Kurs Komputerowy S
System Symboliczny
Mathematica

Listy i macierze

Tworzenie

lista={...,...,...,...}
lista[[i]]
Table[wyra¿enie,{n}]
Table[wyra¿enie$_i$, {i, n}]
Table[wyra¿enie$_i$, {i, pocz, kon}]
Range[n]
Range[pocz, kon]
Range[pocz, kon, krok]

Jednowymiarowe ...

In[1]:=
```
a = {1, 3, 2, 5, 4, 6, 8, 7, 0, 9}
a[[2]]
a[[4]]
```

Out[1]=
```
{1, 3, 2, 5, 4, 6, 8, 7, 0, 9}
```

Out[2]=
```
3
```

Out[3]=
```
5
```

In[4]:=
```
a[[11]]
```

Part::partw : Part 11 of {1, 3, 2, 5, 4, 6, 8, 7, 0, 9} does not exist. >>

Out[4]=
```
{1, 3, 2, 5, 4, 6, 8, 7, 0, 9}[[11]]
```

In[5]:=
```
Table[x, {5}]
```

Out[5]=
```
{x, x, x, x, x}
```

In[6]:=
```
Table[x, {x, 5}]
```

Out[6]=
```
{1, 2, 3, 4, 5}
```

In[7]:=
```
Table[x, {x, 3, 5}]
```

Out[7]=
```
{3, 4, 5}
```

In[8]:=
```
Table[x, {x, 3, 17, .5}]
```

Out[8]=
```
{3., 3.5, 4., 4.5, 5., 5.5, 6., 6.5, 7., 7.5, 8., 8.5, 9., 9.5, 10., 10.5,
 11., 11.5, 12., 12.5, 13., 13.5, 14., 14.5, 15., 15.5, 16., 16.5, 17.}
```

In[9]:=
```
Table[(y + 4)^(2 * z), {x, 3, 17, 3}]
```

Out[9]=
$$\left\{(4+y)^{2z}, (4+y)^{2z}, (4+y)^{2z}, (4+y)^{2z}, (4+y)^{2z}\right\}$$

In[10]:=
```
Range[6]
```

Out[10]=
```
{1, 2, 3, 4, 5, 6}
```

In[11]:=
```
Range[3, 8]
```

Out[11]=
```
{3, 4, 5, 6, 7, 8}
```

In[12]:=
```
Range[3, 8, 0.5]
```

Out[12]=
```
{3., 3.5, 4., 4.5, 5., 5.5, 6., 6.5, 7., 7.5, 8.}
```

Wielowymiarowe ...

In[13]:=
```
b = {{1, 2}, {3, 4}, {5, 6}, {7, 8}, {9, 10}}
b[[2]]
b[[2, 1]]
```

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

Out[14]=
```
{3, 4}
```

Out[15]=
```
3
```

In[16]:=
```
x =.
```

In[17]:=
```
Table[x, {5}, {6}]
```

Out[17]=
```
{{x, x, x, x, x, x}, {x, x, x, x, x, x},
 {x, x, x, x, x, x}, {x, x, x, x, x, x}, {x, x, x, x, x, x}}
```

In[18]:=
```
Table[j * x^i, {i, 5}, {j, 4}]
```

Out[18]=
```
{{x, 2 x, 3 x, 4 x}, {x^2, 2 x^2, 3 x^2, 4 x^2},
 {x^3, 2 x^3, 3 x^3, 4 x^3}, {x^4, 2 x^4, 3 x^4, 4 x^4}, {x^5, 2 x^5, 3 x^5, 4 x^5}}
```

