

hw5project

2024-11-12

HW5 - DSC 441

Single Problem - Entire Data Pipeline

Goal: The goal of this competition is to use various factors to predict obesity risk in individuals, which is related to cardiovascular disease.

```
library(tidyverse)
```

a: Data gathering and integration

```
## -- Attaching core tidyverse packages ----- tidyverse 2.0.0 --
## v dplyr     1.1.4     v readr     2.1.5
## v forcats   1.0.0     v stringr   1.5.1
## v ggplot2   3.5.1     v tibble    3.2.1
## v lubridate 1.9.3     v tidyr    1.3.1
## v purrr    1.0.2
## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()   masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
obes <- read_csv("~/Downloads/ObesityDataSet.csv")
```

```
## Rows: 2111 Columns: 17
## -- Column specification -----
## Delimiter: ","
## chr (9): Gender, family_history_with_overweight, FAVC, CAEC, SMOKE, SCC, CAL...
## dbl (8): Age, Height, Weight, FCVC, NCP, CH2O, FAF, TUE
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
dim(obes)
```

```
## [1] 2111 17
```

```

addlObesityTrain <- read_csv("~/Downloads/addlObesity/train.csv")

## Rows: 20758 Columns: 18
## -- Column specification -----
## Delimiter: ","
## chr (9): Gender, family_history_with_overweight, FAVC, CAEC, SMOKE, SCC, CAL...
## dbl (9): id, Age, Height, Weight, FCVC, NCP, CH20, FAF, TUE
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.

dim(addlObesityTrain)

## [1] 20758     18

# First 5 rows of data sets
head(obes)

## # A tibble: 6 x 17
##   Gender   Age Height Weight family_history_with_overw~1 FAVC   FCVC   NCP CAEC
##   <chr>   <dbl> <dbl>  <dbl> <chr>                <chr> <dbl> <dbl> <chr>
## 1 Female    21    1.62    64   yes                 no      2     3 Some-
## 2 Female    21    1.52    56   yes                 no      3     3 Some-
## 3 Male      23    1.8     77   yes                 no      2     3 Some-
## 4 Male      27    1.8     87   no                  no      3     3 Some-
## 5 Male      22    1.78   89.8 no                  no      2     1 Some-
## 6 Male      29    1.62    53   no                  yes     2     3 Some-
## # i abbreviated name: 1: family_history_with_overweight
## # i 8 more variables: SMOKE <chr>, CH20 <dbl>, SCC <chr>, FAF <dbl>, TUE <dbl>,
## #   CALC <chr>, MTRANS <chr>, NObeyesdad <chr>

head(addlObesityTrain)

## # A tibble: 6 x 18
##   id Gender   Age Height Weight family_history_with_overw~1 FAVC   FCVC   NCP
##   <dbl> <chr>   <dbl> <dbl>  <dbl> <chr>                <chr> <dbl> <dbl>
## 1 0 Male     24.4  1.70   81.7 yes                 yes    2     2.98
## 2 1 Female   18     1.56   57   yes                 yes    2     3
## 3 2 Female   18     1.71   50.2 yes                yes   1.88  1.41
## 4 3 Female   21.0   1.71   131. yes                yes    3     3
## 5 4 Male     31.6   1.91   93.8 yes                yes   2.68  1.97
## 6 5 Male     18.1   1.75   51.6 yes                yes   2.92  3
## # i abbreviated name: 1: family_history_with_overweight
## # i 9 more variables: CAEC <chr>, SMOKE <chr>, CH20 <dbl>, SCC <chr>,
## #   FAF <dbl>, TUE <dbl>, CALC <chr>, MTRANS <chr>, NObeyesdad <chr>

# Merge/Join two tables
obesity <- full_join(obes, addlObesityTrain)

## Joining with 'by = join_by(Gender, Age, Height, Weight,
## family_history_with_overweight, FAVC, FCVC, NCP, CAEC, SMOKE, CH20, SCC, FAF,
## TUE, CALC, MTRANS, NObeyesdad)'

```

```

# new obesity data set has identifying column
head(obesity)

## # A tibble: 6 x 18
##   Gender Age Height Weight family_history_with_overw~1 FAVC   FCVC   NCP CAEC
##   <chr>  <dbl>  <dbl>  <dbl>  <chr>               <chr>  <dbl>  <dbl>  <chr>
## 1 Female   21    1.62   64     yes                no      2     3 Some~
## 2 Female   21    1.52   56     yes                no      3     3 Some~
## 3 Male     23    1.8     77     yes                no      2     3 Some~
## 4 Male     27    1.8     87     no                 no      3     3 Some~
## 5 Male     22    1.78   89.8   no                 no      2     1 Some~
## 6 Male     29    1.62   53     no                 yes     2     3 Some~

## # i abbreviated name: 1: family_history_with_overweight
## # i 9 more variables: SMOKE <chr>, CH20 <dbl>, SCC <chr>, FAF <dbl>, TUE <dbl>,
## #   CALC <chr>, MTRANS <chr>, NObeyesdad <chr>, id <dbl>

```

The data consist of the estimation of obesity levels in people from the countries of Mexico, Peru and Colombia, with ages between 14 and 61 and diverse eating habits and physical condition, the original data was collected using a web platform with a survey where anonymous users answered each question, then the information was processed obtaining 17 attributes and 2111 records.

Additional data was generated from a deep learning model trained on the original “Obesity or CVD risk” dataset (obes), which will be incorporated to the original dataset.

Data Source: Obesity risk dataset

```

# Check for any NA values in dataset
sum(is.na(obesity))

```

b: Data cleaning

```

## [1] 2111

summary(obesity) # NA values only in 'id' column

```

```

##   Gender          Age          Height         Weight
##   Length:22869    Min.   :14.00    Min.   :1.450    Min.   : 39.00
##   Class  :character 1st Qu.:20.00   1st Qu.:1.632   1st Qu.: 66.00
##   Mode   :character Median :22.82   Median :1.700   Median : 84.00
##                               Mean   :23.89   Mean   :1.700   Mean   : 87.77
##                               3rd Qu.:26.00   3rd Qu.:1.763   3rd Qu.:111.53
##                               Max.  :61.00   Max.  :1.980   Max.  :173.00
##
##   family_history_with_overweight      FAVC           FCVC
##   Length:22869                      Length:22869    Min.   :1.000
##   Class  :character                  Class  :character 1st Qu.:2.000
##   Mode   :character                  Mode   :character Median :2.393
##                               Mean   :2.443
##                               3rd Qu.:3.000
##                               Max.  :3.000

```

```

##          NCP           CAEC          SMOKE          CH20
##  Min.   :1.000  Length:22869  Length:22869  Min.   :1.000
##  1st Qu.:3.000  Class  :character  Class  :character  1st Qu.:1.756
##  Median :3.000  Mode   :character  Mode   :character  Median :2.000
##  Mean   :2.754
##  3rd Qu.:3.000
##  Max.   :4.000
##
##          SCC           FAF           TUE           CALC
##  Length:22869  Min.   :0.00000  Min.   :0.0000  Length:22869
##  Class  :character  1st Qu.:0.01586  1st Qu.:0.0000  Class  :character
##  Mode   :character  Median :1.00000  Median :0.5795  Mode   :character
##                      Mean   :0.98438  Mean   :0.6206
##                      3rd Qu.:1.59658  3rd Qu.:1.0000
##                      Max.   :3.00000  Max.   :2.0000
##
##          MTRANS        NObeyesdad      id
##  Length:22869  Length:22869  Min.   :    0
##  Class  :character  Class  :character  1st Qu.: 5189
##  Mode   :character  Mode   :character  Median :10378
##                      Mean   :10378
##                      3rd Qu.:15568
##                      Max.   :20757
##                      NA's   :2111

# remove ID column, which happens to also have NA values
obesity <- obesity %>% select(-c("id"))

# Double check no NA values
sum(is.na(obesity))

```

```
## [1] 0
```

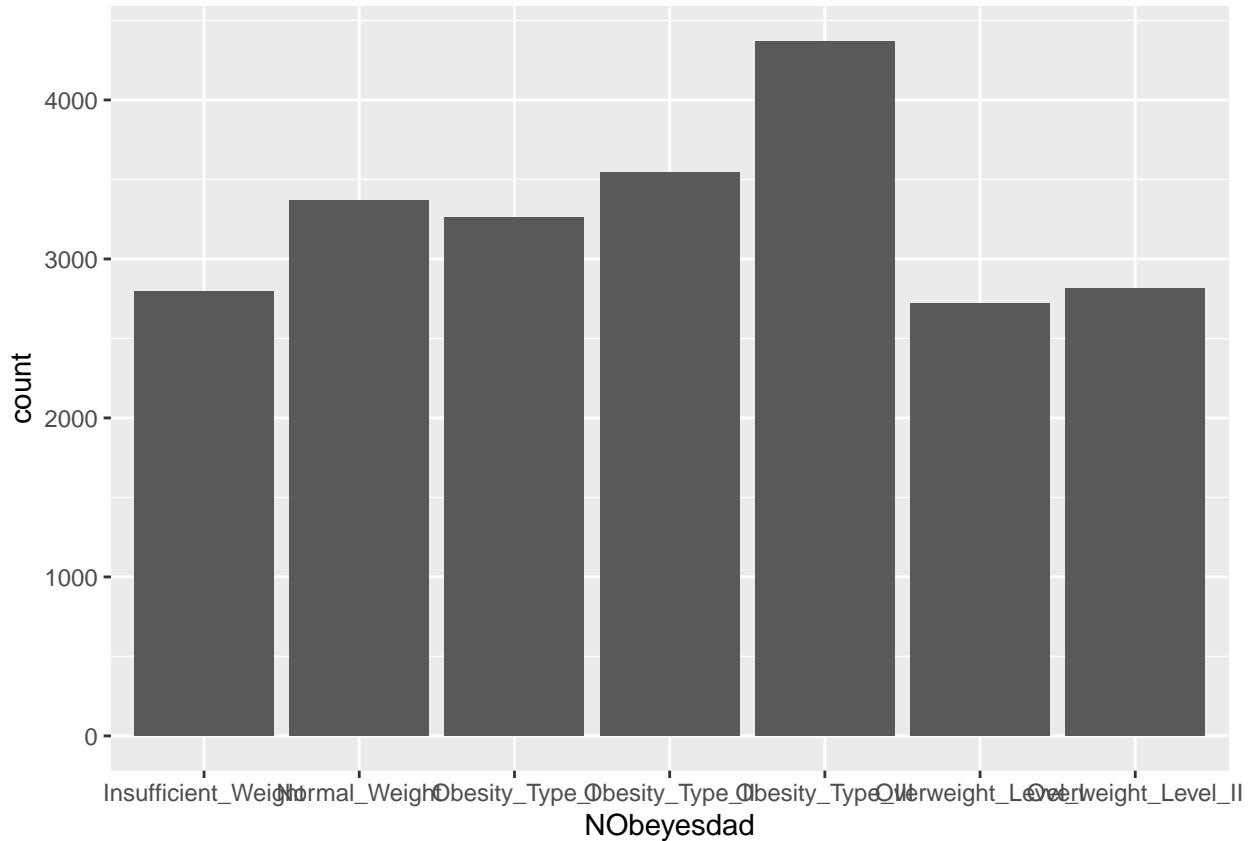
The attributes related with eating habits are: Frequent consumption of high caloric food (FAVC), Frequency of consumption of vegetables (FCVC), Number of main meals (NCP), Consumption of food between meals (CAEC), Consumption of water daily (CH20), and Consumption of alcohol (CALC). The attributes related with the physical condition are: Calories consumption monitoring (SCC), Physical activity frequency (FAF), Time using technology devices (TUE), Transportation used (MTRANS). All NA values were removed from the dataset, which also happened to be the identifying variable from the additional data set appended to the original dataset. All numeric variables were on similar scales, except for age and weight.

```
# Check class values
unique(obesity$NObeyesdad)
```

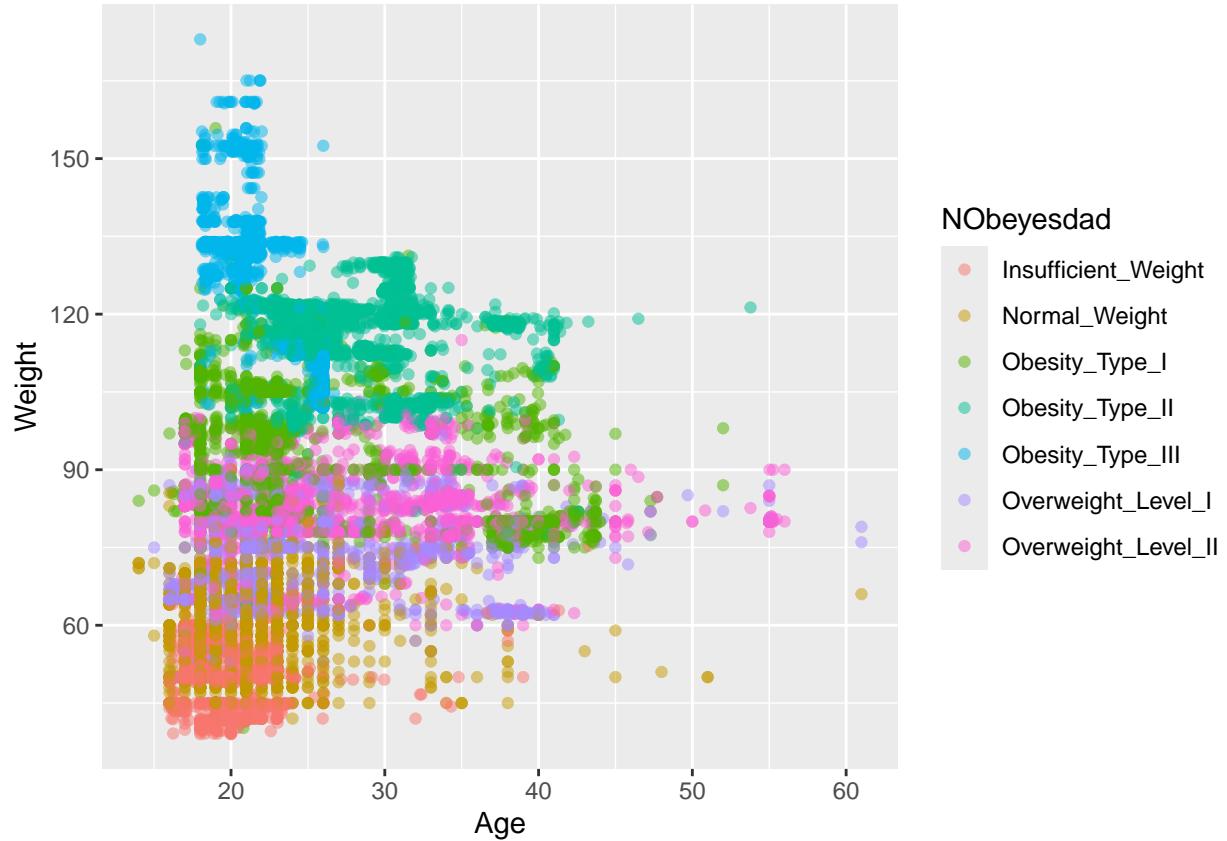
c: Data exploration

```
## [1] "Normal_Weight"      "Overweight_Level_I"  "Overweight_Level_II"
## [4] "Obesity_Type_I"     "Insufficient_Weight" "Obesity_Type_II"
## [7] "Obesity_Type_III"
```

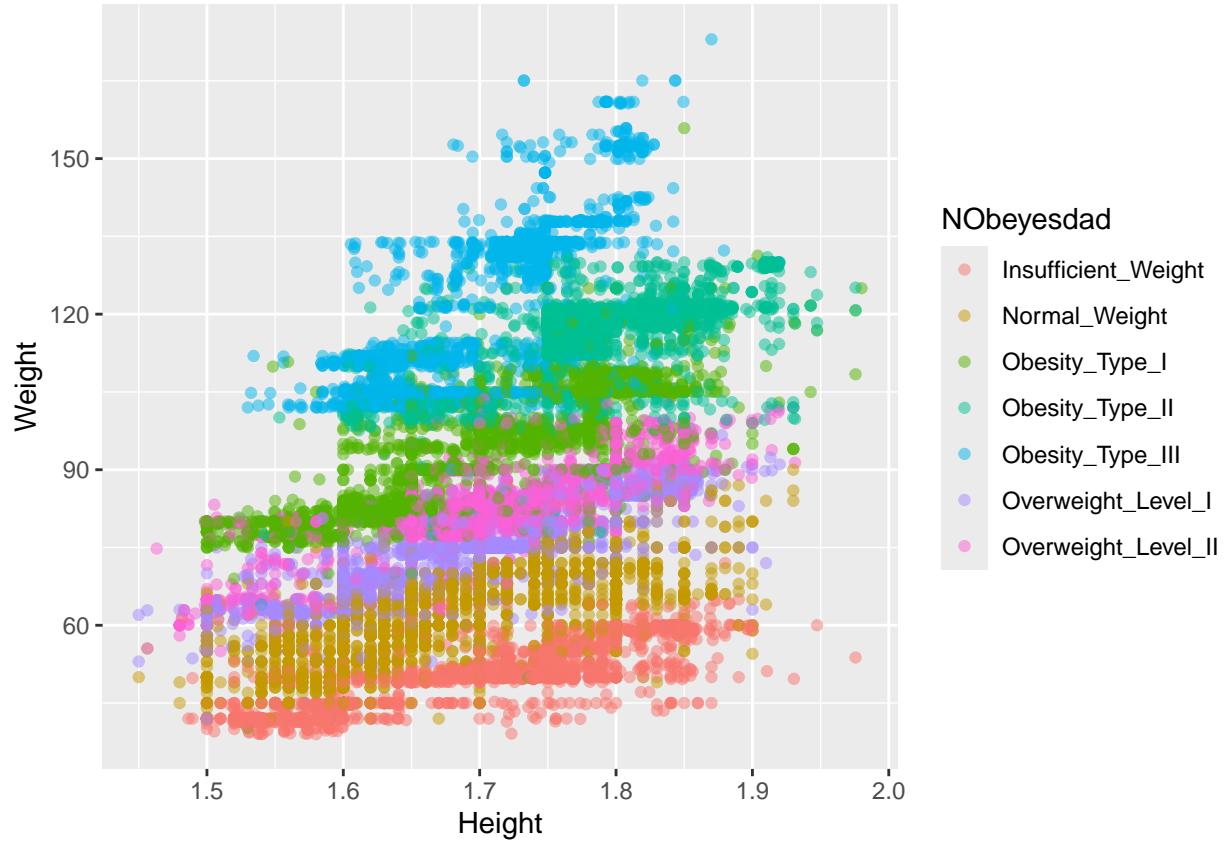
```
ggplot(obesity, aes(NObeyesdad)) + geom_bar()
```

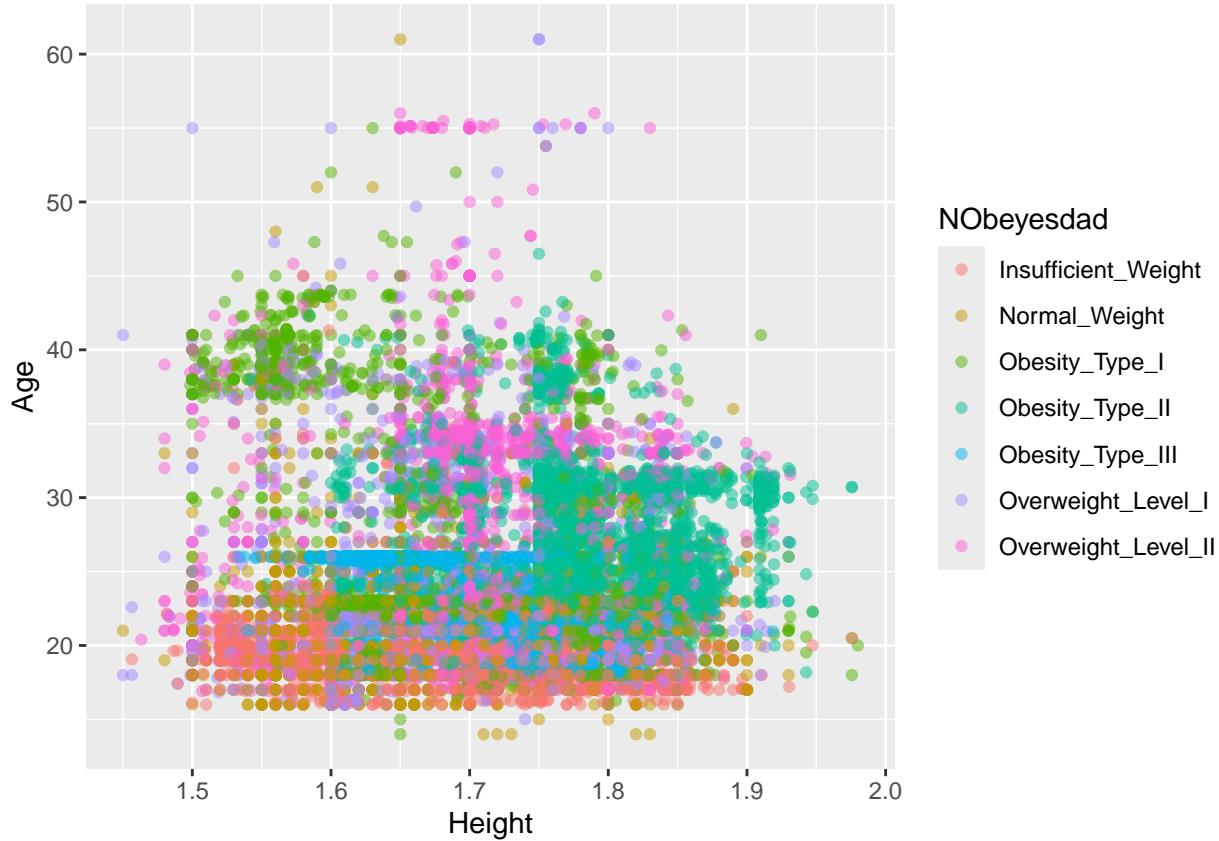


```
# Scatter plot of Age, Weight, Height Against NObeyesdad  
ggplot(obesity, aes(Age, Weight)) + geom_point(aes(color = NObeyesdad), alpha=0.5)
```



```
ggplot(obesity, aes(Height, Weight)) + geom_point(aes(color = NObeyesdad), alpha=0.5)
```





As a result of the bar chart of the categorical target variable, the dataset contains equivalent number of each target class. It's difficult to distinguish any relationship between the target variable and obvious contributing factors to BMI classifications, such as age, weight, and height. There are 7 unique classes for the target NOObeyesdad variable. It would be worthwhile for a feature engineer of BMI for each individual and discover any relationship between it and the target.

```
library(ggplot2)
library(caret)
```

D: Preprocessing

```
## Loading required package: lattice

##
## Attaching package: 'caret'

## The following object is masked from 'package:purrr':
## 
##     lift
```

```

library(dplyr)
library(ggcorrplot)

# Feature Engineering: Calculate BMI from Height and Weight Variables
obesity$BMI <- obesity$Weight / (obesity$Height ** 2)
head(obesity)

```

```

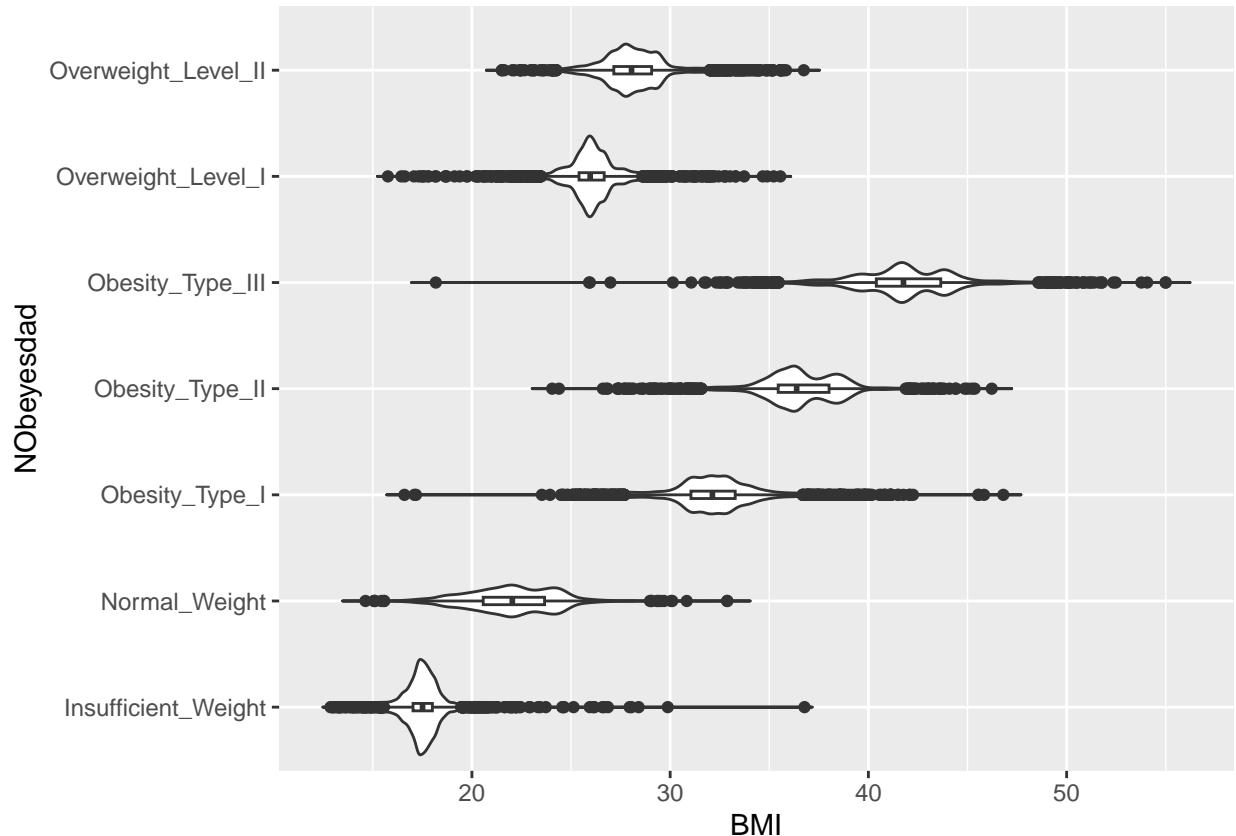
## # A tibble: 6 x 18
##   Gender    Age Height Weight family_history_with_overweight FAVC   FCVC   NCP CAEC
##   <chr>   <dbl>  <dbl>  <dbl> <chr>                  <chr>   <dbl>  <dbl> <chr>
## 1 Female    21    1.62    64 yes                   no      2     3 Some-
## 2 Female    21    1.52    56 yes                   no      3     3 Some-
## 3 Male      23    1.8     77 yes                   no      2     3 Some-
## 4 Male      27    1.8     87 no                    no      3     3 Some-
## 5 Male      22    1.78   89.8 no                   no      2     1 Some-
## 6 Male      29    1.62    53 no                   yes     2     3 Some-
## # i abbreviated name: 1: family_history_with_overweight
## # i 9 more variables: SMOKE <chr>, CH20 <dbl>, SCC <chr>, FAF <dbl>, TUE <dbl>,
## #   CALC <chr>, MTRANS <chr>, NObeyesdad <chr>, BMI <dbl>

```

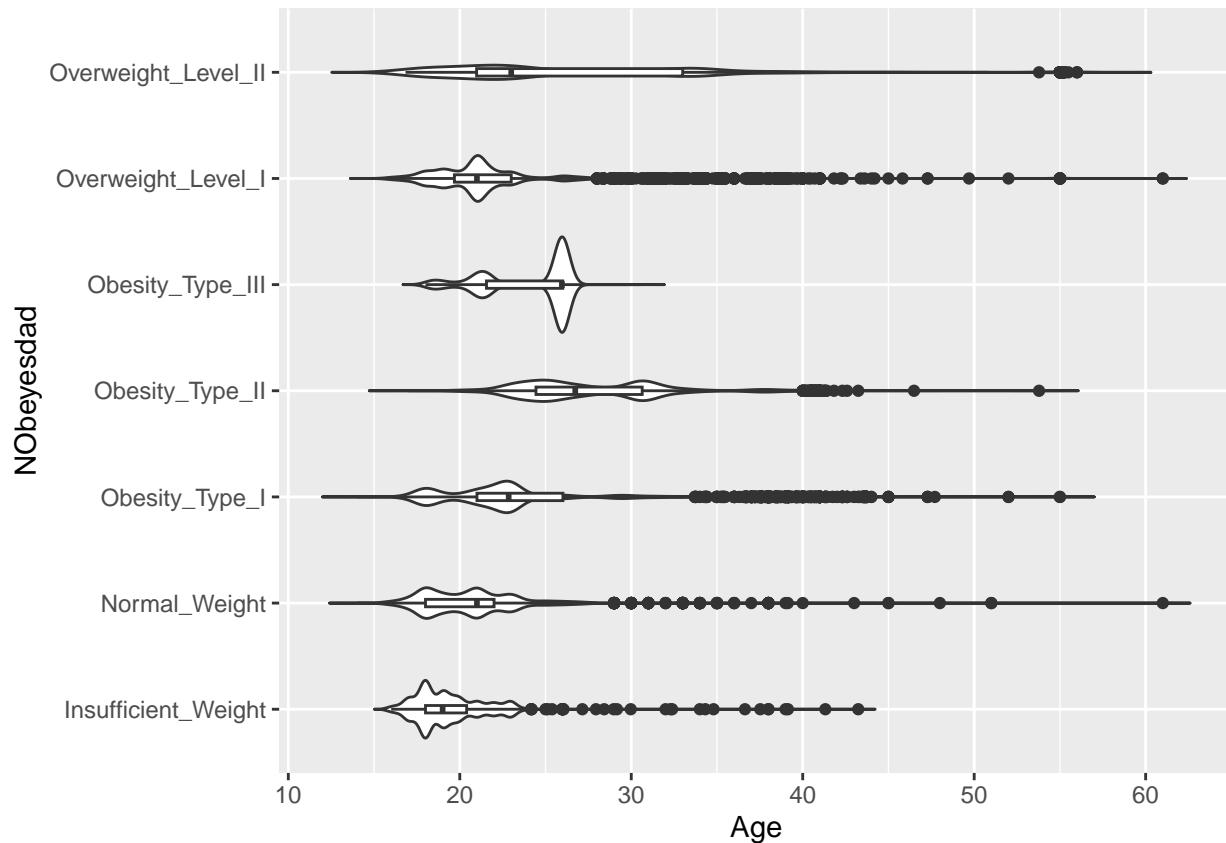
```

# Boxplot/Violin Plot to Illustrate Distribution of BMI for each BMI Class
ggplot(obesity, aes(NObeyesdad, BMI)) + geom_violin(trim = FALSE) + geom_boxplot(width = 0.07) + coord_

```



```
# Boxplot/Violin Plot to Illustrate Distribution of Age for each BMI Class
ggplot(obesity, aes(NObeyesdad, Age)) + geom_violin(trim = FALSE) + geom_boxplot(width = 0.07) + coord_flip()
```



```
# Dummy Variables for Binary Columns
obesity_num <- obesity
obesity_num[,c("SCC", "SMOKE", "FAVC", "family_history_with_overweight")] <- ifelse(obesity_num[,c("SCC", "SMOKE", "FAVC", "family_history_with_overweight")] == "Yes", 1, 0)
obesity_num[,c("Gender")] <- ifelse(obesity_num[,c("Gender")] == "Male", 1, 0)
head(obesity_num)
```

```
## # A tibble: 6 x 18
##   Gender    Age Height Weight family_history_with_overweight FAVC FCVC NCP CAEC
##   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>
## 1     0     21    1.62    64                1     0     2     3 Some-
## 2     0     21    1.52    56                1     0     3     3 Some-
## 3     1     23    1.8      77                1     0     2     3 Some-
## 4     1     27    1.8      87                0     0     3     3 Some-
## 5     1     22    1.78    89.8               0     0     2     1 Some-
## 6     1     29    1.62    53                 0     1     2     3 Some-
## # i abbreviated name: 1: family_history_with_overweight
## # i 9 more variables: SMOKE <dbl>, CH20 <dbl>, SCC <dbl>, FAF <dbl>, TUE <dbl>,
## #   CALC <chr>, MTRANS <chr>, NObeyesdad <chr>, BMI <dbl>
```

```
# One Hot Encoding for Multi-Categorical variables
class <- data.frame(obesity_num$NObeyesdad)
head(class)
```

```

##    obesity_num.NObeyesdad
## 1      Normal_Weight
## 2      Normal_Weight
## 3      Normal_Weight
## 4 Overweight_Level_I
## 5 Overweight_Level_II
## 6      Normal_Weight

att <- obesity_num %>% select(-c("NObeyesdad"))
dummy <- dummyVars(~ ., data = att)
new_Obesity <- data.frame(predict(dummy, newdata = att))
final_Obesity <- cbind(new_Obesity, class)
head(final_Obesity)

##   Gender Age Height Weight family_history_with_overweight FAVC FCVC NCP
## 1      0   21    1.62    64.0                         1     0     2     3
## 2      0   21    1.52    56.0                         1     0     3     3
## 3      1   23    1.80    77.0                         1     0     2     3
## 4      1   27    1.80    87.0                         0     0     3     3
## 5      1   22    1.78    89.8                         0     0     2     1
## 6      1   29    1.62    53.0                         0     1     2     3
##   CAECAlways CAECFrequently CAECno CAECSometimes SMOKE CH20 SCC FAF TUE
## 1          0            0       0           1     0     2     0     0     1
## 2          0            0       0           1     1     3     1     3     0
## 3          0            0       0           1     0     2     0     2     1
## 4          0            0       0           1     0     2     0     2     0
## 5          0            0       0           1     0     2     0     0     0
## 6          0            0       0           1     0     2     0     0     0
##   CALCAlways CALCfrequently CALCno CALCSometimes MTRANSAutomobile MTRANSBike
## 1          0            0       1           0             0       0
## 2          0            0       0           1             0       0
## 3          0            1       0           0             0       0
## 4          0            1       0           0             0       0
## 5          0            0       0           1             0       0
## 6          0            0       0           1             1       0
##   MTRANSMotorbike MTRANSpublic_Transportation MTRANSWalking      BMI
## 1          0                      1           0 24.38653
## 2          0                      1           0 24.23823
## 3          0                      1           0 23.76543
## 4          0                      0           1 26.85185
## 5          0                      1           0 28.34238
## 6          0                      0           0 20.19509

head(final_Obesity)

##   Gender Age Height Weight family_history_with_overweight FAVC FCVC NCP
## 1      0   21    1.62    64.0                         1     0     2     3
## 2      0   21    1.52    56.0                         1     0     3     3
## 3      1   23    1.80    77.0                         1     0     2     3
## 4      1   27    1.80    87.0                         0     0     3     3
## 5      1   22    1.78    89.8                         0     0     2     1
## 6      1   29    1.62    53.0                         0     1     2     3
##   CAECAlways CAECFrequently CAECno CAECSometimes SMOKE CH20 SCC FAF TUE

```

```

## 1      0      0      0      1      0      2      0      0      1
## 2      0      0      0      1      1      3      1      3      0
## 3      0      0      0      1      0      2      0      2      1
## 4      0      0      0      1      0      2      0      2      0
## 5      0      0      0      1      0      2      0      0      0
## 6      0      0      0      1      0      2      0      0      0
##   CALCALways CALCFrequently CALCnno CALCSometimes MTRANSAutomobile MTRANSBike
## 1      0      0      1      0      0      0
## 2      0      0      0      1      0      0
## 3      0      1      0      0      0      0
## 4      0      1      0      0      0      0
## 5      0      0      0      1      0      0
## 6      0      0      0      1      1      0
##   MTRANSMotorbike MTRANSPublic_Transportation MTRANSWalking      BMI
## 1      0                  1      0 24.38653
## 2      0                  1      0 24.23823
## 3      0                  1      0 23.76543
## 4      0                  0      1 26.85185
## 5      0                  1      0 28.34238
## 6      0                  0      0 20.19509
##   obesity_num.NObeyesdad
## 1      Normal_Weight
## 2      Normal_Weight
## 3      Normal_Weight
## 4      Overweight_Level_I
## 5      Overweight_Level_II
## 6      Normal_Weight

# final_Obesity will used for model building, where all numeric variables are necessary
final_Obesity <- final_Obesity %>% rename(bmiCategory = obesity_num.NObeyesdad)
final_Obesity$bmiCategory <- as.factor(final_Obesity$bmiCategory)
head(final_Obesity)

##   Gender Age Height Weight family_history_with_overweight FAVC FCVC NCP
## 1      0  21    1.62   64.0                      1      0      2      3
## 2      0  21    1.52   56.0                      1      0      3      3
## 3      1  23    1.80   77.0                      1      0      2      3
## 4      1  27    1.80   87.0                      0      0      3      3
## 5      1  22    1.78   89.8                      0      0      2      1
## 6      1  29    1.62   53.0                      0      1      2      3
##   CAECALways CAECFrequently CAECnno CAECSometimes SMOKE CH2O SCC FAF TUE
## 1      0      0      0      1      0      2      0      0      1
## 2      0      0      0      1      1      3      1      3      0
## 3      0      0      0      1      0      2      0      2      1
## 4      0      0      0      1      0      2      0      2      0
## 5      0      0      0      1      0      2      0      0      0
## 6      0      0      0      1      0      2      0      0      0
##   CALCALways CALCFrequently CALCnno CALCSometimes MTRANSAutomobile MTRANSBike
## 1      0      0      1      0      0      0
## 2      0      0      0      1      0      0
## 3      0      1      0      0      0      0
## 4      0      1      0      0      0      0
## 5      0      0      0      1      0      0
## 6      0      0      0      1      1      0

