasien, yang karakteristiknya seperti Jumlah Kutil, Area kutil, jenis kelamin dan usia, dll. Digunakan untuk menentukan tingkat ekstremitas kanker, yaitu 0 jinak atau 1 ganas.

Dataset: Cryotherapy.csv Terdiri dari:

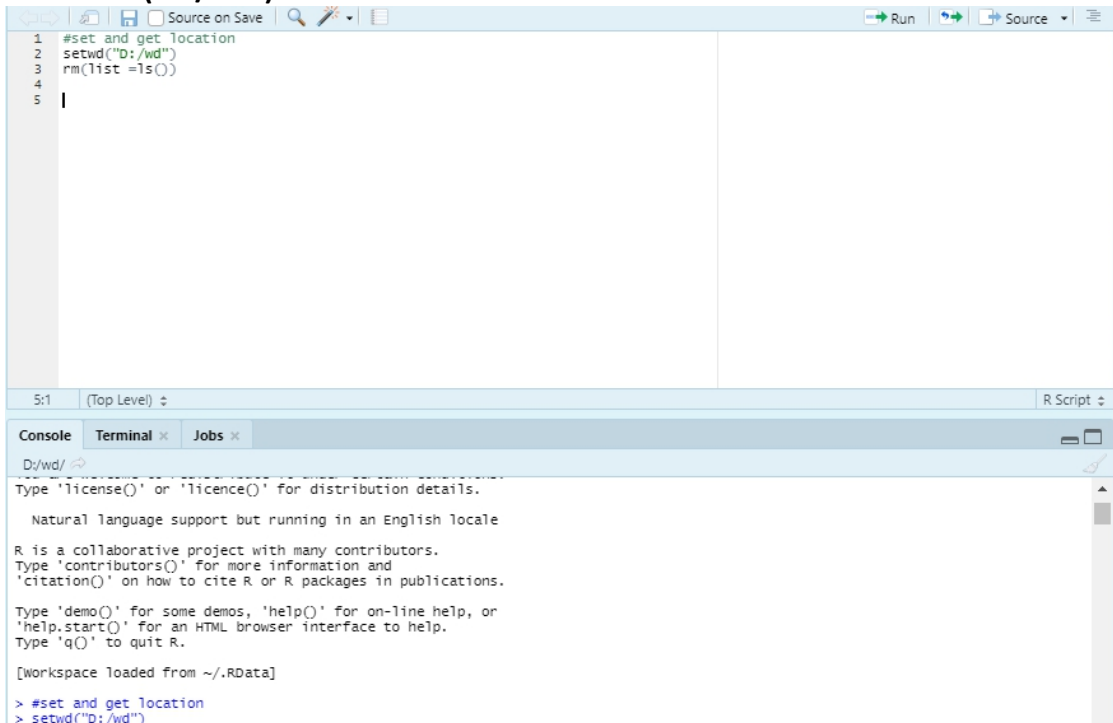
- 90 data
- 7 variabel
- Classification Tree
- Number of samples: 90
- Number of predictors: 6

	A	B	C	D	E	F
1	sex,"age","Time","Number_of_Warts","Type","Area","Result_of_Treatment"					
2	1,"35","12","5","1","100","0"					
3	1,"29","7","5","1","96","1"					
4	1,"50","8","1","3","132","0"					
5	1,"32","11.75","7","3","750","0"					
6	1,"67","9.25","1","1","42","0"					
7	1,"41","8","2","2","20","1"					
8	1,"36","11","2","1","8","0"					
9	1,"59","3.5","3","3","20","0"					
10	1,"20","4.5","12","1","6","1"					
11	2,"34","11.25","3","3","150","0"					
12	2,"21","10.75","5","1","35","0"					
13	2,"15","6","2","1","30","1"					
14	2,"15","2","3","1","4","1"					
15	2,"15","3.75","2","3","70","1"					
16	2,"17","11","2","1","10","0"					
17	2,"17","5.25","3","1","63","1"					
18	2,"23","11.75","12","3","72","0"					
19	2,"27","8.75","2","1","6","0"					
20	2,"15","4.25","1","1","6","1"					
21	2,"18","5.75","1","1","80","1"					
22	1,"22","5.5","2","1","70","1"					
23	2,"16","8.5","1","2","60","1"					
24	1,"28","4.75","3","1","100","1"					
25	2,"40","9.75","1","2","80","0"					
26	1,"30","2.5","2","1","115","1"					
27	2,"34","12","3","3","95","0"					
28	1,"20","0.5","2","1","75","1"					
29	2,"35","12","5","3","100","0"					
30	2,"24","9.5","3","3","20","0"					
31	2,"19","8.75","6","1","160","1"					
32	1,"35","9.25","9","1","100","1"					
33	1,"29","7.25","6","1","96","1"					
34	1,"50","8.75","11","3","132","0"					
35	1,"37","4.75","1","2","75","0"					

