

```

> #HW 17 - Alan Ho
> #OK to post
> #1iii)
> dsolve({diff(x(t), t) = 3·x(t) - y(t), diff(y(t), t) = 2·x(t), x(0) = 2, y(0) = 3}, {x(t), y(t)})
      {x(t) = et + e2t, y(t) = 2et + e2t}

```

(1)

```

> #2i)
> solve(x2 - x - 9 = 0, x)
      1/2 + sqrt(37)/2, 1/2 - sqrt(37)/2

```

(2)

```

> evalf(1/2 + sqrt(37)/2)
      3.541381265

```

(3)

```

> evalf(1/2 - sqrt(37)/2)
      -2.541381265

```

(4)

```

> sys := {A·(1/2 + sqrt(37)/2) + B·(1/2 - sqrt(37)/2) = 6,
          ((1/2 + sqrt(37)/2 - 1)·A) - ((1/2 - sqrt(37)/2 - 1)·B) = 9}
sys := {(-1/2 + sqrt(37)/2)A - (-1/2 - sqrt(37)/2)B = 9, (1/2 + sqrt(37)/2)A + (1/2

```

(5)

```

      - sqrt(37)/2)B = 6}
> evalf(solve(sys, {A, B}))
      {A = 11.95264053, B = 14.29492604}

```

(6)

```

> #2ii)
> with(LinearAlgebra)
[&x, Add, Adjoint, BackwardSubstitute, BandMatrix, Basis, BezoutMatrix, BidiagonalForm,
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,

```

(7)

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]

> $M := \text{Matrix}([[1, 9], [1, 0]])$

$$M := \begin{bmatrix} 1 & 9 \\ 1 & 0 \end{bmatrix} \quad (8)$$

> $\text{Eigenvalues}(M)$

$$\begin{bmatrix} \frac{1}{2} + \frac{\sqrt{37}}{2} \\ \frac{1}{2} - \frac{\sqrt{37}}{2} \end{bmatrix} \quad (9)$$

> $\text{Eigenvectors}(M)$

$$\begin{bmatrix} \frac{1}{2} + \frac{\sqrt{37}}{2} \\ \frac{1}{2} - \frac{\sqrt{37}}{2} \end{bmatrix}, \begin{bmatrix} \frac{9}{-\frac{1}{2} + \frac{\sqrt{37}}{2}} & \frac{9}{-\frac{1}{2} - \frac{\sqrt{37}}{2}} \\ 1 & 1 \end{bmatrix} \quad (10)$$

> #2iii)

> $\text{evalf}(\text{dsolve}(\{\text{diff}(x(t), t) = x(t) + 9 \cdot y(t), \text{diff}(y(t), t) = x(t), x(0) = 6, y(0) = 9\}, \{x(t), y(t)\}))$
 $\{x(t) = 16.80951493 e^{3.541381265 t} - 10.80951493 e^{-2.541381265 t}, y(t) = 4.746598481 e^{3.541381265 t} + 4.253401519 e^{-2.541381265 t}\}$ (11)

> #errors between the maple calculated solution and my hand work are likely just math errors since the function became so complicated it became extremely tedious to follow the work by hand

> #3)

> $M := \text{Matrix}([[1, 1, 1], [1, 1, 0], [1, 0, 0]])$

$$M := \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix} \quad (12)$$

> $\text{Eigenvalues}(M)$

$$\left[\left[\frac{(28 + 84 I\sqrt{3})^{1/3}}{6} + \frac{14}{3 (28 + 84 I\sqrt{3})^{1/3}} + \frac{2}{3} \right], \right. \quad (13)$$

$$\left[\begin{aligned} & -\frac{(28 + 84 I\sqrt{3})^{1/3}}{12} - \frac{7}{3 (28 + 84 I\sqrt{3})^{1/3}} + \frac{2}{3} \\ & + \frac{I\sqrt{3} \left(\frac{(28 + 84 I\sqrt{3})^{1/3}}{6} - \frac{14}{3 (28 + 84 I\sqrt{3})^{1/3}} \right)}{2} \end{aligned} \right]$$

$$\left[\begin{aligned} & -\frac{(28 + 84 I\sqrt{3})^{1/3}}{12} - \frac{7}{3 (28 + 84 I\sqrt{3})^{1/3}} + \frac{2}{3} \\ & - \frac{I\sqrt{3} \left(\frac{(28 + 84 I\sqrt{3})^{1/3}}{6} - \frac{14}{3 (28 + 84 I\sqrt{3})^{1/3}} \right)}{2} \end{aligned} \right]$$

