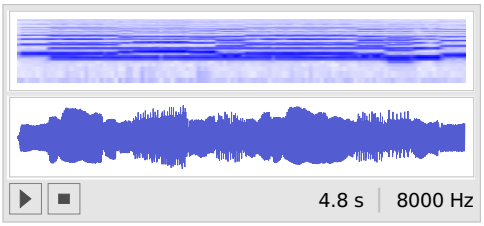
Vectors and Matrices as Data

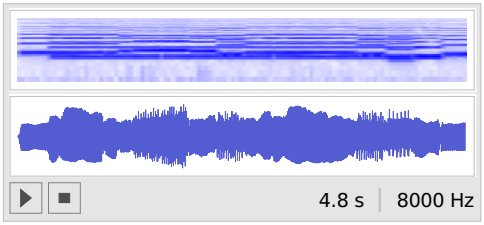
do as fast as possible to test time taken

- Question 1

In[131]:=
```
Sound@
```



Out[131]=



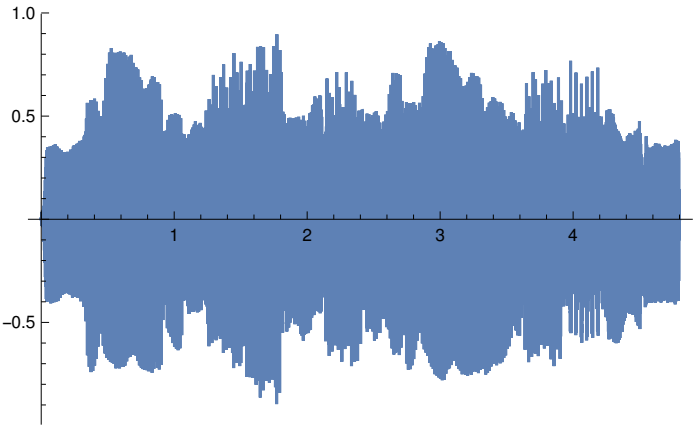

```
x = Import["/home/nathan/QEA-Homework/module 2/day4/hornCSV.csv"];
x1 = Import[
    "/home/nathan/QEA-Homework/module 2/day4/english_horn.wav", "Data"] // Flatten
```

Out[133]=
```
{0.00466919, 0.010376, 0.00534058, 0.00265503, 0.0039978, 0.00146484,
 -0.00146484, -0.00311279, ··· 38384 ···, -0.00665283, -0.00582886, -0.010498,
 -0.00796509, -0.00369263, -0.000457764, 0.000671387, 0.000396729}
```

large output | show less | show more | show all | set size limit...

In[134]:=
```
ListLinePlot[x]
```

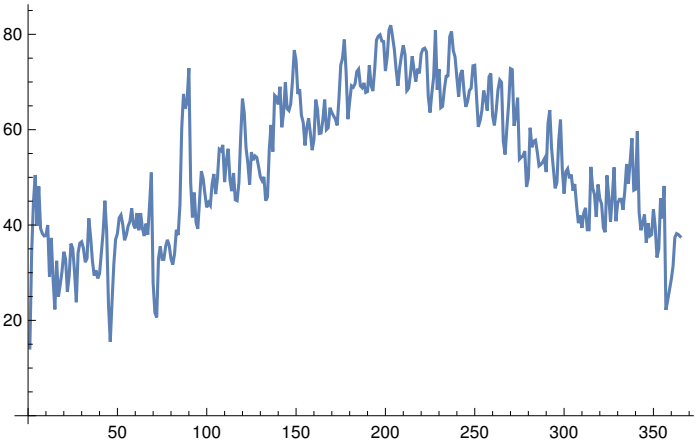
Out[134]=




```
t = Transpose@
    Import["/home/nathan/QEA-Homework/module 2/day4/1998DailyTempBos.csv"];
```

In[136]:=
```
ListLinePlot[t]
```

Out[136]=



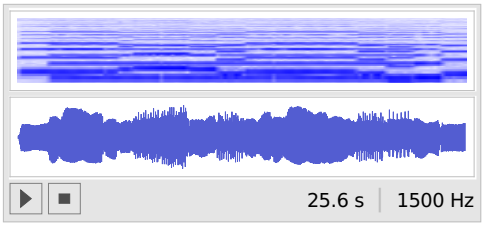
In[137]:=
```
2. Transpose[x1][[1]]
```

Transpose::nmtx : The first two levels of {0.00466919, 0.010376, 0.00534058, 0.00265503, 0.0039978, 0.00146484, –0.00146484, –0.00311279, –0.00344849, ≪33≫, 0.0155029, 0.0135193, 0.0136414, 0.0169067, 0.0230713, 0.0341797, 0.0192261, 0.025116, ≪38350≫} cannot be transposed. ≫

Out[137]=
```
{0.00933838, 0.020752, 0.0106812, 0.00531006, 0.00799561, 0.00292969,
 -0.00292969, -0.00622559, -0.00689697, ··· 38383 ···, -0.0133057, -0.0116577,
 -0.0209961, -0.0159302, -0.00738525, -0.000915527, 0.00134277, 0.000793457}
```
large output | show less | show more | show all | set size limit...

