

> *with(LinearAlgebra);*
 [&x, Add, Adjoint, BackwardSubstitute, BandMatrix, Basis, BezoutMatrix, BidiagonalForm, (1)
 BilinearForm, CARE, CharacteristicMatrix, CharacteristicPolynomial, Column,
 ColumnDimension, ColumnOperation, ColumnSpace, CompanionMatrix,
 CompressedSparseForm, ConditionNumber, ConstantMatrix, ConstantVector, Copy,
 CreatePermutation, CrossProduct, DARE, DeleteColumn, DeleteRow, Determinant, Diagonal,
 DiagonalMatrix, Dimension, Dimensions, DotProduct, EigenConditionNumbers, Eigenvalues,
 Eigenvectors, Equal, ForwardSubstitute, FrobeniusForm, FromCompressedSparseForm,
 FromSplitForm, GaussianElimination, GenerateEquations, GenerateMatrix, Generic,
 GetResultDataType, GetResultShape, GivensRotationMatrix, GramSchmidt, HankelMatrix,
 HermiteForm, HermitianTranspose, HessenbergForm, HilbertMatrix, HouseholderMatrix,
 IdentityMatrix, IntersectionBasis, IsDefinite, IsOrthogonal, IsSimilar, IsUnitary,
 JordanBlockMatrix, JordanForm, KroneckerProduct, LA_Main, LUdecomposition,
 LeastSquares, LinearSolve, LyapunovSolve, Map, Map2, MatrixAdd, MatrixExponential,
 MatrixFunction, MatrixInverse, MatrixMatrixMultiply, MatrixNorm, MatrixPower,
 MatrixScalarMultiply, MatrixVectorMultiply, MinimalPolynomial, Minor, Modular, Multiply,
 NoUserValue, Norm, Normalize, NullSpace, OuterProductMatrix, Permanent, Pivot,
 PopovForm, ProjectionMatrix, QRdecomposition, RandomMatrix, RandomVector, Rank,
 RationalCanonicalForm, ReducedRowEchelonForm, Row, RowDimension, RowOperation,
 RowSpace, ScalarMatrix, ScalarMultiply, ScalarVector, SchurForm, SingularValues,
 SmithForm, SplitForm, StronglyConnectedBlocks, SubMatrix, SubVector, SumBasis,
 SylvesterMatrix, SylvesterSolve, ToeplitzMatrix, Trace, Transpose, TridiagonalForm,
 UnitVector, VandermondeMatrix, VectorAdd, VectorAngle, VectorMatrixMultiply, VectorNorm,
 VectorScalarMultiply, ZeroMatrix, ZeroVector, Zip]

> $A := \begin{bmatrix} 5 & -1 & 0 & 0 & 0 \\ -1 & 5 & -1 & 0 & 0 \\ 0 & -1 & 5 & -1 & 0 \\ 0 & 0 & -1 & 5 & -1 \\ 0 & 0 & 0 & -1 & 5 \end{bmatrix};$

$A := \begin{bmatrix} 5 & -1 & 0 & 0 & 0 \\ -1 & 5 & -1 & 0 & 0 \\ 0 & -1 & 5 & -1 & 0 \\ 0 & 0 & -1 & 5 & -1 \\ 0 & 0 & 0 & -1 & 5 \end{bmatrix}$ (2)

> *Eigenvalues(A);*

$$\begin{bmatrix} 5 \\ 6 \\ 4 \\ 5 - \sqrt{3} \\ 5 + \sqrt{3} \end{bmatrix}$$

(3)

> evalf(%);

$$\begin{bmatrix} 5. \\ 6. \\ 4. \\ 3.267949192 \\ 6.732050808 \end{bmatrix}$$

(4)

> $M := \begin{bmatrix} 2 & -1 & 0 & 0 & 0 \\ -1 & 2 & -1 & 0 & 0 \\ 0 & -1 & 2 & -1 & 0 \\ 0 & 0 & -1 & 2 & -1 \\ 0 & 0 & 0 & -1 & 2 \end{bmatrix};$

$$M := \begin{bmatrix} 2 & -1 & 0 & 0 & 0 \\ -1 & 2 & -1 & 0 & 0 \\ 0 & -1 & 2 & -1 & 0 \\ 0 & 0 & -1 & 2 & -1 \\ 0 & 0 & 0 & -1 & 2 \end{bmatrix}$$

(5)

> Eigenvalues(M);

$$\begin{bmatrix} 1 \\ 2 \\ 3 \\ 2 - \sqrt{3} \\ 2 + \sqrt{3} \end{bmatrix}$$

(6)

> evalf(%);

$$\begin{bmatrix} 1. \\ 2. \\ 3. \\ 0.267949192 \\ 3.732050808 \end{bmatrix}$$

(7)

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> MM :=
```

$$\begin{bmatrix} 2 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 2 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 2 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 2 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 2 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 2 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 2 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 2 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 2 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 2 \end{bmatrix};$$

$$MM := \begin{bmatrix} 2 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 2 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 2 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 2 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 2 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 2 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 2 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 2 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 2 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 2 \end{bmatrix}$$

(8)

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> evalf(Eigenvalues(MM));
```

$$\begin{bmatrix} 2.284629677 + 2. \times 10^{-11} I \\ 0.317492935 + 1. \times 10^{-10} I \\ 3.309721467 + 3. \times 10^{-10} I \\ 3.918985947 + 0. I \\ 1.169169974 - 1. \times 10^{-10} I \\ 1.715370324 + 1.1 \times 10^{-9} I \\ 0.081014054 + 0. I \\ 3.682507065 - 1.0 \times 10^{-9} I \\ 2.830830025 - 1.4 \times 10^{-9} I \\ 0.690278532 + 6. \times 10^{-10} I \end{bmatrix}$$

(9)

```
> sort(%);
```



$$\begin{aligned} & 0.081014054 + 0. I \\ & 0.317492935 + 1. \times 10^{-10} I \\ & 0.690278532 + 6. \times 10^{-10} I \\ & 1.169169974 - 1. \times 10^{-10} I \\ & 1.715370324 + 1.1 \times 10^{-9} I \\ & 2.284629677 + 2. \times 10^{-11} I \\ & 2.830830025 - 1.4 \times 10^{-9} I \\ & 3.309721467 + 3. \times 10^{-10} I \\ & 3.682507065 - 1.0 \times 10^{-9} I \\ & 3.918985947 + 0. I \end{aligned}$$

(10)