```r
# Load required libraries
install.packages("randomForest")
install.packages("keras3")
install.packages("xgboost")
install.packages("ggplot2")
install.packages("corrplot")
install.packages("e1071")  # For SVM
install.packages("rpart")  # For Decision Tree

library(keras3)
library(xgboost)
library(randomForest)
library(ggplot2)
library(corrplot)
library(e1071)
library(rpart)
```

```
Installing package into ‘/usr/local/lib/R/site-library’
(as ‘lib’ is unspecified)

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(as ‘lib’ is unspecified)

also installing the dependencies ‘RcppTOML’, ‘here’, ‘png’, ‘config’, ‘tfautograph’, ‘reticulate’, ‘tensorflo


Installing package into ‘/usr/local/lib/R/site-library’
(as ‘lib’ is unspecified)

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Installing package into ‘/usr/local/lib/R/site-library’
(as ‘lib’ is unspecified)

also installing the dependency ‘proxy’
```

```
Installing package into ‘/usr/local/lib/R/site-library’
(as ‘lib’ is unspecified)

randomForest 4.7-1.2

Type rfNews() to see new features/changes/bug fixes.


Attaching package: ‘ggplot2’


The following object is masked from ‘package:randomForest’:

    margin


corrplot 0.95 loaded
```

```
# Load and summarize the dataset
dataset <- read.csv("/content/station00.csv")
```

```
# Display column names and the first five rows of the dataset
cat("Column names of the dataset:\n")
print(names(dataset))

cat("First five rows of the dataset:\n")
print(head(dataset, 5))
```

```
Column names of the dataset:
 [1] "date_time"         "nwp_globalirrad"   "nwp_directirrad"
 [4] "nwp_temperature"   "nwp_humidity"      "nwp_windspeed"
 [7] "nwp_winddirection" "nwp_pressure"      "lmd_totalirrad"
[10] "lmd_diffuseirrad"  "lmd_temperature"   "lmd_pressure"
[13] "lmd_winddirection" "lmd_windspeed"     "power"
First five rows of the dataset:
```

```
            date_time nwp_globalirrad nwp_directirrad nwp_temperature
1 2018-08-15 16:00:00               0               0           22.78
2 2018-08-15 16:15:00               0               0           22.75
3 2018-08-15 16:30:00               0               0           22.71
4 2018-08-15 16:45:00               0               0           22.64
5 2018-08-15 17:00:00               0               0           22.57
  nwp_humidity nwp_windspeed nwp_winddirection nwp_pressure lmd_totalirrad
1        96.85          4.28            339.41      1007.27              0
2        96.91          4.30            337.27      1007.27              0
3        96.95          4.28            334.47      1007.48              0
4        97.12          4.28            331.52      1007.39              0
5        97.15          4.33            329.78      1007.09              0
  lmd_diffuseirrad lmd_temperature lmd_pressure lmd_winddirection lmd_windspeed
1                0            25.9       1006.3               353           1.1
2                0            25.9       1006.2               330           0.9
3                0            25.8       1006.3                 1           1.9
4                0            25.6       1006.3               309           0.4
5                0            25.7       1006.3               335           1.6
  power
1     0
2     0
3     0
4     0
5     0
```

```
# Check for missing values
cat("Checking for missing values...\n")
missing_values <- sum(is.na(dataset))
cat("Total missing values: ", missing_values, "\n")
```

```
Checking for missing values...
