

Classification with Zero Offset

Setup

```
SetDirectory["C:\Documents and Settings\Administrator\Desktop\Documents\
aca Academic\16412 Cognitive Robotics\aca-16412-doc-FinalProject"];

<< "ZeroOffsetCache.mx"
```

Utilities

```
<< Graphics`MultipleListPlot`

<< Graphics`Graphics`

$TextStyle = {FontFamily -> "Helvetica", FontSize -> 12};

resample[points_, samples_] :=
  Part[points, Map[Round, Range[1, Length[points],
    
$$\frac{\text{Length}[\text{points}] - 1}{\text{samples} - 1}$$
]]]]
```

Algorithm Definition

Optimization parameters:

```
 $\alpha := \text{Table}[\alpha[i], \{i, p\}];$ 
```

Similarity function:

```
 $K[x1_, x2_] := x1.x2$ 
```

Product matrix:

```
 $H := \text{Table}[y[k] y[l] K[xx[k], xx[l]], \{k, p\}, \{l, p\}]$ 
```

Objective function:

$$J := \left(\sum_{k=1}^p \alpha[k] (1 - b y[k]) \right) - \frac{1}{2} \alpha \alpha.H.\alpha$$

Offset:

```

Clear[b]

(* b := -1/2 Sum_{k=1}^P y[k] alpha[k] (K[xx[1], xx[k]] + K[xx[2], xx[k]]) *)

b = 0;

```

Optimal assignment:

```
opt := Last[NMaximize[{J, And@@Thread[alpha >= 0]}, alpha, AccuracyGoal -> 5, PrecisionGoal -> 5]]
```

Decision function (simplified version below for K = Dot):

```

(* DD := Function[x, Evaluate[Simplify[ReplaceAll[Sum_{k=1}^P y[k] alpha[k] K[xx[k], x] + b, opt]]]] *)

DD := Function[x, Evaluate[Simplify[ReplaceAll[x . Sum_{k=1}^P y[k] alpha[k] xx[k] + b, opt]]]]

classifiers[data_] := Last[{time[data], classifiers[data]} =
  Timing[
    Block[{n, pp, p},
      n = Length[data];
      pp = Length /@ data;
      p = Total[pp];
      Block[{xx},
        Evaluate[Table[xx[i], {i, p}]] = Join@@data;
        Table[
          Block[{y},
            Evaluate[Table[y[i], {i, p}]] =
              Flatten[MapThread[Table[#, {#2}] &, {MapAt[1 &, Table[-1, {n}], d], pp}]];
            DD
          ]
        , {d, n}
      ]
    ]
  ]
]
]
]]

```

Algorithm Evaluation

```

distance[traindata_, testdata_] := Outer[Map, classifiers[traindata], testdata, 1]

distancePlot[data_, opts___] := MultipleListPlot[Join@@
  Transpose[Thread /@ Thread[#] & /@ Transpose[{data, -Range[Length[data]] + 1 / 6}]],
  opts, Axes -> {False, True}, Ticks -> None, ImageSize -> 700,
  SymbolShape -> (MakeSymbol[RegularPolygon[12, #]] & /@ Range[2, 6, 2]), Epilog ->
  {Dashing[{Dot}], Line[{{-10^9, #}, {10^9, #}}] & /@ (Rest[-Range[Length[data]] + 1 / 2])},
  PlotLegend -> {"\"2\"", "\"3\"", "\"4\""}]

```

```

distanceGrayPlot[data_, opts___] := MultipleListPlot[Join@@
  Transpose[Thread /@ Thread[#] & /@ Transpose[{data, -Range[Length[data]] - 1 / 6}]],
  opts, Axes → {False, True}, Ticks → None, ImageSize → 700, SymbolShape →
  (MakeSymbol[{GrayLevel[0.7], RegularPolygon[12, #]}] & /@ Range[2, 6, 2]), Epilog →
  {Dashing[{Dot}], Line[{{-109, #}, {109, #}]}] & /@ (Rest[-Range[Length[data]] + 1 / 2])]

success[traindata_, testdata_] :=
  With[{dd = classifiers[traindata]}, Transpose[Abs[1 - IdentityMatrix[Length[dd]] -
    Outer[ $\frac{\text{Count}[\#, \_? \text{Positive}]}{\text{Length}[\#]}$  & [Map[##]] &, dd, testdata, 1]], {1, 1}]]

successPlot[data_, opts___] := MultipleListPlot[data, opts,
  SymbolShape → (MakeSymbol[RegularPolygon[12, #]] & /@ Range[2, 6, 2]), PlotStyle →
  If[Length[ss] == 2, {{}, Dashing[{Dash]}}, {{}, Dashing[{Dash}], Dashing[{Dot]}]},
  PlotJoined → True, Frame → True, PlotRange → {Automatic, {-0.05, 1.05}}, ImageSize → 700]

successGrayPlot[data_, opts___] :=
  MultipleListPlot[data, opts, Prolog → GrayLevel[0.7], SymbolShape →
  (MakeSymbol[{GrayLevel[0.7], RegularPolygon[12, #]}] & /@ Range[2, 6, 2]), PlotStyle →
  If[Length[ss] == 2, {{}, Dashing[{Dash]}}, {{}, Dashing[{Dash}], Dashing[{Dot]}]},
  PlotJoined → True, Frame → True, PlotRange → {Automatic, {-0.05, 1.05}}, ImageSize → 700]

```

Shape Analysis

■ Data Manipulation

```

<< "ShapeData.mx"

dataSet[1, size_, samples_] := Map[Flatten[resample[#, samples]] &, Take[circleSet, size]]

dataSet[2, size_, samples_] := Map[Flatten[resample[#, samples]] &, Take[lineSet, size]]

dataSet[3, size_, samples_] :=
  Map[Flatten[resample[#, samples]] &, Take[ $\frac{1}{5}$  circleSet, size]]

dataSet[4, size_, samples_] := Map[Flatten[resample[#, samples]] &, Take[randomSet, size]]

dataSet[5, size_, samples_] :=
  Map[ $150 + \frac{1}{2} (\# - 150)$  & /@ Flatten[resample[#, samples]] &, Take[circleSet, size]]

dataSet[6, size_, samples_] :=
  Map[ $150 + \frac{1}{5} (\# - 150)$  & /@ Flatten[resample[#, samples]] &, Take[circleSet, size]]

testSet[1, size_, samples_] :=
  Map[Flatten[resample[#, samples]] &, Take[circleSet, -size]]

testSet[2, size_, samples_] := Map[Flatten[resample[#, samples]] &, Take[lineSet, -size]]

```

```

testSet[3, size_, samples_] :=
  Map[Flatten[resample[#, samples]] &, Take[ $\frac{1}{5}$  circleSet, -size]]

testSet[4, size_, samples_] :=
  Map[Flatten[resample[#, samples]] &, Take[randomSet, -size]]

testSet[5, size_, samples_] :=
  Map[ $150 + \frac{1}{2} (\# - 150)$  & /@ Flatten[resample[#, samples]] &, Take[circleSet, -size]]

testSet[6, size_, samples_] :=
  Map[ $150 + \frac{1}{5} (\# - 150)$  & /@ Flatten[resample[#, samples]] &, Take[circleSet, -size]]

SetAttributes[{dataSet, testSet}, Listable];

```

■ Boundary Characterization

■ Circles/Lines with 5 samples, 6 points

```

dist = distance[dataSet[{1, 2}, 5, 6], testSet[{1, 2}, 5, 6]];

distC = distance[dataSet[{1, 2}, 5, 6], dataSet[{1, 2}, 5, 6]];

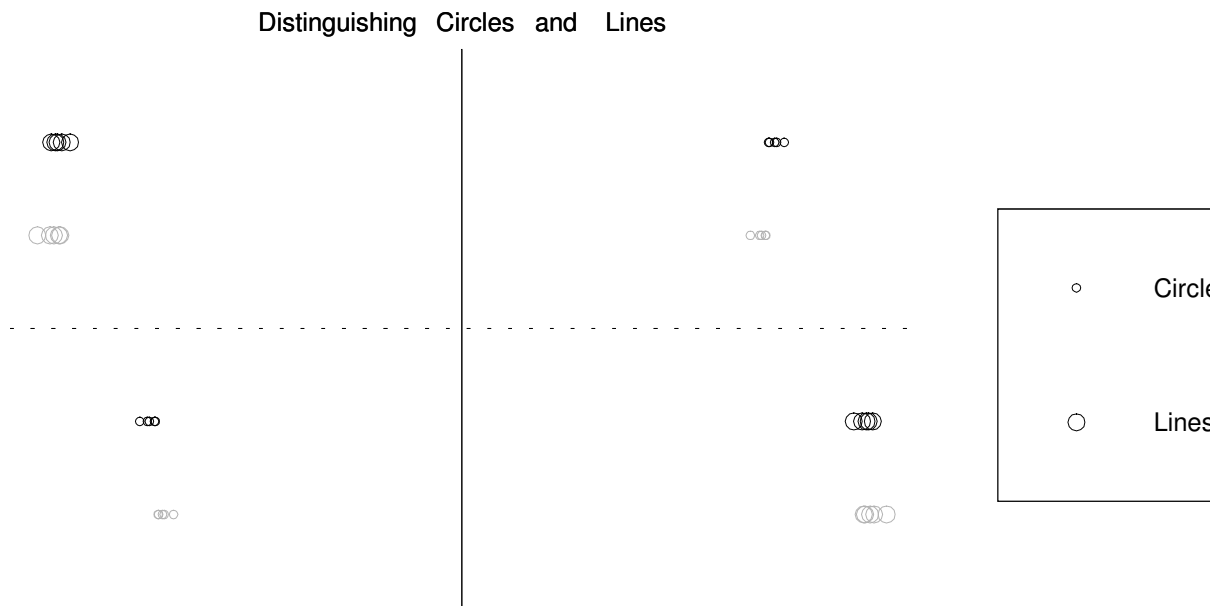
General::spell1 :
Possible spelling error: new symbol name "distC" is similar to existing symbol "dist". More...

```

```

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Circles and Lines",
  PlotLegend → {"Circles", "Lines"}],
  distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Circles and Lines",
  PlotLegend → {"Circles", "Lines"}]
]

```



- Graphics -

```
Export["Shapes_Circles_Lines_Boundary_5.gif", %]
```

Shapes_Circles_Lines_Boundary_5.gif

■ Circles/Lines with 10 samples, 6 points

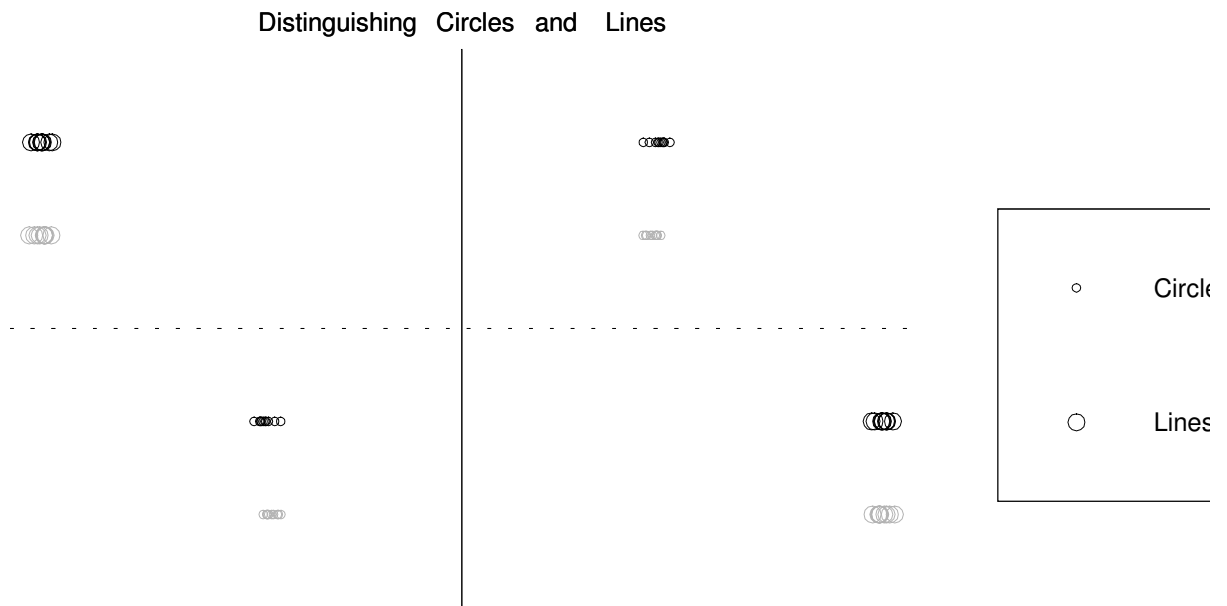
```
dist = distance[dataSet[{1, 2}, 10, 6], testSet[{1, 2}, 10, 6]];
```

```
distC = distance[dataSet[{1, 2}, 10, 6], dataSet[{1, 2}, 10, 6]];
```

```

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Circles and Lines",
  PlotLegend → {"Circles", "Lines"}],
  distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Circles and Lines",
  PlotLegend → {"Circles", "Lines"}]
]

```



```
Export["Shapes_Circles_Lines_Boundary_10.gif", %]
```

Shapes_Circles_Lines_Boundary_10.gif

■ Circles/Scaled Circles with 5 samples, 6 points

```
dist = distance[dataSet[{1, 3}, 5, 6], testSet[{1, 3}, 5, 6]];
```

NMaximize::cvdiv : Failed to converge to a solution. The function may be unbounded. More...

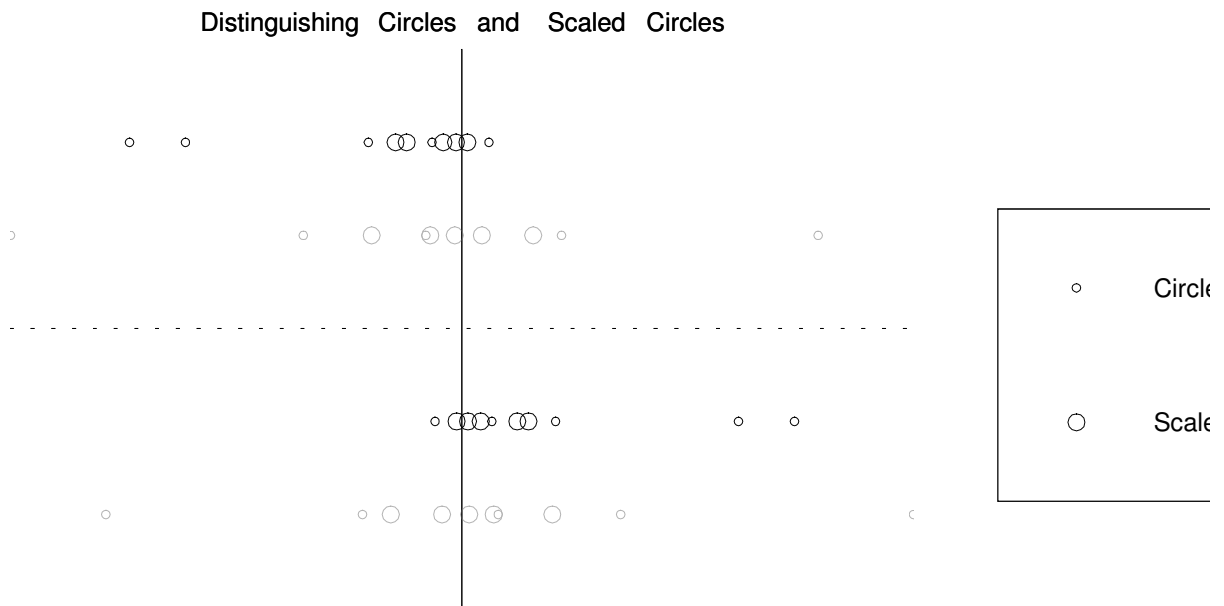
NMaximize::cvdiv : Failed to converge to a solution. The function may be unbounded. More...

```
distC = distance[dataSet[{1, 3}, 5, 6], dataSet[{1, 3}, 5, 6]];
```

```

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Circles and Scaled Circles",
  PlotLegend → {"Circles", "Scaled Circles"}],
  distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Circles and Scaled Circles",
  PlotLegend → {"Circles", "Scaled Circles"}]
]

```



- Graphics -

```
Export["Shapes_Circles_ScaledCircles_Boundary_5.gif", %]
```

Shapes_Circles_ScaledCircles_Boundary_5.gif

■ Circles/Scaled Circles with 10 samples, 6 points

```
dist = distance[dataSet[{1, 3}, 10, 6], testSet[{1, 3}, 10, 6]];
```

NMaximize::cvdiv : Failed to converge to a solution. The function may be unbounded. More...