In[138]:=
```
audio = Sound[SampledSoundList[x1, 1500]]
```

Out[138]=



In[139]:=
```
Export["low.flac", audio]
```

Out[139]=
```
low.flac
```

```
in = Import[
   "/home/nathan/QEA-Homework/module 2/day4/english_horn.wav", "Data"] // Flatten
```

Out[140]=
```
{0.00466919, 0.010376, 0.00534058, 0.00265503, 0.0039978, 0.00146484,
 -0.00146484, -0.00311279, ··· 38384 ···, -0.00665283, -0.00582886, -0.010498,
 -0.00796509, -0.00369263, -0.000457764, 0.000671387, 0.000396729}
```
large output | show less | show more | show all | set size limit...

Question 2

In[141]:=

In[142]:=
$$a = \begin{matrix} 1 \\ 2 \\ 3 \end{matrix};$$

$$b = \begin{matrix} 3 \\ 2 \\ 1 \end{matrix};$$

$$d = \begin{matrix} 3 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 1 \end{matrix};$$

In[145]:=
```
b * a
```

Out[145]=
```
{{3}, {4}, {3}}
```

In[146]:=
```
a.b
```

Dot::dotsh : Tensors {{1}, {2}, {3}} and {{3}, {2}, {1}} have incompatible shapes. >>

Out[146]=
```
{{1}, {2}, {3}}.{{3}, {2}, {1}}
```

In[147]:=
```
a.Transpose[b]
```

Out[147]=
```
{{3, 2, 1}, {6, 4, 2}, {9, 6, 3}}
```

In[148]:=
```
d.a
```

Out[148]=
```
{{3}, {4}, {3}}
```

In[149]:=
```
d.a.Transpose[a]
```

Out[149]=
```
{{3, 6, 9}, {4, 8, 12}, {3, 6, 9}}
```

Question 3, 4

In[150]:=
```
Clear["Global`*"]
```

In[151]:=
```
d = Join[
  {Join[{1}, Table[0, 364]]},
  Table[Join[Table[0, i - 1], {1 / 3, 1 / 3, 1 / 3}, Table[0, 363 - i]], {i, 363}],
  {Join[Table[0, 364], {1}]}
 ]
```

Out[151]=
```
{ ··· 1 ··· }
```

large output | show less | show more | show all | set size limit...

```
t = Import["/home/nathan/QEA-Homework/module 2/day4/1998DailyTempBos.csv"];
```

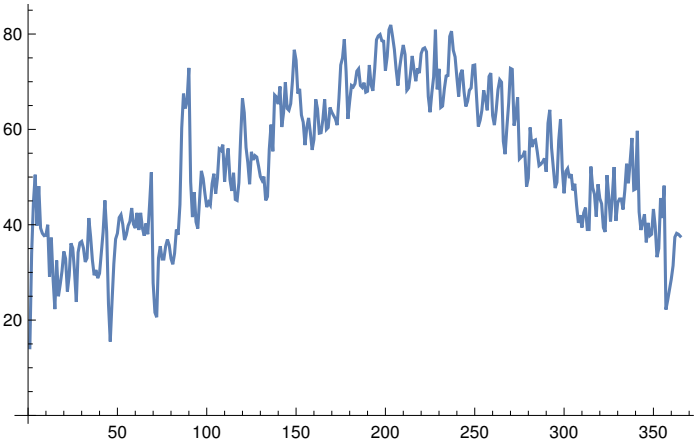
In[153]:=
```
Dimensions[t]
Dimensions[d]
```

