

```
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```
(* SVD Analysis of Alpha Factor & CLB2 & CLN3 *)
```

```
(* Normalize Selected Data *)
```

```
(* Read Selected Data from Select_Data.txt *)
```

```
<< LinearAlgebra`MatrixManipulation`;  
<< NumericalMath`TrigFit`;  
<< Graphics`Graphics`;  
<< Graphics`Arrow`;  
Off[General::"spell"];
```

```
(* Define HardDrive *)
```

```
name = "Marzipan";
```

```
(* Alpha Factor & CLB2 & CLN3 *)
```

```
stream = StringJoin[name, ":Desktop Folder:PNAS Data>Select_Alpha&Cls.txt"];  
matrix = ReadList[stream, Word, RecordLists -> True, NullWords -> True];  
{genes, arrays} = Dimensions[matrix] - {2, 1}  
Clear[stream];
```

```
{4579, 22}
```

```
genenames = TakeRows [  
  TakeColumns[matrix, {1, 1}],  
  {3, genes + 2}];  
arraynames = TakeColumns [  
  TakeRows[matrix, {1, 2}],  
  {2, arrays + 1}];  
matrix = TakeColumns [  
  TakeRows[matrix, {3, genes + 2}],  
  {2, arrays + 1}];  
matrix = ToExpression[matrix];
```

```
sizes = Flatten [  
  Table [  
    Dimensions [  
      Characters [  
        ToString[arraynames[[2, a]]]  
      ]  
    ], {a, 1, arrays}];  
size = Sort[sizes, OrderedQ[{{#2, #1}}]&][[1]];  
Do [  
  Do[arraynames[[2, a]] = StringJoin[ToString[arraynames[[2, a]]], " "],  
    {b, 1, size - sizes[[a]]},  
    {a, 1, arrays}];
```

```
(* Examine Raw Data *)
```

```
(* Calculate Singular Value Decomposition *)
```

```
correlation = Dot[Transpose[matrix], matrix] / (arrays - 1);  
{eigenexpressions, eigengenes} = Eigensystem[correlation];  
eigenexpressions = Sqrt[(arrays - 1) * eigenexpressions];  
Clear[correlation];  
eigengenes[[4]] = -eigengenes[[4]];  
eigengenes[[6]] = -eigengenes[[6]];  
eigengenes[[7]] = -eigengenes[[7]];  
eigengenes[[11]] = -eigengenes[[11]];  
eigenarrays = Dot[eigengenes, Transpose[matrix]];  
Do[  
  eigenarrays[[a]] = eigenarrays[[a]] / eigenexpressions[[a]],  
  {a, 1, arrays}];  
eigenarrays = Transpose[eigenarrays];  
arraycorrelations = Dot[DiagonalMatrix[eigenexpressions], eigengenes];  
genecorrelations = Dot[eigenarrays, DiagonalMatrix[eigenexpressions]];  
genecorrelations = Transpose[genecorrelations];  
fractions = eigenexpressions^2 / Sum[eigenexpressions[[a]]^2, {a, 1, arrays}];  
entropy = -N[Sum[fractions[[a]] * Log[fractions[[a]]], {a, 1, arrays}] / Log[arrays];  
entropy = N[Round[100 * entropy] / 100]
```

0.25

```
(* Create Fractions Bar Charts Displays *)
```

```
fractions[[2]]
```

0.0946134

```
limit = 0.1;
```

```

Clear[gridx, framex, framey, sizes];
gridx = Table[a, {a, 0, limit, N[limit/4]}];
framex = gridx;
sizes = Flatten[
  Table[
    Dimensions[
      Characters[
        ToString[framex[[a]]]
      ]
    ], {a, 1, 5}];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " ",
    {b, 1, 5 - sizes[[a]]}],
  {a, 1, 5}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 5};
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 5};
framey = Table[{a + 1, arrays - a - 7}, {a, 0, 15 - 2};
table = Table[fractions[[arrays - a]], {a, 7, arrays - 2};
g = BarChart[
  table,
  BarOrientation -> Horizontal,
  PlotRange -> {{0, limit * 1.0001}, {0.5, 15 - 1 + 0.5}},
  AspectRatio -> 1,
  Axes -> False,
  Frame -> True,
  FrameTicks -> {None, framey, framex, None},
  FrameLabel -> {None, None, None, None},
  GridLines -> {gridx, None},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 1.75}, {0, 0}, {0, 1}];
g1 = Show[g,
  AspectRatio -> 1.25,
  PlotRange -> All,
  DisplayFunction -> Identity];

```

```

gridx = Table[a, {a, 0, 1, 0.2}];
framex = gridx;
sizes = Flatten[
  Table[
    Dimensions[
      Characters[
        ToString[framex[[a]]]
      ]
    ], {a, 1, 6}]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " ",
    {b, 1, size - sizes[[a]]}],
  {a, 1, 6}];
framex = Table[{gridx[[a]],
  framex[[a]]}, {a, 1, 6}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 6}];
framey = Table[{a + 1, arrays - a}, {a, 0, arrays - 1}];
labelx = ColumnForm[
  {"(b) Eigenexpression Fraction", StringJoin["d = ", ToString[entropy]], " "}, Center];
g = BarChart[
  Table[fractions[[arrays - a]], {a, 0, arrays - 1}],
  BarOrientation -> Horizontal,
  PlotRange -> {{0, 1.0001}, {0.5, arrays + 0.5}},
  AspectRatio -> 1,
  Axes -> False,
  Frame -> True,
  FrameTicks -> {None, framey, framex, None},
  FrameLabel -> {None, None, labelx, None},
  GridLines -> {gridx, None},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 2.7}, {0, 0}, {0, 1}];
g2 = Show[{g,
  Graphics[{RGBColor[1, 1, 0.8], Rectangle[{0.1, 0.6}, {0.98, 20.6}]},
  Graphics[{Rectangle[{0.1, 0.6}, {0.98, 20.6}, g1]}]},
  AspectRatio -> 1.35,
  PlotRange -> All,
  DisplayFunction -> Identity];

```

(* Create Eigengenes 2D Red & Green Raster Display *)

```

contrast = 3.5;
displaying = Table[
  If[contrast * eigengenes[[i, j]] > 0,
    If[contrast * eigengenes[[i, j]] < 1, {contrast * eigengenes[[i, j]], 0}, {1, 0}],
    If[contrast * eigengenes[[i, j]] > -1, {0, -contrast * eigengenes[[i, j]]}, {0, 1}]],
  {i, 1, arrays}, {j, 1, arrays}];
framex = Table[{a - 0.5, arraynames[[2, a]]}, {a, 1, arrays}];
framey = Table[{a + 1 - 0.5, arrays - a}, {a, 0, arrays - 1}];
labely = "Eigengenes";
labelx = ColumnForm[{"(a) Arrays", " ", " "}, Center];
g = Show[
  Graphics[
    RasterArray[
      Table[
        RGBColor[
          displaying[[i, j, 1]], displaying[[i, j, 2]], 0
        ],
        {i, arrays, 1, -1}, {j, 1, arrays}
      ]],
    AspectRatio -> 1, Frame -> True,
    FrameTicks -> {None, framey, framex, None},
    FrameLabel -> {None, labely, labelx, None},
    DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 3, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 2.7}, {0, 0}, {0, 1}];
g1 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All,
  DisplayFunction -> Identity];

```

(* Create Selected Eigengenes Graph Display *)

```

eigengenes1 = Chop[TrigFit[eigengenes[[1]], 2, {x, arrays - 1}], 0.05]
eigengenes4 = Chop[TrigFit[Drop[Drop[eigengenes[[4]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.05]
eigengenes5 = Chop[TrigFit[Drop[Drop[eigengenes[[5]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.05]
eigengenes6 = Chop[TrigFit[Drop[Drop[eigengenes[[6]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.1]

```

-0.211007

$$0.0904703 \sin\left[\frac{4}{17} \pi (-1 + x)\right]$$

$$0.13624 \sin\left[\frac{2}{17} \pi (-1 + x)\right] + 0.151972 \sin\left[\frac{4}{17} \pi (-1 + x)\right]$$

$$0.134031 \cos\left[\frac{2}{17} \pi (-1 + x)\right] + 0.121332 \cos\left[\frac{4}{17} \pi (-1 + x)\right]$$

```
eigengenes7 = Chop[TrigFit[Drop[Drop[eigengenes[[7]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.05]
eigengenes9 = Chop[TrigFit[Drop[Drop[eigengenes[[9]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.15]
eigengenes11 = Chop[TrigFit[Drop[Drop[eigengenes[[11]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.15]
```

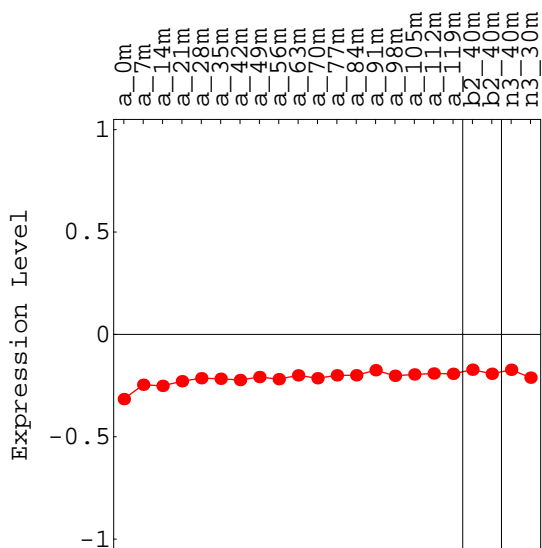
$$0.0788436 \cos\left[\frac{2}{17} \pi (-1 + x)\right] + 0.0901957 \sin\left[\frac{4}{17} \pi (-1 + x)\right]$$

$$0.195534 \cos\left[\frac{4}{17} \pi (-1 + x)\right] - 0.15699 \sin\left[\frac{2}{17} \pi (-1 + x)\right]$$

$$-0.172737 \sin\left[\frac{2}{17} \pi (-1 + x)\right] + 0.179714 \sin\left[\frac{4}{17} \pi (-1 + x)\right]$$

```
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[1, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
  Graphics[{RGBColor[1, 0, 0], line}]},
  Frame -> True,
  FrameLabel -> {None, labely, labelx, None},
  GridLines -> {{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}},
  FrameTicks -> {None, framey, framex, None},
  PlotRange -> {-1.05, 1.05},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p1 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All];
```

(c) Arrays

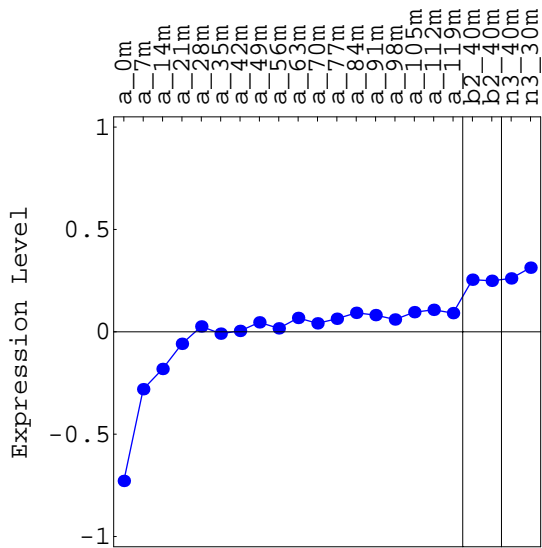


```

labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[2, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
   Graphics[{RGBColor[0, 0, 1], line}]},
  Frame -> True,
  FrameLabel -> {None, labely, labelx, None},
  GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
  FrameTicks -> {None, framey, framex, None},
  PlotRange -> {-1.05, 1.05},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p2 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All];

```

(c) Arrays

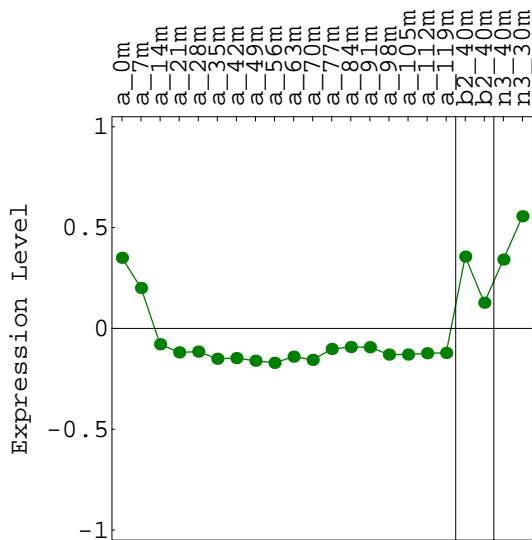


```

labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[3, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[0, 0.5, 0], PointSize[0.022], points}],
   Graphics[{RGBColor[0, 0.5, 0], line}]},
  Frame -> True,
  FrameLabel -> {None, labely, labelx, None},
  GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}},
  FrameTicks -> {None, framey, framex, None},
  PlotRange -> {-1.05, 1.05},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p3 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All];

```

(c) Arrays

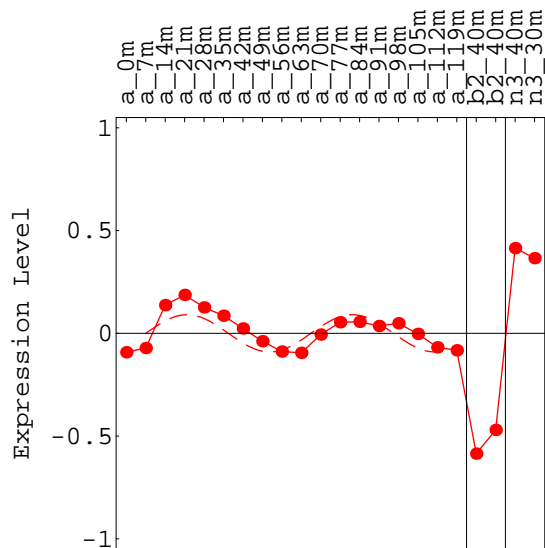


```

graph = Plot[
  eigengenes4,
  {x, 1, arrays - 5},
  PlotStyle -> {RGBColor[1, 0, 0], Dashing[{0.03, 0.02}]},
  DisplayFunction -> Identity];
labelx = ColumnForm[{"(d) Arrays", Center];
labely = ColumnForm[{" ", "Expression Level", Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[4, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
  Graphics[{RGBColor[1, 0, 0], line}],
  graph},
  Frame -> True,
  FrameLabel -> {None, labely, labelx, None},
  GridLines -> {{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}},
  FrameTicks -> {None, framey, framex, None},
  PlotRange -> {-1.05, 1.05},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p4 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All];

```

(d) Arrays

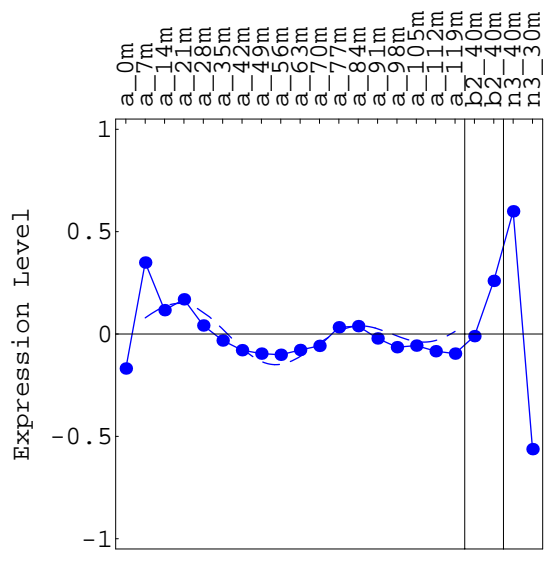


```

graph = Plot[
  eigengenes7,
  {x, 1, arrays - 5},
  PlotStyle -> {RGBColor[0, 0, 1], Dashing[{0.03, 0.02}]},
  DisplayFunction -> Identity];
labelx = ColumnForm[{"(d) Arrays", Center];
labely = ColumnForm[{" ", "Expression Level", Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[7, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
  Graphics[{RGBColor[0, 0, 1], line}],
  graph},
  Frame -> True,
  FrameLabel -> {None, labely, labelx, None},
  GridLines -> {{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}},
  FrameTicks -> {None, framey, framex, None},
  PlotRange -> {-1.05, 1.05},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p7 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All];

