Predicting Office Occupancy

Preprocessing

Read occupancy dataset. Please find dataset here:
https://github.com/LuisM78/Occupancy-detection-data
OfficeOccupancy is dataset2.txt

```
officeOccupancy = Import["Path/officeOccupancy.csv", "CSV"]
```

```
In[249]:= officeOccupancy[[1 ;; 5]]

Out[249]= {{date, Temperature, Humidity, Light, CO2, HumidityRatio, Occupancy},
           {2/11/15 14:48, 21.76, 31.1333, 437.333, 1029.67, 0.00502101, 1},
           {2/11/15 14:49, 21.79, 31, 437.333, 1000, 0.00500858, 1},
           {2/11/15 14:50, 21.7675, 31.1225, 434, 1003.75, 0.00502157, 1},
           {2/11/15 14:51, 21.7675, 31.1225, 439, 1009.5, 0.00502157, 1}}
```

```
In[250]:= TableForm[%249]

                    date            Temperature    Humidity    Light      CO2        HumidityRatio    Occ
                    2/11/15 14:48   21.76          31.1333     437.333    1029.67    0.00502101       1
Out[250]//TableForm= 2/11/15 14:49   21.79          31          437.333    1000       0.00500858       1
                    2/11/15 14:50   21.7675        31.1225     434        1003.75    0.00502157       1
                    2/11/15 14:51   21.7675        31.1225     439        1009.5     0.00502157       1
```

Separate the date from time, and create the new dataset

```
In[505]:= officeOccupancyData = Map[Join[StringSplit[First[#]], Rest[#]] &,
            Rest[officeOccupancy]]

Out[505]= {{2/11/15, 14:48, 21.76, 31.1333, 437.333, 1029.67, 0.00502101, 1},
           {2/11/15, 14:49, 21.79, 31, 437.333, 1000, 0.00500858, 1}, ⋯ 9748 ⋯,
           {2/18/15, 9:17, 20.89, 28.0225, 418.75, 1632, 0.00427949, 1},
           {2/18/15, 9:19, 21, 28.1, 409, 1864, 0.00432073, 1}}

          large output | show less | show more | show all | set size limit...
```

remove Humidity Ration

```
In[506]:= officeOccupancyData = officeOccupancyData[[All, {1, 2, 3, 4, 5, 6, 8}]]
```

Create subsets based on the date

```
office21611 =
  Select[officeOccupancyData, StringMatchQ [First[#], "2/11/15"] &][[All,
    {3, 4, 5, 6, 7}]];
validateDate11 = Map[Rule[Most[#], Last[#]] &, office21611];
office21612 =
  Select[officeOccupancyData, StringMatchQ [First[#], "2/12/15"] &][[All,
    {3, 4, 5, 6, 7}]];
validateDate12 = Map[Rule[Most[#], Last[#]] &, office21612];
office21613 =
  Select[officeOccupancyData, StringMatchQ [First[#], "2/13/15"] &][[All,
    {3, 4, 5, 6, 7}]];
validateDate13 = Map[Rule[Most[#], Last[#]] &, office21613];
office21614 =
  Select[officeOccupancyData, StringMatchQ [First[#], "2/14/15"] &][[All,
    {3, 4, 5, 6, 7}]];
validateDate14 = Map[Rule[Most[#], Last[#]] &, office21614];
office21615 =
  Select[officeOccupancyData, StringMatchQ [First[#], "2/15/15"] &][[All,
    {3, 4, 5, 6, 7}]];
validateDate15 = Map[Rule[Most[#], Last[#]] &, office21615];
office21616 =
  Select[officeOccupancyData, StringMatchQ [First[#], "2/16/15"] &][[All,
    {3, 4, 5, 6, 7}]];
validateDate16 = Map[Rule[Most[#], Last[#]] &, office21616];
office21617 =
  Select[officeOccupancyData, StringMatchQ [First[#], "2/17/15"] &][[All,
    {3, 4, 5, 6, 7}]];
validateDate17 = Map[Rule[Most[#], Last[#]] &, office21617];
office21618 =
  Select[officeOccupancyData, StringMatchQ [First[#], "2/18/15"] &][[All,
    {3, 4, 5, 6, 7}]];
validateDate18 = Map[Rule[Most[#], Last[#]] &, office21618];
```