Tugas Besar Data Mining:

- Pengaturan lokasi direktori

setwd("D:/wd")



The screenshot shows the RStudio interface. The script editor on the left contains the following code:


```
1 #set and get location
2 setwd("D:/wd")
3 rm(list = ls())
4
5 |
```

The console on the right shows the output of the code execution:

```
D:/wd/
Type 'license()' or 'licence()' for distribution details.
Natural language support but running in an English locale
R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.
Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.
[Workspace loaded from ~/.RData]
> #set and get location
> setwd("D:/wd")
```

- Membaca dataset

dataset <- read.csv("Cryotherapy.csv", sep = ";")



The screenshot shows the RStudio interface. The script editor on the left contains the following code:

```
1 #set and get location
2 setwd("D:/wd")
3 rm(list = ls())
4
5 #membacaan dataset
6 dataset <- read.csv("Cryotherapy.csv", sep = ";")
7
8 |
```

The console on the right shows the output of the code execution:

```
D:/wd/
> #set and get location
> setwd("D:/wd")
> rm(list = ls())
> #membacaan dataset
> dataset <- read.csv("Cryotherapy.csv", sep = ";")
```

- Instalasi package
install.packages("C50")
install.packages("printr")

The screenshot shows the RStudio interface. The top pane displays the R script code for installing and loading the packages. The bottom pane shows the console output, which includes warnings about Rtools and the successful installation of both packages.

```

1 #set and get location
2 setwd("D:/wd")
3 rm(list = ls())
4
5 #pembacaan dataset
6 dataset <- read.csv("Cryotherapy.csv", sep = ",")
7
8 #library
9 install.packages("C50")
10 install.packages("printr")
11 library(C50)
12 library(printr)

```

Console Output:

```

D:/wd/
> install.packages("C50")
WARNING: Rtools is required to build R packages but is not currently installed. Please download and install the appropriate version
of Rtools before proceeding:

https://cran.rstudio.com/bin/windows/Rtools/
Installing package into 'C:/Users/PERSONAL/Documents/R/win-library/4.0'
(as 'lib' is unspecified)
trying URL 'https://cran.rstudio.com/bin/windows/contrib/4.0/C50_0.1.3.1.zip'
Content type 'application/zip' length 541679 bytes (528 KB)
downloaded 528 KB

package 'C50' successfully unpacked and MD5 sums checked

The downloaded binary packages are in
C:/Users/PERSONAL/AppData/Local/Temp/RtmpWCMi7b/downloaded_packages
> install.packages("printr")
WARNING: Rtools is required to build R packages but is not currently installed. Please download and install the appropriate version
of Rtools before proceeding:

https://cran.rstudio.com/bin/windows/Rtools/
Installing package into 'C:/Users/PERSONAL/Documents/R/win-library/4.0'
(as 'lib' is unspecified)
trying URL 'https://cran.rstudio.com/bin/windows/contrib/4.0/printr_0.1.zip'
Content type 'application/zip' length 37811 bytes (36 KB)
downloaded 36 KB

package 'printr' successfully unpacked and MD5 sums checked

The downloaded binary packages are in
C:/Users/PERSONAL/AppData/Local/Temp/RtmpWCMi7b/downloaded_packages
> |

```

- Menggunakan package
library(C50)
library(printr)

The screenshot shows the RStudio console with the commands to load the installed packages.

```

C:/Users/PERSONAL/AppData/Local/Temp/RtmpWCMi7b/downloaded_packages
> library(C50)
> library(printr)
> |