```

(d) Arrays

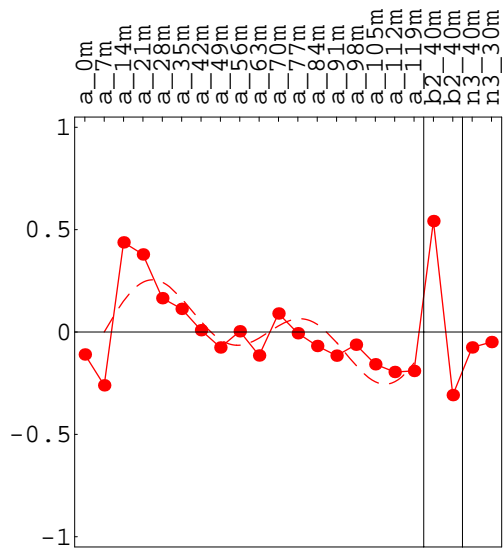


```

graph = Plot[
  eigengenes5,
  {x, 1, arrays - 5},
  PlotStyle -> {RGBColor[1, 0, 0], Dashing[{0.03, 0.02}]},
  DisplayFunction -> Identity];
labelx = ColumnForm[{"(e) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[5, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
  Graphics[{RGBColor[1, 0, 0], line}],
  graph},
  Frame -> True,
  FrameLabel -> {None, labely, labelx, None},
  GridLines -> {{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}},
  FrameTicks -> {None, framey, framex, None},
  PlotRange -> {-1.05, 1.05},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p5 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All];

```

(e) Arrays

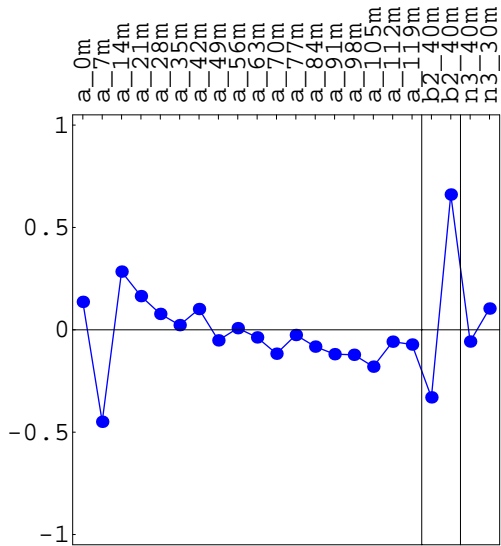


```

labelx = ColumnForm[{"(e) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[8, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
   Graphics[{RGBColor[0, 0, 1], line}]},
  Frame -> True,
  FrameLabel -> {None, labely, labelx, None},
  GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}}},
  FrameTicks -> {None, framey, framex, None},
  PlotRange -> {-1.05, 1.05},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p8 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All];

```

(e) Arrays

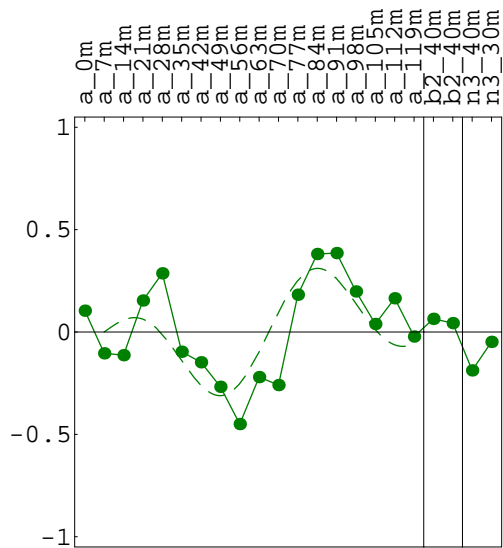


```

graph = Plot[
  eigengenes11,
  {x, 1, arrays - 5},
  PlotStyle -> {RGBColor[0, 0.5, 0], Dashing[{0.03, 0.02}]},
  DisplayFunction -> Identity];
labelx = ColumnForm[{"(e) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[11, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[0, 0.5, 0], PointSize[0.022], points}],
  Graphics[{RGBColor[0, 0.5, 0], line}],
  graph},
  Frame -> True,
  FrameLabel -> {None, labely, labelx, None},
  GridLines -> {{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}},
  FrameTicks -> {None, framey, framex, None},
  PlotRange -> {-1.05, 1.05},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p11 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All];

```

(e) Arrays

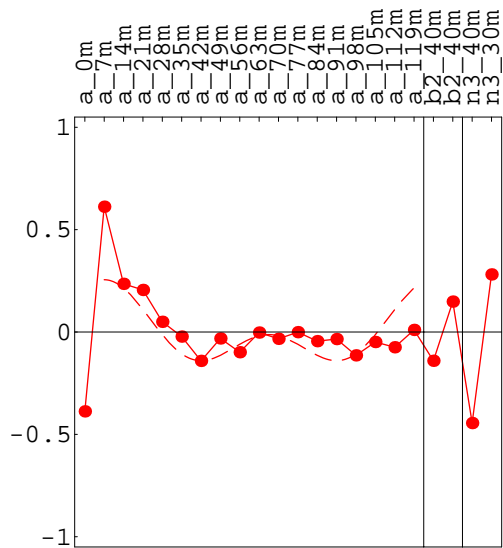


```

graph = Plot[
  eigengenes6,
  {x, 1, arrays - 5},
  PlotStyle -> {RGBColor[1, 0, 0], Dashing[{0.03, 0.02}]},
  DisplayFunction -> Identity];
labelx = ColumnForm[{"(f) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[6, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
  Graphics[{RGBColor[1, 0, 0], line}],
  graph},
  Frame -> True,
  FrameLabel -> {None, labely, labelx, None},
  GridLines -> {{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}},
  FrameTicks -> {None, framey, framex, None},
  PlotRange -> {-1.05, 1.05},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p6 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All];

```

(f) Arrays

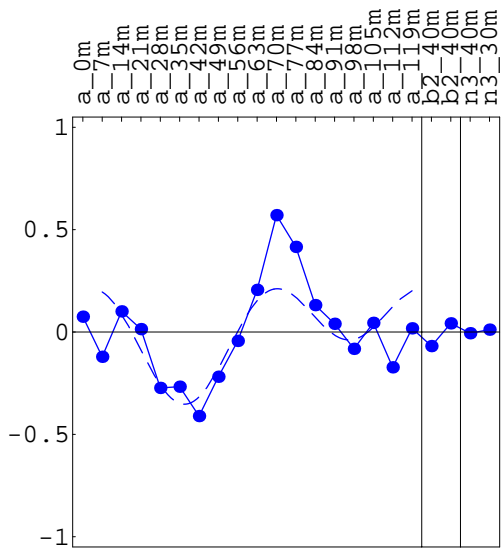


```

graph = Plot[
  eigengenes9,
  {x, 1, arrays - 5},
  PlotStyle -> {RGBColor[0, 0, 1], Dashing[{0.03, 0.02}]},
  DisplayFunction -> Identity];
labelx = ColumnForm[{"(f) Arrays"}, Center];
labely = ColumnForm[{" ", " "}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[9, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
  Graphics[{RGBColor[0, 0, 1], line}],
  graph},
  Frame -> True,
  FrameLabel -> {None, labely, labelx, None},
  GridLines -> {{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}},
  FrameTicks -> {None, framey, framex, None},
  PlotRange -> {-1.05, 1.05},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p9 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All];

```

(f) Arrays



(* Display Selected Eigengenes *)

```

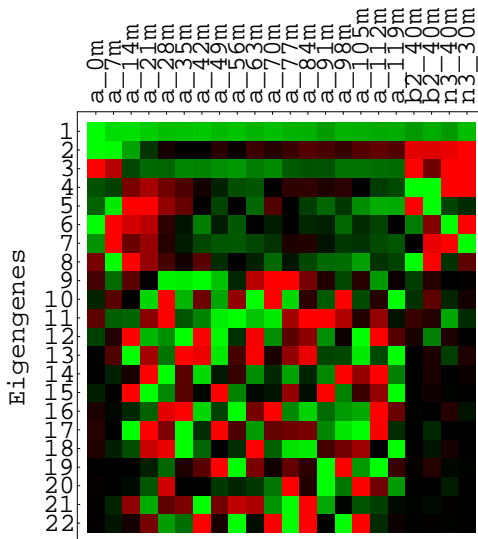
g3 = Show[{p3, p2, p1},
  DisplayFunction -> Identity];
g4 = Show[{p7, p4},
  DisplayFunction -> Identity];
g5 = Show[{p11, p8, p5},
  DisplayFunction -> Identity];

```

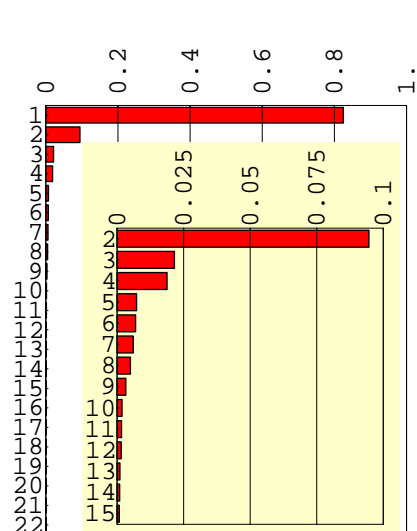
(* Display Eigengenes, Fractions and Selected Eigengenes *)

```
Show[GraphicsArray[{g1, g2, g3}],
GraphicsSpacing -> -0.2];
```

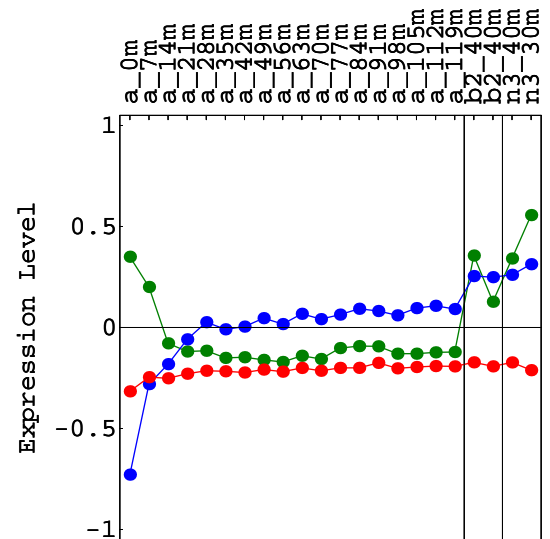
(a) Arrays



(b) Eigenexpression Fraction
d = 0.25

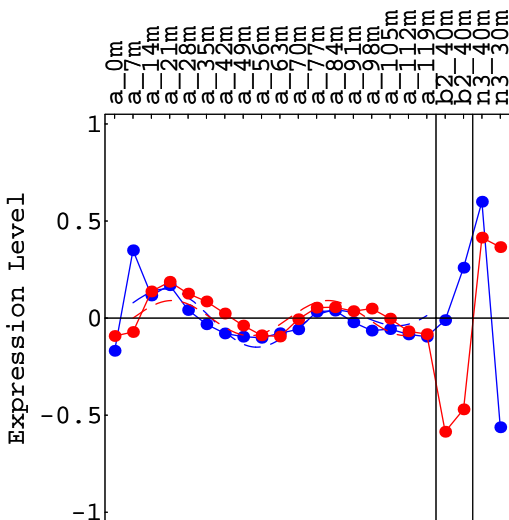


(c) Arrays

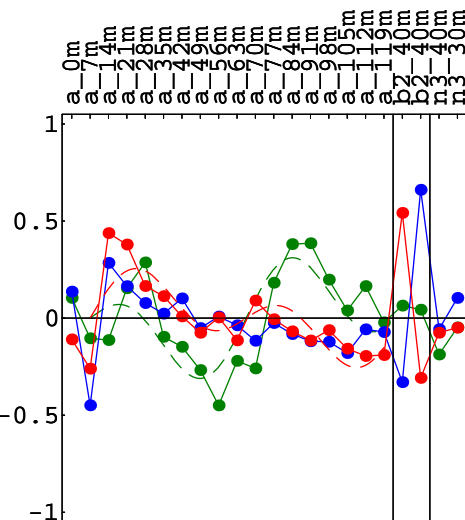


```
Show[GraphicsArray[{g4, g5, g6}],
GraphicsSpacing -> -0.15];
```

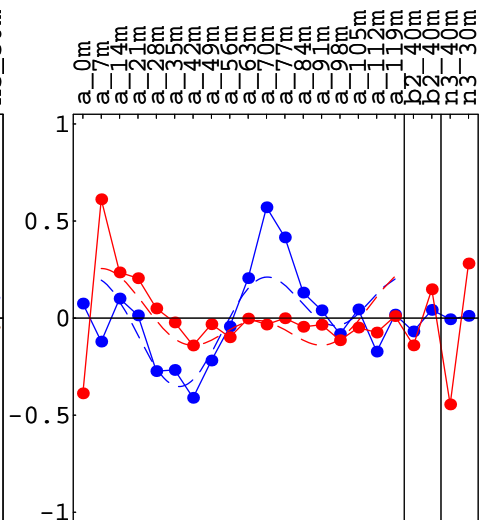
(d) Arrays



(e) Arrays



(f) Arrays



(* and Remove the Additive Constant *)

