In[445]:=
```
(*Successive FastICA Negentropy Laplace*)
x1 = RandomVariate[LaplaceDistribution[0, 1], 10 000];
x2 = RandomVariate[LaplaceDistribution[0, 1], 10 000];
x3 = RandomVariate[LaplaceDistribution[0, 1], 10 000];
x4 = RandomVariate[LaplaceDistribution[0, 1], 10 000];
x5 = RandomVariate[LaplaceDistribution[0, 1], 10 000];
A = {{5, 10, 3, 2, 7}, {10, 2, 7, 6, 2}, {9, 13, 2, 1, 5}, {12, 3, 5, 7, 9}, {4, 7, 3, 8, 9}}
mt = A.{x1, x2, x3, x4, x5};
mt = mt - Mean[Transpose[mt]];
```

Out[450]=
```
{{5, 10, 3, 2, 7}, {10, 2, 7, 6, 2}, {9, 13, 2, 1, 5}, {12, 3, 5, 7, 9}, {4, 7, 3, 8, 9}}
```

In[453]:=
```
Covariance[Transpose[mt]]
```

Out[453]=
```
{{372.403, 234.523, 433.761, 364.958, 356.745},
 {234.523, 384.871, 293.4, 442.692, 281.885}, {433.761, 293.4, 556.689, 420.939, 373.065},
 {364.958, 442.692, 420.939, 617.01, 442.178},
 {356.745, 281.885, 373.065, 442.178, 440.087}}
```

In[454]:=
```
Eigenvalues[Covariance[Transpose[mt]]]
```

Out[454]=
```
{1959.61, 267.558, 113.202, 25.0772, 5.61577}
```

In[455]:=
```
Eigenvectors[Covariance[Transpose[mt]]]
```

Out[455]=
```
{{-0.404953, -0.375325, -0.477543, -0.52691, -0.435273},
 {0.417407, -0.543904, 0.550113, -0.474043, 0.0509684},
 {0.0790055, -0.42243, -0.492585, 0.0636961, 0.754065},
 {0.0500578, 0.612861, -0.0698408, -0.702328, 0.351786},
 {0.808107, 0.0961959, -0.470966, 0.0180914, -0.339961}}
```

In[456]:=
```
d12 = Eigenvalues[Covariance[Transpose[mt]]][[1]]^(-1 / 2);
d22 = Eigenvalues[Covariance[Transpose[mt]]][[2]]^(-1 / 2);
d32 = Eigenvalues[Covariance[Transpose[mt]]][[3]]^(-1 / 2);
d42 = Eigenvalues[Covariance[Transpose[mt]]][[4]]^(-1 / 2);
d52 = Eigenvalues[Covariance[Transpose[mt]]][[5]]^(-1 / 2);
dmat = DiagonalMatrix[{d12, d22, d32, d42, d52}]
```

Out[461]=
```
{{0.02259, 0., 0., 0., 0.}, {0., 0.0611352, 0., 0., 0.},
 {0., 0., 0.0939883, 0., 0.}, {0., 0., 0., 0.199692, 0.}, {0., 0., 0., 0., 0.421983}}
```

In[462]:=
```
emat = Transpose[Eigenvectors[Covariance[Transpose[mt]]]]
```

Out[462]=
```
{{-0.404953, 0.417407, 0.0790055, 0.0500578, 0.808107},
 {-0.375325, -0.543904, -0.42243, 0.612861, 0.0961959},
 {-0.477543, 0.550113, -0.492585, -0.0698408, -0.470966},
 {-0.52691, -0.474043, 0.0636961, -0.702328, 0.0180914},
 {-0.435273, 0.0509684, 0.754065, 0.351786, -0.339961}}
```

In[463]:=
```
vmat = emat.dmat.Transpose[emat]
```

Out[463]=
```
{{0.291014, 0.0253469, -0.146553, -0.00765491, -0.101531},
 {0.0253469, 0.116949, -0.0223513, -0.0675176, 0.00130935},
 {-0.146553, -0.0223513, 0.141032, -0.00700787, 0.0341562},
 {-0.00765491, -0.0675176, -0.00700787, 0.11903, -0.0437148},
 {-0.101531, 0.00130935, 0.0341562, -0.0437148, 0.131364}}
```

In[464]:=
```
x1 = RandomVariate[LaplaceDistribution[0, 1], 10 000];
x2 = RandomVariate[LaplaceDistribution[0, 1], 10 000];
x3 = RandomVariate[LaplaceDistribution[0, 1], 10 000];
x4 = RandomVariate[LaplaceDistribution[0, 1], 10 000];
x5 = RandomVariate[LaplaceDistribution[0, 1], 10 000];
mt = A.{x1, x2, x3, x4, x5};
mt = mt - Mean[Transpose[mt]];
```