```

- Melihat package yang sudah terinstall

Files	Plots	Packages	Help	Viewer
		<input type="text"/>		
	Name	Description	Version	
<input type="checkbox"/>	broom	Convert Statistical Objects into Tidy Tibbles	0.7.2	
<input checked="" type="checkbox"/>	C50	C5.0 Decision Trees and Rule-Based Models	0.1.3.1	
<input type="checkbox"/>	praise	Praise Users	1.0.0	
<input type="checkbox"/>	prettyunits	Pretty, Human Readable Formatting of Quantities	1.1.1	
<input checked="" type="checkbox"/>	printr	Automatically Print R Objects to Appropriate Formats According to the 'knitr' Output Format	0.1	

- Pembuatan model decision tree menggunakan algoritman C5.0

```
> model <- C5.0(Result_of_Treatment ~., data=dataset)
Error: C5.0 models require a factor outcome
> |
```

- Terjadi error karena outputnya bukan factor, factor adalah tipe data. Sehingga untuk melihat tipe kita ketikkan **class(dataset\$Result_of_Treatment)**

```
> #jika model error cek class/tipe dari kolom Result_of_Treatment
> class(dataset$Result_of_Treatment)
[1] "integer"
> |
```

- Setelah di cek tipe datanya, ternyata tipe datanya adalah character. Sehingga kita harus mengonversinya ke factor dengan mengetikkan **dataset\$Result_of_Treatment <- as.factor(dataset\$Result_of_Treatment)**. Selanjutnya jalankan perintah untuk membuat model. Pembuatan model sudah berhasil.

```

8 #library
9 install.packages("C50")
10 install.packages("printr")
11 library(C50)
12 library(printr)
13
14 #Membuat model decision tree menggunakan C5.0
15 model <- C5.0(Result_of_Treatment ~., data=dataset)
16
17 #jika model error, lanjutkan langkah berikut
18 #cek class/tipe dari kolom Result_of_Treatment
19 class(dataset$Result_of_Treatment)
20
21 #mengubah tipe class ke factor
22 dataset$Result_of_Treatment <- as.factor(dataset$Result_of_Treatment)
23 model <- C5.0(Result_of_Treatment ~., data=dataset)
24
25
24:1 (Top Level)
R Script

```

```

D:\wd\
WARNING: Rtools is required to build R packages but is not currently installed. Please download and install the appropriate version
of Rtools before proceeding:

https://cran.rstudio.com/bin/windows/Rtools/
Installing package into 'C:/Users/PERSONAL/Documents/R/win-library/4.0'
(as 'lib' is unspecified)
trying URL 'https://cran.rstudio.com/bin/windows/contrib/4.0/printr_0.1.zip'
Content type 'application/zip' length 37811 bytes (36 KB)
downloaded 36 KB

package 'printr' successfully unpacked and MD5 sums checked

The downloaded binary packages are in
C:/Users/PERSONAL/AppData/Local/Temp/RtmpWCM17b/downloaded_packages
> library(C50)
> library(printr)
> #Membuat model decision tree menggunakan C5.0
> model <- C5.0(Result_of_Treatment ~., data=dataset)
Error: C5.0 models require a factor outcome
> #jika model error cek class/tipe dari kolom Result_of_Treatment
> class(dataset$Result_of_Treatment)
[1] "integer"
> #mengubah tipe class ke factor
> dataset$Result_of_Treatment <- as.factor(dataset$Result_of_Treatment)
> model <- C5.0(Result_of_Treatment ~., data=dataset)
> |

```

- Melihat model
Model

```
> model

Call:
C5.0.formula(formula = Result_of_Treatment ~ ., data = dataset)

Classification Tree
Number of samples: 90
Number of predictors: 6

Tree size: 8

Non-standard options: attempt to group attributes
```