Basic Analysis

Tally occupancy by day

```
tmp = Map[Flatten[#] &, Tally[officeOccupancyData[[All, {1, 7}]]]];
```

```
In[521]:= i = 1;
          l = {};
          While[i ≤ 13, If[tmp[[i, 1]] == tmp[[i + 1, 1]] ,
            If[tmp[[i, 2]] == 1, l = Append[l, {tmp[[i + 1, 1]], tmp[[i + 1, 3]], tmp[[i, 3]]}],
             l = Append[l, {tmp[[i + 1, 1]], tmp[[i, 3]], tmp[[i + 1, 3]]}]];
            i = i + 2, If[tmp[[i, 2]] == 1, l = Append[l, {tmp[[i, 1]], 0, tmp[[i, 3]]}],
             l = Append[l, {tmp[[i, 1]], tmp[[i, 3]], 0}]];
            i = i + 1]]
```

From the tally, one can see that the office room is mostly empty on February 14, 15, and 18

```
In[526]:= ReplacePart[
           Grid[{{"2/11/15", 338, 214}, {"2/12/15", 1196, 244}, {"2/13/15", 946, 494},
             {"2/14/15", 1440, 0}, {"2/15/15", 1440, 0}, {"2/16/15", 889, 551},
             {"2/17/15", 903, 537}, {"2/18/15", 551, 9}}],
           1 →
            Prepend[
             First[Grid[{{"2/11/15", 338, 214}, {"2/12/15", 1196, 244}, {"2/13/15", 946, 494},
                {"2/14/15", 1440, 0}, {"2/15/15", 1440, 0}, {"2/16/15", 889, 551},
                {"2/17/15", 903, 537}, {"2/18/15", 551, 9}}]],
             {"Date", "Non Occupancy Freq", "Occupancy Freq"}]]

            Date   Non Occupancy Freq  Occupancy Freq
          2/11/15         338                214
          2/12/15        1196                244
          2/13/15         946                494
Out[526]= 2/14/15        1440                  0
          2/15/15        1440                  0
          2/16/15         889                551
          2/17/15         903                537
          2/18/15         551                  9
```

■ Sampling

Build training set, testing set, and validation set. You notice that the sets don’t share any common observations.

```
          trainingSet =
            Flatten[
             {zero = RandomSample[Select[officeOccupancyData[[All, {3, 4, 5, 6, 7}]],
                 Last[#] == 0 &], 200],
              one = RandomSample[Select[officeOccupancyData[[All, {3, 4, 5, 6, 7}]],
                 Last[#] == 1 &], 200]}, 1];
          trainingSetRule = Map[Rule[Most[#], Last[#]] &, trainingSet]

In[366]:= testingSet = Flatten[{zero = RandomSample[Select[leftOver, Last[#] == 0 &], 200],
              one = RandomSample[Select[leftOver, Last[#] == 1 &], 200]}, 1];
          testingSetRule = Map[Rule[Most[#], Last[#]] &, testingSet]
```

```
In[372]:= validateSet = Complement[leftOver , testingSetRule];
          validateSetRule =  Map[Rule[Most[#], Last[#]] &, validateSet]
```

Save the sets in a file OccupancyTestingData

```
In[432]:= DumpSave["OccupancyTestingData.mx",
            {testingSet, testingSetRule, trainingSet, trainingSetRule, validateSet,
             validateSetRule, trainer}]
```

Export the sets to CSV files

```
In[527]:= Export["OccupancyTrainingSet.csv", trainingSet, "CSV"];
          Export["OccupancyTestingSet.csv", testingSet, "CSV"];
          Export["OccupancyValidationSet.csv", validateSet, "CSV"];
```

Import datatest.csv. Make sure to overwrite the path

```
dataset = Import["/Path/datatest.csv", "CSV"];
```

Prepare the validation set. Remove the heading

```
dataset = Rest[dataset]
datasetRule = Map[Rule[Most[#], Last[#]] &, dataset];
```