```

```

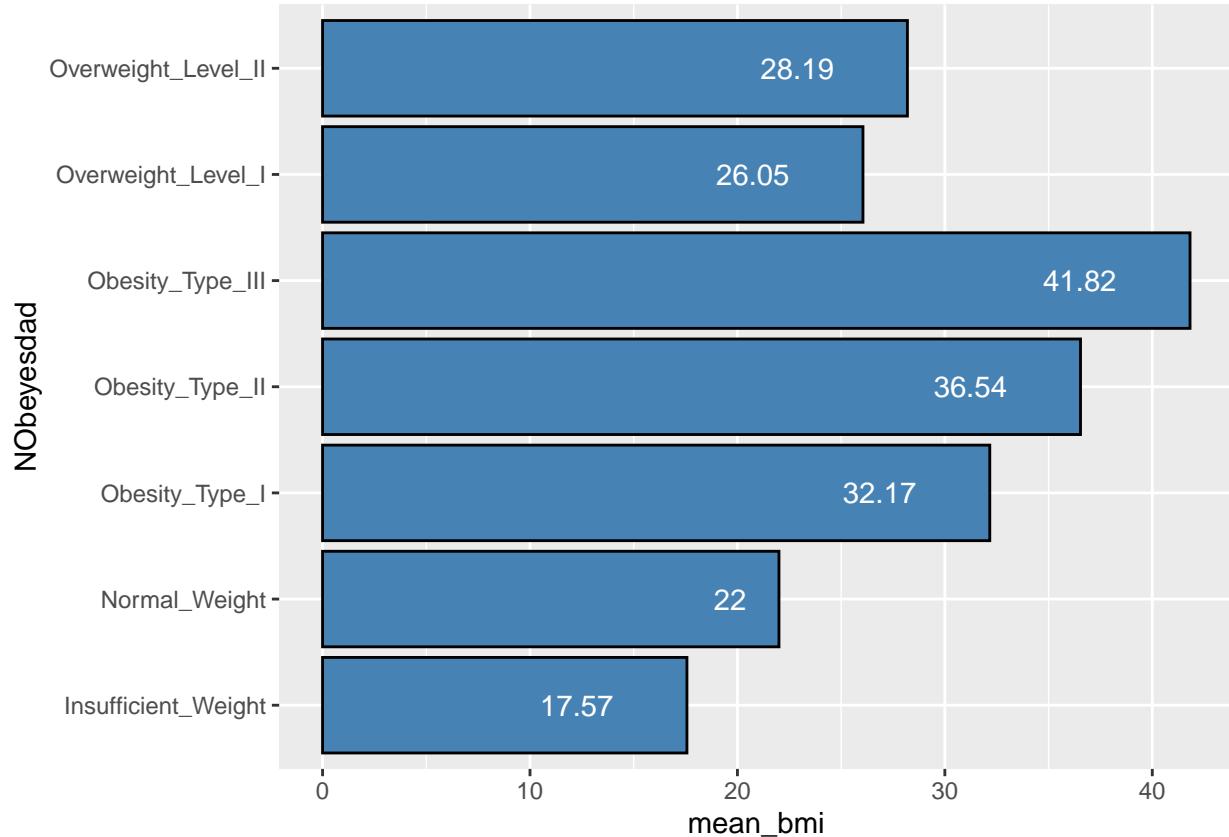
##    MTRANSMotorbike MTRANSPublic_Transportation MTRANSWalking      BMI
## 1          0                  1          0 24.38653
## 2          0                  1          0 24.23823
## 3          0                  1          0 23.76543
## 4          0                  0          1 26.85185
## 5          0                  1          0 28.34238
## 6          0                  0          0 20.19509
##           bmiCategory
## 1      Normal_Weight
## 2      Normal_Weight
## 3      Normal_Weight
## 4 Overweight_Level_I
## 5 Overweight_Level_II
## 6      Normal_Weight

# For data exploration, obesity data set will be utilized
# Mean BMI for Each Class
meanBMI <- obesity %>% group_by(Noobeyesdad) %>% summarise(mean_bmi = mean(BMI))
head(meanBMI)

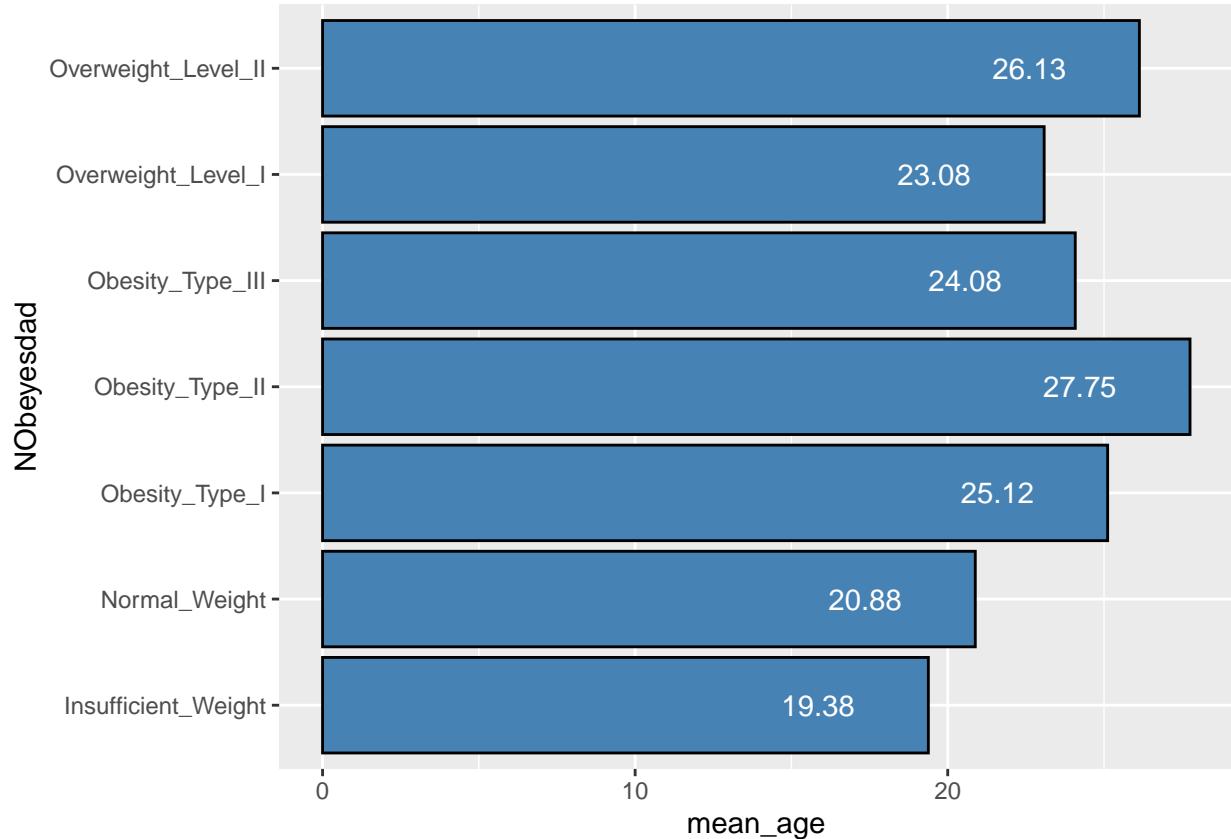
## # A tibble: 6 x 2
##   Noobeyesdad     mean_bmi
##   <chr>            <dbl>
## 1 Insufficient_Weight    17.6
## 2 Normal_Weight        22.0
## 3 Obesity_Type_I       32.2
## 4 Obesity_Type_II      36.5
## 5 Obesity_Type_III     41.8
## 6 Overweight_Level_I    26.1

ggplot(meanBMI, aes(x = mean_bmi, y = Noobeyesdad)) + geom_bar(stat = "identity", fill = 'steelblue', co

```



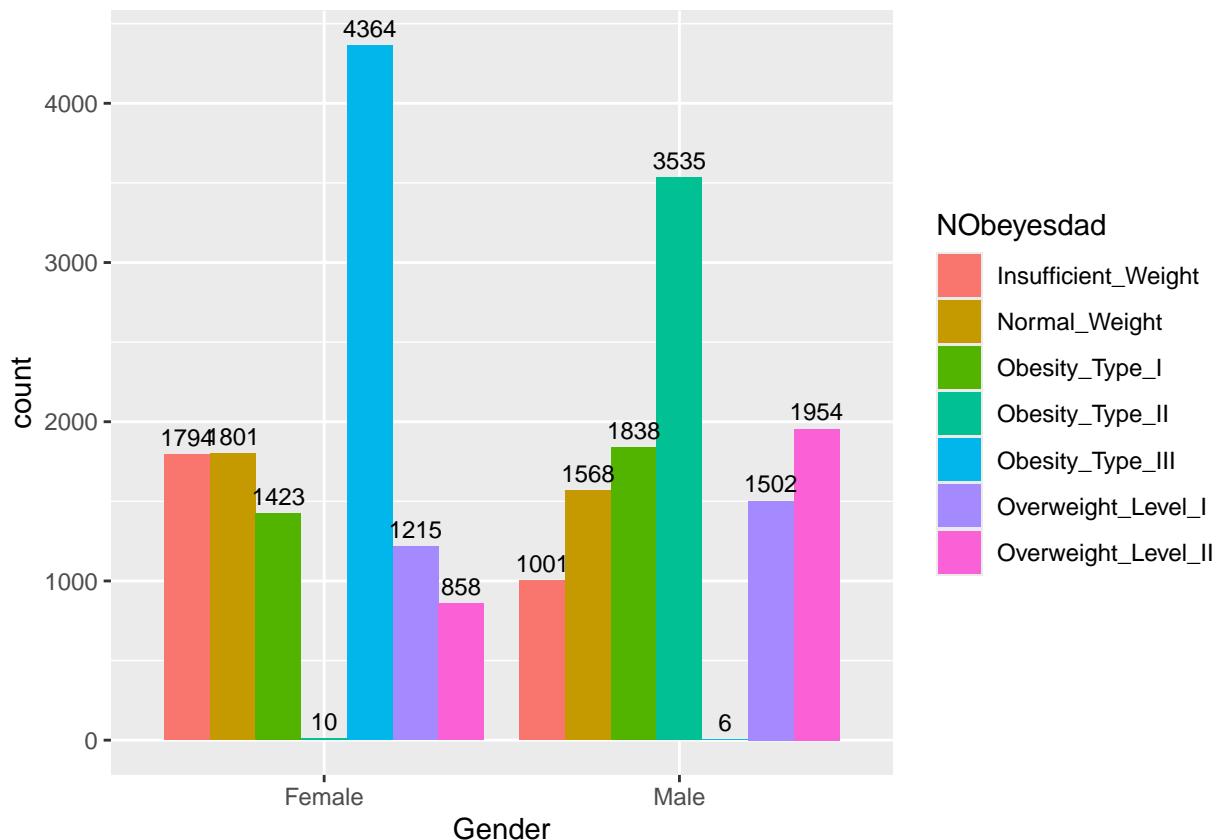
```
# Mean Age for Each Class
meanAge <- obesity %>% group_by(NObeyesdad) %>% summarise(mean_age = mean(Age))
ggplot(meanAge, aes(x = mean_age, y = NObeyesdad)) + geom_bar(stat = "identity", fill = 'steelblue', co
```



```
countPerClassByGender <- obesity %>% group_by(NObeyesdad) %>% group_by(Gender) %>% summarise(n = n())
head(countPerClassByGender)
```

```
## # A tibble: 2 x 2
##   Gender     n
##   <chr>   <int>
## 1 Female 11465
## 2 Male   11404
```

```
# Visualize BMI Class by Gender
gender_class <- obesity %>% count(Gender, NObeyesdad) %>% rename(count = n)
ggplot(gender_class,aes(Gender, count, fill = NObeyesdad)) + geom_col(position = 'dodge') + geom_text(ae
```

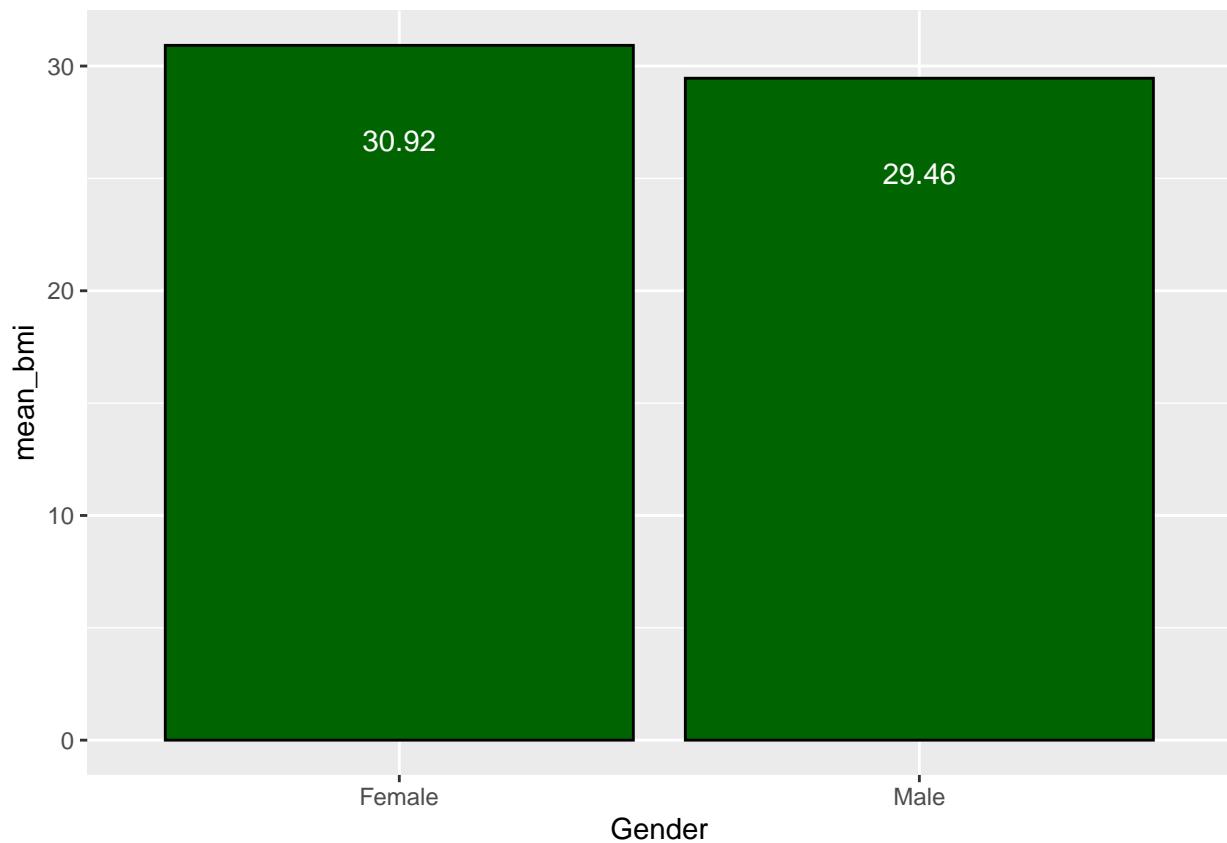


```
# Mean BMI for Each Gender
```

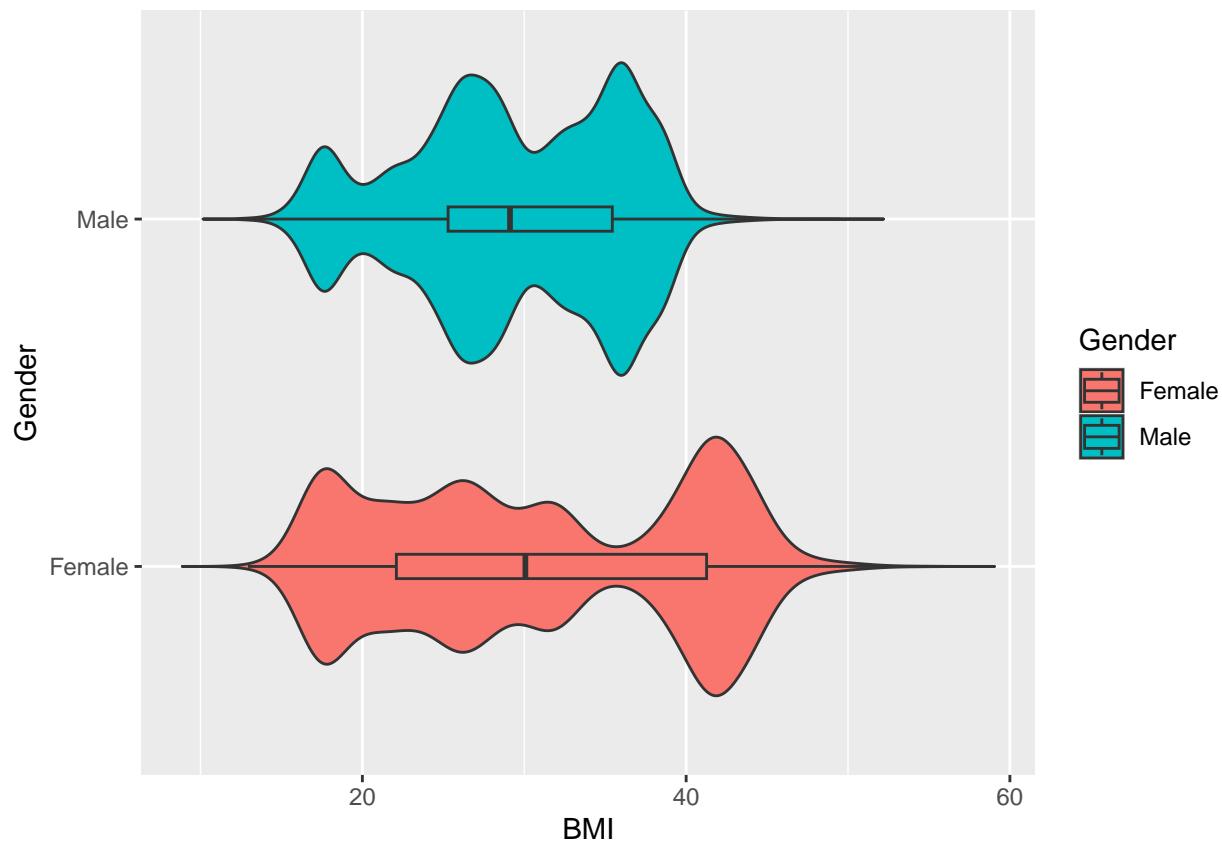
```
meanBMIGender <- obesity %>% group_by(Gender) %>% summarise(mean_bmi = mean(BMI))
head(meanBMIGender)
```

```
## # A tibble: 2 x 2
##   Gender   mean_bmi
##   <chr>     <dbl>
## 1 Female    30.9
## 2 Male      29.5
```

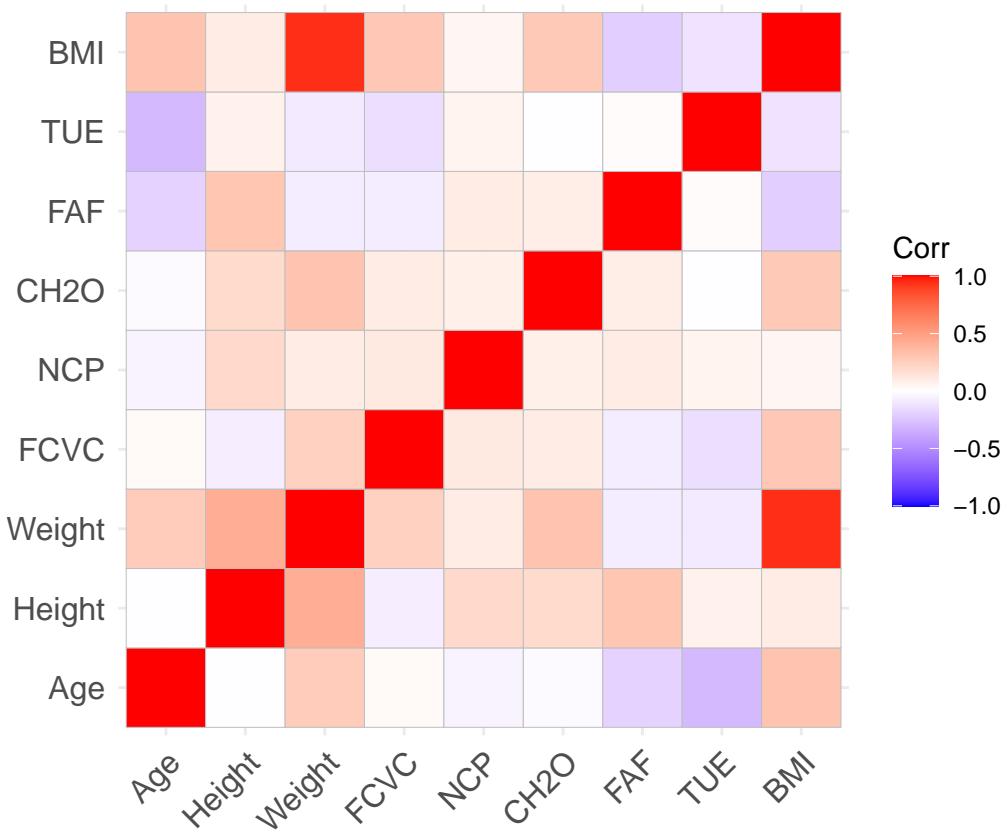
```
ggplot(meanBMIGender, aes(x = Gender, y = mean_bmi)) + geom_bar(stat = "identity", fill = 'darkgreen',
```



```
# Distribution of BMI by Gender  
ggplot(obesity, aes(Gender, BMI, fill = Gender)) + geom_violin(trim = FALSE) + geom_boxplot(width = 0.05)
```

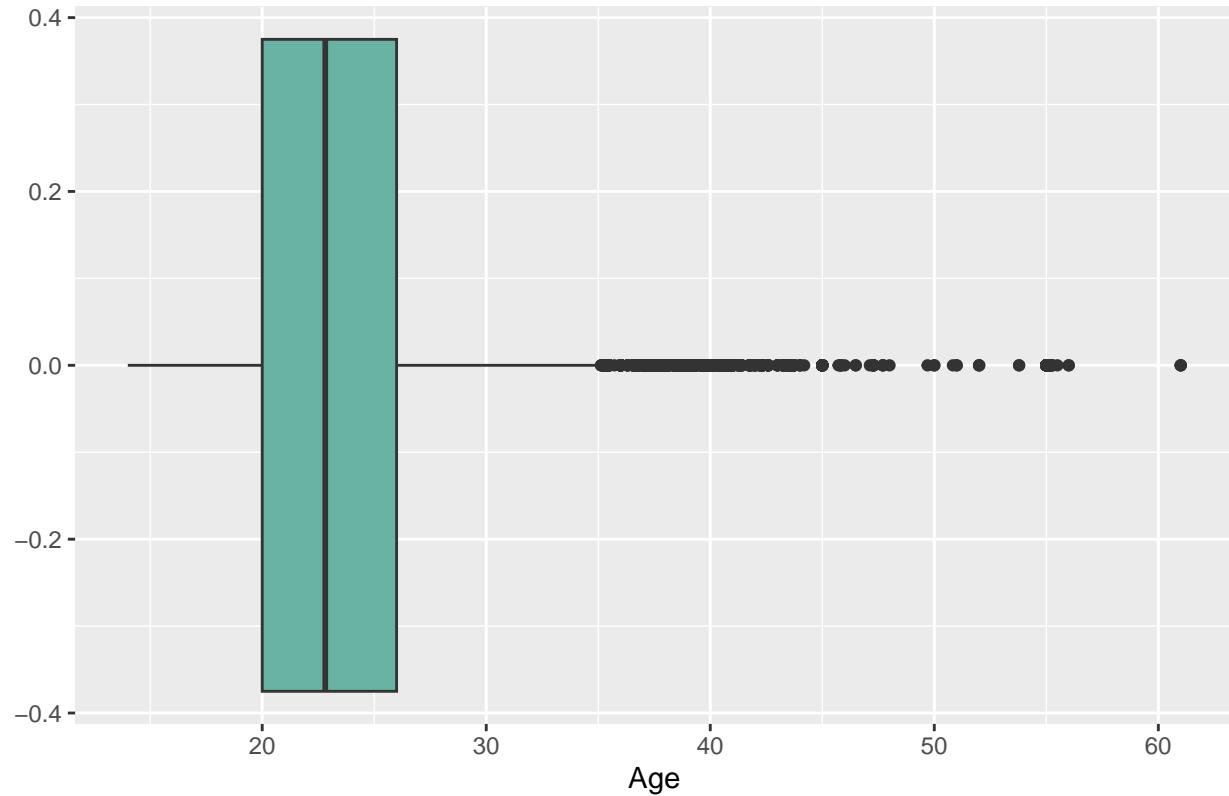


```
# Correlation Matrix Heatmap
obesity_corr <- obesity %>% select_if(is.numeric)
ggcorrplot(cor(obesity_corr))
```



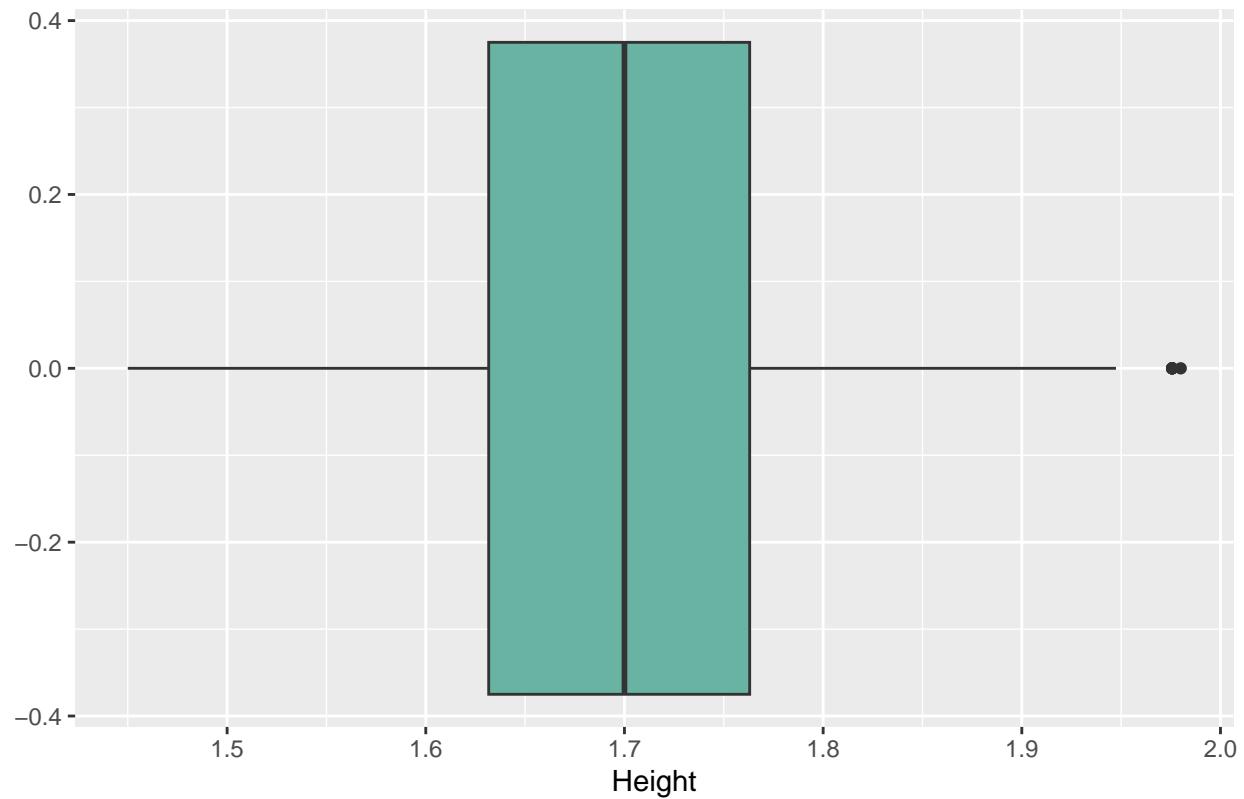
```
# Outlier Detection for all Numeric Variables (pre-dummyVars/OneHotEncoding)
ggplot(obesity, aes(Age)) + geom_boxplot(fill = "#69b3a2") +
  ggtitle("Boxplot of Age") + theme(plot.title = element_text(hjust=0.5))
```

Boxplot of Age



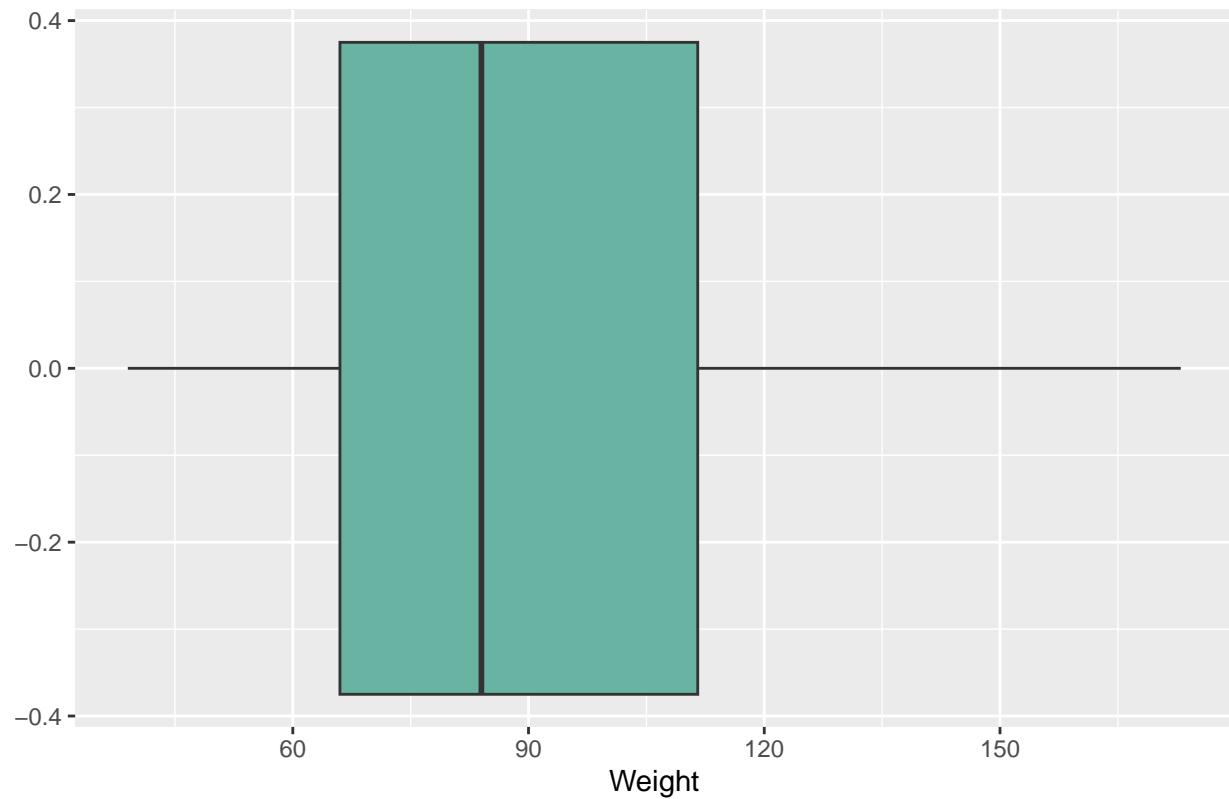
```
ggplot(obesity, aes(Height)) + geom_boxplot(fill = "#69b3a2") +
  ggtitle("Boxplot of Height") + theme(plot.title = element_text(hjust=0.5))
```

Boxplot of Height



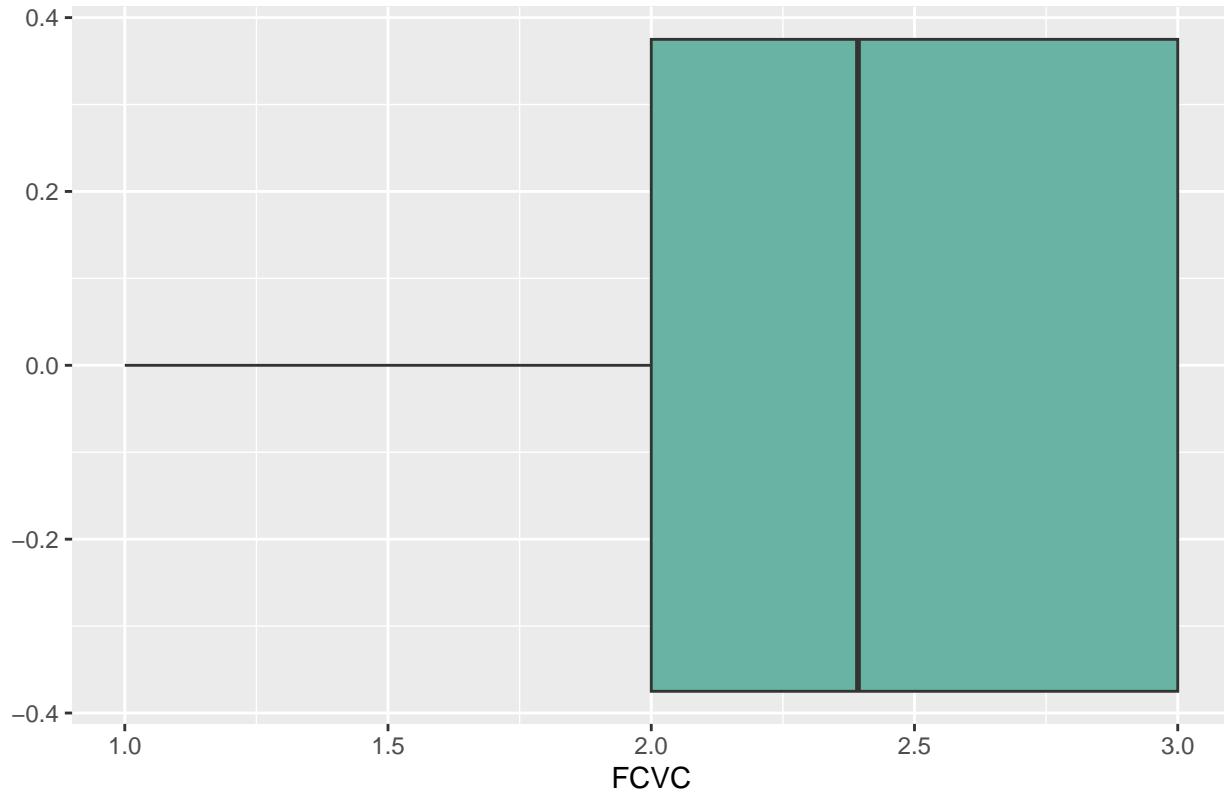
```
ggplot(obesity, aes(Weight)) + geom_boxplot(fill = "#69b3a2") +
  ggtitle("Boxplot of Weight") + theme(plot.title = element_text(hjust=0.5))
```

Boxplot of Weight



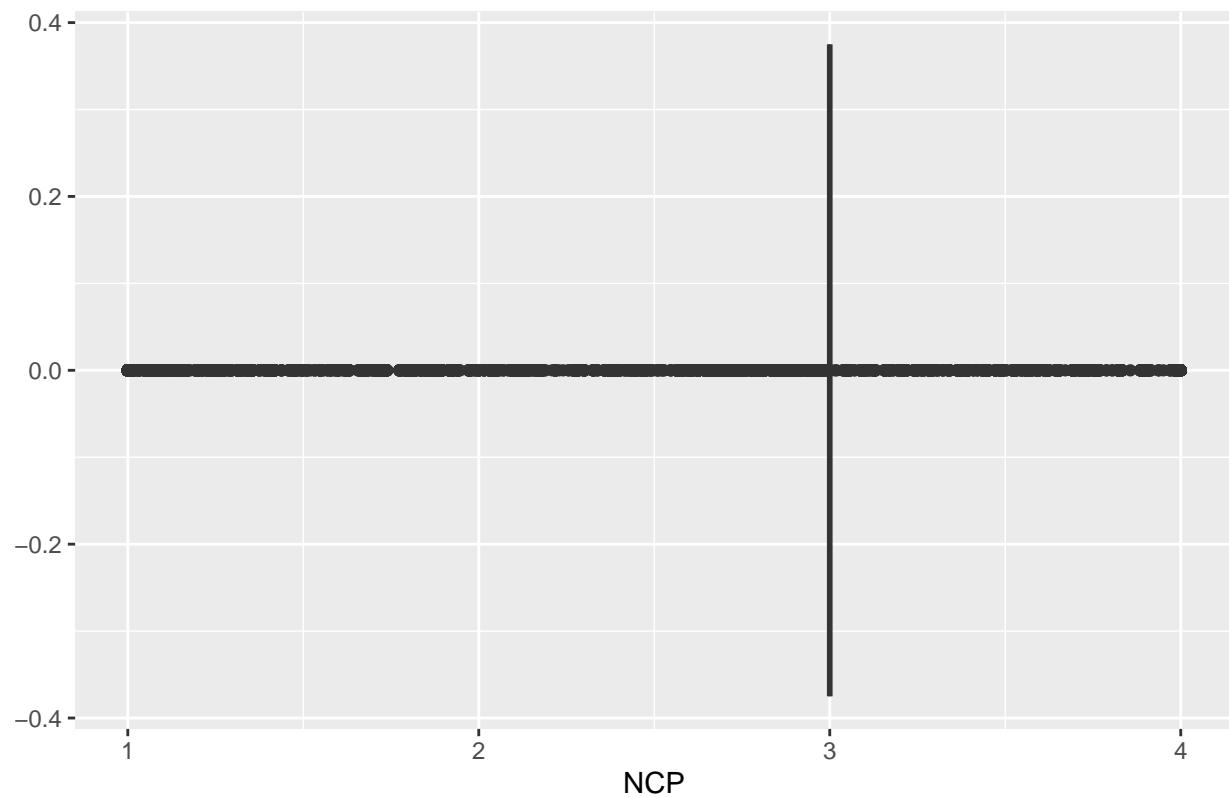
```
ggplot(obesity, aes(FCVC)) + geom_boxplot(fill = "#69b3a2") +
  ggtitle("Boxplot of Frequency of consumption of vegetables (FCVC)") + theme(plot.title = element_text
```