Out[153]=
```
{365, 1}
```

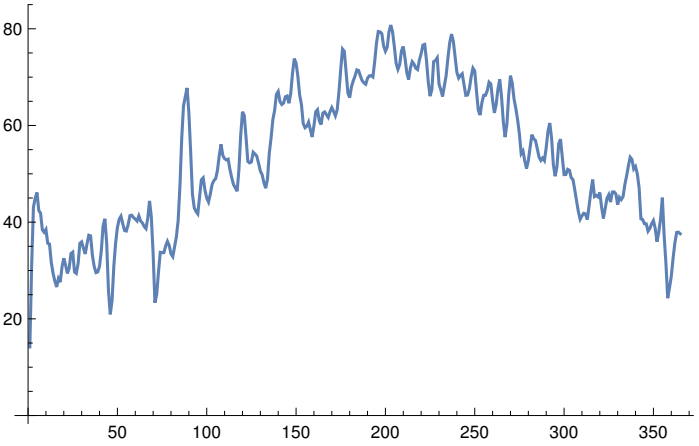
Out[154]=
```
{365, 365}
```

In[155]:=
```
ListLinePlot[Transpose[t]]
ListLinePlot[Transpose[d.t]]
ListLinePlot[Transpose[d.(d.(d.(d.t)))]]
```

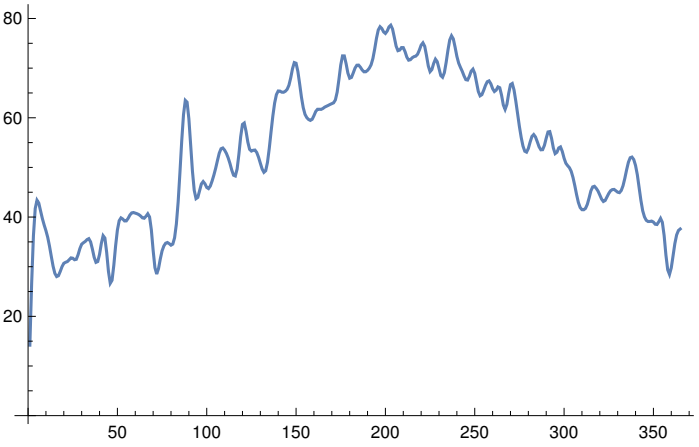
Out[155]=



Out[156]=

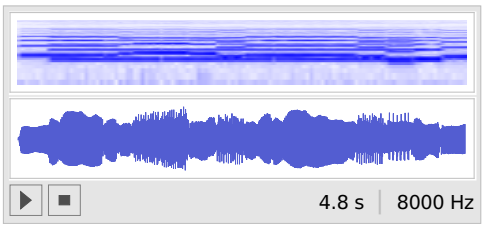


Out[157]=



- Question 7, 8

```
Clear["Global`*"]
soundData = Import[
   "/home/nathan/QEA-Homework/module 2/day4/english_horn.wav", "Data"] // Flatten
Sound[SampledSoundList[soundData, 8000]]
   1 / 3
d = 1 / 3
   1 / 3
soundDatad = ListConvolve[d^T[[1]], soundData]
Sound[SampledSoundList[soundDatad, 8000]]
```




```
ListLinePlot[{soundData, soundDatad}]
```

In[369]:=

Question 10

In[651]:=

```
Clear["Global`*"]
soundData = Import[
   "/home/nathan/QEA-Homework/module 2/day4/english_horn.wav", "Data"] // Flatten
h2 = {1 / 5, 1 / 5, 1 / 5, 1 / 5, 1 / 5}
soundDatah = ListConvolve[h2, soundData]
xhf2 = Table[Cos[1000 t], {t, 0, 10, 10. / 10 000}];
xlf2 = Table[Cos[10 t], {t, 0, 10, 10. / 10 000}];
hfSound2 = ListConvolve[h2, xhf2];
lfSound2 = ListConvolve[h2, xlf2];
"High Frequency + High Pass = " Sound[SampledSoundList[hfSound2, 1000]]
"Low  Frequency + High Pass = " Sound[SampledSoundList[lfSound2, 1000]]
ListLinePlot[{hfSound2, lfSound2}, PlotRange → {{0, 100}, {-1, 1}}]
```

Out[652]=

```
{0.00466919, 0.010376, 0.00534058, 0.00265503, 0.0039978, 0.00146484,
 -0.00146484, -0.00311279, ··· 38 384 ···, -0.00665283, -0.00582886, -0.010498,
 -0.00796509, -0.00369263, -0.000457764, 0.000671387, 0.000396729}
```

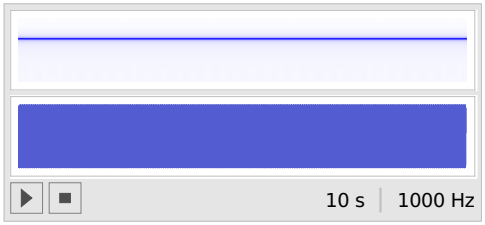
large output | show less | show more | show all | set size limit...