In[19]:=
```
Table[{i, j, j * x^i}, {i, 5}, {j, 4}]
```

Out[19]=
```
{{{1, 1, x}, {1, 2, 2 x}, {1, 3, 3 x}, {1, 4, 4 x}},
 {{2, 1, x^2}, {2, 2, 2 x^2}, {2, 3, 3 x^2}, {2, 4, 4 x^2}},
 {{3, 1, x^3}, {3, 2, 2 x^3}, {3, 3, 3 x^3}, {3, 4, 4 x^3}},
 {{4, 1, x^4}, {4, 2, 2 x^4}, {4, 3, 3 x^4}, {4, 4, 4 x^4}},
 {{5, 1, x^5}, {5, 2, 2 x^5}, {5, 3, 3 x^5}, {5, 4, 4 x^5}}}
```

In[20]:=
```
a = {{1, 2}, 3, {3, {4, 5}, 6}, {5, 6, 7}}
```

Out[20]=
```
{{1, 2}, 3, {3, {4, 5}, 6}, {5, 6, 7}}
```

In[21]:=
```
a[[3]]
```
Out[21]=
```
{3, {4, 5}, 6}
```

In[22]:=
```
a[[3, 2]]
```
Out[22]=
```
{4, 5}
```

In[23]:=
```
a[[3, 2, 1]]
```
Out[23]=
```
4
```

■ Operacje na

lista[[i]]
Part[lista,i]
Take[lista,n] Take[lista, {n}] Take[lista,-n] Take[lista, {-n}] Take[lista, {m, n}]
First[lista]
Last[lista]
Pick[lista,selektor]

In[24]:=
```
a = Range[20]
```
Out[24]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20}
```

In[25]:=
```
a[[15]]
```
Out[25]=
```
15
```

In[26]:=
```
Part[a, 15]
```
Out[26]=
```
15
```

In[27]:=
```
Part[a, 15, 20]
```

Part::partd : Part specification
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20} is longer than depth of object. >>

Out[27]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20}[[15, 20]]
```