Boxplot of Frequency of consumption of vegetables (FCVC)



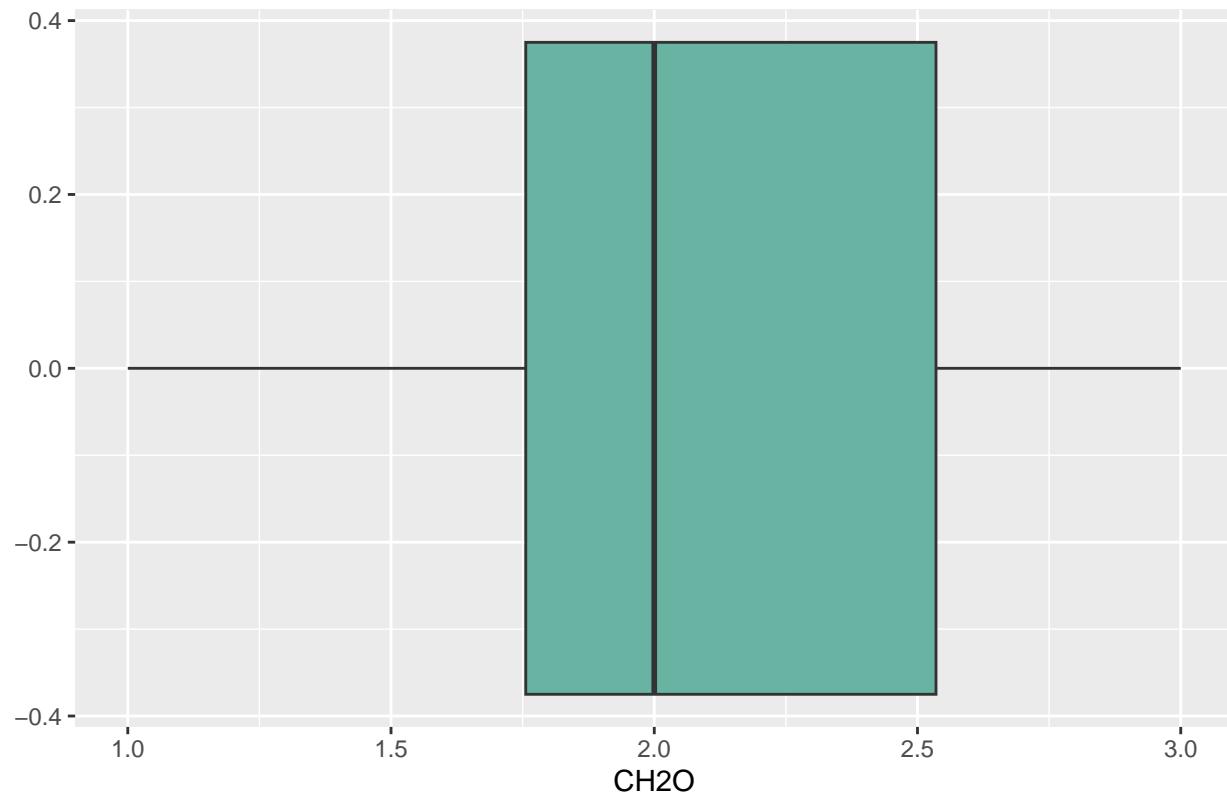
```
ggplot(obesity, aes(NCP)) + geom_boxplot(fill = "#69b3a2") +
  ggtitle("Boxplot of Number of main meals (NCP)") + theme(plot.title = element_text(hjust=0.5))
```

Boxplot of Number of main meals (NCP)



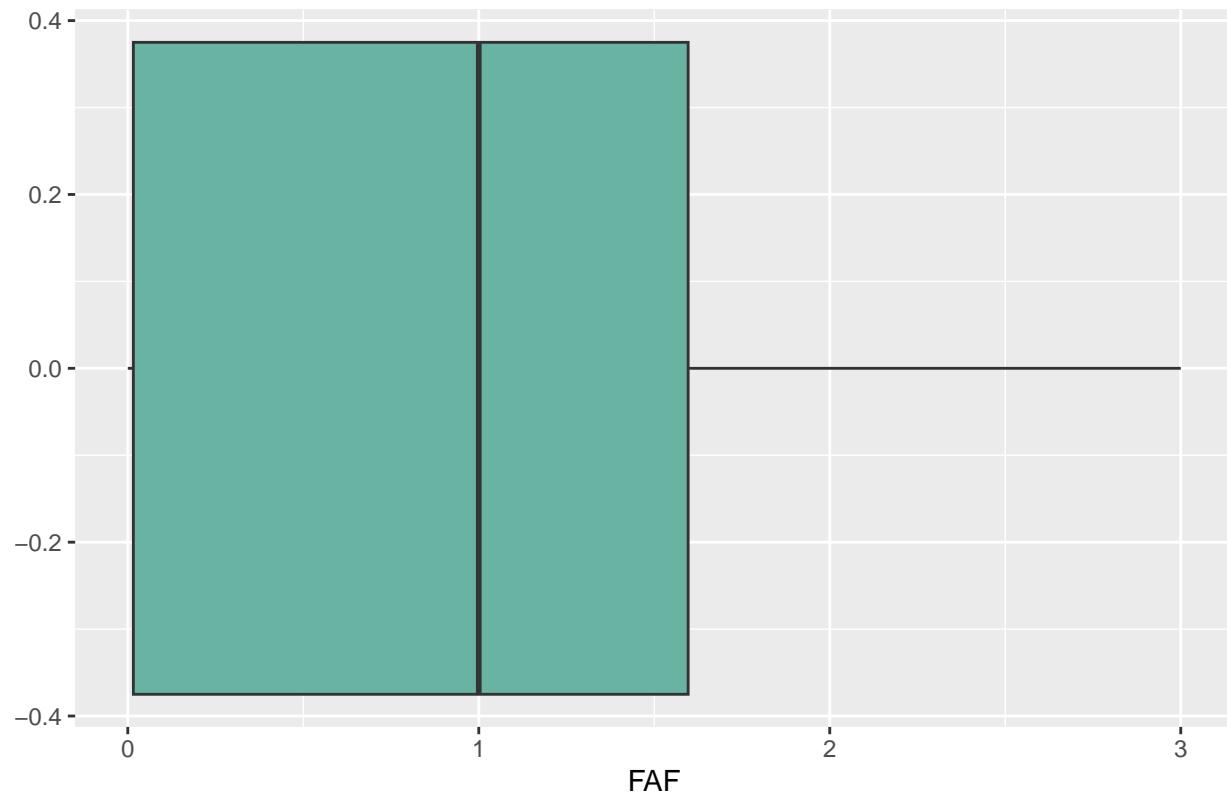
```
ggplot(obesity, aes(CH20)) + geom_boxplot(fill = "#69b3a2") +
  ggtitle("Boxplot of Consumption of water daily (CH20)") + theme(plot.title = element_text(hjust=0.5))
```

Boxplot of Consumption of water daily (CH2O)



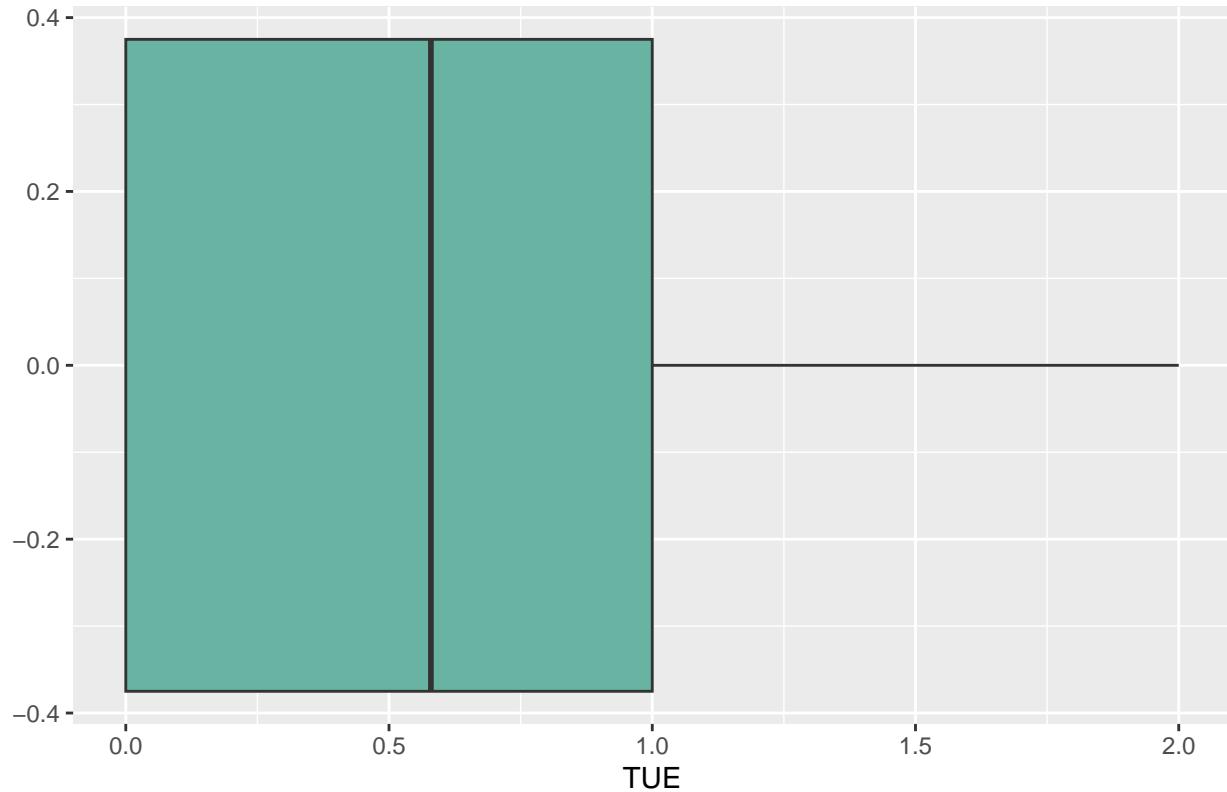
```
ggplot(obesity, aes(FAF)) + geom_boxplot(fill = "#69b3a2") +
  ggtitle("Boxplot of Physical activity frequency (FAF)") + theme(plot.title = element_text(hjust=0.5))
```

Boxplot of Physical activity frequency (FAF)

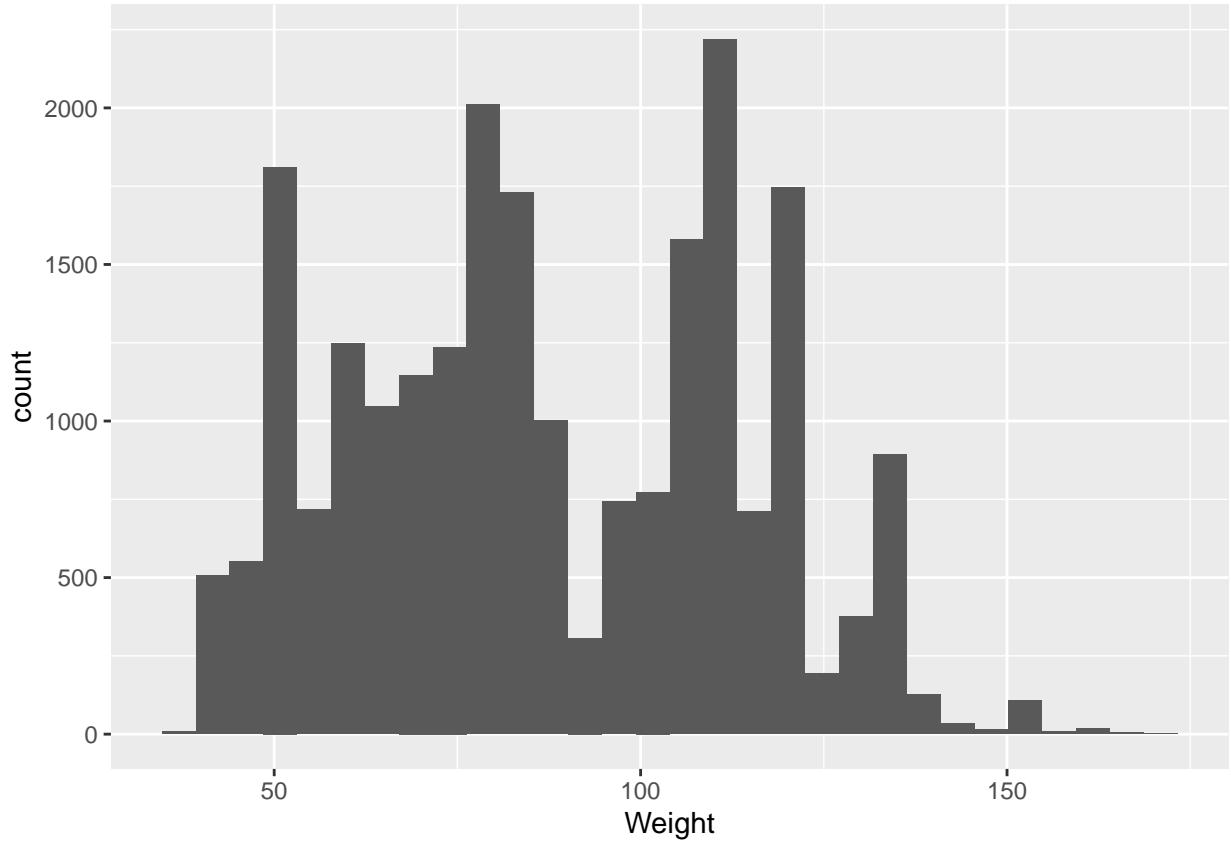


```
ggplot(obesity, aes(TUE)) + geom_boxplot(fill = "#69b3a2") +
  ggtitle("Boxplot of Time using technology devices (TUE)") + theme(plot.title = element_text(hjust=0.5))
```

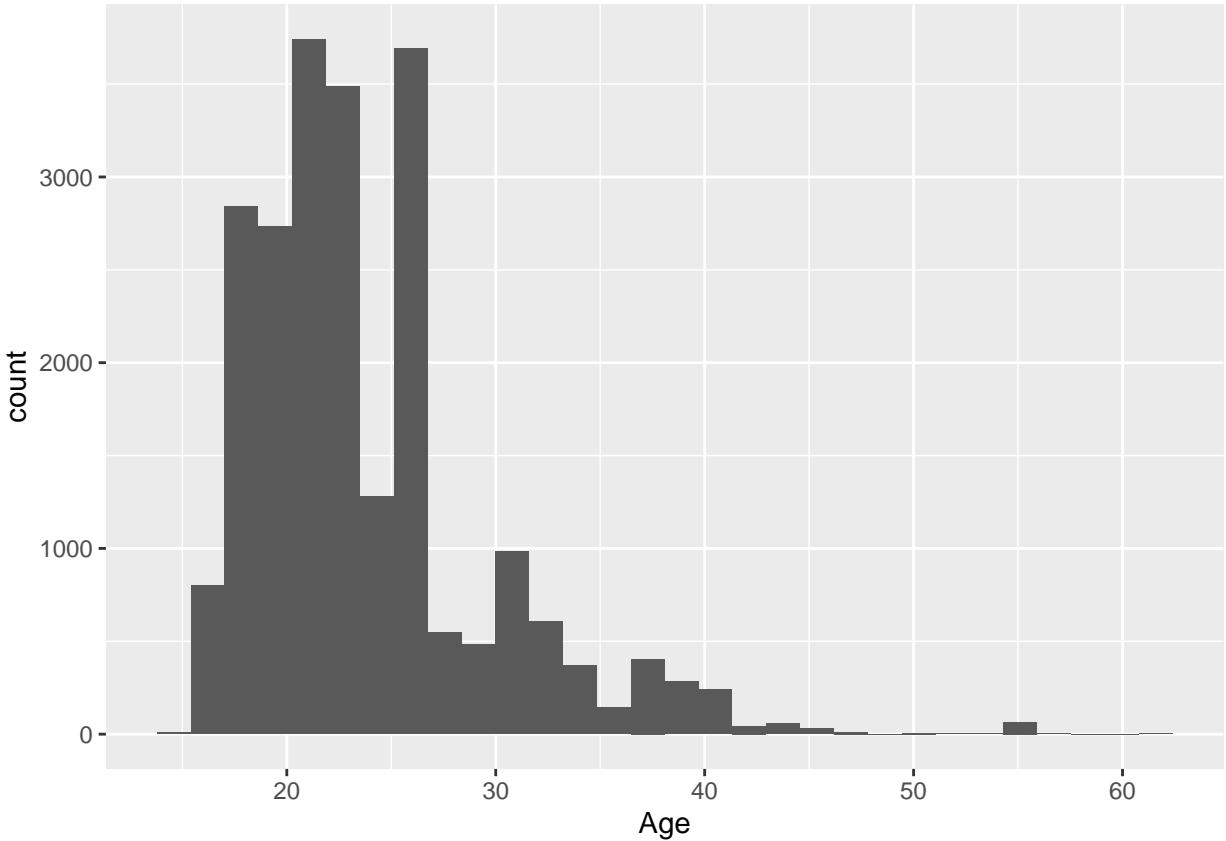
Boxplot of Time using technology devices (TUE)



```
# Check distribution of two extremely differently scaled variables to determine normalization process t  
ggplot(final_Obesity, aes(Weight)) + geom_histogram(bins=30)
```



```
ggplot(final_Obesity, aes(Age)) + geom_histogram(bins = 30)
```



```

# For purposes of the Assignment 5 - Bin the Classes into 2 groups rather than the original 7 groups
# Two groups for purposes of this Assignment 5 will be "Normal" and "Obese"
twoClassData <- final_0besity

# Min-Max Normalization
# formula:  $(x - \min(x)) / (\max(x) - \min(x)) * (new\_max - new\_min) + new\_max$ , where  $x$  is a single row data
twoClassData$Age <- ((twoClassData$Age - min(twoClassData$Age)) / (max(twoClassData$Age) - min(final_0besity$Age))) * (max(twoClassData$Age) - min(twoClassData$Age))
twoClassData$Weight <- ((twoClassData$Weight - min(twoClassData$Weight)) / (max(twoClassData$Weight) - min(twoClassData$Weight))) * (max(twoClassData$Weight) - min(twoClassData$Weight))

twoClassData[,c("bmiCategory")] <- ifelse(twoClassData[,c("bmiCategory")] %in% c("Obesity_Type_I", "Obesity_Type_II"), "Obese", "Normal")
twoClassData$bmiCategory <- as.factor(twoClassData$bmiCategory)

# Finalized data set with Two Classes
head(twoClassData)

##   Gender      Age Height     Weight family_history_with_overweight FAVC FCVC
## 1      0 0.7446809    1.62 1.3059701          1      0      2
## 2      0 0.7446809    1.52 0.8880597          1      0      3
## 3      1 0.9574468    1.80 1.9850746          1      0      2
## 4      1 1.3829787    1.80 2.5074627          0      0      3
## 5      1 0.8510638    1.78 2.6537313          0      0      2
## 6      1 1.5957447    1.62 0.7313433          0      1      2
##   NCP CAECAlways CAECFrequently CAECno CAECSometimes SMOKE CH20 SCC FAF TUE
## 1    3            0              0        0           1      0    2    0    0    1

```

```

## 2   3       0       0       1       1       3   1   3   0
## 3   3       0       0       1       0       2   0   2   1
## 4   3       0       0       1       0       2   0   2   0
## 5   1       0       0       1       0       2   0   0   0
## 6   3       0       0       1       0       2   0   0   0
##   CALCALways CALCFrequently CALCnno CALCSometimes MTRANSAutomobile MTRANSBike
## 1      0           0       1       0           0       0
## 2      0           0       0       1           0       0
## 3      0           1       0       0           0       0
## 4      0           1       0       0           0       0
## 5      0           0       0       1           0       0
## 6      0           0       0       1           1       0
##   MTRANSMotorbike MTRANSPublic_Transportation MTRANSWalking      BMI
## 1      0           1           0 24.38653
## 2      0           1           0 24.23823
## 3      0           1           0 23.76543
## 4      0           0           1 26.85185
## 5      0           1           0 28.34238
## 6      0           0           0 20.19509
##   bmiCategory
## 1     Normal
## 2     Normal
## 3     Normal
## 4     Obese
## 5     Obese
## 6     Normal

```

```

# Check for near zero variance predictors after dummy/one-hot encoding
# (i.e., those variables that have very little variability or few unique values, having minuscule predictivity)
nzv <- nearZeroVar(twoClassData)

# nearZeroVar returns a list of indices
glimpse(nzv)

```

```
##  int [1:9] 9 11 13 15 18 19 23 24 26
```

```
head(twoClassData[,c(nzv)])
```

```

##   CAECALways CAECnno SMOKE SCC CALCALways CALCFrequently MTRANSBike
## 1      0       0       0   0       0           0       0
## 2      0       0       1   1       0           0       0
## 3      0       0       0   0       0           1       0
## 4      0       0       0   0       0           1       0
## 5      0       0       0   0       0           0       0
## 6      0       0       0   0       0           0       0
##   MTRANSMotorbike MTRANSWalking
## 1              0           0
## 2              0           0
## 3              0           0
## 4              0           1
## 5              0           0
## 6              0           0

```

```

# drop predictors with near zero variance
twoClassData <- twoClassData %>% select(-c(nzv))

## Warning: Using an external vector in selections was deprecated in tidyselect 1.1.0.
## i Please use 'all_of()' or 'any_of()' instead.
##   # Was:
##   data %>% select(nzv)
##
##   # Now:
##   data %>% select(all_of(nzv))
##
## See <https://tidyselect.r-lib.org/reference/faq-external-vector.html>.
## This warning is displayed once every 8 hours.
## Call 'lifecycle::last_lifecycle_warnings()' to see where this warning was
## generated.

glimpse(twoClassData)

## Rows: 22,869
## Columns: 19
## $ Gender          <dbl> 0, 0, 1, 1, 1, 0, 1, 1, 1, 0, 1, ~
## $ Age             <dbl> 0.7446809, 0.7446809, 0.9574468, 1.3829~
## $ Height          <dbl> 1.62, 1.52, 1.80, 1.80, 1.78, 1.62, 1.5~
## $ Weight          <dbl> 1.3059701, 0.8880597, 1.9850746, 2.5074~
## $ family_history_with_overweight <dbl> 1, 1, 1, 0, 0, 0, 1, 0, 1, 1, 1, 0, ~
## $ FAVC            <dbl> 0, 0, 0, 0, 1, 1, 0, 1, 1, 1, 0, ~
## $ FCVC            <dbl> 2, 3, 2, 3, 2, 2, 3, 2, 3, 2, 3, ~
## $ NCP              <dbl> 3, 3, 3, 3, 1, 3, 3, 3, 3, 3, 3, 3, ~
## $ CAECFrequently <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, ~
## $ CAECSometimes  <dbl> 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, ~
## $ CH20            <dbl> 2, 3, 2, 2, 2, 2, 2, 2, 2, 3, 2, 3, ~
## $ FAF              <dbl> 0, 3, 2, 2, 0, 0, 1, 3, 1, 1, 2, 2, ~
## $ TUE              <dbl> 1, 0, 1, 0, 0, 0, 0, 1, 1, 2, 1, 0, ~
## $ CALCno           <dbl> 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, ~
## $ CALCSometimes  <dbl> 0, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, ~
## $ MTRANSAutomobile <dbl> 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, ~
## $ MTRANSPublic_Transportation <dbl> 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, ~
## $ BMI              <dbl> 24.38653, 24.23823, 23.76543, 26.85185, ~
## $ bmiCategory      <fct> Normal, Normal, Normal, Obese, Obese, N~
```

After the BMI variable was engineered, one hot encoding was performed for each categorical variable as well as generating dummy variables for each binary variables (i.e., yes/no, female/male). There were two variables of interest with values that were significantly different the value scales for the remaining variables. These variables were weight and age. The distribution for both these variables did not resemble anything close to that of a normal distribution. Therefore, a z-score normalization was not performed for standardization. Rather, a min-max normalization was performed for these variables, which also has the advantage of suppressing any outliers such as the ones seen in Age. Thus, all the variables in the data set were numeric variables and normalized. Finally, near zero variance predictors were removed from the cleaned and pre-processed dataset as these variables have minimal variability or unique values that would have any significance in classification of observations. The data set ‘twoClassData’, which has all numeric independent variables that have been normalized as well as factored dependent variable, will be used for model building.

We were able to highlight different relationships between the independent variables and the dependent variable. For example, male and female had similar average body mass indices, where the female BMI

variance was greater than the male BMI variance. Additionally, Obesity Type III was most common for females while Obesity Type II was most common in males. The exploration into the dataset provides information that confirms the expectations from data about BMI and various health indicators. When looking at the bar chart for mean age and mean BMI to the classification, both mean age and mean BMI increases as the severity of the BMI classification increases. This exploration is expected. Lastly, there were not any concerning outliers or correlations involved with any of the independent variables as shown by the box plots and correlation matrix heat map.

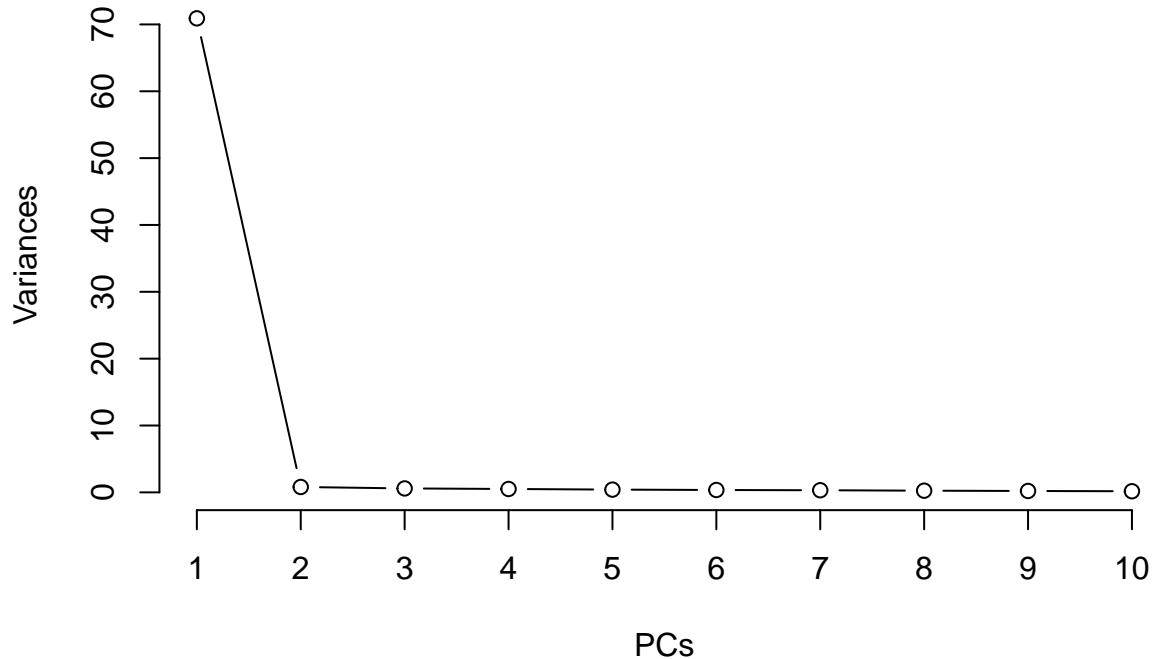
```
twoClassData.predictors <- twoClassData %>% select(,-c("bmiCategory"))
twoClassData.target <- twoClassData %>% select("bmiCategory")

# Get PCA object with prcomp
bmi.pca <- prcomp(twoClassData.predictors)
# View the PCA summary with cumulative proportions
summary(bmi.pca)

## Importance of components:
##          PC1      PC2      PC3      PC4      PC5      PC6      PC7
## Standard deviation 8.4207 0.89683 0.76645 0.71124 0.64119 0.59505 0.56213
## Proportion of Variance 0.9466 0.01074 0.00784 0.00675 0.00549 0.00473 0.00422
## Cumulative Proportion 0.9466 0.95731 0.96515 0.97190 0.97739 0.98212 0.98634
##          PC8      PC9      PC10     PC11     PC12     PC13     PC14
## Standard deviation 0.50087 0.45319 0.40912 0.32970 0.31434 0.28059 0.26870
## Proportion of Variance 0.00335 0.00274 0.00223 0.00145 0.00132 0.00105 0.00096
## Cumulative Proportion 0.98969 0.99243 0.99466 0.99611 0.99743 0.99848 0.99945
##          PC15     PC16     PC17     PC18
## Standard deviation 0.12936 0.11149 0.10898 0.02079
## Proportion of Variance 0.00022 0.00017 0.00016 0.00001
## Cumulative Proportion 0.99967 0.99984 0.99999 1.00000

# Visualize the scree plot
screeplot(bmi.pca, type = "l") + title(xlab = "PCs")
```

bmi.pca



```
## integer(0)

# Create the components
PCAPreProc <- preProcess(twoClassData.predictors, method="pca", pcaComp=2)
bmi.pc <- predict(PCAPreProc, twoClassData.predictors)
# Put back target column
bmi.pc$bmiCategory <- twoClassData.target$bmiCategory
# Make sure that we have the PCs as predictors
head(bmi.pc)
```

```
##          PC1        PC2 bmiCategory
## 1 -1.9646900  0.1693354    Normal
## 2 -1.0274993 -1.0503473    Normal
## 3 -0.9422542  0.5160772    Normal
## 4 -0.7035017  1.7341565   Obese
## 5 -0.6879533 -0.2407376   Obese
## 6 -0.6124041  2.8142946    Normal
```

From the principal component analysis, the results show that 2 principal components capture most of the variance of roughly 95% variance. The second component provides the cumulative variance that exceeds 95%, supporting the use of 2 PCs to model the data.

```

# By default cross validation doesn't use stratified sampling.
# Generate stratified indices (per fold list of indices, which are the row numbers)
idx <- createFolds(twoClassData$bmiCategory, 10, returnTrain = T)

# Train model evaluation method: cross-validation with 10-folds
cv_method_stratified <- trainControl(index = idx, method = "cv", number = 10)
# Scaling method
preproc <- c("center", "scale")

# SVM with Normal Data
svm_norm <- train(bmiCategory ~., data = twoClassData, method = "svmLinear", trControl = cv_method_stratified)

```

Data Classification - Supervised

```

## Support Vector Machines with Linear Kernel
##
## 22869 samples
##     18 predictor
##      2 classes: 'Normal', 'Obese'
##
## Pre-processing: centered (18), scaled (18)
## Resampling: Cross-Validated (10 fold)
## Summary of sample sizes: 20582, 20582, 20583, 20583, 20582, 20581, ...
## Resampling results:
##
##     Accuracy   Kappa
##     0.9733259  0.9320946
##
## Tuning parameter 'C' was held constant at a value of 1

# SVM with PC Data
svm_pc <- train(bmiCategory ~., data = bmi.pc, method = "svmLinear", trControl = cv_method_stratified, preproc = preproc)

```

```

## Support Vector Machines with Linear Kernel
##
## 22869 samples
##     2 predictor
##      2 classes: 'Normal', 'Obese'
##
## Pre-processing: centered (2), scaled (2)
## Resampling: Cross-Validated (10 fold)
## Summary of sample sizes: 20582, 20582, 20583, 20583, 20582, 20581, ...
## Resampling results:
##
##     Accuracy   Kappa
##     0.8647511  0.6479944
##
## Tuning parameter 'C' was held constant at a value of 1

```

Although the principal components reduced the dimensionality of the data set, the full data set will be used moving forward, particularly as the dimensionality of the full data set was already reduced after the removal of near zero variance predictors. The removal of near zero variance predictors should also reduce likelihood of over fitting. The reduction in dimensionality and reduce the risk of over fitting was also the purpose of PCA. Therefore, the parameter for the SVM model will be tuned with the use of the normal data set instead of the PC data. It's also noting the normal data set provided a better model than the PC data set.

```
# train/test splitting
# set the randomize seed
set.seed(123)
# partition data
# By default, createDataPartition uses stratified random sampling under the hood.
index = createDataPartition(y=twoClassData$bmiCategory, p=0.7, list=FALSE)
# training set
train_set = twoClassData[index,]
# testing set
test_set = twoClassData[-index,]
```

In order to train and validate the model, the training and testing sets were created from the dataset.

```
library(e1071) # grid search functionality
# Define the set of values to use for each parameter. SVM has only one: C.
set.seed(12)
grid <- expand.grid(C = 10^seq(-3, 1, 0.5))
cv_method <- trainControl(method = 'cv', number = 10, classProbs = TRUE)
# Fit the model with grid search
svm_grid <- train(bmiCategory ~ ., data = train_set, method = "svmLinear", trControl = cv_method, preProc = NULL)

## line search fails -1.5136 -0.1231037 1.227102e-05 4.235101e-07 -2.208386e-08 2.570088e-09 -2.69903e-09

## Warning in method$predict(modelFit = modelFit, newdata = newdata, submodels =
## param): kernlab class prediction calculations failed; returning NAs

## Warning in method$prob(modelFit = modelFit, newdata = newdata, submodels =
## param): kernlab class probability calculations failed; returning NAs

## Warning in data.frame(..., check.names = FALSE): row names were found from a
## short variable and have been discarded

## Warning in nominalTrainWorkflow(x = x, y = y, wts = weights, info = trainInfo,
## : There were missing values in resampled performance measures.

# View grid search result
svm_grid

## Support Vector Machines with Linear Kernel
##
## 16009 samples
##     18 predictor
##      2 classes: 'Normal', 'Obese'
##
```

```

## Pre-processing: centered (18), scaled (18)
## Resampling: Cross-Validated (10 fold)
## Summary of sample sizes: 14407, 14409, 14408, 14409, 14408, 14409, ...
## Resampling results across tuning parameters:
##
##     C          Accuracy   Kappa
## 0.001000000  0.9570862  0.8902749
## 0.003162278  0.9662061  0.9138475
## 0.010000000  0.9695170  0.9222696
## 0.031622777  0.9717657  0.9280712
## 0.100000000  0.9717656  0.9279293
## 0.316227766  0.9715160  0.9272977
## 1.000000000  0.9714029  0.9269880
## 3.162277660  0.9716409  0.9275618
## 10.000000000 0.9714535  0.9270800
##
## Accuracy was used to select the optimal model using the largest value.
## The final value used for the model was C = 0.03162278.

# Predict with train set
pred_train <- predict(svm_grid, train_set)
# calculation of accuracy: what proportion of predictions match labels
sum(pred_train == train_set$bmiCategory) / nrow(train_set)

## [1] 0.9720157

# Predict with test set
pred_test <- predict(svm_grid, test_set)
# calculation of accuracy: what proportion of predictions match labels
sum(pred_test == test_set$bmiCategory) / nrow(test_set)

## [1] 0.9727405

# Confusion Matrix for SVM Model
# train set
confusionMatrix(train_set$bmiCategory, pred_train)

## Confusion Matrix and Statistics
##
##             Reference
## Prediction Normal  Obese
##    Normal      4068    247
##    Obese       201 11493
##
##                 Accuracy : 0.972
##                 95% CI : (0.9693, 0.9745)
## No Information Rate : 0.7333
## P-Value [Acc > NIR] : <2e-16
##
##                 Kappa : 0.9287
##
## McNemar's Test P-Value : 0.0335

```

```

##          Sensitivity : 0.9529
##          Specificity : 0.9790
##          Pos Pred Value : 0.9428
##          Neg Pred Value : 0.9828
##          Prevalence : 0.2667
##          Detection Rate : 0.2541
##          Detection Prevalence : 0.2695
##          Balanced Accuracy : 0.9659
##
##          'Positive' Class : Normal
##


# test set
confusionMatrix(test_set$bmiCategory, pred_test)

```

```

## Confusion Matrix and Statistics
##
##          Reference
## Prediction Normal  Obese
##     Normal    1742    107
##     Obese      80   4931
##
##          Accuracy : 0.9727
##          95% CI : (0.9686, 0.9765)
##          No Information Rate : 0.7344
##          P-Value [Acc > NIR] : < 2e-16
##
##          Kappa : 0.9305
##
##          Mcnemar's Test P-Value : 0.05726
##
##          Sensitivity : 0.9561
##          Specificity : 0.9788
##          Pos Pred Value : 0.9421
##          Neg Pred Value : 0.9840
##          Prevalence : 0.2656
##          Detection Rate : 0.2539
##          Detection Prevalence : 0.2695
##          Balanced Accuracy : 0.9674
##
##          'Positive' Class : Normal
##
```

With the grid search to determine the best parameter, C, for the SVM model, the best parameter for model that resulted in the optimal accuracy of 0.9717 was C = 0.0316. Based on the predictions generated by the SVM model, the accuracy between the testing set and training set were similar, eliminating any concern for over fitting. The accuracy of predictions on these two sets were also 0.972.

```

# Bin Class Category into Two Bins for Purposes of Assignment 5
twoClassDTData <- obesity
# Drop BMI variable, otherwise DT will split on BMI as BMI classification is dependent on BMI
twoClassDTData <- twoClassDTData %>% select(-c("BMI"))

```

```

# Create two bin target classification
twoClassDTData[,c("NObeyesdad")] <- ifelse(twoClassDTData$NObeyesdad %in% c("Obesity_Type_I", "Obesity_Type_II"), 0, 1)

# Factor Target Variable
twoClassDTData$NObeyesdad <- as.factor(twoClassDTData$NObeyesdad)
# Finalized data set with Two Classes
head(twoClassDTData$NObeyesdad)

## [1] Normal Normal Normal Obese  Obese  Normal
## Levels: Normal Obese