(* Reconstruct Data Without Additive Constant *)

```
eigenexpressions[[1]] = 0;
eigenexpressions[[2]] = 0;
eigenexpressions[[3]] = 0;
eigenexpressions[[10]] = 0;
Do[eigenexpressions[[a]] = 0,
  {a, 12, arrays}];
matrix = Dot[eigenarrays, DiagonalMatrix[eigenexpressions], eigengenes];
```

```
(* Remove the Multiplicative Constant *)
```

```
(* Calculate Singular Value Decomposition *)
```

```
normalization = Log[matrix^2];  
correlation = Dot[Transpose[normalization], normalization] / (arrays - 1);  
{eigenexpressions, eigengenes} = Eigensystem[correlation];  
eigenexpressions = Sqrt[(arrays - 1) * eigenexpressions];  
Clear[correlation];  
eigengenes[[2]] = -eigengenes[[2]];  
eigenarrays = Dot[eigengenes, Transpose[normalization]];  
Do[  
  eigenarrays[[a]] = eigenarrays[[a]] / eigenexpressions[[a]],  
  {a, 1, arrays}];  
eigenarrays = Transpose[eigenarrays];  
fractions = eigenexpressions^2 / Sum[eigenexpressions[[a]]^2, {a, 1, arrays}];  
entropy = -N[Sum[fractions[[a]] * Log[fractions[[a]]], {a, 1, arrays}] / Log[arrays];  
entropy = N[Round[100 * entropy] / 100]
```

```
0.22
```

```
(* Create Fractions Bar Charts Displays *)
```

```
fractions[[2]]
```

```
0.0128277
```

```
limit = 0.016;
```

```
Clear[gridx, framex, framey, sizes];  
gridx = Table[a, {a, 0, limit, N[limit/4]}];  
framex = gridx;  
sizes = Flatten[  
  Table[  
    Dimensions[  
      Characters[  
        ToString[framex[[a]]]  
      ]  
    ], {a, 1, 5}];  
Do[  
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " "],  
    {b, 1, 5 - sizes[[a]]}],  
  {a, 1, 5}];  
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 5};  
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 5};  
framey = Table[{a + 1, arrays - a - 7}, {a, 0, 15 - 2};  
table = Table[fractions[[arrays - a]], {a, 7, arrays - 2};  
g = BarChart[  
  table,  
  BarOrientation -> Horizontal,  
  PlotRange -> {{0, limit * 1.0001}, {0.5, 15 - 1 + 0.5}},  
  AspectRatio -> 1,  
  Axes -> False,  
  Frame -> True,  
  FrameTicks -> {None, framey, framex, None},  
  FrameLabel -> {None, None, None, None},  
  GridLines -> {gridx, None},  
  DisplayFunction -> Identity];  
g = FullGraphics[g];  
g[[1, 2]] = g[[1, 2]] /.  
  Text[a_, {b_, c_}, {0., -1.}] ->  
  Text[a, {b, c + 1.75}, {0, 0}, {0, 1}];
```

```

g1 = Show[g,
  AspectRatio -> 1.25,
  PlotRange -> All,
  DisplayFunction -> Identity];

gridx = Table[a, {a, 0, 1, 0.2}];
framex = gridx;
sizes = Flatten[
  Table[
    Dimensions[
      Characters[
        ToString[framex[[a]]]
      ]
    ], {a, 1, 6}]];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " ",
    {b, 1, size - sizes[[a]]}],
    {a, 1, 6}];
framex = Table[{gridx[[a]],
  framex[[a]]}, {a, 1, 6}];
gridx = Table[{gridx[[a]], RGBColor[0, 0, 0]}, {a, 1, 6}];
framey = Table[{a + 1, arrays - a}, {a, 0, arrays - 1}];
labelx = ColumnForm[
  {"(b) Eigenexpression Fraction", StringJoin["d = ", ToString[entropy]], " "}, Center];
g = BarChart[
  Table[fractions[[arrays - a]], {a, 0, arrays - 1}],
  BarOrientation -> Horizontal,
  PlotRange -> {{0, 1.0001}, {0.5, arrays + 0.5}},
  AspectRatio -> 1,
  Axes -> False,
  Frame -> True,
  FrameTicks -> {None, framey, framex, None},
  FrameLabel -> {None, None, labelx, None},
  GridLines -> {gridx, None},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 2.7}, {0, 0}, {0, 1}];
g2 = Show[{g,
  Graphics[{RGBColor[1, 1, 0.8], Rectangle[{0.1, 0.6}, {0.98, 20.6}]},
  Graphics[{Rectangle[{0.1, 0.6}, {0.98, 20.6}, g1]}]},
  AspectRatio -> 1.35,
  PlotRange -> All,
  DisplayFunction -> Identity];

```

(* Create Eigengenes 2D Red & Green Raster Display *)

```

contrast = 3.5;
displaying = Table[
  If[contrast * eigengenes[[i, j]] > 0,
    If[contrast * eigengenes[[i, j]] < 1, {contrast * eigengenes[[i, j]], 0}, {1, 0}],
    If[contrast * eigengenes[[i, j]] > -1, {0, -contrast * eigengenes[[i, j]]}, {0, 1}]],
  {i, 1, arrays}, {j, 1, arrays}];
framex = Table[{a - 0.5, arraynames[[2, a]]}, {a, 1, arrays}];
framey = Table[{a + 1 - 0.5, arrays - a}, {a, 0, arrays - 1}];
labely = "Eigengenes";
labelx = ColumnForm[{"(a) Arrays", " ", " "}, Center];
g = Show[
  Graphics[
    RasterArray[
      Table[
        RGBColor[
          displaying[[i, j, 1]], displaying[[i, j, 2]], 0
        ],
        {i, arrays, 1, -1}, {j, 1, arrays}
      ]],
    AspectRatio -> 1, Frame -> True,
    FrameTicks -> {None, framey, framex, None},
    FrameLabel -> {None, labely, labelx, None},
    DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 3, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 2.7}, {0, 0}, {0, 1}];
g1 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All,
  DisplayFunction -> Identity];

```

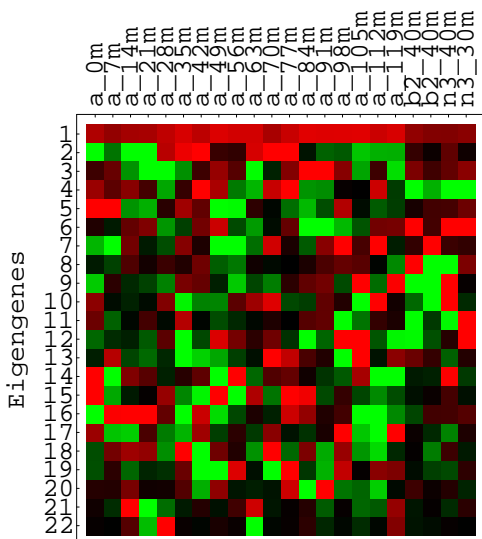
(* Display Both Eigengenes & Fractions *)

```

Show[GraphicsArray[{g1, g2}],
  GraphicsSpacing -> -0.125];

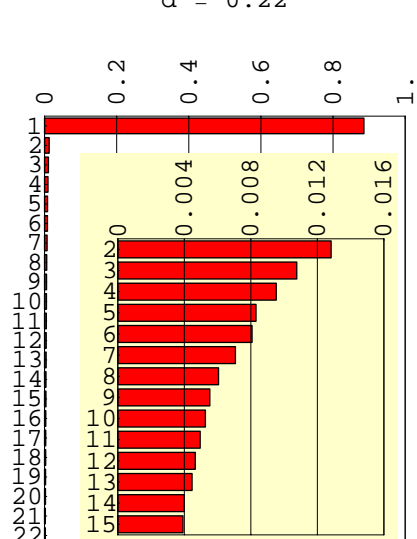
```

(a) Arrays



(b) Eigenexpression Fraction

d = 0.22



```
(* Reconstruct the Data Without Multiplicative Constant *)
```

```
eigenexpressions[[1]] = 0;  
normalization = Dot[eigenarrays, DiagonalMatrix[eigenexpressions], eigengenes];  
normalization = Sqrt[Exp[normalization]];  
matrix = Sign[matrix];  
matrix = N[matrix * normalization];  
Clear[normalization];
```

```
(* Examine Normalized Data *)
```

```
(* Calculate Singular Value Decomposition *)
```

```
correlation = Dot[Transpose[matrix], matrix] / (arrays - 1);  
{eigenexpressions, eigengenes} = Eigensystem[correlation];  
eigenexpressions = Sqrt[(arrays - 1) * eigenexpressions];  
Clear[correlation];  
eigengenes[[1]] = -eigengenes[[1]];  
eigengenes[[3]] = -eigengenes[[3]];  
eigenarrays = Dot[eigengenes, Transpose[matrix]];  
Do[  
  eigenarrays[[a]] = eigenarrays[[a]] / eigenexpressions[[a]],  
  {a, 1, arrays}];  
eigenarrays = Transpose[eigenarrays];  
arraycorrelations = Dot[DiagonalMatrix[eigenexpressions], eigengenes];  
genecorrelations = Dot[eigenarrays, DiagonalMatrix[eigenexpressions]];  
genecorrelations = Transpose[genecorrelations];  
fractions = eigenexpressions^2 / Sum[eigenexpressions[[a]]^2, {a, 1, arrays}];  
entropy = -N[Sum[fractions[[a]] * Log[fractions[[a]]], {a, 1, arrays}] / Log[arrays];  
entropy = N[Round[100 * entropy] / 100]
```

0.62

```
(* Create Fractions Bar Charts Displays *)
```

```
fractions[[1]]
```

0.225307

```
limit = 0.25;
```

```

Clear[gridx, framex, framey, sizes];
gridx = Table[a, {a, 0, limit, N[limit/5]}];
framex = gridx;
sizes = Flatten[
  Table[
    Dimensions[
      Characters[
        ToString[framex[[a]]]
      ]
    ], {a, 1, 6}];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " ",
    {b, 1, size - sizes[[a]]}],
  {a, 1, 6}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 6}];
framey = Table[{a + 1, arrays - a}, {a, 0, arrays - 1}];
labelx = ColumnForm[
  {"(b) Eigenexpression Fraction", StringJoin["d = ", ToString[entropy]], " "}, Center];
g = BarChart[
  Table[fractions[[arrays - a]], {a, 0, arrays - 1}],
  BarOrientation -> Horizontal,
  PlotRange -> {{0, limit * 1.0001}, {0.5, arrays + 0.5}},
  AspectRatio -> 1,
  Axes -> False,
  Frame -> True,
  FrameTicks -> {None, framey, framex, None},
  FrameLabel -> {None, None, labelx, None},
  GridLines -> {gridx, None},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 2.7}, {0, 0}, {0, 1}];
g2 = Show[g,
  AspectRatio -> 1.35,
  PlotRange -> All,
  DisplayFunction -> Identity];

```

(* Create Eigengenes 2D Red & Green Raster Display *)

```

contrast = 3.5;
displaying = Table[
  If[contrast * eigengenes[[i, j]] > 0,
    If[contrast * eigengenes[[i, j]] < 1, {contrast * eigengenes[[i, j]], 0}, {1, 0}],
    If[contrast * eigengenes[[i, j]] > -1, {0, -contrast * eigengenes[[i, j]]}, {0, 1}]],
  {i, 1, arrays}, {j, 1, arrays}];
framex = Table[{a - 0.5, arraynames[[2, a]]}, {a, 1, arrays}];
framey = Table[{a + 1 - 0.5, arrays - a}, {a, 0, arrays - 1}];
labely = "Eigengenes";
labelx = ColumnForm[{"(a) Arrays", " ", " "}, Center];
g = Show[
  Graphics[
    RasterArray[
      Table[
        RGBColor[
          displaying[[i, j, 1]], displaying[[i, j, 2]], 0
        ],
        {i, arrays, 1, -1}, {j, 1, arrays}
      ]],
    AspectRatio -> 1, Frame -> True,
    FrameTicks -> {None, framey, framex, None},
    FrameLabel -> {None, labely, labelx, None},
    DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 3, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 2.7}, {0, 0}, {0, 1}];
g1 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All,
  DisplayFunction -> Identity];

```

(* Create Selected Eigengenes Graph Display *)

```

eigengenes1 = Chop[TrigFit[Drop[Drop[eigengenes[[1]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.1]
eigengenes2 = Chop[TrigFit[Drop[Drop[eigengenes[[2]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.1]
eigengenes3 = Chop[TrigFit[Drop[Drop[eigengenes[[3]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.1]

0.156573 Sin[ $\frac{2}{17} \pi (-1 + x)$ ] + 0.245919 Sin[ $\frac{4}{17} \pi (-1 + x)$ ]

0.268897 Cos[ $\frac{4}{17} \pi (-1 + x)$ ] - 0.101226 Sin[ $\frac{2}{17} \pi (-1 + x)$ ]

-0.112311 Cos[ $\frac{4}{17} \pi (-1 + x)$ ] - 0.237957 Sin[ $\frac{2}{17} \pi (-1 + x)$ ] + 0.164016 Sin[ $\frac{4}{17} \pi (-1 + x)$ ]

eigengenes1 = 0.34 * Sin[4 * Pi * (x - 1) / 17] + 0.24 * Sin[2 * Pi * (x - 1) / 17];
eigengenes2 = 0.34 * Cos[4 * Pi * (x - 1) / 17] - 0.24 * Sin[2 * Pi * (x - 1) / 17];
eigengenes3 = 0.34 * Sin[4 * Pi * (x - 1) / 17 - Pi / 4] - 0.24 * Sin[2 * Pi * (x - 1) / 17];

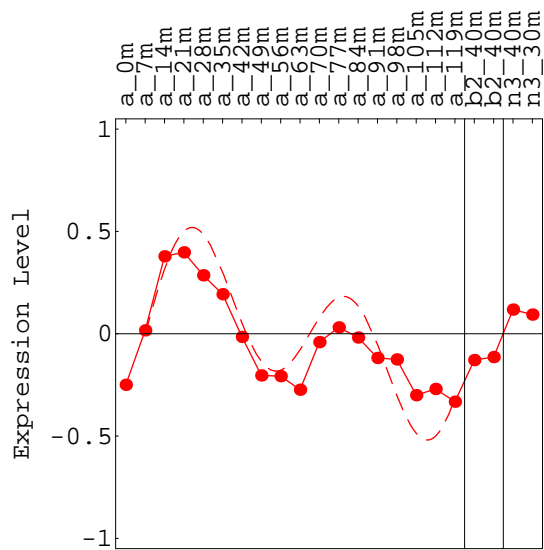
```

```

graph = Plot[
  eigengenes1,
  {x, 1, arrays - 5},
  PlotStyle -> {RGBColor[1, 0, 0], Dashing[{0.03, 0.02}]},
  DisplayFunction -> Identity];
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[1, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
  Graphics[{RGBColor[1, 0, 0], line}],
  graph},
  Frame -> True,
  FrameLabel -> {None, labely, labelx, None},
  GridLines -> {{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}},
  FrameTicks -> {None, framey, framex, None},
  PlotRange -> {-1.05, 1.05},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p1 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All];

```

(c) Arrays

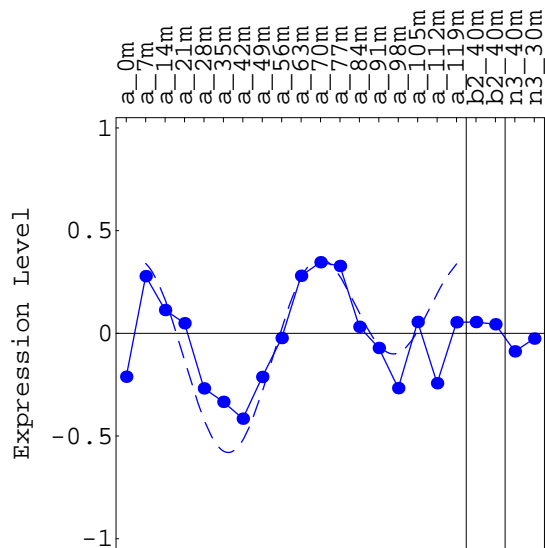


```

graph = Plot[
  eigengenes2,
  {x, 1, arrays - 5},
  PlotStyle -> {RGBColor[0, 0, 1], Dashing[{0.03, 0.02}]},
  DisplayFunction -> Identity];
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[2, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
  Graphics[{RGBColor[0, 0, 1], line}],
  graph},
  Frame -> True,
  FrameLabel -> {None, labely, labelx, None},
  GridLines -> {{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}},
  FrameTicks -> {None, framey, framex, None},
  PlotRange -> {-1.05, 1.05}, DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p2 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All];

```

(c) Arrays

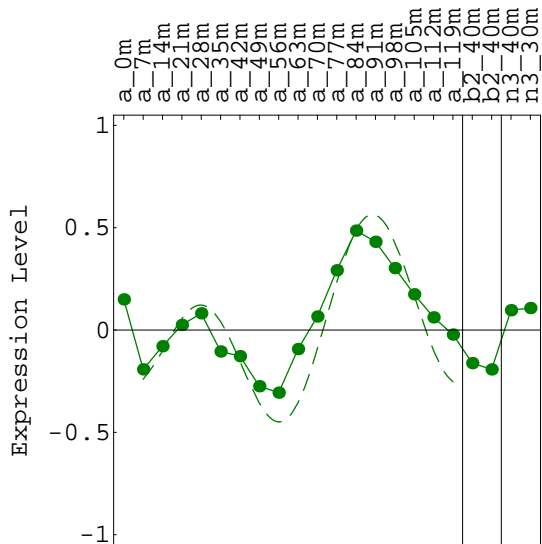


```

graph = Plot[
  eigengenes3,
  {x, 1, arrays - 5},
  PlotStyle -> {RGBColor[0, 0.5, 0], Dashing[{0.03, 0.02}]},
  DisplayFunction -> Identity];
labelx = ColumnForm[{"(c) Arrays", Center];
labely = ColumnForm[{" ", "Expression Level", Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[3, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[0, 0.5, 0], PointSize[0.022], points}],
  Graphics[{RGBColor[0, 0.5, 0], line}],
  graph},
  Frame -> True,
  FrameLabel -> {None, labely, labelx, None},
  GridLines -> {{{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}},
  FrameTicks -> {None, framey, framex, None},
  PlotRange -> {-1.05, 1.05}, DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p3 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All];