In[28]:=
```
Part[a, {15, 20}]
```

Out[28]=
```
{15, 20}
```

In[29]:=
```
Part[a, 15 ;; 20]
```

Out[29]=
```
{15, 16, 17, 18, 19, 20}
```

In[30]:=
```
Part[a, 15 ;; 20 ;; 2]
```

Out[30]=
```
{15, 17, 19}
```

In[31]:=
```
Take[a, 5]
```

Out[31]=
```
{1, 2, 3, 4, 5}
```

In[32]:=
```
Take[a, -5]
```

Out[32]=
```
{16, 17, 18, 19, 20}
```

In[33]:=
```
Take[a, {5}]
```

Out[33]=
```
{5}
```

In[34]:=
```
Take[a, {-5}]
```

Out[34]=
```
{16}
```

In[35]:=
```
Take[a, {5, 9}]
```

Out[35]=
```
{5, 6, 7, 8, 9}
```

In[36]:=
```
First[a]
Last[a]
```

Out[36]=
```
1
```

Out[37]=
```
20
```

In[38]:=
```
Pick[{1, 5, 4, 3}, {True, False, False, True}]
```

Out[38]=
```
{1, 3}
```

In[39]:=
```
a
```

Out[39]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20}
```

In[40]:=
```
Pick[a, {1, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0}, 1]
Pick[a, {1, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0}, 0]
```

Out[40]=
```
{1, 5, 7, 8, 13, 14, 15}
```

Out[41]=
```
{2, 3, 4, 6, 9, 10, 11, 12, 16, 17, 18, 19, 20}
```

wyrazenia

In[42]:=
```
d = 2 + x
```

Out[42]=
```
2 + x
```

In[43]:=
```
FullForm[d]
```

Out[43]//FullForm=
```
Plus[2, x]
```

In[44]:=
```
FullForm[a]
```

Out[44]//FullForm=
```
List[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20]
```

In[45]:=
```
d[[1]]
d[[2]]
```

Out[45]= 2

Out[46]= x

In[47]:=
```
d[[0]]
```

Out[47]= Plus

In[48]:=
```
d[[0]] = Times
```

Out[48]= Times

In[49]:=
```
d
```

Out[49]= 2 x

In[50]:=
```
d[[2]] = y
```

Out[50]= y

In[51]:=
```
d
```

Out[51]= 2 y

In[52]:=
```
e = Expand[(3 + y)^4]
```

Out[52]= $81 + 108\,y + 54\,y^2 + 12\,y^3 + y^4$

In[53]:=
```
e[[3]]
```

Out[53]= $54\,y^2$

In[54]:=
```
e[[3, 2]]
```

Out[54]= y^2

In[55]:=
```
e[[3, 2, 2]]
```
Out[55]=
```
2
```

In[56]:=
```
e[[3, 2, 2]] = 10
```
Out[56]=
```
10
```

In[57]:=
```
e
```
Out[57]=
$$81 + 108\,y + 12\,y^3 + y^4 + 54\,y^{10}$$

In[58]:=
```
FullForm[e]
```
Out[58]//FullForm=
```
Plus[81, Times[108, y], Times[12, Power[y, 3]],
 Power[y, 4], Times[54, Power[y, 10]]]
```

In[59]:=
```
FullForm[a]
```
Out[59]//FullForm=
```
List[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20]
```

Drop[lista,n] Drop[lista, {n}] Drop[lista,-n] Drop[lista, {-n}] Drop[lista, {m, n}]
Rest[lista]
Most[lista]
Delete[lista, pozycja]
Position[lista, element]
Insert[lista, element, pozycja]
Prepend[lista, element] PrependTo[lista, element]
Append[lista, element] AppendTo[lista, element]

In[60]:=
```
a
```
Out[60]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20}
```

In[61]:=
```
Take[a, 5]
```
Out[61]=
```
{1, 2, 3, 4, 5}
```

In[62]:=
```
Drop[a, 5]
```

Out[62]=
```
{6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20}
```

In[63]:=
```
Drop[a, -5]
Drop[a, {5}]
Drop[a, {-5}]
Drop[a, {5, 9}]
```

Out[63]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15}
```

Out[64]=
```
{1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20}
```

Out[65]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20}
```

Out[66]=
```
{1, 2, 3, 4, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20}
```

In[67]:=
```
Rest[a]
```

Out[67]=
```
{2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20}
```

In[68]:=
```
Most[a]
```

Out[68]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19}
```

In[69]:=
```
Delete[a, 5]
```

Out[69]=
```
{1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20}
```

In[70]:=
```
Delete[a, {5, 8}]
```

Delete::partw : Part {5, 8} of {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20} does not exist. >>

Out[70]=
```
Delete[
 {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20}, {5, 8}]
```

In[71]:=
```
Delete[a, {{5}, {8}}]
```

Out[71]=
```
{1, 2, 3, 4, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20}
```

In[72]:=
```
Clear[b, c, d, e]
```

In[73]:=
```
a = {b, c, d, b, c, e, c, d, b}
```

Out[73]=
```
{b, c, d, b, c, e, c, d, b}
```

In[74]:=
```
Position[a, b]
```

Out[74]=
```
{{1}, {4}, {9}}
```

In[75]:=
```
a
```

Out[75]=
```
{b, c, d, b, c, e, c, d, b}
```

In[76]:=
```
Insert[a, 6, 2]
```

Out[76]=
```
{b, 6, c, d, b, c, e, c, d, b}
```

In[77]:=
```
Insert[a, 6, {{2}, {5}}]
```

Out[77]=
```
{b, 6, c, d, b, 6, c, e, c, d, b}
```

In[78]:=
```
Prepend[a, x]
```

Out[78]=
```
{x, b, c, d, b, c, e, c, d, b}
```

In[79]:=
```
a
```

Out[79]=
```
{b, c, d, b, c, e, c, d, b}
```

In[80]:=
```
PrependTo[a, x]
```

Out[80]=
```
{x, b, c, d, b, c, e, c, d, b}
```

In[81]:=
```
a
```

Out[81]=
```
{x, b, c, d, b, c, e, c, d, b}
```

In[82]:=
```
Append[a, y]
```
Out[82]=
```
{x, b, c, d, b, c, e, c, d, b, y}
```

In[83]:=
```
a
```
Out[83]=
```
{x, b, c, d, b, c, e, c, d, b}
```

In[84]:=
```
AppendTo[a, y]
```
Out[84]=
```
{x, b, c, d, b, c, e, c, d, b, y}
```

In[85]:=
```
a
```
Out[85]=
```
{x, b, c, d, b, c, e, c, d, b, y}
```

Riffle[lista,element]
Reverse[lista]
Join[$lista_1$, $lista_2$, ...]
Sort[lista]

In[86]:=
```
a = Range[10]
```
Out[86]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10}
```