```

Similar to the dataset created for the SVM model, where there were two bins for classification, the dataset for DT model was generated using the same procedures. However, this dataset did not remove any near zero variance predictors, did not create any dummy variables, and did not normalize variables. As decision trees can operate with categorical variables, the data set prior to one hot encoding (obesity) was used to train and tune parameters for this decision tree. The “obesity” data was also binned into two categories under similar classifications under the SVM model data set.

```

# train/test splitting
# set the randomize seed
set.seed(94)
# partition data
# By default, createDataPartition uses stratified random sampling under the hood.
index_DT = createDataPartition(y=twoClassDTData$NObeyesdad, p=0.7, list=FALSE)
# training set
train_set_DT = twoClassDTData[index_DT,]
# testing set
test_set_DT = twoClassDTData[-index_DT,]

```

The training and testing sets were created from the ‘twoClassDTData’ set.

```

library(rpart)
train_control_DT = trainControl(method = "cv", number = 10)

# Fit the model
tree <- train(NObeyesdad ~ ., data = train_set_DT, method = "rpart1SE", trControl = train_control_DT)
tree

## CART
##
## 16009 samples
##      16 predictor
##      2 classes: 'Normal', 'Obese'
##
## No pre-processing
## Resampling: Cross-Validated (10 fold)
## Summary of sample sizes: 14407, 14407, 14409, 14408, 14409, 14407, ...
## Resampling results:
##
##   Accuracy   Kappa
##   0.963959  0.9077174

```

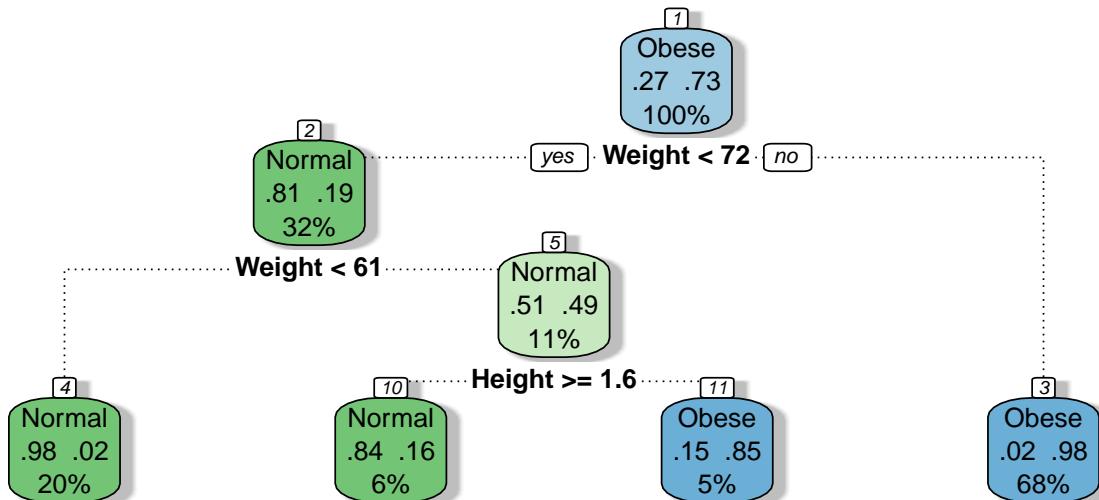
```

# Visualize this DT
library(rattle)

## Loading required package: bitops

## Rattle: A free graphical interface for data science with R.
## Version 5.5.1 Copyright (c) 2006-2021 Togaware Pty Ltd.
## Type 'rattle()' to shake, rattle, and roll your data.

# Visualize your decision tree
fancyRpartPlot(tree$finalModel, caption = "")
```



```

# Training Set predictions
train_DT_pred <- predict(tree, train_set_DT)
# Testing Set predictions
test_DT_pred <- predict(tree, test_set_DT)

# Confusion Matrix for DT
# train set
confusionMatrix(train_set_DT$NObeyesdad, train_DT_pred)

## Confusion Matrix and Statistics
##
## Reference
```

```

## Prediction Normal Obese
##      Normal    3971    344
##      Obese     231 11463
##
##                  Accuracy : 0.9641
##                  95% CI : (0.9611, 0.9669)
##      No Information Rate : 0.7375
##      P-Value [Acc > NIR] : < 2.2e-16
##
##                  Kappa : 0.908
##
##      Mcnemar's Test P-Value : 3.001e-06
##
##                  Sensitivity : 0.9450
##                  Specificity : 0.9709
##      Pos Pred Value : 0.9203
##      Neg Pred Value : 0.9802
##                  Prevalence : 0.2625
##      Detection Rate : 0.2480
##      Detection Prevalence : 0.2695
##      Balanced Accuracy : 0.9579
##
##      'Positive' Class : Normal
##

# test set
confusionMatrix(test_set_DT$NObeyesdad, test_DT_pred)

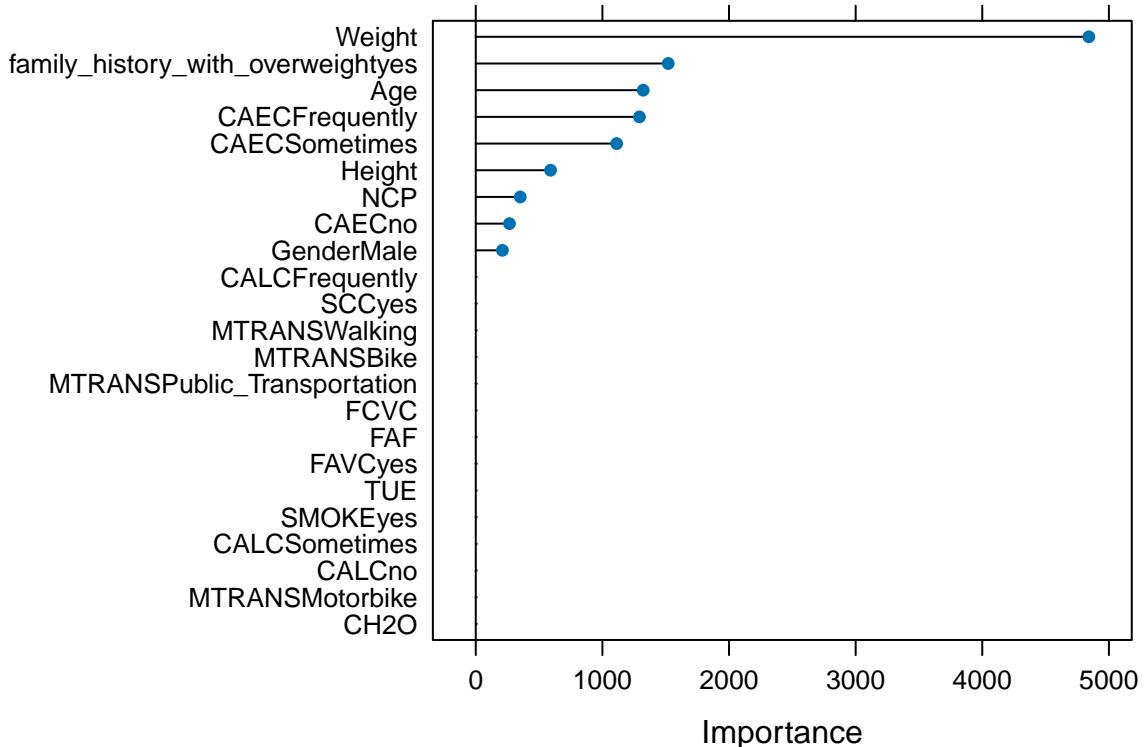
```

```

## Confusion Matrix and Statistics
##
##      Reference
## Prediction Normal Obese
##      Normal    1675    174
##      Obese      93  4918
##
##                  Accuracy : 0.9611
##                  95% CI : (0.9562, 0.9655)
##      No Information Rate : 0.7423
##      P-Value [Acc > NIR] : < 2.2e-16
##
##                  Kappa : 0.8998
##
##      Mcnemar's Test P-Value : 9.785e-07
##
##                  Sensitivity : 0.9474
##                  Specificity : 0.9658
##      Pos Pred Value : 0.9059
##      Neg Pred Value : 0.9814
##                  Prevalence : 0.2577
##      Detection Rate : 0.2442
##      Detection Prevalence : 0.2695
##      Balanced Accuracy : 0.9566
##
##      'Positive' Class : Normal

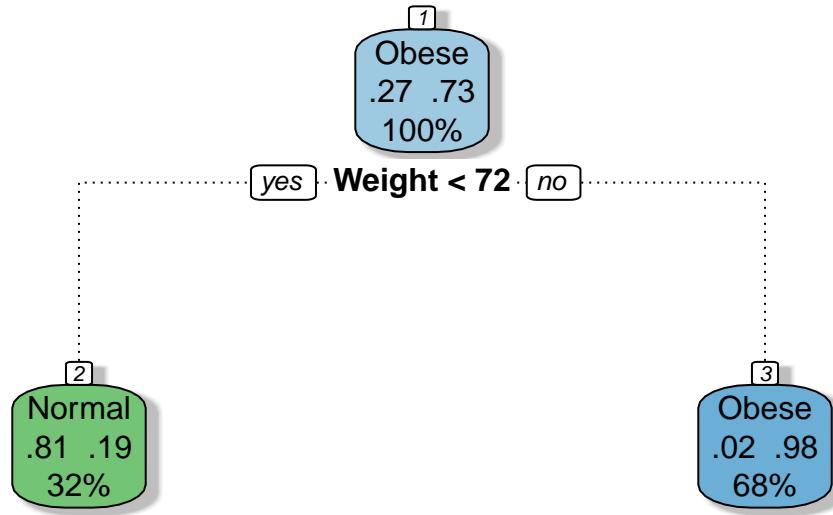
```

```
##  
  
# Check Variable Importance  
importance <- varImp(tree, scale = FALSE)  
plot(importance)
```



Based on the model generated, the DT had a maximum depth of 3 levels with a total of 11 nodes, where 4 of the nodes were terminal nodes. The visualization of the decision tree show us that the most impact variables were weight and height, specifically cutting the height at either 72 kg or 61 kg and the height at 1.6 meters. Most of the dataset was classified using the weight attribute as seen by nodes 4 and 3, carrying 20% and 68% of the total dataset respectively. We see that nine variables from the data set have direct relevance on the target variable as a result of the checking for variable importance in the DT. Finally, the accuracy of the decision tree on the test and training sets were similar with an accuracy of 0.96, confirming no overfitting was present.

```
# Set hyperparameters tunes  
# Recall rpart1SE default parameters: minsplit = 20, minbucket = round(minsplit/3), cp = 0.01, maxdepth  
hypers = rpart.control(maxdepth = 2, minsplit = 5000, minbucket = 2500)  
  
# Fit the model  
tree2 <- train(NObeyesdad ~., data = train_set_DT, control = hypers, trControl = train_control_DT, method = "rpart")  
fancyRpartPlot(tree2$finalModel, caption = "")
```



```

# Evaluate the fit with a confusion matrix
train_DT_pred2 <- predict(tree2, test_set_DT)
# Confusion Matrix
confusionMatrix(test_set_DT$NObeyesdad, train_DT_pred2)

```

```

## Confusion Matrix and Statistics
##
##             Reference
## Prediction Normal  Obese
##     Normal      1744     105
##     Obese       393    4618
##
##                         Accuracy : 0.9274
##                             95% CI : (0.921, 0.9334)
##     No Information Rate : 0.6885
##     P-Value [Acc > NIR] : < 2.2e-16
##
##                         Kappa : 0.8243
##
##     Mcnemar's Test P-Value : < 2.2e-16
##
##                         Sensitivity : 0.8161
##                         Specificity  : 0.9778
##     Pos Pred Value : 0.9432
##     Neg Pred Value : 0.9216
##     Prevalence   : 0.3115

```

```

##           Detection Rate : 0.2542
##     Detection Prevalence : 0.2695
##       Balanced Accuracy : 0.8969
##
##       'Positive' Class : Normal
##

```

Given a maximum level of 3 in the DT modeled, an attempt was made to tune parameters that would create a simpler model with less levels to determine if it would improve the accuracy of the model. The accuracy for the simplified DT model, where parameters were set to reduce complexity of the initial DT, was less accurate. Therefore, the initial DT model was kept. An attempt to try parameters that made a more complex DT was not necessary as the default parameters for the ‘rsPart1SE’ method gave the algorithm freedom to try more complex trees than the one that was created.

```
library(pROC)
```

Data Classification Adv. Evaluation

```

## Type 'citation("pROC")' for a citation.

##
## Attaching package: 'pROC'

## The following objects are masked from 'package:stats':
##
##     cov, smooth, var

# 1)
# Confusion Matrix for SVM Model
# train set
train_results <- confusionMatrix(train_set$bmiCategory, pred_train)
# test set
test_results <- confusionMatrix(test_set$bmiCategory, pred_test)

# 2)
# Manual calculation of precision and recall: Positive instances for Normal Classification
# precision: Precision = TP / (TP + FP)
# recall: Recall = TP / (TP + FN)

# Precession Recall for Train Set
train_results$table

##           Reference
## Prediction Normal Obese
##       Normal    4068    247
##       Obese      201 11493

```

```

precision_SVM_train <- 4085 / (4085+230)
precision_SVM_train

## [1] 0.9466976

recall_SVM_train <- 4085 / (4085+204)
recall_SVM_train

## [1] 0.9524365

# Precision Recall for Test Set
test_results$table

##           Reference
## Prediction Normal  Obese
##       Normal    1742   107
##       Obese      80   4931

precision_SVM_test <- 1753 / (1753+96)
precision_SVM_test

## [1] 0.94808

recall_SVM_test <- 1753 / (1753+78)
recall_SVM_test

## [1] 0.9574003

library(kernlab)

##
## Attaching package: 'kernlab'

## The following object is masked from 'package:purrr':
## 
##     cross

## The following object is masked from 'package:ggplot2':
## 
##     alpha

# 3) ROC plot
# Get class probabilities for decision tree model
pred_test_ROC <- predict(svm_grid, test_set, type = 'prob')
head(pred_test_ROC)

```

```

##           Normal      Obese
## 1 3.384104e-01 0.661589554
## 2 9.959078e-01 0.004092192
## 3 9.991114e-01 0.000888592
## 4 8.975021e-01 0.102497914
## 5 4.623132e-05 0.999953769
## 6 9.973749e-01 0.002625114

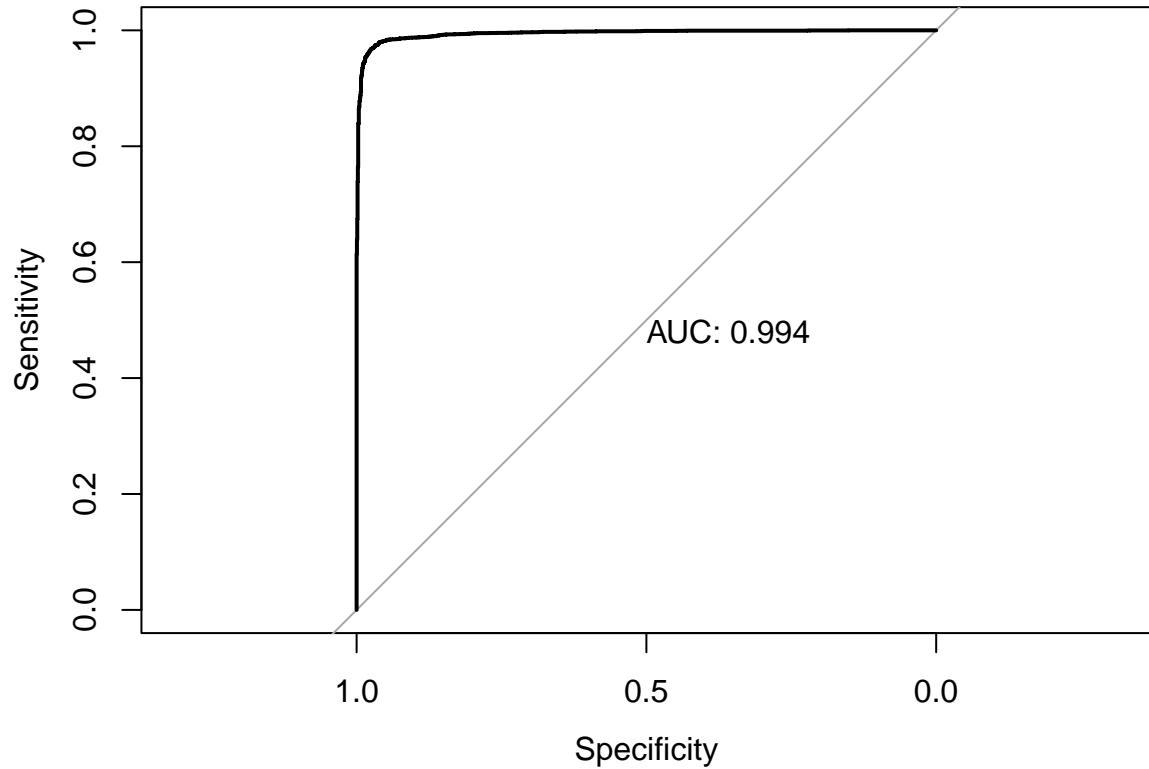
roc_obj <- roc((test_set$bmiCategory), pred_test_ROC[,1])

## Setting levels: control = Normal, case = Obese

## Setting direction: controls > cases

plot(roc_obj, print.auc=TRUE)

```



As the accuracy of the SVM model was greater than the accuracy of the DT, the confusion matrix for the SVM model was generated for this portion of the analysis/assignment. Additionally, the confusion matrix of for the SVM model illustrated no concern for over fitting as accuracy for testing and training sets were similar. Although these performance measures of my SVM classifier were lower than the accuracy of the model, the measures as a collective indicate the reliability of the model. Despite the lower performance measures, the precision and recall as well as the metrics from the confusion matrix show similar results, which show that the model is effective at predicting ‘normal’ vs. ‘obese’ individuals. The ROC plot also confirms the performance and effectiveness of the SVM classifier with an AUC of near 1. Thus, these performance measures make the classifier look favorable compared to the accuracy metric.

```
library(factoextra)
```

Data Clustering Model - Unsupervised

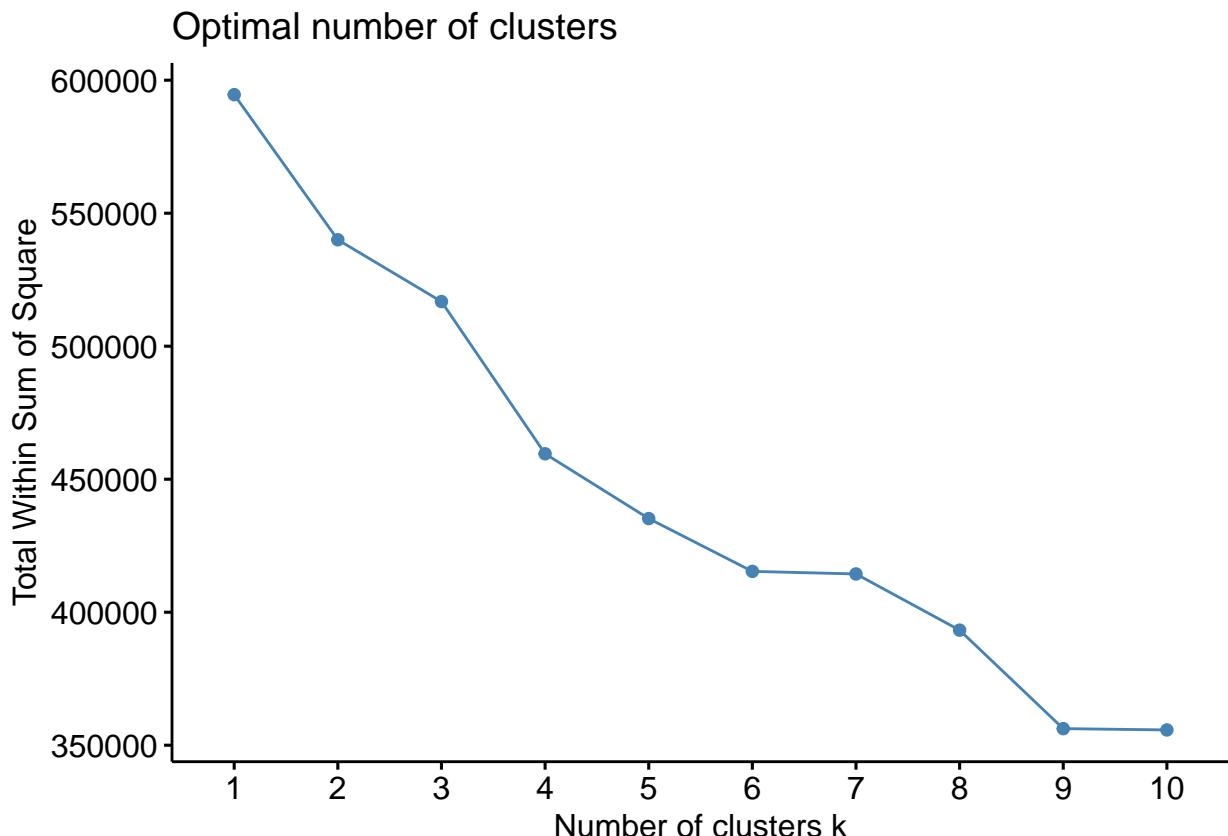
```
## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa

library(stats)
# Use non-categorical variable data set without BMI variable
# Data set has also been standardized from previous machine learning algorithm (SVM), data also needs to be scaled
# Re-factor target variable from 2 factors to original 7 factors for purposes of clustering algorithm (K-Means)
kmean_data <- final_Obesity %>% select(-c("BMI"))

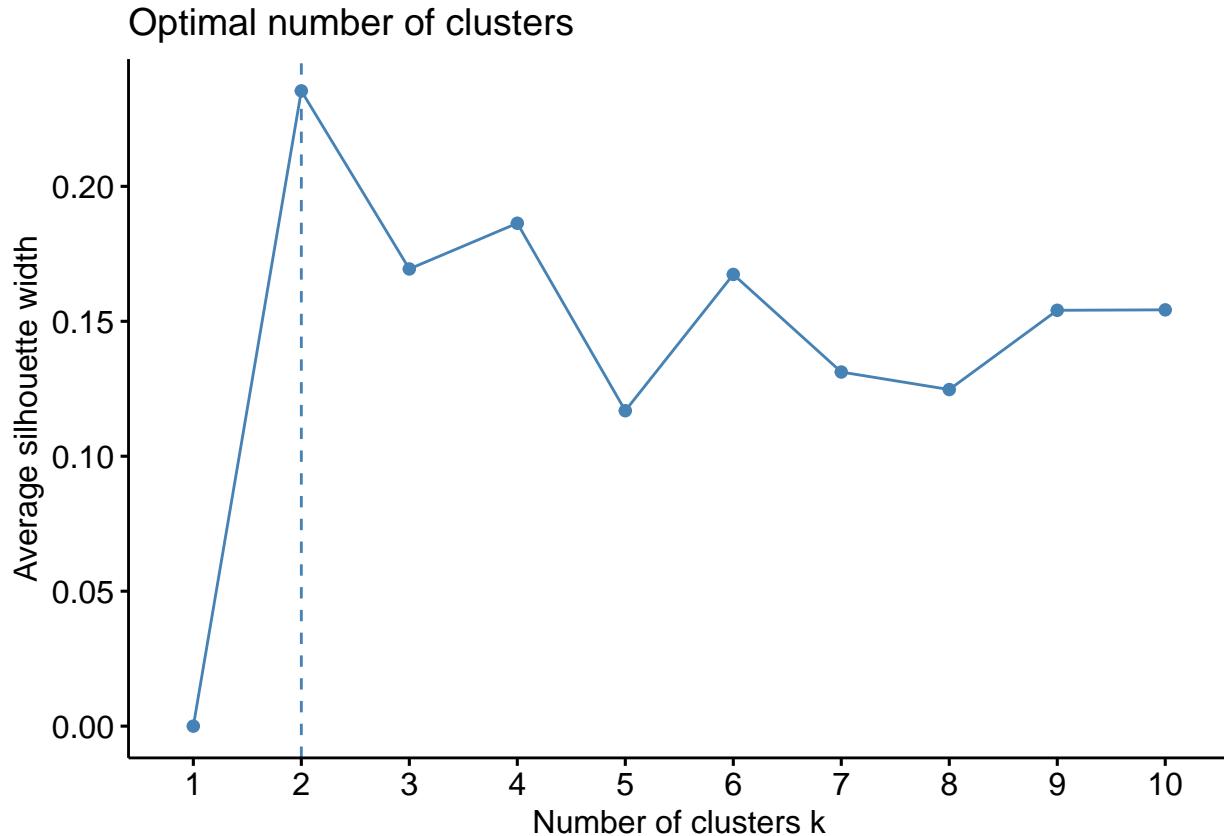
# Divide predictors vs target
kmean_target <- kmean_data %>% select(c("bmiCategory"))
kmean_vars <- kmean_data %>% select(-c("bmiCategory"))

# Normalize data to center around mean given cluster deals with distances
set.seed(30)
# Center scale allows us to standardize the data
preproc_kmean <- preprocess(kmean_vars, method=c("center", "scale"))
# Fit data based on standardized preprocessing
kmean_vars <- predict(preproc_kmean, kmean_vars)

# Find number of clusters for k-means
fviz_nbclust(kmean_vars, kmeans, method = "wss")
```



```
fviz_nbclust(kmean_vars, kmeans, method = "silhouette")
```



```
# Fit the data
fit <- kmeans(kmean_vars, centers = 4, nstart = 25)
# Display the kmeans object information
fit

## K-means clustering with 4 clusters of sizes 3444, 11837, 3814, 3774
##
## Cluster means:
##           Gender      Age      Height      Weight family_history_with_overweight
## 1 -0.1303151 -0.5561699 -0.3160862 -1.01929474          -0.79727381
## 2 -0.1202501 -0.1664645  0.1020370  0.37109226          0.11973521
## 3  0.1599796 -0.4080412 -0.1619773 -0.27663517          0.08085381
## 4  0.3344048  1.4420135  0.1321066  0.04581836          0.27030443
##           FAVC      FCVC       NCP   CAECAlways CAECFrequently CAECno
## 1 -0.33209793 -0.04902389  0.045922289  0.78668430     1.9906677  0.6702877
## 2  0.13187216  0.20353389  0.102712117 -0.15417559    -0.3669476 -0.1209985
## 3 -0.16437252 -0.37355395 -0.350406682 -0.15417559    -0.3669476 -0.1209985
## 4  0.05556209 -0.21612550 -0.009938687 -0.07852108    -0.2948498 -0.1098894
##           CAECSometimes      SMOKE      CH20       SCC       FAF       TUE
## 1    -2.3190795  0.019436596 -0.2901210  0.31469041  0.24337044  0.058816515
## 2     0.4304447 -0.002712392  0.1651101 -0.05355676 -0.11981332  0.003559802
## 3     0.4304447 -0.049756097 -0.1121413 -0.01958828  0.19288349  0.349576948
## 4     0.3312187  0.041053710 -0.1397787 -0.09939922 -0.04122818 -0.418120808
```

```

##      CALCAways CALCFrequently      CALCno CALCSometimes MTRANSAutomobile
## 1  0.037297034   0.1487012  0.20968351 -0.2566654   -0.2976056
## 2 -0.006612663  -0.1634710 -0.58304325  0.6233185   -0.4597835
## 3 -0.006612663   0.2135820  1.57527317 -1.6025940   -0.4335340
## 4 -0.006612663   0.1611759  0.04537389 -0.1012114   2.1518043
##      MTRANSBike MTRANSMotorbike MTRANSPublic_Transportation MTRANSWalking
## 1  0.036076884   0.06669204          0.2071595   0.1694450
## 2 -0.014713728  -0.02624022          0.4555584   -0.0422177
## 3  0.015858806   0.01036506          0.3698154   0.1013339
## 4 -0.002800178   0.01096604          -1.9916211  -0.1246225
##
## Clustering vector:
##    1   2   3   4   5   6   7   8   9   10  11  12  13
##    3   2   3   3   2   4   2   2   3   3   1   1   2
##   14  15  16  17  18  19  20  21  22  23  24  25  26
##    4   2   1   2   4   4   2   3   4   4   2   2   1
##   27  28  29  30  31  32  33  34  35  36  37  38  39
##    1   1   2   3   1   2   2   2   1   2   3   2   2
##   40  41  42  43  44  45  46  47  48  49  50  51  52
##    2   2   1   3   3   1   3   1   1   2   2   2   4
##   53  54  55  56  57  58  59  60  61  62  63  64  65
##    3   1   1   1   4   3   3   3   2   2   1   4   1
##   66  67  68  69  70  71  72  73  74  75  76  77  78
##    1   1   4   4   1   1   1   3   2   1   3   1   3
##   79  80  81  82  83  84  85  86  87  88  89  90  91
##    3   2   3   1   1   1   1   3   1   3   1   4   1
##   92  93  94  95  96  97  98  99  100 101 102 103 104
##    1   1   1   3   1   2   1   1   3   2   1   1   1
##  105 106 107 108 109 110 111 112 113 114 115 116 117
##    4   2   2   4   3   3   2   3   1   3   1   1   3
##  118 119 120 121 122 123 124 125 126 127 128 129 130
##    1   2   1   1   1   1   3   3   1   2   2   1   3
##  131 132 133 134 135 136 137 138 139 140 141 142 143
##    1   3   1   1   4   4   2   4   1   1   1   1   1
##  144 145 146 147 148 149 150 151 152 153 154 155 156
##    4   2   1   1   4   1   4   2   4   4   4   2   1
##  157 158 159 160 161 162 163 164 165 166 167 168 169
##    1   1   4   4   2   4   1   1   4   2   4   3   2
##  170 171 172 173 174 175 176 177 178 179 180 181 182
##    4   2   1   2   3   1   3   1   1   1   1   3   1
##  183 184 185 186 187 188 189 190 191 192 193 194 195
##    1   2   1   4   4   3   4   3   2   1   4   1   1
##  196 197 198 199 200 201 202 203 204 205 206 207 208
##    2   2   4   1   2   2   4   2   4   4   3   1   1
##  209 210 211 212 213 214 215 216 217 218 219 220 221
##    2   2   1   3   3   3   2   2   1   1   3   2   1
##  222 223 224 225 226 227 228 229 230 231 232 233 234
##    2   1   1   3   2   4   2   4   4   2   2   3   4
##  235 236 237 238 239 240 241 242 243 244 245 246 247
##    1   1   1   3   3   1   3   3   1   4   2   4   2
##  248 249 250 251 252 253 254 255 256 257 258 259 260
##    1   1   2   3   4   4   2   3   3   2   3   3   1
##  261 262 263 264 265 266 267 268 269 270 271 272 273
##    3   1   2   1   1   1   1   4   1   2   2   1   3

```

##	274	275	276	277	278	279	280	281	282	283	284	285	286
##	1	2	1	1	1	4	2	1	1	1	2	2	1
##	287	288	289	290	291	292	293	294	295	296	297	298	299
##	2	3	3	4	1	1	1	1	2	3	2	4	1
##	300	301	302	303	304	305	306	307	308	309	310	311	312
##	2	2	2	1	1	2	2	1	1	1	3	1	1
##	313	314	315	316	317	318	319	320	321	322	323	324	325
##	3	1	3	1	4	3	2	4	1	4	1	4	2
##	326	327	328	329	330	331	332	333	334	335	336	337	338
##	2	2	1	2	2	1	3	3	1	1	1	3	1
##	339	340	341	342	343	344	345	346	347	348	349	350	351
##	2	3	3	2	2	3	1	1	1	2	3	1	3
##	352	353	354	355	356	357	358	359	360	361	362	363	364
##	1	3	4	3	2	3	3	4	2	1	3	4	2
##	365	366	367	368	369	370	371	372	373	374	375	376	377
##	1	2	4	1	4	1	3	1	3	2	1	4	4
##	378	379	380	381	382	383	384	385	386	387	388	389	390
##	1	1	2	3	1	1	4	3	1	3	1	3	3
##	391	392	393	394	395	396	397	398	399	400	401	402	403
##	1	2	1	2	3	2	4	1	1	1	3	1	1
##	404	405	406	407	408	409	410	411	412	413	414	415	416
##	4	4	3	4	1	2	2	3	2	4	2	4	3
##	417	418	419	420	421	422	423	424	425	426	427	428	429
##	4	3	2	2	4	4	2	4	4	1	3	1	1
##	430	431	432	433	434	435	436	437	438	439	440	441	442
##	1	2	1	1	2	1	3	4	1	4	1	4	1
##	443	444	445	446	447	448	449	450	451	452	453	454	455
##	2	2	2	2	1	2	2	2	2	1	1	4	3
##	456	457	458	459	460	461	462	463	464	465	466	467	468
##	1	1	2	1	1	1	3	4	2	1	1	1	1
##	469	470	471	472	473	474	475	476	477	478	479	480	481
##	1	3	1	3	1	1	3	3	3	1	1	1	2
##	482	483	484	485	486	487	488	489	490	491	492	493	494
##	2	1	3	4	1	3	3	2	3	1	2	4	1
##	495	496	497	498	499	500	501	502	503	504	505	506	507
##	2	1	2	2	2	2	2	2	2	2	2	2	2
##	508	509	510	511	512	513	514	515	516	517	518	519	520
##	2	2	2	1	1	1	1	1	1	1	1	1	3
##	521	522	523	524	525	526	527	528	529	530	531	532	533
##	3	3	1	1	1	1	1	1	1	1	1	4	4
##	534	535	536	537	538	539	540	541	542	543	544	545	546
##	4	1	1	1	2	2	2	1	1	1	1	1	1
##	547	548	549	550	551	552	553	554	555	556	557	558	559
##	2	2	2	1	1	1	2	2	2	2	2	2	4
##	560	561	562	563	564	565	566	567	568	569	570	571	572
##	4	3	2	2	2	4	4	4	1	1	1	2	2
##	573	574	575	576	577	578	579	580	581	582	583	584	585
##	2	1	1	1	1	1	1	4	4	4	1	1	1
##	586	587	588	589	590	591	592	593	594	595	596	597	598
##	2	2	2	2	2	2	4	4	4	4	4	4	2
##	599	600	601	602	603	604	605	606	607	608	609	610	611
##	2	2	1	1	1	1	1	1	2	2	2	3	1
##	612	613	614	615	616	617	618	619	620	621	622	623	624
##	1	1	1	1	1	1	4	1	2	2	1	1	1

##	625	626	627	628	629	630	631	632	633	634	635	636	637
##	2	2	4	2	4	1	2	1	1	4	1	2	2
##	638	639	640	641	642	643	644	645	646	647	648	649	650
##	4	4	2	1	1	2	3	3	3	1	1	1	1
##	651	652	653	654	655	656	657	658	659	660	661	662	663
##	1	1	1	1	1	2	3	3	1	1	1	1	1
##	664	665	666	667	668	669	670	671	672	673	674	675	676
##	1	1	1	2	4	4	4	2	1	2	2	2	2
##	677	678	679	680	681	682	683	684	685	686	687	688	689
##	2	2	2	1	3	1	2	2	2	1	1	1	2
##	690	691	692	693	694	695	696	697	698	699	700	701	702
##	2	2	2	2	2	4	4	3	3	2	2	4	4
##	703	704	705	706	707	708	709	710	711	712	713	714	715
##	4	1	3	1	2	2	2	2	2	1	1	1	1
##	716	717	718	719	720	721	722	723	724	725	726	727	728
##	4	4	4	1	1	1	2	2	2	2	2	1	4
##	729	730	731	732	733	734	735	736	737	738	739	740	741
##	4	4	4	4	4	2	2	2	1	1	1	1	1
##	742	743	744	745	746	747	748	749	750	751	752	753	754
##	1	2	2	2	4	1	4	2	1	2	4	2	2
##	755	756	757	758	759	760	761	762	763	764	765	766	767
##	3	2	4	2	1	4	4	2	1	1	1	4	4
##	768	769	770	771	772	773	774	775	776	777	778	779	780
##	2	2	2	1	1	2	2	2	3	2	4	2	2
##	781	782	783	784	785	786	787	788	789	790	791	792	793
##	2	2	4	2	2	2	2	4	4	4	2	3	3
##	794	795	796	797	798	799	800	801	802	803	804	805	806
##	2	2	4	4	3	2	3	3	3	2	4	4	1
##	807	808	809	810	811	812	813	814	815	816	817	818	819
##	1	4	2	1	1	2	2	4	2	2	2	2	3
##	820	821	822	823	824	825	826	827	828	829	830	831	832
##	2	4	4	2	2	1	4	4	4	2	2	1	1
##	833	834	835	836	837	838	839	840	841	842	843	844	845
##	1	1	1	4	4	2	2	2	2	2	2	2	1
##	846	847	848	849	850	851	852	853	854	855	856	857	858
##	1	2	2	2	2	2	2	2	3	2	2	4	2
##	859	860	861	862	863	864	865	866	867	868	869	870	871
##	2	2	2	2	4	4	2	2	2	3	2	2	4
##	872	873	874	875	876	877	878	879	880	881	882	883	884
##	4	4	4	3	3	3	3	3	2	2	2	4	4
##	885	886	887	888	889	890	891	892	893	894	895	896	897
##	3	3	2	2	3	3	3	2	2	4	4	1	1
##	898	899	900	901	902	903	904	905	906	907	908	909	910
##	4	2	2	1	2	4	4	2	2	2	3	2	2
##	911	912	913	914	915	916	917	918	919	920	921	922	923
##	4	2	2	1	1	4	4	4	2	2	1	1	1
##	924	925	926	927	928	929	930	931	932	933	934	935	936
##	1	4	4	2	2	2	2	1	1	2	2	2	2
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##	976	977	978	979	980	981	982	983	984	985	986	987	988
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##	989	990	991	992	993	994	995	996	997	998	999	1000	1001
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##	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014
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##	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027
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##	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105
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##	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118
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##	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131
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##	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950
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##	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
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##	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
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##	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
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##	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600
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##	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613
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##	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626
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##	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743
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##	3940	3941	3942	3943	3944	3945	3946	3947	3948	3949	3950	3951	3952
##	1	2	4	1	2	2	2	2	3	2	2	1	2
##	3953	3954	3955	3956	3957	3958	3959	3960	3961	3962	3963	3964	3965
##	4	2	2	1	2	4	4	2	4	2	1	3	4
##	3966	3967	3968	3969	3970	3971	3972	3973	3974	3975	3976	3977	3978
##	4	3	2	3	1	3	2	2	1	2	2	2	2
##	3979	3980	3981	3982	3983	3984	3985	3986	3987	3988	3989	3990	3991
##	2	3	2	3	3	2	2	2	4	4	3	2	2
##	3992	3993	3994	3995	3996	3997	3998	3999	4000	4001	4002	4003	4004
##	3	2	4	2	4	1	2	1	1	2	2	3	2
##	4005	4006	4007	4008	4009	4010	4011	4012	4013	4014	4015	4016	4017
##	3	2	2	3	3	4	1	3	2	1	2	1	3
##	4018	4019	4020	4021	4022	4023	4024	4025	4026	4027	4028	4029	4030
##	3	4	2	1	4	2	2	2	3	3	2	2	2
##	4031	4032	4033	4034	4035	4036	4037	4038	4039	4040	4041	4042	4043
##	2	1	1	2	3	1	3	1	2	2	3	2	4
##	4044	4045	4046	4047	4048	4049	4050	4051	4052	4053	4054	4055	4056
##	1	4	3	4	1	2	1	4	4	2	3	1	1
##	4057	4058	4059	4060	4061	4062	4063	4064	4065	4066	4067	4068	4069
##	1	4	2	2	4	1	4	2	4	2	2	2	2
##	4070	4071	4072	4073	4074	4075	4076	4077	4078	4079	4080	4081	4082
##	3	3	3	4	1	2	1	1	2	1	3	2	2
##	4083	4084	4085	4086	4087	4088	4089	4090	4091	4092	4093	4094	4095
##	2	3	2	2	2	2	2	2	3	1	2	3	2
##	4096	4097	4098	4099	4100	4101	4102	4103	4104	4105	4106	4107	4108
##	3	2	2	2	4	2	4	2	3	2	2	1	4
##	4109	4110	4111	4112	4113	4114	4115	4116	4117	4118	4119	4120	4121
##	2	2	2	4	2	4	1	2	3	4	2	2	2
##	4122	4123	4124	4125	4126	4127	4128	4129	4130	4131	4132	4133	4134
##	4	4	1	2	2	2	3	1	1	2	2	2	2

