Classification workflows conversational agent example runs

Anton Antonov
MathematicaForPrediction at GitHub
MathematicaForPrediction at WordPress
ConversationalAgents at GitHub
May 2018

Introduction

This (laconic) notebook gives basic demonstrations of the functionalities developed in the project “Classification workflows conversational agent”.

Load preliminary code

Load the packages for the `ClCon` monad, monad tracing, functional parsers, and data obtaining:

```
In[1]:= Import["https://raw.githubusercontent.com/antononcube/MathematicaForPrediction/master/MonadicProgramming/MonadicContextualClassification.m"]
        Import["https://raw.githubusercontent.com/antononcube/MathematicaForPrediction/master/MonadicProgramming/MonadicTracing.m"]
        Import["https://raw.githubusercontent.com/antononcube/MathematicaForPrediction/master/FunctionalParsers.m"]
        Import["https://raw.githubusercontent.com/antononcube/MathematicaVsR/master/Projects/ProgressiveMachineLearning/Mathematica/GetMachineLearningDataset.m"]
```

```
» Importing from GitHub: MathematicaForPredictionUtilities.m
» Importing from GitHub: MosaicPlot.m
» Importing from GitHub: CrossTabulate.m
» Importing from GitHub: StateMonadCodeGenerator.m
» Importing from GitHub: ClassifierEnsembles.m
» Importing from GitHub: ROCFunctions.m
» Importing from GitHub: VariableImportanceByClassifiers.m
» Importing from GitHub: SSparseMatrix.m
» Importing from GitHub: OutlierIdentifiers.m
```

Load project code

Get and run the parsers specification and generation code:

```
In[14]:= Clear["ebnf*"]
         Get["https://raw.githubusercontent.com/antononcube/ConversationalAgents/master/EBNF/ClassifierWorkflowsGrammar.ebnf"]
         Names["ebnf*"]
         LeafCount /@ res

Out[16]= {ebnfClassifierEnsembleMaking, ebnfClassifierMaking, ebnfClassifierQuery, ebnfClassifierTesting, ebnfCommand,
          ebnfDataLoad, ebnfDataOutliers, ebnfDataStatistics, ebnfDataTransform, ebnfPipelineCommands, ebnfSplitting, ebnfVerification}

Out[17]= {628, 763, 897, 466, 424, 960, 531, 905, 4465, 491, 843, 24}
```

Load the translator package:

```
In[18]:= Import["https://raw.githubusercontent.com/antononcube/ConversationalAgents/master/Projects/ClassficationWorkflowsAgent/Mathematica/ClConTranslator.m"]
```

Get data

Get the Titanic data (from WL’s repository):

```
In[19]:= dsTitanic = GetMachineLearningDataset["Titanic"];
```

Generate a classification pipeline

Generate a ClCon pipeline from a sequence of natural language commands:

```
In[20]:= clCommands = {
            "load the titanic data",
            "split the data with 65 percent for training", "summarize data", "train a random forest classifier",
            "show classifier information",
            "display classifier training time", "show accuracy, precision, recall, and area under roc curve", "display confusion matrix plot",
            "compute the variable importance estimates"};
         pl = ToClConPipelineFunction[clCommands]

Out[21]= Function[{x, c}, (((((((ClConUnit[x, c] ⟹ ClConSplitData[0.65]) ⟹ ClConEchoFunctionValue[summaries:, (Multicolumn[#1, 5] &) /@ RecordsSummary /@ #1 &]) ⟹ ClConMakeClassifier[RandomForest]) ⟹
                        ClConEchoFunctionContext[classifier info:, If[AssociationQ[#1[classifier]], ClassifierInformation /@ #1[classifier], ClassifierInformation[#1[classifier]]] &]) ⟹
                      ClConEchoFunctionContext[classifier property "TrainingTime" :, If[AssociationQ[#1[classifier]], (ClassifierInformation[#1, TrainingTime] &) /@ #1[classifier],
                         ClassifierInformation[#1[classifier], TrainingTime]] &]) ⟹
                    Function[{x$, c$}, ClConUnit[x$, c$] ⟹ ClConClassifierMeasurements[{Accuracy, Precision, Recall, AreaUnderROCCurve}] ⟹ ClConEchoValue]) ⟹
                  Function[{x$, c$}, ClConUnit[x$, c$] ⟹ ClConClassifierMeasurements[{ConfusionMatrixPlot}] ⟹ ClConEchoValue]) ⟹
                Function[{x, c}, ClConUnit[x, c] ⟹ ClConAccuracyByVariableShuffling[] ⟹ ClConEchoValue]]
```