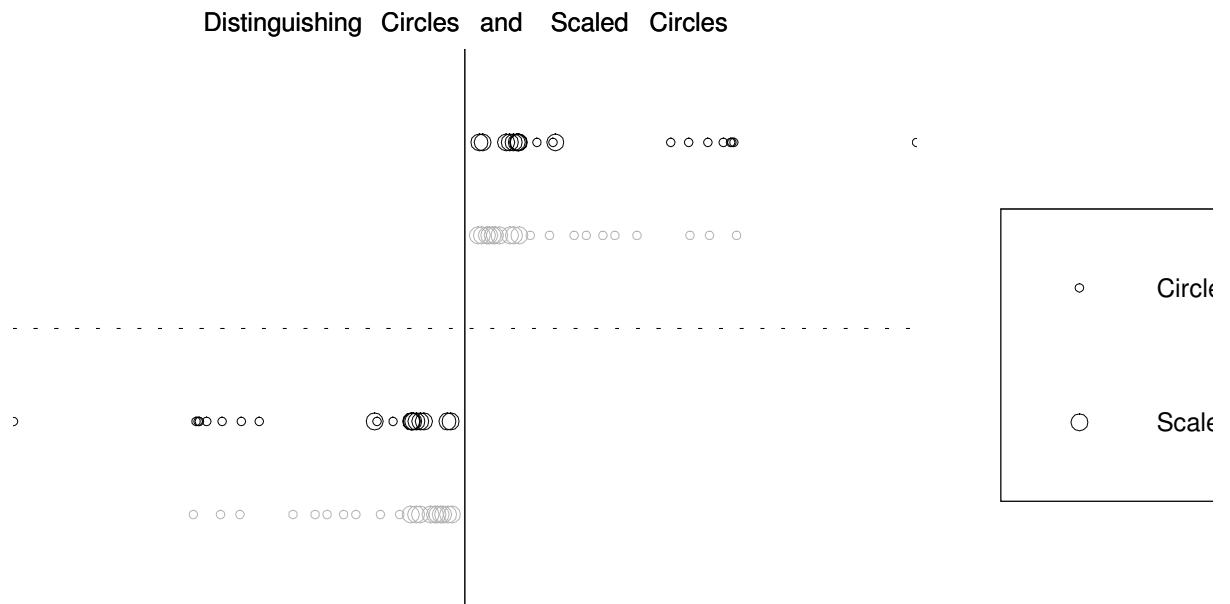
NMaximize::cvdiv : Failed to converge to a solution. The function may be unbounded. More...

```
distC = distance[dataSet[{1, 3}, 10, 6], dataSet[{1, 3}, 10, 6]];
```

```

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Circles and Scaled Circles",
  PlotLegend → {"Circles", "Scaled Circles"}],
  distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Circles and Scaled Circles",
  PlotLegend → {"Circles", "Scaled Circles"}]
]

```



- Graphics -

```

Export["Shapes_Circles_ScaledCircles_Boundary_10.gif", %]

Shapes_Circles_ScaledCircles_Boundary_10.gif

```

■ Circles/Random Shapes with 10 samples, 2 points

```

dist = distance[dataSet[{1, 4}, 10, 2], testSet[{1, 4}, 10, 2]];

distC = distance[dataSet[{1, 4}, 10, 2], dataSet[{1, 4}, 10, 2]];

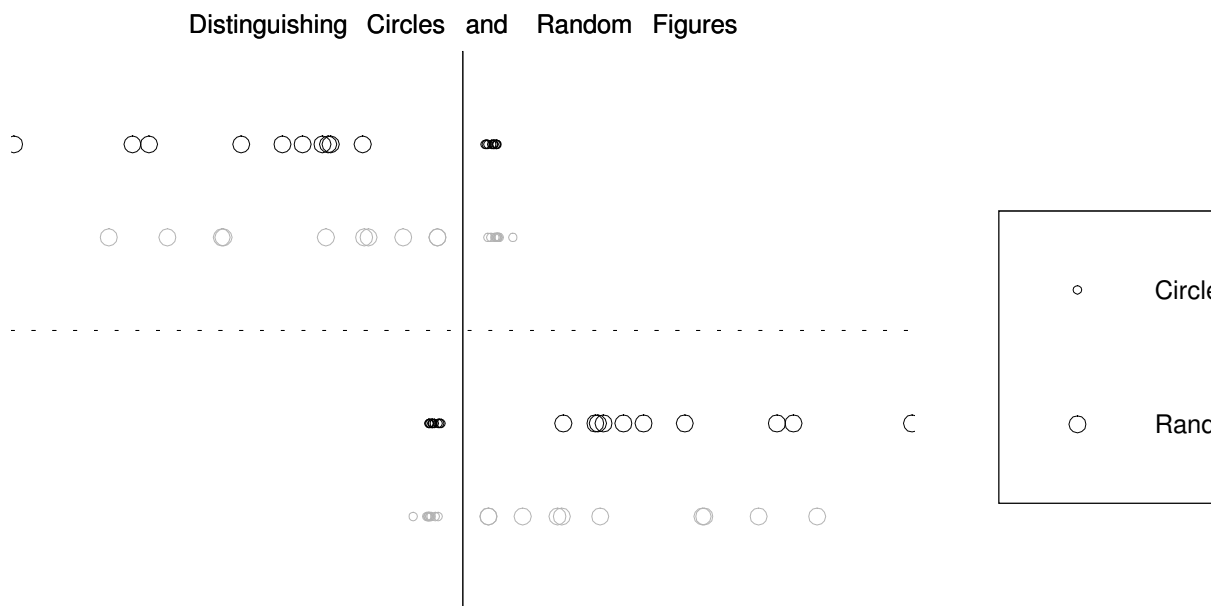
```



```

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Circles and Random Figures",
  PlotLegend → {"Circles", "Random Figures"}],
  distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Circles and Random Figures",
  PlotLegend → {"Circles", "Random Figures"}]
]

```



- Graphics -

```
Export["Shapes_Circles_RandomFigures_Boundary.gif", %]
```

Shapes_Circles_RandomFigures_Boundary.gif

■ Small Circles/Random Shapes with 10 samples, 2 points

```
dist = distance[dataSet[{5, 4}, 10, 2], testSet[{5, 4}, 10, 2]];
```

NMaximize::cvdiv : Failed to converge to a solution. The function may be unbounded. More...

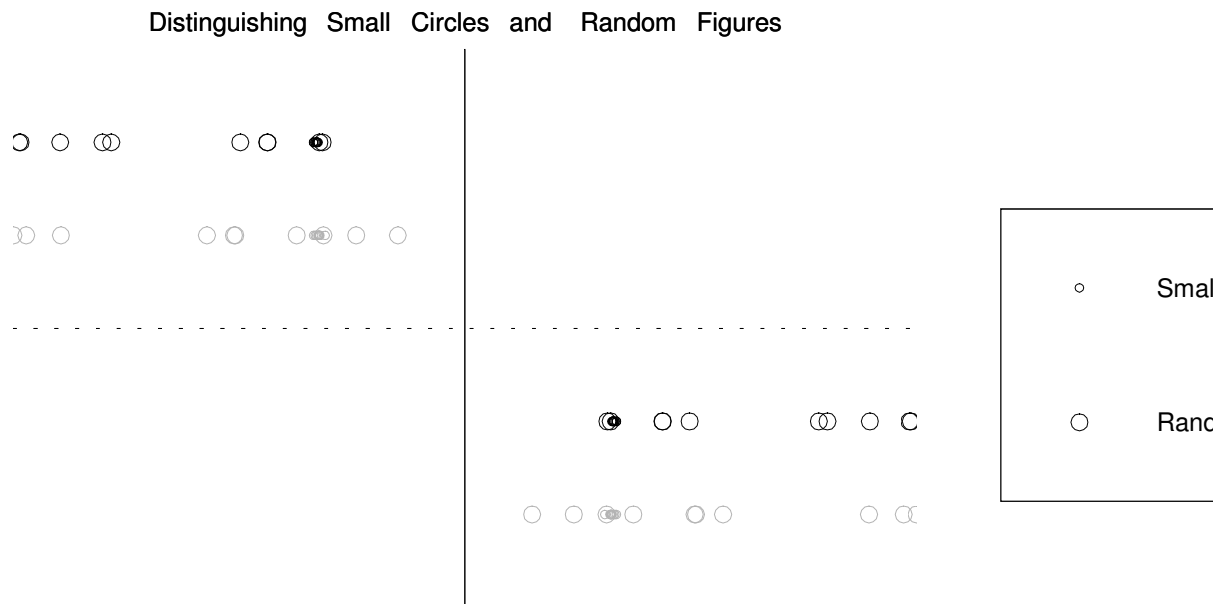
NMaximize::cvdiv : Failed to converge to a solution. The function may be unbounded. More...

```
distC = distance[dataSet[{5, 4}, 10, 2], dataSet[{5, 4}, 10, 2]];
```

```

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Small Circles and Random Figures",
  PlotLegend → {"Small Circles", "Random Figures"}],
  distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Small Circles and Random Figures",
  PlotLegend → {"Small Circles", "Random Figures"}]
]

```



```
Export["Shapes_SmallCircles_RandomFigures_Boundary.gif", %]
```

Shapes_SmallCircles_RandomFigures_Boundary.gif

■ Tiny Circles/Random Shapes with 10 samples, 2 points

```
dist = distance[dataSet[{6, 4}, 10, 2], testSet[{6, 4}, 10, 2]];
```

NMaximize::cvdiv : Failed to converge to a solution. The function may be unbounded. More...

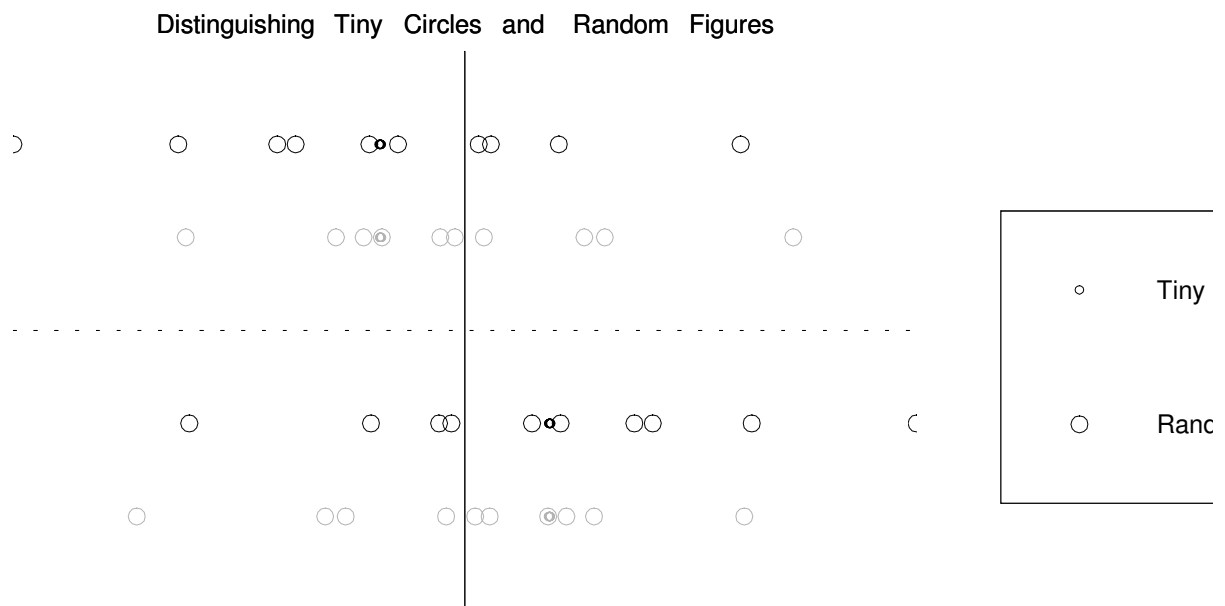
NMaximize::cvdiv : Failed to converge to a solution. The function may be unbounded. More...

```
distC = distance[dataSet[{6, 4}, 10, 2], dataSet[{6, 4}, 10, 2]];
```

```

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Tiny Circles and Random Figures",
  PlotLegend → {"Tiny Circles", "Random Figures"}],
  distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Tiny Circles and Random Figures",
  PlotLegend → {"Tiny Circles", "Random Figures"}]
]

```



- Graphics -

```

Export["Shapes_TinyCircles_RandomFigures_Boundary.gif", %]
Shapes_TinyCircles_RandomFigures_Boundary.gif

```

Handwriting Analysis

■ Data Manipulation

```

dataNames = {"dongs_05092005", "jing2qu_05082005"};

dataNumbers = {"2", "3", "4"};

dataFile[name_, number_] :=
  "NumberData/" <> dataNames[[name]] <> "_20_" <> dataNumbers[[number]] <> "s_.txt"

testNames = {"dongs_05092005", "jing2qu_05092005"};

```

```
testNumbers = dataNumbers;

testFile[name_, number_] :=
  "NumberTests/" <> testNames[[name]] <> "_10_" <> testNumbers[[number]] <> "s_.txt"

dataSet[name_, number_, size_, samples_] := Map[Flatten[resample[#, samples]] &,
  Take[ToExpression[Import[dataFile[name, number]]], size]]

testSet[name_, number_, size_, samples_] := Map[Flatten[resample[#, samples]] &,
  Take[ToExpression[Import[testFile[name, number]]], size]]

SetAttributes[{dataSet, testSet}, Listable];
```

■ Boundary Characterization

■ Shen numerals with 10 samples, 6 points

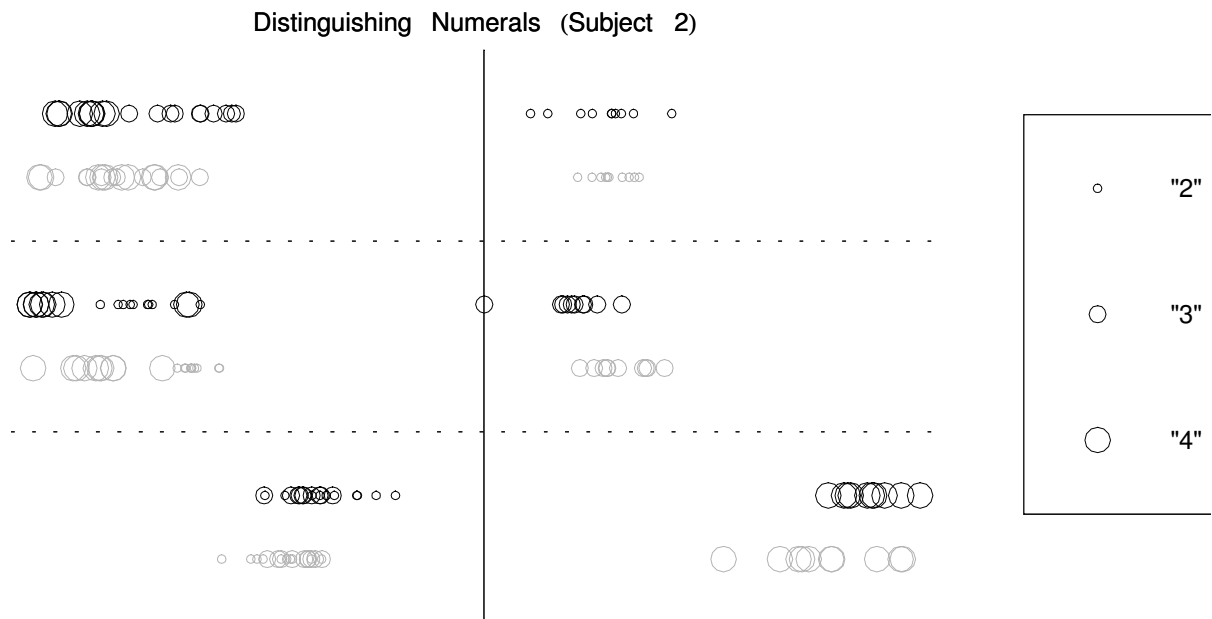
```
dist = distance[dataSet[2, Range[3], 10, 6], testSet[2, Range[3], 10, 6]];

distC = distance[dataSet[2, Range[3], 10, 6], dataSet[2, Range[3], 10, 6]];
```

```

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Numerals (Subject 2)",
  PlotLegend → {"\"2\"", "\"3\"", "\"4\""},
  distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Numerals (Subject 2)",
  PlotLegend → {"\"2\"", "\"3\"", "\"4\""}]
]

```



- Graphics -

```
Export["Shen_Numerals_Motion_Boundary.gif", %]
```

Shen_Numerals_Motion_Boundary.gif

■ Shannon numerals with 10 samples, 6 points

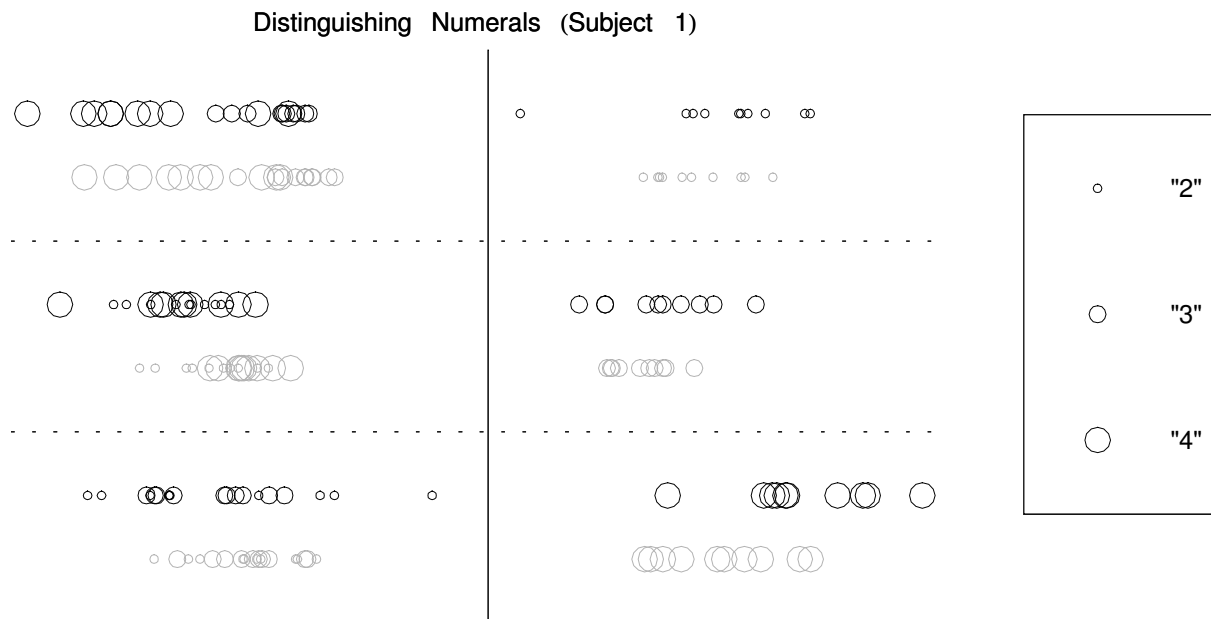
```
dist = distance[dataSet[1, Range[3], 10, 6], testSet[1, Range[3], 10, 6]];
```

```
distC = distance[dataSet[1, Range[3], 10, 6], dataSet[1, Range[3], 10, 6]];
```

```

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Numerals (Subject 1)",
  PlotLegend → {"\"2\"", "\"3\"", "\"4\""},
  distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Numerals (Subject 1)",
  PlotLegend → {"\"2\"", "\"3\"", "\"4\""}]
]