##	4135	4136	4137	4138	4139	4140	4141	4142	4143	4144	4145	4146	4147
##	1	2	1	3	2	3	3	2	2	1	2	2	2
##	4148	4149	4150	4151	4152	4153	4154	4155	4156	4157	4158	4159	4160
##	3	4	2	2	2	2	3	1	4	1	4	4	2
##	4161	4162	4163	4164	4165	4166	4167	4168	4169	4170	4171	4172	4173
##	2	4	4	3	3	1	2	2	2	3	1	2	3
##	4174	4175	4176	4177	4178	4179	4180	4181	4182	4183	4184	4185	4186
##	4	1	4	3	3	4	4	2	2	1	4	1	1
##	4187	4188	4189	4190	4191	4192	4193	4194	4195	4196	4197	4198	4199
##	4	2	1	2	2	1	2	1	3	2	2	2	2
##	4200	4201	4202	4203	4204	4205	4206	4207	4208	4209	4210	4211	4212
##	4	4	4	2	1	2	2	2	3	3	2	4	4
##	4213	4214	4215	4216	4217	4218	4219	4220	4221	4222	4223	4224	4225
##	2	2	2	1	2	2	2	2	3	2	2	3	1
##	4226	4227	4228	4229	4230	4231	4232	4233	4234	4235	4236	4237	4238
##	1	3	2	1	3	4	2	2	3	2	3	2	4
##	4239	4240	4241	4242	4243	4244	4245	4246	4247	4248	4249	4250	4251
##	1	2	2	2	2	4	4	4	3	2	2	3	2
##	4252	4253	4254	4255	4256	4257	4258	4259	4260	4261	4262	4263	4264
##	3	1	3	3	2	2	2	2	1	3	1	4	2
##	4265	4266	4267	4268	4269	4270	4271	4272	4273	4274	4275	4276	4277
##	2	4	2	2	2	2	2	4	3	2	3	3	2
##	4278	4279	4280	4281	4282	4283	4284	4285	4286	4287	4288	4289	4290
##	1	2	3	2	3	3	4	2	2	3	3	3	2
##	4291	4292	4293	4294	4295	4296	4297	4298	4299	4300	4301	4302	4303
##	2	2	3	2	2	4	3	2	2	2	2	2	2
##	4304	4305	4306	4307	4308	4309	4310	4311	4312	4313	4314	4315	4316
##	1	2	2	4	2	2	2	4	2	2	1	4	2
##	4317	4318	4319	4320	4321	4322	4323	4324	4325	4326	4327	4328	4329
##	2	2	4	2	2	2	2	2	3	2	2	4	2
##	4330	4331	4332	4333	4334	4335	4336	4337	4338	4339	4340	4341	4342
##	2	2	4	2	4	3	2	4	4	3	2	2	1
##	4343	4344	4345	4346	4347	4348	4349	4350	4351	4352	4353	4354	4355
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##	4356	4357	4358	4359	4360	4361	4362	4363	4364	4365	4366	4367	4368
##	3	2	3	4	2	2	3	3	2	2	2	1	2
##	4369	4370	4371	4372	4373	4374	4375	4376	4377	4378	4379	4380	4381
##	2	2	2	2	4	1	2	4	2	2	2	2	4
##	4382	4383	4384	4385	4386	4387	4388	4389	4390	4391	4392	4393	4394
##	2	3	1	2	2	2	1	2	1	2	3	3	1
##	4395	4396	4397	4398	4399	4400	4401	4402	4403	4404	4405	4406	4407
##	3	4	1	1	4	2	2	2	1	2	4	1	3
##	4408	4409	4410	4411	4412	4413	4414	4415	4416	4417	4418	4419	4420
##	4	4	4	3	2	1	3	4	2	4	2	2	2
##	4421	4422	4423	4424	4425	4426	4427	4428	4429	4430	4431	4432	4433
##	1	2	4	2	2	3	1	4	2	1	3	2	2
##	4434	4435	4436	4437	4438	4439	4440	4441	4442	4443	4444	4445	4446
##	2	3	3	1	2	2	4	4	2	1	2	1	2
##	4447	4448	4449	4450	4451	4452	4453	4454	4455	4456	4457	4458	4459
##	2	2	4	3	3	2	2	2	3	3	2	4	3
##	4460	4461	4462	4463	4464	4465	4466	4467	4468	4469	4470	4471	4472
##	4	1	2	3	3	2	2	4	4	1	2	2	2
##	4473	4474	4475	4476	4477	4478	4479	4480	4481	4482	4483	4484	4485
##	2	3	2	1	4	2	2	2	2	2	2	4	3

##	4486	4487	4488	4489	4490	4491	4492	4493	4494	4495	4496	4497	4498
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##	4499	4500	4501	4502	4503	4504	4505	4506	4507	4508	4509	4510	4511
##	1	4	2	4	1	2	4	4	2	3	4	2	1
##	4512	4513	4514	4515	4516	4517	4518	4519	4520	4521	4522	4523	4524
##	2	2	1	1	2	2	2	2	2	4	1	4	3
##	4525	4526	4527	4528	4529	4530	4531	4532	4533	4534	4535	4536	4537
##	2	2	3	2	1	4	2	2	2	1	1	2	2
##	4538	4539	4540	4541	4542	4543	4544	4545	4546	4547	4548	4549	4550
##	2	2	3	1	2	1	3	2	4	4	2	2	2
##	4551	4552	4553	4554	4555	4556	4557	4558	4559	4560	4561	4562	4563
##	2	2	2	3	2	4	1	3	3	1	2	4	2
##	4564	4565	4566	4567	4568	4569	4570	4571	4572	4573	4574	4575	4576
##	2	2	2	2	4	2	2	2	4	3	2	3	4
##	4577	4578	4579	4580	4581	4582	4583	4584	4585	4586	4587	4588	4589
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##	4590	4591	4592	4593	4594	4595	4596	4597	4598	4599	4600	4601	4602
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##	4603	4604	4605	4606	4607	4608	4609	4610	4611	4612	4613	4614	4615
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##	4616	4617	4618	4619	4620	4621	4622	4623	4624	4625	4626	4627	4628
##	2	4	2	2	2	2	3	1	4	4	3	3	2
##	4629	4630	4631	4632	4633	4634	4635	4636	4637	4638	4639	4640	4641
##	2	2	2	2	2	1	1	2	2	1	2	2	4
##	4642	4643	4644	4645	4646	4647	4648	4649	4650	4651	4652	4653	4654
##	3	2	1	2	1	2	4	4	4	4	1	3	1
##	4655	4656	4657	4658	4659	4660	4661	4662	4663	4664	4665	4666	4667
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##	4668	4669	4670	4671	4672	4673	4674	4675	4676	4677	4678	4679	4680
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##	4681	4682	4683	4684	4685	4686	4687	4688	4689	4690	4691	4692	4693
##	2	2	4	1	2	2	2	3	4	2	3	2	3
##	4694	4695	4696	4697	4698	4699	4700	4701	4702	4703	4704	4705	4706
##	3	2	2	4	4	1	3	2	4	2	4	2	1
##	4707	4708	4709	4710	4711	4712	4713	4714	4715	4716	4717	4718	4719
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##	4720	4721	4722	4723	4724	4725	4726	4727	4728	4729	4730	4731	4732
##	2	1	2	3	4	2	2	3	4	2	2	4	3
##	4733	4734	4735	4736	4737	4738	4739	4740	4741	4742	4743	4744	4745
##	2	4	2	1	2	2	2	3	2	2	2	1	1
##	4746	4747	4748	4749	4750	4751	4752	4753	4754	4755	4756	4757	4758
##	2	2	2	3	2	4	2	2	4	1	2	2	3
##	4759	4760	4761	4762	4763	4764	4765	4766	4767	4768	4769	4770	4771
##	2	2	4	2	2	4	2	4	3	4	2	2	3
##	4772	4773	4774	4775	4776	4777	4778	4779	4780	4781	4782	4783	4784
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##	4785	4786	4787	4788	4789	4790	4791	4792	4793	4794	4795	4796	4797
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##	4811	4812	4813	4814	4815	4816	4817	4818	4819	4820	4821	4822	4823
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##	4824	4825	4826	4827	4828	4829	4830	4831	4832	4833	4834	4835	4836
##	1	2	2	1	2	4	1	2	2	2	4	1	1

##	4837	4838	4839	4840	4841	4842	4843	4844	4845	4846	4847	4848	4849
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##	4850	4851	4852	4853	4854	4855	4856	4857	4858	4859	4860	4861	4862
##	4	4	2	2	3	3	2	3	2	2	2	2	2
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##	2	4	2	3	4	3	2	2	3	2	4	1	2
##	4876	4877	4878	4879	4880	4881	4882	4883	4884	4885	4886	4887	4888
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##	4889	4890	4891	4892	4893	4894	4895	4896	4897	4898	4899	4900	4901
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##	4915	4916	4917	4918	4919	4920	4921	4922	4923	4924	4925	4926	4927
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##	4941	4942	4943	4944	4945	4946	4947	4948	4949	4950	4951	4952	4953
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##	4967	4968	4969	4970	4971	4972	4973	4974	4975	4976	4977	4978	4979
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##	4980	4981	4982	4983	4984	4985	4986	4987	4988	4989	4990	4991	4992
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##	4993	4994	4995	4996	4997	4998	4999	5000	5001	5002	5003	5004	5005
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##	5006	5007	5008	5009	5010	5011	5012	5013	5014	5015	5016	5017	5018
##	1	3	2	2	4	4	2	1	2	1	2	3	1
##	5019	5020	5021	5022	5023	5024	5025	5026	5027	5028	5029	5030	5031
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##	5032	5033	5034	5035	5036	5037	5038	5039	5040	5041	5042	5043	5044
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##	5045	5046	5047	5048	5049	5050	5051	5052	5053	5054	5055	5056	5057
##	3	3	2	1	4	2	3	2	2	2	3	2	1
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##	1	2	2	4	3	2	2	1	4	2	2	2	3
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##	5188	5189	5190	5191	5192	5193	5194	5195	5196	5197	5198	5199	5200
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##	5214	5215	5216	5217	5218	5219	5220	5221	5222	5223	5224	5225	5226
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##	5253	5254	5255	5256	5257	5258	5259	5260	5261	5262	5263	5264	5265
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##	5266	5267	5268	5269	5270	5271	5272	5273	5274	5275	5276	5277	5278
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##	5292	5293	5294	5295	5296	5297	5298	5299	5300	5301	5302	5303	5304
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##	5396	5397	5398	5399	5400	5401	5402	5403	5404	5405	5406	5407	5408
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##	5409	5410	5411	5412	5413	5414	5415	5416	5417	5418	5419	5420	5421
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##	5422	5423	5424	5425	5426	5427	5428	5429	5430	5431	5432	5433	5434
##	2	3	2	4	1	3	1	1	1	4	2	4	2
##	5435	5436	5437	5438	5439	5440	5441	5442	5443	5444	5445	5446	5447
##	4	2	4	2	3	2	4	2	1	2	3	2	2
##	5448	5449	5450	5451	5452	5453	5454	5455	5456	5457	5458	5459	5460
##	2	3	2	3	2	3	2	2	4	2	4	1	4
##	5461	5462	5463	5464	5465	5466	5467	5468	5469	5470	5471	5472	5473
##	4	3	2	1	1	1	3	1	3	2	3	3	2
##	5474	5475	5476	5477	5478	5479	5480	5481	5482	5483	5484	5485	5486
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##	5487	5488	5489	5490	5491	5492	5493	5494	5495	5496	5497	5498	5499
##	2	1	3	4	2	1	3	1	1	4	2	1	2
##	5500	5501	5502	5503	5504	5505	5506	5507	5508	5509	5510	5511	5512
##	1	2	2	3	2	2	1	4	4	2	2	3	2
##	5513	5514	5515	5516	5517	5518	5519	5520	5521	5522	5523	5524	5525
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##	5526	5527	5528	5529	5530	5531	5532	5533	5534	5535	5536	5537	5538
##	2	2	2	4	2	2	2	2	3	4	1	2	1

##	5539	5540	5541	5542	5543	5544	5545	5546	5547	5548	5549	5550	5551
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##	5552	5553	5554	5555	5556	5557	5558	5559	5560	5561	5562	5563	5564
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##	5565	5566	5567	5568	5569	5570	5571	5572	5573	5574	5575	5576	5577
##	4	3	3	1	1	2	2	4	3	2	4	2	1
##	5578	5579	5580	5581	5582	5583	5584	5585	5586	5587	5588	5589	5590
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##	5591	5592	5593	5594	5595	5596	5597	5598	5599	5600	5601	5602	5603
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##	5656	5657	5658	5659	5660	5661	5662	5663	5664	5665	5666	5667	5668
##	4	4	3	4	1	4	2	2	2	1	3	2	2
##	5669	5670	5671	5672	5673	5674	5675	5676	5677	5678	5679	5680	5681
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##	5747	5748	5749	5750	5751	5752	5753	5754	5755	5756	5757	5758	5759
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##	5760	5761	5762	5763	5764	5765	5766	5767	5768	5769	5770	5771	5772
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##	5773	5774	5775	5776	5777	5778	5779	5780	5781	5782	5783	5784	5785
##	1	2	3	3	3	2	2	3	1	2	2	2	2
##	5786	5787	5788	5789	5790	5791	5792	5793	5794	5795	5796	5797	5798
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##	2	3	2	4	2	3	4	2	2	2	2	2	2
##	5812	5813	5814	5815	5816	5817	5818	5819	5820	5821	5822	5823	5824
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##	5851	5852	5853	5854	5855	5856	5857	5858	5859	5860	5861	5862	5863
##	3	2	2	2	4	2	2	2	4	1	4	2	2
##	5864	5865	5866	5867	5868	5869	5870	5871	5872	5873	5874	5875	5876
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##	5877	5878	5879	5880	5881	5882	5883	5884	5885	5886	5887	5888	5889
##	2	4	1	4	3	3	4	1	2	2	2	1	2

##	5890	5891	5892	5893	5894	5895	5896	5897	5898	5899	5900	5901	5902
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##	5903	5904	5905	5906	5907	5908	5909	5910	5911	5912	5913	5914	5915
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##	5916	5917	5918	5919	5920	5921	5922	5923	5924	5925	5926	5927	5928
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##	5929	5930	5931	5932	5933	5934	5935	5936	5937	5938	5939	5940	5941
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##	5942	5943	5944	5945	5946	5947	5948	5949	5950	5951	5952	5953	5954
##	3	4	2	3	2	3	1	4	1	2	1	2	4
##	5955	5956	5957	5958	5959	5960	5961	5962	5963	5964	5965	5966	5967
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##	5968	5969	5970	5971	5972	5973	5974	5975	5976	5977	5978	5979	5980
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##	5981	5982	5983	5984	5985	5986	5987	5988	5989	5990	5991	5992	5993
##	2	3	3	1	2	1	2	2	2	3	3	4	3
##	5994	5995	5996	5997	5998	5999	6000	6001	6002	6003	6004	6005	6006
##	2	4	2	4	2	2	2	2	2	2	4	4	2
##	6007	6008	6009	6010	6011	6012	6013	6014	6015	6016	6017	6018	6019
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##	6072	6073	6074	6075	6076	6077	6078	6079	6080	6081	6082	6083	6084
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##	6098	6099	6100	6101	6102	6103	6104	6105	6106	6107	6108	6109	6110
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##	6124	6125	6126	6127	6128	6129	6130	6131	6132	6133	6134	6135	6136
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##	6137	6138	6139	6140	6141	6142	6143	6144	6145	6146	6147	6148	6149
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##	6150	6151	6152	6153	6154	6155	6156	6157	6158	6159	6160	6161	6162
##	3	2	2	2	2	3	1	2	2	2	2	2	4
##	6163	6164	6165	6166	6167	6168	6169	6170	6171	6172	6173	6174	6175
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##	6176	6177	6178	6179	6180	6181	6182	6183	6184	6185	6186	6187	6188
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##	6189	6190	6191	6192	6193	6194	6195	6196	6197	6198	6199	6200	6201
##	4	2	3	4	3	2	1	2	1	2	1	4	4
##	6202	6203	6204	6205	6206	6207	6208	6209	6210	6211	6212	6213	6214
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##	6228	6229	6230	6231	6232	6233	6234	6235	6236	6237	6238	6239	6240
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##	6241	6242	6243	6244	6245	6246	6247	6248	6249	6250	6251	6252	6253
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##	6254	6255	6256	6257	6258	6259	6260	6261	6262	6263	6264	6265	6266
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##	6358	6359	6360	6361	6362	6363	6364	6365	6366	6367	6368	6369	6370
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##	6423	6424	6425	6426	6427	6428	6429	6430	6431	6432	6433	6434	6435
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##	2	2	3	1	2	2	2	2	2	2	2	2	1
##	6449	6450	6451	6452	6453	6454	6455	6456	6457	6458	6459	6460	6461
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##	6462	6463	6464	6465	6466	6467	6468	6469	6470	6471	6472	6473	6474
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##	6592	6593	6594	6595	6596	6597	6598	6599	6600	6601	6602	6603	6604
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##	6670	6671	6672	6673	6674	6675	6676	6677	6678	6679	6680	6681	6682
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##	6696	6697	6698	6699	6700	6701	6702	6703	6704	6705	6706	6707	6708
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##	6709	6710	6711	6712	6713	6714	6715	6716	6717	6718	6719	6720	6721
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##	6787	6788	6789	6790	6791	6792	6793	6794	6795	6796	6797	6798	6799
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##	6891	6892	6893	6894	6895	6896	6897	6898	6899	6900	6901	6902	6903
##	4	3	1	2	4	3	3	3	2	2	3	4	2
##	6904	6905	6906	6907	6908	6909	6910	6911	6912	6913	6914	6915	6916
##	3	2	3	4	1	2	2	3	2	1	1	4	3
##	6917	6918	6919	6920	6921	6922	6923	6924	6925	6926	6927	6928	6929
##	4	4	2	1	3	4	2	2	2	2	2	2	4
##	6930	6931	6932	6933	6934	6935	6936	6937	6938	6939	6940	6941	6942
##	4	2	2	4	2	1	1	2	2	1	2	2	3

##	6943	6944	6945	6946	6947	6948	6949	6950	6951	6952	6953	6954	6955
##	4	4	3	2	2	3	2	2	3	3	1	2	3
##	6956	6957	6958	6959	6960	6961	6962	6963	6964	6965	6966	6967	6968
##	2	3	2	1	1	2	2	2	3	3	3	2	2
##	6969	6970	6971	6972	6973	6974	6975	6976	6977	6978	6979	6980	6981
##	2	2	1	3	2	2	2	2	2	2	2	2	3
##	6982	6983	6984	6985	6986	6987	6988	6989	6990	6991	6992	6993	6994
##	4	4	1	2	1	2	4	3	2	1	2	1	2
##	6995	6996	6997	6998	6999	7000	7001	7002	7003	7004	7005	7006	7007
##	3	2	2	1	1	1	4	4	2	1	2	1	1
##	7008	7009	7010	7011	7012	7013	7014	7015	7016	7017	7018	7019	7020
##	1	2	2	2	2	4	1	2	2	1	1	2	1
##	7021	7022	7023	7024	7025	7026	7027	7028	7029	7030	7031	7032	7033
##	2	4	1	3	2	2	1	2	1	2	3	2	2
##	7034	7035	7036	7037	7038	7039	7040	7041	7042	7043	7044	7045	7046
##	2	2	2	2	2	2	2	2	1	2	2	2	1
##	7047	7048	7049	7050	7051	7052	7053	7054	7055	7056	7057	7058	7059
##	3	3	1	2	2	2	2	2	2	1	3	2	4
##	7060	7061	7062	7063	7064	7065	7066	7067	7068	7069	7070	7071	7072
##	1	3	1	2	2	3	3	3	1	2	3	3	2
##	7073	7074	7075	7076	7077	7078	7079	7080	7081	7082	7083	7084	7085
##	2	4	3	2	2	1	2	2	2	2	4	2	2
##	7086	7087	7088	7089	7090	7091	7092	7093	7094	7095	7096	7097	7098
##	2	4	2	1	3	2	2	2	2	1	2	2	1
##	7099	7100	7101	7102	7103	7104	7105	7106	7107	7108	7109	7110	7111
##	2	3	2	1	2	2	2	2	2	1	1	2	4
##	7112	7113	7114	7115	7116	7117	7118	7119	7120	7121	7122	7123	7124
##	3	4	1	4	2	4	2	3	2	2	2	4	2
##	7125	7126	7127	7128	7129	7130	7131	7132	7133	7134	7135	7136	7137
##	2	2	2	2	3	1	1	3	2	3	1	2	2
##	7138	7139	7140	7141	7142	7143	7144	7145	7146	7147	7148	7149	7150
##	2	4	4	4	3	4	2	2	1	2	2	2	2
##	7151	7152	7153	7154	7155	7156	7157	7158	7159	7160	7161	7162	7163
##	2	1	2	1	2	4	2	1	4	3	3	2	3
##	7164	7165	7166	7167	7168	7169	7170	7171	7172	7173	7174	7175	7176
##	3	4	2	4	1	2	2	4	4	2	2	3	2
##	7177	7178	7179	7180	7181	7182	7183	7184	7185	7186	7187	7188	7189
##	3	4	2	3	3	2	2	2	4	3	1	3	4
##	7190	7191	7192	7193	7194	7195	7196	7197	7198	7199	7200	7201	7202
##	1	4	2	4	1	2	2	1	2	2	2	4	3
##	7203	7204	7205	7206	7207	7208	7209	7210	7211	7212	7213	7214	7215
##	2	4	2	2	4	2	2	2	2	4	2	3	2
##	7216	7217	7218	7219	7220	7221	7222	7223	7224	7225	7226	7227	7228
##	4	4	4	2	2	1	2	2	2	4	2	4	3
##	7229	7230	7231	7232	7233	7234	7235	7236	7237	7238	7239	7240	7241
##	4	4	4	1	4	2	4	4	1	3	1	2	2
##	7242	7243	7244	7245	7246	7247	7248	7249	7250	7251	7252	7253	7254
##	2	4	3	2	3	4	3	3	2	1	2	1	1
##	7255	7256	7257	7258	7259	7260	7261	7262	7263	7264	7265	7266	7267
##	2	1	1	2	4	3	1	3	2	2	4	2	1
##	7268	7269	7270	7271	7272	7273	7274	7275	7276	7277	7278	7279	7280
##	2	2	1	2	2	1	2	3	1	2	3	2	2
##	7281	7282	7283	7284	7285	7286	7287	7288	7289	7290	7291	7292	7293
##	4	2	3	4	1	2	2	2	2	2	4	2	4

##	7294	7295	7296	7297	7298	7299	7300	7301	7302	7303	7304	7305	7306
##	2	3	2	2	2	4	4	2	2	4	2	2	3
##	7307	7308	7309	7310	7311	7312	7313	7314	7315	7316	7317	7318	7319
##	3	2	1	3	2	2	2	4	2	3	2	2	4
##	7320	7321	7322	7323	7324	7325	7326	7327	7328	7329	7330	7331	7332
##	1	2	2	3	3	4	2	3	2	2	2	3	1
##	7333	7334	7335	7336	7337	7338	7339	7340	7341	7342	7343	7344	7345
##	2	2	2	3	2	1	2	2	2	1	3	3	3
##	7346	7347	7348	7349	7350	7351	7352	7353	7354	7355	7356	7357	7358
##	2	3	3	2	1	2	2	2	2	3	2	2	2
##	7359	7360	7361	7362	7363	7364	7365	7366	7367	7368	7369	7370	7371
##	2	2	2	1	1	2	2	4	3	1	2	4	1
##	7372	7373	7374	7375	7376	7377	7378	7379	7380	7381	7382	7383	7384
##	4	4	2	2	3	2	1	3	4	1	1	2	2
##	7385	7386	7387	7388	7389	7390	7391	7392	7393	7394	7395	7396	7397
##	1	2	4	2	1	1	2	3	2	2	2	1	3
##	7398	7399	7400	7401	7402	7403	7404	7405	7406	7407	7408	7409	7410
##	2	2	2	4	2	2	2	2	2	2	2	2	2
##	7411	7412	7413	7414	7415	7416	7417	7418	7419	7420	7421	7422	7423
##	2	4	4	2	4	3	4	2	2	3	2	3	1
##	7424	7425	7426	7427	7428	7429	7430	7431	7432	7433	7434	7435	7436
##	3	3	2	3	2	2	4	3	1	3	2	4	2
##	7437	7438	7439	7440	7441	7442	7443	7444	7445	7446	7447	7448	7449
##	3	2	2	1	2	2	4	1	2	2	1	3	2
##	7450	7451	7452	7453	7454	7455	7456	7457	7458	7459	7460	7461	7462
##	2	2	2	2	2	2	4	2	2	2	2	3	2
##	7463	7464	7465	7466	7467	7468	7469	7470	7471	7472	7473	7474	7475
##	2	3	2	2	4	2	3	2	2	1	2	4	1
##	7476	7477	7478	7479	7480	7481	7482	7483	7484	7485	7486	7487	7488
##	2	2	2	2	1	2	3	2	3	3	1	2	3
##	7489	7490	7491	7492	7493	7494	7495	7496	7497	7498	7499	7500	7501
##	2	2	2	2	2	2	2	2	1	2	2	2	4
##	7502	7503	7504	7505	7506	7507	7508	7509	7510	7511	7512	7513	7514
##	1	3	2	4	1	4	4	4	2	2	1	2	2
##	7515	7516	7517	7518	7519	7520	7521	7522	7523	7524	7525	7526	7527
##	2	1	1	2	2	4	3	2	2	3	4	2	3
##	7528	7529	7530	7531	7532	7533	7534	7535	7536	7537	7538	7539	7540
##	1	2	2	3	2	4	2	4	2	2	3	1	4
##	7541	7542	7543	7544	7545	7546	7547	7548	7549	7550	7551	7552	7553
##	2	2	1	4	4	4	2	2	2	2	2	4	4
##	7554	7555	7556	7557	7558	7559	7560	7561	7562	7563	7564	7565	7566
##	2	2	3	2	2	2	1	4	1	4	4	4	1
##	7567	7568	7569	7570	7571	7572	7573	7574	7575	7576	7577	7578	7579
##	2	1	2	2	2	2	2	2	4	2	3	2	3
##	7580	7581	7582	7583	7584	7585	7586	7587	7588	7589	7590	7591	7592
##	4	2	2	4	1	2	2	4	4	2	1	4	3
##	7593	7594	7595	7596	7597	7598	7599	7600	7601	7602	7603	7604	7605
##	2	2	2	3	4	3	2	2	2	4	4	2	2
##	7606	7607	7608	7609	7610	7611	7612	7613	7614	7615	7616	7617	7618
##	2	3	2	4	2	3	2	2	2	3	2	4	3
##	7619	7620	7621	7622	7623	7624	7625	7626	7627	7628	7629	7630	7631
##	2	2	2	2	1	2	2	2	3	2	2	2	2
##	7632	7633	7634	7635	7636	7637	7638	7639	7640	7641	7642	7643	7644
##	2	2	3	2	2	2	2	2	3	1	2	2	4

##	7645	7646	7647	7648	7649	7650	7651	7652	7653	7654	7655	7656	7657
##	2	2	4	1	2	4	1	3	1	2	2	2	2
##	7658	7659	7660	7661	7662	7663	7664	7665	7666	7667	7668	7669	7670
##	2	2	2	1	3	4	2	3	4	1	4	2	2
##	7671	7672	7673	7674	7675	7676	7677	7678	7679	7680	7681	7682	7683
##	2	4	2	2	1	2	2	2	3	2	2	2	4
##	7684	7685	7686	7687	7688	7689	7690	7691	7692	7693	7694	7695	7696
##	3	1	2	2	3	3	4	2	2	2	2	2	3
##	7697	7698	7699	7700	7701	7702	7703	7704	7705	7706	7707	7708	7709
##	4	2	1	3	3	4	2	4	3	3	2	2	1
##	7710	7711	7712	7713	7714	7715	7716	7717	7718	7719	7720	7721	7722
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##	7723	7724	7725	7726	7727	7728	7729	7730	7731	7732	7733	7734	7735
##	3	2	4	2	2	4	2	1	2	1	3	4	4
##	7736	7737	7738	7739	7740	7741	7742	7743	7744	7745	7746	7747	7748
##	4	4	3	4	4	2	2	2	1	4	2	2	3
##	7749	7750	7751	7752	7753	7754	7755	7756	7757	7758	7759	7760	7761
##	2	2	2	1	2	2	2	4	2	4	3	2	2
##	7762	7763	7764	7765	7766	7767	7768	7769	7770	7771	7772	7773	7774
##	1	3	4	2	3	2	2	2	2	3	2	2	2
##	7775	7776	7777	7778	7779	7780	7781	7782	7783	7784	7785	7786	7787
##	2	1	3	2	2	1	4	2	2	1	4	2	1
##	7788	7789	7790	7791	7792	7793	7794	7795	7796	7797	7798	7799	7800
##	2	2	2	4	2	4	2	2	2	2	2	2	2
##	7801	7802	7803	7804	7805	7806	7807	7808	7809	7810	7811	7812	7813
##	3	2	2	3	2	1	2	4	3	2	3	2	4
##	7814	7815	7816	7817	7818	7819	7820	7821	7822	7823	7824	7825	7826
##	2	2	2	3	4	2	3	1	2	4	2	2	3
##	7827	7828	7829	7830	7831	7832	7833	7834	7835	7836	7837	7838	7839
##	1	1	2	2	1	1	2	2	2	3	3	4	1
##	7840	7841	7842	7843	7844	7845	7846	7847	7848	7849	7850	7851	7852
##	1	3	2	4	2	4	2	2	2	2	2	4	2
##	7853	7854	7855	7856	7857	7858	7859	7860	7861	7862	7863	7864	7865
##	1	2	4	2	1	3	2	2	2	2	3	4	1
##	7866	7867	7868	7869	7870	7871	7872	7873	7874	7875	7876	7877	7878
##	4	1	2	2	2	2	2	2	2	3	4	2	1
##	7879	7880	7881	7882	7883	7884	7885	7886	7887	7888	7889	7890	7891
##	2	2	4	2	1	2	2	3	2	2	2	4	2
##	7892	7893	7894	7895	7896	7897	7898	7899	7900	7901	7902	7903	7904
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##	7905	7906	7907	7908	7909	7910	7911	7912	7913	7914	7915	7916	7917
##	3	4	2	2	2	2	2	1	1	4	2	3	3
##	7918	7919	7920	7921	7922	7923	7924	7925	7926	7927	7928	7929	7930
##	2	1	2	2	2	4	2	3	3	2	1	2	1
##	7931	7932	7933	7934	7935	7936	7937	7938	7939	7940	7941	7942	7943
##	2	1	2	4	1	3	1	4	1	3	4	2	4
##	7944	7945	7946	7947	7948	7949	7950	7951	7952	7953	7954	7955	7956
##	3	3	2	2	2	2	4	3	2	3	3	4	4
##	7957	7958	7959	7960	7961	7962	7963	7964	7965	7966	7967	7968	7969
##	1	1	4	1	2	4	4	2	1	2	3	2	3
##	7970	7971	7972	7973	7974	7975	7976	7977	7978	7979	7980	7981	7982
##	1	2	3	2	3	2	3	2	2	2	2	2	3
##	7983	7984	7985	7986	7987	7988	7989	7990	7991	7992	7993	7994	7995
##	2	1	2	2	3	4	4	4	3	2	2	1	2

##	7996	7997	7998	7999	8000	8001	8002	8003	8004	8005	8006	8007	8008
##	3	1	2	4	2	2	2	1	2	1	2	3	2
##	8009	8010	8011	8012	8013	8014	8015	8016	8017	8018	8019	8020	8021
##	4	4	3	1	2	4	1	2	2	4	1	4	2
##	8022	8023	8024	8025	8026	8027	8028	8029	8030	8031	8032	8033	8034
##	3	2	1	4	2	2	2	2	2	4	3	2	2
##	8035	8036	8037	8038	8039	8040	8041	8042	8043	8044	8045	8046	8047
##	4	4	1	2	4	2	2	4	2	2	1	4	4
##	8048	8049	8050	8051	8052	8053	8054	8055	8056	8057	8058	8059	8060
##	2	1	1	1	4	3	3	4	2	2	3	2	2
##	8061	8062	8063	8064	8065	8066	8067	8068	8069	8070	8071	8072	8073
##	2	1	2	4	4	4	4	4	4	2	4	2	1
##	8074	8075	8076	8077	8078	8079	8080	8081	8082	8083	8084	8085	8086
##	1	2	2	4	3	2	2	2	2	2	4	2	2
##	8087	8088	8089	8090	8091	8092	8093	8094	8095	8096	8097	8098	8099
##	2	2	2	3	3	2	2	1	3	2	4	4	3
##	8100	8101	8102	8103	8104	8105	8106	8107	8108	8109	8110	8111	8112
##	2	2	4	2	2	3	4	4	2	2	4	2	3
##	8113	8114	8115	8116	8117	8118	8119	8120	8121	8122	8123	8124	8125
##	2	4	2	3	4	2	1	1	4	3	4	3	4
##	8126	8127	8128	8129	8130	8131	8132	8133	8134	8135	8136	8137	8138
##	2	3	2	2	4	4	1	1	1	4	2	3	3
##	8139	8140	8141	8142	8143	8144	8145	8146	8147	8148	8149	8150	8151
##	3	1	2	2	2	1	3	2	1	2	2	3	3
##	8152	8153	8154	8155	8156	8157	8158	8159	8160	8161	8162	8163	8164
##	2	2	2	2	3	2	2	3	2	3	1	2	4
##	8165	8166	8167	8168	8169	8170	8171	8172	8173	8174	8175	8176	8177
##	2	3	2	1	3	2	2	4	2	2	2	2	4
##	8178	8179	8180	8181	8182	8183	8184	8185	8186	8187	8188	8189	8190
##	2	2	2	2	3	4	3	2	3	2	2	2	3
##	8191	8192	8193	8194	8195	8196	8197	8198	8199	8200	8201	8202	8203
##	4	2	4	4	2	3	3	2	2	2	2	2	2
##	8204	8205	8206	8207	8208	8209	8210	8211	8212	8213	8214	8215	8216
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##	8217	8218	8219	8220	8221	8222	8223	8224	8225	8226	8227	8228	8229
##	2	1	2	4	2	2	1	2	4	4	2	2	3
##	8230	8231	8232	8233	8234	8235	8236	8237	8238	8239	8240	8241	8242
##	2	2	3	1	2	3	3	2	2	2	4	2	2
##	8243	8244	8245	8246	8247	8248	8249	8250	8251	8252	8253	8254	8255
##	4	1	2	3	2	2	3	2	2	1	2	3	3
##	8256	8257	8258	8259	8260	8261	8262	8263	8264	8265	8266	8267	8268
##	2	2	2	2	4	3	2	2	2	2	2	2	4
##	8269	8270	8271	8272	8273	8274	8275	8276	8277	8278	8279	8280	8281
##	4	2	2	2	2	2	4	1	1	2	2	2	2
##	8282	8283	8284	8285	8286	8287	8288	8289	8290	8291	8292	8293	8294
##	2	3	4	3	4	4	4	2	2	2	3	2	2
##	8295	8296	8297	8298	8299	8300	8301	8302	8303	8304	8305	8306	8307
##	2	2	4	4	2	2	2	2	1	2	1	4	2
##	8308	8309	8310	8311	8312	8313	8314	8315	8316	8317	8318	8319	8320
##	4	3	2	3	1	2	3	2	3	3	2	2	4
##	8321	8322	8323	8324	8325	8326	8327	8328	8329	8330	8331	8332	8333
##	1	4	3	1	3	2	2	2	3	1	1	3	2
##	8334	8335	8336	8337	8338	8339	8340	8341	8342	8343	8344	8345	8346
##	1	2	2	3	3	2	3	1	2	2	2	2	2