> $\text{Eigenvectors}(M)$

$$\left[\left[\frac{(28 + 84 I\sqrt{3})^{1/3}}{6} + \frac{14}{3 (28 + 84 I\sqrt{3})^{1/3}} + \frac{2}{3} \right], \right. \quad (14)$$

$$\left[\begin{aligned} & -\frac{(28 + 84 I\sqrt{3})^{1/3}}{12} - \frac{7}{3 (28 + 84 I\sqrt{3})^{1/3}} + \frac{2}{3} \end{aligned} \right]$$

$$+ \frac{I\sqrt{3} \left(\frac{(28 + 84I\sqrt{3})^{1/3}}{6} - \frac{14}{3(28 + 84I\sqrt{3})^{1/3}} \right)}{2},$$

$$\left[-\frac{(28 + 84I\sqrt{3})^{1/3}}{12} - \frac{7}{3(28 + 84I\sqrt{3})^{1/3}} + \frac{2}{3} \right.$$

$$\left. - \frac{I\sqrt{3} \left(\frac{(28 + 84I\sqrt{3})^{1/3}}{6} - \frac{14}{3(28 + 84I\sqrt{3})^{1/3}} \right)}{2} \right], \left[-1 \right. /$$

$$\left(\left(\frac{(28 + 84I\sqrt{3})^{1/3}}{6} + \frac{14}{3(28 + 84I\sqrt{3})^{1/3}} + \frac{2}{3} \right)^2 - \frac{(28 + 84I\sqrt{3})^{1/3}}{3} \right.$$

$$\left. - \frac{28}{3(28 + 84I\sqrt{3})^{1/3}} - \frac{7}{3} \right), -1 / \left(\left(-\frac{(28 + 84I\sqrt{3})^{1/3}}{12} \right. \right.$$

$$\left. - \frac{7}{3(28 + 84I\sqrt{3})^{1/3}} + \frac{2}{3} \right)$$

$$+ \frac{I\sqrt{3} \left(\frac{(28 + 84 I\sqrt{3})^{1/3}}{6} - \frac{14}{3 (28 + 84 I\sqrt{3})^{1/3}} \right)^2}{2} + \frac{(28 + 84 I\sqrt{3})^{1/3}}{6}$$

$$+ \frac{14}{3 (28 + 84 I\sqrt{3})^{1/3}} - \frac{7}{3} - I\sqrt{3} \left(\frac{(28 + 84 I\sqrt{3})^{1/3}}{6} \right.$$

$$\left. - \frac{14}{3 (28 + 84 I\sqrt{3})^{1/3}} \right), -1 \left(\left(- \frac{(28 + 84 I\sqrt{3})^{1/3}}{12} \right. \right.$$

$$\left. - \frac{7}{3 (28 + 84 I\sqrt{3})^{1/3}} + \frac{2}{3} \right.$$

$$\left. - \frac{I\sqrt{3} \left(\frac{(28 + 84 I\sqrt{3})^{1/3}}{6} - \frac{14}{3 (28 + 84 I\sqrt{3})^{1/3}} \right)^2}{2} + \frac{(28 + 84 I\sqrt{3})^{1/3}}{6} \right.$$

$$\left. + \frac{14}{3 (28 + 84 I\sqrt{3})^{1/3}} - \frac{7}{3} + I\sqrt{3} \left(\frac{(28 + 84 I\sqrt{3})^{1/3}}{6} \right. \right.$$