```

(c) Arrays



(* Display Selected Eigengenes *)

```

g3 = Show[{p3, p2, p1},
  DisplayFunction -> Identity];

```

(* Create Formulas Display *)

```
p1 = Show[Graphics[{RGBColor[1, 0, 0], Text["  $\sqrt{\frac{2}{T}} \sin(\frac{4 \pi t}{T}) + \sqrt{\frac{1}{T}} \sin(\frac{2 \pi t}{T})$ ", {605, 1}]}],  
  AspectRatio -> 120 / 750,  
  PlotRange -> {{0, 750}, {-1.55, 1.55}}];
```

$$\sqrt{\frac{2}{T}} \sin\left(\frac{4 \pi t}{T}\right) + \sqrt{\frac{1}{T}} \sin\left(\frac{2 \pi t}{T}\right)$$

```
p2 = Show[Graphics[{RGBColor[0, 0, 1], Text["  $\sqrt{\frac{2}{T}} \cos(\frac{4 \pi t}{T}) - \sqrt{\frac{1}{T}} \sin(\frac{2 \pi t}{T})$ ", {605, 0}]}],  
  AspectRatio -> 120 / 750,  
  PlotRange -> {{0, 750}, {-1.55, 1.55}}];
```

$$\sqrt{\frac{2}{T}} \cos\left(\frac{4 \pi t}{T}\right) - \sqrt{\frac{1}{T}} \sin\left(\frac{2 \pi t}{T}\right)$$

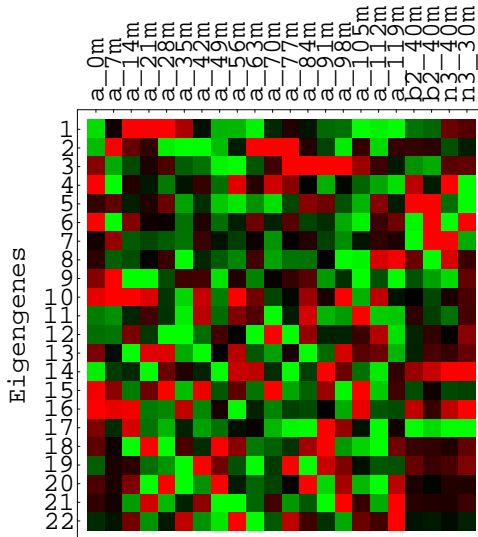
```
p3 = Show[Graphics[{RGBColor[0, 0.5, 0], Text["  $\sqrt{\frac{2}{T}} \sin(\frac{4 \pi t}{T} - \frac{\pi}{4}) - \sqrt{\frac{1}{T}} \sin(\frac{2 \pi t}{T})$ ", {605, -1}]}],  
  AspectRatio -> 120 / 750,  
  PlotRange -> {{0, 750}, {-1.55, 1.55}}];
```

$$\sqrt{\frac{2}{T}} \sin\left(\frac{4 \pi t}{T} - \frac{\pi}{4}\right) - \sqrt{\frac{1}{T}} \sin\left(\frac{2 \pi t}{T}\right)$$

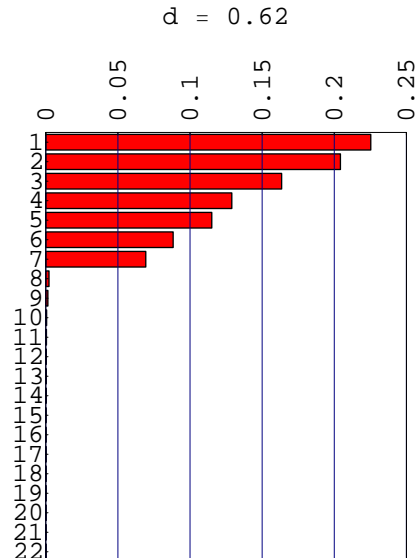
(* Display Eigenvalues, Fractions, Selected Eigenvalues and Formulas *)

```
Show[GraphicsArray[{g1, g2, g3}],
GraphicsSpacing -> -0.2];
```

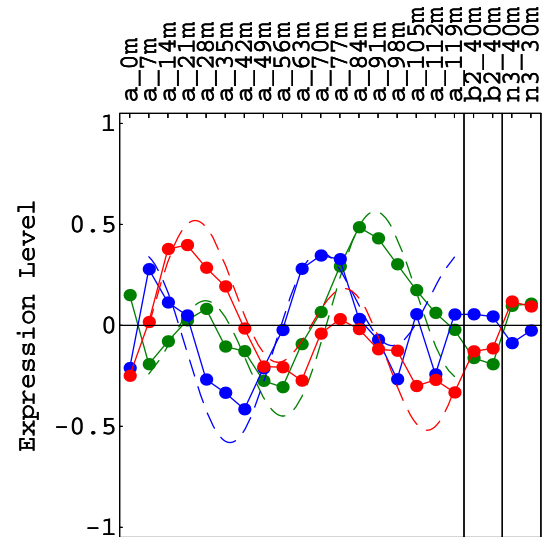
(a) Arrays



(b) Eigenexpression Fraction



(c) Arrays



```
Show[{p1, p2, p3},
AspectRatio -> 120 / 750,
PlotRange -> {{0, 750}, {-1.55, 1.55}}];
```

$$\sqrt{\frac{2}{T}} \sin\left(\frac{4\pi t}{T}\right) + \sqrt{\frac{1}{T}} \sin\left(\frac{2\pi t}{T}\right)$$

$$\sqrt{\frac{2}{T}} \cos\left(\frac{4\pi t}{T}\right) - \sqrt{\frac{1}{T}} \sin\left(\frac{2\pi t}{T}\right)$$

$$\sqrt{\frac{2}{T}} \sin\left(\frac{4\pi t}{T} - \frac{\pi}{4}\right) - \sqrt{\frac{1}{T}} \sin\left(\frac{2\pi t}{T}\right)$$

```
(* Rotate Eigenenes & Eigenarrays in Degenerate Subspace *)
```

```
(* Degenerate Subspace Assumption *)
```

```
eigenexpression =  
  Sqrt[eigenexpressions[[1]]^2 + eigenexpressions[[2]]^2 + eigenexpressions[[3]]^2] / Sqrt[3];  
eigenexpressions[[1]] = eigenexpression;  
eigenexpressions[[2]] = eigenexpression;  
eigenexpressions[[3]] = eigenexpression;  
Clear[eigenexpression];
```

```
fractions = eigenexpressions^2 / Sum[eigenexpressions[[a]]^2, {a, 1, arrays}];
```

```
(* First Rotation *)
```

```
eigenarrays = Transpose[eigenarrays];
```

```
Clear[x];
```

```
x = x /. NSolve[  
  (x * eigengenes[[2, 20]] + Sqrt[1 - x^2] * eigengenes[[1, 20]]) -  
  (x * eigengenes[[2, 21]] + Sqrt[1 - x^2] * eigengenes[[1, 21]]) == 0, x][[1]]
```

```
0.869386
```

```
eigengenes1 = Table[eigengenes[[1, a]], {a, 1, arrays}];  
eigengenes2 = Table[eigengenes[[2, a]], {a, 1, arrays}];  
eigengenes[[2]] = x * eigengenes2 + Sqrt[1 - x^2] * eigengenes1;  
eigengenes[[1]] = -Sqrt[1 - x^2] * eigengenes2 + x * eigengenes1;  
Clear[eigengenes1, eigengenes2];  
eigenarrays1 = Table[eigenarrays[[1, a]], {a, 1, genes}];  
eigenarrays2 = Table[eigenarrays[[2, a]], {a, 1, genes}];  
eigenarrays[[2]] = x * eigenarrays2 + Sqrt[1 - x^2] * eigenarrays1;  
eigenarrays[[1]] = -Sqrt[1 - x^2] * eigenarrays2 + x * eigenarrays1;  
Clear[x, eigenarrays1, eigenarrays2];
```

```
(* Second Rotation *)
```

```
Clear[x];
```

```
x = x /. NSolve[  
  (x * eigengenes[[1, 20]] + Sqrt[1 - x^2] * eigengenes[[3, 20]]) -  
  (x * eigengenes[[1, 21]] + Sqrt[1 - x^2] * eigengenes[[3, 21]]) == 0, x][[1]]
```

```
-0.735103
```

```
eigengenes1 = Table[eigengenes[[1, a]], {a, 1, arrays}];  
eigengenes3 = Table[eigengenes[[3, a]], {a, 1, arrays}];  
eigengenes[[1]] = Sqrt[1 - x^2] * eigengenes1 - x * eigengenes3;  
eigengenes[[3]] = -x * eigengenes1 - Sqrt[1 - x^2] * eigengenes3;  
Clear[eigengenes1, eigengenes3];  
eigenarrays1 = Table[eigenarrays[[1, a]], {a, 1, genes}];  
eigenarrays3 = Table[eigenarrays[[3, a]], {a, 1, genes}];  
eigenarrays[[1]] = Sqrt[1 - x^2] * eigenarrays1 - x * eigenarrays3;  
eigenarrays[[3]] = -x * eigenarrays1 - Sqrt[1 - x^2] * eigenarrays3;  
Clear[x, eigenarrays1, eigenarrays3];
```

```
eigenarrays = Transpose[eigenarrays];
```

(* Create Fractions Bar Charts Displays *)

```
fractions[[1]]
0.197346

limit = 0.25;

Clear[gridx, framex, framey, sizes];
gridx = Table[a, {a, 0, limit, N[limit/5]};
framex = gridx;
sizes = Flatten[
  Table[
    Dimensions[
      Characters[
        ToString[framex[[a]]]
      ]
    ], {a, 1, 6}];];
Do[
  Do[framex[[a]] = StringJoin[ToString[framex[[a]]], " ",
    {b, 1, size - sizes[[a]]}],
    {a, 1, 6}];
framex = Table[{gridx[[a]], framex[[a]]}, {a, 1, 6};
framey = Table[{a + 1, arrays - a}, {a, 0, arrays - 1};
labelx = ColumnForm[
  {"(b) Eigenexpression Fraction", StringJoin["d = ", ToString[entropy]], " "}, Center];
g = BarChart[
  Table[fractions[[arrays - a]], {a, 0, arrays - 1}],
  BarOrientation -> Horizontal,
  PlotRange -> {{0, limit * 1.0001}, {0.5, arrays + 0.5}},
  AspectRatio -> 1,
  Axes -> False,
  Frame -> True,
  FrameTicks -> {None, framey, framex, None},
  FrameLabel -> {None, None, labelx, None},
  GridLines -> {gridx, None},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 2.7}, {0, 0}, {0, 1}];
g2 = Show[g,
  AspectRatio -> 1.35,
  PlotRange -> All,
  DisplayFunction -> Identity];
```

(* Create Eigengenes 2D Red & Green Raster Display *)

```

contrast = 3.5;
displaying = Table[
  If[contrast * eigengenes[[i, j]] > 0,
    If[contrast * eigengenes[[i, j]] < 1, {contrast * eigengenes[[i, j]], 0}, {1, 0}],
    If[contrast * eigengenes[[i, j]] > -1, {0, -contrast * eigengenes[[i, j]]}, {0, 1}]],
  {i, 1, arrays}, {j, 1, arrays}];
framex = Table[{a - 0.5, arraynames[[2, a]]}, {a, 1, arrays}];
framey = Table[{a + 1 - 0.5, arrays - a}, {a, 0, arrays - 1}];
labely = "Eigengenes";
labelx = ColumnForm[{"(a) Arrays", " ", " "}, Center];
g = Show[
  Graphics[
    RasterArray[
      Table[
        RGBColor[
          displaying[[i, j, 1]], displaying[[i, j, 2]], 0
        ],
        {i, arrays, 1, -1}, {j, 1, arrays}
      ]],
    AspectRatio -> 1, Frame -> True,
    FrameTicks -> {None, framey, framex, None},
    FrameLabel -> {None, labely, labelx, None},
    DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 3, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 3}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 2.7}, {0, 0}, {0, 1}];
g1 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All,
  DisplayFunction -> Identity];

```

(* Create Selected Eigengenes Graph Display *)

```

eigengenes1 = Chop[TrigFit[Drop[Drop[eigengenes[[1]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.1]
eigengenes2 = Chop[TrigFit[Drop[Drop[eigengenes[[2]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.1]
eigengenes3 = Chop[TrigFit[Drop[Drop[eigengenes[[3]], {19, 22}], {1}], 2, {x - 1, arrays - 5}], 0.1]

-0.18596 Cos[ $\frac{4}{17} \pi (-1 + x)$ ] + 0.233424 Sin[ $\frac{4}{17} \pi (-1 + x)$ ]

0.22261 Cos[ $\frac{4}{17} \pi (-1 + x)$ ] + 0.204797 Sin[ $\frac{4}{17} \pi (-1 + x)$ ]

0.100832 Cos[ $\frac{2}{17} \pi (-1 + x)$ ] + 0.298157 Sin[ $\frac{2}{17} \pi (-1 + x)$ ]

eigengenes1 = 0.34 * Sin[4 * Pi * (x - 1) / 17 - Pi / 4];
eigengenes2 = 0.34 * Cos[4 * Pi * (x - 1) / 17 - Pi / 4];
eigengenes3 = 0.34 * Sin[2 * Pi * (x - 1) / 17 + Pi / 8];

```

```

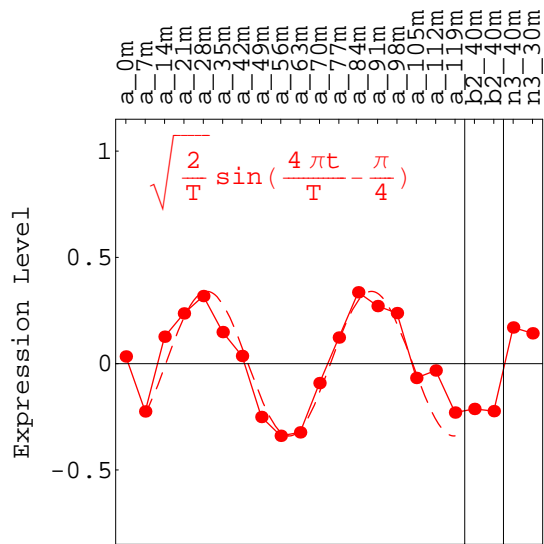
graph = Plot[
  eigengenes1,
  {x, 1, arrays - 5},
  PlotStyle -> {RGBColor[1, 0, 0], Dashing[{0.03, 0.02}]},
  DisplayFunction -> Identity];
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[1, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[1, 0, 0], PointSize[0.022], points}],
  Graphics[{RGBColor[1, 0, 0], line}],
  graph,

  Graphics[{RGBColor[1, 0, 0], Text[" $\sqrt{\frac{2}{T}} \sin(\frac{4\pi t}{T} - \frac{\pi}{4})$ ", {8, 0.9}]}]}],

Frame -> True,
FrameLabel -> {None, labely, labelx, None},
GridLines -> {{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}},
FrameTicks -> {None, framey, framex, None},
PlotRange -> {-0.85, 1.15},
DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p1 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All];