Build and Train Models

Deep Fast Forward

Sampling

```
coder888 =
  NetChain[{10, Ramp, 10, Ramp, 8, Ramp, 6, Ramp, DotPlusLayer[2], SoftmaxLayer[]},
   "Input" → 4, "Output" → NetDecoder[{"Class", {0, 1}}]]
trainer888 = NetInitialize[coder888]
```

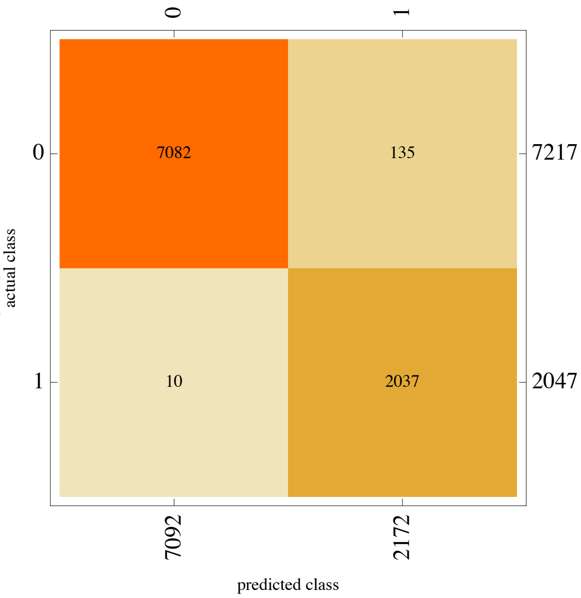
Train the model

```
train888  = NetTrain[trainer888, trainingSetRule, ValidationSet → testingSetRule]
```

test the model performance with validateSet

```
ClassifierMeasurements[train888, validateSetRule,
 {"ConfusionMatrixPlot", "Accuracy", "Precision", "Recall", "FScore"}]
```

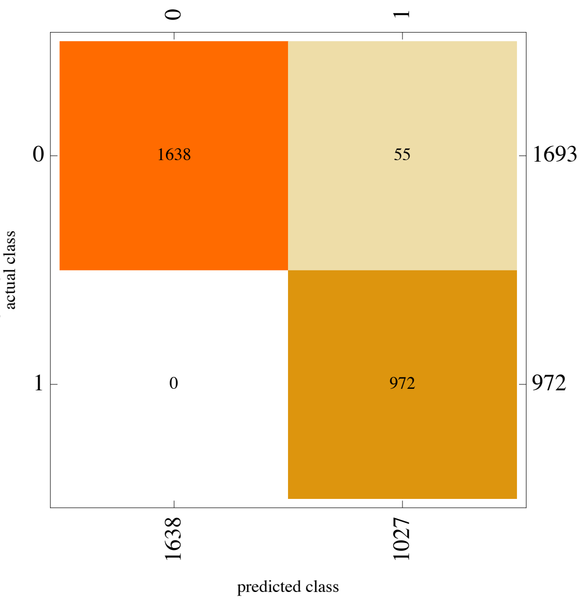
```
{
```



```
 , 0.9843480138169257`,
<|0 → 0.9812941665511986`, 1 → 0.995114802149487`|>,
<|0 → 0.9985899605188945`, 1 → 0.9378453038674033`|>,
<|0 → 0.9898665175763505`, 1 → 0.9656316662716282`|>}
```

test model performance with datatest

```
ClassifierMeasurements[train888, datasetRule,
 {"ConfusionMatrixPlot", "Accuracy", "Precision", "Recall", "FScore"}]
```



```
{ , 0.9793621013133208`,
 <|0 → 0.96751329001772`, 1 → 1.`|>, <|0 → 1.`, 1 → 0.9464459591041869`|>,
 <|0 → 0.9834884419093367`, 1 → 0.9724862431215607`|>}
```

Find Best Dates Combination

Find all performances starting from February 11th to February 16

```
s = {validateDate11, validateDate12, validateDate13, validateDate16, validateDate17}
Table[Table[trainTV = NetTrain[trainer, s[[i]], ValidationSet → s[[k]]];
  c = ClassifierMeasurements[trainTV, datasetRule, "Accuracy"];
  {i, k, c}, {k, i + 1, 5}], {i, 4}]
(*export to excel to clean and make it nice looking *)
Export["Selection.xls", Grid[Flatten[%, 1]], "XLS"]
```