$$\left. - \frac{14}{3 (28 + 84 I\sqrt{3})^{1/3}} \right) \left. \right],$$

$$\left[- \left(\left(\frac{(28 + 84 I\sqrt{3})^{1/3}}{6} + \frac{14}{3 (28 + 84 I\sqrt{3})^{1/3}} + \frac{2}{3} \right)^2 \right. \right.$$

$$- \left(\frac{(28 + 84 I \sqrt{3})^{1/3}}{6} - \frac{14}{3 (28 + 84 I \sqrt{3})^{1/3}} - \frac{8}{3} \right) /$$

$$\left(\left(\frac{(28 + 84 I \sqrt{3})^{1/3}}{6} + \frac{14}{3 (28 + 84 I \sqrt{3})^{1/3}} + \frac{2}{3} \right)^2 - \frac{(28 + 84 I \sqrt{3})^{1/3}}{3} \right.$$

$$\left. - \frac{28}{3 (28 + 84 I \sqrt{3})^{1/3}} - \frac{7}{3} \right), - \left(\left(- \frac{(28 + 84 I \sqrt{3})^{1/3}}{12} \right.$$

$$\left. - \frac{7}{3 (28 + 84 I \sqrt{3})^{1/3}} + \frac{2}{3} \right)$$

$$+ \frac{i\sqrt{3} \left(\frac{(28 + 84i\sqrt{3})^{1/3}}{6} - \frac{14}{3(28 + 84i\sqrt{3})^{1/3}} \right)}{2} \right)^2 + \frac{(28 + 84i\sqrt{3})^{1/3}}{12}$$

$$+ \frac{7}{3(28 + 84i\sqrt{3})^{1/3}} - \frac{8}{3}$$

$$- \frac{i\sqrt{3} \left(\frac{(28 + 84i\sqrt{3})^{1/3}}{6} - \frac{14}{3(28 + 84i\sqrt{3})^{1/3}} \right)}{2} \Big/ \left(\left(\right. \right.$$

$$- \frac{(28 + 84i\sqrt{3})^{1/3}}{12} - \frac{7}{3(28 + 84i\sqrt{3})^{1/3}} + \frac{2}{3}$$

$$+ \frac{i\sqrt{3} \left(\frac{(28 + 84i\sqrt{3})^{1/3}}{6} - \frac{14}{3(28 + 84i\sqrt{3})^{1/3}} \right)}{2} \right)^2 + \frac{(28 + 84i\sqrt{3})^{1/3}}{6}$$

$$+ \frac{14}{3(28 + 84i\sqrt{3})^{1/3}} - \frac{7}{3} - i\sqrt{3} \left(\frac{(28 + 84i\sqrt{3})^{1/3}}{6} \right.$$

$$\left. - \frac{14}{3(28 + 84i\sqrt{3})^{1/3}} \right), - \left(\left(-\frac{(28 + 84i\sqrt{3})^{1/3}}{12} \right. \right.$$

$$\left. - \frac{7}{3(28 + 84i\sqrt{3})^{1/3}} + \frac{2}{3} \right.$$

$$\left. - \frac{i\sqrt{3} \left(\frac{(28 + 84i\sqrt{3})^{1/3}}{6} - \frac{14}{3(28 + 84i\sqrt{3})^{1/3}} \right)}{2} \right)^2 + \frac{(28 + 84i\sqrt{3})^{1/3}}{12}$$

$$+ \frac{7}{3(28 + 84i\sqrt{3})^{1/3}} - \frac{8}{3}$$

$$+ \frac{i\sqrt{3} \left(\frac{(28 + 84i\sqrt{3})^{1/3}}{6} - \frac{14}{3(28 + 84i\sqrt{3})^{1/3}} \right)}{2} \right) / \left(\left(\right. \right.$$

