

```
j = 1;
k = 4;
```

"These index the samples used, ie if
we combine DNA samples 1 to 4 we let j =1 and k = 4"

Gammas and Lambdas for Canonical form

These index the samples used, ie if we combine DNA samples 1 to 4 we let j =1 and k = 4

```
(*num=2;*)
(*StringJoin["C:\\Users\\George\\Documents\\SVD DNA stuff\\MPSs\\Lambdas",
  "\\Lambda",ToString[j],ToString[k],"ofSVDnum", ToString[2],".txt" ]

Import[StringJoin["C:\\Users\\George\\Documents\\SVD DNA stuff\\MPSs\\Lambdas",
  "\\Lambda",ToString[j],ToString[k],"ofSVDnum", ToString[2],".txt" ]];*)
```

```
Table[Anum = ToExpression[StringReplace[
  Import[StringJoin["C:\\Users\\George\\Documents\\SVD DNA stuff\\MPSs\\Lambdas",
    "\\Lambda", ToString[j], ToString[k], "ofSVDnum", ToString[num], ".txt" ]],
  {"e" → "*10^", "[" → "{", "]" → "}"}]], {num, 2, 12}];
```

```
Table[Γnum = ToExpression[StringReplace[
  Import[StringJoin["C:\\Users\\George\\Documents\\SVD DNA stuff\\MPSs\\Gammas",
    "\\Gamma", ToString[j], ToString[k], "ofSVDnum", ToString[num], ".txt" ]],
  {"e" → "*10^", "[" → "{", "]" → "}"}]], {num, 2, 12}];
```

$$(\Gamma_2 \cdot \Lambda_2) \cdot (\Gamma_3 \cdot \Lambda_3) \cdot (\Gamma_4 \cdot \Lambda_4) \cdot (\Gamma_5 \cdot \Lambda_5) \cdot (\Gamma_6 \cdot \Lambda_6) \cdot$$

$$(\Gamma_7 \cdot \Lambda_7) \cdot (\Gamma_8 \cdot \Lambda_8) \cdot (\Gamma_9 \cdot \Lambda_9) \cdot (\Gamma_{10} \cdot \Lambda_{10}) \cdot (\Gamma_{11} \cdot \Lambda_{11}) \cdot (\Gamma_{12} \cdot \Lambda_{12})$$

... 1 ...

large output

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Resizing

```
Do[Anum = (Γnum · Λnum), {num, 2, 12}]
```

```
maxdim = Max[Flatten[Table[{Length[Anum], Length[Anum[[1]]]}, {num, 2, 12}]]]
```

```
Do[Bnum = ArrayPad[Anum, {{0, (maxdim - Length[Anum])}, {0, (maxdim - Length[Anum[[1]])}}],
  {num, 2, 12}]
```

1024

$$(A_2) \cdot (A_3) \cdot (A_4) \cdot (A_5) \cdot (A_6) \cdot (A_7) \cdot (A_8) \cdot (A_9) \cdot (A_{10}) \cdot (A_{11}) \cdot (A_{12})$$

