Assignment 03 -- solutions

In the list below, determine how many numbers are smaller than 0.5. Use do-loop and if-function:
ran = {0.115982, 0.915117, 0.27832, 0.190823, 0.440397, 0.076071, 0.733455, 0.0238866, 0.519024, 0.862353, 0.517789, 0.508546, 0.00592584, 0.63973, 0.087796, 0.914853, 0.852816, 0.50755, 0.019956, 0.0450688, 0.389318, 0.613672, 0.433074, 0.870317, 0.285534, 0.273034, 0.135192, 0.723829, 0.764315, 0.660089, 0.158247, 0.380149, 0.797884, 0.559137, 0.0662414, 0.205511, 0.757676, 0.228942, 0.643928, 0.514522, 0.559161, 0.628176, 0.0743335}

```
Clear[ran];
ran = {0.115982, 0.915117, 0.27832, 0.190823, 0.440397, 0.076071, 0.733455,
   0.0238866, 0.519024, 0.862353, 0.517789, 0.508546, 0.00592584, 0.63973,
   0.087796, 0.914853, 0.852816, 0.50755, 0.019956, 0.0450688, 0.389318, 0.613672,
   0.433074, 0.870317, 0.285534, 0.273034, 0.135192, 0.723829, 0.764315,
   0.660089, 0.158247, 0.380149, 0.797884, 0.559137, 0.0662414, 0.205511,
   0.757676, 0.228942, 0.643928, 0.514522, 0.559161, 0.628176, 0.0743335};
Clear[howmany, dim];
howmany = 0;
dim = Length[ran];
Do[ If[ran⟦k⟧ < 0.5, howmany = howmany + 1], {k, 1, dim}];
Print["There are ", howmany, " numbers smaller than 0.5"]
```

```
There are 21 numbers smaller than 0.5
```

Construct a 5x5 matrix where each element is the sum of the indexes indicating its position in the row and in the column.

$$\begin{pmatrix} 2 & 3 & 4 & 5 & 6 \\ 3 & 4 & 5 & 6 & 7 \\ 4 & 5 & 6 & 7 & 8 \\ 5 & 6 & 7 & 8 & 9 \\ 6 & 7 & 8 & 9 & 10 \end{pmatrix}$$

```
Clear[elem, mat];
Do[Do[elem[j, k] = j + k, {j, 1, 5}], {k, 1, 5}];
mat = Table[Table[elem[j, k], {k, 1, 5}], {j, 1, 5}];
MatrixForm[mat]
```

Construct a 5x5 matrix that looks like:

$$\begin{pmatrix} 7 & 7 & 7 & 7 & 7 \\ 7 & 0 & 0 & 0 & 7 \\ 7 & 0 & 0 & 0 & 7 \\ 7 & 0 & 0 & 0 & 7 \\ 7 & 7 & 7 & 7 & 7 \end{pmatrix}$$

```
Clear[elem, mat];
Do[Do[elem[j, k] = 0, {j, 1, 5}], {k, 1, 5}];
Do[
  Do[elem[k, j] = 7, {j, 1, 5}];
  Do[elem[j, k] = 7, {j, 1, 5}];
  , {k, 1, 5, 4}];
mat = Table[Table[elem[j, k], {k, 1, 5}], {j, 1, 5}];
MatrixForm[mat]
```

Construct a 5x5 matrix that looks like:

$$\begin{pmatrix} 1 & 0 & 0 & 0 & -1 \\ 0 & 1 & 0 & -1 & 0 \\ 0 & 0 & 10 & 0 & 0 \\ 0 & -1 & 0 & 1 & 0 \\ -1 & 0 & 0 & 0 & 1 \end{pmatrix}$$

```
Clear[elem, mat];
Do[Do[elem[j, k] = 0, {j, 1, 5}], {k, 1, 5}];
Do[elem[j, j] = 1, {j, 1, 5}];
Do[elem[j, 6 - j] = -1, {j, 1, 5}];
elem[3, 3] = 10;
mat = Table[Table[elem[j, k], {k, 1, 5}], {j, 1, 5}];
MatrixForm[mat]
```