```

(c) Arrays



```

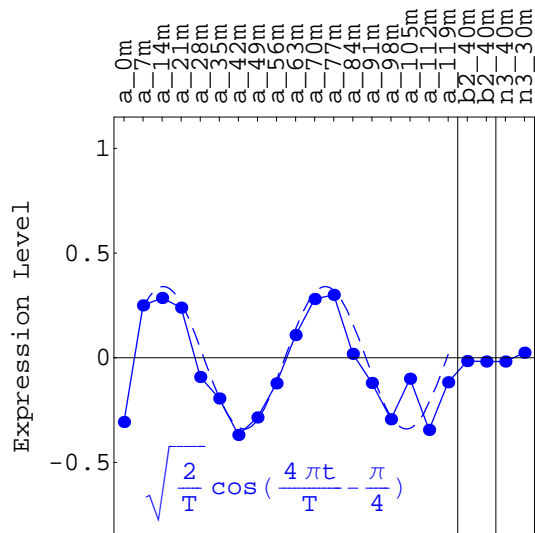
graph = Plot[
  eigengenes2,
  {x, 1, arrays - 5},
  PlotStyle -> {RGBColor[0, 0, 1], Dashing[{0.03, 0.02}]},
  DisplayFunction -> Identity];
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[2, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[0, 0, 1], PointSize[0.022], points}],
  Graphics[{RGBColor[0, 0, 1], line}],
  graph,

  Graphics[{RGBColor[0, 0, 1], Text[" $\sqrt{\frac{2}{T}} \cos(\frac{4\pi t}{T} - \frac{\pi}{4})$ ", {8, -0.6}]}]},

Frame -> True,
FrameLabel -> {None, labely, labelx, None},
GridLines -> {{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}},
FrameTicks -> {None, framey, framex, None},
PlotRange -> {-0.85, 1.15},
DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p2 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All];

```

(c) Arrays

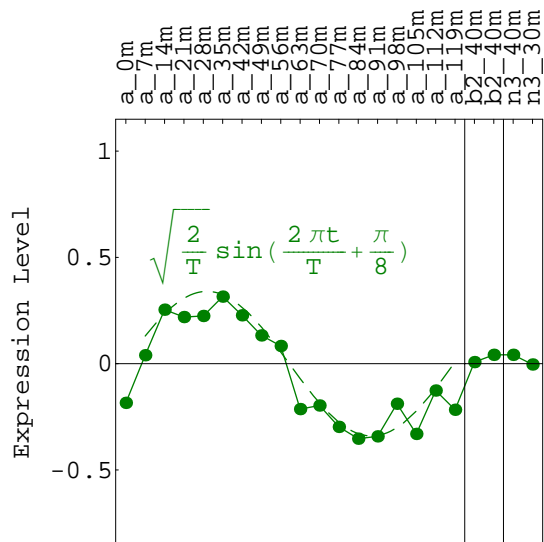


```

graph = Plot[
  eigengenes3,
  {x, 1, arrays - 5},
  PlotStyle -> {RGBColor[0, 0.5, 0], Dashing[{0.03, 0.02]}},
  DisplayFunction -> Identity];
labelx = ColumnForm[{"(c) Arrays"}, Center];
labely = ColumnForm[{" ", "Expression Level"}, Center];
framex = Table[{a - 1, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {-1, -0.5, 0, 0.5, 1};
coordinates = Table[{a - 1, eigengenes[[3, a]]}, {a, 1, arrays}];
points = Table[Point[coordinates[[a]]], {a, 1, arrays}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[0, 0.5, 0], PointSize[0.022], points}],
  Graphics[{RGBColor[0, 0.5, 0], line}],
  graph,
  Graphics[{RGBColor[0, 0.5, 0], Text[" $\sqrt{\frac{2}{T}} \sin(\frac{2\pi t}{T} + \frac{\pi}{8})$ ", {8, 0.55}]}]},
  Frame -> True,
  FrameLabel -> {None, labely, labelx, None},
  GridLines -> {{17.5, RGBColor[0, 0, 0]}, {19.5, RGBColor[0, 0, 0]}}, {{0, RGBColor[0, 0, 0]}},
  FrameTicks -> {None, framey, framex, None},
  PlotRange -> {-0.85, 1.15},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b - 5.4, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 0.625}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 0.25}, {0, 0}, {0, 1}];
p3 = Show[g,
  AspectRatio -> 1.05,
  PlotRange -> All];

```

(c) Arrays



(* Display Selected Eigengenes *)

```

g3 = Show[{p3, p2, p1},
  DisplayFunction -> Identity];

```

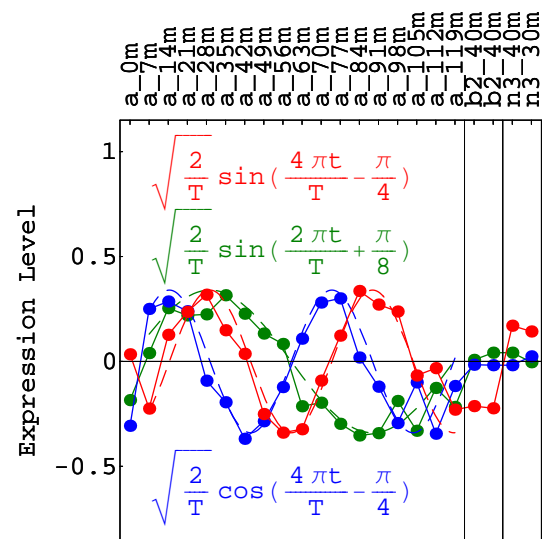
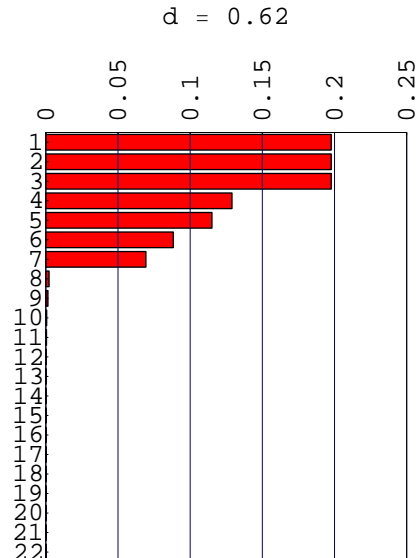
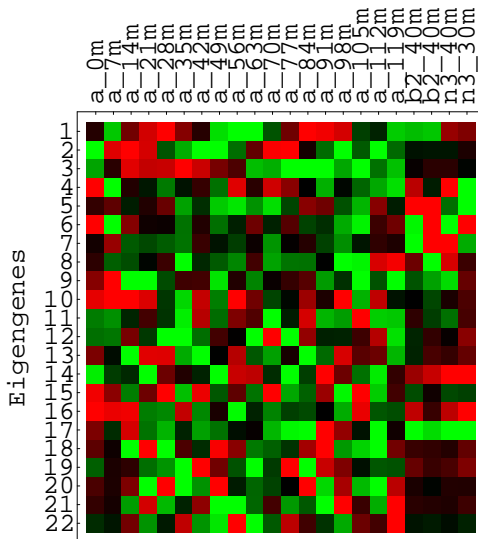
(* Display Eigengenes, Fractions and Selected Eigenenes *)

```
Show[GraphicsArray[{g1, g2, g3}],
GraphicsSpacing -> -0.2];
```

(a) Arrays

(b) Eigenexpression Fraction

(c) Arrays



(* Reconstruct Data With Rotated Eigengenes and Eigenarrays *)

```
matrix = Dot[eigenarrays, DiagonalMatrix[eigenexpressions], eigengenes];
arraycorrelations = Dot[DiagonalMatrix[eigenexpressions], eigengenes];
genecorrelations = Dot[eigenarrays, DiagonalMatrix[eigenexpressions]];
genecorrelations = Transpose[genecorrelations];
```

(* Create Parameter Graphs of Arrays According to Projections on Eigenarrays *)

```
labelx = ColumnForm[{"Array Correlation with  $|\alpha_2\rangle$ "}, Center];
labely = ColumnForm[{"Array Correlation with  $|\alpha_1\rangle$ "}, Center];
matrix = Transpose[matrix];
coordinates = Table[
  {arraycorrelations[[2, a]] / Sqrt[Dot[matrix[[a]], matrix[[a]]]],
  arraycorrelations[[1, a]] / Sqrt[Dot[matrix[[a]], matrix[[a]]]]},
  {a, 1, arrays}];
matrix = Transpose[matrix];
points0 = Point[coordinates[[1]]];
points1 = {Point[coordinates[[2]]], Point[coordinates[[10]]], Point[coordinates[[11]]]};
points2 = {Point[coordinates[[3]]], Point[coordinates[[4]]], Point[coordinates[[12]]],
  Point[coordinates[[13]]], Point[coordinates[[21]]], Point[coordinates[[22]]]};
points3 = {Point[coordinates[[5]]], Point[coordinates[[6]]], Point[coordinates[[14]]],
  Point[coordinates[[15]]]};
points4 = {Point[coordinates[[7]]], Point[coordinates[[16]]], Point[coordinates[[19]]],
  Point[coordinates[[20]]]};
points5 = {Point[coordinates[[8]]], Point[coordinates[[9]]], Point[coordinates[[17]]],
  Point[coordinates[[18]]]};
textcoordinates = coordinates;
Do[textcoordinates[[a, 1]] =
  If[textcoordinates[[a, 1]] > 0, textcoordinates[[a, 1]] + 0.085, textcoordinates[[a, 1]] - 0.085],
  {a, 1, 9}];
Do[textcoordinates[[a, 1]] =
  If[textcoordinates[[a, 1]] > 0, textcoordinates[[a, 1]] + 0.11, textcoordinates[[a, 1]] - 0.11],
  {a, 10, arrays}];
```

```

textcoordinates[[3]] = textcoordinates[[3]] + {0, 0.02};
textcoordinates[[10]] = textcoordinates[[10]] + {-0.22, -0.04};
textcoordinates[[12]] = textcoordinates[[12]] + {-0.22, -0.04};
textcoordinates[[15]] = textcoordinates[[15]] + {0, -0.08};
textcoordinates[[17]] = textcoordinates[[17]] + {0.1, -0.1};
texts = Table[Text[a, textcoordinates[[a]]], {a, 1, arrays}];
zerophase = N[ArcTan[arraycorrelations[[1, 2]] / (arraycorrelations[[2, 2]])]];
radius = Sqrt[coordinates[[2, 1]]^2 + coordinates[[2, 2]]^2];
p = Show[{
  Graphics[{RGBColor[0, 0, 0], PointSize[0.035], points0}],
  Graphics[{RGBColor[1, 1, 0], PointSize[0.035], points1}],
  Graphics[{RGBColor[0, 0.5, 0], PointSize[0.035], points2}],
  Graphics[{RGBColor[0, 0, 1], PointSize[0.035], points3}],
  Graphics[{RGBColor[1, 0, 0], PointSize[0.035], points4}],
  Graphics[{RGBColor[1, 0.5, 0], PointSize[0.035], points5}],
  Graphics[{RGBColor[1, 0.5, 0], Text["G2/M", {-0.6, -0.95}]}],
  Graphics[{RGBColor[0, 0, 0], Text["M/G1", {0.875, -0.775}]}],
  Graphics[{RGBColor[1, 0, 0], Text["S/G2", {-0.875, -0.75}]}],
  Graphics[{RGBColor[0, 0, 1], Text["S", {-0.8, 0.8}]}],
  Graphics[{RGBColor[0, 0.5, 0], Text["G1", {0.55, 0.95}]}],
  Graphics[{RGBColor[0, 0, 0], Text["(a)", {-0.9, 0.95}]}],
  Graphics[texts],
  Graphics[{RGBColor[0, 0, 0], Arrow[{0.675, -0.875}, {0.04, -0.395}],
    HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75}],
  Graphics[{RGBColor[0, 0, 0], Text["CLB2", {0.75, -0.95}]}],
  Graphics[{RGBColor[0, 0, 0], Arrow[{0.665, 0.8}, {0.03, 0.325}],
    HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75}],
  Graphics[{RGBColor[0, 0, 0], Text["CLN3", {0.85, 0.8}]}],
  Graphics[{RGBColor[0, 0, 0], Dashing[{0.03, 0.02}], Circle[{0, 0}, 0.5, {0.5 * Pi, 1.5 * Pi}]}],
  Graphics[{RGBColor[0, 0, 0], Dashing[{0.03, 0.02}], Circle[{0, 0}, 1]}],
  Graphics[{RGBColor[0, 0, 0], Circle[{0, 0}, radius, {zerophase, 0}]}],
  Graphics[{RGBColor[0, 0, 0], Arrow[
    {radius * Cos[-0.05], radius * Sin[-0.05]}, {radius * Cos[0], radius * Sin[0]},
    HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75}],
  Graphics[{RGBColor[0, 0, 0], Circle[{0, 0}, 0.925, {zerophase, -0.5 * zerophase}]}],
  Graphics[{RGBColor[0, 0, 0], Arrow[
    {0.925 * Cos[-0.5 * zerophase - 0.05], 0.925 * Sin[-0.5 * zerophase - 0.05]},
    {0.925 * Cos[-0.5 * zerophase], 0.925 * Sin[-0.5 * zerophase]},
    HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75}],
  Graphics[{RGBColor[0, 0, 0], Arrow[{0, 0}, coordinates[[2]],
    HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75}],
  Graphics[{RGBColor[0, 0, 0], Text["r", {0.2, -0.3}]}],
  Graphics[{RGBColor[0, 0, 0], Text[" $\frac{\pi}{4}$ ", {0.4, -0.15}]}],
  AspectRatio -> 1,
  PlotRange -> {{-1.05, 1.05}, {-1.05, 1.05}},
  Frame -> True,
  FrameTicks -> False,
  FrameLabel -> {labelx, labely, None, None},
  GridLines -> {{0, RGBColor[0, 0, 0]}, {0, RGBColor[0, 0, 0]}},
  DisplayFunction -> Identity];
p = FullGraphics[p];
p[[1, 2]] = p[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {-1.18, 0}, {0, 0}, {0, 1}];
p1 = Show[p,
  AspectRatio -> 1.,
  PlotRange -> All,
  DisplayFunction -> Identity];