```



- Graphics -

```
Export["Shannon_Numerals_Motion_Boundary.gif", %]
```

Shannon_Numerals_Motion_Boundary.gif

■ 2 numerals with 10 samples, 6 points

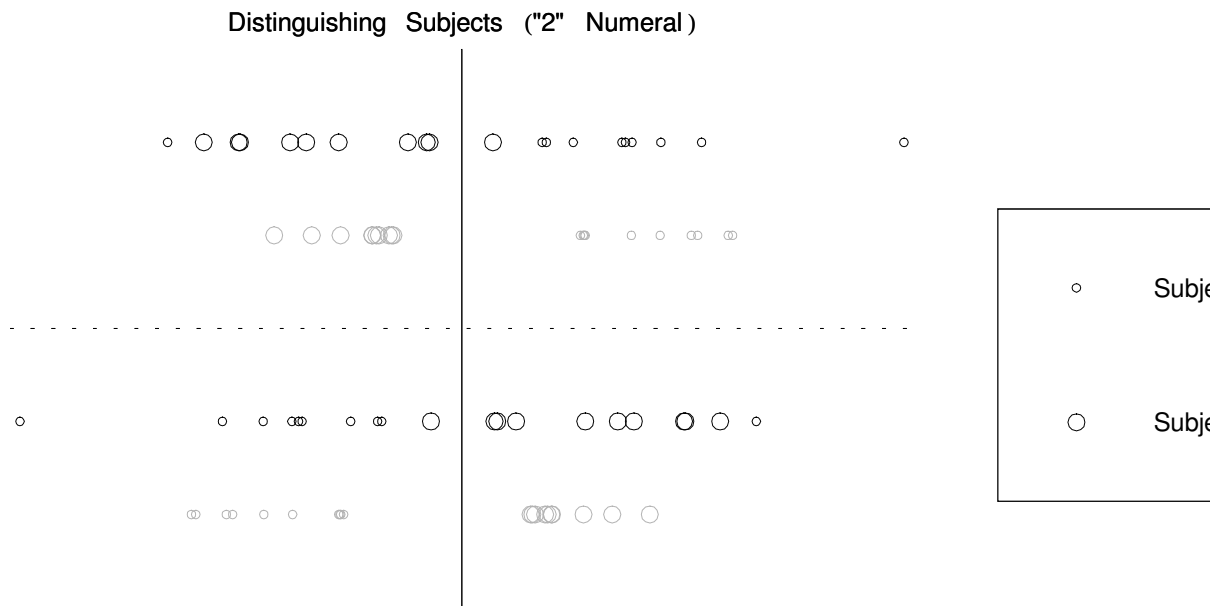
```
dist = distance[dataSet[Range[2], 1, 10, 6], testSet[Range[2], 1, 10, 6]];
```

```
distC = distance[dataSet[Range[2], 1, 10, 6], dataSet[Range[2], 1, 10, 6]];
```

```

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Subjects (\\"2\\" Numeral )",
  PlotLegend → {"Subject 1", "Subject 2"}],
  distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Subjects (\\"2\\" Numeral )",
  PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["2_Numerals_Subject_Boundary.gif", %]
```

2_Numerals_Subject_Boundary.gif

■ 3 numerals with 10 samples, 6 points

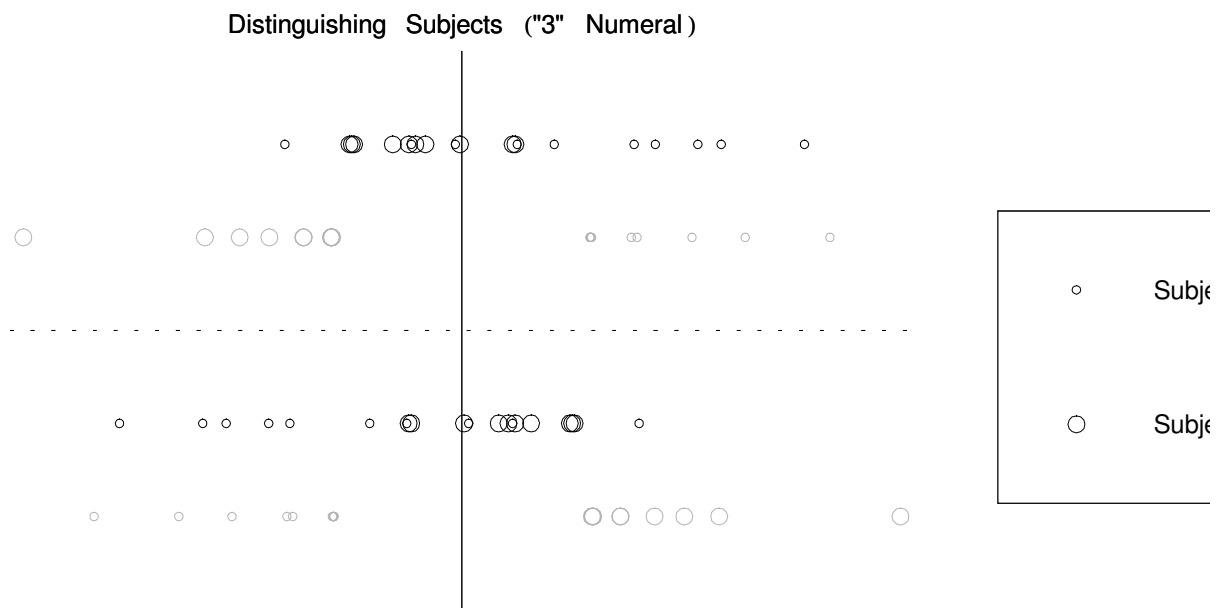
```
dist = distance[dataSet[Range[2], 2, 10, 6], testSet[Range[2], 2, 10, 6]];
```

```
distC = distance[dataSet[Range[2], 2, 10, 6], dataSet[Range[2], 2, 10, 6]];
```

```

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Subjects (\\"3\\" Numeral )",
  PlotLegend → {"Subject 1", "Subject 2"}],
  distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Subjects (\\"3\\" Numeral )",
  PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["3_Numerals_Subject_Boundary.gif", %]
```

3_Numerals_Subject_Boundary.gif

■ 4 numerals with 10 samples, 6 points

```
dist = distance[dataSet[Range[2], 3, 10, 6], testSet[Range[2], 3, 10, 6]];
```

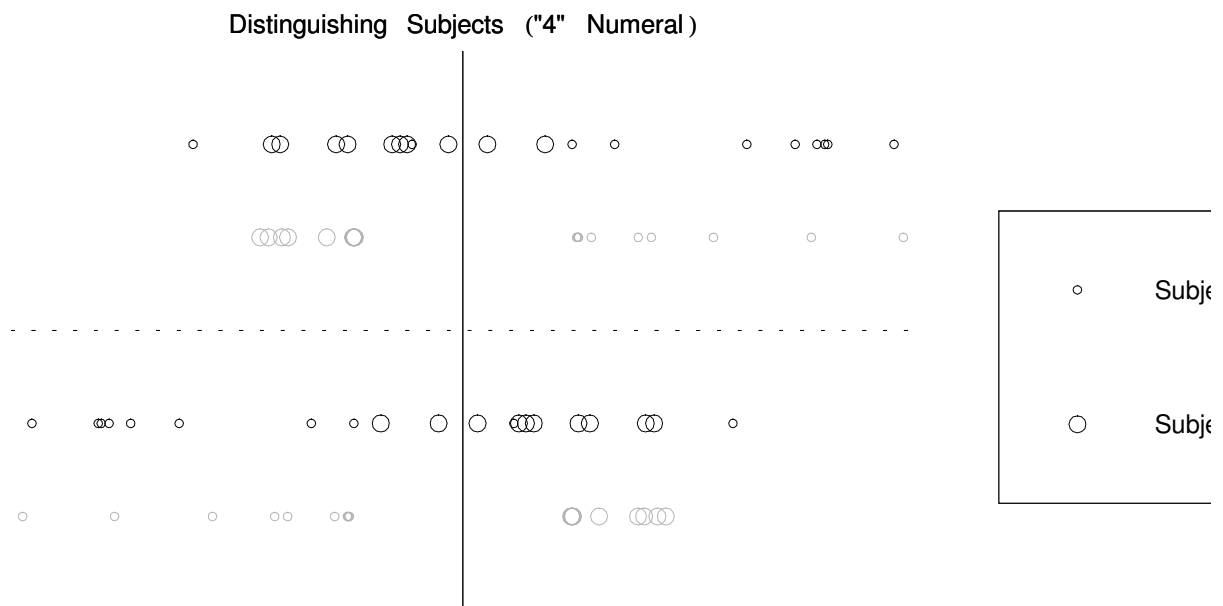
```
distC = distance[dataSet[Range[2], 3, 10, 6], dataSet[Range[2], 3, 10, 6]];
```



```

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Subjects (\\"4\\" Numeral )",
  PlotLegend → {"Subject 1", "Subject 2"}],
  distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Subjects (\\"4\\" Numeral )",
  PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["4_Numerals_Subject_Boundary.gif", %]
```

4_Numerals_Subject_Boundary.gif

■ Sensitivity Analyses

```
numSamples = {1, 2, 3, 5, 7, 10};
```

```
numPoints = {2, 3, 5, 10, 20, 40, 80};
```

■ Shen numerals versus sample size with 6 points

```
temp = success[dataSet[2, Range[3], #, 6], testSet[2, Range[3], 10, 6]] & /@ numSamples
```

```
{{1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}}
```

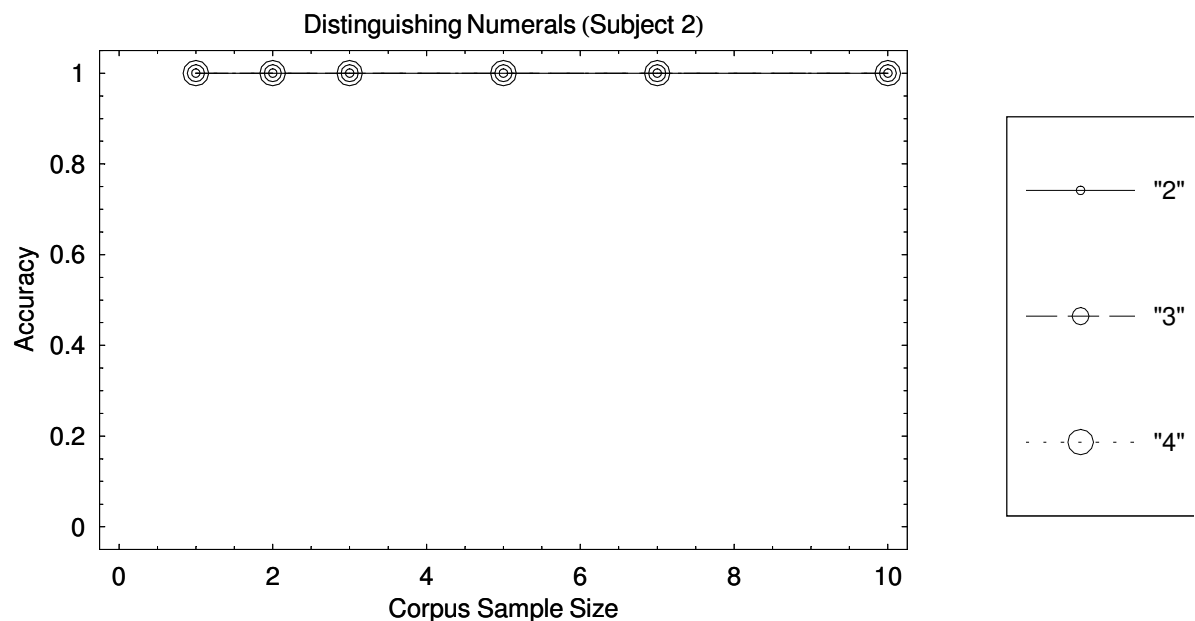
```
tempC = success[dataSet[2, Range[3], #, 6], dataSet[2, Range[3], #, 6]] & /@ numSamples
```

```
General::spell11 :
```

```
Possible spelling error: new symbol name "tempC" is similar to existing symbol "temp". More...
```

```
{{1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}}
```

```
DisplayTogether[
  successGrayPlot[Thread[{numSamples, #}] & /@ Transpose[tempC],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Numerals (Subject 2)",
    PlotLegend → {"\"2\"", "\"3\"", "\"4\""},
    successPlot[Thread[{numSamples, #}] & /@ Transpose[temp],
      FrameLabel → {"Corpus Sample Size", "Accuracy"},
      PlotLabel → "Distinguishing Numerals (Subject 2)",
      PlotLegend → {"\"2\"", "\"3\"", "\"4\""}]
]
```



- Graphics -

```
Export["Shen_Numerals_Motion_Samples.gif", %]
```

```
Shen_Numerals_Motion_Samples.gif
```

■ Shen numerals versus point resolution with 5 samples

```
temp = success[dataSet[2, Range[3], 5, #], testSet[2, Range[3], 10, #]] & /@ numPoints
```

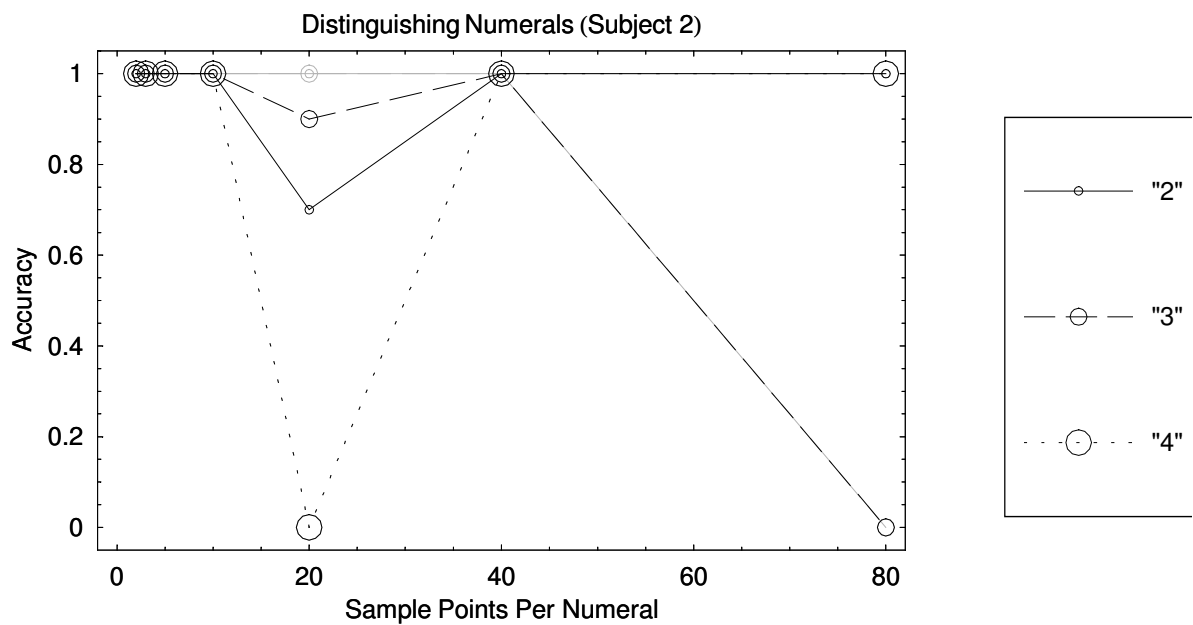
```
{{1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {7/10, 9/10, 0}, {1, 1, 1}, {1, 0, 1}}
```

```

tempC = success[dataSet[2, Range[3], 5, #], dataSet[2, Range[3], 5, #]] & /@ numPoints
{{1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 0}, {1, 1, 1}, {1, 0, 1}}

DisplayTogether[
  successGrayPlot[Thread[{numPoints, #}] & /@ Transpose[tempC],
    FrameLabel → {"Sample Points Per Numeral", "Accuracy"},
    PlotLabel → "Distinguishing Numerals (Subject 2)",
    PlotLegend → {"\"2\"", "\"3\"", "\"4\""},
    successPlot[Thread[{numPoints, #}] & /@ Transpose[temp],
      FrameLabel → {"Sample Points Per Numeral", "Accuracy"},
      PlotLabel → "Distinguishing Numerals (Subject 2)",
      PlotLegend → {"\"2\"", "\"3\"", "\"4\""}]
]

```



- Graphics -

```
Export["Shen_Numerals_Motion_Points.gif", %]
```

Shen_Numerals_Motion_Points.gif

■ Shannon numerals versus sample size with 6 points

```

temp = success[dataSet[1, Range[3], #, 6], testSet[1, Range[3], 10, 6]] & /@ numSamples
{{9/10, 1, 1}, {1, 1, 1}, {1, 1, 1}, {9/10, 1, 1}, {9/10, 1, 1}, {1, 1, 1}}

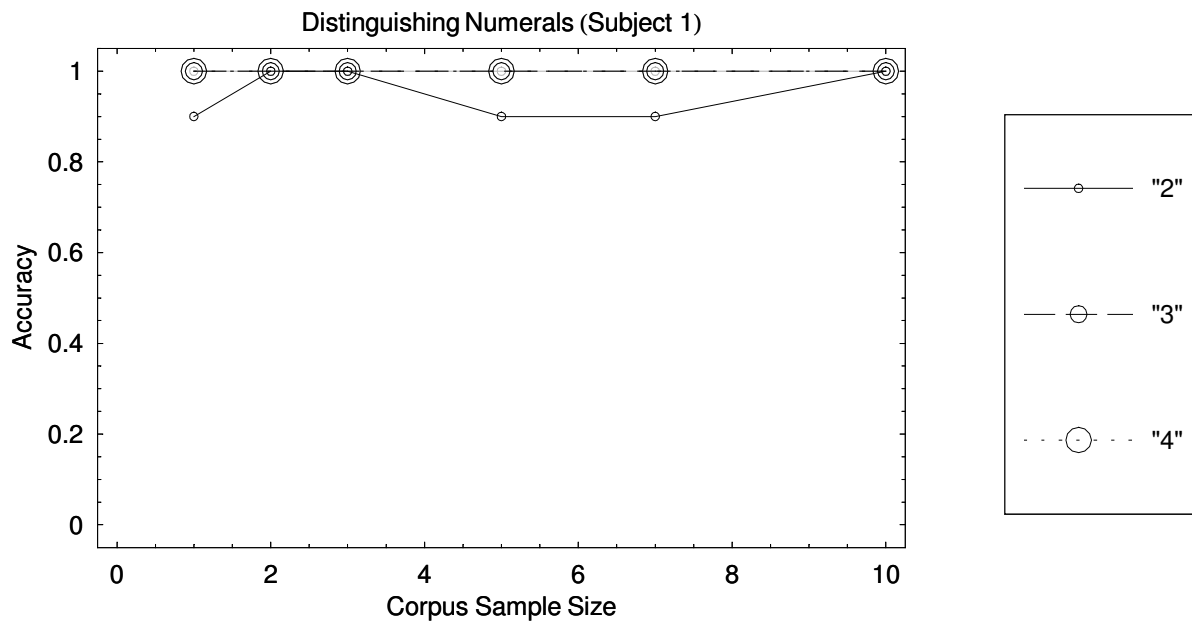
tempC = success[dataSet[1, Range[3], #, 6], dataSet[1, Range[3], #, 6]] & /@ numSamples
{{1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}}