In[87]:=
```
e =.
```

In[88]:=
```
Riffle[a, e]
```
Out[88]=
```
{1, e, 2, e, 3, e, 4, e, 5, e, 6, e, 7, e, 8, e, 9, e, 10}
```

In[89]:=
```
Riffle[a, {e, f}]
```
Out[89]=
```
{1, e, 2, f, 3, e, 4, f, 5, e, 6, f, 7, e, 8, f, 9, e, 10}
```

In[90]:=
```
Riffle[a, e, 3]
```
Out[90]=
```
{1, 2, e, 3, 4, e, 5, 6, e, 7, 8, e, 9, 10}
```

In[91]:=
```
Riffle[a, e, {3, 7, 2}]
```
Out[91]=
```
{1, 2, e, 3, e, 4, e, 5, 6, 7, 8, 9, 10}
```

In[92]:=
```
a
```
Out[92]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10}
```

In[93]:=
```
Reverse[a]
```
Out[93]=
```
{10, 9, 8, 7, 6, 5, 4, 3, 2, 1}
```

In[94]:=
```
b = {Table[RandomInteger[20], {10}]}
```
Out[94]=
```
{{10, 11, 6, 13, 5, 6, 15, 6, 12, 19}}
```

In[95]:=
```
a
```
Out[95]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10}
```

In[96]:=
```
Join[a, b]
```
Out[96]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, {10, 11, 6, 13, 5, 6, 15, 6, 12, 19}}
```

In[97]:=
```
Sort[b]
```
Out[97]=
```
{{10, 11, 6, 13, 5, 6, 15, 6, 12, 19}}
```

■ Wymiary

Length[lista]
Dimensions[lista]
TensorRank[lista]

In[98]:=
```
a
```
Out[98]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10}
```

In[99]:=
```
Length[a]
```
Out[99]=
```
10
```

In[100]:=
```
b = {{1, 4}, {3, 2}, {5, 2}, {5, 6}}
```
Out[100]=
```
{{1, 4}, {3, 2}, {5, 2}, {5, 6}}
```

In[101]:=
```
Length[b]
```
Out[101]=
```
4
```

In[102]:=
```
Dimensions[a]
```
Out[102]=
```
{10}
```

In[103]:=
```
Dimensions[b]
```
Out[103]=
```
{4, 2}
```

In[104]:=
```
TensorRank[a]
```
Out[104]=
```
1
```

In[105]:=
```
TensorRank[b]
```
Out[105]=
```
2
```

In[106]:=
```
b
```
Out[106]=
```
{{1, 4}, {3, 2}, {5, 2}, {5, 6}}
```

In[107]:=
```
c = Delete[b, {3, 1}]
```
Out[107]=
```
{{1, 4}, {3, 2}, {2}, {5, 6}}
```

In[108]:=
```
Length[c]
```
Out[108]=
```
4
```

In[109]:=
```
Dimensions[c]
```
Out[109]=
```
{4}
```

In[110]:=
```
TensorRank[c]
```
Out[110]=
```
1
```

■ Wy wietlanie

Column[lista]
TableForm[lista]
MatrixForm[macierz]