##	8347	8348	8349	8350	8351	8352	8353	8354	8355	8356	8357	8358	8359
##	4	1	4	3	1	4	3	3	2	2	1	3	2
##	8360	8361	8362	8363	8364	8365	8366	8367	8368	8369	8370	8371	8372
##	1	4	4	2	3	3	3	4	2	2	2	4	1
##	8373	8374	8375	8376	8377	8378	8379	8380	8381	8382	8383	8384	8385
##	2	4	2	4	1	2	1	2	2	1	3	2	2
##	8386	8387	8388	8389	8390	8391	8392	8393	8394	8395	8396	8397	8398
##	2	2	3	2	2	2	2	2	2	2	2	2	2
##	8399	8400	8401	8402	8403	8404	8405	8406	8407	8408	8409	8410	8411
##	1	2	3	1	2	2	2	2	2	2	2	2	4
##	8412	8413	8414	8415	8416	8417	8418	8419	8420	8421	8422	8423	8424
##	3	3	2	2	1	2	2	1	2	3	2	4	3
##	8425	8426	8427	8428	8429	8430	8431	8432	8433	8434	8435	8436	8437
##	2	2	3	4	2	3	4	2	1	2	2	2	3
##	8438	8439	8440	8441	8442	8443	8444	8445	8446	8447	8448	8449	8450
##	2	4	2	2	2	2	1	2	1	1	2	3	2
##	8451	8452	8453	8454	8455	8456	8457	8458	8459	8460	8461	8462	8463
##	4	2	4	2	1	2	4	2	1	1	3	4	2
##	8464	8465	8466	8467	8468	8469	8470	8471	8472	8473	8474	8475	8476
##	1	1	2	2	2	4	4	4	2	4	2	3	3
##	8477	8478	8479	8480	8481	8482	8483	8484	8485	8486	8487	8488	8489
##	2	4	4	1	3	2	3	2	2	2	2	2	2
##	8490	8491	8492	8493	8494	8495	8496	8497	8498	8499	8500	8501	8502
##	2	3	2	2	2	2	1	3	4	2	4	4	1
##	8503	8504	8505	8506	8507	8508	8509	8510	8511	8512	8513	8514	8515
##	3	2	1	2	2	2	3	3	2	2	4	1	1
##	8516	8517	8518	8519	8520	8521	8522	8523	8524	8525	8526	8527	8528
##	2	3	2	2	2	4	2	3	3	2	2	4	2
##	8529	8530	8531	8532	8533	8534	8535	8536	8537	8538	8539	8540	8541
##	2	2	2	2	2	2	2	4	1	2	4	3	2
##	8542	8543	8544	8545	8546	8547	8548	8549	8550	8551	8552	8553	8554
##	2	3	1	4	1	3	4	3	1	1	2	2	2
##	8555	8556	8557	8558	8559	8560	8561	8562	8563	8564	8565	8566	8567
##	2	2	1	2	4	2	3	2	1	2	1	4	4
##	8568	8569	8570	8571	8572	8573	8574	8575	8576	8577	8578	8579	8580
##	3	2	2	2	4	3	2	4	4	1	1	2	1
##	8581	8582	8583	8584	8585	8586	8587	8588	8589	8590	8591	8592	8593
##	2	2	2	1	4	2	1	2	1	1	2	3	4
##	8594	8595	8596	8597	8598	8599	8600	8601	8602	8603	8604	8605	8606
##	1	2	2	3	2	2	2	4	2	2	2	2	2
##	8607	8608	8609	8610	8611	8612	8613	8614	8615	8616	8617	8618	8619
##	2	1	2	3	3	1	3	2	1	2	4	2	4
##	8620	8621	8622	8623	8624	8625	8626	8627	8628	8629	8630	8631	8632
##	1	4	3	2	1	4	2	2	2	1	1	2	3
##	8633	8634	8635	8636	8637	8638	8639	8640	8641	8642	8643	8644	8645
##	4	3	2	2	2	2	1	1	2	3	2	2	2
##	8646	8647	8648	8649	8650	8651	8652	8653	8654	8655	8656	8657	8658
##	2	2	2	2	2	2	2	4	4	4	2	4	3
##	8659	8660	8661	8662	8663	8664	8665	8666	8667	8668	8669	8670	8671
##	4	3	4	3	2	2	1	2	2	2	2	2	2
##	8672	8673	8674	8675	8676	8677	8678	8679	8680	8681	8682	8683	8684
##	1	2	2	4	2	2	2	3	3	2	2	3	2
##	8685	8686	8687	8688	8689	8690	8691	8692	8693	8694	8695	8696	8697
##	2	3	1	2	4	2	1	1	3	2	2	1	2

##	8698	8699	8700	8701	8702	8703	8704	8705	8706	8707	8708	8709	8710
##	3	2	2	1	2	4	2	2	2	2	2	2	2
##	8711	8712	8713	8714	8715	8716	8717	8718	8719	8720	8721	8722	8723
##	4	2	2	2	2	2	2	1	2	2	3	3	3
##	8724	8725	8726	8727	8728	8729	8730	8731	8732	8733	8734	8735	8736
##	2	4	1	2	3	2	2	3	1	3	4	2	2
##	8737	8738	8739	8740	8741	8742	8743	8744	8745	8746	8747	8748	8749
##	4	3	1	2	4	2	3	3	1	1	4	2	2
##	8750	8751	8752	8753	8754	8755	8756	8757	8758	8759	8760	8761	8762
##	3	2	1	3	2	4	4	2	3	2	3	2	1
##	8763	8764	8765	8766	8767	8768	8769	8770	8771	8772	8773	8774	8775
##	4	2	1	4	2	1	4	4	2	2	3	2	3
##	8776	8777	8778	8779	8780	8781	8782	8783	8784	8785	8786	8787	8788
##	2	2	2	2	2	2	1	4	2	3	2	2	3
##	8789	8790	8791	8792	8793	8794	8795	8796	8797	8798	8799	8800	8801
##	4	4	3	1	4	1	2	3	2	2	2	4	2
##	8802	8803	8804	8805	8806	8807	8808	8809	8810	8811	8812	8813	8814
##	1	2	2	2	2	3	2	2	3	3	2	2	1
##	8815	8816	8817	8818	8819	8820	8821	8822	8823	8824	8825	8826	8827
##	3	3	2	3	2	3	2	4	3	2	2	2	3
##	8828	8829	8830	8831	8832	8833	8834	8835	8836	8837	8838	8839	8840
##	4	2	4	4	2	1	2	2	2	2	2	1	2
##	8841	8842	8843	8844	8845	8846	8847	8848	8849	8850	8851	8852	8853
##	1	4	2	3	1	2	1	3	2	4	2	2	4
##	8854	8855	8856	8857	8858	8859	8860	8861	8862	8863	8864	8865	8866
##	2	1	3	2	2	2	2	1	3	2	2	1	2
##	8867	8868	8869	8870	8871	8872	8873	8874	8875	8876	8877	8878	8879
##	2	4	2	1	2	1	4	2	1	4	2	3	3
##	8880	8881	8882	8883	8884	8885	8886	8887	8888	8889	8890	8891	8892
##	2	2	2	2	1	4	1	3	2	2	2	2	2
##	8893	8894	8895	8896	8897	8898	8899	8900	8901	8902	8903	8904	8905
##	2	1	2	2	4	2	2	4	2	1	4	2	2
##	8906	8907	8908	8909	8910	8911	8912	8913	8914	8915	8916	8917	8918
##	3	2	2	3	3	3	3	2	2	1	3	3	1
##	8919	8920	8921	8922	8923	8924	8925	8926	8927	8928	8929	8930	8931
##	4	3	3	4	1	2	2	2	2	1	2	3	2
##	8932	8933	8934	8935	8936	8937	8938	8939	8940	8941	8942	8943	8944
##	1	3	2	2	2	4	3	3	3	4	2	2	3
##	8945	8946	8947	8948	8949	8950	8951	8952	8953	8954	8955	8956	8957
##	2	2	3	1	3	1	2	2	3	2	4	3	3
##	8958	8959	8960	8961	8962	8963	8964	8965	8966	8967	8968	8969	8970
##	1	4	2	4	2	2	1	2	2	3	2	2	4
##	8971	8972	8973	8974	8975	8976	8977	8978	8979	8980	8981	8982	8983
##	2	2	2	1	1	1	3	3	2	2	2	3	4
##	8984	8985	8986	8987	8988	8989	8990	8991	8992	8993	8994	8995	8996
##	2	2	2	2	2	2	4	2	3	1	3	4	2
##	8997	8998	8999	9000	9001	9002	9003	9004	9005	9006	9007	9008	9009
##	2	2	2	2	1	2	2	1	2	3	4	3	4
##	9010	9011	9012	9013	9014	9015	9016	9017	9018	9019	9020	9021	9022
##	3	2	4	2	2	1	1	2	2	2	4	2	1
##	9023	9024	9025	9026	9027	9028	9029	9030	9031	9032	9033	9034	9035
##	2	2	2	4	2	2	2	3	2	4	2	4	4
##	9036	9037	9038	9039	9040	9041	9042	9043	9044	9045	9046	9047	9048
##	2	2	2	1	2	2	4	2	2	2	3	1	2

##	9049	9050	9051	9052	9053	9054	9055	9056	9057	9058	9059	9060	9061
##	4	2	3	3	2	4	3	4	4	2	2	3	1
##	9062	9063	9064	9065	9066	9067	9068	9069	9070	9071	9072	9073	9074
##	2	3	2	1	2	1	2	2	1	2	2	2	4
##	9075	9076	9077	9078	9079	9080	9081	9082	9083	9084	9085	9086	9087
##	2	2	3	2	3	4	2	3	2	1	3	1	1
##	9088	9089	9090	9091	9092	9093	9094	9095	9096	9097	9098	9099	9100
##	2	2	3	2	2	1	3	2	2	2	2	2	3
##	9101	9102	9103	9104	9105	9106	9107	9108	9109	9110	9111	9112	9113
##	2	3	2	2	2	1	2	2	2	2	1	2	2
##	9114	9115	9116	9117	9118	9119	9120	9121	9122	9123	9124	9125	9126
##	2	2	2	4	3	2	2	2	1	2	2	3	2
##	9127	9128	9129	9130	9131	9132	9133	9134	9135	9136	9137	9138	9139
##	3	2	2	2	2	1	2	2	3	2	1	2	2
##	9140	9141	9142	9143	9144	9145	9146	9147	9148	9149	9150	9151	9152
##	1	2	4	1	2	3	2	1	4	2	2	4	2
##	9153	9154	9155	9156	9157	9158	9159	9160	9161	9162	9163	9164	9165
##	2	1	3	3	2	1	2	2	4	3	4	1	3
##	9166	9167	9168	9169	9170	9171	9172	9173	9174	9175	9176	9177	9178
##	3	2	2	2	2	3	2	3	4	1	2	1	2
##	9179	9180	9181	9182	9183	9184	9185	9186	9187	9188	9189	9190	9191
##	1	4	2	3	1	1	2	2	1	2	2	1	3
##	9192	9193	9194	9195	9196	9197	9198	9199	9200	9201	9202	9203	9204
##	2	2	2	1	4	4	2	2	3	3	2	4	2
##	9205	9206	9207	9208	9209	9210	9211	9212	9213	9214	9215	9216	9217
##	1	3	2	2	2	2	2	3	3	4	3	3	2
##	9218	9219	9220	9221	9222	9223	9224	9225	9226	9227	9228	9229	9230
##	2	4	3	3	2	2	1	2	2	4	2	2	4
##	9231	9232	9233	9234	9235	9236	9237	9238	9239	9240	9241	9242	9243
##	4	2	2	1	2	2	2	1	2	3	1	2	2
##	9244	9245	9246	9247	9248	9249	9250	9251	9252	9253	9254	9255	9256
##	2	3	2	3	2	4	2	2	2	1	2	2	3
##	9257	9258	9259	9260	9261	9262	9263	9264	9265	9266	9267	9268	9269
##	2	2	4	3	3	2	1	2	3	2	2	4	4
##	9270	9271	9272	9273	9274	9275	9276	9277	9278	9279	9280	9281	9282
##	1	2	4	2	2	2	2	1	2	2	2	4	2
##	9283	9284	9285	9286	9287	9288	9289	9290	9291	9292	9293	9294	9295
##	2	2	2	1	2	4	2	4	4	2	4	4	2
##	9296	9297	9298	9299	9300	9301	9302	9303	9304	9305	9306	9307	9308
##	2	1	4	2	4	2	2	2	2	4	2	4	2
##	9309	9310	9311	9312	9313	9314	9315	9316	9317	9318	9319	9320	9321
##	1	3	2	2	2	2	2	4	4	2	3	2	3
##	9322	9323	9324	9325	9326	9327	9328	9329	9330	9331	9332	9333	9334
##	2	2	4	2	2	3	4	3	1	2	2	3	3
##	9335	9336	9337	9338	9339	9340	9341	9342	9343	9344	9345	9346	9347
##	1	2	1	2	4	4	2	2	2	4	2	3	1
##	9348	9349	9350	9351	9352	9353	9354	9355	9356	9357	9358	9359	9360
##	2	3	2	2	1	2	2	2	1	3	1	1	1
##	9361	9362	9363	9364	9365	9366	9367	9368	9369	9370	9371	9372	9373
##	3	1	3	3	2	2	1	2	2	4	2	4	4
##	9374	9375	9376	9377	9378	9379	9380	9381	9382	9383	9384	9385	9386
##	2	1	4	2	3	1	4	1	1	1	4	4	2
##	9387	9388	9389	9390	9391	9392	9393	9394	9395	9396	9397	9398	9399
##	2	4	2	4	2	3	1	2	2	3	4	4	4

##	9400	9401	9402	9403	9404	9405	9406	9407	9408	9409	9410	9411	9412
##	2	4	2	1	1	2	2	2	2	2	4	3	3
##	9413	9414	9415	9416	9417	9418	9419	9420	9421	9422	9423	9424	9425
##	2	3	2	4	3	3	3	1	2	2	2	4	2
##	9426	9427	9428	9429	9430	9431	9432	9433	9434	9435	9436	9437	9438
##	2	2	4	2	2	2	2	4	3	2	1	2	3
##	9439	9440	9441	9442	9443	9444	9445	9446	9447	9448	9449	9450	9451
##	2	2	2	2	2	4	4	2	4	3	2	2	1
##	9452	9453	9454	9455	9456	9457	9458	9459	9460	9461	9462	9463	9464
##	1	2	2	3	3	4	2	4	3	2	2	2	2
##	9465	9466	9467	9468	9469	9470	9471	9472	9473	9474	9475	9476	9477
##	2	2	1	4	2	2	1	4	1	2	2	3	3
##	9478	9479	9480	9481	9482	9483	9484	9485	9486	9487	9488	9489	9490
##	2	2	1	2	2	1	2	4	3	4	2	1	2
##	9491	9492	9493	9494	9495	9496	9497	9498	9499	9500	9501	9502	9503
##	2	2	2	4	2	2	2	3	2	2	3	3	1
##	9504	9505	9506	9507	9508	9509	9510	9511	9512	9513	9514	9515	9516
##	4	2	1	3	2	3	3	3	2	3	2	2	2
##	9517	9518	9519	9520	9521	9522	9523	9524	9525	9526	9527	9528	9529
##	1	2	2	2	2	1	2	2	2	2	3	2	2
##	9530	9531	9532	9533	9534	9535	9536	9537	9538	9539	9540	9541	9542
##	4	2	2	3	3	2	2	4	2	2	2	1	1
##	9543	9544	9545	9546	9547	9548	9549	9550	9551	9552	9553	9554	9555
##	1	4	3	2	4	2	2	2	2	2	3	2	1
##	9556	9557	9558	9559	9560	9561	9562	9563	9564	9565	9566	9567	9568
##	4	1	1	2	1	2	4	1	2	1	2	4	2
##	9569	9570	9571	9572	9573	9574	9575	9576	9577	9578	9579	9580	9581
##	2	1	2	1	2	4	2	1	4	1	2	2	2
##	9582	9583	9584	9585	9586	9587	9588	9589	9590	9591	9592	9593	9594
##	2	2	3	2	4	2	1	1	2	1	4	4	2
##	9595	9596	9597	9598	9599	9600	9601	9602	9603	9604	9605	9606	9607
##	2	2	2	2	2	2	2	1	2	1	2	1	1
##	9608	9609	9610	9611	9612	9613	9614	9615	9616	9617	9618	9619	9620
##	4	2	3	4	2	4	4	2	3	4	2	3	2
##	9621	9622	9623	9624	9625	9626	9627	9628	9629	9630	9631	9632	9633
##	2	2	2	3	2	3	4	4	4	1	2	2	4
##	9634	9635	9636	9637	9638	9639	9640	9641	9642	9643	9644	9645	9646
##	3	1	2	3	2	4	2	3	4	2	4	2	3
##	9647	9648	9649	9650	9651	9652	9653	9654	9655	9656	9657	9658	9659
##	2	4	3	4	4	2	3	2	2	2	2	1	4
##	9660	9661	9662	9663	9664	9665	9666	9667	9668	9669	9670	9671	9672
##	1	2	2	2	2	2	2	4	2	1	1	4	4
##	9673	9674	9675	9676	9677	9678	9679	9680	9681	9682	9683	9684	9685
##	1	1	3	3	1	2	2	2	2	2	2	3	3
##	9686	9687	9688	9689	9690	9691	9692	9693	9694	9695	9696	9697	9698
##	2	2	3	4	3	2	1	2	2	2	1	2	2
##	9699	9700	9701	9702	9703	9704	9705	9706	9707	9708	9709	9710	9711
##	3	2	3	2	2	2	2	2	1	2	2	2	2
##	9712	9713	9714	9715	9716	9717	9718	9719	9720	9721	9722	9723	9724
##	4	3	3	4	4	1	2	2	4	2	2	2	2
##	9725	9726	9727	9728	9729	9730	9731	9732	9733	9734	9735	9736	9737
##	2	4	2	2	2	3	2	4	2	2	3	2	3
##	9738	9739	9740	9741	9742	9743	9744	9745	9746	9747	9748	9749	9750
##	4	1	1	2	2	2	2	2	2	2	3	3	4

##	9751	9752	9753	9754	9755	9756	9757	9758	9759	9760	9761	9762	9763
##	1	2	2	3	2	2	2	4	3	1	2	2	2
##	9764	9765	9766	9767	9768	9769	9770	9771	9772	9773	9774	9775	9776
##	2	3	4	2	2	2	2	4	4	2	1	3	1
##	9777	9778	9779	9780	9781	9782	9783	9784	9785	9786	9787	9788	9789
##	2	2	2	2	2	2	2	2	4	2	2	2	2
##	9790	9791	9792	9793	9794	9795	9796	9797	9798	9799	9800	9801	9802
##	2	4	2	2	1	4	2	3	3	3	2	3	1
##	9803	9804	9805	9806	9807	9808	9809	9810	9811	9812	9813	9814	9815
##	2	4	2	2	1	2	2	2	2	2	4	4	2
##	9816	9817	9818	9819	9820	9821	9822	9823	9824	9825	9826	9827	9828
##	2	2	1	4	3	4	1	2	2	2	2	1	2
##	9829	9830	9831	9832	9833	9834	9835	9836	9837	9838	9839	9840	9841
##	2	2	1	4	2	4	2	4	2	2	4	1	3
##	9842	9843	9844	9845	9846	9847	9848	9849	9850	9851	9852	9853	9854
##	2	2	2	2	2	1	2	4	2	2	1	2	2
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## 12065 12066 12067 12068 12069 12070 12071 12072 12073 12074 12075 12076 12077
## 1 2 2 2 1 2 2 2 1 1 3 2
## 12078 12079 12080 12081 12082 12083 12084 12085 12086 12087 12088 12089 12090
## 2 3 2 2 2 4 2 3 2 2 4 4 2
## 12091 12092 12093 12094 12095 12096 12097 12098 12099 12100 12101 12102 12103
## 2 3 2 4 3 2 2 3 2 2 2 3 2
## 12104 12105 12106 12107 12108 12109 12110 12111 12112 12113 12114 12115 12116
## 2 1 2 2 2 2 2 2 1 2 2 2 2
## 12117 12118 12119 12120 12121 12122 12123 12124 12125 12126 12127 12128 12129
## 2 2 3 2 2 3 2 2 1 1 2 2 2
## 12130 12131 12132 12133 12134 12135 12136 12137 12138 12139 12140 12141 12142
## 2 2 2 1 4 4 1 4 2 2 2 2 2
## 12143 12144 12145 12146 12147 12148 12149 12150 12151 12152 12153 12154 12155
## 3 2 2 3 3 3 2 2 2 2 1 2 2
## 12156 12157 12158 12159 12160 12161 12162 12163 12164 12165 12166 12167 12168
## 1 2 1 3 4 2 3 1 3 2 2 2 2
## 12169 12170 12171 12172 12173 12174 12175 12176 12177 12178 12179 12180 12181
## 2 2 1 1 2 1 2 4 2 4 2 1 4
## 12182 12183 12184 12185 12186 12187 12188 12189 12190 12191 12192 12193 12194
## 2 2 4 3 3 3 1 2 4 4 1 2 3
## 12195 12196 12197 12198 12199 12200 12201 12202 12203 12204 12205 12206 12207
## 2 3 2 1 3 2 4 4 4 3 1 1 3

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## 12208 12209 12210 12211 12212 12213 12214 12215 12216 12217 12218 12219 12220
##   3     1     2     2     4     1     2     2     2     1     3     1     2     3
## 12221 12222 12223 12224 12225 12226 12227 12228 12229 12230 12231 12232 12233
##   4     2     2     1     3     2     2     2     2     1     1     2     2     1
## 12234 12235 12236 12237 12238 12239 12240 12241 12242 12243 12244 12245 12246
##   2     3     2     3     2     1     2     2     2     4     2     4     4     3
## 12247 12248 12249 12250 12251 12252 12253 12254 12255 12256 12257 12258 12259
##   2     2     2     1     3     2     3     2     3     2     3     2     2     2
## 12260 12261 12262 12263 12264 12265 12266 12267 12268 12269 12270 12271 12272
##   2     2     3     3     3     2     4     2     3     2     2     2     2     2
## 12273 12274 12275 12276 12277 12278 12279 12280 12281 12282 12283 12284 12285
##   3     2     2     2     1     2     1     1     1     1     3     2     2     3
## 12286 12287 12288 12289 12290 12291 12292 12293 12294 12295 12296 12297 12298
##   3     4     1     3     2     2     2     2     4     2     4     3     2
## 12299 12300 12301 12302 12303 12304 12305 12306 12307 12308 12309 12310 12311
##   3     2     3     3     4     2     1     2     2     2     2     4     1
## 12312 12313 12314 12315 12316 12317 12318 12319 12320 12321 12322 12323 12324
##   2     4     4     3     1     2     4     2     2     2     4     4     2
## 12325 12326 12327 12328 12329 12330 12331 12332 12333 12334 12335 12336 12337
##   2     4     2     2     2     2     2     2     2     3     2     3     1
## 12338 12339 12340 12341 12342 12343 12344 12345 12346 12347 12348 12349 12350
##   3     3     1     2     3     1     4     2     2     4     1     2     4     4
## 12351 12352 12353 12354 12355 12356 12357 12358 12359 12360 12361 12362 12363
##   2     2     2     3     3     3     2     2     3     2     2     2     2
## 12364 12365 12366 12367 12368 12369 12370 12371 12372 12373 12374 12375 12376
##   2     2     2     4     4     2     2     2     2     2     2     2     2
## 12377 12378 12379 12380 12381 12382 12383 12384 12385 12386 12387 12388 12389
##   3     2     2     2     4     2     2     2     2     1     4     2     2     2
## 12390 12391 12392 12393 12394 12395 12396 12397 12398 12399 12400 12401 12402
##   2     2     4     3     3     4     2     2     2     2     1     2     2     2
## 12403 12404 12405 12406 12407 12408 12409 12410 12411 12412 12413 12414 12415
##   1     2     2     2     2     3     3     2     1     3     3     2     2     2
## 12416 12417 12418 12419 12420 12421 12422 12423 12424 12425 12426 12427 12428
##   3     2     2     2     2     3     3     2     2     3     3     2     2     2
## 12429 12430 12431 12432 12433 12434 12435 12436 12437 12438 12439 12440 12441
##   2     2     2     4     2     3     2     2     2     2     2     2     2     1
## 12442 12443 12444 12445 12446 12447 12448 12449 12450 12451 12452 12453 12454
##   4     4     2     2     2     4     2     4     2     2     2     2     2     3
## 12455 12456 12457 12458 12459 12460 12461 12462 12463 12464 12465 12466 12467
##   2     2     2     2     4     1     2     2     2     2     1     2     2     2
## 12468 12469 12470 12471 12472 12473 12474 12475 12476 12477 12478 12479 12480
##   2     3     2     3     4     1     1     1     1     2     2     2     2     1
## 12481 12482 12483 12484 12485 12486 12487 12488 12489 12490 12491 12492 12493
##   1     2     2     2     2     1     1     2     2     4     1     3     2
## 12494 12495 12496 12497 12498 12499 12500 12501 12502 12503 12504 12505 12506
##   1     2     2     2     2     2     4     1     2     2     2     2     2     2
## 12507 12508 12509 12510 12511 12512 12513 12514 12515 12516 12517 12518 12519
##   3     2     3     4     3     3     2     2     3     2     2     4     1
## 12520 12521 12522 12523 12524 12525 12526 12527 12528 12529 12530 12531 12532
##   2     2     1     3     4     2     3     4     3     3     2     3     4
## 12533 12534 12535 12536 12537 12538 12539 12540 12541 12542 12543 12544 12545
##   2     4     4     2     1     2     2     4     2     1     3     2     1
## 12546 12547 12548 12549 12550 12551 12552 12553 12554 12555 12556 12557 12558
##   4     3     3     2     3     2     2     2     4     2     2     2     2

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## 12559 12560 12561 12562 12563 12564 12565 12566 12567 12568 12569 12570 12571
## 2 3 4 1 2 1 4 3 3 2 2 3 4
## 12572 12573 12574 12575 12576 12577 12578 12579 12580 12581 12582 12583 12584
## 4 3 2 2 2 2 2 4 4 4 2 2 2
## 12585 12586 12587 12588 12589 12590 12591 12592 12593 12594 12595 12596 12597
## 2 2 2 2 4 1 2 2 2 2 2 2
## 12598 12599 12600 12601 12602 12603 12604 12605 12606 12607 12608 12609 12610
## 4 2 2 3 2 2 3 2 2 2 1 2
## 12611 12612 12613 12614 12615 12616 12617 12618 12619 12620 12621 12622 12623
## 2 3 1 2 3 2 2 1 1 2 2 3
## 12624 12625 12626 12627 12628 12629 12630 12631 12632 12633 12634 12635 12636
## 4 2 4 4 2 2 4 2 2 2 2 2
## 12637 12638 12639 12640 12641 12642 12643 12644 12645 12646 12647 12648 12649
## 2 2 3 2 2 1 1 2 2 2 2 4
## 12650 12651 12652 12653 12654 12655 12656 12657 12658 12659 12660 12661 12662
## 2 2 2 3 2 2 2 2 3 2 1 4
## 12663 12664 12665 12666 12667 12668 12669 12670 12671 12672 12673 12674 12675
## 3 2 2 2 1 2 3 3 2 2 1 2
## 12676 12677 12678 12679 12680 12681 12682 12683 12684 12685 12686 12687 12688
## 3 2 3 2 1 2 1 4 1 2 3 4
## 12689 12690 12691 12692 12693 12694 12695 12696 12697 12698 12699 12700 12701
## 1 4 2 1 2 2 1 2 2 3 2 2
## 12702 12703 12704 12705 12706 12707 12708 12709 12710 12711 12712 12713 12714
## 2 3 2 3 2 3 4 2 3 2 2 2
## 12715 12716 12717 12718 12719 12720 12721 12722 12723 12724 12725 12726 12727
## 1 1 2 2 2 2 4 2 2 2 2 3
## 12728 12729 12730 12731 12732 12733 12734 12735 12736 12737 12738 12739 12740
## 3 2 3 4 2 2 4 2 2 2 2 2
## 12741 12742 12743 12744 12745 12746 12747 12748 12749 12750 12751 12752 12753
## 2 2 2 2 4 1 2 4 3 1 2 1
## 12754 12755 12756 12757 12758 12759 12760 12761 12762 12763 12764 12765 12766
## 3 2 2 1 2 2 3 2 2 2 1 1
## 12767 12768 12769 12770 12771 12772 12773 12774 12775 12776 12777 12778 12779
## 4 2 2 2 2 3 4 4 3 2 3 4
## 12780 12781 12782 12783 12784 12785 12786 12787 12788 12789 12790 12791 12792
## 2 1 2 2 2 4 3 2 2 2 2 4
## 12793 12794 12795 12796 12797 12798 12799 12800 12801 12802 12803 12804 12805
## 2 4 4 1 1 2 2 3 3 2 3 4
## 12806 12807 12808 12809 12810 12811 12812 12813 12814 12815 12816 12817 12818
## 2 2 2 2 1 2 3 3 2 2 2 3
## 12819 12820 12821 12822 12823 12824 12825 12826 12827 12828 12829 12830 12831
## 3 3 3 2 2 2 2 3 2 3 2 1
## 12832 12833 12834 12835 12836 12837 12838 12839 12840 12841 12842 12843 12844
## 2 4 2 2 1 1 2 4 2 2 2 2
## 12845 12846 12847 12848 12849 12850 12851 12852 12853 12854 12855 12856 12857
## 2 3 1 3 2 1 3 4 2 2 1 2
## 12858 12859 12860 12861 12862 12863 12864 12865 12866 12867 12868 12869 12870
## 2 3 2 3 2 4 3 1 2 2 2 2
## 12871 12872 12873 12874 12875 12876 12877 12878 12879 12880 12881 12882 12883
## 2 3 4 2 2 4 4 1 2 2 1 1
## 12884 12885 12886 12887 12888 12889 12890 12891 12892 12893 12894 12895 12896
## 2 4 2 2 3 4 3 2 4 4 2 3
## 12897 12898 12899 12900 12901 12902 12903 12904 12905 12906 12907 12908 12909
## 1 3 2 2 2 2 2 4 3 3 3 1

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## 12910 12911 12912 12913 12914 12915 12916 12917 12918 12919 12920 12921 12922
##   1    2    1    2    3    2    2    2    2    4    2    3    2
## 12923 12924 12925 12926 12927 12928 12929 12930 12931 12932 12933 12934 12935
##   2    2    2    2    2    4    3    1    3    2    1    3    2
## 12936 12937 12938 12939 12940 12941 12942 12943 12944 12945 12946 12947 12948
##   2    2    3    2    1    4    2    4    1    2    2    2    2
## 12949 12950 12951 12952 12953 12954 12955 12956 12957 12958 12959 12960 12961
##   3    2    2    4    2    2    2    2    3    1    2    2    3
## 12962 12963 12964 12965 12966 12967 12968 12969 12970 12971 12972 12973 12974
##   2    2    2    2    4    4    4    2    1    4    2    2    1
## 12975 12976 12977 12978 12979 12980 12981 12982 12983 12984 12985 12986 12987
##   3    2    2    2    1    2    3    2    2    3    2    4    1
## 12988 12989 12990 12991 12992 12993 12994 12995 12996 12997 12998 12999 13000
##   4    4    4    2    2    4    1    3    4    1    2    2    2
## 13001 13002 13003 13004 13005 13006 13007 13008 13009 13010 13011 13012 13013
##   4    2    2    2    2    2    1    1    2    2    4    2    2
## 13014 13015 13016 13017 13018 13019 13020 13021 13022 13023 13024 13025 13026
##   3    2    3    4    2    3    2    2    4    1    2    2    1
## 13027 13028 13029 13030 13031 13032 13033 13034 13035 13036 13037 13038 13039
##   4    2    3    3    2    4    2    3    3    1    2    2    2
## 13040 13041 13042 13043 13044 13045 13046 13047 13048 13049 13050 13051 13052
##   4    2    2    2    2    2    2    2    2    2    2    1    2
## 13053 13054 13055 13056 13057 13058 13059 13060 13061 13062 13063 13064 13065
##   2    4    3    4    1    3    3    4    1    2    2    1    1
## 13066 13067 13068 13069 13070 13071 13072 13073 13074 13075 13076 13077 13078
##   2    1    3    4    2    2    2    2    4    3    4    4    1
## 13079 13080 13081 13082 13083 13084 13085 13086 13087 13088 13089 13090 13091
##   2    4    2    3    2    1    3    4    2    1    1    4    2
## 13092 13093 13094 13095 13096 13097 13098 13099 13100 13101 13102 13103 13104
##   2    2    2    2    2    3    2    2    2    3    4    4    2
## 13105 13106 13107 13108 13109 13110 13111 13112 13113 13114 13115 13116 13117
##   2    2    2    2    2    2    2    1    3    1    2    2    2
## 13118 13119 13120 13121 13122 13123 13124 13125 13126 13127 13128 13129 13130
##   2    2    2    3    4    4    2    1    4    2    2    2    2
## 13131 13132 13133 13134 13135 13136 13137 13138 13139 13140 13141 13142 13143
##   4    1    3    3    2    4    4    2    2    2    3    4    4
## 13144 13145 13146 13147 13148 13149 13150 13151 13152 13153 13154 13155 13156
##   2    2    2    2    4    1    2    2    4    2    2    2    2
## 13157 13158 13159 13160 13161 13162 13163 13164 13165 13166 13167 13168 13169
##   1    2    4    4    2    2    1    1    2    2    2    3    1
## 13170 13171 13172 13173 13174 13175 13176 13177 13178 13179 13180 13181 13182
##   3    4    2    2    2    4    2    2    2    2    2    4    2
## 13183 13184 13185 13186 13187 13188 13189 13190 13191 13192 13193 13194 13195
##   2    2    2    2    2    1    1    2    1    2    1    2    2
## 13196 13197 13198 13199 13200 13201 13202 13203 13204 13205 13206 13207 13208
##   2    2    4    2    2    2    4    4    2    1    2    1    2
## 13209 13210 13211 13212 13213 13214 13215 13216 13217 13218 13219 13220 13221
##   2    4    2    2    3    3    3    2    1    2    2    1    4
## 13222 13223 13224 13225 13226 13227 13228 13229 13230 13231 13232 13233 13234
##   2    2    2    4    2    2    1    2    2    2    3    2    2
## 13235 13236 13237 13238 13239 13240 13241 13242 13243 13244 13245 13246 13247
##   4    4    2    4    2    2    2    4    4    4    2    1    2
## 13248 13249 13250 13251 13252 13253 13254 13255 13256 13257 13258 13259 13260
##   3    3    2    3    3    3    2    2    1    2    2    4    3

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## 13261 13262 13263 13264 13265 13266 13267 13268 13269 13270 13271 13272 13273
## 2 2 2 3 2 4 4 2 2 3 4 3 3
## 13274 13275 13276 13277 13278 13279 13280 13281 13282 13283 13284 13285 13286
## 2 2 4 3 3 1 2 2 2 4 4 2 2
## 13287 13288 13289 13290 13291 13292 13293 13294 13295 13296 13297 13298 13299
## 2 2 2 2 1 2 2 2 4 2 3 3
## 13300 13301 13302 13303 13304 13305 13306 13307 13308 13309 13310 13311 13312
## 1 2 4 2 3 1 2 1 3 3 3 3
## 13313 13314 13315 13316 13317 13318 13319 13320 13321 13322 13323 13324 13325
## 3 4 2 4 4 4 2 2 2 2 3 2
## 13326 13327 13328 13329 13330 13331 13332 13333 13334 13335 13336 13337 13338
## 2 4 2 2 3 3 1 3 2 2 4 2 3
## 13339 13340 13341 13342 13343 13344 13345 13346 13347 13348 13349 13350 13351
## 2 2 2 1 3 3 2 2 2 2 1 2 4
## 13352 13353 13354 13355 13356 13357 13358 13359 13360 13361 13362 13363 13364
## 1 3 1 1 2 1 4 3 2 2 2 3 1
## 13365 13366 13367 13368 13369 13370 13371 13372 13373 13374 13375 13376 13377
## 1 2 4 1 2 2 2 2 2 2 4 2 2
## 13378 13379 13380 13381 13382 13383 13384 13385 13386 13387 13388 13389 13390
## 2 4 4 3 2 3 2 4 2 2 2 2 4
## 13391 13392 13393 13394 13395 13396 13397 13398 13399 13400 13401 13402 13403
## 2 3 4 3 3 3 2 2 2 2 1 2 2
## 13404 13405 13406 13407 13408 13409 13410 13411 13412 13413 13414 13415 13416
## 3 1 2 2 4 2 3 2 2 3 2 3 4
## 13417 13418 13419 13420 13421 13422 13423 13424 13425 13426 13427 13428 13429
## 2 3 4 1 3 2 2 2 1 4 2 2 2
## 13430 13431 13432 13433 13434 13435 13436 13437 13438 13439 13440 13441 13442
## 2 2 2 2 1 2 2 2 2 3 2 2 3
## 13443 13444 13445 13446 13447 13448 13449 13450 13451 13452 13453 13454 13455
## 3 2 4 4 2 2 3 2 2 2 1 2 1
## 13456 13457 13458 13459 13460 13461 13462 13463 13464 13465 13466 13467 13468
## 4 1 2 3 4 3 1 2 2 2 2 4 2
## 13469 13470 13471 13472 13473 13474 13475 13476 13477 13478 13479 13480 13481
## 1 2 2 2 3 2 1 2 4 2 3 2 3
## 13482 13483 13484 13485 13486 13487 13488 13489 13490 13491 13492 13493 13494
## 1 2 4 2 1 1 2 2 3 2 3 3 2
## 13495 13496 13497 13498 13499 13500 13501 13502 13503 13504 13505 13506 13507
## 2 2 2 4 1 1 2 4 2 2 4 2 4
## 13508 13509 13510 13511 13512 13513 13514 13515 13516 13517 13518 13519 13520
## 2 2 2 1 2 3 2 2 2 2 2 2 4
## 13521 13522 13523 13524 13525 13526 13527 13528 13529 13530 13531 13532 13533
## 2 4 1 2 4 4 2 2 2 3 2 2 2
## 13534 13535 13536 13537 13538 13539 13540 13541 13542 13543 13544 13545 13546
## 4 2 1 1 4 2 2 2 2 2 1 4
## 13547 13548 13549 13550 13551 13552 13553 13554 13555 13556 13557 13558 13559
## 2 1 1 2 1 1 3 1 2 3 2 2 1
## 13560 13561 13562 13563 13564 13565 13566 13567 13568 13569 13570 13571 13572
## 4 4 1 1 4 1 2 2 2 2 2 2 2
## 13573 13574 13575 13576 13577 13578 13579 13580 13581 13582 13583 13584 13585
## 4 1 4 1 4 2 2 1 1 2 4 2 2
## 13586 13587 13588 13589 13590 13591 13592 13593 13594 13595 13596 13597 13598
## 2 4 2 1 1 2 3 2 2 4 1 2 4
## 13599 13600 13601 13602 13603 13604 13605 13606 13607 13608 13609 13610 13611
## 2 3 1 4 1 1 2 2 2 2 4 2