```

```

DisplayTogether[
  successGrayPlot[Thread[{numSamples, #}] & /@Transpose[tempC],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Numerals (Subject 1)",
    PlotLegend → {"\"2\"", "\"3\"", "\"4\""},
  successPlot[Thread[{numSamples, #}] & /@Transpose[temp],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Numerals (Subject 1)",
    PlotLegend → {"\"2\"", "\"3\"", "\"4\""}]
]

```



- Graphics -

```
Export["Shannon_Numerals_Motion_Samples.gif", %]
```

Shannon_Numerals_Motion_Samples.gif

■ Shannon numerals versus point resolution with 5 samples

```
temp = success[dataSet[1, Range[3], 5, #], testSet[1, Range[3], 10, #]] & /@numPoints
```

```
{ {1, 1, 1}, {1, 1, 9/10}, {1, 1, 1}, {1, 1, 1}, {1, 9/10, 1}, {1, 1, 1}, {9/10, 1, 1} }
```

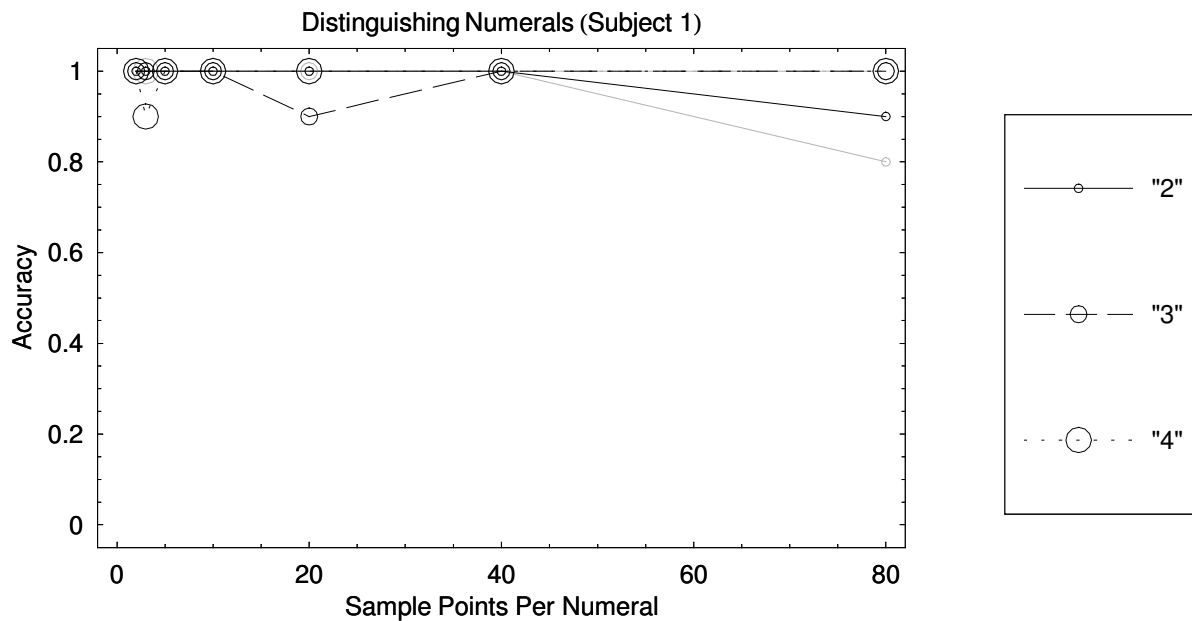
```
tempC = success[dataSet[1, Range[3], 5, #], dataSet[1, Range[3], 5, #]] & /@numPoints
```

```
{ {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {4/5, 1, 1} }
```

```

DisplayTogether[
  successGrayPlot[Thread[{numPoints, #}] & /@Transpose[tempC],
    FrameLabel → {"Sample Points Per Numeral", "Accuracy"},
    PlotLabel → "Distinguishing Numerals (Subject 1)",
    PlotLegend → {"\"2\"", "\"3\"", "\"4\""},
  successPlot[Thread[{numPoints, #}] & /@Transpose[temp],
    FrameLabel → {"Sample Points Per Numeral", "Accuracy"},
    PlotLabel → "Distinguishing Numerals (Subject 1)",
    PlotLegend → {"\"2\"", "\"3\"", "\"4\""}]
]

```



- Graphics -

```
Export["Shannon_Numerals_Motion_Points.gif", %]
```

Shannon_Numerals_Motion_Points.gif

■ 2 numerals versus sample size with 6 points

```
temp = success[dataSet[Range[2], 1, #, 6], testSet[Range[2], 1, 10, 6]] & /@ numSamples
```

```
{{0, 2/5}, {1/2, 9/10}, {1/5, 9/10}, {7/10, 4/5}, {4/5, 9/10}, {9/10, 9/10}}
```

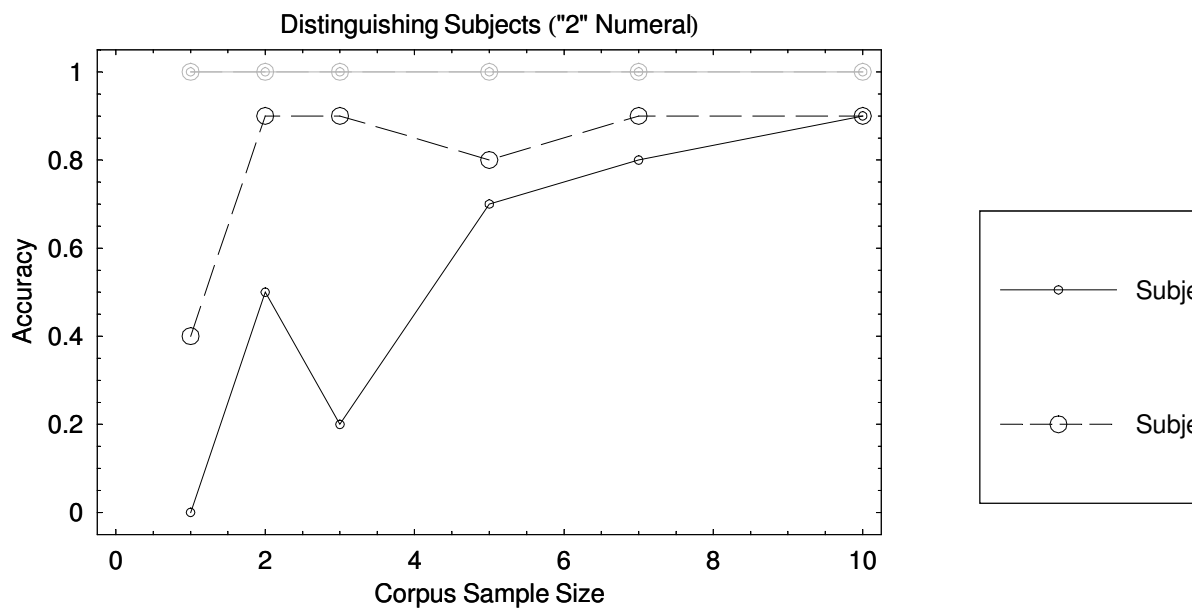
```
tempC = success[dataSet[Range[2], 1, #, 6], dataSet[Range[2], 1, #, 6]] & /@ numSamples
```

```
{{1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}}
```

```

DisplayTogether[
  successGrayPlot[Thread[{numSamples, #}] & /@Transpose[tempC],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"2\\" Numeral)",
    PlotLegend → {"Subject 1", "Subject 2"}],
  successPlot[Thread[{numSamples, #}] & /@Transpose[temp],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"2\\" Numeral)",
    PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["2_Numerals_Subject_Samples.gif", %]
```

2_Numerals_Subject_Samples.gif

■ 3 numerals versus sample size with 6 points

```
temp = success[dataSet[Range[2], 2, #, 6], testSet[Range[2], 2, 10, 6]] & /@numSamples
```

```
{{1, 0}, {3/5, 9/10}, {1, 3/10}, {1, 3/10}, {1, 1/10}, {7/10, 4/5}}
```

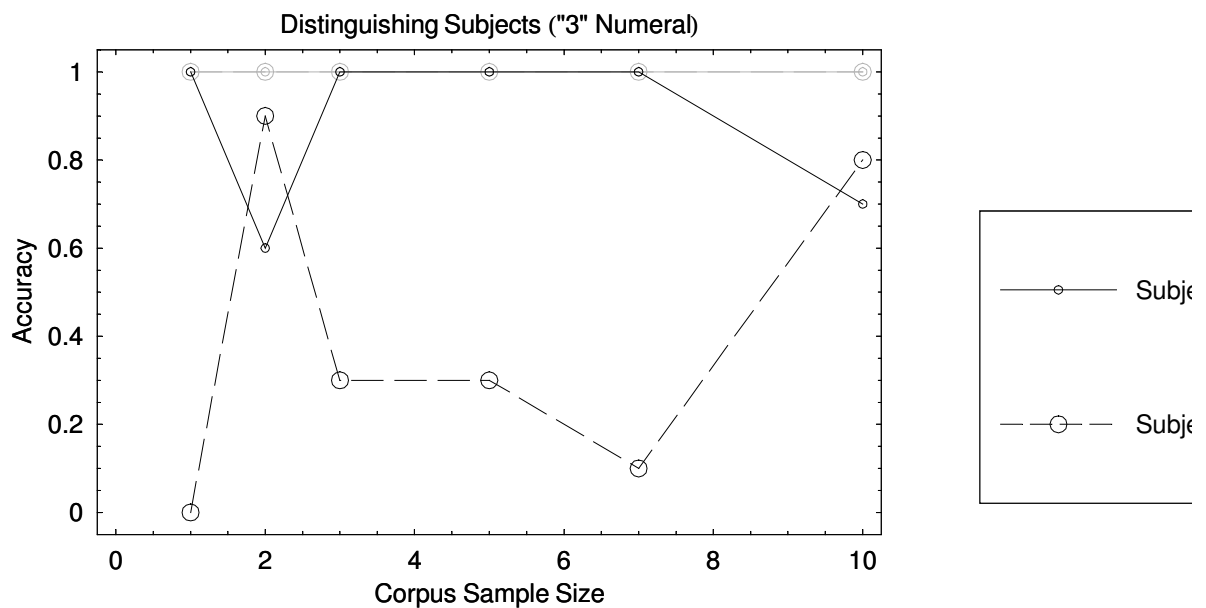
```
tempC = success[dataSet[Range[2], 2, #, 6], dataSet[Range[2], 2, #, 6]] & /@numSamples
```

```
{{1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}}
```

```

DisplayTogether[
  successGrayPlot[Thread[{numSamples, #}] & /@Transpose[tempC],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"3\\" Numeral)",
    PlotLegend → {"Subject 1", "Subject 2"}],
  successPlot[Thread[{numSamples, #}] & /@Transpose[temp],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"3\\" Numeral)",
    PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["3_Numerals_Subject_Samples.gif", %]
```

3_Numerals_Subject_Samples.gif

■ 4 numerals versus sample size with 6 points

```
temp = success[dataSet[Range[2], 3, #, 6], testSet[Range[2], 3, 10, 6]] & /@numSamples
```

```
{{0, 4/5}, {4/5, 4/5}, {9/10, 9/10}, {9/10, 9/10}, {9/10, 7/10}, {4/5, 4/5}}
```

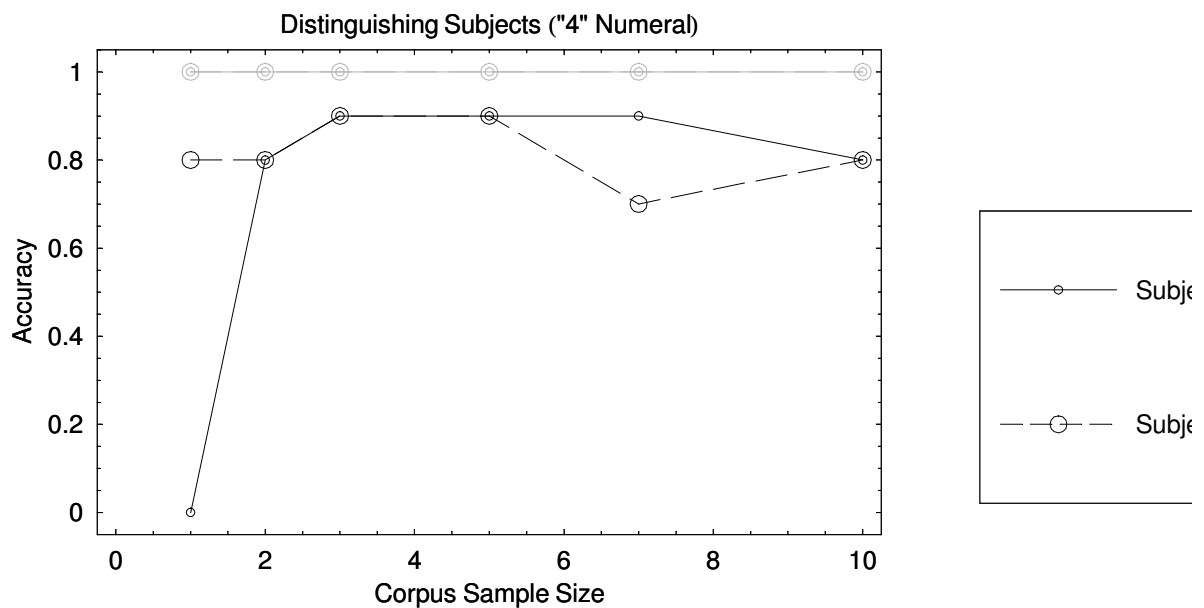
```
tempC = success[dataSet[Range[2], 3, #, 6], dataSet[Range[2], 3, #, 6]] & /@numSamples
```

```
{{1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}}
```

```

DisplayTogether[
  successGrayPlot[Thread[{numSamples, #}] & /@Transpose[tempC],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"4\\" Numeral)",
    PlotLegend → {"Subject 1", "Subject 2"}],
  successPlot[Thread[{numSamples, #}] & /@Transpose[temp],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"4\\" Numeral)",
    PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["4_Numerals_Subject_Samples.gif", %]
```

4_Numerals_Subject_Samples.gif

■ 2 numerals versus point resolution with 5 samples

```
temp = success[dataSet[Range[2], 1, 5, #], testSet[Range[2], 1, 10, #]] & /@numPoints
```

```
{{{2/5, 3/10}, {9/10, 4/5}, {1/2, 9/10}, {7/10, 9/10}, {7/10, 9/10}, {1/2, 9/10}, {2/5, 9/10}}}
```

```
tempC = success[dataSet[Range[2], 1, 5, #], dataSet[Range[2], 1, 5, #]] & /@numPoints
```

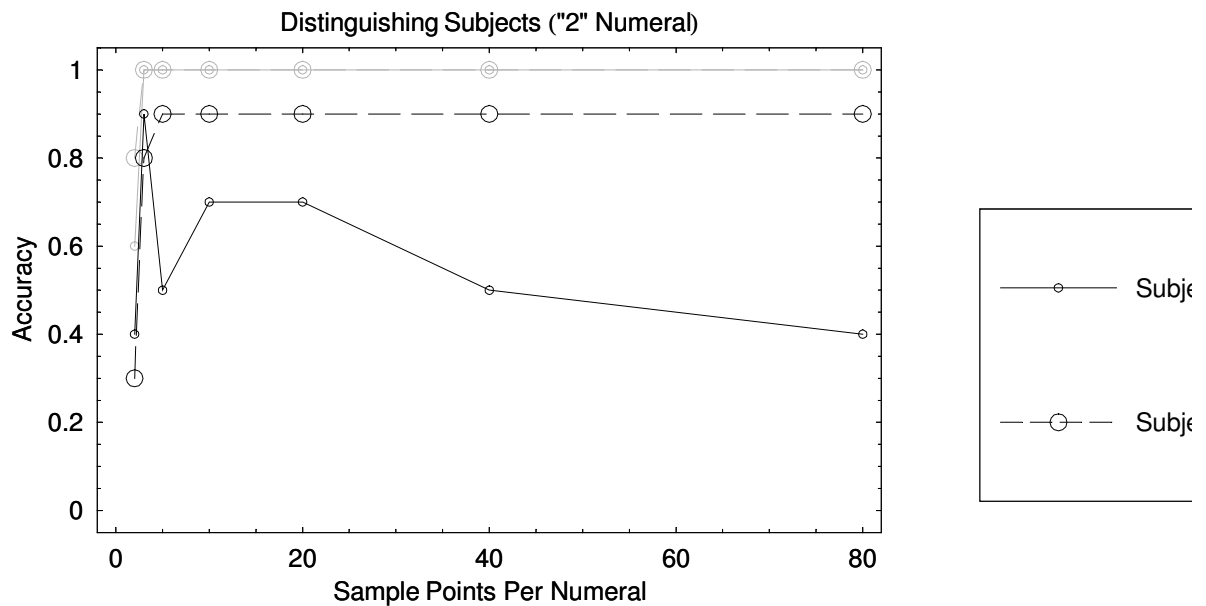
```
{{{3/5, 4/5}, {1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}}}
```



```

DisplayTogether[
  successGrayPlot[Thread[{numPoints, #}] & /@Transpose[tempC],
    FrameLabel → {"Sample Points Per Numeral", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"2\\" Numeral)",
    PlotLegend → {"Subject 1", "Subject 2"}],
  successPlot[Thread[{numPoints, #}] & /@Transpose[temp],
    FrameLabel → {"Sample Points Per Numeral", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"2\\" Numeral)",
    PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```

Export["2_Numerals_Subject_Points.gif", %]

2_Numerals_Subject_Points.gif