In[471]:=
```
zmat = vmat.mt;
```

In[472]:=
```
m = 5;
wmatinit = {RandomReal[{-Sqrt[3], Sqrt[3]}, m],
   RandomReal[{-Sqrt[3], Sqrt[3]}, m], RandomReal[{-Sqrt[3], Sqrt[3]}, m],
   RandomReal[{-Sqrt[3], Sqrt[3]}, m], RandomReal[{-Sqrt[3], Sqrt[3]}, m]};
wmatinit = {{1, 0, 0, 0, 0}, {0, 1, 0, 0, 0}, {0, 0, 1, 0, 0},
   {0, 0, 0, 1, 0}, {0, 0, 0, 0, 1}};
wmat = {};
i = 1;
While[i <= m,
 wmat = Append[wmat, wmatinit[[All, i]] / Norm[wmatinit[[All, i]]]];
 i++;
]
wmat = Transpose[wmat]
(*
w={1,0,0,0,0};
*)
epsilon = 0.0001;
n = Length[x1];
p = 1;
wmatconv = {};
For[p = 1, p ≤ m, p++,
 w = wmat[[All, p]] / Norm[wmat[[All, p]]];
 cnt = 1;
 wbefore = w;
 While[cnt < n,
  wbefore = w;
  w = (1 / n) * Sum[Tanh[w.zmat[[All, i]]] * zmat[[All, i]], {i, 1, n}] -
     (1 / n) * Sum[1 - (Tanh[w.zmat[[All, i]]])^2, {i, 1, n}] * w;
  If[2 ≤ p,
   w = w - Sum[(w.wmatconv[[j]]) * wmatconv[[j]], {j, 1, p - 1}], a = 0
  ];
  w = w / Norm[w];

  Print["cnt=", cnt];
  Print["w=", w];

  ++cnt;
  If[1 - epsilon <= Abs[w.wbefore] && Abs[w.wbefore] <= 1 + epsilon,
   Print["収束した:"];
   Print["w=", w];
   Print["Abs[w.wbefore]=", Abs[w.wbefore]];
   wmatconv = Append[wmatconv, w];
   cnt = n;
  ]
 ]
]
Kurtosis[w.zmat] - 3
```

Out[478]=
```
{{1, 0, 0, 0, 0}, {0, 1, 0, 0, 0}, {0, 0, 1, 0, 0}, {0, 0, 0, 1, 0}, {0, 0, 0, 0, 1}}

cnt=1

w={-0.976083, -0.151802, 0.000463026, -0.13516, 0.0771298}

cnt=2

w={0.929312, 0.278546, -0.150184, 0.130734, -0.138362}
```

```
cnt=3
w={-0.821694, -0.461594, 0.270502, -0.0557519, 0.188337}
cnt=4
w={0.703701, 0.606396, -0.315761, -0.0430785, -0.188488}
cnt=5
w={-0.65575, -0.653168, 0.333826, 0.0703995, 0.164215}
cnt=6
w={0.647901, 0.660672, -0.339868, -0.0722033, -0.151702}
cnt=7
w={-0.646486, -0.662346, 0.340662, 0.0727888, 0.14834}
収束した:
w={-0.646486, -0.662346, 0.340662, 0.0727888, 0.14834}
Abs[w.wbefore]=0.999991
cnt=1
w={0.670006, -0.502175, 0.446993, -0.167261, -0.266707}
cnt=2
w={-0.560249, 0.413409, -0.504601, 0.158734, 0.485177}
cnt=3
w={0.451209, -0.432707, 0.339428, -0.101111, -0.695514}
cnt=4
w={-0.325622, 0.428853, -0.151586, 0.031731, 0.828293}
cnt=5
w={0.293968, -0.413212, 0.13169, -0.0307407, -0.851206}
cnt=6
w={-0.292376, 0.412568, -0.130233, 0.0299202, 0.852319}
収束した:
w={-0.292376, 0.412568, -0.130233, 0.0299202, 0.852319}
Abs[w.wbefore]=0.999997
cnt=1
w={-0.436539, -0.0647229, -0.858709, 0.0662052, -0.251953}
cnt=2
w={0.497091, -0.0635138, 0.74275, -0.302205, 0.325364}
cnt=3
w={-0.493221, 0.0682041, -0.73232, 0.331192, -0.325731}
cnt=4
w={0.49264, -0.0674791, 0.732876, -0.331424, 0.325274}
収束した:
w={0.49264, -0.0674791, 0.732876, -0.331424, 0.325274}
Abs[w.wbefore]=0.999999
```

```
cnt=1
w={-0.193305, -0.0683264, -0.280724, -0.936637, -0.0432511}
cnt=2
w={0.155784, 0.117131, 0.319588, 0.927203, 0.0130256}
cnt=3
w={-0.0775616, -0.212785, -0.391445, -0.890611, 0.047845}
cnt=4
w={-0.0477403, 0.350408, 0.483086, 0.78867, -0.139864}
cnt=5
w={0.137199, -0.437082, -0.531092, -0.683725, 0.201487}
cnt=6
w={-0.139603, 0.43927, 0.532171, 0.680515, -0.203093}
収束した:
w={-0.139603, 0.43927, 0.532171, 0.680515, -0.203093}
Abs[w.wbefore]=0.999988
cnt=1
w={-0.484137, 0.43997, 0.216045, -0.648741, -0.32326}
cnt=2
w={0.484137, -0.43997, -0.216045, 0.648741, 0.32326}
収束した:
w={0.484137, -0.43997, -0.216045, 0.648741, 0.32326}
Abs[w.wbefore]=1.
```