In[111]:=
```
a = Table[(2 * (i + 4))^j, {i, 1, 3}, {j, 1, 3}]
```
Out[111]=
```
{{10, 100, 1000}, {12, 144, 1728}, {14, 196, 2744}}
```

In[112]:=
```
a[[1]]
```
Out[112]=
```
{10, 100, 1000}
```

In[113]:=
```
Column[a[[2]]]
```
Out[113]=
```
12
144
1728
```

In[114]:=
```
TableForm[a]
```
Out[114]//TableForm=
```
10    100    1000
12    144    1728
14    196    2744
```

In[115]:=
```
%
```
Out[115]=
```
{{10, 100, 1000}, {12, 144, 1728}, {14, 196, 2744}}
```

In[116]:=
```
Grid[a]
```
Out[116]=
```
10  100  1000
12  144  1728
14  196  2744
```

In[117]:=
```
%
```
Out[117]=
```
10  100  1000
12  144  1728
14  196  2744
```

In[118]:=
```
MatrixForm[a]
```
Out[118]//MatrixForm=

$$\begin{pmatrix} 10 & 100 & 1000 \\ 12 & 144 & 1728 \\ 14 & 196 & 2744 \end{pmatrix}$$

In[119]:=
```
b = Delete[a, {2, 1}]
```
Out[119]=
```
{{10, 100, 1000}, {144, 1728}, {14, 196, 2744}}
```

In[120]:=
```
Grid[b]
```
Out[120]=
```
 10   100  1000
144  1728
 14   196  2744
```

In[121]:=
```
TableForm[b]
```
Out[121]//TableForm=
```
10     100     1000
144    1728
14     196     2744
```

In[122]:=
```
MatrixForm[b]
```

Out[122]//MatrixForm=

$$\begin{pmatrix} \{10, 100, 1000\} \\ \{144, 1728\} \\ \{14, 196, 2744\} \end{pmatrix}$$

■ Manipulacje

ReplacePart[lista, pozycja->element]
Intersection[$lista_1$, $lista_2$, ...]
Union[$lista_1$, $lista_2$]
Complement[$lista_1$, $lista_2$, ...]
RotateLeft[lista,n]
RotateRight[lista,n]
Partition[lista,n]
Flatten[lista]
Permutations[lista]
Signature[lista]