Out[653]= $\left\{\frac{1}{5}, \frac{1}{5}, \frac{1}{5}, \frac{1}{5}, \frac{1}{5}\right\}$

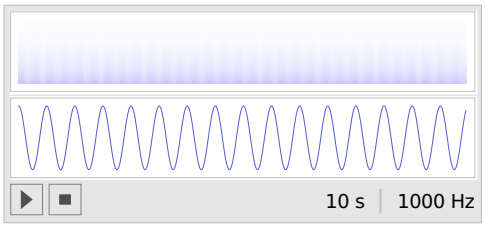
Out[654]=
{0.00540771, 0.00476685, 0.00239868, 0.000708008, -0.000512695,
 -0.00227051, -0.00422363, ··· 38382 ···, -0.0150452, -0.0136292,
 -0.0103455, -0.00692749, -0.00568848, -0.00438843, -0.00220947}

large output | show less | show more | show all | set size limit...

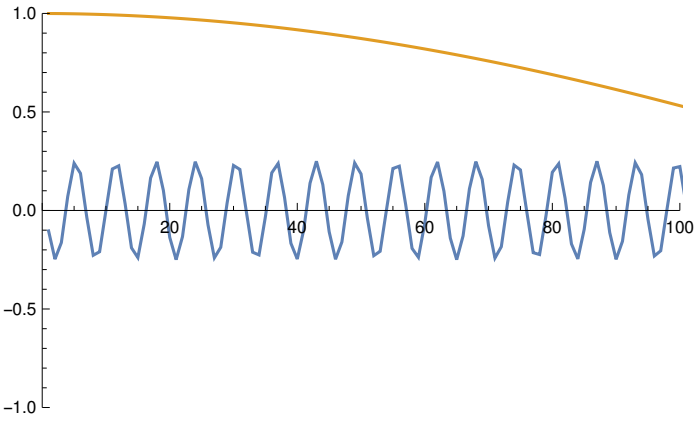
Out[659]= High Frequency + High Pass =



Out[660]= Low Frequency + High Pass =



Out[661]=



■ Question 12

```
Clear["Global`*"]
soundData = Import[
    "/home/nathan/QEA-Homework/module 2/day4/english_horn.wav", "Data"] // Flatten
N@Length[soundData] / 8000
h = Join[{1 / 2}, Table[0, 8000], {1 / 2}];
soundData[[1 ;; 4000]];
soundData[[Length[soundData] - 4000 ;; Length[soundData]]];
SoundDatah = ListConvolve[h, soundData]
soundDatahFull = Join[(1 / 2) * soundData[[1 ;; 4000]], ListConvolve[h, soundData],
    (1 / 2) * soundData[[Length[soundData] - 4000 ;; Length[soundData]]]];
Sound[SampledSoundList[soundData, 8000]]
Sound[SampledSoundList[SoundDatah, 8000]]
Sound[SampledSoundList[soundDatahFull, 8000]]
```

Question 13

In[467]:=
```
Clear["Global`*"]

t = Import["/home/nathan/QEA-Homework/module 2/day4/1998DailyTempBos.csv"];
```

In[469]:=
```
h = Table[1 / 5, 5]
```

Out[469]=
$$\left\{\frac{1}{5}, \frac{1}{5}, \frac{1}{5}, \frac{1}{5}, \frac{1}{5}\right\}$$