Out[484]= 3.73151

In[485]:=
```
MatrixForm[Transpose[wmatconv]]
tmat = vmat.A;
truemat = {};
i = 1;
While[i ≤ m,
  truemat = Append[truemat, tmat[[All, i]] / Norm[tmat[[All, i]]]];
  i++;
 ];
truemat = Transpose[truemat];
MatrixForm[truemat]
```

Out[485]//MatrixForm=

$$\begin{pmatrix} -0.646486 & -0.292376 & 0.49264 & -0.139603 & 0.484137 \\ -0.662346 & 0.412568 & -0.0674791 & 0.43927 & -0.43997 \\ 0.340662 & -0.130233 & 0.732876 & 0.532171 & -0.216045 \\ 0.0727888 & 0.0299202 & -0.331424 & 0.680515 & 0.648741 \\ 0.14834 & 0.852319 & 0.325274 & -0.203093 & 0.32326 \end{pmatrix}$$

Out[491]//MatrixForm=

$$\begin{pmatrix} -0.15461 & 0.45163 & 0.583881 & -0.394695 & 0.521068 \\ 0.413678 & 0.00478686 & 0.727313 & 0.37996 & -0.414646 \\ 0.52128 & 0.759235 & -0.347406 & -0.0879195 & -0.169433 \\ 0.680199 & -0.352926 & -0.0642305 & 0.079527 & 0.635574 \\ -0.265638 & 0.308243 & -0.0726803 & 0.828126 & 0.351987 \end{pmatrix}$$

In[492]:=
```
m = 5;
wmatinit = {RandomReal[{-Sqrt[3], Sqrt[3]}, m],
   RandomReal[{-Sqrt[3], Sqrt[3]}, m], RandomReal[{-Sqrt[3], Sqrt[3]}, m],
   RandomReal[{-Sqrt[3], Sqrt[3]}, m], RandomReal[{-Sqrt[3], Sqrt[3]}, m]};
(*
wmatinit={{1,0,0,0,0},{0,1,0,0,0},{0,0,1,0,0},{0,0,0,1,0},{0,0,0,0,1}};
*)
wmat = {};
i = 1;
While[i <= m,
 wmat = Append[wmat, wmatinit[[All, i]] / Norm[wmatinit[[All, i]]]];
 i++;
]
wmat = Transpose[wmat]
(*
w={1,0,0,0,0};
*)
epsilon = 0.0001;
n = Length[x1];
p = 1;
wmatconv = {};
For[p = 1, p ≤ m, p++,
 w = wmat[[All, p]] / Norm[wmat[[All, p]]];
 cnt = 1;
 wbefore = w;
 While[cnt < n,
  wbefore = w;
  w = (1 / n) * Sum[Tanh[w.zmat[[All, i]]] * zmat[[All, i]], {i, 1, n}] -
    (1 / n) * Sum[1 - (Tanh[w.zmat[[All, i]]])^2, {i, 1, n}] * w;
  If[2 ≤ p,
   w = w - Sum[(w.wmatconv[[j]]) * wmatconv[[j]], {j, 1, p - 1}], a = 0
  ];
  w = w / Norm[w];

  Print["cnt=", cnt];
  Print["w=", w];

  ++cnt;
  If[1 - epsilon <= Abs[w.wbefore] && Abs[w.wbefore] <= 1 + epsilon,
   Print["収束した:"];
   Print["w=", w];
   Print["Abs[w.wbefore]=", Abs[w.wbefore]];
   wmatconv = Append[wmatconv, w];
   cnt = n;
  ]
 ]
]
```

