In[∘]:=
```
Remove["Global`*"]
```

LAB 12

Vector u as list

In[∘]:=
```
u = {5, 3, 1, 2}
```

Out[∘]= {5, 3, 1, 2}

Vector u as a Matrix

In[∘]:=
```
Mu = MatrixForm[u]
```

Out[∘]//MatrixForm=

$$\begin{pmatrix} 5 \\ 3 \\ 1 \\ 2 \end{pmatrix}$$

Vector v as list

In[∘]:=
```
v = {I, 4, 1 - I, -1}
```

Out[∘]= $\{i, 4, 1 - i, -1\}$

Vector v as a Matrix

In[∘]:=
```
Mv = MatrixForm[v]
```

Out[∘]//MatrixForm=

$$\begin{pmatrix} i \\ 4 \\ 1 - i \\ -1 \end{pmatrix}$$

Matrix A as a list

In[∘]:=
```
A = {{1, 5, 7, -3}, {-3, 8, 4, 2}, {-7, 5, 7, 0}, {3, 6, 5, 4}}
```

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

Matrix A as a matrix

In[∘]:=
```
MA = MatrixForm[A]
```

Out[∘]//MatrixForm=

$$\begin{pmatrix} 1 & 5 & 7 & -3 \\ -3 & 8 & 4 & 2 \\ -7 & 5 & 7 & 0 \\ 3 & 6 & 5 & 4 \end{pmatrix}$$

matrix B as a list

In[∘]:=
```
B = {{0, 9, -3 - I, 9}, {9, 6, 2 + I, 4}, {-3 + I, 2 - I, 12, -7 - I}, {9, 4, -7 + I, -4}}
```

Out[∘]= $\{\{0, 9, -3 - i, 9\}, \{9, 6, 2 + i, 4\}, \{-3 + i, 2 - i, 12, -7 - i\}, \{9, 4, -7 + i, -4\}\}$

Matrix B as a matrix

In[•]:=
```
MB = MatrixForm[B]
```

Out[•]//MatrixForm=

$$\begin{pmatrix} 0 & 9 & -3-i & 9 \\ 9 & 6 & 2+i & 4 \\ -3+i & 2-i & 12 & -7-i \\ 9 & 4 & -7+i & -4 \end{pmatrix}$$

Dual vector v

In[•]:=
```
dv = ConjugateTranspose[v]
```

Out[•]= $\{i, 4, 1-i, -1\}$

Matrix form of dual vector v

In[•]:=
```
Mdv = MatrixForm[dv]
```

Out[•]//MatrixForm=

$$\begin{pmatrix} i \\ 4 \\ 1-i \\ -1 \end{pmatrix}$$

Proof that matrix B is Hermitian

In[•]:=
```
HermitianMatrixQ[B]
```

Out[•]= True

Square of the norm of v

In[•]:=
```
sqn = v.dv
```

Out[•]= $16-2i$

In[•]:=
```
Dot[v, dv]
```

Out[•]= $16-2i$

Product of Matrix A and vector u in matrix form

In[•]:=
```
Dot[A, u] // MatrixForm
```

Out[•]//MatrixForm=

$$\begin{pmatrix} 21 \\ 17 \\ -13 \\ 46 \end{pmatrix}$$

Product of dual vector v and matrix B in matrix form

In[•]:=
```
Dot[dv, B] // MatrixForm
```

Out[•]//MatrixForm=

$$\begin{pmatrix} 25+4i \\ 21+6i \\ 28-12i \\ 12+15i \end{pmatrix}$$

show that matrix A and matrix B do not commute

In[ ]:= `A == B`

Out[ ]= `False`

Inverse of matrix A

In[ ]:= `IA = Inverse[A]`

Out[ ]= $\left\{\left\{\frac{110}{1693}, -\frac{51}{1693}, -\frac{158}{1693}, \frac{108}{1693}\right\}, \left\{\frac{84}{1693}, \frac{392}{1693}, -\frac{213}{1693}, -\frac{133}{1693}\right\}, \left\{\frac{50}{1693}, -\frac{331}{1693}, \frac{236}{1693}, \frac{203}{1693}\right\}, \left\{-\frac{271}{1693}, -\frac{136}{1693}, \frac{143}{1693}, \frac{288}{1693}\right\}\right\}$

In[ ]:= `MIA = MatrixForm[IA]`

Out[ ]//MatrixForm=

$$\begin{pmatrix} \frac{110}{1693} & -\frac{51}{1693} & -\frac{158}{1693} & \frac{108}{1693} \\ \frac{84}{1693} & \frac{392}{1693} & -\frac{213}{1693} & -\frac{133}{1693} \\ \frac{50}{1693} & -\frac{331}{1693} & \frac{236}{1693} & \frac{203}{1693} \\ -\frac{271}{1693} & -\frac{136}{1693} & \frac{143}{1693} & \frac{288}{1693} \end{pmatrix}$$

product of inverse matrix A and matrix A

In[ ]:= `Dot[IA, A]`

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

In[ ]:= `Dot[A, IA]`

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