In[470]:=
```
t1 = ListConvolve[h, t^T[[1]]];
```

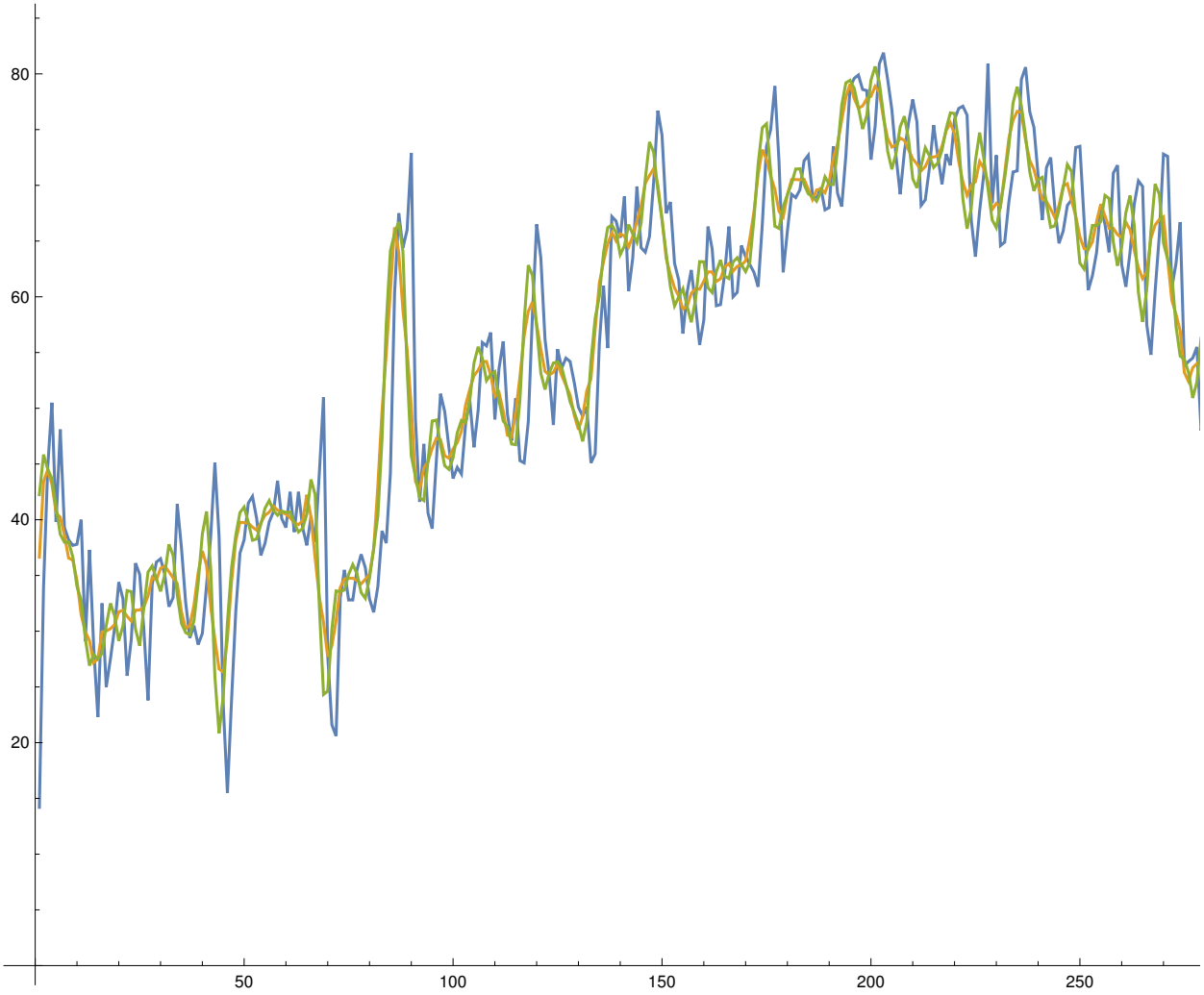
In[471]:=
```
k = {.036, .241, .446, .241, .036}
```