Total missing values:  0
```

```
# Remove rows with missing values (if necessary)
dataset <- na.omit(dataset)
cat("Dataset dimensions after removing missing values:\n")
print(dim(dataset))
```

```
Dataset dimensions after removing missing values:
[1] 28896    15
```

```
# Randomly sample 10% of the dataset
set.seed(42)  # For reproducibility
sample_size <- floor(0.1 * nrow(dataset))
sampled_data <- dataset[sample(1:nrow(dataset), sample_size), ]

cat("First 5 rows of the sampled data (10% of dataset):\n")
print(head(sampled_data, 5))
```

```
First 5 rows of the sampled data (10% of dataset):
                date_time nwp_globalirrad nwp_directirrad nwp_temperature
27185 2019-05-26 20:00:00            0.00            0.00           15.72
28645 2019-06-11 01:00:00          626.01          575.58           27.06
18753 2019-02-28 00:00:00           76.17           60.89            2.00
21657 2019-03-30 06:00:00          767.57          712.91           11.88
9290  2018-11-20 10:15:00            0.00            0.00            6.39
      nwp_humidity nwp_windspeed nwp_winddirection nwp_pressure lmd_totalirrad
27185        46.42          4.66             354.72      1009.43              0
28645        40.46          1.26             359.19      1002.89            589
18753        72.41          1.06             104.62      1016.01             55
21657        12.02          7.43             338.04      1016.97            884
9290         27.71          3.28              70.73      1019.45              0
      lmd_diffuseirrad lmd_temperature lmd_pressure lmd_winddirection
27185                0            19.3       1007.0               314
28645              512            26.3       1001.6                81
18753               40            -0.7       1016.3               237
21657               75            12.7       1015.8               294
9290                 0             8.7       1018.4               355
      lmd_windspeed    power
27185           3.0 0.000000
28645           1.5 2.974219
18753           0.7 0.348047
21657           5.3 4.619531
9290            0.2 0.000000
```

```
# Select columns 2, 3, 9, and 10 as features and column 14 as the target (power)
X <- sampled_data[, c(2, 3, 9, 10)]
y <- sampled_data[, 14]  # Target variable 'power'
```

```r
# Train-test split (80% training, 20% testing) on the 10% sample
set.seed(42)
train_idx <- sample(1:nrow(X), size = 0.8 * nrow(X))
test_idx <- setdiff(1:nrow(X), train_idx)

X_train <- as.matrix(X[train_idx, ])
y_train <- y[train_idx]
X_test <- as.matrix(X[test_idx, ])
y_test <- y[test_idx]

cat("Training set size: ", nrow(X_train), "\n")
cat("Test set size: ", nrow(X_test), "\n")
```

```
Training set size:  2311
Test set size:  578
```

```r
# Initialize the results data frame with appropriate columns
results <- data.frame(
  Model = character(),
  RMSE = numeric(),
  Time = numeric(),
  stringsAsFactors = FALSE
)
```

```r
# Define RMSE function for evaluation
rmse <- function(actual, predicted) {
  sqrt(mean((actual - predicted)^2))
}
```

```r
# 1. Artificial Neural Network (ANN)
cat("Training ANN model...\n")
ann_time <- system.time({
  ann_model <- keras_model_sequential() %>%
    layer_dense(units = 16, input_shape = ncol(X_train), activation = "relu") %>%
    layer_dense(units = 8, activation = "relu") %>%
    layer_dense(units = 1)
  ann_model %>% compile(optimizer = "adam", loss = "mse")
```

```
  ann_model %>% fit(X_train, y_train, epochs = 50, batch_size = 10, verbose = 0)
  predictions_ann <- ann_model %>% predict(X_test)
})
ann_rmse <- rmse(y_test, predictions_ann)
results <- rbind(results, data.frame(Model = "ANN", RMSE = ann_rmse, Time = ann_time["elapsed"]))
```

```
Training ANN model...
```

```
# 2. Support Vector Machine (SVM)
cat("Training SVM model...\n")
svm_time <- system.time({
  svm_model <- svm(X_train, y_train)
  predictions_svm <- predict(svm_model, X_test)
})
svm_rmse <- rmse(y_test, predictions_svm)
results <- rbind(results, data.frame(Model = "SVM", RMSE = svm_rmse, Time = svm_time["elapsed"]))
```

```
Training SVM model...
```

```
# 3. Decision Tree
cat("Training Decision Tree model...\n")
dt_time <- system.time({
  dt_model <- rpart(y_train ~ ., data = as.data.frame(X_train))
  predictions_dt <- predict(dt_model, as.data.frame(X_test))
})
dt_rmse <- rmse(y_test, predictions_dt)
results <- rbind(results, data.frame(Model = "Decision Tree", RMSE = dt_rmse, Time = dt_time["elapsed"]))
```

```
Training Decision Tree model...
```

```
# 4. Random Forest
cat("Training Random Forest model...\n")
rf_time <- system.time({
  rf_model <- randomForest(X_train, y_train, ntree = 100)
```

```
  predictions_rf <- predict(rf_model, X_test)
})
rf_rmse <- rmse(y_test, predictions_rf)
results <- rbind(results, data.frame(Model = "Random Forest", RMSE = rf_rmse, Time = rf_time["elapsed"]))
```

```
Training Random Forest model...
