Solution to Assignment 02

FUNCTION

Define a function "volume" to compute the volume of a right circular cylinder of radius r and height h. Use it to compute the volume of a cylinder of radius 4 m and height 10 m.

```
Clear[volume];
volume[r_, h_] := Pi r^2 h
volume[4, 10.]
(* area in meter^2 *)
```

```
502.655
```

Define a function "fac" to compute the factorial of a number. But avoid using " ! ", use instead "Product". Use this function to compute the factorial of 4, 5, and 6.

```
fac[x_] := Product[k, {k, 1, x}];
fac[4]
fac[5]
fac[6]
```

```
24
```

```
120
```

```
720
```

Define a function "fib" to compute any Fibonacci number. Find the 9th Fibonacci number.

```
Clear[fib];
fib[1] = 1;
fib[2] = 1;
fib[x_] := fib[x - 2] + fib[x - 1];
fib[9]
```

```
34
```

TABLE

The number e is defined as the limit of
$(1+1/n)^n$ when n approaches infinity.
Use the Table function to list the value of $(1+1/n)^n$ for n=10,10^2, 10^3,... 10^6. The numbers get closer and closer to e . [hint: replace n in the expression by 10^k and let k go from 1 to 6]

```
Exp[1.]
Table[(1. + 1. / 10^k)^(10^k), {k, 1, 6}]
```

```
2.71828
```

```
{2.59374, 2.70481, 2.71692, 2.71815, 2.71827, 2.71828}
```

In the list of random numbers:
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}

(i) What is the maximum value and its position?
(ii) What is the minimum value and its position?
(iii) How many entries are there in the list?
(iv) Multiply the third element by the last one.
(v) Sort the elements in increasing order.

```
(* (i) *)
Max[ran]
Position[ran, Max[ran]]
```

```
0.915117
```

```
{{2}}
```

```
(* (ii) *)
Min[ran]
Position[ran, Min[ran]]
```

```
0.00592584
```

```
{{13}}
```

```
(* (iii) *)
Length[ran]
```

```
43
```

```
(* (iv) *)
ran[[3]] × Last[ran]
```

```
0.0206885
```

```
(* (v) *)
Sort[ran]
```

```
{0.00592584, 0.019956, 0.0238866, 0.0450688, 0.0662414, 0.0743335, 0.076071,
 0.087796, 0.115982, 0.135192, 0.158247, 0.190823, 0.205511, 0.228942,
 0.273034, 0.27832, 0.285534, 0.380149, 0.389318, 0.433074, 0.440397, 0.50755,
 0.508546, 0.514522, 0.517789, 0.519024, 0.559137, 0.559161, 0.613672,
 0.628176, 0.63973, 0.643928, 0.660089, 0.723829, 0.733455, 0.757676,
 0.764315, 0.797884, 0.852816, 0.862353, 0.870317, 0.914853, 0.915117}
```

Write a 5X5 matrix filled with random integers between 1 and 9.
Divide the element in the first row and third column by the element in the last row and in the last column.

```
Clear[tab];
tab = Table[Table[RandomInteger[{1, 9}], {k, 1, 5}], {j, 1, 5}] ;
MatrixForm[tab]
tab[[1, 3]] / tab[[5, 5]]
```

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

$$\frac{4}{7}$$

Write a 7X7 diagonal matrix, whose diagonal elements are the first seven prime numbers.
What is the value of the sum of these elements?

```
Clear[tab];
tab = DiagonalMatrix[Table[Prime[k], {k, 1, 7}]];
MatrixForm[tab]
Tr[tab]
```

$$\begin{pmatrix} 2 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 3 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 5 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 7 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 11 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 13 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 17 \end{pmatrix}$$

```
58
```

Given the vectors
v1 = {1, 2, 3};
v2 = {4, 5, 6};
Compute the dot product bewteen them.
Compute the cross product.

```
Clear[v1, v2];
v1 = {1, 2, 3};
v2 = {4, 5, 6};
v1.v2
```

```
32
```

```
Cross[v1, v2]
```

```
{-3, 6, -3}
```

Given the matrices
m1 = { {1, 2, 3}, {1, 2, 3}, {1, 2, 3} };
m2 = { {9, 8, 7}, {6, 5, 4}, {3, 2, 1} };
Compute
*) m1+m2, m1-m2, m1.m2,
*) the transpose of m1,
*) the determinant of m2 (according to this result, will we have an inverse?),
*) the trace of m2

```
Clear[m1, m2];
m1 = {{1, 2, 3}, {1, 2, 3}, {1, 2, 3}};
m2 = {{9, 8, 7}, {6, 5, 4}, {3, 2, 1}};
Print["m1+m2= ", m1 + m2 // MatrixForm]
Print["m1-m2= ", m1 - m2 // MatrixForm]
Print["m1.m2= ", m1.m2 // MatrixForm]
Print[];
Print["The transpose of m1 is ", Transpose[m1] // MatrixForm]
Print[];
Print["The determinant of m2 is ", Det[m2]]
Print["Based on the result for the determinant, m2 has no inverse."]
Print[];
Print["The trace of m2 is ", Tr[m2]]
```

$$\text{m1+m2=}\begin{pmatrix} 10 & 10 & 10 \\ 7 & 7 & 7 \\ 4 & 4 & 4 \end{pmatrix}$$

$$\text{m1-m2=}\begin{pmatrix} -8 & -6 & -4 \\ -5 & -3 & -1 \\ -2 & 0 & 2 \end{pmatrix}$$

$$\text{m1.m2=}\begin{pmatrix} 30 & 24 & 18 \\ 30 & 24 & 18 \\ 30 & 24 & 18 \end{pmatrix}$$

$$\text{The transpose of m1 is }\begin{pmatrix} 1 & 1 & 1 \\ 2 & 2 & 2 \\ 3 & 3 & 3 \end{pmatrix}$$

The determinant of m2 is 0

Based on the result for the determinant, m2 has no inverse.

The trace of m2 is 15