```

```
(* Create Parameter Graphs of Genes According to Projections on Eigengenes *)
```

```
labelx = ColumnForm[{"Gene Correlation with  $|\gamma_2\rangle$ "}, Center];
labely = ColumnForm[{"Gene Correlation with  $|\gamma_1\rangle$ "}, Center];
coordinates = Table[
  {genecorrelations[[2, a]] / Sqrt[Dot[matrix[[a]], matrix[[a]]],
    genecorrelations[[1, a]] / Sqrt[Dot[matrix[[a]], matrix[[a]]]}],
  {a, 1, genes}];
points = Table[Point[coordinates[[a]], {a, 1, genes}];
stream = StringJoin[name, ":Desktop Folder:PNAS Data:Classify_Alpha&Cls.txt"];
list = ReadList[stream, Word, RecordLists -> True, NullWords -> True];
list = Drop[list, 2];

position = Position[list, "M/G1"];
points1 = Table[Point[coordinates[[position[[a, 1]]]], {a, 1, Dimensions[position][[1]]};
radii1 = Table[Sqrt[coordinates[[position[[a, 1]], 1]]^2 + coordinates[[position[[a, 1]], 2]]^2],
  {a, 1, Dimensions[position][[1]]};
Dimensions[points1][[1]]
position = Position[list, "G1"];
points2 = Table[Point[coordinates[[position[[a, 1]]]], {a, 1, Dimensions[position][[1]]};
radii2 = Table[Sqrt[coordinates[[position[[a, 1]], 1]]^2 + coordinates[[position[[a, 1]], 2]]^2],
  {a, 1, Dimensions[position][[1]]};
Dimensions[points2][[1]]
position = Position[list, "S"];
points3 = Table[Point[coordinates[[position[[a, 1]]]], {a, 1, Dimensions[position][[1]]};
radii3 = Table[Sqrt[coordinates[[position[[a, 1]], 1]]^2 + coordinates[[position[[a, 1]], 2]]^2],
  {a, 1, Dimensions[position][[1]]};
Dimensions[points3][[1]]
position = Position[list, "S/G2"];
points4 = Table[Point[coordinates[[position[[a, 1]]]], {a, 1, Dimensions[position][[1]]};
radii4 = Table[Sqrt[coordinates[[position[[a, 1]], 1]]^2 + coordinates[[position[[a, 1]], 2]]^2],
  {a, 1, Dimensions[position][[1]]};
Dimensions[points4][[1]]
position = Position[list, "G2/M"];
points5 = Table[Point[coordinates[[position[[a, 1]]]], {a, 1, Dimensions[position][[1]]};
radii5 = Table[Sqrt[coordinates[[position[[a, 1]], 1]]^2 + coordinates[[position[[a, 1]], 2]]^2],
  {a, 1, Dimensions[position][[1]]};
Dimensions[points5][[1]]

87
238
54
95
164

radii = AppendRows[{radii1}, {radii2}, {radii3}, {radii4}, {radii5}][[1]];
radii = Sort[radii, OrderedQ[{{#1}, {#2}}]&];
N[Round[radii[[94]] * 100 / 100]
N[Round[radii[[95]] * 100 / 100]

0.49
0.5

(* 638 cell cycle genes, 87 in M/G1, 238 in G1, 54 in S, 95 in S/G2, 164 in G2/M. *)

(* 544 with more than 25% of normalized expression in the cell cycle subspace. *)
```

```

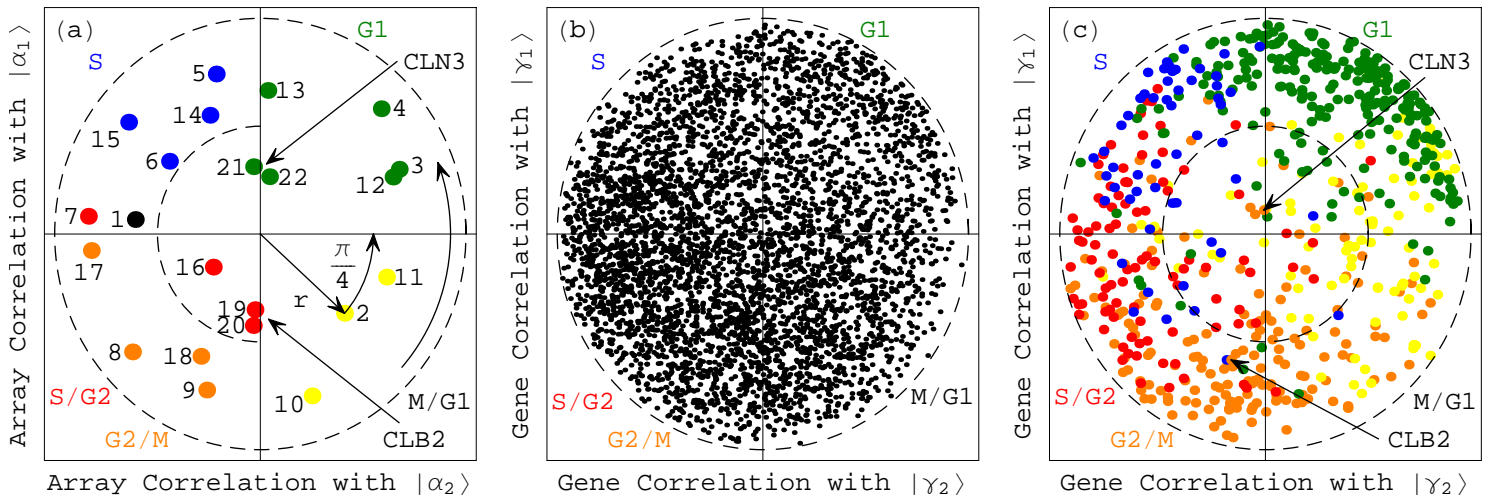
p = Show[{
  Graphics[{RGBColor[0, 0, 0], PointSize[0.01], points}],
  Graphics[{RGBColor[1, 0.5, 0], Text["G2/M", {-0.6, -0.95}]}],
  Graphics[{RGBColor[0, 0, 0], Text["M/G1", {0.875, -0.75}]}],
  Graphics[{RGBColor[1, 0, 0], Text["S/G2", {-0.875, -0.775}]}],
  Graphics[{RGBColor[0, 0, 1], Text["S", {-0.8, 0.8}]}],
  Graphics[{RGBColor[0, 0.5, 0], Text["G1", {0.55, 0.95}]}],
  Graphics[{RGBColor[0, 0, 0], Text["(b)", {-0.9, 0.95}]}],
  Graphics[{RGBColor[0, 0, 0], Dashing[{0.03, 0.025}], Circle[{0, 0}, 1]}]},
AspectRatio -> 1,
PlotRange -> {{-1.05, 1.05}, {-1.05, 1.05}},
Frame -> True,
FrameTicks -> False,
FrameLabel -> {labelx, labely, None, None},
GridLines -> {{0, RGBColor[0, 0, 0]}, {0, RGBColor[0, 0, 0]}},
DisplayFunction -> Identity];
p = FullGraphics[p];
p[[1, 2]] = p[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {-1.18, 0}, {0, 0}, {0, 1}];
p2 = Show[p,
  AspectRatio -> 1.,
  PlotRange -> All,
  DisplayFunction -> Identity];

clb2 = coordinates[Position[list, "YPR119W"][[1, 1]]];
c1n3 = coordinates[Position[list, "YAL040C"][[1, 1]]];
p = Show[{
  Graphics[{RGBColor[1, 0.5, 0], PointSize[0.02], points5}],
  Graphics[{RGBColor[1, 1, 0], PointSize[0.02], points1}],
  Graphics[{RGBColor[1, 0, 0], PointSize[0.02], points4}],
  Graphics[{RGBColor[0, 0.5, 0], PointSize[0.02], points2}],
  Graphics[{RGBColor[0, 0, 1], PointSize[0.02], points3}],
  Graphics[{RGBColor[1, 0.5, 0], Text["G2/M", {-0.6, -0.95}]}],
  Graphics[{RGBColor[0, 0, 0], Text["M/G1", {0.875, -0.775}]}],
  Graphics[{RGBColor[1, 0, 0], Text["S/G2", {-0.875, -0.75}]}],
  Graphics[{RGBColor[0, 0, 1], Text["S", {-0.8, 0.8}]}],
  Graphics[{RGBColor[0, 0.5, 0], Text["G1", {0.55, 0.95}]}],
  Graphics[{RGBColor[0, 0, 0], Text["(c)", {-0.9, 0.95}]}],
  Graphics[{RGBColor[1, 0.5, 0], PointSize[0.02], Point[clb2]}],
  Graphics[{RGBColor[0, 0, 0], Arrow[{0.55, -0.95}, clb2,
    HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75}]}],
  Graphics[{RGBColor[0, 0, 0], Text["CLB2", {0.75, -0.95}]}],
  Graphics[{RGBColor[1, 0.5, 0], PointSize[0.02], Point[c1n3]}],
  Graphics[{RGBColor[0, 0, 0], Arrow[{0.775, 0.725}, c1n3,
    HeadCenter -> 0.5, HeadLength -> 0.035, HeadWidth -> 0.75}]}],
  Graphics[{RGBColor[0, 0, 0], Text["CLN3", {0.85, 0.8}]}],
  Graphics[{RGBColor[0, 0, 0], Dashing[{0.03, 0.02}], Circle[{0, 0}, 0.5]}],
  Graphics[{RGBColor[0, 0, 0], Dashing[{0.03, 0.02}], Circle[{0, 0}, 1]}]},
AspectRatio -> 1,
PlotRange -> {{-1.05, 1.05}, {-1.05, 1.05}},
Frame -> True,
FrameTicks -> False,
FrameLabel -> {labelx, labely, None, None},
GridLines -> {{0, RGBColor[0, 0, 0]}, {0, RGBColor[0, 0, 0]}},
DisplayFunction -> Identity];
p = FullGraphics[p];
p[[1, 2]] = p[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {-1.18, 0}, {0, 0}, {0, 1}];
p3 = Show[p,
  AspectRatio -> 1.,
  PlotRange -> All,
  DisplayFunction -> Identity];

```

(* Display Both Arrays & Genes Parameter Graphs *)

```
Show[GraphicsArray[{p1, p2, p3}],
GraphicsSpacing -> 0];
```



(* Sort Normalized Data *)

(* Define the Initial Phase According to the Initial Array *)

```
zerophase = N[ArcTan[arraycorrelations[[1, 2]] / (arraycorrelations[[2, 2]])] / Pi]
-0.232818
```

(* Sort Data by Phase *)

```
radii = Table[Sqrt[coordinates[[a, 1]]^2 + coordinates[[a, 2]]^2], {a, 1, genes}];
coordinates = Table[
  {-genecorrelations[[2, a]] / Sqrt[genecorrelations[[1, a]]^2 + genecorrelations[[2, a]]^2],
  -genecorrelations[[1, a]] / Sqrt[genecorrelations[[1, a]]^2 + genecorrelations[[2, a]]^2],
  N[ArcTan[genecorrelations[[1, a]] / (genecorrelations[[2, a]])] / Pi],
  radii[[a]]},
  {a, 1, genes}];
sortmatrix = AppendRows[coordinates, genenames, matrix];
sortmatrix = Sort[sortmatrix, OrderedQ[{{#1}, {#2}}]&];
negative1 = 1913;
positive1 = 1914;
sortmatrix[[negative1, 1]]
sortmatrix[[positive1, 1]]
```

-0.000990132

0.000695258

```
sortmatrix = Transpose[Drop[Transpose[sortmatrix], {1}]];
sortmatrix = AppendColumns[
  Sort[
    TakeRows[sortmatrix, {1, negative1}],
    OrderedQ[{{#2}, {#1}}]&],
  Sort[
    TakeRows[sortmatrix, {positive1, genes}],
    OrderedQ[{{#1}, {#2}}]&
  ];
sortmatrix = Transpose[Drop[Transpose[sortmatrix], {1}]];
```

(* Correct for the Phase & Calibrate According to the Initial Phase *)

```
Do[sortmatrix[[a, 1]] = sortmatrix[[a, 1]] - zerophase,
  {a, 1, negative1}];
Do[sortmatrix[[a, 1]] = sortmatrix[[a, 1]] + 1 - zerophase,
  {a, positive1, genes}];
negative2 = 620;
positive2 = 621;
sortmatrix[[negative2, 1]]
sortmatrix[[positive2, 1]]
```

-0.000297782

0.00017983

```
sortmatrix = AppendColumns[
  TakeRows[sortmatrix, {positive2, genes}],
  TakeRows[sortmatrix, {1, negative2}]
];
positive3 = 3959;
negative3 = 3960;
sortmatrix[[positive3, 1]]
sortmatrix[[negative3, 1]]
```

1.7326

-0.266866

```
Do[sortmatrix[[a, 1]] = sortmatrix[[a, 1]] + 2,
  {a, negative3, genes}];
```

(* Reconstruct Data With Sorted Genes *)

```
matrix = TakeColumns[sortmatrix, {4, arrays + 3}];
eigenarrays = Dot[eigengenes, Transpose[matrix]];
Do[
  eigenarrays[[a]] = eigenarrays[[a]] / eigenexpressions[[a]],
  {a, 1, arrays}];
eigenarrays = Transpose[eigenarrays];
arraycorrelations = Dot[DiagonalMatrix[eigenexpressions], eigengenes];
genecorrelations = Dot[eigenarrays, DiagonalMatrix[eigenexpressions]];
genecorrelations = Transpose[genecorrelations];
```

(* Classify Gene Phases into Cell Cycle Phases *)

```
phases = TakeColumns[sortmatrix, {1, 1}];  
ph1 = -zerophase;  
ph2 = 0.5 - zerophase;  
ph3 = 1 - zerophase;  
ph4 = 1.25 - zerophase;  
ph5 = 1.5 - zerophase;
```

```
endph5 = 400;  
beginph1 = 401;  
phases[[endph5]] - ph1  
phases[[beginph1]] - ph1
```

```
{-0.000187677}
```

```
{0.000212016}
```

```
endph1 = 1293;  
beginph2 = 1294;  
phases[[endph1]] - ph2  
phases[[beginph2]] - ph2
```

```
{-0.00100573}
```

```
{0.000373599}
```

```
endph2 = 2489;  
beginph3 = 2490;  
phases[[endph2]] - ph3  
phases[[beginph3]] - ph3
```

```
{-0.000678895}
```

```
{0.0000777914}
```

```
endph3 = 3296;  
beginph4 = 3297;  
phases[[endph3]] - ph4  
phases[[beginph4]] - ph4
```

```
{-0.000102043}
```

```
{0.0000380196}
```

```
endph4 = 3959;  
beginph5 = 3960;  
phases[[endph4]] - ph5  
phases[[beginph5]] - ph5
```

```
{-0.000221307}
```

```
{0.000315169}
```

(* 4579 yeast genes, 1020 in M/G1, 893 in G1, 1196 in S, 807 in S/G2, 663 in G2/M. *)

```
(* Create Classified Sorted Data 2D Red & Green Raster Display *)
```

```
contrast = 2;
displaying = Table[
  If[contrast*matrix[[i, j]] > 0,
    If[contrast*matrix[[i, j]] < 1, {contrast*matrix[[i, j]], 0}, {1, 0}],
    If[contrast*matrix[[i, j]] > -1, {0, -contrast*matrix[[i, j]]}, {0, 1}]],
  {i, 1, genes}, {j, 1, arrays}];
framex = Table[{a - 0.5, arraynames[[2, a]]}, {a, 1, arrays}];
framey = {
  {genes - endph5 / 2, "M/G1"},
  {genes - (endph5 + endph1) / 2, "G1"},
  {genes - (endph1 + endph2) / 2, "S"},
  {genes - (endph2 + endph3) / 2, "S/G2"},
  {genes - (endph3 + endph4) / 2, "G2/M"},
  {(genes - endph4) / 2, "M/G1"}];
gridy = {
  {genes - endph1 + 0.5, {RGBColor[0, 0, 0]}},
  {genes - endph2 + 0.5, {RGBColor[0, 0, 0]}},
  {genes - endph3 + 0.5, {RGBColor[0, 0, 0]}},
  {genes - endph4 + 0.5, {RGBColor[0, 0, 0]}},
  {genes - endph5 + 0.5, {RGBColor[0, 0, 0]}}];
labelx = "(a) Arrays";
labely = ColumnForm[{" ", "Genes", " ", " ", " ", " ", " ", " ", " "}, Center];
g = Show[
  Graphics[
    RasterArray[
      Table[
        RGBColor[
          displaying[[i, j, 1]], displaying[[i, j, 2]], 0
        ],
        {i, genes, 1, -1}, {j, 1, arrays}
      ]],
    AspectRatio -> 1,
    Frame -> True,
    FrameTicks -> {None, framey, framex, None},
    FrameLabel -> {None, labely, labelx, None},
    GridLines -> {None, gridy},
    DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {1., 0.}] ->
  Text[a, {b - 1.5, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 800}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 350}, {0, 0}, {0, 1}];
g1 = Show[g,
  AspectRatio -> GoldenRatio * 1.15,
  PlotRange -> All,
  DisplayFunction -> Identity];
```