$$\begin{aligned}
& -\frac{(28 + 84 I\sqrt{3})^{1/3}}{12} - \frac{7}{3(28 + 84 I\sqrt{3})^{1/3}} + \frac{2}{3} \\
& - \frac{I\sqrt{3} \left(\frac{(28 + 84 I\sqrt{3})^{1/3}}{6} - \frac{14}{3(28 + 84 I\sqrt{3})^{1/3}} \right)^2}{2} + \frac{(28 + 84 I\sqrt{3})^{1/3}}{6} \\
& + \frac{14}{3(28 + 84 I\sqrt{3})^{1/3}} - \frac{7}{3} + I\sqrt{3} \left(\frac{(28 + 84 I\sqrt{3})^{1/3}}{6} \right. \\
& \left. - \frac{14}{3(28 + 84 I\sqrt{3})^{1/3}} \right) \Bigg],
\end{aligned}$$

$$\begin{bmatrix} 1, 1, 1 \end{bmatrix}$$

> evalf(dsolve({diff(x(t), t) = x(t) + y(t) + z(t), diff(y(t), t) = x(t) + y(t), diff(z(t), t) = x(t), x(0) = 1, y(0) = 2, z(0) = -1}, {x(t), y(t), z(t)}))

$$\begin{aligned}
& \{x(t) = -(0.5697026303 + 9.421197469 \cdot 10^{-10} I) e^{(0.5549581324 - 4.760383402 \cdot 10^{-10} I) t} \\
& + (0.3971667823 - 1.841712215 \cdot 10^{-10} I) e^{(-0.8019377366 + 1.336718457 \cdot 10^{-10} I) t} \\
& + (1.172535850 - 1.800998826 \cdot 10^{-10} I) e^{(2.246979605 + 7.972616167 \cdot 10^{-10} I) t}, y(t) \\
& = (1.280110190 + 2.165080321 \cdot 10^{-9} I) e^{(0.5549581324 - 4.760383402 \cdot 10^{-10} I) t} \\
& + (-0.2204109358 + 2.329371991 \cdot 10^{-10} I) e^{(-0.8019377366 + 1.336718457 \cdot 10^{-10} I) t} \\
& + (0.9403007426 - 1.140497572 \cdot 10^{-9} I) e^{(2.246979605 + 7.972616167 \cdot 10^{-10} I) t}, z(t) = \\
& - (1.026568667 + 2.171696203 \cdot 10^{-9} I) e^{(0.5549581324 - 4.760383402 \cdot 10^{-10} I) t} \\
& + (-0.4952588764 + 3.734690814 \cdot 10^{-11} I) e^{(-0.8019377366 + 1.336718457 \cdot 10^{-10} I) t} \\
& + (0.5218275450 + 1.069774777 \cdot 10^{-9} I) e^{(2.246979605 + 7.972616167 \cdot 10^{-10} I) t} \}
\end{aligned}$$

(15)

```

[> #4)
[> read("M17.txt")
[> print(HW2g)

```

proc(u, v, M) (16)

local LI, w ;

$LI := HW3g(u, v, w, M)$; $normal(subs(w = 1 - u - v, [LI[1], LI[2]]))$

end proc

> $M := Matrix([[1, 1, 1], [1, 1, 1], [1, 1, 1]])$

$$M := \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix} \quad (17)$$

> $HW2g(u, v, M)$

$$\left[u^2 + uv + \frac{1}{4} v^2, -2uv - 2u^2 + 2u - \frac{1}{2} v^2 + v \right] \quad (18)$$

> $Orb2(HW2g(u, v, M), u, v, [0.5, 0.7], 1, 20)$

$[[0.5, 0.7], [-0.1386986302, 0.6643835616], [0.1983291823, 0.5841655828],$ (19)
 $[0.1303123358, 0.6072046515], [0.1535535438, 0.5929684287], [0.1446869024,$
 $0.6020449339], [0.1492343301, 0.5958264290], [0.1464925883, 0.6001287078],$
 $[0.1483116754, 0.5971136955], [0.1470633478, 0.5992237562], [0.1479333180,$
 $0.5977416946], [0.1473245951, 0.5987810445], [0.1477515834, 0.5980511157],$
 $[0.1474520214, 0.5985632880], [0.1476623032, 0.5982036718], [0.1475147152,$
 $0.5984560589], [0.1476183208, 0.5982788700], [0.1475455979, 0.5984032383],$
 $[0.1475966480, 0.5983159305], [0.1475608135, 0.5983772145]]$