Out[471]=
```
{0.036, 0.241, 0.446, 0.241, 0.036}
```

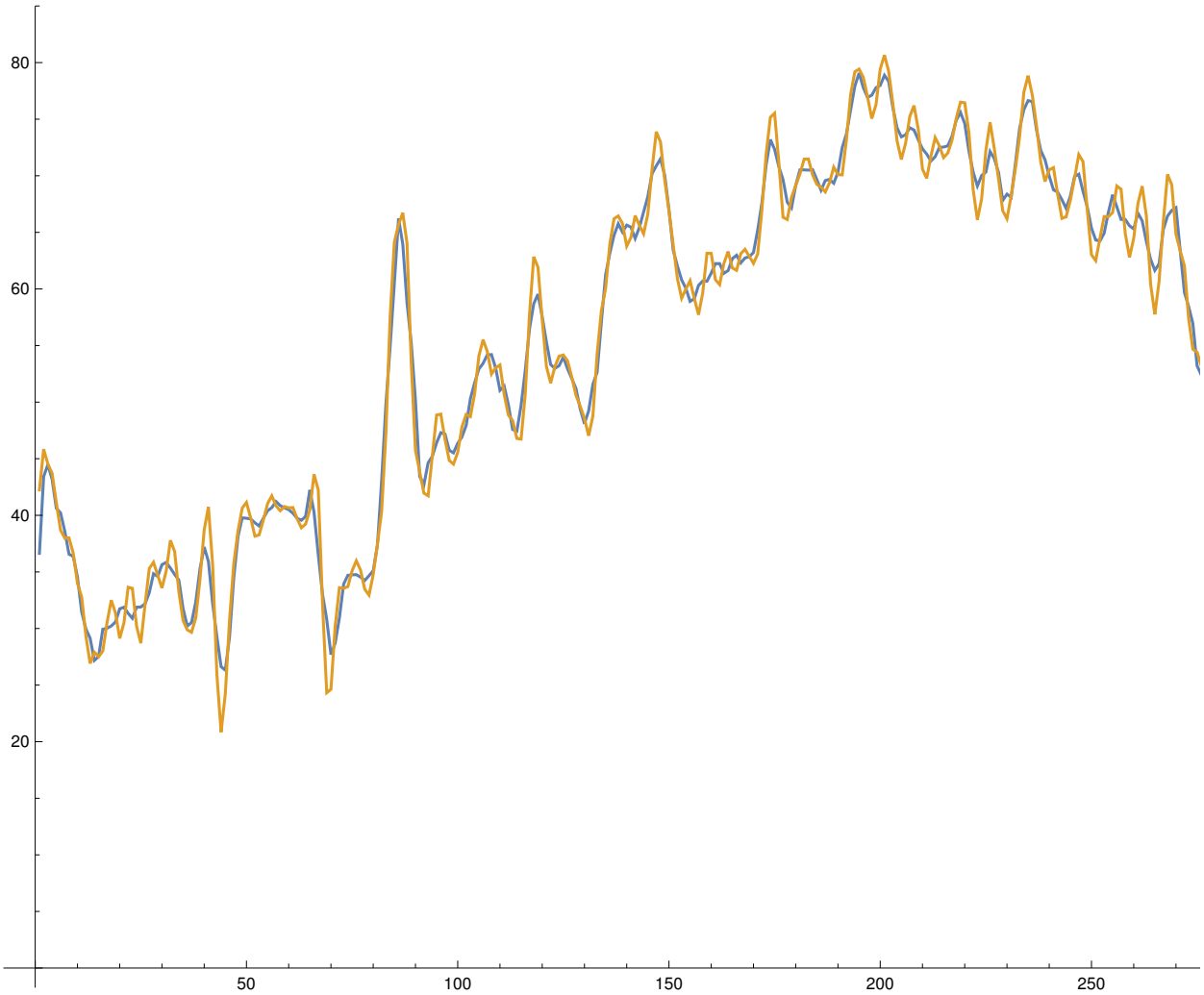
In[472]:=
```
t2 = ListConvolve[k, t^T[[1]]];
```

In[473]:=
```
ListLinePlot[{t^T[[1]], t1, t2}]
ListLinePlot[{t1, t2}]
```

Out[473]=



Out[474]=



Question 14

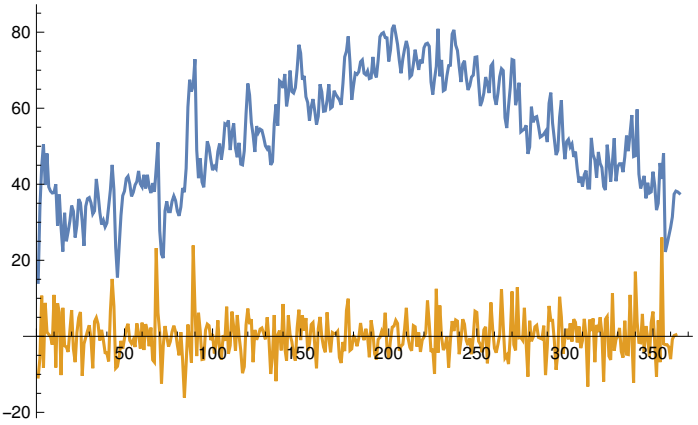
In[475]:=
```
Clear["Global`*"]
```

In[666]:=
```
t = Import["/home/nathan/QEA-Homework/module 2/day4/1998DailyTempBos.csv"];
h = {-1, 1, 0};
t = t^T[[1]];
```

In[669]:=
```
t1 = ListConvolve[h, t];
```

In[670]:=
```
ListLinePlot[{t, t1}]
```

Out[670]=



Define Kernal

In[671]:=
```
Clear["Global`*"]
```

In[672]:=
```
Kernal[vec_, kern_] := Join[
  {vec[[1]]},
  Table[Total[vec[[i ;; i + Length[kern] - 1]] * kern],
   {i, 1, 1 + Length[vec] - Length[kern]}], {vec[[-1]]}]
```