(* Create Classified Sorted Eigenarrays 2D Red & Green Raster Display *)

```

contrast = 50;
displaying = Table[
  If[contrast * eigenarrays[[i, j]] > 0,
    If[contrast * eigenarrays[[i, j]] < 1, {contrast * eigenarrays[[i, j]], 0}, {1, 0}],
    If[contrast * eigenarrays[[i, j]] > -1, {0, -contrast * eigenarrays[[i, j]]}, {0, 1}]],
  {i, 1, genes}, {j, 1, arrays}];
labelx = "(b) Eigenarrays";
labely = ColumnForm[{" ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " "}, Center];
framex = Table[{a - 0.5, ToString[a]}, {a, 1, arrays}];
sizes = Flatten[
  Table[
    Dimensions[
      Characters[
        framex[[a, 2]]]], {a, 1, arrays}]];
Do[
  Do[framex[[a, 2]] = StringJoin[framex[[a, 2]], " "],
    {b, 1, size - sizes[[a]]}],
  {a, 1, arrays}];
framey = {
  {genes - endph5 / 2, " ", 0},
  {genes - (endph5 + endph1) / 2, " ", 0},
  {genes - (endph1 + endph2) / 2, " ", 0},
  {genes - (endph2 + endph3) / 2, " ", 0},
  {genes - (endph3 + endph4) / 2, " ", 0},
  {(genes - endph4) / 2, " ", 0}};
gridy = {
  {genes - endph1 + 0.5, {RGBColor[0, 0, 0]}},
  {genes - endph2 + 0.5, {RGBColor[0, 0, 0]}},
  {genes - endph3 + 0.5, {RGBColor[0, 0, 0]}},
  {genes - endph4 + 0.5, {RGBColor[0, 0, 0]}},
  {genes - endph5 + 0.5, {RGBColor[0, 0, 0]}}];
g = Show[
  Graphics[
    RasterArray[
      Table[
        RGBColor[
          displaying[[i, j, 1]], displaying[[i, j, 2]], 0
        ],
        {i, genes, 1, -1}, {j, 1, arrays}
      ]]],
  AspectRatio -> 1,
  Frame -> True,
  FrameTicks -> {None, framey, framex, None},
  FrameLabel -> {None, labely, labelx, None},
  GridLines -> {None, gridy},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {1., 0.}] ->
  Text[a, {b - 1.5, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 800}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 350}, {0, 0}, {0, 1}];
g2 = Show[g,
  AspectRatio -> GoldenRatio * 1.15,
  PlotRange -> All,
  DisplayFunction -> Identity];

```

(* Create Classified Selected Eigenarrays Graph Display *)

```
eigenarrays = Transpose[eigenarrays];

eigenarrays1 = Chop[TrigFit[eigenarrays[[1]], 1, {x, genes - 1}], 0.0025]
eigenarrays2 = Chop[TrigFit[eigenarrays[[2]], 1, {x, genes - 1}], 0.003]

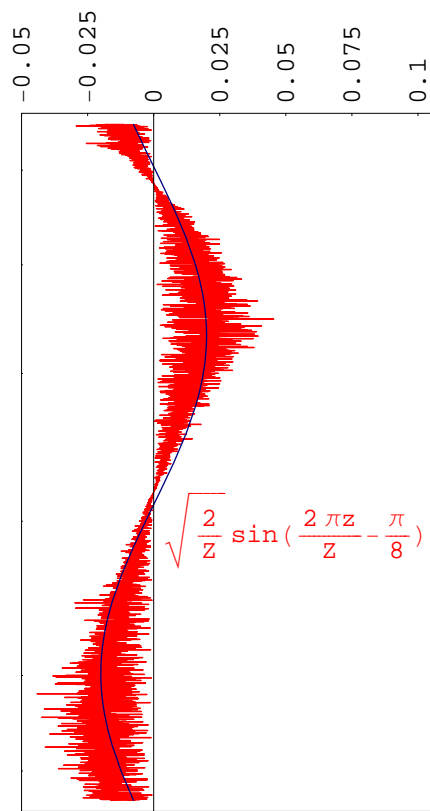
-0.00813596 Cos[ $\frac{\pi x}{2289}$ ] + 0.0172082 Sin[ $\frac{\pi x}{2289}$ ]

0.0172443 Cos[ $\frac{\pi x}{2289}$ ] + 0.00788086 Sin[ $\frac{\pi x}{2289}$ ]

eigenarrays1 = 0.02 * Sin[Pi * x / 2289 - Pi / 8];
eigenarrays2 = 0.02 * Cos[Pi * x / 2289 - Pi / 8];

graph = ParametricPlot[{eigenarrays1, -x},
  {x, genes - 1, 0},
  PlotStyle -> {RGBColor[0, 0, 0.5]},
  DisplayFunction -> Identity];
labelx = "(c) Expression Level";
labeled = ColumnForm[{" ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " "}, Center];
framex = {
  {-0.05, "-0.05 "}, {-0.025, "-0.025"}, {0, "0 "},
  {0.025, "0.025 "}, {0.05, "0.05 "}, {0.075, "0.075 "}, {0.1, "0.1 "}};
framey = {
  {-genes + endph5 / 2, " ", 0},
  {-genes + (endph5 + endph1) / 2, " ", 0},
  {-genes + (endph1 + endph2) / 2, " ", 0},
  {-genes + (endph2 + endph3) / 2, " ", 0},
  {-genes + (endph3 + endph4) / 2, " ", 0},
  {- (genes - endph4) / 2, " ", 0}};
coordinates = Table[{eigenarrays[[1, a]], -a + 1}, {a, 1, genes}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[1, 0, 0], line}],
  graph,
  Graphics[{RGBColor[1, 0, 0], Text[" $\sqrt{\frac{2}{z}} \sin(\frac{2\pi z}{z} - \frac{\pi}{8})$ ", {0.054, -2750}]}]},
  Frame -> True,
  FrameLabel -> {None, labeled, labelx, None},
  FrameTicks -> {None, framey, framex, None},
  GridLines -> {{0, RGBColor[0, 0, 0]}}, None},
  AspectRatio -> GoldenRatio * 1.15,
  PlotRange -> {{-0.05, 0.105}, {75, -genes + 1 - 75}},
  DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labeled, {b_, c_}, {1., 0.}] ->
  Text[labeled, {b, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {1., 0.}] ->
  Text[a, {b - 0.01, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 800}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 350}, {0, 0}, {0, 1}];
p1 = Show[g,
  AspectRatio -> GoldenRatio * 1.15,
  PlotRange -> All];
```

(c) Expression Level



```

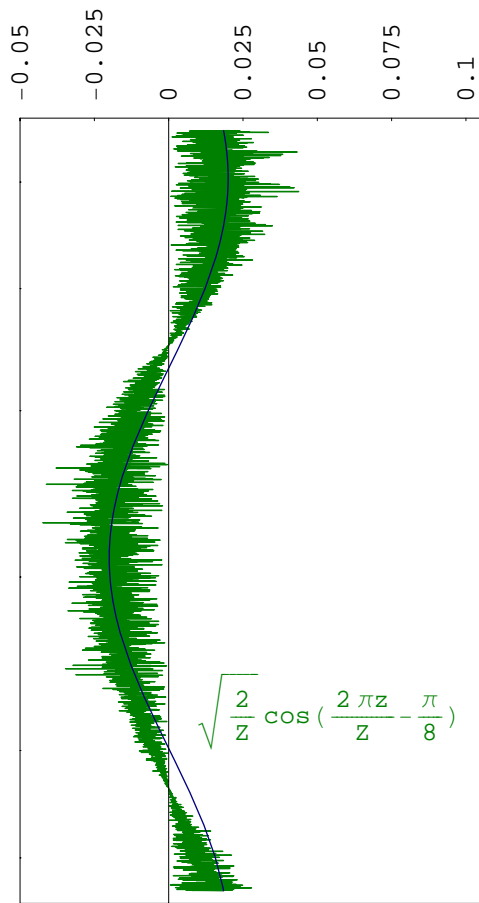
graph = ParametricPlot[{eigenarrays2, -x},
  {x, 0, genes - 1},
  PlotStyle -> {RGBColor[0, 0, 0.5]},
  DisplayFunction -> Identity];
labelx = "(c) Expression Level";
labely = ColumnForm[{" ", " ", " ", " ", " ", " "}, Center];
framex = {
  {-0.05, "-0.05 "}, {-0.025, "-0.025"}, {0, "0 "},
  {0.025, "0.025 "}, {0.05, "0.05 "}, {0.075, "0.075 "}, {0.1, "0.1 "}};
framey = {
  {-genes + endph5 / 2, " ", 0},
  {-genes + (endph5 + endph1) / 2, " ", 0},
  {-genes + (endph1 + endph2) / 2, " ", 0},
  {-genes + (endph2 + endph3) / 2, " ", 0},
  {-genes + (endph3 + endph4) / 2, " ", 0},
  {-(genes - endph4) / 2, " ", 0}};
coordinates = Table[{eigenarrays[[2, a]], -a + 1}, {a, 1, genes}];
line = Line[coordinates];
g = Show[
  {Graphics[{RGBColor[0, 0.5, 0], line}],
  graph,

  Graphics[{RGBColor[0, 0.5, 0], Text[" $\sqrt{\frac{2}{z}} \cos(\frac{2\pi z}{z} - \frac{\pi}{8})$ ", {0.054, -3500}]}]},

Frame -> True,
FrameLabel -> {None, labely, labelx, None},
FrameTicks -> {None, framey, framex, None},
GridLines -> {{0, RGBColor[0, 0, 0]}}, None},
AspectRatio -> GoldenRatio * 1.15,
PlotRange -> {{-0.05, 0.105}, {75, -genes + 1 - 75}},
DisplayFunction -> Identity];
g = FullGraphics[g];
g[[1, 2]] = g[[1, 2]] /.
  Text[labely, {b_, c_}, {1., 0.}] ->
  Text[labely, {b, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {1., 0.}] ->
  Text[a, {b - 0.01, c}, {0, 0}, {0, 1}];
g[[1, 2]] = g[[1, 2]] /.
  Text[labelx, {b_, c_}, {0., -1.}] ->
  Text[labelx, {b, c + 800}, {0, -1}, {1, 0}];
g[[1, 2]] = g[[1, 2]] /.
  Text[a_, {b_, c_}, {0., -1.}] ->
  Text[a, {b, c + 350}, {0, 0}, {0, 1}];
p2 = Show[g,
  AspectRatio -> GoldenRatio * 1.15,
  PlotRange -> All];

```

(c) Expression Level

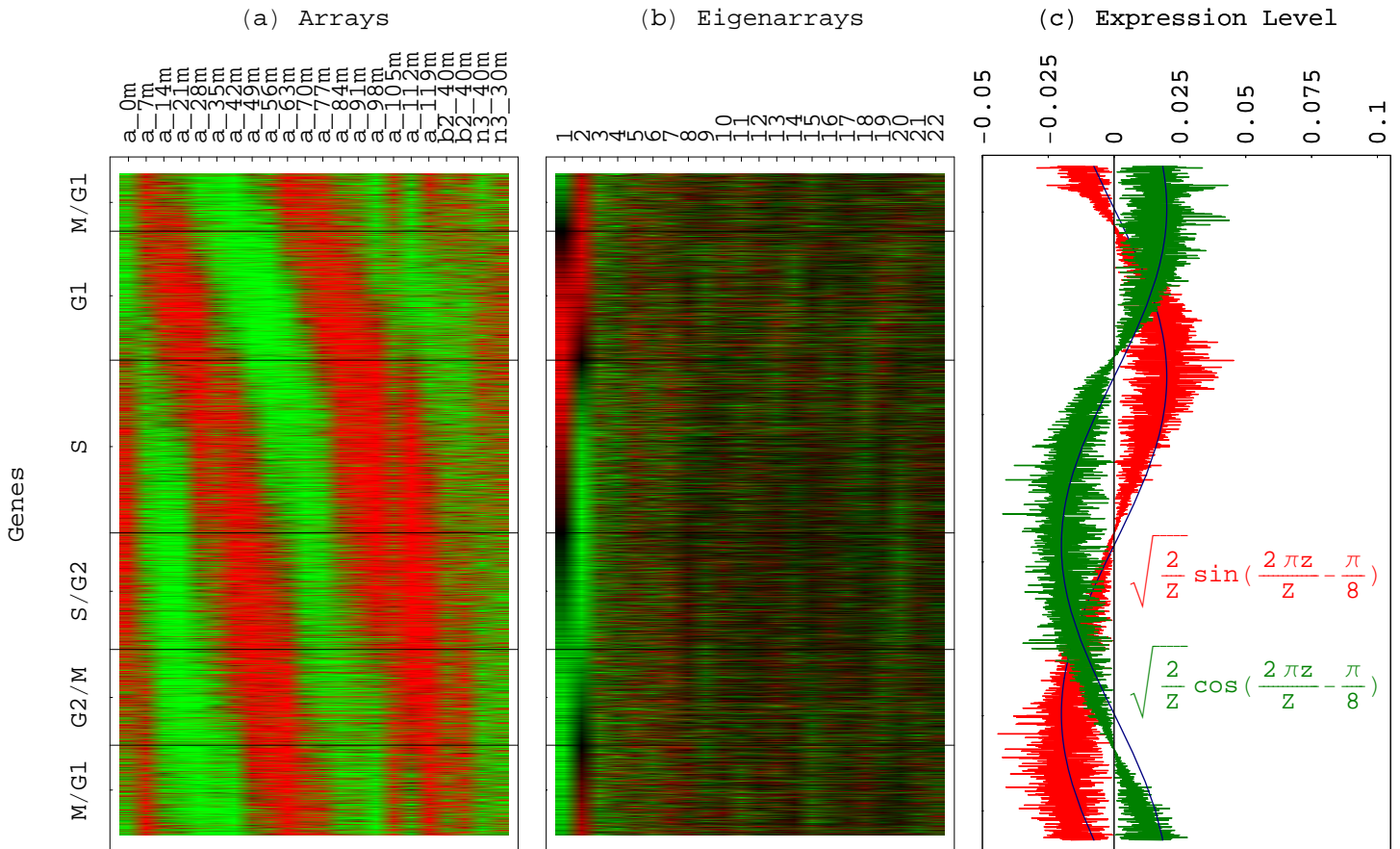


(* Display Classified Selected Sorted Eigenarrays *)

```
g3 = Show[{p1, p2},  
  DisplayFunction -> Identity];
```

(* Display Classified Sorted Data, Eigenarrays and Selected Eigenarrays *)

```
Show[GraphicsArray[{g1, g2, g3}],
GraphicsSpacing -> -0.225];
```



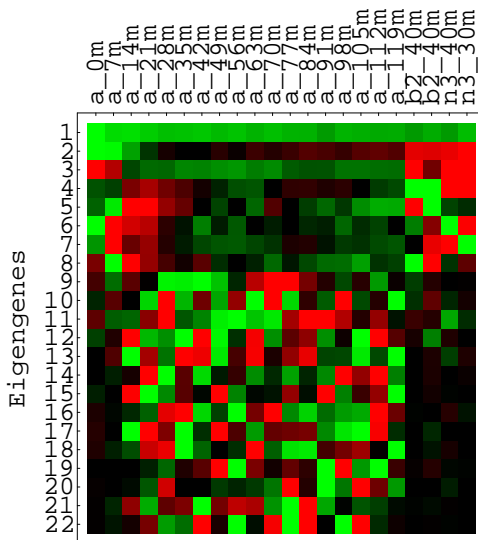
(* Save Sorted Rotated Normalized Data in Sort_Data.txt *)

```
sortmatrix = AppendRows[
  Table[{a}, {a, 1, genes}],
  N[Round[TakeColumns[sortmatrix, {1, 2}] * 1000] / 1000],
  TakeColumns[sortmatrix, {3, 3}],
  N[Round[TakeColumns[sortmatrix, {4, arrays + 3}] * 100000] / 100000]];
sortmatrix = AppendColumns[
  AppendRows[{{" ", " ", " ", " "}, {" ", "Phase", "Radius", "UID"}], arraynames],
  sortmatrix];
stream = OpenWrite[
  StringJoin[name, ":Desktop Folder:PNAS Data:Sort_Alpha&Cls.nb"],
  PageWidth -> Infinity];
Write[
  stream,
  OutputForm[
    TableForm[sortmatrix, TableSpacing -> {0, 1}]
  ]];
Close[stream];
Clear[sortmatrix];
```