```

■ 3 numerals versus point resolution with 5 samples

```

temp = success[dataSet[Range[2], 2, 5, #], testSet[Range[2], 2, 10, #]] & /@numPoints
{{1/2, 1/5}, {2/5, 1/10}, {9/10, 2/5}, {7/10, 3/5}, {1, 1/10}, {1, 1/10}, {1, 0}}

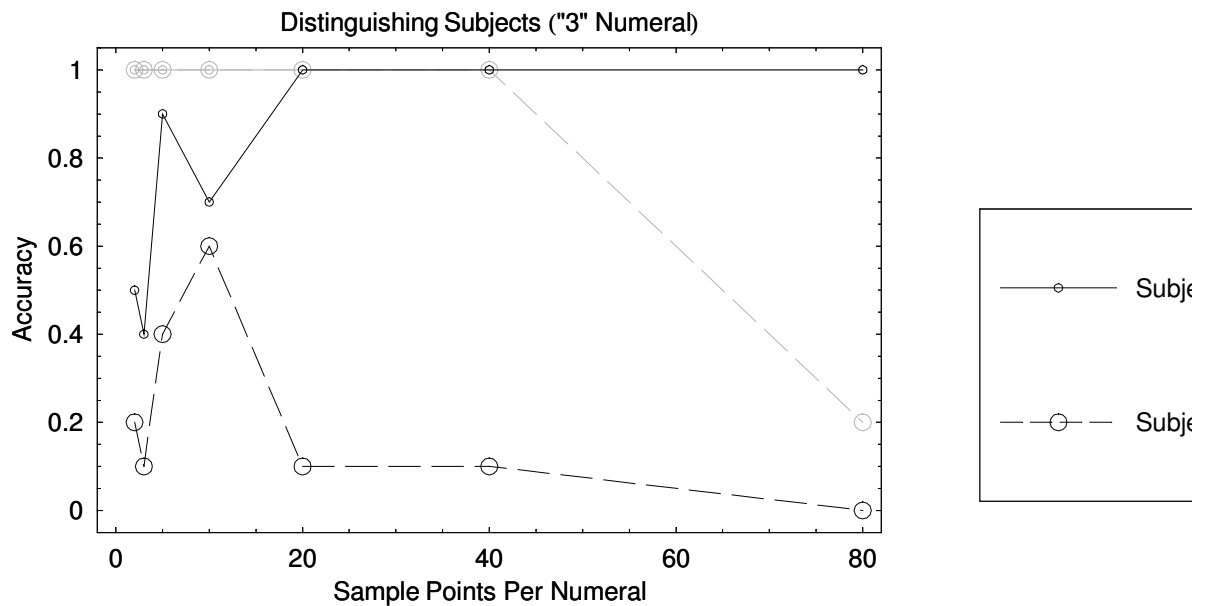
tempC = success[dataSet[Range[2], 2, 5, #], dataSet[Range[2], 2, 5, #]] & /@numPoints
{{1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1/5}}

```

```

DisplayTogether[
  successGrayPlot[Thread[{numPoints, #}] & /@Transpose[tempC],
    FrameLabel → {"Sample Points Per Numeral", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"3\\" Numeral)",
    PlotLegend → {"Subject 1", "Subject 2"}],
  successPlot[Thread[{numPoints, #}] & /@Transpose[temp],
    FrameLabel → {"Sample Points Per Numeral", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"3\\" Numeral)",
    PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["3_Numerals_Subject_Points.gif", %]
```

3_Numerals_Subject_Points.gif

■ 4 numerals versus point resolution with 5 samples

```
temp = success[dataSet[Range[2], 3, 5, #], testSet[Range[2], 3, 10, #]] & /@numPoints
```

```
{{{7/10, 1}, {1/2, 1}, {7/10, 7/10}, {1/2, 1}, {1/2, 7/10}, {1/2, 9/10}, {2/5, 9/10}}}
```

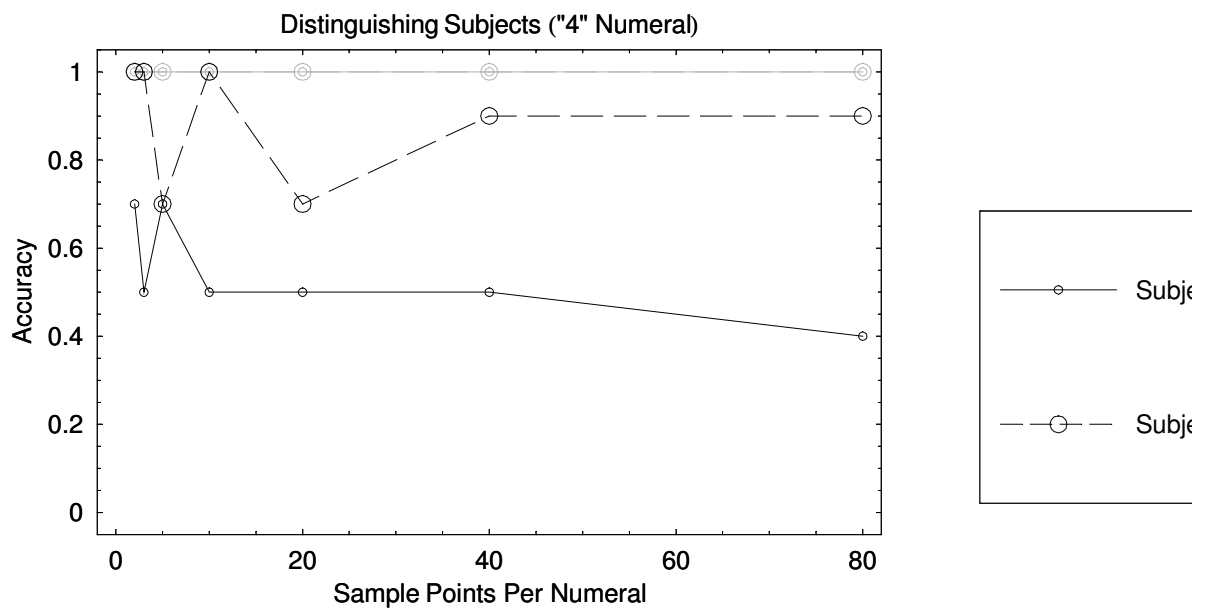
```
tempC = success[dataSet[Range[2], 3, 5, #], dataSet[Range[2], 3, 5, #]] & /@numPoints
```

```
{{{1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}}}
```

```

DisplayTogether[
  successGrayPlot[Thread[{numPoints, #}] & /@Transpose[tempC],
    FrameLabel → {"Sample Points Per Numeral", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"4\\" Numeral)",
    PlotLegend → {"Subject 1", "Subject 2"}],
  successPlot[Thread[{numPoints, #}] & /@Transpose[temp],
    FrameLabel → {"Sample Points Per Numeral", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"4\\" Numeral)",
    PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["4_Numerals_Subject_Points.gif", %]
```

4_Numerals_Subject_Points.gif

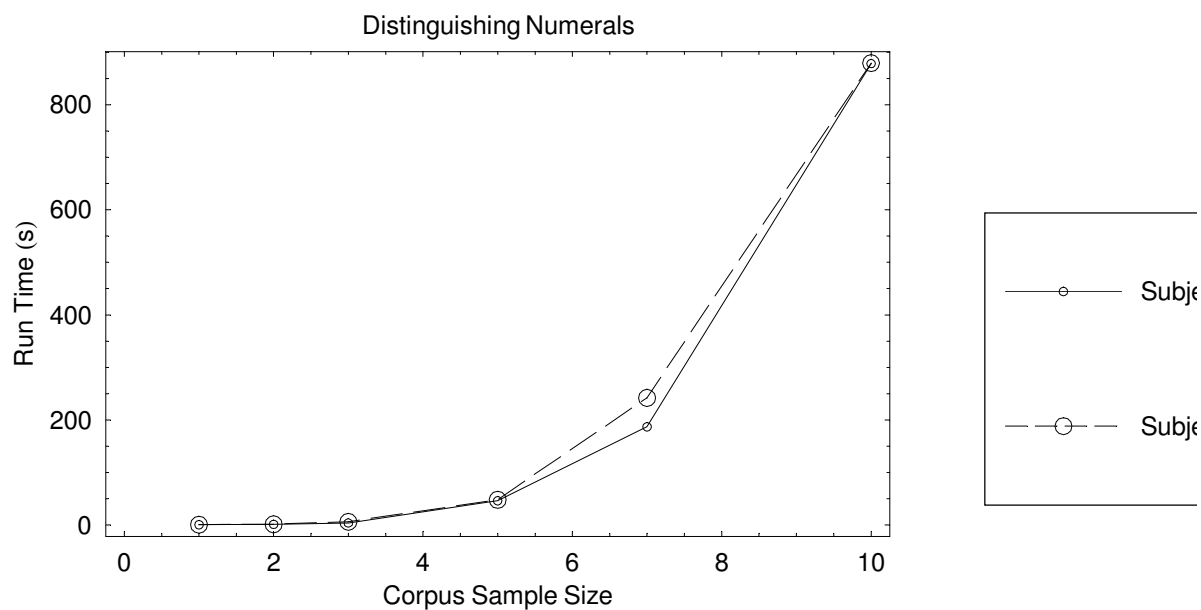
■ Subjects numerals time versus sample size with 6 points

```

temp = Table[time[dataSet[s, Range[3], #, 6]] / Second & /@numSamples, {s, 2}]
{{0.441, 1.202, 3.695, 45.916, 186.939, 878.363},
 {0.481, 1.322, 5.818, 47.898, 241.888, 879.175}}

```

```
successPlot[Thread[{numSamples, #}] & /@ temp,
  FrameLabel -> {"Corpus Sample Size", "Run Time (s)"}, PlotRange -> {Automatic, All},
  PlotLabel -> "Distinguishing Numerals", PlotLegend -> {"Subject 1", "Subject 2"}]
```



- Graphics -

```
Export["Time_Numerals_Motion_Samples.gif", %]
```

Time_Numerals_Motion_Samples.gif

■ Subjects numerals time versus point resolution with 5 samples

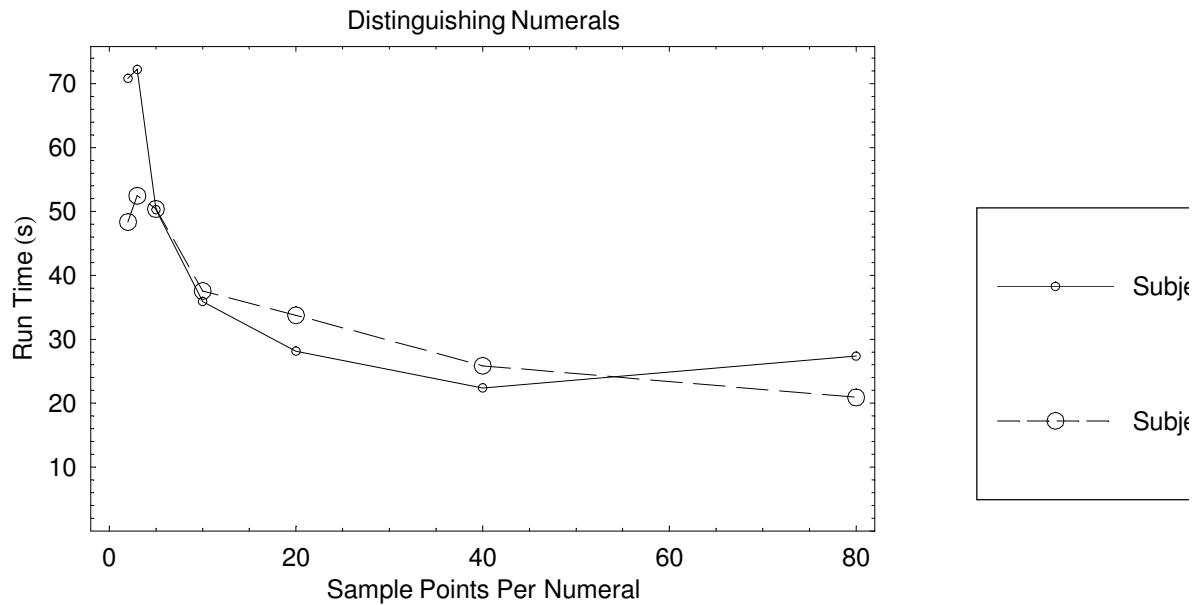
```
temp = Table[time[dataSet[s, Range[3], 5, #]] / Second & /@ numPoints, {s, 2}]
```

```
{{70.852, 72.244, 50.283, 35.932, 28.15, 22.402, 27.37},
 {48.37, 52.476, 50.413, 37.564, 33.768, 25.857, 20.9}}
```

```

successPlot[Thread[{numPoints, #}] & /@temp,
  FrameLabel → {"Sample Points Per Numeral", "Run Time (s)"},
  PlotRange → {Automatic, {0, 1.05 Max @@ temp}},
  PlotLabel → "Distinguishing Numerals", PlotLegend → {"Subject 1", "Subject 2"}]

```



- Graphics -

```
Export["Time_Numerals_Motion_Points.gif", %]
```

Time_Numerals_Motion_Points.gif

Gesture Analysis

■ Data Manipulation

```

dataNames = {"Dong", "Shen"};

dataNumbers = {"come", "lift", "point"};

dataFile[name_, number_] :=
  "GestureData/data_" <> dataNames[[name]] <> "_" <> dataNumbers[[number]] <> ".dat"

testFile[name_, number_] :=
  "GestureData/data_" <> dataNames[[name]] <> "_" <> dataNumbers[[number]] <> ".dat"

dataSet[name_, number_, size_, samples_] := Map[Flatten[resample[#, samples]] &,
  Take[Take[Split[Import[dataFile[name, number]], ## != {"*"} &], {2, -1, 2}], size]]

```

```
testSet[name_, number_, size_, samples_] := Map[Flatten[resample[#, samples]] &,
  Take[Take[Split[Import[testFile[name, number]], ## != {"*"} &], {2, -1, 2}], -size]]

SetAttributes[{dataSet, testSet}, Listable];
```

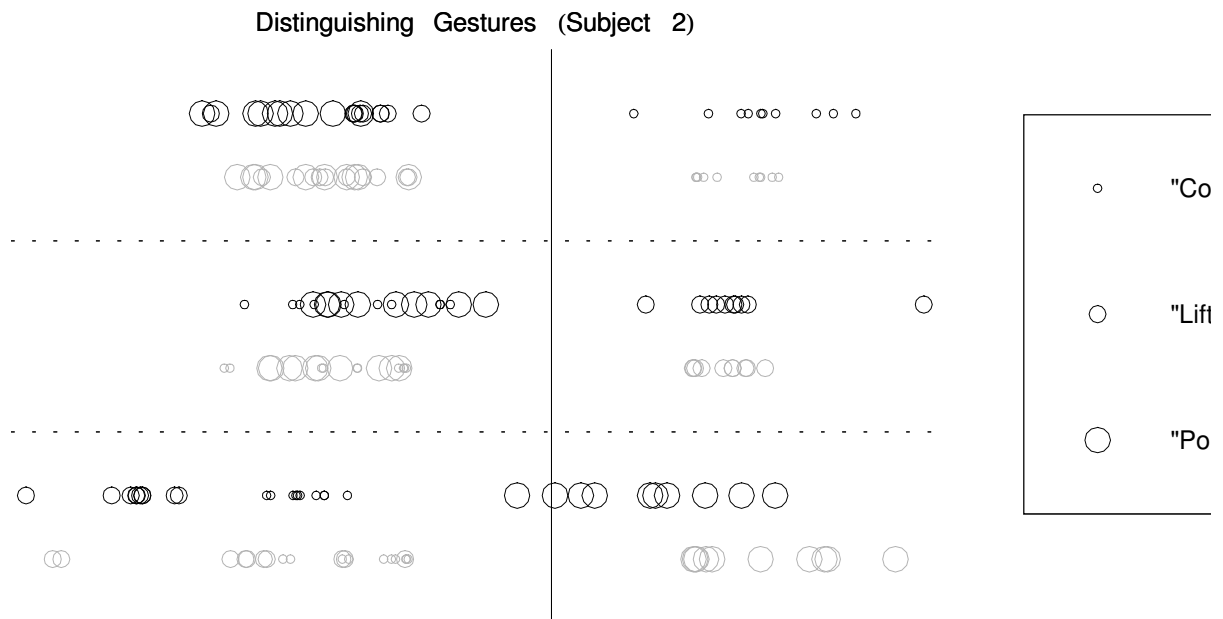
■ Boundary Characterization

■ Shen gestures with 10 samples, 6 points

```
dist = distance[dataSet[2, Range[3], 10, 6], testSet[2, Range[3], 10, 6]];

distC = distance[dataSet[2, Range[3], 10, 6], dataSet[2, Range[3], 10, 6]];

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]], {-1/2, -Length[dist] - 1/2}},
    PlotLabel → "Distinguishing Gestures (Subject 2)",
    PlotLegend → {"\Come\"", "\Lift\"", "\Point\""},
    distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]], {-1/2, -Length[dist] - 1/2}},
    PlotLabel → "Distinguishing Gestures (Subject 2)",
    PlotLegend → {"\Come\"", "\Lift\"", "\Point\""}]
]
```