> *#stabilization seen after just one generation*

> $M := RandomMatrix(3, 3)$

$$M := \begin{bmatrix} 57 & -76 & -32 \\ 27 & -72 & -74 \\ -93 & -2 & -4 \end{bmatrix} \quad (20)$$

> $Orb2(HW2g(u, v, M), u, v, [0.5, 0.7], 1000, 1020)$

$[[0.1518401674, 0.5711683710], [0.1518401672, 0.5711683715], [0.1518401674,$ (21)
 $0.5711683710], [0.1518401672, 0.5711683715], [0.1518401674, 0.5711683710],$
 $[0.1518401672, 0.5711683715], [0.1518401674, 0.5711683710], [0.1518401672,$
 $0.5711683715], [0.1518401674, 0.5711683710], [0.1518401672, 0.5711683715],$
 $[0.1518401674, 0.5711683710], [0.1518401672, 0.5711683715], [0.1518401674,$
 $0.5711683710], [0.1518401672, 0.5711683715], [0.1518401674, 0.5711683710],$
 $[0.1518401672, 0.5711683715], [0.1518401674, 0.5711683710], [0.1518401672,$
 $0.5711683715], [0.1518401674, 0.5711683710], [0.1518401672, 0.5711683715],$
 $[0.1518401674, 0.5711683710]]$

> $M := RandomMatrix(3, 3)$

(22)

$$M := \begin{bmatrix} -50 & 25 & -2 \\ -80 & 94 & 50 \\ 43 & 12 & 10 \end{bmatrix} \quad (22)$$

> *Orb2*(*HW2g*(*u*, *v*, *M*), *u*, *v*, [0.5, 0.7], 1000, 1020)

[[1.000000000, 2.543536952 × 10⁻²¹⁰], [1.000000000, -1.576992910 × 10⁻²¹⁰],
[1.000000000, 9.777356040 × 10⁻²¹¹], [1.000000000, -6.061960745 × 10⁻²¹¹],
[1.000000000, 3.758415662 × 10⁻²¹¹], [1.000000000, -2.330217710 × 10⁻²¹¹],
[1.000000000, 1.444734980 × 10⁻²¹¹], [1.000000000, -8.957356875 × 10⁻²¹²],
[1.000000000, 5.553561260 × 10⁻²¹²], [1.000000000, -3.443207981 × 10⁻²¹²],
[1.000000000, 2.134788948 × 10⁻²¹²], [1.000000000, -1.323569148 × 10⁻²¹²],
[1.000000000, 8.206128720 × 10⁻²¹³], [1.000000000, -5.087799805 × 10⁻²¹³],
[1.000000000, 3.154435879 × 10⁻²¹³], [1.000000000, -1.955750245 × 10⁻²¹³],
[1.000000000, 1.212565152 × 10⁻²¹³], [1.000000000, -7.517903940 × 10⁻²¹⁴],
[1.000000000, 4.661100443 × 10⁻²¹⁴], [1.000000000, -2.889882275 × 10⁻²¹⁴],
[1.000000000, 1.791727010 × 10⁻²¹⁴]]

> *M* := *RandomMatrix*(3, 3)

$$M := \begin{bmatrix} -32 & -13 & 42 \\ -1 & 82 & 18 \\ 52 & 72 & -59 \end{bmatrix} \quad (24)$$

> *Orb2*(*HW2g*(*u*, *v*, *M*), *u*, *v*, [0.5, 0.7], 1000, 1020)

[[0.1475755935, 0.5983519371], [0.1475755937, 0.5983519365], [0.1475755936,
0.5983519369], [0.1475755937, 0.5983519364], [0.1475755935, 0.5983519371],
[0.1475755937, 0.5983519365], [0.1475755936, 0.5983519369], [0.1475755937,
0.5983519364], [0.1475755935, 0.5983519371], [0.1475755937, 0.5983519365],
[0.1475755936, 0.5983519369], [0.1475755937, 0.5983519364], [0.1475755935,
0.5983519371], [0.1475755937, 0.5983519365], [0.1475755936, 0.5983519369],
[0.1475755937, 0.5983519364], [0.1475755935, 0.5983519371], [0.1475755937,
0.5983519365], [0.1475755936, 0.5983519369], [0.1475755937, 0.5983519364],
[0.1475755935, 0.5983519371]]