In[123]:=
```
a = Table[(2 * (i + 4))^j, {i, 1, 3}, {j, 1, 3}]
```

Out[123]=
```
{{10, 100, 1000}, {12, 144, 1728}, {14, 196, 2744}}
```

In[124]:=
```
ReplacePart[a, 2 → {x, y}]
```

Out[124]=
```
{{10, 100, 1000}, {x, y}, {14, 196, 2744}}
```

In[125]:=
```
ReplacePart[a, {2, 3} → x]
```

Out[125]=
```
{{10, 100, 1000}, {12, 144, x}, {14, 196, 2744}}
```

In[126]:=
```
ReplacePart[a, {2 → x, 3 → x}]
```

Out[126]=
```
{{10, 100, 1000}, x, x}
```

In[127]:=
```
a = Range[5]
b = Range[3, 7]
```

Out[127]=
```
{1, 2, 3, 4, 5}
```

Out[128]=
```
{3, 4, 5, 6, 7}
```

In[129]:=
```
Intersection[a, b]
```

Out[129]=
```
{3, 4, 5}
```

In[130]:=
```
Union[a, b]
```

Out[130]=
```
{1, 2, 3, 4, 5, 6, 7}
```

In[131]:=
```
Complement[a, b]
```

Out[131]=
```
{1, 2}
```

In[132]:=
```
a
```

Out[132]=
```
{1, 2, 3, 4, 5}
```

In[133]:=
```
RotateLeft[a, 2]
```

Out[133]=
```
{3, 4, 5, 1, 2}
```

In[134]:=
```
RotateLeft[a, 5]
```

Out[134]=
```
{1, 2, 3, 4, 5}
```

In[135]:=
```
RotateRight[a, 2]
```

Out[135]=
```
{4, 5, 1, 2, 3}
```

In[136]:=
```
RotateLeft[a, -2]
```

Out[136]=
```
{4, 5, 1, 2, 3}
```

In[137]:=
```
a = Table[(2 * (i + 4))^j, {i, 1, 3}, {j, 1, 3}]
```

Out[137]=
```
{{10, 100, 1000}, {12, 144, 1728}, {14, 196, 2744}}
```

In[138]:=
```
Grid[a]
```

Out[138]=
```
10  100  1000
12  144  1728
14  196  2744
```

In[139]:=
```
RotateLeft[a, 1]
```

Out[139]=
```
{{12, 144, 1728}, {14, 196, 2744}, {10, 100, 1000}}
```

In[140]:=
```
Grid[%]
```

Out[140]=
```
12  144  1728
14  196  2744
10  100  1000
```

In[141]:=
```
RotateLeft[a, {0, 1}]
```

Out[141]=
```
{{100, 1000, 10}, {144, 1728, 12}, {196, 2744, 14}}
```

In[142]:=
```
Grid[%]
```

Out[142]=
```
100  1000  10
144  1728  12
196  2744  14
```

In[143]:=
```
b = Range[20]
```

Out[143]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20}
```

In[144]:=
```
Partition[b, 5]
```

Out[144]=
```
{{1, 2, 3, 4, 5}, {6, 7, 8, 9, 10}, {11, 12, 13, 14, 15}, {16, 17, 18, 19, 20}}
```

In[145]:=
```
Partition[b, 6]
```

Out[145]=
```
{{1, 2, 3, 4, 5, 6}, {7, 8, 9, 10, 11, 12}, {13, 14, 15, 16, 17, 18}}
```

In[146]:=
```
Flatten[%]
```

Out[146]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18}
```

In[147]:=
```
a = Range[4]
```

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

In[148]:=
```
b = Permutations[a]
```

Out[148]=
```
{{1, 2, 3, 4}, {1, 2, 4, 3}, {1, 3, 2, 4}, {1, 3, 4, 2}, {1, 4, 2, 3}, {1, 4, 3, 2},
 {2, 1, 3, 4}, {2, 1, 4, 3}, {2, 3, 1, 4}, {2, 3, 4, 1}, {2, 4, 1, 3}, {2, 4, 3, 1},
 {3, 1, 2, 4}, {3, 1, 4, 2}, {3, 2, 1, 4}, {3, 2, 4, 1}, {3, 4, 1, 2}, {3, 4, 2, 1},
 {4, 1, 2, 3}, {4, 1, 3, 2}, {4, 2, 1, 3}, {4, 2, 3, 1}, {4, 3, 1, 2}, {4, 3, 2, 1}}
```

In[149]:=
```
Length[b]
```

Out[149]=
```
24
```

In[150]:=
```
Signature[b[[4]]]
```

Out[150]=
```
1
```

In[151]:=
```
Signature[b[[3]]]
```

Out[151]=
```
-1
```

wyra¿enia:
Apply[polecenie,wyra¿enie]

In[152]:=
```
a = Table[x^i, {i, 1, 4}]
```

Out[152]=
$$\{x, x^2, x^3, x^4\}$$

In[153]:=
```
FullForm[a]
```
Out[153]//FullForm=
```
List[x, Power[x, 2], Power[x, 3], Power[x, 4]]
```

In[154]:=
```
b = a
```
Out[154]=
$$\{x, x^2, x^3, x^4\}$$

In[155]:=
```
b[[0]] = Plus
```
Out[155]=
```
Plus
```

In[156]:=
```
b
```
Out[156]=
$$x + x^2 + x^3 + x^4$$

In[157]:=
```
a
```
Out[157]=
$$\{x, x^2, x^3, x^4\}$$

In[158]:=
```
Apply[Plus, a]
```
Out[158]=
$$x + x^2 + x^3 + x^4$$

In[159]:=
```
Plus @@ a
```
Out[159]=
$$x + x^2 + x^3 + x^4$$

In[160]:=
```
Apply[List, a, 2]
```
Out[160]=
```
{x, {x, 2}, {x, 3}, {x, 4}}
```