- Graphics -

```
Export["Shen_Gestures_Motion_Boundary.gif", %]
```

Shen_Gestures_Motion_Boundary.gif

■ Shannon gestures with 10 samples, 6 points

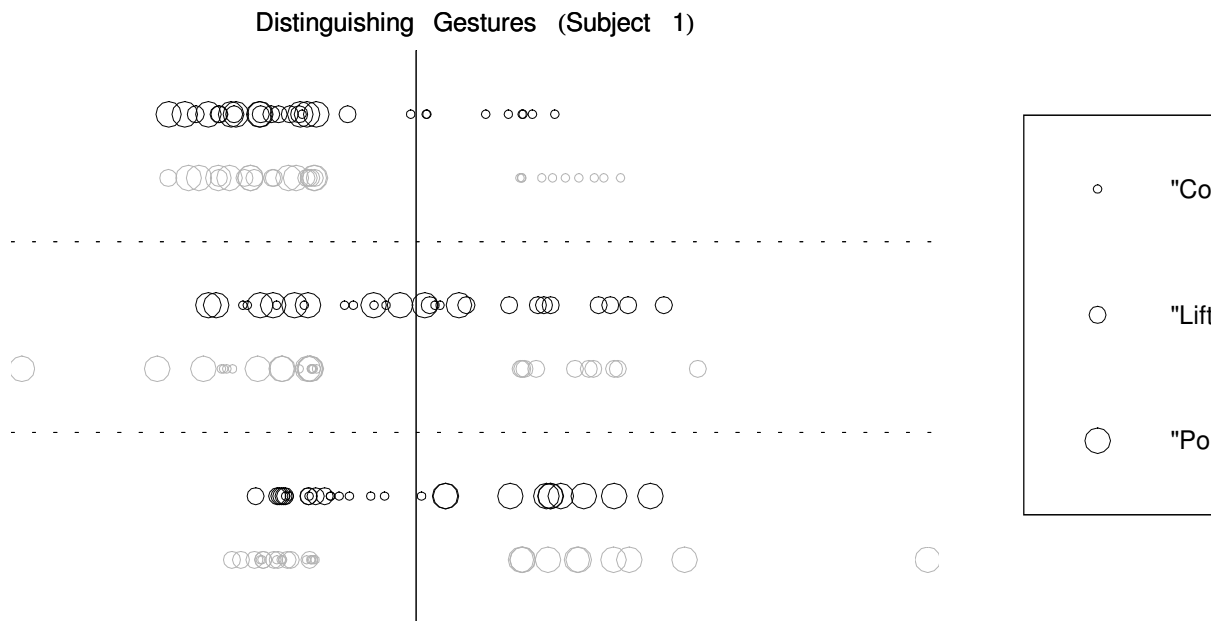
```

dist = distance[dataSet[1, Range[3], 10, 6], testSet[1, Range[3], 10, 6]];

distC = distance[dataSet[1, Range[3], 10, 6], dataSet[1, Range[3], 10, 6]];

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]], {-1/2, -Length[dist] - 1/2}},
    PlotLabel → "Distinguishing Gestures (Subject 1)",
    PlotLegend → {"\"Come\"", "\"Lift\"", "\"Point\""},
  distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]], {-1/2, -Length[dist] - 1/2}},
    PlotLabel → "Distinguishing Gestures (Subject 1)",
    PlotLegend → {"\"Come\"", "\"Lift\"", "\"Point\""}
]

```



- Graphics -

```
Export["Shannon_Gestures_Motion_Boundary.gif", %]
```

Shannon_Gestures_Motion_Boundary.gif

■ Come gestures with 10 samples, 6 points

```

dist = distance[dataSet[Range[2], 1, 10, 6], testSet[Range[2], 1, 10, 6]];

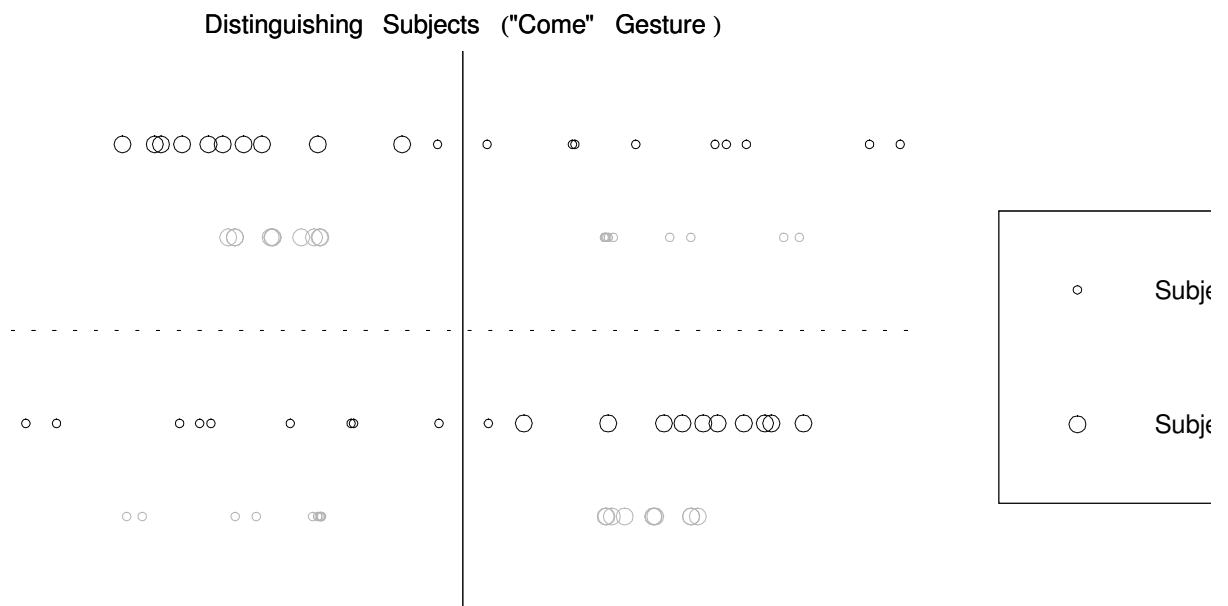
distC = distance[dataSet[Range[2], 1, 10, 6], dataSet[Range[2], 1, 10, 6]];

```

```

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Subjects (\\"Come\\" Gesture )",
  PlotLegend → {"Subject 1", "Subject 2"}],
  distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Subjects (\\"Come\\" Gesture )",
  PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["Come_Gestures_Subject_Boundary.gif", %]
```

Come_Gestures_Subject_Boundary.gif

■ Lift gestures with 10 samples, 6 points

```
dist = distance[dataSet[Range[2], 2, 10, 6], testSet[Range[2], 2, 10, 6]];
```

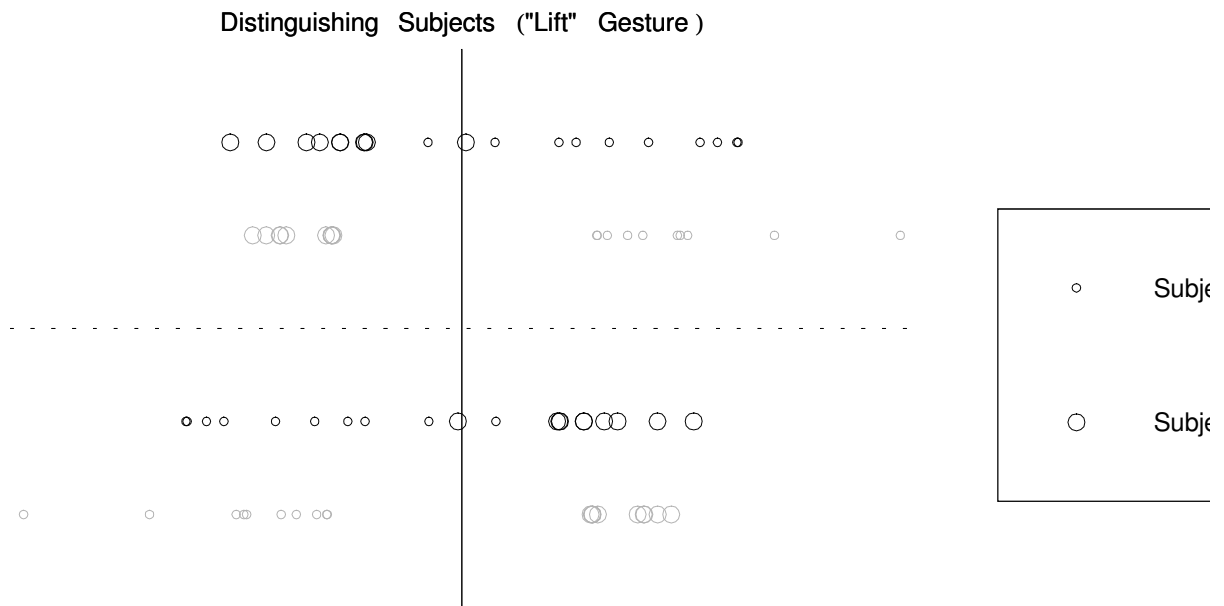
```
distC = distance[dataSet[Range[2], 2, 10, 6], dataSet[Range[2], 2, 10, 6]];
```



```

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Subjects (\\"Lift\\" Gesture )",
  PlotLegend → {"Subject 1", "Subject 2"}],
  distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Subjects (\\"Lift\\" Gesture )",
  PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["Lift_Gestures_Subject_Boundary.gif", %]
```

Lift_Gestures_Subject_Boundary.gif

■ Point gestures with 10 samples, 6 points

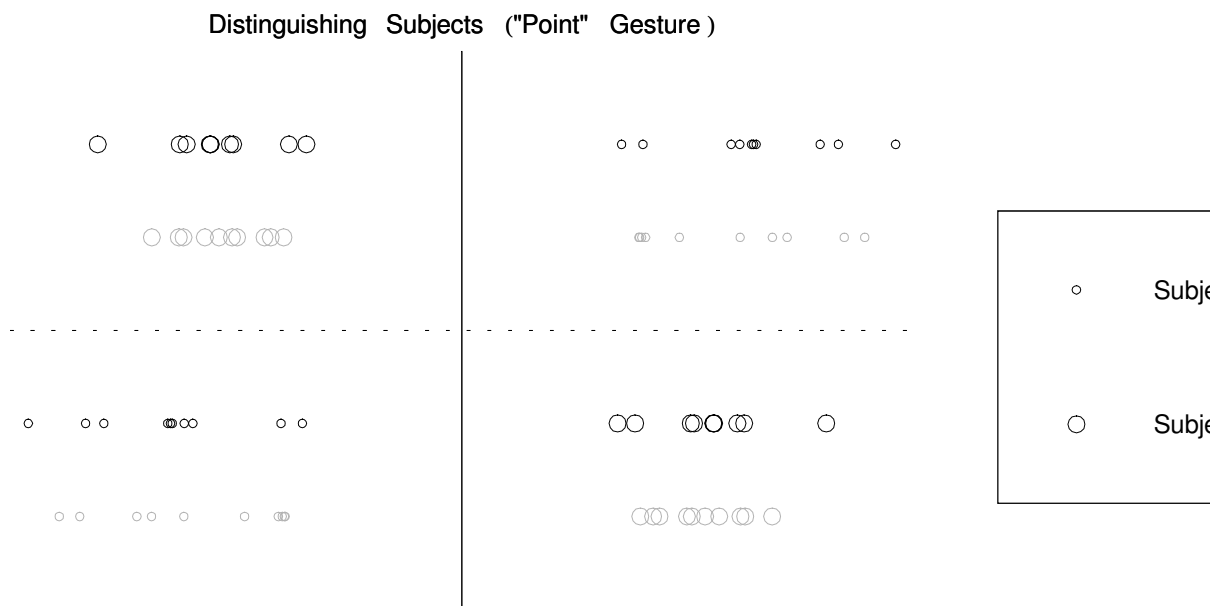
```
dist = distance[dataSet[Range[2], 3, 10, 6], testSet[Range[2], 3, 10, 6]];
```

```
distC = distance[dataSet[Range[2], 3, 10, 6], dataSet[Range[2], 3, 10, 6]];
```

```

DisplayTogether[
  distanceGrayPlot[distC, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Subjects (\\"Point\\" Gesture)",
  PlotLegend → {"Subject 1", "Subject 2"}],
  distancePlot[dist, PlotRange →
    {{Min[#] - 0.1, Max[#] + 0.1} & [Flatten[{dist, distC}]]}, {-1/2, -Length[dist] - 1/2}},
  PlotLabel → "Distinguishing Subjects (\\"Point\\" Gesture)",
  PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["Point_Gestures_Subject_Boundary.gif", %]
```

Point_Gestures_Subject_Boundary.gif

■ Sensitivity Analyses

```
numSamples = {1, 2, 3, 5, 7, 10};
```

```
numPoints = {2, 3, 5, 10, 20};
```

■ Shen gestures versus sample size with 6 points

```
temp = success[dataSet[2, Range[3], #, 6], testSet[2, Range[3], 10, 6]] & /@ numSamples
```

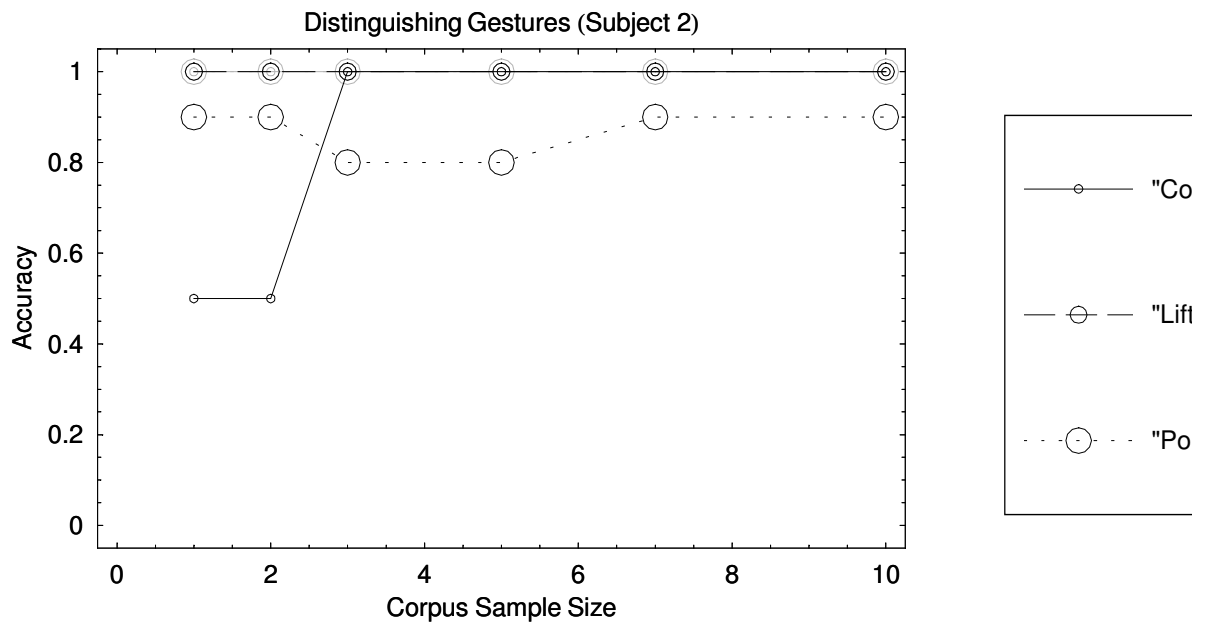
```
{{1/2, 1, 9/10}, {1/2, 1, 9/10}, {1, 1, 4/5}, {1, 1, 4/5}, {1, 1, 9/10}, {1, 1, 9/10}}
```

```

tempC = success[dataSet[2, Range[3], #, 6], dataSet[2, Range[3], #, 6]] & /@ numSamples
{{1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}}

DisplayTogether[
  successGrayPlot[Thread[{numSamples, #}] & /@ Transpose[tempC],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Gestures (Subject 2)",
    PlotLegend → {"\"Come\"", "\"Lift\"", "\"Point\""},
    successPlot[Thread[{numSamples, #}] & /@ Transpose[temp],
      FrameLabel → {"Corpus Sample Size", "Accuracy"},
      PlotLabel → "Distinguishing Gestures (Subject 2)",
      PlotLegend → {"\"Come\"", "\"Lift\"", "\"Point\""}]
]

```



- Graphics -

```
Export["Shen_Gestures_Motion_Samples.gif", %]
```

Shen_Gestures_Motion_Samples.gif

■ Shen gestures versus point resolution with 5 samples

```

temp = success[dataSet[2, Range[3], 5, #], testSet[2, Range[3], 10, #]] & /@ numPoints
{{1, 4/5, 9/10}, {1, 1, 4/5}, {4/5, 1, 4/5}, {1, 1, 4/5}, {1, 1, 4/5}}

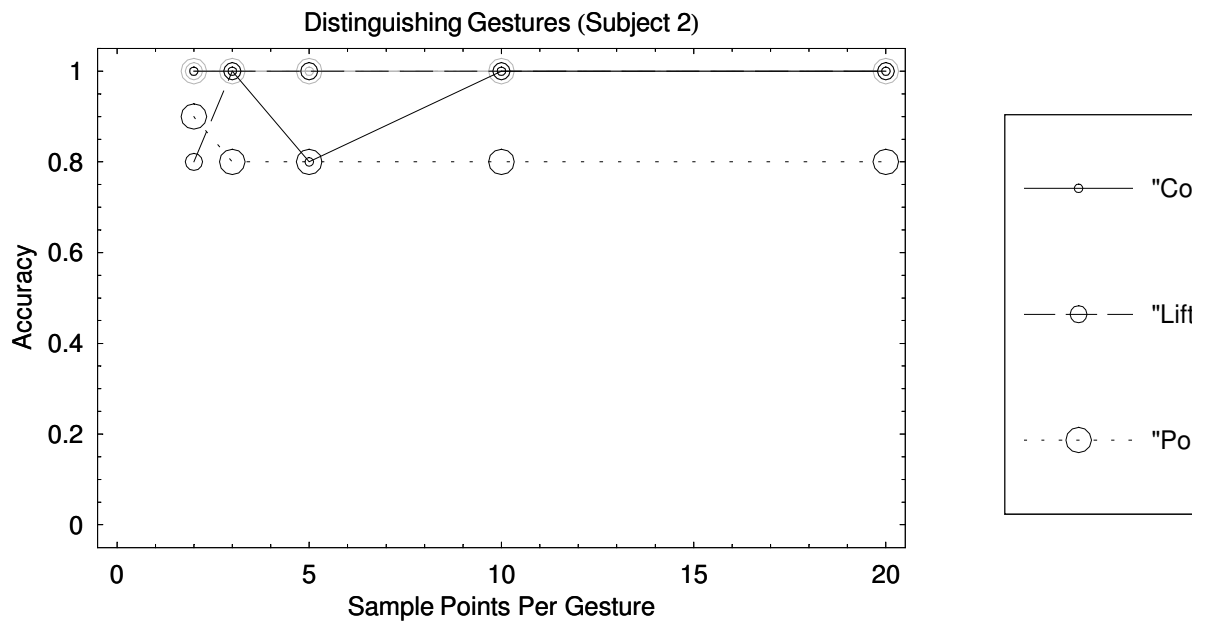
tempC = success[dataSet[2, Range[3], 5, #], dataSet[2, Range[3], 5, #]] & /@ numPoints
{{1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}}