Classification Tree

- Number of samples: 90
- Number of predictors: 6

summary(model)

```
> summary(model)

Call:
C5.0.formula(formula = Result_of_Treatment ~ ., data = dataset)

C5.0 [Release 2.07 GPL Edition]      Tue Jan 12 13:29:37 2021
-----

Class specified by attribute 'outcome'

Read 90 cases (7 attributes) from undefined.data

Decision tree:

Time <= 8:
:...age <= 41: 1 (39)
:  age > 41: 0 (4)
Time > 8:
:...age <= 16: 1 (4)
  age > 16:
    ...Type > 2: 0 (19)
    Type <= 2:
      ...Area <= 10: 0 (9)
      Area > 10:
        ...Area <= 20: 1 (3)
        Area > 20:
          ...Area <= 96: 0 (9)
          Area > 96: 1 (3/1)

Evaluation on training data (90 cases):

      Decision Tree
      -----
      Size      Errors

      8      1( 1.1%)  <<

      (a)  (b)  <-classified as
      ----  ----
      41     1   (a): class 0
          48   (b): class 1

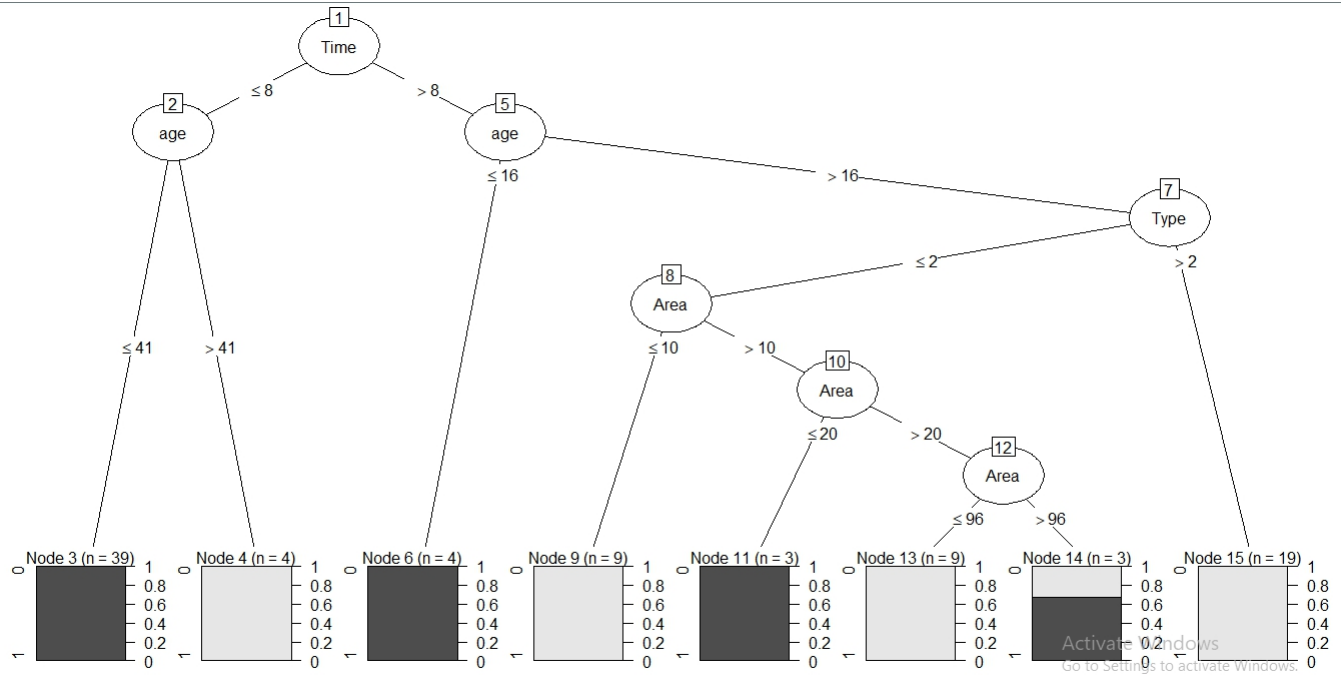
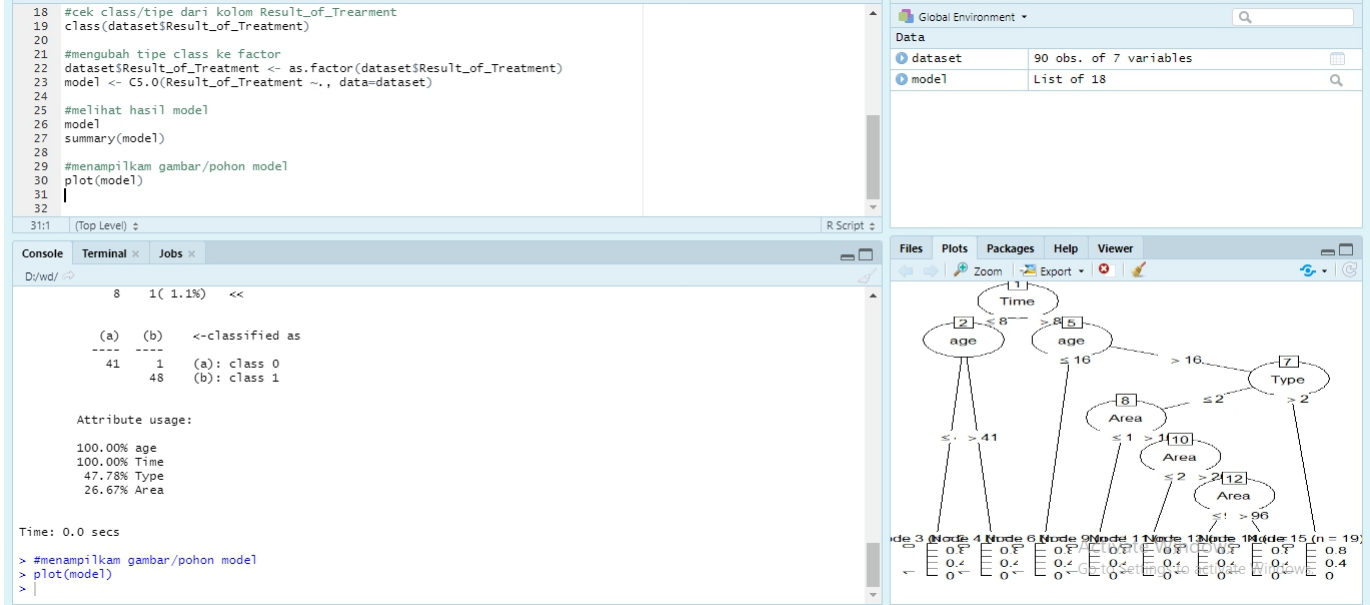
Attribute usage:

100.00% age
100.00% Time
 47.78% Type
 26.67% Area

Time: 0.0 secs

> |
```