In[161]:=
```
FullForm[a]
```
Out[161]//FullForm=
```
List[x, Power[x, 2], Power[x, 3], Power[x, 4]]
```

■ Obliczenia

$$lista_1 + lista_2$$

lista$_1$ * lista$_2$
lista$_1$. lista$_2$ Dot[lista$_1$, lista$_2$]
Det[macierz]
Minors[m,k]
MatrixPower[macierz,n]

In[162]:=
```
a = Range[4]
b = {k, l, m, n}
c = Range[10, 6, -1]
```

Out[162]=
```
{1, 2, 3, 4}
```

Out[163]=
```
{k, l, m, n}
```

Out[164]=
```
{10, 9, 8, 7, 6}
```

In[165]:=
```
a + b
```

Out[165]=
```
{1 + k, 2 + l, 3 + m, 4 + n}
```

In[166]:=
```
a + c
```

Thread::tdlen : Objects of unequal length in {1, 2, 3, 4} + {10, 9, 8, 7, 6} cannot be combined. >>

Out[166]=
```
{1, 2, 3, 4} + {10, 9, 8, 7, 6}
```

In[167]:=
```
a * b
```

Out[167]=
```
{k, 2 l, 3 m, 4 n}
```

In[168]:=
```
a.b
```

Out[168]=
```
k + 2 l + 3 m + 4 n
```

In[169]:=
```
Dot[a, b]
```

Out[169]=
```
k + 2 l + 3 m + 4 n
```

In[170]:=
```
Sum[a[[i]] * b[[i]], {i, 1, Length[a]}]
```

Out[170]=
```
k + 2 l + 3 m + 4 n
```

In[171]:=
```
2.5
```

Out[171]=
```
2.5
```

In[172]:=
```
a = Table[(i + 3)^j, {i, 2}, {j, 2}]
```

Out[172]=
```
{{4, 16}, {5, 25}}
```

In[173]:=
```
Grid[a]
```

Out[173]=
```
4  16
5  25
```

In[174]:=
```
Det[a]
```

Out[174]=
```
20
```

In[175]:=
```
b = Table[(i + 2)^j, {i, 4}, {j, 4}]
```

Out[175]=
```
{{3, 9, 27, 81}, {4, 16, 64, 256}, {5, 25, 125, 625}, {6, 36, 216, 1296}}
```

In[176]:=
```
Det[b]
```

Out[176]=
```
4320
```

In[177]:=
```
Grid[b]
```

Out[177]=
```
3  9   27   81
4  16  64   256
5  25  125  625
6  36  216  1296
```

In[178]:=
```
Minors[b, 2]
```

Out[178]=
```
{{12, 84, 444, 144, 1008, 1728}, {30, 240, 1470, 450, 3600, 6750},
 {54, 486, 3402, 972, 8748, 17 496}, {20, 180, 1220, 400, 3600, 8000},
 {48, 480, 3648, 1152, 11 520, 27 648}, {30, 330, 2730, 900, 9900, 27 000}}
```

In[179]:=
```
a
```

Out[179]=
```
{{4, 16}, {5, 25}}
```

In[180]:=
```
a * a
```

Out[180]=
```
{{16, 256}, {25, 625}}
```

In[181]:=
```
a^2
```

Out[181]=
```
{{16, 256}, {25, 625}}
```

In[182]:=
```
a.a
```

Out[182]=
```
{{96, 464}, {145, 705}}
```

In[183]:=
```
MatrixPower[a, 2]
```

Out[183]=
```
{{96, 464}, {145, 705}}
```

Inverse[macierz]
IdentityMatrix[n]
DiagonalMatrix[wektor]
Transpose[macierz]
Eigenvalues[macierz]
Eigenvectors[macierz]
Eigensystem[macierz]
LinearSolve[m,b]