Find all performances starting from February 17 to February 12

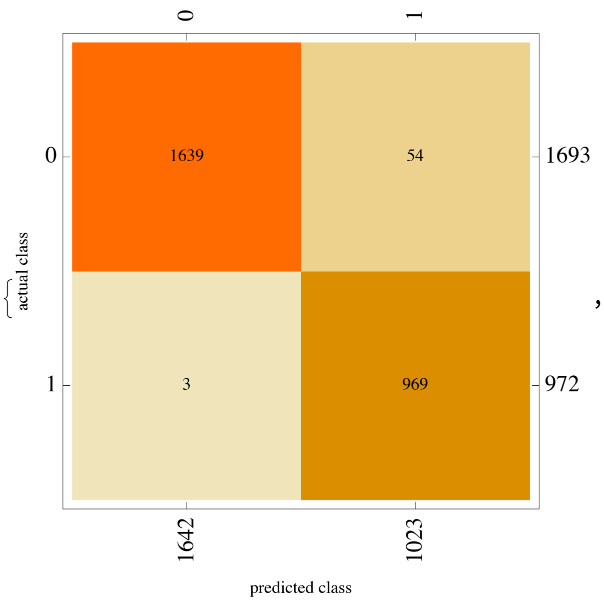
```
s = Reverse[{validateDate11, validateDate12, validateDate13, validateDate16,
   validateDate17}]
Table[Table[trainTV = NetTrain[trainer, s[[i]], ValidationSet → s[[k]]];
  c = ClassifierMeasurements[trainTV, datasetRule, "Accuracy"];
  {i, k, c}, {k, i + 1, 5}], {i, 4}]
Export["Selection2.xls", Grid[Flatten[%, 1]], "XLS"]
```

Random Forest and KNN

Random Forest

```
In[537]:=
        c = Classify[trainingSetRule, ValidationSet → testingSetRule, Method → "RandomForest"];
        ClassifierInformation[c];
        ClassifierMeasurements[c, datasetRule,
         {"ConfusionMatrixPlot", "Accuracy", "Precision", "Recall", "FScore"}]
```

```
Out[539]= {
```

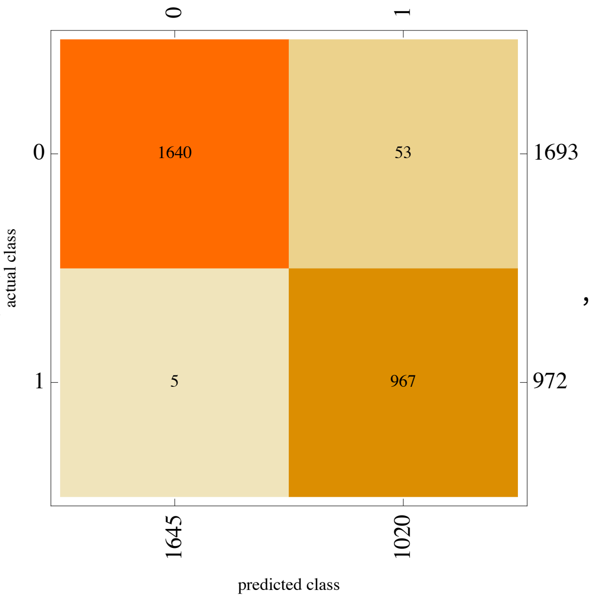


```
, 0.978612, <|0 → 0.968104, 1 → 0.996914|>,
<|0 → 0.998173, 1 → 0.947214|>, <|0 → 0.982909, 1 → 0.971429|>}
```

K Nearest Neighbor

```
In[540]:= c = Classify[trainingSetRule, ValidationSet → testingSetRule,
              Method -> "NearestNeighbors"];
          ClassifierInformation[c];
          ClassifierMeasurements[c, datasetRule,
           {"ConfusionMatrixPlot", "Accuracy", "Precision", "Recall", "FScore"}]
```

```
Out[542]= {
```



```
, 0.978236, <|0 → 0.968695, 1 → 0.994856|>,
<|0 → 0.99696, 1 → 0.948039|>, <|0 → 0.982624, 1 → 0.970884|>}
```