\$Aborted

```

Table[{" =num" num, Length[Anum], Length[Anum[[1]]]}, {num, 2, 12}]
{{2 =num, 4, 1024}, {3 =num, 8, 512}, {4 =num, 16, 256},
 {5 =num, 32, 128}, {6 =num, 64, 64}, {7 =num, 128, 32}, {8 =num, 64, 16},
 {9 =num, 32, 8}, {10 =num, 16, 4}, {11 =num, 8, 2}, {12 =num, 4, 1}}

Table[{" =num" num, Length[Bnum], Length[Bnum[[1]]]}, {num, 2, 12}]
{{2 =num, 1024, 1024}, {3 =num, 1024, 1024}, {4 =num, 1024, 1024}, {5 =num, 1024, 1024},
 {6 =num, 1024, 1024}, {7 =num, 1024, 1024}, {8 =num, 1024, 1024}, {9 =num, 1024, 1024},
 {10 =num, 1024, 1024}, {11 =num, 1024, 1024}, {12 =num, 1024, 1024}}

mpsB = (B2) . (B3) . (B4) . (B5) . (B6) . (B7) . (B8) . (B9) . (B10) . (B11) . (B12) ;

Union[Flatten[mpsB]]
{0., 5.0146 × 1094, 1.10321 × 1095, 5.65829 × 1095, 1.24482 × 1096}

Outer[Times, (B2), (B3), (B4), (B5), (B6), (B7), (B8), (B9), (B10), (B11), (B12)]

(*If[Length[Anum] ≤ Length[A(num-1)[[1]]],
 ArrayPad[Anum, {0, (Length[A(num-1)[[1]]] - Length[A(num)])}],
 ArrayPad[Anum, {0, (Length[A(num-1)[[1]]] - Length[A(num)])}],
]*)

ArrayPad[{{1, 2}, {3, 4}, {5, 6}}, {{0, 1}, {0, 2}}] // MatrixForm

$$\begin{pmatrix} 1 & 2 & 0 & 0 \\ 3 & 4 & 0 & 0 \\ 5 & 6 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$


$$\begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 5 & 8 & 9 \\ 4 & 6 & 1 & 3 \\ 5 & 7 & 8 & 1 \end{pmatrix} \cdot \begin{pmatrix} 3 & 4 & 3 & 4 \\ 7 & 6 & 8 & 9 \\ 4 & 6 & 1 & 3 \\ 5 & 7 & 8 & 1 \end{pmatrix}$$


$$\begin{pmatrix} 1 & 2 & 0 & 0 \\ 2 & 5 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} \cdot \begin{pmatrix} 3 & 4 & 0 & 0 \\ 7 & 6 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$


$$\begin{pmatrix} 1 & 2 \\ 2 & 5 \end{pmatrix} \cdot \begin{pmatrix} 3 & 4 \\ 7 & 6 \end{pmatrix}$$

{{49, 62, 54, 35}, {118, 149, 126, 86}, {73, 79, 85, 76}, {101, 117, 87, 108}}
{{17, 16, 0, 0}, {41, 38, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}}
{{17, 16}, {41, 38}}

```

Although in the code technically starts with files Lambda 2 and Gamma 2, this is more for naming

Also need to reshape Lamdas after midpoint so that we can properly combine them with gammas

Also deal with e's so they don't mess anything up

```

Table[{" =num" num, Length[ $\Lambda_{\text{num}}$ ], Length[ $\Lambda_{\text{num}}$ [[1]]]}, {num, 2, 12}]
Table[{" =num" num, Length[ $\Gamma_{\text{num}}$ ], Length[ $\Gamma_{\text{num}}$ [[1]]]}, {num, 2, 12}]

{{2 =num, 4, 1024}, {3 =num, 8, 512}, {4 =num, 16, 256},
 {5 =num, 32, 128}, {6 =num, 64, 64}, {7 =num, 128, 32}, {8 =num, 64, 16},
 {9 =num, 32, 8}, {10 =num, 16, 4}, {11 =num, 8, 2}, {12 =num, 4, 1}}

{{2 =num, 4, 4}, {3 =num, 8, 8}, {4 =num, 16, 16},
 {5 =num, 32, 32}, {6 =num, 64, 64}, {7 =num, 128, 128}, {8 =num, 64, 64},
 {9 =num, 32, 32}, {10 =num, 16, 16}, {11 =num, 8, 8}, {12 =num, 4, 4}}

Table[( $\Gamma_{\text{num}} \cdot \Lambda_{\text{num}}$ ), {num, 2, 12}] (*coupled gammas and lambdas properly shaped to combine,
just need to reshape lambdas from midpoint on *)

```

```

{{ { ... 1 ... }, { ... 1 ... }, { ... 1 ... }, { ... 5 ... },
  { { ... 1 ... }, { ... 14 ... }, { ... 1 ... } }, { {-4.40931 × 1011, 1.2594 × 1011},
  {-3.01476 × 1011, -1.84197 × 1011}, {-3.43588 × 1011, 9.81368 × 1010},
  {-2.3492 × 1011, -1.43532 × 1011}, {0., 0.}, {0., 0.}, {0., 0.}, {0., 0.}},
  { {3.28985 × 1011}, {8.99369 × 1011}, {1.37432 × 1011}, {3.75707 × 1011}} }