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## 13612 13613 13614 13615 13616 13617 13618 13619 13620 13621 13622 13623 13624
##   3     1     2     1     4     4     1     2     2     2     2     2     2
## 13625 13626 13627 13628 13629 13630 13631 13632 13633 13634 13635 13636 13637
##   2     2     3     2     2     2     2     2     2     2     2     4     2     2
## 13638 13639 13640 13641 13642 13643 13644 13645 13646 13647 13648 13649 13650
##   2     3     2     3     1     2     4     3     1     3     2     2     2     2
## 13651 13652 13653 13654 13655 13656 13657 13658 13659 13660 13661 13662 13663
##   2     2     4     3     4     1     3     2     4     3     3     3     4     3
## 13664 13665 13666 13667 13668 13669 13670 13671 13672 13673 13674 13675 13676
##   4     3     1     1     2     2     2     2     2     3     2     3     4     3
## 13677 13678 13679 13680 13681 13682 13683 13684 13685 13686 13687 13688 13689
##   2     4     2     1     4     2     2     2     1     2     1     2     2     1
## 13690 13691 13692 13693 13694 13695 13696 13697 13698 13699 13700 13701 13702
##   2     4     4     1     2     3     2     2     2     2     1     1     1     2
## 13703 13704 13705 13706 13707 13708 13709 13710 13711 13712 13713 13714 13715
##   4     2     1     4     2     2     2     2     1     2     1     2     2     1
## 13716 13717 13718 13719 13720 13721 13722 13723 13724 13725 13726 13727 13728
##   1     1     2     4     4     3     1     2     3     2     2     2     4     3
## 13729 13730 13731 13732 13733 13734 13735 13736 13737 13738 13739 13740 13741
##   2     2     3     3     2     4     2     2     2     1     2     2     2     2
## 13742 13743 13744 13745 13746 13747 13748 13749 13750 13751 13752 13753 13754
##   1     2     1     2     2     2     1     2     2     2     2     2     1     4
## 13755 13756 13757 13758 13759 13760 13761 13762 13763 13764 13765 13766 13767
##   2     2     4     1     2     2     1     2     2     2     1     2     2     2
## 13768 13769 13770 13771 13772 13773 13774 13775 13776 13777 13778 13779 13780
##   2     2     1     2     2     3     1     2     4     1     4     2     2     4
## 13781 13782 13783 13784 13785 13786 13787 13788 13789 13790 13791 13792 13793
##   3     2     3     4     1     2     2     2     2     4     4     2     4     2
## 13794 13795 13796 13797 13798 13799 13800 13801 13802 13803 13804 13805 13806
##   1     1     2     4     2     2     3     2     1     2     2     1     3
## 13807 13808 13809 13810 13811 13812 13813 13814 13815 13816 13817 13818 13819
##   4     2     3     1     2     3     3     2     2     4     2     4     3
## 13820 13821 13822 13823 13824 13825 13826 13827 13828 13829 13830 13831 13832
##   2     3     4     3     2     2     2     1     2     3     3     2     2
## 13833 13834 13835 13836 13837 13838 13839 13840 13841 13842 13843 13844 13845
##   2     2     2     2     1     1     2     1     4     4     4     3     4
## 13846 13847 13848 13849 13850 13851 13852 13853 13854 13855 13856 13857 13858
##   3     2     2     2     2     2     4     3     1     2     2     3     4     2
## 13859 13860 13861 13862 13863 13864 13865 13866 13867 13868 13869 13870 13871
##   2     4     2     2     2     3     1     2     2     2     4     1     1
## 13872 13873 13874 13875 13876 13877 13878 13879 13880 13881 13882 13883 13884
##   2     2     3     1     1     4     2     4     2     4     4     4     2
## 13885 13886 13887 13888 13889 13890 13891 13892 13893 13894 13895 13896 13897
##   2     2     2     4     3     2     2     2     2     4     2     2     1
## 13898 13899 13900 13901 13902 13903 13904 13905 13906 13907 13908 13909 13910
##   1     2     2     1     2     2     2     2     2     2     4     2     4
## 13911 13912 13913 13914 13915 13916 13917 13918 13919 13920 13921 13922 13923
##   4     3     4     2     2     3     3     2     3     2     2     4     2
## 13924 13925 13926 13927 13928 13929 13930 13931 13932 13933 13934 13935 13936
##   2     2     2     3     2     2     2     2     2     2     1     2     3
## 13937 13938 13939 13940 13941 13942 13943 13944 13945 13946 13947 13948 13949
##   1     3     2     2     3     2     4     4     4     4     3     2     1     1
## 13950 13951 13952 13953 13954 13955 13956 13957 13958 13959 13960 13961 13962
##   4     1     1     2     2     2     2     2     1     1     3     2     2

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## 13963 13964 13965 13966 13967 13968 13969 13970 13971 13972 13973 13974 13975
##   4     2     2     2     2     2     1     3     2     2     2     2     3     2
## 13976 13977 13978 13979 13980 13981 13982 13983 13984 13985 13986 13987 13988
##   3     3     1     4     4     2     2     3     4     3     2     1     4
## 13989 13990 13991 13992 13993 13994 13995 13996 13997 13998 13999 14000 14001
##   3     2     2     1     2     4     2     1     2     4     2     1     3
## 14002 14003 14004 14005 14006 14007 14008 14009 14010 14011 14012 14013 14014
##   2     4     2     2     3     4     2     2     2     2     3     3     2
## 14015 14016 14017 14018 14019 14020 14021 14022 14023 14024 14025 14026 14027
##   2     2     1     2     1     2     2     2     4     2     2     4     2
## 14028 14029 14030 14031 14032 14033 14034 14035 14036 14037 14038 14039 14040
##   2     3     2     1     2     2     1     4     3     4     2     2     3
## 14041 14042 14043 14044 14045 14046 14047 14048 14049 14050 14051 14052 14053
##   2     4     1     1     3     2     2     2     3     1     2     1     1
## 14054 14055 14056 14057 14058 14059 14060 14061 14062 14063 14064 14065 14066
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##   2     3     2     1     2     3     2     2     2     2     3     2     4
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## 16212 16213 16214 16215 16216 16217 16218 16219 16220 16221 16222 16223 16224
## 3 4 2 3 1 3 2 4 2 1 4 1 1
## 16225 16226 16227 16228 16229 16230 16231 16232 16233 16234 16235 16236 16237
## 2 2 4 2 3 4 2 2 4 2 3 2 2
## 16238 16239 16240 16241 16242 16243 16244 16245 16246 16247 16248 16249 16250
## 3 2 3 2 2 2 3 3 2 2 2 2 4
## 16251 16252 16253 16254 16255 16256 16257 16258 16259 16260 16261 16262 16263
## 3 1 2 3 2 2 3 2 2 1 3 3 2
## 16264 16265 16266 16267 16268 16269 16270 16271 16272 16273 16274 16275 16276
## 2 2 2 2 2 3 2 1 2 2 3 2 1
## 16277 16278 16279 16280 16281 16282 16283 16284 16285 16286 16287 16288 16289
## 2 2 2 2 4 3 4 2 3 4 2 2 2
## 16290 16291 16292 16293 16294 16295 16296 16297 16298 16299 16300 16301 16302
## 2 2 2 2 1 1 2 2 2 1 2 1 4
## 16303 16304 16305 16306 16307 16308 16309 16310 16311 16312 16313 16314 16315
## 3 4 2 2 2 3 2 3 2 1 1 4 1
## 16316 16317 16318 16319 16320 16321 16322 16323 16324 16325 16326 16327 16328
## 1 2 2 2 2 3 2 1 3 4 1 4 2
## 16329 16330 16331 16332 16333 16334 16335 16336 16337 16338 16339 16340 16341
## 2 1 4 3 2 1 1 2 2 2 2 2 3
## 16342 16343 16344 16345 16346 16347 16348 16349 16350 16351 16352 16353 16354
## 1 2 1 2 2 2 3 2 2 2 2 3 2
## 16355 16356 16357 16358 16359 16360 16361 16362 16363 16364 16365 16366 16367
## 4 1 3 2 3 3 2 2 2 2 3 3 2
## 16368 16369 16370 16371 16372 16373 16374 16375 16376 16377 16378 16379 16380
## 2 2 3 4 2 2 2 2 3 2 1 2 2
## 16381 16382 16383 16384 16385 16386 16387 16388 16389 16390 16391 16392 16393
## 2 1 3 2 2 2 1 4 1 2 3 2 2
## 16394 16395 16396 16397 16398 16399 16400 16401 16402 16403 16404 16405 16406
## 4 1 1 4 2 2 2 2 2 2 1 1 2
## 16407 16408 16409 16410 16411 16412 16413 16414 16415 16416 16417 16418 16419
## 2 4 2 2 1 2 3 1 2 1 2 1 4

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## 16420 16421 16422 16423 16424 16425 16426 16427 16428 16429 16430 16431 16432
## 2 3 2 3 4 2 4 1 2 2 2 2 2 4
## 16433 16434 16435 16436 16437 16438 16439 16440 16441 16442 16443 16444 16445
## 3 1 3 4 3 2 3 4 2 2 1 3 4
## 16446 16447 16448 16449 16450 16451 16452 16453 16454 16455 16456 16457 16458
## 1 2 2 2 2 2 4 4 2 2 4 2 2
## 16459 16460 16461 16462 16463 16464 16465 16466 16467 16468 16469 16470 16471
## 2 4 2 2 2 4 2 1 2 4 2 1 2
## 16472 16473 16474 16475 16476 16477 16478 16479 16480 16481 16482 16483 16484
## 2 2 4 1 4 4 2 2 3 1 3 4 2
## 16485 16486 16487 16488 16489 16490 16491 16492 16493 16494 16495 16496 16497
## 2 2 3 3 2 2 2 2 1 2 1 3 1
## 16498 16499 16500 16501 16502 16503 16504 16505 16506 16507 16508 16509 16510
## 2 3 2 2 1 3 1 2 4 2 4 2 2
## 16511 16512 16513 16514 16515 16516 16517 16518 16519 16520 16521 16522 16523
## 4 2 2 1 2 2 2 2 2 3 2 2 2
## 16524 16525 16526 16527 16528 16529 16530 16531 16532 16533 16534 16535 16536
## 2 2 2 2 4 4 2 3 2 2 2 3 2
## 16537 16538 16539 16540 16541 16542 16543 16544 16545 16546 16547 16548 16549
## 2 2 3 3 3 1 2 2 4 1 4 1 3
## 16550 16551 16552 16553 16554 16555 16556 16557 16558 16559 16560 16561 16562
## 2 2 2 3 3 2 3 2 2 4 2 3 4
## 16563 16564 16565 16566 16567 16568 16569 16570 16571 16572 16573 16574 16575
## 4 4 2 2 2 4 4 2 2 4 2 2 3
## 16576 16577 16578 16579 16580 16581 16582 16583 16584 16585 16586 16587 16588
## 2 2 2 1 2 2 2 4 1 2 2 4 1
## 16589 16590 16591 16592 16593 16594 16595 16596 16597 16598 16599 16600 16601
## 2 2 2 1 2 2 4 2 2 3 2 2 2
## 16602 16603 16604 16605 16606 16607 16608 16609 16610 16611 16612 16613 16614
## 2 2 2 3 4 1 2 2 2 3 4 2 2
## 16615 16616 16617 16618 16619 16620 16621 16622 16623 16624 16625 16626 16627
## 2 3 2 3 2 2 4 3 2 2 4 2 2
## 16628 16629 16630 16631 16632 16633 16634 16635 16636 16637 16638 16639 16640
## 1 2 4 3 2 2 3 2 2 2 1 4
## 16641 16642 16643 16644 16645 16646 16647 16648 16649 16650 16651 16652 16653
## 1 3 2 1 4 2 4 1 2 2 2 4 2
## 16654 16655 16656 16657 16658 16659 16660 16661 16662 16663 16664 16665 16666
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## 16667 16668 16669 16670 16671 16672 16673 16674 16675 16676 16677 16678 16679
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## 16680 16681 16682 16683 16684 16685 16686 16687 16688 16689 16690 16691 16692
## 2 2 1 2 3 2 4 2 3 2 4 3 2
## 16693 16694 16695 16696 16697 16698 16699 16700 16701 16702 16703 16704 16705
## 1 3 2 3 1 2 2 3 2 1 1 1 2
## 16706 16707 16708 16709 16710 16711 16712 16713 16714 16715 16716 16717 16718
## 2 2 2 2 4 4 4 3 4 1 2 1 2
## 16719 16720 16721 16722 16723 16724 16725 16726 16727 16728 16729 16730 16731
## 3 3 1 4 2 4 3 2 2 2 2 1 4
## 16732 16733 16734 16735 16736 16737 16738 16739 16740 16741 16742 16743 16744
## 2 3 4 3 3 2 4 2 2 4 2 4 3
## 16745 16746 16747 16748 16749 16750 16751 16752 16753 16754 16755 16756 16757
## 2 2 3 2 2 4 2 1 2 2 2 3 3
## 16758 16759 16760 16761 16762 16763 16764 16765 16766 16767 16768 16769 16770
## 2 3 2 1 3 2 2 4 2 2 1 4 4

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## 16771 16772 16773 16774 16775 16776 16777 16778 16779 16780 16781 16782 16783
## 2 2 4 2 2 4 2 3 2 4 2 4 2
## 16784 16785 16786 16787 16788 16789 16790 16791 16792 16793 16794 16795 16796
## 2 2 2 4 1 2 2 2 3 3 3 4 1 2
## 16797 16798 16799 16800 16801 16802 16803 16804 16805 16806 16807 16808 16809
## 1 1 4 2 2 2 1 2 2 3 4 2 3
## 16810 16811 16812 16813 16814 16815 16816 16817 16818 16819 16820 16821 16822
## 2 3 3 3 2 1 2 2 2 3 1 1 2
## 16823 16824 16825 16826 16827 16828 16829 16830 16831 16832 16833 16834 16835
## 2 2 1 4 2 2 2 2 2 3 4 3 3
## 16836 16837 16838 16839 16840 16841 16842 16843 16844 16845 16846 16847 16848
## 2 2 1 2 2 1 2 2 2 2 4 4 3
## 16849 16850 16851 16852 16853 16854 16855 16856 16857 16858 16859 16860 16861
## 2 3 2 2 3 4 4 2 2 2 2 2 1
## 16862 16863 16864 16865 16866 16867 16868 16869 16870 16871 16872 16873 16874
## 2 2 1 2 2 2 2 3 1 2 4 4 1
## 16875 16876 16877 16878 16879 16880 16881 16882 16883 16884 16885 16886 16887
## 2 3 4 2 2 2 3 2 2 2 3 4
## 16888 16889 16890 16891 16892 16893 16894 16895 16896 16897 16898 16899 16900
## 2 3 3 3 2 4 2 2 1 4 2 2 4
## 16901 16902 16903 16904 16905 16906 16907 16908 16909 16910 16911 16912 16913
## 2 2 1 4 2 1 4 2 2 3 3 1 1
## 16914 16915 16916 16917 16918 16919 16920 16921 16922 16923 16924 16925 16926
## 2 4 4 4 2 4 2 3 2 2 2 2 3
## 16927 16928 16929 16930 16931 16932 16933 16934 16935 16936 16937 16938 16939
## 4 2 2 1 2 2 4 1 2 4 4 2 3
## 16940 16941 16942 16943 16944 16945 16946 16947 16948 16949 16950 16951 16952
## 1 2 3 2 2 2 1 2 2 2 2 2 1
## 16953 16954 16955 16956 16957 16958 16959 16960 16961 16962 16963 16964 16965
## 3 1 2 3 2 2 3 1 2 4 2 3 3
## 16966 16967 16968 16969 16970 16971 16972 16973 16974 16975 16976 16977 16978
## 2 3 2 3 2 1 2 2 2 2 2 2 3
## 16979 16980 16981 16982 16983 16984 16985 16986 16987 16988 16989 16990 16991
## 2 1 3 2 2 2 4 2 2 3 2 2 1
## 16992 16993 16994 16995 16996 16997 16998 16999 17000 17001 17002 17003 17004
## 2 1 3 2 4 1 4 2 1 4 2 2 4
## 17005 17006 17007 17008 17009 17010 17011 17012 17013 17014 17015 17016 17017
## 1 2 2 3 2 3 4 2 4 1 2 2 2
## 17018 17019 17020 17021 17022 17023 17024 17025 17026 17027 17028 17029 17030
## 2 1 2 4 2 3 4 2 2 2 2 2 1
## 17031 17032 17033 17034 17035 17036 17037 17038 17039 17040 17041 17042 17043
## 3 4 2 2 2 4 1 3 3 2 2 3 3
## 17044 17045 17046 17047 17048 17049 17050 17051 17052 17053 17054 17055 17056
## 3 4 2 1 1 1 2 3 1 4 3 1 2
## 17057 17058 17059 17060 17061 17062 17063 17064 17065 17066 17067 17068 17069
## 4 2 2 4 1 2 1 2 4 2 1 2 1
## 17070 17071 17072 17073 17074 17075 17076 17077 17078 17079 17080 17081 17082
## 2 1 1 2 2 2 3 2 2 2 4 2 1
## 17083 17084 17085 17086 17087 17088 17089 17090 17091 17092 17093 17094 17095
## 4 1 1 2 2 2 2 2 1 1 2 2 2
## 17096 17097 17098 17099 17100 17101 17102 17103 17104 17105 17106 17107 17108
## 2 3 4 2 3 4 3 3 2 2 3 3 2
## 17109 17110 17111 17112 17113 17114 17115 17116 17117 17118 17119 17120 17121
## 2 2 2 2 2 2 2 2 1 2 2 1

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## 17122 17123 17124 17125 17126 17127 17128 17129 17130 17131 17132 17133 17134
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## 17135 17136 17137 17138 17139 17140 17141 17142 17143 17144 17145 17146 17147
##   2     1     2     4     2     4     4     2     1     4     1     4     2
## 17148 17149 17150 17151 17152 17153 17154 17155 17156 17157 17158 17159 17160
##   3     3     2     2     2     2     3     3     3     2     2     3     1
## 17161 17162 17163 17164 17165 17166 17167 17168 17169 17170 17171 17172 17173
##   2     2     3     2     2     2     2     2     3     2     4     3     3
## 17174 17175 17176 17177 17178 17179 17180 17181 17182 17183 17184 17185 17186
##   4     2     2     2     2     3     1     3     2     3     4     4     2
## 17187 17188 17189 17190 17191 17192 17193 17194 17195 17196 17197 17198 17199
##   2     2     3     2     2     4     2     2     2     1     3     4     2
## 17200 17201 17202 17203 17204 17205 17206 17207 17208 17209 17210 17211 17212
##   1     3     2     2     2     3     1     2     2     4     4     2     1
## 17213 17214 17215 17216 17217 17218 17219 17220 17221 17222 17223 17224 17225
##   2     2     2     2     1     2     2     1     3     2     1     2     2
## 17226 17227 17228 17229 17230 17231 17232 17233 17234 17235 17236 17237 17238
##   1     4     1     2     3     1     3     2     3     2     2     4     1
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##   2     2     2     2     2     1     2     2     3     2     1     2     2
## 17252 17253 17254 17255 17256 17257 17258 17259 17260 17261 17262 17263 17264
##   3     2     2     2     2     2     3     4     4     4     2     2     2
## 17265 17266 17267 17268 17269 17270 17271 17272 17273 17274 17275 17276 17277
##   2     2     2     3     2     2     1     4     2     2     2     2     2
## 17278 17279 17280 17281 17282 17283 17284 17285 17286 17287 17288 17289 17290
##   2     2     2     4     2     2     2     1     2     2     3     2     4
## 17291 17292 17293 17294 17295 17296 17297 17298 17299 17300 17301 17302 17303
##   2     2     4     3     4     2     1     2     2     1     2     3     2
## 17304 17305 17306 17307 17308 17309 17310 17311 17312 17313 17314 17315 17316
##   3     4     2     2     4     1     3     3     2     1     4     2     3
## 17317 17318 17319 17320 17321 17322 17323 17324 17325 17326 17327 17328 17329
##   4     3     1     1     4     2     4     1     4     2     4     4     2
## 17330 17331 17332 17333 17334 17335 17336 17337 17338 17339 17340 17341 17342
##   2     2     2     2     4     2     1     4     4     2     2     2     2
## 17343 17344 17345 17346 17347 17348 17349 17350 17351 17352 17353 17354 17355
##   3     2     2     2     2     2     4     4     2     3     1     3     2     1
## 17356 17357 17358 17359 17360 17361 17362 17363 17364 17365 17366 17367 17368
##   4     2     3     2     4     2     4     2     3     4     2     2     3
## 17369 17370 17371 17372 17373 17374 17375 17376 17377 17378 17379 17380 17381
##   1     4     4     2     2     2     2     4     4     1     3     4     2
## 17382 17383 17384 17385 17386 17387 17388 17389 17390 17391 17392 17393 17394
##   2     3     1     1     2     3     4     3     2     2     3     3     2
## 17395 17396 17397 17398 17399 17400 17401 17402 17403 17404 17405 17406 17407
##   1     4     2     4     3     3     4     2     1     3     3     3     4
## 17408 17409 17410 17411 17412 17413 17414 17415 17416 17417 17418 17419 17420
##   2     3     2     1     2     2     3     3     4     3     4     4     1
## 17421 17422 17423 17424 17425 17426 17427 17428 17429 17430 17431 17432 17433
##   2     2     2     1     3     4     2     2     4     3     2     4     4
## 17434 17435 17436 17437 17438 17439 17440 17441 17442 17443 17444 17445 17446
##   2     2     1     3     2     2     1     3     1     2     2     3     2
## 17447 17448 17449 17450 17451 17452 17453 17454 17455 17456 17457 17458 17459
##   1     2     2     2     2     2     4     3     2     3     2     4     3
## 17460 17461 17462 17463 17464 17465 17466 17467 17468 17469 17470 17471 17472
##   3     1     2     2     2     2     2     1     3     2     2     4     2

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## 17473 17474 17475 17476 17477 17478 17479 17480 17481 17482 17483 17484 17485
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## 17486 17487 17488 17489 17490 17491 17492 17493 17494 17495 17496 17497 17498
##   2     1     2     1     3     2     1     3     4     2     4     2     2
## 17499 17500 17501 17502 17503 17504 17505 17506 17507 17508 17509 17510 17511
##   1     4     1     2     2     4     2     1     4     2     2     1     2
## 17512 17513 17514 17515 17516 17517 17518 17519 17520 17521 17522 17523 17524
##   4     3     2     1     4     2     2     2     2     2     3     4     4
## 17525 17526 17527 17528 17529 17530 17531 17532 17533 17534 17535 17536 17537
##   1     1     2     2     1     4     2     1     1     2     2     2     2
## 17538 17539 17540 17541 17542 17543 17544 17545 17546 17547 17548 17549 17550
##   2     4     3     2     1     2     3     2     1     2     1     2     3
## 17551 17552 17553 17554 17555 17556 17557 17558 17559 17560 17561 17562 17563
##   4     1     1     2     2     1     2     4     3     2     2     2     4
## 17564 17565 17566 17567 17568 17569 17570 17571 17572 17573 17574 17575 17576
##   3     2     1     4     4     2     3     4     3     2     1     1     2
## 17577 17578 17579 17580 17581 17582 17583 17584 17585 17586 17587 17588 17589
##   4     2     3     1     2     2     4     1     2     1     1     2     1
## 17590 17591 17592 17593 17594 17595 17596 17597 17598 17599 17600 17601 17602
##   4     1     2     3     3     3     3     2     4     3     3     3     3
## 17603 17604 17605 17606 17607 17608 17609 17610 17611 17612 17613 17614 17615
##   2     2     2     2     4     2     2     3     3     1     3     2     3
## 17616 17617 17618 17619 17620 17621 17622 17623 17624 17625 17626 17627 17628
##   2     2     2     2     2     3     2     2     4     2     2     2     2
## 17629 17630 17631 17632 17633 17634 17635 17636 17637 17638 17639 17640 17641
##   3     3     2     3     2     3     2     1     3     3     1     1     2
## 17642 17643 17644 17645 17646 17647 17648 17649 17650 17651 17652 17653 17654
##   2     2     4     2     2     2     4     3     1     4     2     2     4
## 17655 17656 17657 17658 17659 17660 17661 17662 17663 17664 17665 17666 17667
##   4     2     2     3     2     2     2     2     3     2     1     1     2
## 17668 17669 17670 17671 17672 17673 17674 17675 17676 17677 17678 17679 17680
##   2     3     2     2     2     1     2     4     2     1     3     4     2
## 17681 17682 17683 17684 17685 17686 17687 17688 17689 17690 17691 17692 17693
##   1     2     1     1     2     2     2     3     2     2     2     2     1
## 17694 17695 17696 17697 17698 17699 17700 17701 17702 17703 17704 17705 17706
##   2     4     3     3     2     4     2     3     2     2     2     2     3
## 17707 17708 17709 17710 17711 17712 17713 17714 17715 17716 17717 17718 17719
##   1     4     4     3     2     2     1     1     2     1     2     4     4
## 17720 17721 17722 17723 17724 17725 17726 17727 17728 17729 17730 17731 17732
##   2     2     2     4     2     4     1     2     2     3     2     1     1
## 17733 17734 17735 17736 17737 17738 17739 17740 17741 17742 17743 17744 17745
##   4     2     3     3     4     4     2     3     2     1     1     2     1
## 17746 17747 17748 17749 17750 17751 17752 17753 17754 17755 17756 17757 17758
##   4     2     2     2     1     2     1     4     4     3     4     2     4
## 17759 17760 17761 17762 17763 17764 17765 17766 17767 17768 17769 17770 17771
##   2     4     4     2     1     2     1     2     3     1     4     2     1
## 17772 17773 17774 17775 17776 17777 17778 17779 17780 17781 17782 17783 17784
##   2     1     2     4     2     4     2     2     2     4     2     1     2
## 17785 17786 17787 17788 17789 17790 17791 17792 17793 17794 17795 17796 17797
##   4     4     2     2     1     3     4     4     2     2     3     2     2
## 17798 17799 17800 17801 17802 17803 17804 17805 17806 17807 17808 17809 17810
##   1     4     2     1     3     3     1     2     2     2     2     3     2
## 17811 17812 17813 17814 17815 17816 17817 17818 17819 17820 17821 17822 17823
##   4     2     3     1     1     2     4     2     2     2     2     1     1

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## 17824 17825 17826 17827 17828 17829 17830 17831 17832 17833 17834 17835 17836
##   1     4     2     2     2     4     2     1     4     3     3     3     2     2
## 17837 17838 17839 17840 17841 17842 17843 17844 17845 17846 17847 17848 17849
##   2     2     1     3     1     3     2     2     2     3     2     2     2
## 17850 17851 17852 17853 17854 17855 17856 17857 17858 17859 17860 17861 17862
##   4     3     1     2     4     2     2     2     1     2     4     3     3
## 17863 17864 17865 17866 17867 17868 17869 17870 17871 17872 17873 17874 17875
##   2     3     3     3     4     4     2     2     2     3     4     2     4
## 17876 17877 17878 17879 17880 17881 17882 17883 17884 17885 17886 17887 17888
##   2     3     2     3     3     2     2     2     2     2     2     3     2
## 17889 17890 17891 17892 17893 17894 17895 17896 17897 17898 17899 17900 17901
##   2     4     2     4     2     2     2     4     2     4     1     2     2
## 17902 17903 17904 17905 17906 17907 17908 17909 17910 17911 17912 17913 17914
##   2     2     2     2     2     4     3     2     2     2     3     1     2
## 17915 17916 17917 17918 17919 17920 17921 17922 17923 17924 17925 17926 17927
##   2     2     2     2     2     1     4     1     2     2     2     1     2
## 17928 17929 17930 17931 17932 17933 17934 17935 17936 17937 17938 17939 17940
##   2     3     1     3     1     2     2     2     2     2     2     1     2
## 17941 17942 17943 17944 17945 17946 17947 17948 17949 17950 17951 17952 17953
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## 17954 17955 17956 17957 17958 17959 17960 17961 17962 17963 17964 17965 17966
##   4     2     2     3     2     2     1     2     2     2     1     1     1
## 17967 17968 17969 17970 17971 17972 17973 17974 17975 17976 17977 17978 17979
##   3     2     3     2     2     1     2     3     2     2     3     2     2
## 17980 17981 17982 17983 17984 17985 17986 17987 17988 17989 17990 17991 17992
##   3     4     2     3     2     2     2     2     2     2     3     4     3
## 17993 17994 17995 17996 17997 17998 17999 18000 18001 18002 18003 18004 18005
##   3     3     2     2     2     1     3     4     4     2     3     2     2
## 18006 18007 18008 18009 18010 18011 18012 18013 18014 18015 18016 18017 18018
##   1     2     2     2     4     1     2     2     2     2     2     4     3
## 18019 18020 18021 18022 18023 18024 18025 18026 18027 18028 18029 18030 18031
##   2     1     1     4     4     1     2     3     2     2     2     4     2
## 18032 18033 18034 18035 18036 18037 18038 18039 18040 18041 18042 18043 18044
##   2     2     3     2     2     1     2     1     4     2     2     2     2
## 18045 18046 18047 18048 18049 18050 18051 18052 18053 18054 18055 18056 18057
##   3     3     2     1     2     2     1     2     2     2     2     2     2
## 18058 18059 18060 18061 18062 18063 18064 18065 18066 18067 18068 18069 18070
##   2     3     2     2     2     2     2     2     2     3     2     2     2
## 18071 18072 18073 18074 18075 18076 18077 18078 18079 18080 18081 18082 18083
##   1     3     3     2     3     4     2     2     3     3     2     2     2
## 18084 18085 18086 18087 18088 18089 18090 18091 18092 18093 18094 18095 18096
##   4     1     1     2     2     4     4     1     2     1     1     1     3
## 18097 18098 18099 18100 18101 18102 18103 18104 18105 18106 18107 18108 18109
##   2     4     3     4     2     2     4     1     2     4     2     1     1
## 18110 18111 18112 18113 18114 18115 18116 18117 18118 18119 18120 18121 18122
##   2     1     1     3     2     2     4     4     3     4     3     2     2
## 18123 18124 18125 18126 18127 18128 18129 18130 18131 18132 18133 18134 18135
##   2     1     2     3     2     2     3     2     4     2     4     2     2
## 18136 18137 18138 18139 18140 18141 18142 18143 18144 18145 18146 18147 18148
##   2     3     2     2     3     3     2     3     3     1     4     2     4
## 18149 18150 18151 18152 18153 18154 18155 18156 18157 18158 18159 18160 18161
##   2     2     4     1     4     2     2     2     3     4     4     3     2
## 18162 18163 18164 18165 18166 18167 18168 18169 18170 18171 18172 18173 18174
##   2     2     2     2     1     2     2     2     2     1     1     2     2

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## 18175 18176 18177 18178 18179 18180 18181 18182 18183 18184 18185 18186 18187
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##   4     4     2     2     3     2     3     2     2     3     2     1     2
## 18201 18202 18203 18204 18205 18206 18207 18208 18209 18210 18211 18212 18213
##   4     2     2     2     4     2     2     3     3     3     3     1     2
## 18214 18215 18216 18217 18218 18219 18220 18221 18222 18223 18224 18225 18226
##   1     4     2     2     3     2     3     1     2     2     3     2     2
## 18227 18228 18229 18230 18231 18232 18233 18234 18235 18236 18237 18238 18239
##   3     4     2     3     2     4     3     2     2     3     4     2     4
## 18240 18241 18242 18243 18244 18245 18246 18247 18248 18249 18250 18251 18252
##   2     2     1     3     2     4     2     1     2     1     4     2     1
## 18253 18254 18255 18256 18257 18258 18259 18260 18261 18262 18263 18264 18265
##   4     2     2     2     2     1     2     4     2     2     2     2     2
## 18266 18267 18268 18269 18270 18271 18272 18273 18274 18275 18276 18277 18278
##   2     2     4     4     2     4     2     3     4     2     2     4     1
## 18279 18280 18281 18282 18283 18284 18285 18286 18287 18288 18289 18290 18291
##   2     2     4     2     4     3     2     4     2     2     3     4     2
## 18292 18293 18294 18295 18296 18297 18298 18299 18300 18301 18302 18303 18304
##   3     1     2     2     2     2     2     4     4     2     1     1     2
## 18305 18306 18307 18308 18309 18310 18311 18312 18313 18314 18315 18316 18317
##   3     1     3     3     4     2     2     2     2     2     2     2     3
## 18318 18319 18320 18321 18322 18323 18324 18325 18326 18327 18328 18329 18330
##   2     2     2     1     4     4     3     4     3     2     2     2     2
## 18331 18332 18333 18334 18335 18336 18337 18338 18339 18340 18341 18342 18343
##   2     4     4     2     2     2     1     3     3     3     3     3     2
## 18344 18345 18346 18347 18348 18349 18350 18351 18352 18353 18354 18355 18356
##   2     3     1     2     4     4     3     3     2     4     2     2     4
## 18357 18358 18359 18360 18361 18362 18363 18364 18365 18366 18367 18368 18369
##   2     4     1     3     1     2     2     2     1     3     1     2     4
## 18370 18371 18372 18373 18374 18375 18376 18377 18378 18379 18380 18381 18382
##   4     2     2     4     2     1     3     4     2     3     2     2     4
## 18383 18384 18385 18386 18387 18388 18389 18390 18391 18392 18393 18394 18395
##   2     2     4     2     2     1     2     2     4     2     4     2     3
## 18396 18397 18398 18399 18400 18401 18402 18403 18404 18405 18406 18407 18408
##   2     1     2     1     4     2     2     3     2     3     3     2     3
## 18409 18410 18411 18412 18413 18414 18415 18416 18417 18418 18419 18420 18421
##   2     2     2     2     2     4     4     1     2     2     3     2     3
## 18422 18423 18424 18425 18426 18427 18428 18429 18430 18431 18432 18433 18434
##   2     4     3     1     2     3     2     2     2     3     3     2     2
## 18435 18436 18437 18438 18439 18440 18441 18442 18443 18444 18445 18446 18447
##   3     2     4     2     3     3     2     4     2     1     2     2     2
## 18448 18449 18450 18451 18452 18453 18454 18455 18456 18457 18458 18459 18460
##   2     1     4     4     2     2     2     2     3     3     3     1     2
## 18461 18462 18463 18464 18465 18466 18467 18468 18469 18470 18471 18472 18473
##   1     2     1     2     1     2     1     3     3     2     1     2     3
## 18474 18475 18476 18477 18478 18479 18480 18481 18482 18483 18484 18485 18486
##   1     3     4     2     2     2     1     4     2     2     4     2     2
## 18487 18488 18489 18490 18491 18492 18493 18494 18495 18496 18497 18498 18499
##   2     3     1     1     1     2     2     2     2     3     2     1     3
## 18500 18501 18502 18503 18504 18505 18506 18507 18508 18509 18510 18511 18512
##   3     2     2     2     4     2     2     4     4     3     2     1     1
## 18513 18514 18515 18516 18517 18518 18519 18520 18521 18522 18523 18524 18525
##   2     2     4     4     2     3     2     2     4     2     4     2     2