In[184]:=
```
a = Table[(i + 2)^j, {i, 2}, {j, 2}]
```

Out[184]=
```
{{3, 9}, {4, 16}}
```

In[185]:=
```
b = Inverse[a]
```

Out[185]=
$$\left\{\left\{\frac{4}{3}, -\frac{3}{4}\right\}, \left\{-\frac{1}{3}, \frac{1}{4}\right\}\right\}$$

In[186]:=
```
a.b
```

Out[186]=
```
{{1, 0}, {0, 1}}
```

In[187]:=
```
Grid[%]
```

Out[187]=
```
1 0
0 1
```

In[188]:=
```
b.a
```

Out[188]=
```
{{1, 0}, {0, 1}}
```

In[189]:=
```
IdentityMatrix[3]
```

Out[189]=
```
{{1, 0, 0}, {0, 1, 0}, {0, 0, 1}}
```

In[190]:=
```
Grid[%]
```

Out[190]=
```
1 0 0
0 1 0
0 0 1
```

In[191]:=
```
DiagonalMatrix[{3, 2, 4}]
```

Out[191]=
```
{{3, 0, 0}, {0, 2, 0}, {0, 0, 4}}
```

In[192]:=
```
Grid[%]
```

Out[192]=
```
3 0 0
0 2 0
0 0 4
```

In[193]:=
```
Grid[a]
```

Out[193]=
```
3  9
4  16
```

In[194]:=
```
b = Transpose[a]
Grid[b]
```

Out[194]=
```
{{3, 4}, {9, 16}}
```

Out[195]=
```
3  4
9  16
```

In[196]:=
```
a
```

Out[196]=
```
{{3, 9}, {4, 16}}
```

In[197]:=
```
ev = Eigenvalues[a]
```

Out[197]=
$$\left\{\frac{1}{2}\left(19+\sqrt{313}\right),\ \frac{1}{2}\left(19-\sqrt{313}\right)\right\}$$

In[198]:=
```
v = Eigenvectors[a]
```

Out[198]=
$$\left\{\left\{-4+\frac{1}{8}\left(19+\sqrt{313}\right),\ 1\right\},\ \left\{-4+\frac{1}{8}\left(19-\sqrt{313}\right),\ 1\right\}\right\}$$

In[199]:=
```
a.Transpose[v] == Transpose[v].DiagonalMatrix[ev]
```

Out[199]=
```
True
```

In[200]:=
```
a.v[[1]] // N
```

Out[200]=
```
{10.7594, 18.3459}
```

In[201]:=
```
ev[[1]] * v[[1]] // N
```

Out[201]=
```
{10.7594, 18.3459}
```

In[202]:=
```
Eigensystem[a]
```

Out[202]=
$$\left\{\left\{\frac{1}{2}\left(19+\sqrt{313}\right),\ \frac{1}{2}\left(19-\sqrt{313}\right)\right\},\ \left\{\left\{-4+\frac{1}{8}\left(19+\sqrt{313}\right),\ 1\right\},\ \left\{-4+\frac{1}{8}\left(19-\sqrt{313}\right),\ 1\right\}\right\}\right\}$$

In[203]:=
```
a
```

Out[203]=
```
{{3, 9}, {4, 16}}
```

In[204]:=
```
b = {4, 5}
s = LinearSolve[a, b]
```

Out[204]=
```
{4, 5}
```

Out[205]=
$$\left\{\frac{19}{12},\ -\frac{1}{12}\right\}$$

In[206]:=
```
a
```

Out[206]=
```
{{3, 9}, {4, 16}}
```

In[207]:=
```
a.s
```

Out[207]=
```
{4, 5}
```