```

large output

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Gamma square, just need to make lambda square by inserting appropriately sized rows of zeroes

```
ArrayPad[{{1, 2}, {3, 4}}, {0, 2}] // MatrixForm
```

$$\begin{pmatrix} 1 & 2 & 0 & 0 \\ 3 & 4 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

```
Clear[num]
```

```
Max[Length[ $\Lambda_{\text{num}}$ ], Length[ $\Lambda_{\text{num}}$ [[1]]]]
```

```
1024
```

```
(* If[Length[ $\Lambda_{\text{num}}$ ]>Length[ $\Lambda_{\text{num}}$ [[1]]],
  PadRight[ $\Lambda_{\text{num}}$ [[i]],Length[ $\Lambda_{\text{num}}$ ]],PadRight[ $\Lambda_{\text{num}}$ [[1]],Length[ $\Lambda_{\text{num}}$ ]]];*)
```

```
Do[
```

```
  padded $\Lambda_{\text{num}}$  = ArrayPad[ $\Lambda_{\text{num}}$ , {0, Max[Length[ $\Lambda_{\text{num}}$ ], Length[ $\Lambda_{\text{num}}$ [[1]]]]}],
  {num, 2, 12}]
```

```
Table[{" =num" num, Length[ $\Lambda_{\text{num}}$ ], Length[ $\Lambda_{\text{num}}$ [[1]]]}, {num, 2, 12}]
```

```
Table[{" =num" num, Length[padded $\Lambda_{\text{num}}$ ], Length[padded $\Lambda_{\text{num}}$ [[1]]]}, {num, 2, 12}]
```

```

{{2 =num, 4, 1024}, {3 =num, 8, 512}, {4 =num, 16, 256},
 {5 =num, 32, 128}, {6 =num, 64, 64}, {7 =num, 128, 32}, {8 =num, 64, 16},
 {9 =num, 32, 8}, {10 =num, 16, 4}, {11 =num, 8, 2}, {12 =num, 4, 1}}

{{2 =num, 1028, 2048}, {3 =num, 520, 1024}, {4 =num, 272, 512},
 {5 =num, 160, 256}, {6 =num, 128, 128}, {7 =num, 256, 160}, {8 =num, 128, 80},
 {9 =num, 64, 40}, {10 =num, 32, 20}, {11 =num, 16, 10}, {12 =num, 8, 5}}

```



```

Do[resized $\Lambda_{\text{num}}$  = 0 IdentityMatrix[Max[Length[ $\Lambda_{\text{num}}$ ], Length[ $\Lambda_{\text{num}}$ [[1]]]], {num, 2, 12}]
Do[
  Do[
    resized $\Lambda_{\text{num}}$ [[i]] = PadRight[ $\Lambda_{\text{num}}$ [[i]], Length[ $\Lambda_{\text{num}}$ ]]
    , {i, 1, Length[ $\Lambda_{\text{num}}$ ]}
  ], {num, 2, 12}
]

 $\Lambda_2$ ;
resized $\Lambda_2$ ;
Table[resized $\Lambda_{\text{num}}$ , {num, 2, 12}];

```

```

{{ { ... 1 ... }, { ... 1 ... }, { ... 1 ... }, { ... 1 ... }, ... 3 ... ,
  { ... 1 ... }, { ... 1 ... }, { {0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0},
    {0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0},
    {0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0}, {0, 0, 0, 0, 0, 0, 0, 0, 0} }},
  { {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0}, {0, 0, 0, 0} } }

```

large output

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```

Table[Length[( $\Gamma_{\text{num}}$  .  $\Lambda_{\text{num}}$ )], {num, 2, 12}]
Table[Length[( $\Gamma_{\text{num}}$  .  $\Lambda_{\text{num}}$ )][[1]]], {num, 2, 12}]
{4, 8, 16, 32, 64, 128, 64, 32, 16, 8, 4}
{1024, 512, 256, 128, 64, 32, 16, 8, 4, 2, 1}

```

M's