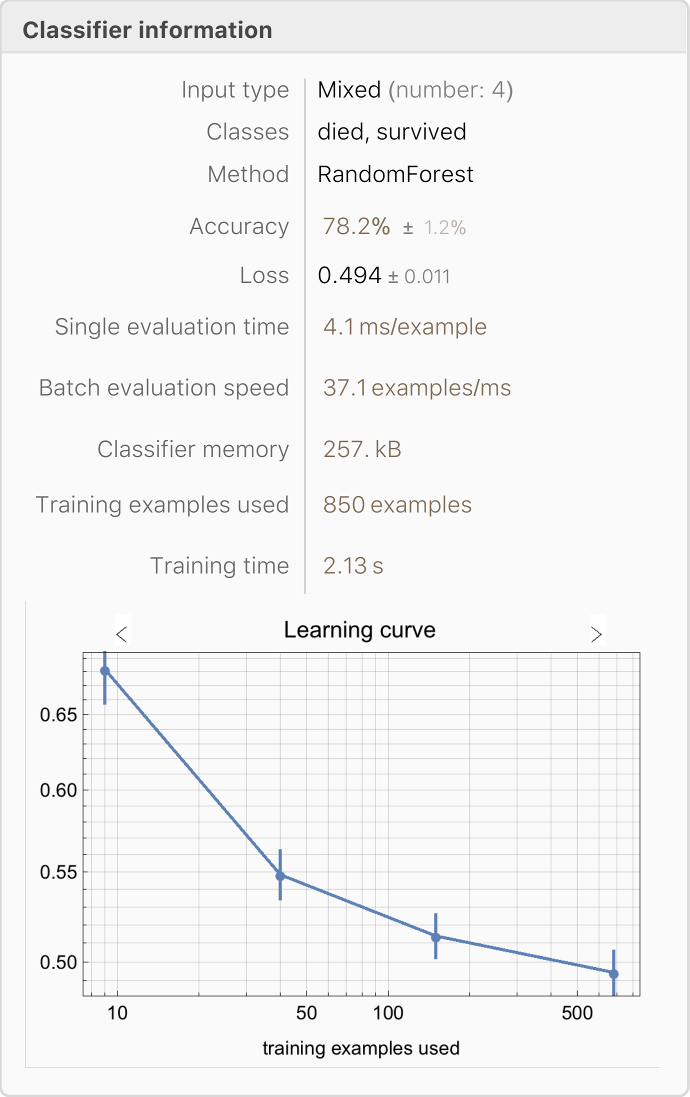
Run the generated pipeline

Run the generated pipeline over the Titanic data:

```
In[22]:= ClConUnit[dsTitanic] ⟹ pl;
```

```
                          1 id                                3 passengerAge                                                          1 id                                   3 passengerAge
                          Min     1           2 passengerClass Min     -1                                                           Min     2           2 passengerClass  Min     -1
                          1st Qu  345                         1st Qu  10         4 passengerSex 5 passengerSurvival                 1st Qu  308                            1st Qu  0          4 passengerSex 5 passengerSurvival
» summaries: ⟨|trainingData → Mean    667.188     3rd  470    Median  20         male    545   died      525    , testData →     Median  622         3rd  239          Median  20         male    298  died      284    |⟩
                          Median  675.5       1st  203        Mean    23.9965    female  305   survived  325                        Mean    632.429     1st  120          Mean    22.7233    female  161  survived  175
                          3rd Qu  1000        2nd  177        3rd Qu  40                                                            3rd Qu  956.75      2nd  100          3rd Qu  37.5
                          Max     1307                        Max     80                                                            Max     1309                          Max     80
```

» classifier info:



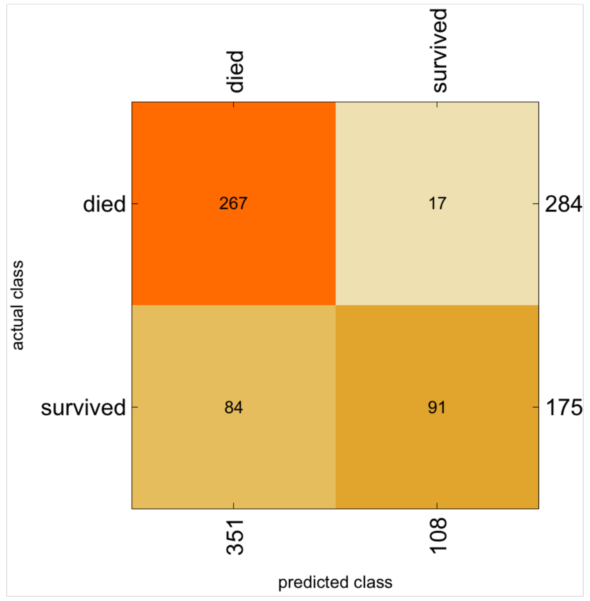
Classifier information

Input type Mixed (number: 4)
Classes died, survived
Method RandomForest
Accuracy 78.2% ± 1.2%
Loss 0.494 ± 0.011
Single evaluation time 4.1 ms/example
Batch evaluation speed 37.1 examples/ms
Classifier memory 257. kB
Training examples used 850 examples
Training time 2.13 s

» classifier property "TrainingTime" : 2.13723 s

» value: ⟨|Accuracy → 0.779956, Precision → ⟨|died → 0.760684, survived → 0.842593|⟩, Recall → ⟨|died → 0.940141, survived → 0.52|⟩, AreaUnderROCCurve → ⟨|died → 0.86994, survived → 0.824004|⟩|⟩

```
» value: ⟨|ConfusionMatrixPlot →
```



```
|⟩
```

```
» value: ⟨|None → 0.779956, id → 0.786492, passengerClass → 0.782135, passengerAge → 0.764706, passengerSex → 0.605664|⟩
```