> *M* := *RandomMatrix*(3, 3)

$$M := \begin{bmatrix} 88 & 10 & -20 \\ 95 & -61 & -78 \\ 63 & -26 & -4 \end{bmatrix} \quad (26)$$

> *Orb2*(*HW2g*(*u*, *v*, *M*), *u*, *v*, [0.5, 0.7], 1000, 1020)

[[0.9999999992, 4.285714284 × 10⁻¹⁰], [0.9999999992, 4.285714284 × 10⁻¹⁰],
[0.9999999992, 4.285714284 × 10⁻¹⁰], [0.9999999992, 4.285714284 × 10⁻¹⁰],

[0.9999999992, $4.285714284 \times 10^{-10}$], [0.9999999992, $4.285714284 \times 10^{-10}$],
 [0.9999999992, $4.285714284 \times 10^{-10}$], [0.9999999992, $4.285714284 \times 10^{-10}$],
 [0.9999999992, $4.285714284 \times 10^{-10}$], [0.9999999992, $4.285714284 \times 10^{-10}$],
 [0.9999999992, $4.285714284 \times 10^{-10}$], [0.9999999992, $4.285714284 \times 10^{-10}$],
 [0.9999999992, $4.285714284 \times 10^{-10}$], [0.9999999992, $4.285714284 \times 10^{-10}$],
 [0.9999999992, $4.285714284 \times 10^{-10}$], [0.9999999992, $4.285714284 \times 10^{-10}$],
 [0.9999999992, $4.285714284 \times 10^{-10}$], [0.9999999992, $4.285714284 \times 10^{-10}$],
 [0.9999999992, $4.285714284 \times 10^{-10}$]]

> $M := \text{RandomMatrix}(3, 3)$

$$M := \begin{bmatrix} -17 & -86 & -97 \\ 35 & 50 & -38 \\ -26 & -94 & -36 \end{bmatrix} \quad (28)$$

> $\text{Orb2}(\text{HW2g}(u, v, M), u, v, [0.5, 0.7], 1000, 1020)$

[[-1.334535596, 2.135359703], [0.3123721596, 0.6012019940], [0.5341480315, 0.6927931365], [-0.2431366893, 0.8170724290], [4.492924651, 4.172624114], [-0.1020581988, 1.065993630], [0.2920987729, 0.5058816145], [0.1097102430, 0.6178403295], [-0.2159598572, 0.5304209040], [-0.2045983534, -0.1509751182], [0.1967728394, -7.681002750], [0.08779222995, 0.6351194800], [-0.2959094870, 0.5041168135], [-0.1988885872, -0.4574467402], [-0.008029771640, 1.991426446], [0.1184835622, 0.5401168760], [-0.07919048135, 0.5120564550], [-0.1434308747, 0.2064857426], [-0.02514680136, -0.1495761924], [-0.007886594260, -0.7154449460], [0.07551432385, 1.155647640]]

>

> $M := \text{RandomMatrix}(3, 3)$

$$M := \begin{bmatrix} -67 & -36 & -62 \\ 28 & -88 & -94 \\ -81 & 91 & 27 \end{bmatrix} \quad (30)$$