- Menampilkan pohon yang sudah dibangun
plot(model)



- Menjadikan dataset sebagai data testing. Namun hanya kolom 1, 2, 3, 4,5,6 saja dan tanpa label.
datatesting <- dataset[,1:6]

	sex	age	Time	Number_of_Warts	Type	Area
1	1	35	12.00	5	1	100
2	1	29	7.00	5	1	96
3	1	50	8.00	1	3	132
4	1	32	11.75	7	3	750
5	1	67	9.25	1	1	42
6	1	41	8.00	2	2	20
7	1	36	11.00	2	1	8
8	1	59	3.50	3	3	20
9	1	20	4.50	12	1	6
10	2	34	11.25	3	3	150
11	2	21	10.75	5	1	35
12	2	15	6.00	2	1	30
13	2	15	2.00	3	1	4
14	2	15	3.75	2	3	70
15	2	17	11.00	2	1	10
16	2	17	5.25	3	1	63
17	2	23	11.75	12	3	72
18	2	27	8.75	2	1	6
19	2	15	4.25	1	1	6
20	2	18	5.75	1	1	80
21	1	22	5.50	2	1	70

- Melihat prediksi
predictions <- predict(model, datatesting)

Environment

Object	Class	Attributes
dataset	data.frame	90 obs. of 7 variables
datatesting	data.frame	90 obs. of 6 variables
model	lm	List of 18
predictions	Factor w/ 2 levels "0","1"	2 2 1 1 1 2 1

Console

```

24 #melihat hasil model
25 model
26 summary(model)
27 #menampilkan gambar/pohon model
28 plot(model)
29 #membuat dataset
30 datatesting <- dataset[,1:6]
31 #prediksi
32 predictions <- predict(model, datatesting)
33
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41 1 (a): class 0
42 48 (b): class 1
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```

head(predictions)

```
> head(predictions)
[1] 1 1 0 0 0 1
Levels: 0 1
```

- Membandingkan hasil prediksi dengan dataset
table(predictions, dataset\$Result_of_Treatment)

```
> table(predictions, dataset$Result_of_Treatment)

predictions 0 1
0 41 0
1 1 48
> |
```

- Melihat tingkat akurasi
mean(predictions == dataset\$Result_of_Treatment)