```

```
# 5. XGBoost
cat("Training XGBoost model...\n")
xgb_time <- system.time({
  dtrain <- xgb.DMatrix(data = X_train, label = y_train)
  dtest <- xgb.DMatrix(data = X_test)
  xgb_model <- xgb.train(list(objective = "reg:squarederror", eta = 0.1, max_depth = 3), data = dtrain, nrounds =
  predictions_xgb <- predict(xgb_model, dtest)
})
xgb_rmse <- rmse(y_test, predictions_xgb)
results <- rbind(results, data.frame(Model = "XGBoost", RMSE = xgb_rmse, Time = xgb_time["elapsed"]))
```

```
Training XGBoost model...
```

```
# 6. Convolutional Neural Network (CNN)
cat("Training CNN model...\n")
cnn_time <- system.time({
  # Reshape input data for CNN (CNNs expect a 3D input: samples, timesteps, features)
  X_train_cnn <- array(X_train, dim = c(nrow(X_train), ncol(X_train), 1))
  X_test_cnn <- array(X_test, dim = c(nrow(X_test), ncol(X_test), 1))

  cnn_model <- keras_model_sequential() %>%
    layer_conv_1d(filters = 32, kernel_size = 2, activation = "relu", input_shape = c(ncol(X_train), 1)) %>%
    layer_max_pooling_1d(pool_size = 2) %>%
    layer_flatten() %>%
    layer_dense(units = 16, activation = "relu") %>%
    layer_dense(units = 1)

  cnn_model %>% compile(optimizer = "adam", loss = "mse")
```

```
  cnn_model %>% fit(X_train_cnn, y_train, epochs = 50, batch_size = 10, verbose = 0)

  predictions_cnn <- cnn_model %>% predict(X_test_cnn)
})
cnn_rmse <- rmse(y_test, predictions_cnn)
results <- rbind(results, data.frame(Model = "CNN", RMSE = cnn_rmse, Time = cnn_time["elapsed"]))
```

```
Training CNN model...
```

```
# 7. Long Short-Term Memory (LSTM)
cat("Training LSTM model...\n")
lstm_time <- system.time({
  # Reshape input data for LSTM (LSTM expects a 3D input: samples, timesteps, features)
  X_train_lstm <- array(X_train, dim = c(nrow(X_train), ncol(X_train), 1))
  X_test_lstm <- array(X_test, dim = c(nrow(X_test), ncol(X_test), 1))

  lstm_model <- keras_model_sequential() %>%
    layer_lstm(units = 50, input_shape = list(ncol(X_train), 1), return_sequences = FALSE) %>%
    layer_dense(units = 1)

  lstm_model %>% compile(optimizer = "adam", loss = "mse")
  lstm_model %>% fit(X_train_lstm, y_train, epochs = 50, batch_size = 10, verbose = 0)

  predictions_lstm <- lstm_model %>% predict(X_test_lstm)
})
lstm_rmse <- rmse(y_test, predictions_lstm)
results <- rbind(results, data.frame(Model = "LSTM", RMSE = lstm_rmse, Time = lstm_time["elapsed"]))
```

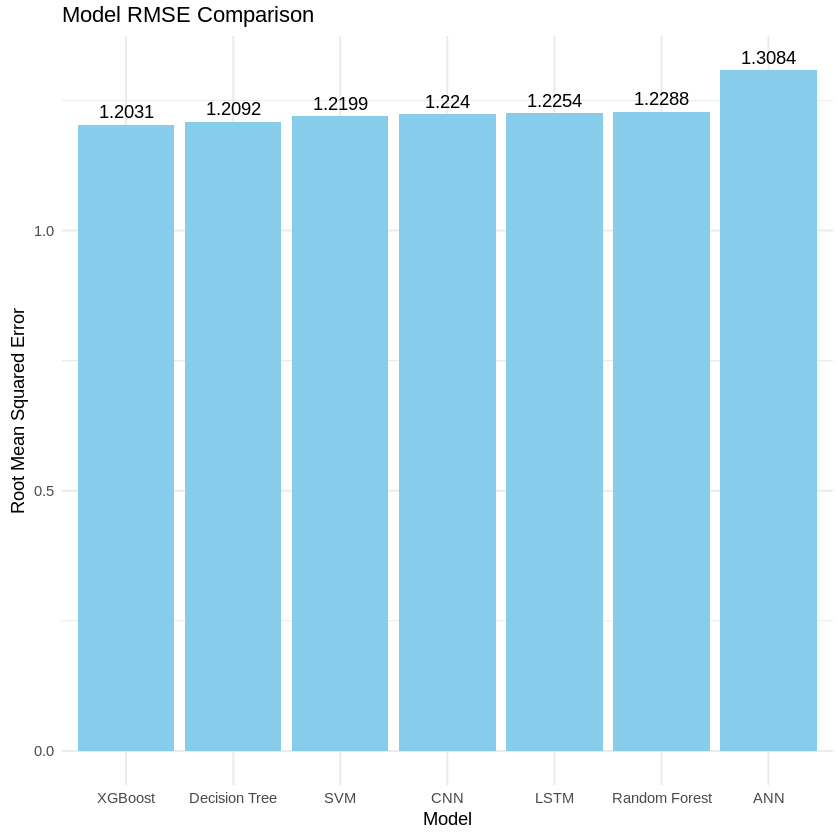
```
Training LSTM model...