```

```

DisplayTogether[
  successGrayPlot[Thread[{numPoints, #}] & /@Transpose[tempC],
    FrameLabel → {"Sample Points Per Gesture", "Accuracy"},
    PlotLabel → "Distinguishing Gestures (Subject 2)",
    PlotLegend → {"\Come\"", "\Lift\"", "\Point\""},
    successPlot[Thread[{numPoints, #}] & /@Transpose[temp],
      FrameLabel → {"Sample Points Per Gesture", "Accuracy"},
      PlotLabel → "Distinguishing Gestures (Subject 2)",
      PlotLegend → {"\Come\"", "\Lift\"", "\Point\""}]
]

```



- Graphics -

```
Export["Shen_Gestures_Motion_Points.gif", %]
```

Shen_Gestures_Motion_Points.gif

■ Shannon gestures versus sample size with 6 points

```
temp = success[dataSet[1, Range[3], #, 6], testSet[1, Range[3], 10, 6]] & /@ numSamples
```

```
{{1/10, 1, 1/2}, {7/10, 1, 1/2}, {3/5, 1, 1}, {3/5, 9/10, 1}, {7/10, 1, 1}, {4/5, 1, 1}}
```

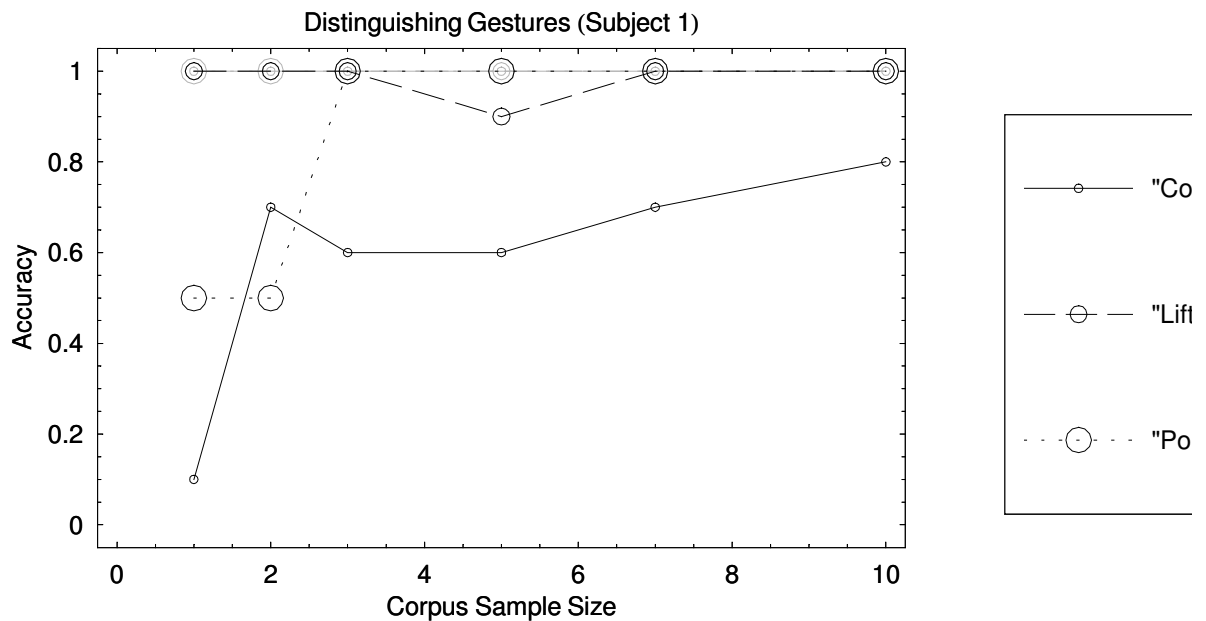
```
tempC = success[dataSet[1, Range[3], #, 6], dataSet[1, Range[3], #, 6]] & /@ numSamples
```

```
{{1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}}
```

```

DisplayTogether[
  successGrayPlot[Thread[{numSamples, #}] & /@Transpose[tempC],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Gestures (Subject 1)",
    PlotLegend → {"\"Come\"", "\"Lift\"", "\"Point\""},
    successPlot[Thread[{numSamples, #}] & /@Transpose[temp],
      FrameLabel → {"Corpus Sample Size", "Accuracy"},
      PlotLabel → "Distinguishing Gestures (Subject 1)",
      PlotLegend → {"\"Come\"", "\"Lift\"", "\"Point\""}]
]

```



- Graphics -

```
Export["Shannon_Gestures_Motion_Samples.gif", %]
```

Shannon_Gestures_Motion_Samples.gif

■ Shannon gestures versus point resolution with 5 samples

```
temp = success[dataSet[1, Range[3], 5, #], testSet[1, Range[3], 10, #]] & /@numPoints
```

```
{{{3/10, 1, 1}, {1/5, 1, 1}, {4/5, 9/10, 9/10}, {4/5, 1, 9/10}, {4/5, 1, 9/10}}}
```

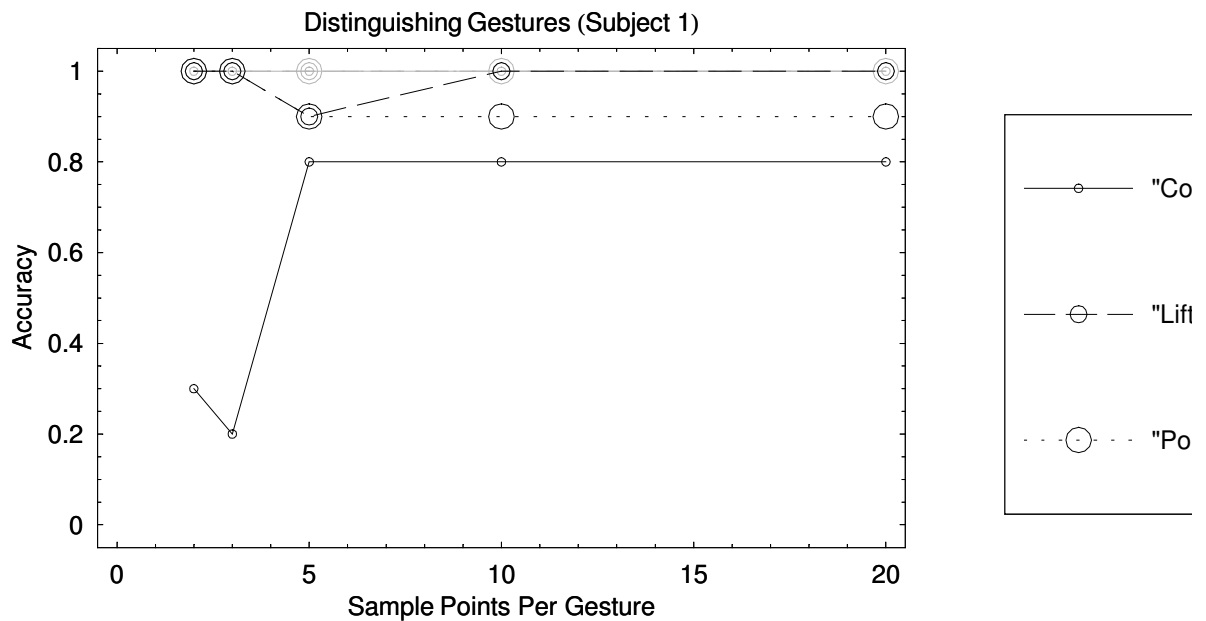
```
tempC = success[dataSet[1, Range[3], 5, #], dataSet[1, Range[3], 5, #]] & /@numPoints
```

```
{{{1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}, {1, 1, 1}}}
```

```

DisplayTogether[
  successGrayPlot[Thread[{numPoints, #}] & /@Transpose[tempC],
    FrameLabel → {"Sample Points Per Gesture", "Accuracy"},
    PlotLabel → "Distinguishing Gestures (Subject 1)",
    PlotLegend → {"\Come\"", "\Lift\"", "\Point\""},
  successPlot[Thread[{numPoints, #}] & /@Transpose[temp],
    FrameLabel → {"Sample Points Per Gesture", "Accuracy"},
    PlotLabel → "Distinguishing Gestures (Subject 1)",
    PlotLegend → {"\Come\"", "\Lift\"", "\Point\""}]
]

```



- Graphics -

```
Export["Shannon_Gestures_Motion_Points.gif", %]
```

Shannon_Gestures_Motion_Points.gif

■ Come gestures versus sample size with 6 points

```
temp = success[dataSet[Range[2], 1, #, 6], testSet[Range[2], 1, 10, 6]] & /@ numSamples
```

```
{{{3/10, 1}, {9/10, 3/5}, {1, 1}, {1, 1}, {1, 1}, {9/10, 1}}}
```

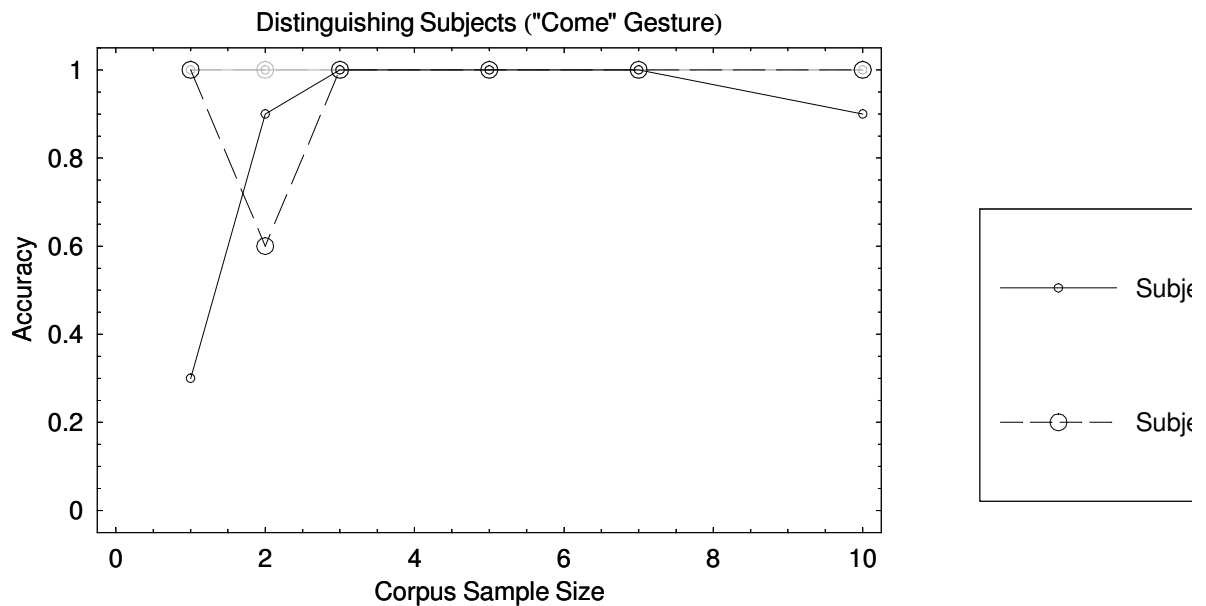
```
tempC = success[dataSet[Range[2], 1, #, 6], dataSet[Range[2], 1, #, 6]] & /@ numSamples
```

```
{{{1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}}}
```

```

DisplayTogether[
  successGrayPlot[Thread[{numSamples, #}] & /@Transpose[tempC],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"Come\\" Gesture)",
    PlotLegend → {"Subject 1", "Subject 2"}],
  successPlot[Thread[{numSamples, #}] & /@Transpose[temp],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"Come\\" Gesture)",
    PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["Come_Gestures_Subject_Samples.gif", %]
```

Come_Gestures_Subject_Samples.gif

■ Lift gestures versus sample size with 6 points

```
temp = success[dataSet[Range[2], 2, #, 6], testSet[Range[2], 2, 10, 6]] & /@numSamples
```

```
{{1/5, 1}, {1/2, 1}, {7/10, 1}, {4/5, 9/10}, {4/5, 9/10}, {9/10, 9/10}}
```

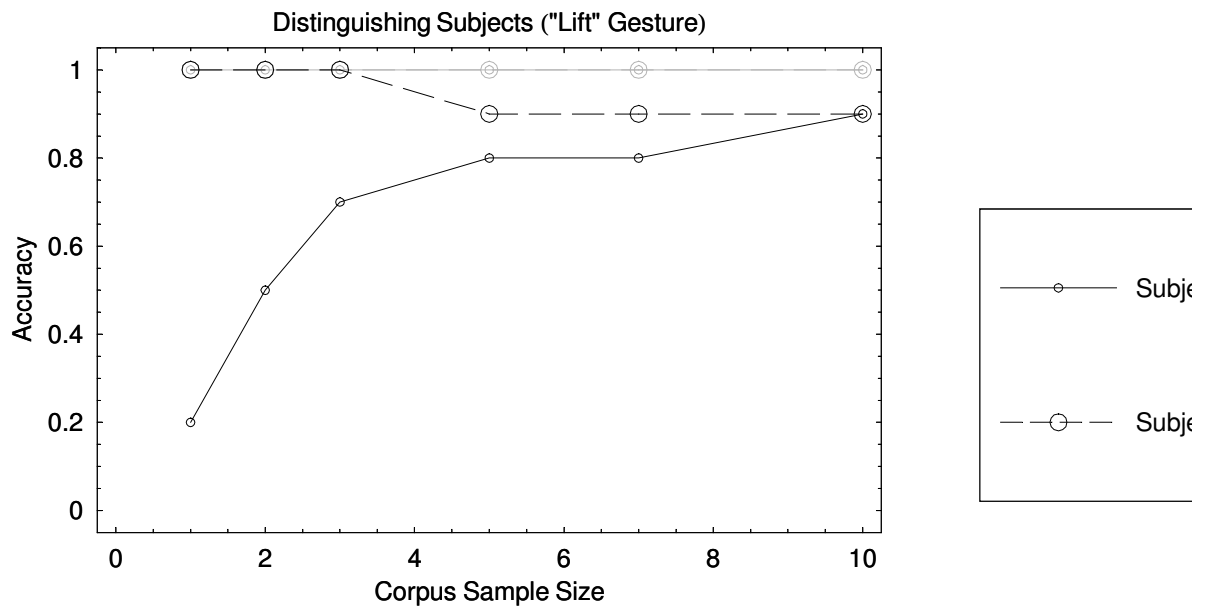
```
tempC = success[dataSet[Range[2], 2, #, 6], dataSet[Range[2], 2, #, 6]] & /@numSamples
```

```
{{1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}}
```

```

DisplayTogether[
  successGrayPlot[Thread[{numSamples, #}] & /@Transpose[tempC],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"Lift\\" Gesture)",
    PlotLegend → {"Subject 1", "Subject 2"}],
  successPlot[Thread[{numSamples, #}] & /@Transpose[temp],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"Lift\\" Gesture)",
    PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["Lift_Gestures_Subject_Samples.gif", %]
```

Lift_Gestures_Subject_Samples.gif

■ Point gestures versus sample size with 6 points

```
temp = success[dataSet[Range[2], 3, #, 6], testSet[Range[2], 3, 10, 6]] & /@numSamples
```

```
{{{3/10, 1}, {1/2, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}}}
```

```
tempC = success[dataSet[Range[2], 3, #, 6], dataSet[Range[2], 3, #, 6]] & /@numSamples
```

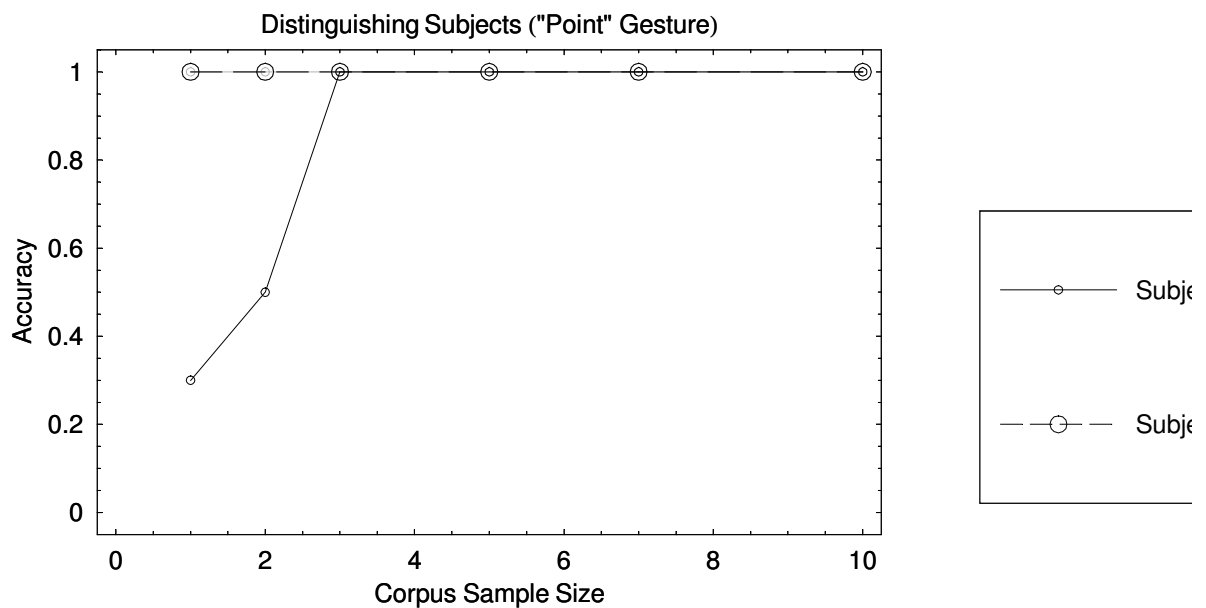
```
{{{1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}}}
```



```

DisplayTogether[
  successGrayPlot[Thread[{numSamples, #}] & /@Transpose[tempC],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"Point\\" Gesture)",
    PlotLegend → {"Subject 1", "Subject 2"}],
  successPlot[Thread[{numSamples, #}] & /@Transpose[temp],
    FrameLabel → {"Corpus Sample Size", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"Point\\" Gesture)",
    PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["Point_Gestures_Subject_Samples.gif", %]
```