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## 18526 18527 18528 18529 18530 18531 18532 18533 18534 18535 18536 18537 18538
##   1     4     4     2     2     3     2     2     2     2     2     2     2     4
## 18539 18540 18541 18542 18543 18544 18545 18546 18547 18548 18549 18550 18551
##   3     2     2     2     2     2     2     2     2     4     4     2     3     3
## 18552 18553 18554 18555 18556 18557 18558 18559 18560 18561 18562 18563 18564
##   2     3     2     2     2     1     3     4     2     2     4     2     3
## 18565 18566 18567 18568 18569 18570 18571 18572 18573 18574 18575 18576 18577
##   3     2     2     4     3     1     4     2     3     2     2     2     1
## 18578 18579 18580 18581 18582 18583 18584 18585 18586 18587 18588 18589 18590
##   1     2     2     3     2     1     3     1     1     2     3     1     2
## 18591 18592 18593 18594 18595 18596 18597 18598 18599 18600 18601 18602 18603
##   1     3     2     2     2     1     1     2     4     4     4     4     2
## 18604 18605 18606 18607 18608 18609 18610 18611 18612 18613 18614 18615 18616
##   4     3     1     4     2     2     2     2     3     1     2     2     1
## 18617 18618 18619 18620 18621 18622 18623 18624 18625 18626 18627 18628 18629
##   2     2     3     4     2     4     3     1     3     1     3     2     1
## 18630 18631 18632 18633 18634 18635 18636 18637 18638 18639 18640 18641 18642
##   1     2     1     2     1     3     1     2     4     2     2     4     2
## 18643 18644 18645 18646 18647 18648 18649 18650 18651 18652 18653 18654 18655
##   2     3     3     4     3     2     2     2     2     3     4     2     2
## 18656 18657 18658 18659 18660 18661 18662 18663 18664 18665 18666 18667 18668
##   1     1     3     2     2     3     4     2     4     4     2     3     2
## 18669 18670 18671 18672 18673 18674 18675 18676 18677 18678 18679 18680 18681
##   1     4     2     2     2     2     2     2     2     3     3     2     2
## 18682 18683 18684 18685 18686 18687 18688 18689 18690 18691 18692 18693 18694
##   3     4     4     2     4     2     1     3     2     3     4     2     2
## 18695 18696 18697 18698 18699 18700 18701 18702 18703 18704 18705 18706 18707
##   2     2     1     1     2     2     4     2     2     1     4     4     3
## 18708 18709 18710 18711 18712 18713 18714 18715 18716 18717 18718 18719 18720
##   2     2     1     3     4     4     1     2     2     3     1     4     1
## 18721 18722 18723 18724 18725 18726 18727 18728 18729 18730 18731 18732 18733
##   2     2     2     4     2     1     2     2     2     2     1     2     4
## 18734 18735 18736 18737 18738 18739 18740 18741 18742 18743 18744 18745 18746
##   4     2     3     2     2     2     2     2     1     2     3     4     2
## 18747 18748 18749 18750 18751 18752 18753 18754 18755 18756 18757 18758 18759
##   1     2     3     3     2     3     1     4     1     2     2     2     2
## 18760 18761 18762 18763 18764 18765 18766 18767 18768 18769 18770 18771 18772
##   2     2     4     2     2     4     4     2     2     2     1     3
## 18773 18774 18775 18776 18777 18778 18779 18780 18781 18782 18783 18784 18785
##   2     2     2     2     2     2     2     4     3     4     1     4     2
## 18786 18787 18788 18789 18790 18791 18792 18793 18794 18795 18796 18797 18798
##   1     3     1     3     2     4     4     2     2     2     2     2     4
## 18799 18800 18801 18802 18803 18804 18805 18806 18807 18808 18809 18810 18811
##   2     2     2     2     2     2     2     2     4     1     4     2     2
## 18812 18813 18814 18815 18816 18817 18818 18819 18820 18821 18822 18823 18824
##   2     2     4     2     2     2     3     1     2     2     2     1     2
## 18825 18826 18827 18828 18829 18830 18831 18832 18833 18834 18835 18836 18837
##   3     4     4     2     1     4     1     2     2     2     2     2     2
## 18838 18839 18840 18841 18842 18843 18844 18845 18846 18847 18848 18849 18850
##   2     2     4     3     3     1     1     2     4     3     1     3     2
## 18851 18852 18853 18854 18855 18856 18857 18858 18859 18860 18861 18862 18863
##   4     2     2     2     4     4     1     2     2     2     1     2
## 18864 18865 18866 18867 18868 18869 18870 18871 18872 18873 18874 18875 18876
##   4     4     4     2     2     4     2     1     2     4     4     2     2

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## 18877 18878 18879 18880 18881 18882 18883 18884 18885 18886 18887 18888 18889
## 2     3     4     3     1     2     2     1     3     2     2     2     4     2
## 18890 18891 18892 18893 18894 18895 18896 18897 18898 18899 18900 18901 18902
## 4     1     2     4     2     1     4     4     4     4     2     2     2     3
## 18903 18904 18905 18906 18907 18908 18909 18910 18911 18912 18913 18914 18915
## 2     2     1     2     4     3     2     1     3     3     2     4     4
## 18916 18917 18918 18919 18920 18921 18922 18923 18924 18925 18926 18927 18928
## 2     1     2     3     4     2     2     2     2     2     2     2     3     2
## 18929 18930 18931 18932 18933 18934 18935 18936 18937 18938 18939 18940 18941
## 2     2     2     1     4     1     2     1     2     4     1     2     2
## 18942 18943 18944 18945 18946 18947 18948 18949 18950 18951 18952 18953 18954
## 3     3     3     1     2     1     2     2     2     2     2     2     2     2
## 18955 18956 18957 18958 18959 18960 18961 18962 18963 18964 18965 18966 18967
## 4     3     2     1     3     2     3     2     3     3     2     2     2     4
## 18968 18969 18970 18971 18972 18973 18974 18975 18976 18977 18978 18979 18980
## 1     3     4     4     2     3     2     2     2     2     2     3     2     2
## 18981 18982 18983 18984 18985 18986 18987 18988 18989 18990 18991 18992 18993
## 2     2     2     2     2     1     1     2     2     4     2     3     4
## 18994 18995 18996 18997 18998 18999 19000 19001 19002 19003 19004 19005 19006
## 2     2     2     2     2     3     3     3     3     4     1     2     2
## 19007 19008 19009 19010 19011 19012 19013 19014 19015 19016 19017 19018 19019
## 2     3     1     4     2     4     3     3     3     4     2     2     2
## 19020 19021 19022 19023 19024 19025 19026 19027 19028 19029 19030 19031 19032
## 3     3     2     2     3     2     3     2     4     2     2     2     4     2
## 19033 19034 19035 19036 19037 19038 19039 19040 19041 19042 19043 19044 19045
## 2     2     2     1     4     3     2     1     4     2     2     2     4     2
## 19046 19047 19048 19049 19050 19051 19052 19053 19054 19055 19056 19057 19058
## 2     2     4     2     1     2     2     2     2     3     2     2     2     2
## 19059 19060 19061 19062 19063 19064 19065 19066 19067 19068 19069 19070 19071
## 2     2     2     2     1     2     2     2     4     2     3     2     2     2
## 19072 19073 19074 19075 19076 19077 19078 19079 19080 19081 19082 19083 19084
## 1     1     2     1     4     2     2     2     1     2     2     2     2     3
## 19085 19086 19087 19088 19089 19090 19091 19092 19093 19094 19095 19096 19097
## 1     3     2     2     4     2     1     2     2     3     2     2     2     2
## 19098 19099 19100 19101 19102 19103 19104 19105 19106 19107 19108 19109 19110
## 1     2     2     2     2     1     1     4     4     2     1     2     2     2
## 19111 19112 19113 19114 19115 19116 19117 19118 19119 19120 19121 19122 19123
## 4     2     4     2     2     4     2     1     2     2     1     2     4
## 19124 19125 19126 19127 19128 19129 19130 19131 19132 19133 19134 19135 19136
## 4     4     2     2     3     2     1     2     2     2     2     1     2
## 19137 19138 19139 19140 19141 19142 19143 19144 19145 19146 19147 19148 19149
## 4     2     3     2     4     2     2     2     2     2     2     1     2
## 19150 19151 19152 19153 19154 19155 19156 19157 19158 19159 19160 19161 19162
## 2     2     2     1     1     1     1     2     2     2     2     3     2
## 19163 19164 19165 19166 19167 19168 19169 19170 19171 19172 19173 19174 19175
## 2     3     3     3     2     3     2     4     1     1     2     2     1
## 19176 19177 19178 19179 19180 19181 19182 19183 19184 19185 19186 19187 19188
## 4     2     2     2     3     2     4     1     2     3     2     3     2
## 19189 19190 19191 19192 19193 19194 19195 19196 19197 19198 19199 19200 19201
## 2     1     2     4     4     2     4     3     2     2     2     4     2
## 19202 19203 19204 19205 19206 19207 19208 19209 19210 19211 19212 19213 19214
## 1     4     2     2     2     2     2     2     2     1     2     4     2
## 19215 19216 19217 19218 19219 19220 19221 19222 19223 19224 19225 19226 19227
## 4     4     2     4     1     2     3     3     4     2     2     4     2

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## 19228 19229 19230 19231 19232 19233 19234 19235 19236 19237 19238 19239 19240
## 1 1 2 4 1 2 2 2 2 3 3 2 1 2
## 19241 19242 19243 19244 19245 19246 19247 19248 19249 19250 19251 19252 19253
## 1 2 1 4 2 2 2 2 2 2 2 2 3 2
## 19254 19255 19256 19257 19258 19259 19260 19261 19262 19263 19264 19265 19266
## 1 4 3 2 2 2 2 4 4 2 2 1 3
## 19267 19268 19269 19270 19271 19272 19273 19274 19275 19276 19277 19278 19279
## 2 2 2 2 2 2 1 1 1 3 1 3 1
## 19280 19281 19282 19283 19284 19285 19286 19287 19288 19289 19290 19291 19292
## 3 1 3 2 3 2 3 3 3 1 2 2 1
## 19293 19294 19295 19296 19297 19298 19299 19300 19301 19302 19303 19304 19305
## 2 3 2 2 4 4 4 1 2 1 3 2 1
## 19306 19307 19308 19309 19310 19311 19312 19313 19314 19315 19316 19317 19318
## 2 3 2 4 2 2 2 2 1 2 2 2 2
## 19319 19320 19321 19322 19323 19324 19325 19326 19327 19328 19329 19330 19331
## 2 2 3 2 3 2 3 3 3 2 3 1 1
## 19332 19333 19334 19335 19336 19337 19338 19339 19340 19341 19342 19343 19344
## 1 2 4 1 2 2 2 3 3 4 3 2 2
## 19345 19346 19347 19348 19349 19350 19351 19352 19353 19354 19355 19356 19357
## 2 4 3 1 2 3 2 4 2 4 3 2 4
## 19358 19359 19360 19361 19362 19363 19364 19365 19366 19367 19368 19369 19370
## 1 2 3 2 1 2 2 4 2 3 3 4 4
## 19371 19372 19373 19374 19375 19376 19377 19378 19379 19380 19381 19382 19383
## 2 4 4 2 1 2 3 3 1 2 3 4 4
## 19384 19385 19386 19387 19388 19389 19390 19391 19392 19393 19394 19395 19396
## 2 4 2 4 3 1 1 2 2 4 2 2 1
## 19397 19398 19399 19400 19401 19402 19403 19404 19405 19406 19407 19408 19409
## 3 2 2 1 2 3 2 2 1 4 2 2 2
## 19410 19411 19412 19413 19414 19415 19416 19417 19418 19419 19420 19421 19422
## 2 4 2 2 2 1 3 4 2 1 2 2 2
## 19423 19424 19425 19426 19427 19428 19429 19430 19431 19432 19433 19434 19435
## 1 2 3 4 2 2 2 3 2 4 1 2 2
## 19436 19437 19438 19439 19440 19441 19442 19443 19444 19445 19446 19447 19448
## 1 4 2 4 1 1 3 2 3 3 2 3 1
## 19449 19450 19451 19452 19453 19454 19455 19456 19457 19458 19459 19460 19461
## 2 3 2 4 3 2 2 2 1 2 2 2 1
## 19462 19463 19464 19465 19466 19467 19468 19469 19470 19471 19472 19473 19474
## 2 2 2 2 2 1 2 4 4 2 3 4 2
## 19475 19476 19477 19478 19479 19480 19481 19482 19483 19484 19485 19486 19487
## 4 2 1 2 3 2 3 4 2 2 2 3 4
## 19488 19489 19490 19491 19492 19493 19494 19495 19496 19497 19498 19499 19500
## 4 1 4 4 2 1 2 3 2 2 2 3 1
## 19501 19502 19503 19504 19505 19506 19507 19508 19509 19510 19511 19512 19513
## 2 3 3 3 2 2 1 1 4 1 2 3 4
## 19514 19515 19516 19517 19518 19519 19520 19521 19522 19523 19524 19525 19526
## 2 2 4 4 2 3 3 4 2 1 2 1 1
## 19527 19528 19529 19530 19531 19532 19533 19534 19535 19536 19537 19538 19539
## 2 2 4 2 1 1 1 4 2 3 1 2 1
## 19540 19541 19542 19543 19544 19545 19546 19547 19548 19549 19550 19551 19552
## 2 2 2 2 1 3 2 2 2 2 2 4 2
## 19553 19554 19555 19556 19557 19558 19559 19560 19561 19562 19563 19564 19565
## 4 2 1 2 4 1 2 2 3 4 2 2 1
## 19566 19567 19568 19569 19570 19571 19572 19573 19574 19575 19576 19577 19578
## 2 3 2 1 2 3 3 2 2 3 2 2 1

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## 19579 19580 19581 19582 19583 19584 19585 19586 19587 19588 19589 19590 19591
## 2 2 2 3 3 2 2 2 3 2 2 4 2 2
## 19592 19593 19594 19595 19596 19597 19598 19599 19600 19601 19602 19603 19604
## 2 2 2 1 2 2 3 2 2 4 2 4 2 2
## 19605 19606 19607 19608 19609 19610 19611 19612 19613 19614 19615 19616 19617
## 3 4 1 4 2 3 2 2 4 4 1 2 1
## 19618 19619 19620 19621 19622 19623 19624 19625 19626 19627 19628 19629 19630
## 2 2 1 3 2 2 2 3 1 4 3 2 2
## 19631 19632 19633 19634 19635 19636 19637 19638 19639 19640 19641 19642 19643
## 2 2 2 2 2 2 1 2 2 1 4 3 2
## 19644 19645 19646 19647 19648 19649 19650 19651 19652 19653 19654 19655 19656
## 2 4 2 4 4 2 2 2 3 2 2 4 1
## 19657 19658 19659 19660 19661 19662 19663 19664 19665 19666 19667 19668 19669
## 3 1 2 3 3 1 2 4 4 1 3 2 2
## 19670 19671 19672 19673 19674 19675 19676 19677 19678 19679 19680 19681 19682
## 2 2 3 3 3 2 2 2 3 2 3 1 4
## 19683 19684 19685 19686 19687 19688 19689 19690 19691 19692 19693 19694 19695
## 1 1 2 3 2 2 2 2 1 2 4 1 2
## 19696 19697 19698 19699 19700 19701 19702 19703 19704 19705 19706 19707 19708
## 2 2 1 2 4 2 2 2 4 4 2 2 2
## 19709 19710 19711 19712 19713 19714 19715 19716 19717 19718 19719 19720 19721
## 1 4 2 2 2 2 2 2 1 2 2 4 1
## 19722 19723 19724 19725 19726 19727 19728 19729 19730 19731 19732 19733 19734
## 3 2 2 3 3 2 2 4 2 2 2 1 2
## 19735 19736 19737 19738 19739 19740 19741 19742 19743 19744 19745 19746 19747
## 2 2 3 2 2 1 3 2 2 2 2 1 2
## 19748 19749 19750 19751 19752 19753 19754 19755 19756 19757 19758 19759 19760
## 4 3 2 2 3 4 2 1 2 3 2 2 2
## 19761 19762 19763 19764 19765 19766 19767 19768 19769 19770 19771 19772 19773
## 3 2 2 3 3 2 2 2 1 2 4 1 1
## 19774 19775 19776 19777 19778 19779 19780 19781 19782 19783 19784 19785 19786
## 4 2 2 2 1 2 2 2 2 4 2 1
## 19787 19788 19789 19790 19791 19792 19793 19794 19795 19796 19797 19798 19799
## 4 4 2 2 4 2 2 2 1 2 1 4 4
## 19800 19801 19802 19803 19804 19805 19806 19807 19808 19809 19810 19811 19812
## 3 2 2 3 2 4 2 4 2 2 2 2 2
## 19813 19814 19815 19816 19817 19818 19819 19820 19821 19822 19823 19824 19825
## 1 4 3 2 4 1 2 2 1 3 4 2 1
## 19826 19827 19828 19829 19830 19831 19832 19833 19834 19835 19836 19837 19838
## 2 2 2 2 1 2 1 1 3 2 4 2 3
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## 2 1 4 2 4 2 2 2 2 2 4 2 2
## 19852 19853 19854 19855 19856 19857 19858 19859 19860 19861 19862 19863 19864
## 2 2 2 2 2 2 1 2 2 4 2 4 2
## 19865 19866 19867 19868 19869 19870 19871 19872 19873 19874 19875 19876 19877
## 4 1 2 2 2 3 4 2 4 1 2 2 3
## 19878 19879 19880 19881 19882 19883 19884 19885 19886 19887 19888 19889 19890
## 3 1 4 2 1 2 1 2 2 1 2 2 2
## 19891 19892 19893 19894 19895 19896 19897 19898 19899 19900 19901 19902 19903
## 4 2 2 3 3 2 2 2 1 3 2 2 2
## 19904 19905 19906 19907 19908 19909 19910 19911 19912 19913 19914 19915 19916
## 2 1 3 2 3 1 1 2 2 4 2 3 3
## 19917 19918 19919 19920 19921 19922 19923 19924 19925 19926 19927 19928 19929
## 3 2 2 1 2 2 1 4 3 2 3 3 1

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## 19982 19983 19984 19985 19986 19987 19988 19989 19990 19991 19992 19993 19994
## 3     2     3     2     3     2     4     3     1     2     2     2     4
## 19995 19996 19997 19998 19999 20000 20001 20002 20003 20004 20005 20006 20007
## 2     1     2     2     2     4     3     2     4     4     2     2     2
## 20008 20009 20010 20011 20012 20013 20014 20015 20016 20017 20018 20019 20020
## 1     4     2     2     4     1     2     2     2     3     1     2     2
## 20021 20022 20023 20024 20025 20026 20027 20028 20029 20030 20031 20032 20033
## 1     1     4     2     2     2     2     2     3     1     4     2     3
## 20034 20035 20036 20037 20038 20039 20040 20041 20042 20043 20044 20045 20046
## 2     1     1     4     2     2     3     3     4     3     2     3     2
## 20047 20048 20049 20050 20051 20052 20053 20054 20055 20056 20057 20058 20059
## 4     2     2     2     2     2     2     2     1     2     3     2     2
## 20060 20061 20062 20063 20064 20065 20066 20067 20068 20069 20070 20071 20072
## 3     2     2     3     2     4     4     1     2     4     2     2     3
## 20073 20074 20075 20076 20077 20078 20079 20080 20081 20082 20083 20084 20085
## 2     2     1     2     2     2     2     2     1     2     2     2     4
## 20086 20087 20088 20089 20090 20091 20092 20093 20094 20095 20096 20097 20098
## 4     1     2     2     2     2     2     4     3     2     4     3     2
## 20099 20100 20101 20102 20103 20104 20105 20106 20107 20108 20109 20110 20111
## 1     4     3     2     2     1     2     2     2     2     1     2     3
## 20112 20113 20114 20115 20116 20117 20118 20119 20120 20121 20122 20123 20124
## 2     1     2     1     2     4     2     4     4     2     1     2     2
## 20125 20126 20127 20128 20129 20130 20131 20132 20133 20134 20135 20136 20137
## 4     4     1     2     1     4     2     4     2     1     2     2     2
## 20138 20139 20140 20141 20142 20143 20144 20145 20146 20147 20148 20149 20150
## 2     4     2     3     4     2     2     2     2     2     4     4     2
## 20151 20152 20153 20154 20155 20156 20157 20158 20159 20160 20161 20162 20163
## 2     2     1     3     3     1     2     1     2     2     2     4     3
## 20164 20165 20166 20167 20168 20169 20170 20171 20172 20173 20174 20175 20176
## 4     2     1     3     4     1     4     1     2     3     2     2     2
## 20177 20178 20179 20180 20181 20182 20183 20184 20185 20186 20187 20188 20189
## 2     4     2     2     4     3     2     2     2     1     1     2     4
## 20190 20191 20192 20193 20194 20195 20196 20197 20198 20199 20200 20201 20202
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## 20203 20204 20205 20206 20207 20208 20209 20210 20211 20212 20213 20214 20215
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## 20216 20217 20218 20219 20220 20221 20222 20223 20224 20225 20226 20227 20228
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## 20229 20230 20231 20232 20233 20234 20235 20236 20237 20238 20239 20240 20241
## 3     3     2     3     4     2     2     2     2     4     2     3     4
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## 2     4     2     2     2     2     1     3     2     3     2     2     2
## 20255 20256 20257 20258 20259 20260 20261 20262 20263 20264 20265 20266 20267
## 1     3     2     2     4     2     3     3     2     1     4     4     1
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## 21282 21283 21284 21285 21286 21287 21288 21289 21290 21291 21292 21293 21294
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## 21295 21296 21297 21298 21299 21300 21301 21302 21303 21304 21305 21306 21307
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## 22010 22011 22012 22013 22014 22015 22016 22017 22018 22019 22020 22021 22022
##   3     3     1     2     4     2     4     3     3     3     1     3     1
## 22023 22024 22025 22026 22027 22028 22029 22030 22031 22032 22033 22034 22035
##   2     2     4     4     2     1     2     1     2     2     2     2     2

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## 22036 22037 22038 22039 22040 22041 22042 22043 22044 22045 22046 22047 22048
##   3     2     2     4     4     4     2     2     2     2     2     2     2
## 22049 22050 22051 22052 22053 22054 22055 22056 22057 22058 22059 22060 22061
##   2     2     2     2     1     3     2     2     2     3     2     2     3
## 22062 22063 22064 22065 22066 22067 22068 22069 22070 22071 22072 22073 22074
##   2     2     2     2     1     4     1     3     3     2     2     1     3
## 22075 22076 22077 22078 22079 22080 22081 22082 22083 22084 22085 22086 22087
##   2     2     4     4     2     1     1     2     3     3     1     2     1
## 22088 22089 22090 22091 22092 22093 22094 22095 22096 22097 22098 22099 22100
##   2     2     2     2     3     2     2     1     2     4     2     2     4
## 22101 22102 22103 22104 22105 22106 22107 22108 22109 22110 22111 22112 22113
##   2     2     4     2     4     1     3     2     2     2     1     2     4
## 22114 22115 22116 22117 22118 22119 22120 22121 22122 22123 22124 22125 22126
##   2     4     2     2     2     3     2     1     2     4     3     2     2
## 22127 22128 22129 22130 22131 22132 22133 22134 22135 22136 22137 22138 22139
##   1     2     2     3     3     2     2     2     4     1     2     4     2
## 22140 22141 22142 22143 22144 22145 22146 22147 22148 22149 22150 22151 22152
##   4     1     1     1     3     2     2     2     2     2     2     2     2
## 22153 22154 22155 22156 22157 22158 22159 22160 22161 22162 22163 22164 22165
##   3     3     2     2     1     1     4     3     4     2     1     2     1
## 22166 22167 22168 22169 22170 22171 22172 22173 22174 22175 22176 22177 22178
##   2     2     2     4     3     1     2     2     2     2     2     2     4
## 22179 22180 22181 22182 22183 22184 22185 22186 22187 22188 22189 22190 22191
##   2     4     2     4     3     2     4     1     4     1     2     2     2
## 22192 22193 22194 22195 22196 22197 22198 22199 22200 22201 22202 22203 22204
##   2     2     1     1     2     2     2     2     2     2     2     3     2
## 22205 22206 22207 22208 22209 22210 22211 22212 22213 22214 22215 22216 22217
##   3     2     2     2     3     4     2     1     2     4     1     2     3
## 22218 22219 22220 22221 22222 22223 22224 22225 22226 22227 22228 22229 22230
##   2     2     3     1     2     2     2     2     2     4     2     4     2
## 22231 22232 22233 22234 22235 22236 22237 22238 22239 22240 22241 22242 22243
##   4     1     4     2     2     2     2     2     2     2     1     3     4
## 22244 22245 22246 22247 22248 22249 22250 22251 22252 22253 22254 22255 22256
##   2     3     2     3     2     2     2     2     3     2     3     2     2
## 22257 22258 22259 22260 22261 22262 22263 22264 22265 22266 22267 22268 22269
##   1     4     1     4     2     2     3     4     4     2     1     2     2
## 22270 22271 22272 22273 22274 22275 22276 22277 22278 22279 22280 22281 22282
##   2     3     3     2     4     3     2     3     4     1     2     2     4
## 22283 22284 22285 22286 22287 22288 22289 22290 22291 22292 22293 22294 22295
##   2     3     2     3     2     3     4     2     1     2     2     2     1
## 22296 22297 22298 22299 22300 22301 22302 22303 22304 22305 22306 22307 22308
##   1     2     3     2     4     2     2     1     1     2     2     2     1
## 22309 22310 22311 22312 22313 22314 22315 22316 22317 22318 22319 22320 22321
##   2     2     2     2     3     2     2     3     1     2     2     1     1
## 22322 22323 22324 22325 22326 22327 22328 22329 22330 22331 22332 22333 22334
##   2     2     2     2     1     4     2     2     4     1     3     3     3
## 22335 22336 22337 22338 22339 22340 22341 22342 22343 22344 22345 22346 22347
##   2     4     3     4     2     4     2     2     4     2     2     2     3
## 22348 22349 22350 22351 22352 22353 22354 22355 22356 22357 22358 22359 22360
##   3     2     2     2     2     2     2     2     2     2     2     2     2
## 22361 22362 22363 22364 22365 22366 22367 22368 22369 22370 22371 22372 22373
##   4     3     3     2     3     1     2     4     3     2     1     1     4
## 22374 22375 22376 22377 22378 22379 22380 22381 22382 22383 22384 22385 22386
##   4     4     2     1     2     4     1     4     2     3     1     2     4

```

```

## 22387 22388 22389 22390 22391 22392 22393 22394 22395 22396 22397 22398 22399
##   3     2     3     4     3     2     4     4     2     2     2     2     1     2
## 22400 22401 22402 22403 22404 22405 22406 22407 22408 22409 22410 22411 22412
##   2     4     2     2     2     2     3     2     2     1     3     4     3
## 22413 22414 22415 22416 22417 22418 22419 22420 22421 22422 22423 22424 22425
##   2     3     3     2     3     2     2     2     2     2     3     4     2
## 22426 22427 22428 22429 22430 22431 22432 22433 22434 22435 22436 22437 22438
##   4     3     2     2     2     2     1     2     1     1     1     2     3
## 22439 22440 22441 22442 22443 22444 22445 22446 22447 22448 22449 22450 22451
##   2     2     3     2     2     2     2     1     2     2     2     4     2
## 22452 22453 22454 22455 22456 22457 22458 22459 22460 22461 22462 22463 22464
##   2     4     4     3     2     2     2     4     2     2     2     1     3
## 22465 22466 22467 22468 22469 22470 22471 22472 22473 22474 22475 22476 22477
##   1     2     3     3     1     4     2     1     1     3     2     2     2
## 22478 22479 22480 22481 22482 22483 22484 22485 22486 22487 22488 22489 22490
##   4     3     2     4     2     2     2     1     1     2     2     4     2
## 22491 22492 22493 22494 22495 22496 22497 22498 22499 22500 22501 22502 22503
##   2     4     4     2     4     2     1     4     1     2     2     2     4
## 22504 22505 22506 22507 22508 22509 22510 22511 22512 22513 22514 22515 22516
##   1     1     3     2     2     4     2     2     2     2     2     3     4
## 22517 22518 22519 22520 22521 22522 22523 22524 22525 22526 22527 22528 22529
##   3     1     2     4     2     2     2     3     2     2     2     3     4
## 22530 22531 22532 22533 22534 22535 22536 22537 22538 22539 22540 22541 22542
##   4     1     2     2     2     1     1     2     2     3     3     2     2
## 22543 22544 22545 22546 22547 22548 22549 22550 22551 22552 22553 22554 22555
##   1     2     1     2     3     2     3     3     3     2     1     2     2
## 22556 22557 22558 22559 22560 22561 22562 22563 22564 22565 22566 22567 22568
##   2     2     3     2     2     4     1     1     2     3     3     2     2
## 22569 22570 22571 22572 22573 22574 22575 22576 22577 22578 22579 22580 22581
##   4     2     2     2     2     2     4     1     2     4     2     2     3
## 22582 22583 22584 22585 22586 22587 22588 22589 22590 22591 22592 22593 22594
##   2     2     4     2     2     1     2     2     2     1     1     2     4
## 22595 22596 22597 22598 22599 22600 22601 22602 22603 22604 22605 22606 22607
##   1     2     2     2     3     4     2     4     2     2     1     4     1
## 22608 22609 22610 22611 22612 22613 22614 22615 22616 22617 22618 22619 22620
##   1     2     4     2     3     2     2     2     2     1     2     3     2
## 22621 22622 22623 22624 22625 22626 22627 22628 22629 22630 22631 22632 22633
##   3     2     3     3     4     3     2     2     2     4     2     2     2
## 22634 22635 22636 22637 22638 22639 22640 22641 22642 22643 22644 22645 22646
##   2     4     2     3     1     3     1     3     4     2     4     2     3
## 22647 22648 22649 22650 22651 22652 22653 22654 22655 22656 22657 22658 22659
##   3     2     4     3     2     3     3     1     3     2     2     3     4
## 22660 22661 22662 22663 22664 22665 22666 22667 22668 22669 22670 22671 22672
##   3     2     3     1     3     4     3     1     4     4     3     3     2
## 22673 22674 22675 22676 22677 22678 22679 22680 22681 22682 22683 22684 22685
##   1     4     2     2     2     2     2     2     2     2     2     3     2
## 22686 22687 22688 22689 22690 22691 22692 22693 22694 22695 22696 22697 22698
##   2     1     2     2     1     2     1     1     2     4     1     2     3
## 22699 22700 22701 22702 22703 22704 22705 22706 22707 22708 22709 22710 22711
##   1     2     2     4     1     2     2     2     2     2     3     4     4
## 22712 22713 22714 22715 22716 22717 22718 22719 22720 22721 22722 22723 22724
##   2     3     4     3     2     4     2     2     2     1     2     2     2
## 22725 22726 22727 22728 22729 22730 22731 22732 22733 22734 22735 22736 22737
##   4     2     2     2     2     2     2     3     4     2     2     2     3

```

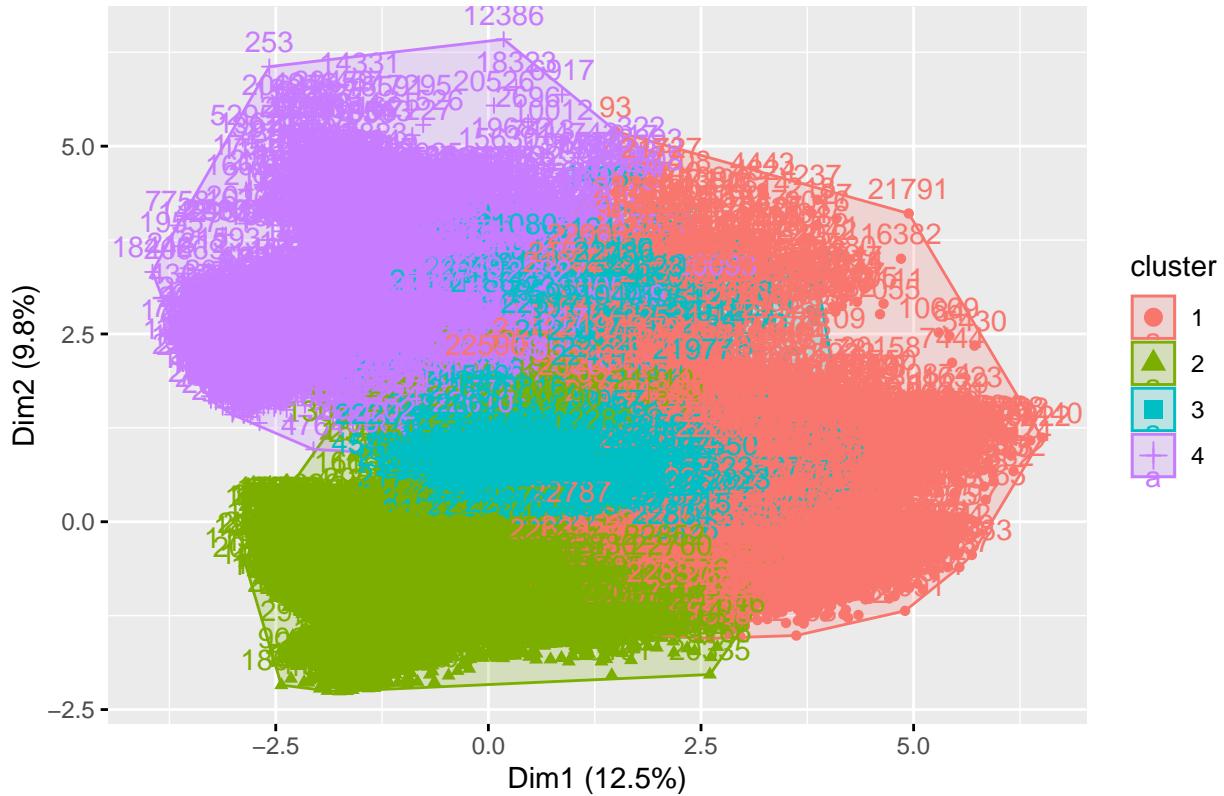
```

## 22738 22739 22740 22741 22742 22743 22744 22745 22746 22747 22748 22749 22750
##   2     1     3     1     2     2     2     2     2     4     2     3     2
## 22751 22752 22753 22754 22755 22756 22757 22758 22759 22760 22761 22762 22763
##   1     2     3     2     3     2     4     1     4     2     2     2     1
## 22764 22765 22766 22767 22768 22769 22770 22771 22772 22773 22774 22775 22776
##   2     2     1     2     2     4     3     2     2     2     2     2     2
## 22777 22778 22779 22780 22781 22782 22783 22784 22785 22786 22787 22788 22789
##   2     2     2     3     2     2     2     4     4     3     1     4     1
## 22790 22791 22792 22793 22794 22795 22796 22797 22798 22799 22800 22801 22802
##   2     2     2     4     2     4     2     3     2     1     2     3
## 22803 22804 22805 22806 22807 22808 22809 22810 22811 22812 22813 22814 22815
##   2     1     1     2     2     2     2     3     2     1     2     2     2
## 22816 22817 22818 22819 22820 22821 22822 22823 22824 22825 22826 22827 22828
##   3     2     4     2     4     2     4     3     2     2     1     4     2
## 22829 22830 22831 22832 22833 22834 22835 22836 22837 22838 22839 22840 22841
##   1     2     1     2     1     3     1     2     4     1     4     1     3
## 22842 22843 22844 22845 22846 22847 22848 22849 22850 22851 22852 22853 22854
##   2     1     4     2     2     2     2     2     2     2     2     2     1
## 22855 22856 22857 22858 22859 22860 22861 22862 22863 22864 22865 22866 22867
##   2     2     1     2     4     3     2     3     2     4     2     1     3
## 22868 22869
##   4     2
##
## Within cluster sum of squares by cluster:
## [1] 163257.43 149575.02 73332.24 73052.89
## (between_SS / total_SS = 22.8 %)
##
## Available components:
##
## [1] "cluster"      "centers"       "totss"        "withinss"      "tot.withinss"
## [6] "betweenss"    "size"          "iter"          "ifault"

# Display cluster plot
fviz_cluster(fit, data = kmean_vars)

```

Cluster plot



```
bmi_result <- data.frame(Status = kmean_data$bmiCategory, Kmeans = fit$cluster)

# Crosstab for Kmeans
bmi_result %>% group_by(Kmeans) %>% select(Kmeans, Status) %>% table()
```

```
##      Status
## Kmeans Insufficient_Weight Normal_Weight Obesity_Type_I Obesity_Type_II
##   1           1383          1128        109            21
##   2           858           1276        960          2077
##   3           289           728       1343          402
##   4           265           237        849          1045
##      Status
## Kmeans Obesity_Type_III Overweight_Level_I Overweight_Level_II
##   1             5          578        220
##   2            4364         1330        972
##   3             0          302        750
##   4             1          507        870
```

Based on k-means clustering, the machine learning algorithm indicated the optimal number of clusters was 4. As seen in the wss and silhouette plots, the optimal number of clusters for the data was 4 clusters, which was used to fit the data into the k-means model. Given the original dataset, where there were 7 independent classes in the target variable, this makes sense as the major groups in the original dataset were: Insufficient Weight, Normal, Obesity Type I, Obesity Type II, Obesity Type III, Overweight Level I, and Overweight Level II. However, it would be reasonable to cluster these into Insufficient, Normal, Obese, and Overweight.

Report: Final Remarks When looking at decision trees, support vector machines (SVM), and k-means clustering for a dataset on BMI classification, there are some fascinating insights to consider. Decision trees did well in their interpretability, making it easy to grasp how classifications are made based on factors like age, height, and weight. In this case, it was only the weight and height factors that played a major role in classification. The decision tree did a great job of capturing non-linear relationships in the data, and there wasn't any risk of over fitting as the tree was pruned. The analysis also conducted a search into potential simpler trees to ensure the outputted model was not too complex and ensure zero risk of over fitting the data.

SVMs focused on maximizing the margin between classes, in this case only two, which lead to better generalization when dealing with new data. Their advantage was drawing decision boundaries, especially in cases where BMI classes overlap. However, the interpretability isn't anything like that of decision tree. The SVM model did perform better in accuracy than the decision tree, but could be argued that this difference is marginal and might consider level of interpretability when deciding on a classification algorithm.

K-means clustering was useful for uncovering natural groupings in the data without any pre-defined labels, or unsupervised learning. K-means performance relied heavily on the choice of features and the distance between two observations. The determination of the right number of clusters was obvious in this analysis, as seen by the silhouette and wss plots, however, there are times when determining the number of clusters is too difficult. The concern for the k-means model generated in this project was the lack of clarity in the clusters as seen in the cross tabulation of data points in clusters to their actual labels.

In the end, comparing these models using metrics like accuracy, precision, and recall provides a well-rounded picture of their effectiveness. The model chosen often comes down to the specific context such as whether the priority is interpretability or predictive power. By combining these approaches, it provides a more nuanced understanding of BMI classification, leveraging each model's strengths to boost both accuracy and insights. Obviously in this case, it was a confirmation to see the models determine weight and height as the leading contributors to BMI classification.

Reflection The Foundations of Data Science course has transformed how I view the field. Initially, I thought of data science as just a technical area focused on algorithms and coding. However, the course emphasized the importance of storytelling, ethics, and domain knowledge, which opened my eyes to a more holistic approach. I've learned to blend statistical analysis, data visualization, and effective communication. Now, I see data science not just as a set of tools, but as a way to drive insights and tackle real-world challenges, and have already been thinking about how I can use these skills in varying fields. I am looking forward to applying this knowledge with Python.