```

```
# ---------- Model Evaluation Visualizations ----------

# Convert RMSE and Time columns to numeric for visualization
results$RMSE <- as.numeric(results$RMSE)
results$Time <- as.numeric(results$Time)
```

```
# Plot RMSE comparison
cat("Plotting RMSE comparison...\n")
ggplot(results, aes(x = reorder(Model, RMSE), y = RMSE)) +
  geom_bar(stat = "identity", fill = "skyblue") +
  geom_text(aes(label = round(RMSE, 4)), vjust = -0.5) +
  labs(title = "Model RMSE Comparison", x = "Model", y = "Root Mean Squared Error") +
  theme_minimal()
```

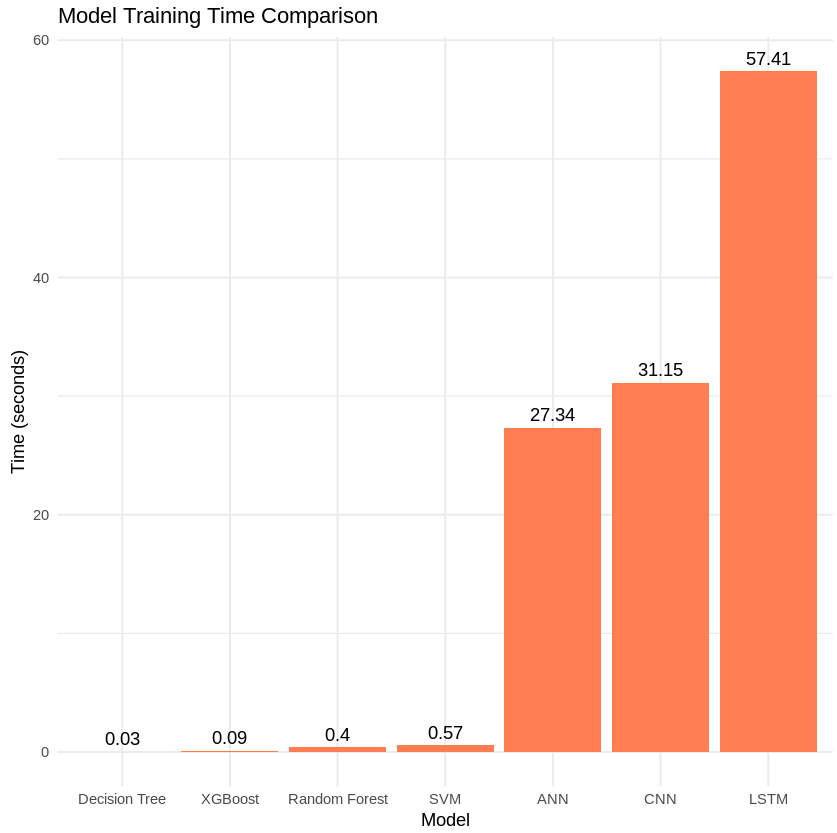
```
Plotting RMSE comparison...
```




```
# Plot training times comparison
cat("Plotting training time comparison...\n")
ggplot(results, aes(x = reorder(Model, Time), y = Time)) +
  geom_bar(stat = "identity", fill = "coral") +
  geom_text(aes(label = round(Time, 2)), vjust = -0.5) +
  labs(title = "Model Training Time Comparison", x = "Model", y = "Time (s
  theme_minimal()
```

```
  theme_minimal()
```

```
Plotting training time comparison...
```



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