Point_Gestures_Subject_Samples.gif

■ Come gestures versus point resolution with 5 samples

```
temp = success[dataSet[Range[2], 1, 5, #], testSet[Range[2], 1, 10, #]] & /@numPoints
```

```
{{1/2, 1}, {7/10, 1}, {1, 4/5}, {9/10, 9/10}, {1, 9/10}}
```

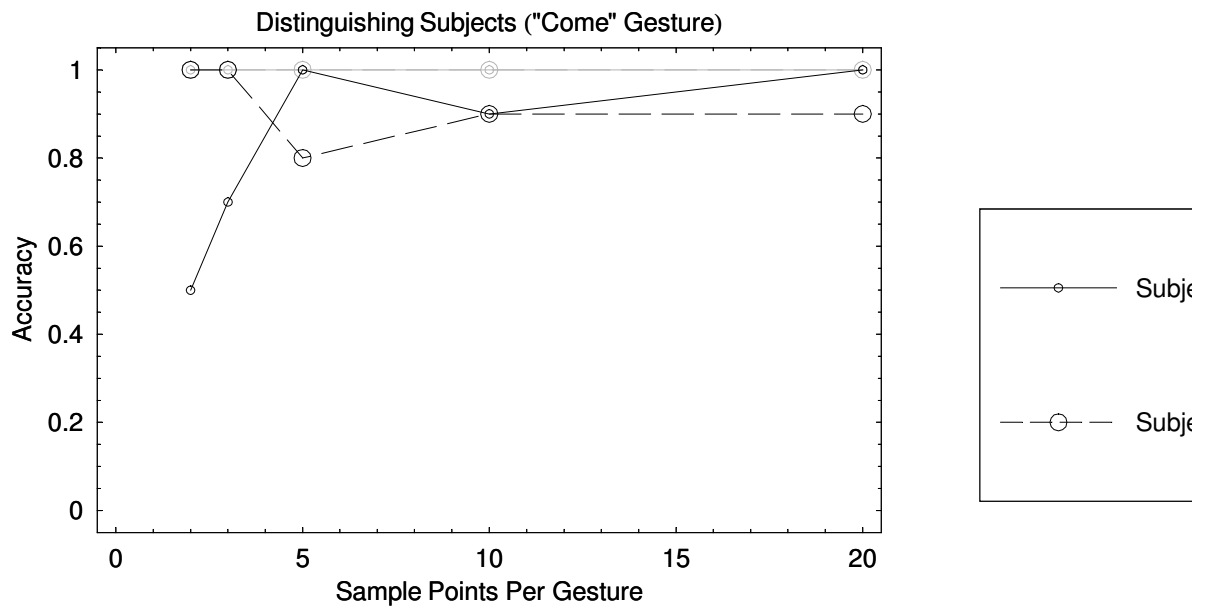
```
tempC = success[dataSet[Range[2], 1, 5, #], dataSet[Range[2], 1, 5, #]] & /@numPoints
```

```
{{1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}}
```

```

DisplayTogether[
  successGrayPlot[Thread[{numPoints, #}] & /@Transpose[tempC],
    FrameLabel → {"Sample Points Per Gesture", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"Come\\" Gesture)",
    PlotLegend → {"Subject 1", "Subject 2"}],
  successPlot[Thread[{numPoints, #}] & /@Transpose[temp],
    FrameLabel → {"Sample Points Per Gesture", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"Come\\" Gesture)",
    PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["Come_Gestures_Subject_Points.gif", %]
```

Come_Gestures_Subject_Points.gif

■ Lift gestures versus point resolution with 5 samples

```
temp = success[dataSet[Range[2], 2, 5, #], testSet[Range[2], 2, 10, #]] & /@numPoints
```

```
{{{3/10, 9/10}, {3/5, 9/10}, {3/5, 1}, {4/5, 1}, {4/5, 1}}}
```

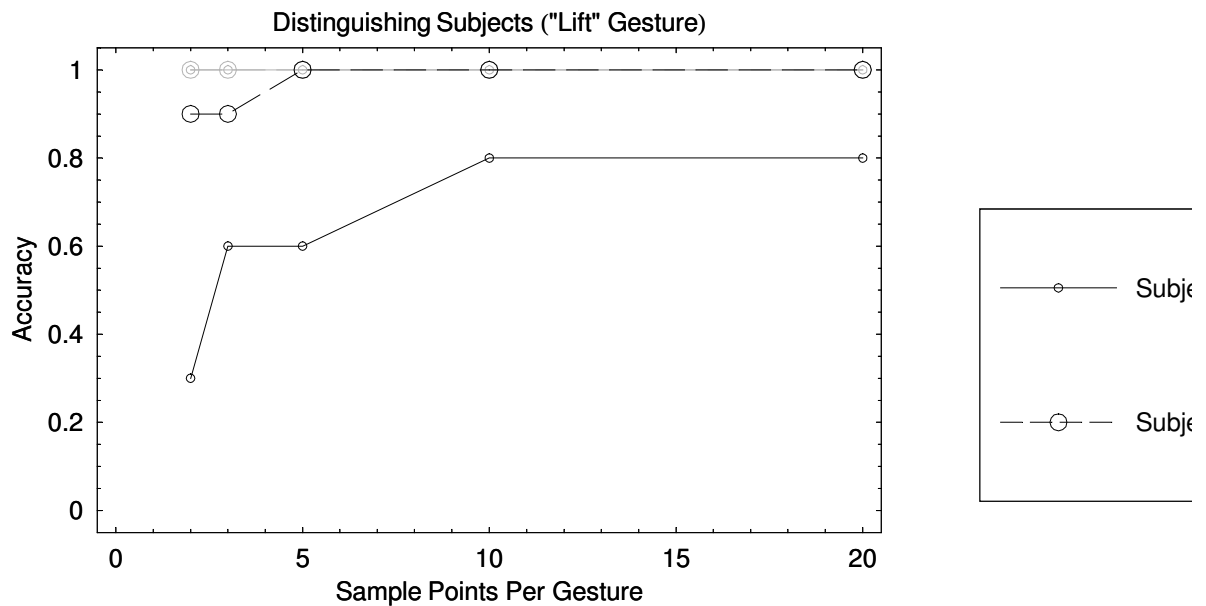
```
tempC = success[dataSet[Range[2], 2, 5, #], dataSet[Range[2], 2, 5, #]] & /@numPoints
```

```
{{{1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}}}
```

```

DisplayTogether[
  successGrayPlot[Thread[{numPoints, #}] & /@Transpose[tempC],
    FrameLabel → {"Sample Points Per Gesture", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"Lift\\" Gesture)",
    PlotLegend → {"Subject 1", "Subject 2"}],
  successPlot[Thread[{numPoints, #}] & /@Transpose[temp],
    FrameLabel → {"Sample Points Per Gesture", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"Lift\\" Gesture)",
    PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["Lift_Gestures_Subject_Points.gif", %]
```

Lift_Gestures_Subject_Points.gif

■ Point gestures versus point resolution with 5 samples

```
temp = success[dataSet[Range[2], 3, 5, #], testSet[Range[2], 3, 10, #]] & /@numPoints
```

```
{{{9/10, 9/10}, {1, 1}, {1, 1}, {1, 1}, {1, 1}}
```

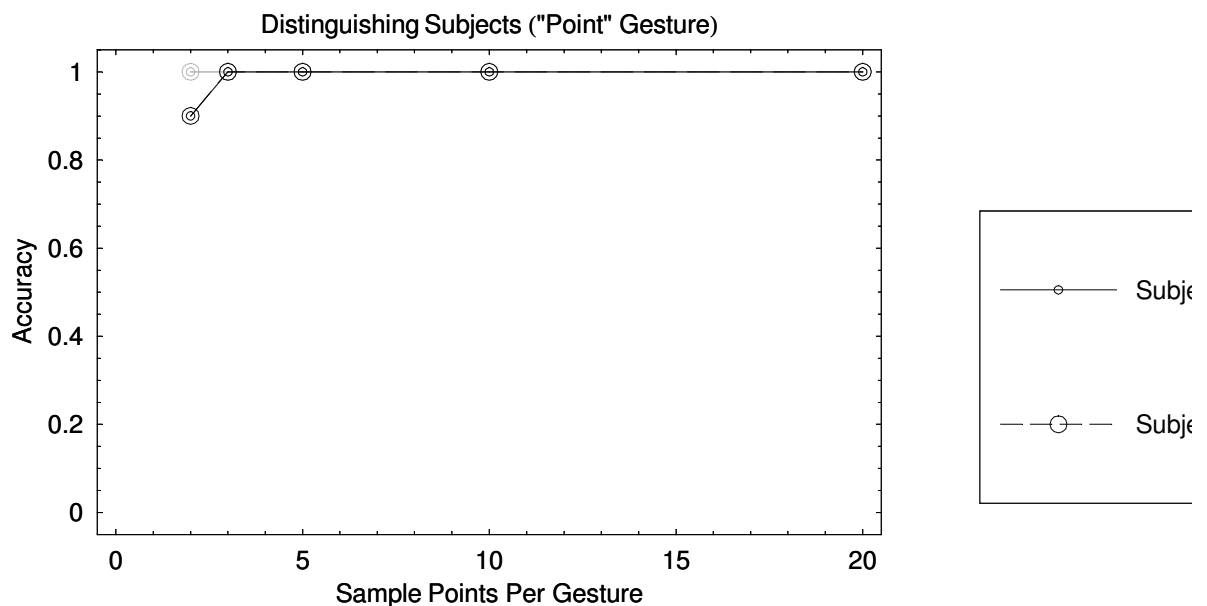
```
tempC = success[dataSet[Range[2], 3, 5, #], dataSet[Range[2], 3, 5, #]] & /@numPoints
```

```
{{1, 1}, {1, 1}, {1, 1}, {1, 1}, {1, 1}}
```

```

DisplayTogether[
  successGrayPlot[Thread[{numPoints, #}] & /@Transpose[tempC],
    FrameLabel → {"Sample Points Per Gesture", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"Point\\" Gesture)",
    PlotLegend → {"Subject 1", "Subject 2"}],
  successPlot[Thread[{numPoints, #}] & /@Transpose[temp],
    FrameLabel → {"Sample Points Per Gesture", "Accuracy"},
    PlotLabel → "Distinguishing Subjects (\\"Point\\" Gesture)",
    PlotLegend → {"Subject 1", "Subject 2"}]
]

```



- Graphics -

```
Export["Point_Gestures_Subject_Points.gif", %]
```

Point_Gestures_Subject_Points.gif

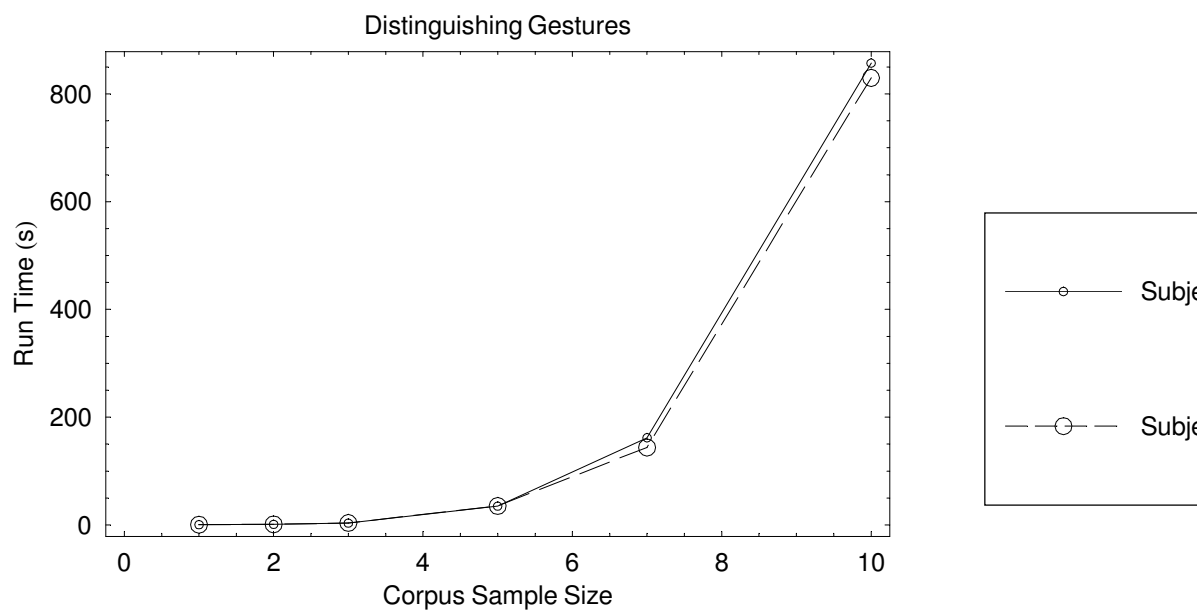
■ Subjects gestures time versus sample size with 6 points

```

temp = Table[time[dataSet[s, Range[3], #, 6]] / Second & /@numSamples, {s, 2}]
{{0.541, 1.191, 3.455, 34.81, 161.692, 857.012},
 {0.451, 1.162, 3.535, 35.211, 143.786, 829.703}}

```

```
successPlot[Thread[{numSamples, #}] & /@ temp,
  FrameLabel -> {"Corpus Sample Size", "Run Time (s)"}, PlotRange -> {Automatic, All},
  PlotLabel -> "Distinguishing Gestures", PlotLegend -> {"Subject 1", "Subject 2"}]
```



▪ Graphics ▪

```
Export["Time_Gestures_Motion_Samples.gif", %]
```

Time_Gestures_Motion_Samples.gif

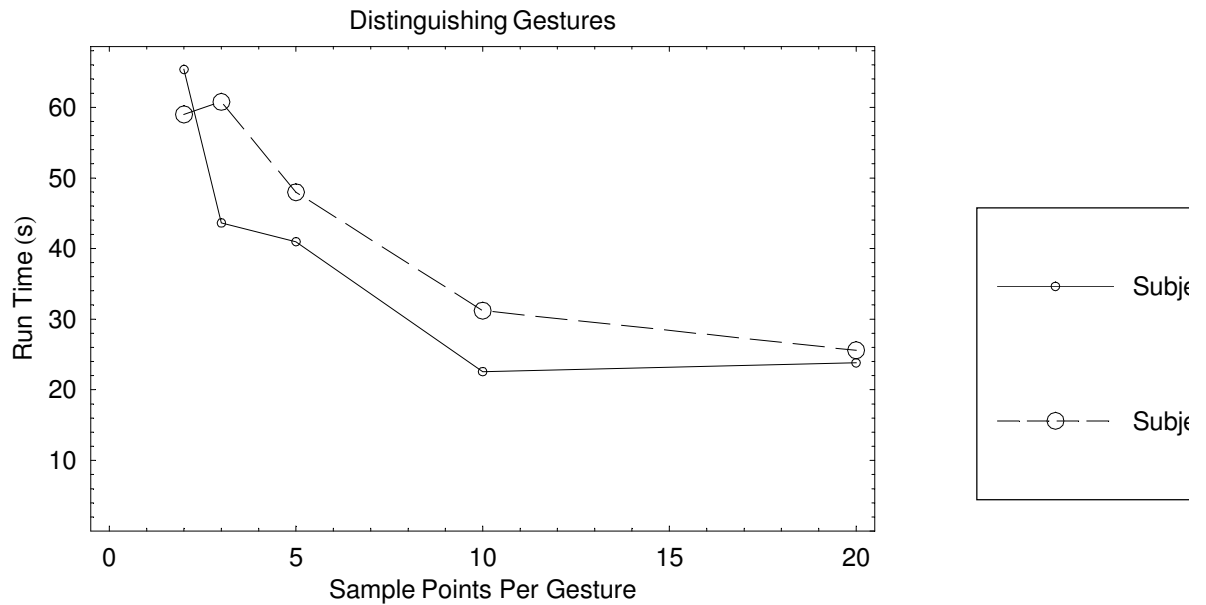
■ Subjects gestures time versus point resolution with 5 samples

```
temp = Table[time[dataSet[s, Range[3], 5, #]] / Second & /@ numPoints, {s, 2}]
{{65.354, 43.623, 40.959, 22.562, 23.814}, {58.995, 60.767, 47.969, 31.205, 25.587}}
```

```

successPlot[Thread[{numPoints, #}] & /@ temp,
  FrameLabel → {"Sample Points Per Gesture", "Run Time (s)"},
  PlotRange → {Automatic, {0, 1.05 Max @@ temp}},
  PlotLabel → "Distinguishing Gestures", PlotLegend → {"Subject 1", "Subject 2"}]

```



- Graphics -

```
Export["Time_Gestures_Motion_Points.gif", %]
```

```
Time_Gestures_Motion_Points.gif
```

Save Data

```
DumpSave["ZeroOffsetCache.mx", {time, classifiers}]
```

```
{time, classifiers}
```