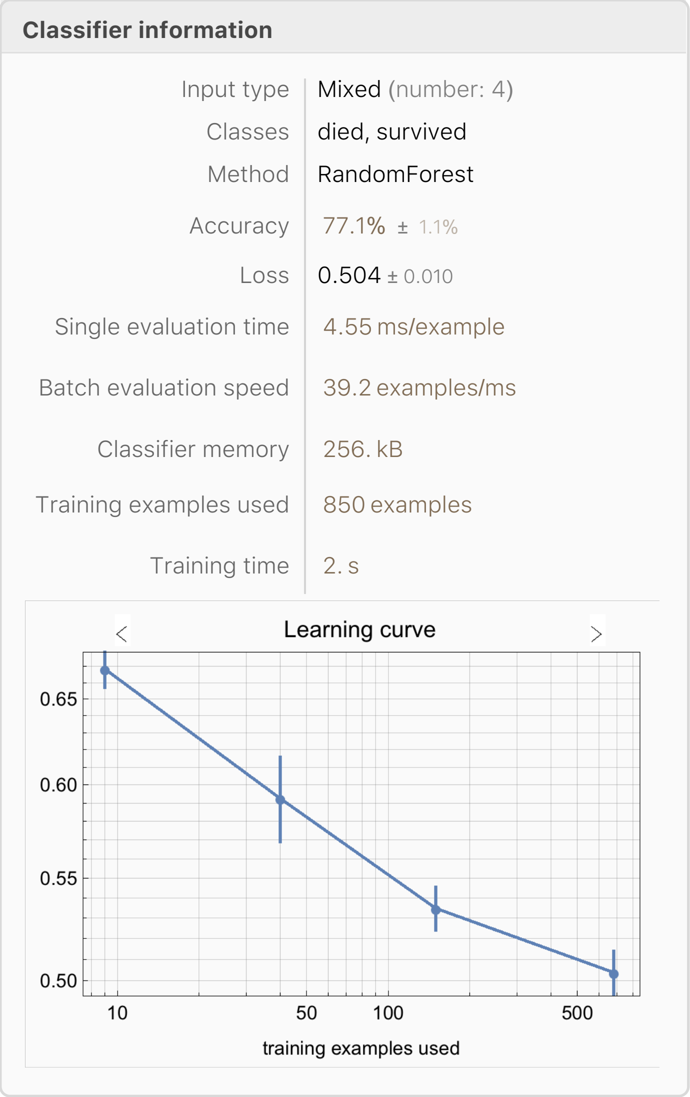
Trace run and ode-command table

Run the generated pipeline through TraceMonad in order to obtain tabulated correspondence between (1) the generated ClCon pipeline components and (2) the natural language commands used to generate them:

```
In[23]:= (p =
     ClConUnit[dsTitanic] ⟹
      ToClConPipelineFunction[clCommands, "Trace" → True]) ⟹
   TraceMonadTakeGrid[]
```

```
                                1 id                          3 passengerAge                                                             1 id                          3 passengerAge
                                Min      3     2 passengerClass Min      -1                                                               Min      1      2 passengerClass Min      -1
                                1st Qu  348                     1st Qu  10       4 passengerSex  5 passengerSurvival                    1st Qu  276.5                   1st Qu  10       4 passengerSex  5 passengerSurvival
» summaries: ⟨|trainingData →  Median  656.5   3rd  468         Median  20       male    556     died      525       , testData →  Mean    641.438  3rd  241        Median  20       male    287     died      284      |⟩
                                Mean    662.324 1st  193        Mean    23.1576  female  294     survived  325                     Median  643      1st  130        Mean    24.2767  female  172     survived  175
                                3rd Qu  975     2nd  189        3rd Qu  40                                                          3rd Qu  996.5    2nd  88         3rd Qu  40
                                Max     1309                    Max     70                                                          Max     1307                     Max     80
```

» classifier info:



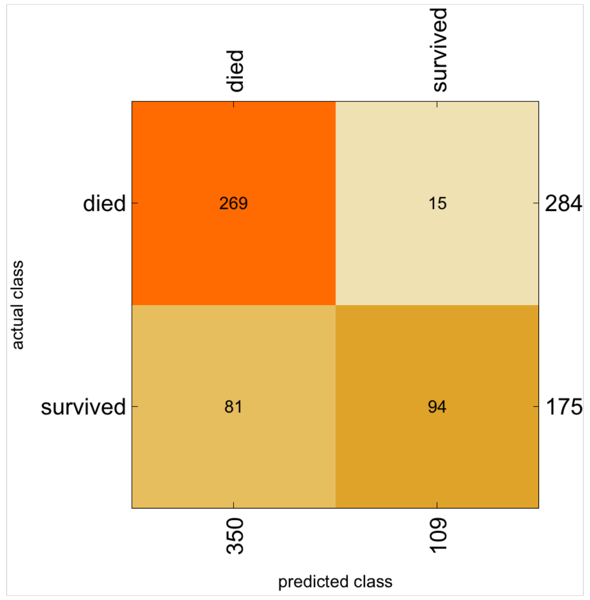
Classifier information

Input type	Mixed (number: 4)
Classes	died, survived
Method	RandomForest
Accuracy	77.1% ± 1.1%
Loss	0.504 ± 0.010
Single evaluation time	4.55 ms/example
Batch evaluation speed	39.2 examples/ms
Classifier memory	256. kB
Training examples used	850 examples
Training time	2. s

» classifier property "TrainingTime" : `2.00355 s`

» value: ⟨| `Accuracy → 0.79085, Precision → ⟨| died → 0.768571, survived → 0.862385 |⟩, Recall → ⟨| died → 0.947183, survived → 0.537143 |⟩, AreaUnderROCCurve → ⟨| died → 0.866519, survived → 0.820463 |⟩` |⟩

» value: ⟨| `ConfusionMatrixPlot →`



|⟩

» value: ⟨|None → 0.79085, id → 0.784314, passengerClass → 0.8061, passengerAge → 0.769063, passengerSex → 0.633987|⟩

Out[23]=

ClConUnit[x, c] ⟹	
ClConSplitData[0.65`] ⟹	split the data with 65 percent for training
ClConEchoFunctionValue["summaries:", (Multicolumn[#1, 5] &) /@ RecordsSummary /@ #1 &] ⟹	summarize data
ClConMakeClassifier["RandomForest"] ⟹	train a random forest classifier
ClConEchoFunctionContext["classifier info:", If[AssociationQ[#1["classifier"]], ClassifierInformation /@ #1["classifier"], ClassifierInformation[#1["classifier"]]] &] ⟹	show classifier information
ClConEchoFunctionContext["classifier property "TrainingTime" :", If[AssociationQ[#1["classifier"]], (ClassifierInformation[#1, "TrainingTime"] &) /@ #1["classifier"], ClassifierInformation[#1["classifier"], "TrainingTime"]] &] ⟹	display classifier training time
Function[{x$, c$}, ClConUnit[x$, c$] ⟹ ClConClassifierMeasurements[{"Accuracy", "Precision", "Recall", "AreaUnderROCCurve"}] ⟹ ClConEchoValue] ⟹	show accuracy, precision, recall, and area under roc curve
Function[{x$, c$}, ClConUnit[x$, c$] ⟹ ClConClassifierMeasurements[{"ConfusionMatrixPlot"}] ⟹ ClConEchoValue] ⟹	display confusion matrix plot
Function[{x, c}, ClConUnit[x, c] ⟹ ClConAccuracyByVariableShuffling[] ⟹ ClConEchoValue]	compute the variable importance estimates