> $\text{Orb2}(\text{HW2g}(u, v, M), u, v, [0.5, 0.7], 1000, 1020)$

[[1.000000000, $1.545104386 \times 10^{-1629}$], [1.000000000, $3.459188924 \times 10^{-1631}$], [1.000000000, $7.744452815 \times 10^{-1633}$], [1.000000000, $1.733832720 \times 10^{-1634}$], [1.000000000, $3.881715045 \times 10^{-1636}$], [1.000000000, $8.690406820 \times 10^{-1638}$], [1.000000000, $1.945613467 \times 10^{-1639}$], [1.000000000, $4.355851046 \times 10^{-1641}$], [1.000000000, $9.751905330 \times 10^{-1643}$], [1.000000000, $2.183262388 \times 10^{-1644}$], [1.000000000, $4.887900868 \times 10^{-1646}$], [1.000000000, $1.094306164 \times 10^{-1647}$], [1.000000000, $2.449939173 \times 10^{-1649}$], [1.000000000, $5.484938445 \times 10^{-1651}$], [1.000000000, $1.227971294 \times 10^{-1652}$], [1.000000000, $2.749189464 \times 10^{-1654}$],

[1.000000000, $6.154901785 \times 10^{-1656}$], [1.000000000, $1.377963086 \times 10^{-1657}$],
 [1.000000000, $3.084991984 \times 10^{-1659}$], [1.000000000, $6.906698470 \times 10^{-1661}$],
 [1.000000000, $1.546275777 \times 10^{-1662}$]]

> $M := \text{RandomMatrix}(3, 3)$

$$M := \begin{bmatrix} 81 & 20 & 26 \\ 35 & 39 & -74 \\ 80 & -35 & 13 \end{bmatrix} \quad (32)$$

> $\text{Orb2}(\text{HW2g}(u, v, M), u, v, [0.5, 0.7], 1000, 1020)$

[[0.9999999998, $8.310205080 \times 10^{-11}$], [0.9999999995, $-5.591434285 \times 10^{-11}$],
 [0.9999999990, $6.549053290 \times 10^{-10}$], [0.9999999995, $7.939217230 \times 10^{-10}$],
 [0.9999999998, $8.310205080 \times 10^{-11}$], [0.9999999995, $-5.591434285 \times 10^{-11}$],
 [0.9999999990, $6.549053290 \times 10^{-10}$], [0.9999999995, $7.939217230 \times 10^{-10}$],
 [0.9999999998, $8.310205080 \times 10^{-11}$], [0.9999999995, $-5.591434285 \times 10^{-11}$],
 [0.9999999990, $6.549053290 \times 10^{-10}$], [0.9999999995, $7.939217230 \times 10^{-10}$],
 [0.9999999998, $8.310205080 \times 10^{-11}$], [0.9999999995, $-5.591434285 \times 10^{-11}$],
 [0.9999999990, $6.549053290 \times 10^{-10}$], [0.9999999995, $7.939217230 \times 10^{-10}$],
 [0.9999999998, $8.310205080 \times 10^{-11}$], [0.9999999995, $-5.591434285 \times 10^{-11}$],
 [0.9999999990, $6.549053290 \times 10^{-10}$], [0.9999999995, $7.939217230 \times 10^{-10}$],
 [0.9999999998, $8.310205080 \times 10^{-11}$]]

> $M := \text{RandomMatrix}(3, 3)$

$$M := \begin{bmatrix} -72 & -85 & 83 \\ -79 & -19 & -45 \\ 75 & 57 & 68 \end{bmatrix} \quad (34)$$

> $\text{Orb2}(\text{HW2g}(u, v, M), u, v, [0.5, 0.7], 1000, 1020)$

[[0.8908421562, 0.1084014596], [0.8908421570, 0.1084014597], [0.8908421558,
 0.1084014614], [0.8908421528, 0.1084014633], [0.8908421525, 0.1084014632],
 [0.8908421530, 0.1084014628], [0.8908421530, 0.1084014622], [0.8908421548,
 0.1084014606], [0.8908421562, 0.1084014596], [0.8908421570, 0.1084014597],
 [0.8908421558, 0.1084014614], [0.8908421528, 0.1084014633], [0.8908421525,
 0.1084014632], [0.8908421530, 0.1084014628], [0.8908421530, 0.1084014622],
 [0.8908421548, 0.1084014606], [0.8908421562, 0.1084014596], [0.8908421570,
 0.1084014597], [0.8908421558, 0.1084014614], [0.8908421528, 0.1084014633],
 [0.8908421525, 0.1084014632]]