Given the matrix and vector
m1 = { {1, 2, 3}, {1, 1, 1}, {3, 2, 1} };
v1 = {6, 5, 4};
Use do-loops to compute the vector Vprod=m1.v1
Show Vprod in MatrixForm
Compare the result from your little code with m1.v1

```
Clear[m1, v1, vt, Vprod];
m1 = {{1, 2, 3}, {1, 1, 1}, {3, 2, 1}};
v1 = {6, 5, 4};
Do[
  vt[j] = Sum[m1[[j, k]] * v1[[k]], {k, 1, 3}];
  , {j, 1, 3}];

Vprod = Table[vt[j], {j, 1, 3}];
MatrixForm[Vprod]
Print["My code is right, it gives the same result as the operation below."]
MatrixForm[m1.v1]
```

$$\begin{pmatrix} 28 \\ 15 \\ 32 \end{pmatrix}$$

```
My code is right, it gives the same result as the operation below.
```

$$\begin{pmatrix} 28 \\ 15 \\ 32 \end{pmatrix}$$

Given the matrices
m1 = { {1, 2, 3}, {1, 1, 1}, {3, 2, 1} };
m2 = { {9, 8, 7}, {6, 5, 4}, {3, 2, 1} };
Use do-loops to compute the matrix mprod=m1.m2
Show mprod in MatrixForm
Compare the result from your little code with m1.m2
Do m1 and m2 commute, that is, is m1.m2 equal to m2.m1?

```
Clear[m1, m2, mt, mprod];
m1 = {{1, 2, 3}, {1, 1, 1}, {3, 2, 1}};
m2 = {{9, 8, 7}, {6, 5, 4}, {3, 2, 1}};
Do[
 Do[
   mt[i, j] = Sum[m1[[i, k]] * m2[[k, j]], {k, 1, 3}];
   , {j, 1, 3}];
 , {i, 1, 3}]
mprod = Table[Table[mt[i, j], {j, 1, 3}], {i, 1, 3}];
MatrixForm[mprod]
Print["My code is right, it gives the same results as the operation below."]
MatrixForm[m1.m2]
Print["m1 and m2 do not commute, because the
   result for m2.m1 (below) is different than m1.m2 (above)."]
MatrixForm[m2.m1]
```

$$\begin{pmatrix} 30 & 24 & 18 \\ 18 & 15 & 12 \\ 42 & 36 & 30 \end{pmatrix}$$

```
My code is right, it gives the same results as the operation below.
```

$$\begin{pmatrix} 30 & 24 & 18 \\ 18 & 15 & 12 \\ 42 & 36 & 30 \end{pmatrix}$$

```
m1 and m2 do not commute, because the
  result for m2.m1 (below) is different than m1.m2 (above).
```

$$\begin{pmatrix} 38 & 40 & 42 \\ 23 & 25 & 27 \\ 8 & 10 & 12 \end{pmatrix}$$

A projectile initially placed at xo=0 and yo=0 is launched with vox=10 (pointing to the right) and voy=7 (pointing up).

Use this information to make three lists:
1) Time and vertical position y, starting at time=0 with increments 0.05. Stop right before y becomes negative.
2) Time and horizontal position x for the same instants of time above.
3) Horizontal and vertical positions, as obtained in (1) and (2).

Export the data in three different files. They will be used in the next class.
Careful with the folder where you save your data!

```
Clear[x, y, xt, yt, xy];
x[t_, xo_, vox_] := xo + vox * t;
y[t_, yo_, voy_] := yo + voy * t - (9.8 / 2.) * t^2;

yt = Table[{0.05 k, y[0.05 k, 0, 7]}, {k, 0, 28}] ;
xt = Table[{0.05 k, x[0.05 k, 0, 10]}, {k, 0, 28}] ;
xy = Table[{x[0.05 k, 0, 10], y[0.05 k, 0, 7]}, {k, 0, 28}] ;

SetDirectory["Yeshiva"];
SetDirectory["ANGEL"];
SetDirectory["Presentations_Computational"];

Export["TimeVertical.dat", yt];
Export["TimeHorizontal.dat", xt];
Export["HorizontalVertical.dat", xy];
```