```
> #Melihat tingkat akurasi
> mean(predictions == dataset$Result_of_Treatment)
[1] 0.9888889
```

- rules yang dihasilkan

```
> rulemodel <- C5.0(Result_of_Treatment ~., data = dataset, rules = TRUE)
> rulemodel

Call:
C5.0.formula(formula = Result_of_Treatment ~ ., data = dataset, rules = TRUE)

Rule-Based Model
Number of samples: 90
Number of predictors: 6

Number of Rules: 8

Non-standard options: attempt to group attributes

> |
```

```
> summary(rulemodel)

Call:
C5.0.formula(formula = Result_of_Treatment ~ ., data = dataset, rules = TRUE)

C5.0 [Release 2.07 GPL Edition] Tue Jan 12 13:40:59 2021
-----

Class specified by attribute 'outcome'

Read 90 cases (7 attributes) from undefined.data

Rules:

Rule 1: (19, lift 2.0)
Time > 8
Type > 2
-> class 0 [0.952]

Rule 2: (16, lift 2.0)
age > 16
Time > 8
Area > 20
Area <= 96
-> class 0 [0.944]

Rule 3: (9, lift 1.9)
Time > 8
Area <= 10
-> class 0 [0.909]

Rule 4: (9, lift 1.9)
age > 41
-> class 0 [0.909]

Rule 5: (39, lift 1.8)
age <= 41
Time <= 8
-> class 1 [0.976]
```



```
Rule 6: (15, lift 1.8)
  age <= 16
  -> class 1 [0.941]
```

```
Rule 7: (5, lift 1.6)
  Type <= 2
  Area > 10
  Area <= 20
  -> class 1 [0.857]
```

```
Rule 8: (11/1, lift 1.6)
  Type <= 2
  Area > 96
  -> class 1 [0.846]
```

Default class: 1

Evaluation on training data (90 cases):

Rules		
No	Errors	
8	1 (1.1%)	<<

(a)	(b)	<-classified as
41	1	(a): class 0
	48	(b): class 1

Attribute usage:

84.44% Time
72.22% age
45.56% Area
38.89% Type

Rule yang dihasilkan :

➤ **rule 1 :**
time > 8
type > 2
class -> 0 (jinak)

➤ **rule 2 :**
age > 16
Time > 8
Area > 20
Area <= 96
class -> 0 (jinak)

➤ **rule 3 :**
Time > 8
Area <= 10
class -> 0 (jinak)

➤ **rule 4 :**
age > 41
Area <= 10
Class -> 0 (Jinak)

➤ **rule 5 :**
age <= 41
Time <= 8
class -> 1 (Ganas)

➤ **rule 6 :**
age <= 16
class -> 1 (Ganas)

➤ **rule 7 :**
Type <= 2
Area >
Area <= 20
class -> 1 (Ganas)

➤ **rule 8 :**
Type <= 2
Area >96
class -> 1 (Ganas)

Kode penuh:

```
#set and get location
setwd("D:/wd")
rm(list = ls())

#pembacaan dataset
dataset <- read.csv("Cryotherapy.csv", sep = ",")

#library
install.packages("C50")
install.packages("printr")
library(C50)
library(printr)

#Membuat model decision tree menggunakan C5.0
model <- C5.0(Result_of_Treatment ~., data=dataset)

#jika model error cek class/tipe dari kolom Result_of_Treatment
class(dataset$Result_of_Treatment)

#mengubah tipe class ke factor
dataset$Result_of_Treatment <- as.factor(dataset$Result_of_Treatment)
model <- C5.0(Result_of_Treatment ~., data=dataset)

#melihat hasil model
model
summary(model)

#menampilkan gambar/pohon model
plot(model)

#membuat dataset
datatesting <- dataset[,1:6]

#prediksi
predictions <- predict(model, datatesting)
head(predictions)
#membandingkan hasil prediksi dari datatesting dengan dataset
table(predictions, dataset$Result_of_Treatment)

#Melihat tingkat akurasi
mean(predictions == dataset$Result_of_Treatment)

#Mengetahui rule model
rulemodel <- C5.0(Result_of_Treatment ~., data = dataset, rules = TRUE)
rulemodel
summary(rulemodel)
```