> $M := \text{RandomMatrix}(3, 3)$

(36)

$$M := \begin{bmatrix} 92 & 62 & 28 \\ 73 & 11 & -48 \\ -39 & 61 & -63 \end{bmatrix} \quad (36)$$

> *Orb2*(*HW2g*(*u*, *v*, *M*), *u*, *v*, [0.5, 0.7], 1000, 1020)

[[1.000000000, -1.169590644 × 10⁻¹⁰], [1.000000000, -1.169590644 × 10⁻¹⁰],
[1.000000000, -1.169590644 × 10⁻¹⁰], [1.000000000, -1.169590644 × 10⁻¹⁰],
[1.000000000, -1.169590644 × 10⁻¹⁰], [1.000000000, -1.169590644 × 10⁻¹⁰],
[1.000000000, -1.169590644 × 10⁻¹⁰], [1.000000000, -1.169590644 × 10⁻¹⁰],
[1.000000000, -1.169590644 × 10⁻¹⁰], [1.000000000, -1.169590644 × 10⁻¹⁰],
[1.000000000, -1.169590644 × 10⁻¹⁰], [1.000000000, -1.169590644 × 10⁻¹⁰],
[1.000000000, -1.169590644 × 10⁻¹⁰], [1.000000000, -1.169590644 × 10⁻¹⁰],
[1.000000000, -1.169590644 × 10⁻¹⁰], [1.000000000, -1.169590644 × 10⁻¹⁰],
[1.000000000, -1.169590644 × 10⁻¹⁰], [1.000000000, -1.169590644 × 10⁻¹⁰],
[1.000000000, -1.169590644 × 10⁻¹⁰], [1.000000000, -1.169590644 × 10⁻¹⁰],
[1.000000000, -1.169590644 × 10⁻¹⁰]]

(37)

> *M* := *RandomMatrix*(3, 3)

$$M := \begin{bmatrix} -32 & 31 & 11 \\ -9 & -66 & -76 \\ 69 & -81 & 82 \end{bmatrix} \quad (38)$$

> *Orb2*(*HW2g*(*u*, *v*, *M*), *u*, *v*, [0.5, 0.7], 1000, 1020)

[[-1.171046530 × 10⁻⁴¹, -7.303109865 × 10⁻²¹], [-1.073212592 × 10⁻⁴¹, 6.991391760
× 10⁻²¹], [-9.835520965 × 10⁻⁴², -6.692978695 × 10⁻²¹], [-9.013821990 × 10⁻⁴²,
6.407302775 × 10⁻²¹], [-8.260771050 × 10⁻⁴², -6.133820340 × 10⁻²¹],
[-7.570633020 × 10⁻⁴², 5.872010935 × 10⁻²¹], [-6.938151890 × 10⁻⁴²,
-5.621376320 × 10⁻²¹], [-6.358510775 × 10⁻⁴², 5.381439525 × 10⁻²¹],
[-5.827295215 × 10⁻⁴², -5.151743935 × 10⁻²¹], [-5.340459535 × 10⁻⁴²,
4.931852426 × 10⁻²¹], [-4.894296070 × 10⁻⁴², -4.721346530 × 10⁻²¹],
[-4.485406896 × 10⁻⁴², 4.519825642 × 10⁻²¹], [-4.110677966 × 10⁻⁴²,
-4.326906255 × 10⁻²¹], [-3.767255399 × 10⁻⁴², 4.142221232 × 10⁻²¹],
[-3.452523732 × 10⁻⁴², -3.965419106 × 10⁻²¹], [-3.164086017 × 10⁻⁴²,
3.796163412 × 10⁻²¹], [-2.899745545 × 10⁻⁴², -3.634132047 × 10⁻²¹],
[-2.657489142 × 10⁻⁴², 3.479016655 × 10⁻²¹], [-2.435471814 × 10⁻⁴²,
-3.330522042 × 10⁻²¹], [-2.232002703 × 10⁻⁴², 3.188365614 × 10⁻²¹],
[-2.045532223 × 10⁻⁴², -3.052276838 × 10⁻²¹]]

(39)