In[673]:=
```
Kernal[{1, 3, 2, -1, 3, 1}, {1 / 2, 1 / 3, 1 / 4}]
```

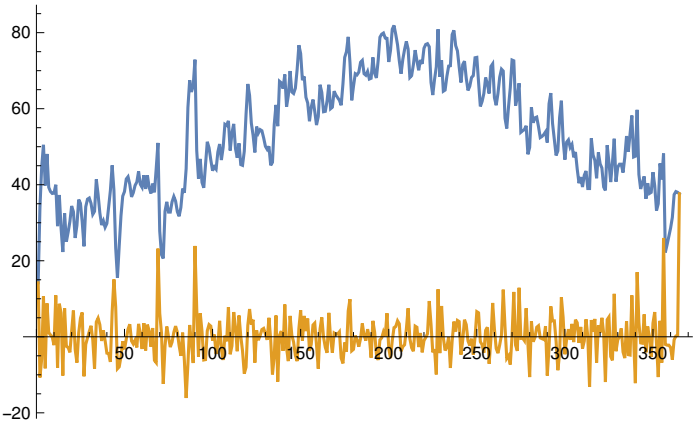
Out[673]=
$$\left\{1, 2, \frac{23}{12}, \frac{17}{12}, \frac{3}{4}, 1\right\}$$

In[638]:=
```
t = Import["/home/nathan/QEA-Homework/module 2/day4/1998DailyTempBos.csv"];
k = {0, 1, -1};
t = t^T[[1]];
```

In[649]:=
```
tk = Kernal[t, k];
```

In[650]:=
```
ListLinePlot[{t, tk}]
```

Out[650]=



Define Kernal 2D

In[242]:=
```
Clear["Global`*"]
```

In[243]:=
```
a = {{1, 2, 3, 4, 5}, {6, 7, 8, 9, 10},
    {11, 12, 13, 14, 15}, {16, 17, 18, 19, 20}, {21, 22, 23, 24, 25}};
a1 = a
k = (1 / 11) * {{1, 1, 1}, {1, 3, 1}, {1, 1, 1}}
```

Out[244]=
```
{{1, 2, 3, 4, 5}, {6, 7, 8, 9, 10},
 {11, 12, 13, 14, 15}, {16, 17, 18, 19, 20}, {21, 22, 23, 24, 25}}
```

Out[245]= $\left\{\left\{\frac{1}{11}, \frac{1}{11}, \frac{1}{11}\right\}, \left\{\frac{1}{11}, \frac{3}{11}, \frac{1}{11}\right\}, \left\{\frac{1}{11}, \frac{1}{11}, \frac{1}{11}\right\}\right\}$

In[246]:=
```
Kernal2D[a_, a1_, k_] := For[t = 2, t < Length[a], t = t + 1,
  For[z = 2, z < Length[a], z = z + 1,
   a1[[t, z]] =
         k[[1, 1]] a[[t - 1, z - 1]] +
         k[[1, 2]] a[[t - 1, z]] +
         k[[1, 3]] a[[t - 1, z + 1]] +
         k[[2, 1]] a[[t, z - 1]] +
         k[[2, 2]] a[[t, z]] +
         k[[2, 3]] a[[t, z + 1]] +
         k[[3, 1]] a[[t + 1, z - 1]] +
         k[[3, 2]] a[[t + 1, z]] +
         k[[3, 3]] a[[t + 1, z + 1]]]
 ]
```

In[247]:=
```
Kernal2D[a, a1, k]
```

Set::setps : {{1, 2, 3, 4, 5}, {6, 7, 8, 9, 10}, {11, 12, 13, 14, 15}, {16, 17, 18, 19, 20}, {21, 22, 23, 24, 25}} in the part assignment is not a symbol. ≫

Set::setps : {{1, 2, 3, 4, 5}, {6, 7, 8, 9, 10}, {11, 12, 13, 14, 15}, {16, 17, 18, 19, 20}, {21, 22, 23, 24, 25}} in the part assignment is not a symbol. ≫

Set::setps : {{1, 2, 3, 4, 5}, {6, 7, 8, 9, 10}, {11, 12, 13, 14, 15}, {16, 17, 18, 19, 20}, {21, 22, 23, 24, 25}} in the part assignment is not a symbol. ≫

General::stop : Further output of Set::setps will be suppressed during this calculation. ≫