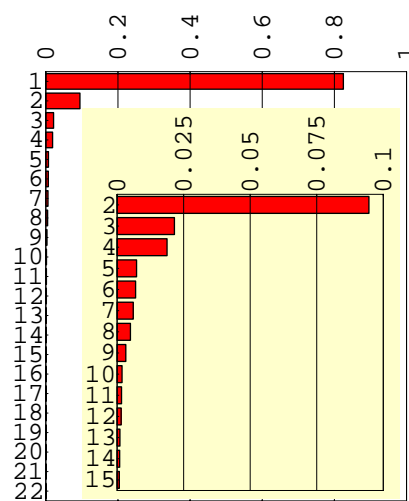
(* Summarize Alpha Factor & CLB2 & CLN3 Analysis *)

(* Centering by Removing the Additive Constant, i.e., the Steady State *)

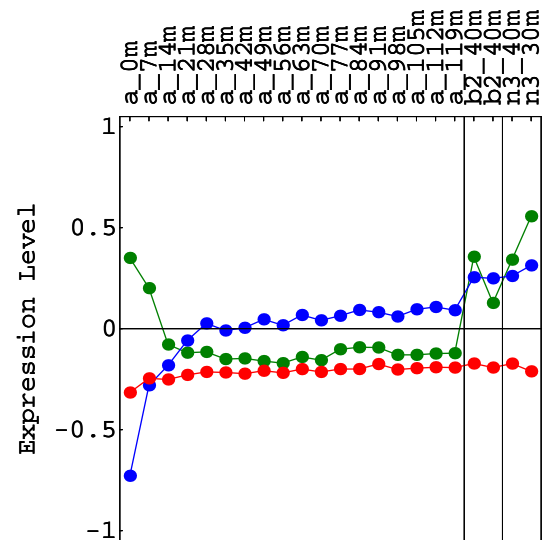
(a) Arrays



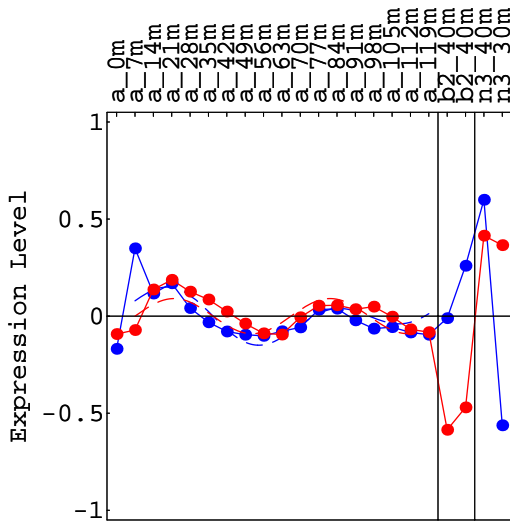
(b) Eigenexpression Fraction
d = 0.25



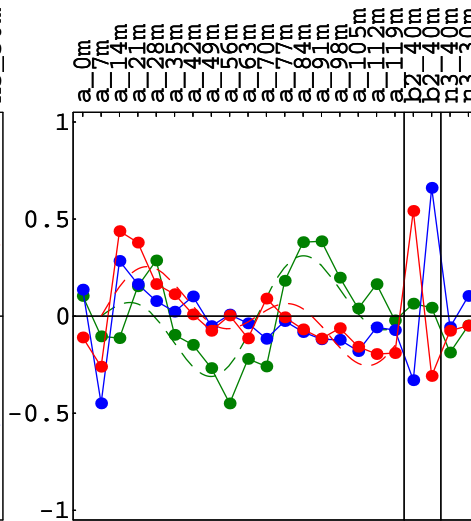
(c) Arrays



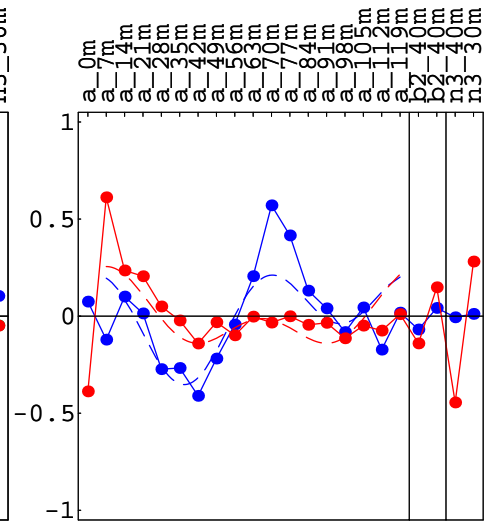
(d) Arrays



(e) Arrays

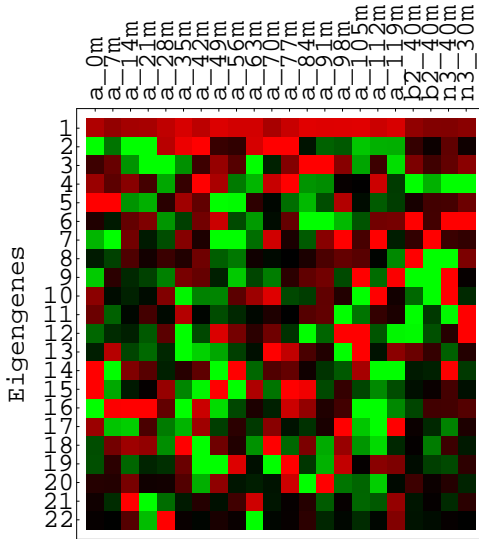


(f) Arrays



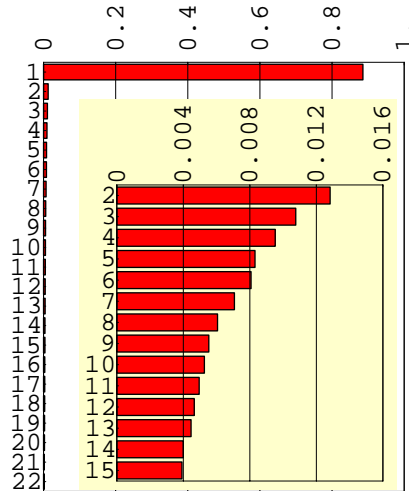
(* Normalizing the Variances by Removing the Multiplicative Constant *)

(a) Arrays



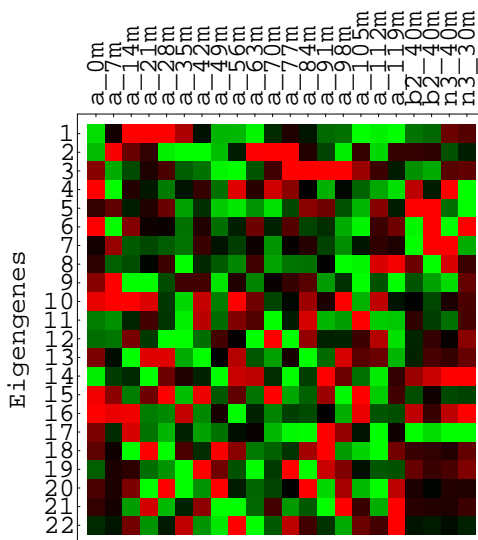
(b) Eigenexpression Fraction

d = 0.22



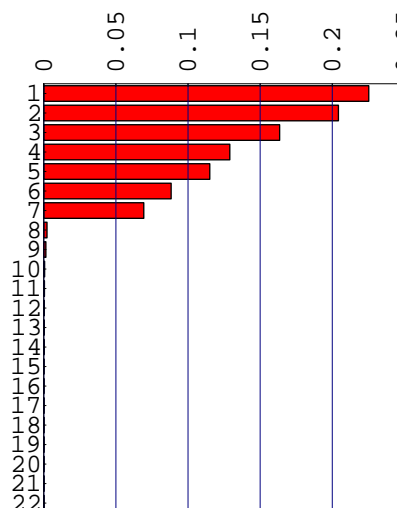
(* Normalized Data *)

(a) Arrays

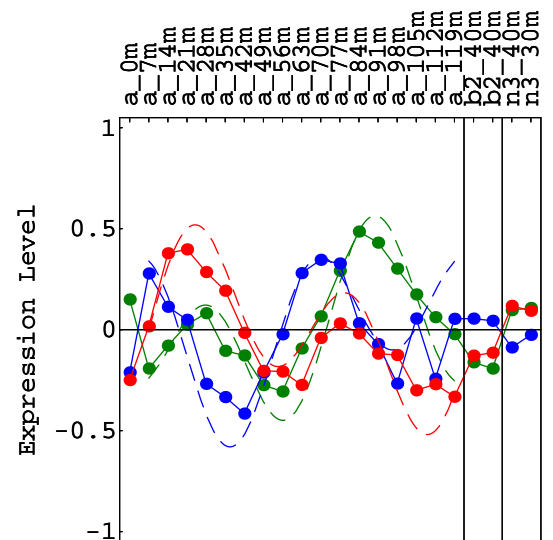


(b) Eigenexpression Fraction

d = 0.62



(c) Arrays

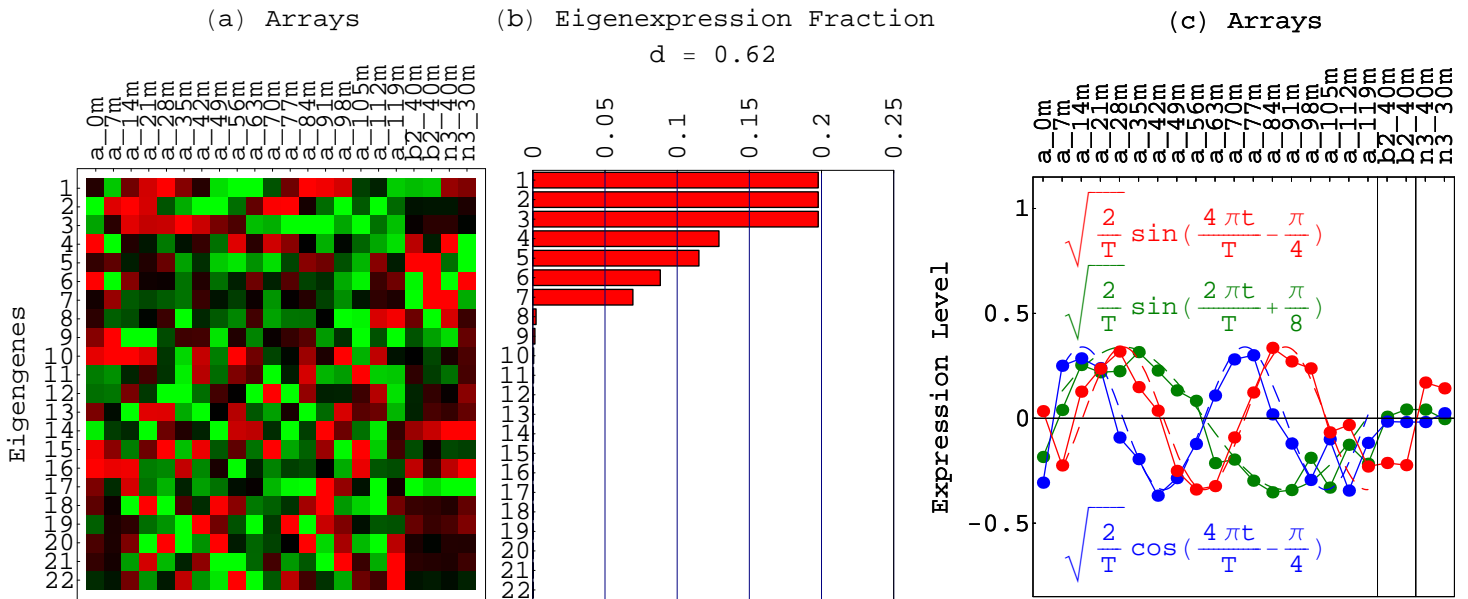


$$\sqrt{\frac{2}{T}} \sin\left(\frac{4\pi t}{T}\right) + \sqrt{\frac{1}{T}} \sin\left(\frac{2\pi t}{T}\right)$$

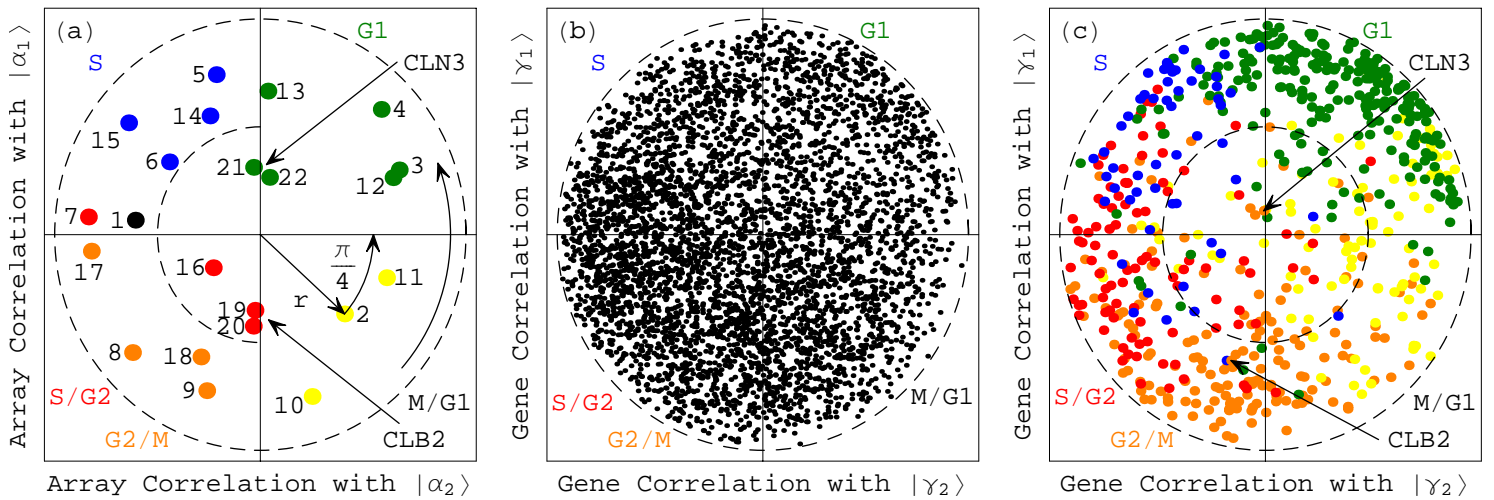
$$\sqrt{\frac{2}{T}} \cos\left(\frac{4\pi t}{T}\right) - \sqrt{\frac{1}{T}} \sin\left(\frac{2\pi t}{T}\right)$$

$$\sqrt{\frac{2}{T}} \sin\left(\frac{4\pi t}{T} - \frac{\pi}{4}\right) - \sqrt{\frac{1}{T}} \sin\left(\frac{2\pi t}{T}\right)$$

(* Rotated Normalized Data *)



(* Sorting the Rotated Normalized Data *)



(* Classified Sorted Rotated Normalized Data *)