```

Table[Mnum = ToExpression[StringReplace[
  Import[StringJoin["C:\\Users\\George\\Documents\\SVD DNA stuff\\MPSs\\Ms",
    "\\mpsM", ToString[j], ToString[k], "ofSVDnum", ToString[num], ".txt" ]],
  {"e" → "*10^", "[" → "{", "]" → "}"}]], {num, 2, 12}];

```

```
Table[{" =num" num, Length[Mnum], Length[Mnum[[1]]]}, {num, 2, 12}]
```

```

{{2 =num, 4, 1024}, {3 =num, 8, 512}, {4 =num, 16, 256},
 {5 =num, 32, 128}, {6 =num, 64, 64}, {7 =num, 128, 32}, {8 =num, 64, 16},
 {9 =num, 32, 8}, {10 =num, 16, 4}, {11 =num, 8, 2}, {12 =num, 4, 1}}

```

```
(M2) . (M3) . (M4) . (M5) . (M6) . (M7) . (M8) . (M9) . (M10) . (M11) . (M12)
```

```

{{3420.86, -68742.3, -58761.1, -38341.4, 595.435, 578.617, 5642.45, 5642.45, 4602.3,
  4568.92, 3194.68, 3194.68, -221.658, -313.646, -2083.9, -2150.66, 114.811, 148.191,
  545.236, 545.492, 8669.52, 8666.08, 5584.02, 5617.4, -2033.89, -2067.01, 5836.16,
  5894.76, 4529.3, 4495.67, 545.236, 545.492, 5392.1, 5392.1, 5994.46, 6028.09, -1841.89,
  -1909.16, 4298.54, 4264.07, 204.133, 170.497, 612.253, 612.253, 5551., 5517.62,
  170.753, 137.372, 3110.84, 3111.1, 1304.11, 1304.11, -1724.93, -1791.95, 3111.1,
  3111.1, 7810.33, 7810.33, -1729.26, -1796.02, 5969.74, 5969.49, 95.7108, 95.7108,
  3010.7, 3010.96, 1304.11, 1304.11, 2982.64, 2923.97, -1637.53, -1637.53, 6032.81,
  6023.7, 5796.53, 5763.15, 1112.7, 1112.96, 5241.89, 5241.89, 161.704, 154.062,
  9062.18, 9033.26, 6086.77, 6090.46, 5450.6, 5425.63, 5383.84, 5359., 5317.21, 5258.6,

```

47.7943, 81.1746, 5711.28, 5673.71, 3328.73, 3261.72, -1266.08, -1266.08, 3169.71,
 3169.71, 64.6123, 97.9926, 131.373, 131.117, 4642.72, 4642.98, -1404.25, -1403.74,
 5241.89, 5267.11, 5304.44, 5304.44, 4415.32, 4386.38, 5175.13, 5241.89, 5392.25,
 5384.1, 5325.62, 5291.98, 5250.19, 5225.48, -105.083, -112.98, 1396.56, 1396.56,
 4448.7, 4419.76, -46.2195, -79.8556, -1421.01, -1420.49, 3319.79, 3319.79, 3319.79,
 3319.79, -238.092, -271.473, -1428.84, -1428.84, 5121.11, 5154.49, 5250.58, 5225.48,
 -1458.02, -1524.78, -1524.78, -1566.31, 3378.27, 3378.27, 3378.27, 3378.27, 214.696,
 248.332, 9283.62, 9220.93, 5308.9, 5342.28, 1304.11, 1304.11, -313.262, -413.403,
 5337.82, 5337.82, 6303.42, 6387., 6395.15, 6491.66, 7159.67, 7159.42, 4225.74, 4192.36,
 3312.04, 3278.85, 6541.16, 6633.14, 9538.3, 9475.75, -179.741, -213.121, 9404.52,
 9371.27, 5324., 5290.87, 3069.44, 3069.44, 5463.06, 5463.06, 1413.38, 1446.76,
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 481.994, 1304.11, 1304.11, 5103.11, 5069.47, 464.665, 515.119, 5450.58, 5450.58,
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 9325.28, 1046.45, 1046.2, 1029.63, 1029.63, 3763.37, 3763.62, 498.301, 531.681,
 3020.22, 2986.84, 6979.56, 7041.86, 1304.11, 1304.11, 3861.69, 3828.31, 7029.5,