In[173]:=
```
For[t = 2, t < Length[a], t = t + 1,
 For[z = 2, z < Length[a], z = z + 1,
  a1[[t, z]] =
        k[[1, 1]] a[[t - 1, z - 1]] +
        k[[1, 2]] a[[t - 1, z]] +
        k[[1, 3]] a[[t - 1, z + 1]] +
        k[[2, 1]] a[[t, z - 1]] +
        k[[2, 2]] a[[t, z]] +
        k[[2, 3]] a[[t, z + 1]] +
        k[[3, 1]] a[[t + 1, z - 1]] +
        k[[3, 2]] a[[t + 1, z]] +
        k[[3, 3]] a[[t + 1, z + 1]]]
]
MatrixForm[N@a1]
```

Out[174]//MatrixForm=

$$\begin{pmatrix} 1. & 2. & 3. & 4. & 5. \\ 6. & 7. & 8. & 9. & 10. \\ 11. & 12. & 13. & 14. & 15. \\ 16. & 17. & 18. & 19. & 20. \\ 21. & 22. & 23. & 24. & 25. \end{pmatrix}$$

In[269]:=
```
house = Import["/home/nathan/QEA-Homework/module 2/day4/house.png", "Data"];
a = house;
a1 = house;
a2 = house;
a3 = house;
k1 = (1 / 11) * {{1, 1, 1}, {1, 3, 1}, {1, 1, 1}};
k2 = {{0, 1, 0}, {1, -4, 1}, {0, 1, 0}}
k3 = {{-1, -1, -1}, {-1, 9, -1}, {-1, -1, -1}}
```

Out[275]= {{0, 1, 0}, {1, -4, 1}, {0, 1, 0}}

Out[276]= {{-1, -1, -1}, {-1, 9, -1}, {-1, -1, -1}}

In[277]:=
```
For[t = 2, t < Length[a], t = t + 1,
 For[z = 2, z < Length[a], z = z + 1,
  a1[[t, z]] =
        k1[[1, 1]] a[[t - 1, z - 1]] +
        k1[[1, 2]] a[[t - 1, z]] +
        k1[[1, 3]] a[[t - 1, z + 1]] +
        k1[[2, 1]] a[[t, z - 1]] +
        k1[[2, 2]] a[[t, z]] +
        k1[[2, 3]] a[[t, z + 1]] +
        k1[[3, 1]] a[[t + 1, z - 1]] +
        k1[[3, 2]] a[[t + 1, z]] +
        k1[[3, 3]] a[[t + 1, z + 1]]]
]
```

In[278]:=
```
For[t = 2, t < Length[a], t = t + 1,
 For[z = 2, z < Length[a], z = z + 1,
  a2[[t, z]] =
        k2[[1, 1]] a[[t - 1, z - 1]] +
        k2[[1, 2]] a[[t - 1, z]] +
        k2[[1, 3]] a[[t - 1, z + 1]] +
        k2[[2, 1]] a[[t, z - 1]] +
        k2[[2, 2]] a[[t, z]] +
        k2[[2, 3]] a[[t, z + 1]] +
        k2[[3, 1]] a[[t + 1, z - 1]] +
        k2[[3, 2]] a[[t + 1, z]] +
        k2[[3, 3]] a[[t + 1, z + 1]]]
]
```

In[279]:=
```
For[t = 2, t < Length[a], t = t + 1,
 For[z = 2, z < Length[a], z = z + 1,
  a3[[t, z]] =
        k3[[1, 1]] a[[t - 1, z - 1]] +
        k3[[1, 2]] a[[t - 1, z]] +
        k3[[1, 3]] a[[t - 1, z + 1]] +
        k3[[2, 1]] a[[t, z - 1]] +
        k3[[2, 2]] a[[t, z]] +
        k3[[2, 3]] a[[t, z + 1]] +
        k3[[3, 1]] a[[t + 1, z - 1]] +
        k3[[3, 2]] a[[t + 1, z]] +
        k3[[3, 3]] a[[t + 1, z + 1]]]
]
```

In[280]:=
```
Image[a, "Byte"]
Image[a1, "Byte"]
Image[a2, "Byte"]
Image[a3, "Byte"]
```

Out[280]=

Out[281]=

Out[282]=

Out[283]=

In[287]:=
```
Export["/home/nathan/QEA-Homework/module 2/day4/houseA.png", Image[a1, "Byte"]];
Export["/home/nathan/QEA-Homework/module 2/day4/houseB.png", Image[a2, "Byte"]];
Export["/home/nathan/QEA-Homework/module 2/day4/houseC.png", Image[a3, "Byte"]];
```