Out[497]=
```
{{0.303049, 0.0285452, -0.315116, -0.0945348, -0.530582},
 {-0.646108, -0.759591, 0.691873, -0.665595, 0.268532},
 {-0.134568, 0.153752, -0.24184, 0.470921, 0.578647},
 {0.142368, 0.259286, -0.364953, -0.204325, 0.548073},
 {0.672554, -0.57562, 0.479934, 0.533415, -0.105623}}
```

```
cnt=1
```

```
w={-0.477291, 0.382022, 0.0835266, -0.383221, -0.687326}
```

```
cnt=2
w={0.537896, -0.303729, -0.0438967, 0.590122, 0.517924}
cnt=3
w={-0.564969, 0.347636, 0.0860033, -0.612123, -0.421744}
cnt=4
w={0.573443, -0.342972, -0.0958222, 0.622513, 0.396017}
cnt=5
w={-0.576036, 0.342855, 0.0986641, -0.623258, -0.390446}
収束した:
w={-0.576036, 0.342855, 0.0986641, -0.623258, -0.390446}
Abs[w.wbefore]=0.999977
cnt=1
w={-0.220596, 0.501704, -0.242246, -0.0586678, 0.798439}
cnt=2
w={0.411719, -0.314955, 0.0724172, -0.00854842, -0.852041}
cnt=3
w={-0.426183, 0.307296, -0.0718594, 0.0206027, 0.847554}
cnt=4
w={0.42647, -0.307276, 0.0716511, -0.0209692, -0.847426}
収束した:
w={0.42647, -0.307276, 0.0716511, -0.0209692, -0.847426}
Abs[w.wbefore]=1.
cnt=1
w={-0.438202, -0.300918, 0.747493, 0.394109, -0.0579644}
cnt=2
w={0.571629, 0.442138, -0.534881, -0.427856, 0.0927174}
cnt=3
w={-0.577004, -0.618725, 0.448584, 0.285975, -0.0351776}
cnt=4
w={0.54683, 0.738006, -0.367249, -0.145112, -0.0198671}
cnt=5
w={-0.537671, -0.751461, 0.361102, 0.1223, 0.0294001}
cnt=6
w={0.537692, 0.750621, -0.362545, -0.123145, -0.0291855}
収束した:
w={0.537692, 0.750621, -0.362545, -0.123145, -0.0291855}
Abs[w.wbefore]=0.999998
cnt=1
w={-0.433499, 0.0690112, -0.655038, 0.530181, -0.311687}
```

```
cnt=2
w={0.414177, 0.00202384, 0.745283, -0.440117, 0.281607}
cnt=3
w={-0.413315, -0.00455918, -0.748194, 0.436718, -0.280416}
収束した:
w={-0.413315, -0.00455918, -0.748194, 0.436718, -0.280416}
Abs[w.wbefore]=0.999986
cnt=1
w={0.16237, -0.473899, -0.542124, -0.636571, 0.223463}
cnt=2
w={-0.16237, 0.473899, 0.542124, 0.636571, -0.223463}
収束した:
w={-0.16237, 0.473899, 0.542124, 0.636571, -0.223463}
Abs[w.wbefore]=1.
```

In[503]:=
```
MatrixForm[Transpose[wmatconv]]
tmat = vmat.A;
truemat = {};
i = 1;
While[i ≤ m,
  truemat = Append[truemat, tmat[[All, i]] / Norm[tmat[[All, i]]]];
  i++;
 ];
truemat = Transpose[truemat];
MatrixForm[truemat]
```

Out[503]//MatrixForm=

$$\begin{pmatrix} -0.576036 & 0.42647 & 0.537692 & -0.413315 & -0.16237 \\ 0.342855 & -0.307276 & 0.750621 & -0.00455918 & 0.473899 \\ 0.0986641 & 0.0716511 & -0.362545 & -0.748194 & 0.542124 \\ -0.623258 & -0.0209692 & -0.123145 & 0.436718 & 0.636571 \\ -0.390446 & -0.847426 & -0.0291855 & -0.280416 & -0.223463 \end{pmatrix}$$

Out[509]//MatrixForm=

$$\begin{pmatrix} -0.15461 & 0.45163 & 0.583881 & -0.394695 & 0.521068 \\ 0.413678 & 0.00478686 & 0.727313 & 0.37996 & -0.414646 \\ 0.52128 & 0.759235 & -0.347406 & -0.0879195 & -0.169433 \\ 0.680199 & -0.352926 & -0.0642305 & 0.079527 & 0.635574 \\ -0.265638 & 0.308243 & -0.0726803 & 0.828126 & 0.351987 \end{pmatrix}$$