 7096.01, 1304.11, 1304.11, 3825.18, 3791.8, 1304.11, 1304.11, 1304.11, 1304.11,
 1304.11, 1304.11, 5166.78, 5166.78, 1304.11, 1304.11, 729.212, 745.774, 5484.11,
 5475.96, 5133.4, 5133.4, 5450.73, 5409.2, 5384.22, 5342.31, 6975.95, 6975.95, 5225.48,
 5166.87, -198.676, -198.164, 3879.15, 3879.4, 237.513, 170.369, 7313.36, 7371.72,
 5225.48, 5200.51, 3908.36, 3908.61, 1163.16, 1129.52, 6975.95, 6975.95, 3605.45,
 3572.13, 4049.85, 4049.85, 3111.1, 3111.1, 1304.11, 1304.11, 5457.87, 4828.84, 9112.25,
 9049.7, 206.54, 206.54, 3638.63, 3630.48, 265.403, 198.642, 1096.4, 1063.01, 1096.4,
 1063.01, 9033.26, 8999.63, 3563.85, 3526.01, 3526.01, 3492.63, 8845.6, 8816.16,
 6959.14, 6959.14, 7859.62, 7922.43, 5175.28, 5150.56, 6959.14, 6959.14, 6959.14,
 6959.14, 4858.16, 4833.32, 6959.14, 6959.14, 6959.14, 6959.14, 6959.14, 6959.14,
 6959.14, 6959.14, 4501.11, 4467.48, 8845.6, 8845.6, 3930.97, 3893.19, 6959.14,
 6959.14, 4561.63, 4527.99, 828.841, 829.097, 8214.31, 8214.31, 8214.31, 8214.31,
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 1263.64, 798.979, 815.542, 832.36, 865.74, 8214.31, 8214.31, 4766.41, 4766.41,
 4672.19, 4672.19, 4672.19, 4672.19, 4672.19, 4672.19, 3734.64, 3764.07, 4353.36,
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 6416.77, 6400.08, 4672.19, 4672.19, 695.831, 695.831, 3732.44, 3732.44, 3222.12,
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 3748.21, 3715.08, 562.054, 562.054, 528.674, 545.236, 3647.98, 3647.98, 4308.14,
 4308.14, 2510.1, 2510.1, 3647.98, 3647.98, 2623.95, 2590.57, 1516.78, 1550.16,
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 3673.16, 3681.83, 2410.24, 2410.24, 6558.7, 6550.42, 4549.35, 4582.73, 4714.85,
 4714.85, 2017.49, 2050.87, 2832.42, 2832.42, 5068.95, 5131.52, 1304.11, 1304.11,
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 3647.98, 2832.77, 2799.39, 4361.48, 4394.86, 595.435, 595.435, 595.69, 595.435,
 3689.85, 3698.52, 2410.24, 2410.24, 3647.98, 3647.98, 5445.53, 5509.15, 3647.98,
 3647.98, 2727.35, 2727.35, 6691.97, 6683.56, 4494.23, 4494.23, 3647.98, 3647.98,
 5821.04, 5875.2, 2510.1, 2510.1, 4793.33, 4826.71, 1304.11, 1304.11, 4860.09,
 4893.48, 7731.69, 7777.68, 2774.42, 2707.4, 6474.99, 6450.02, 4508.84, 4471.32,
 2832.77, 2765.75, 2451.43, 2484.81, 4379.46, 4346.14, 578.872, 612.508, 6090.11,
 6137.07, 4052.98, 4052.98, 4052.98, 4052.98, 4058.27, 4020.75, 2510.1, 2510.1,
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 2799.39, 2732.37, 2732.63, 2665.61, 4032.07, 4023.91, 1304.11, 1304.11, 2832.42,
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 4865.3, 4898.68, 2510.1, 2510.1, 2482.4, 2415.39, 3940.46, 3940.46, 895.602,
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