

EXPERIMENT - 05

Matrix of linear transformation w.r.t standard basis

Maxima code :

Find the matrix of linear transformation
 $T: V_2(\mathbb{R}) \rightarrow V_2(\mathbb{R})$ defined by $T(x, y) = (2x + 3y, 4x - 5y)$ with respect to standard basis.

```

kill(all);
T(x):= l2*xl13 + 3*xl23, l4*xl13 - 5*xl23;
u13: [1,0];
u23: [0,1];
v13: [1,0];
v23: [0,1];
for i:1 thru 2 do
  [
    eq13: v13l13 * x + v23l23 * y
  ];
for k:1 thru 2 do
  [
    g0ln: solve ([eq13= T(u13)l13, eq12] = T(u13)l23],
    [x,y]);
    ask3: ev (x, g0ln),
    blv3: ev (y, g0ln)
  ];
print (" The matrix of the linear transformation
      is ")$;
print (" The matrix of the linear transformation is ");$;
A:matrix ([a13, a23], [b13, b23]);
```

$$1. T(x, y) = (2x + 3y, 4x - 5y)$$

$$\text{so, } K.T \quad e_1 = (1, 0) \quad e_2 = (0, 1)$$

$$T(1, 0) = T(e_1) = (2, 4)$$

$$T(0, 1) = T(e_2) = (3, -5)$$

∴ The matrix of linear transformation is given

$$\text{by } m(T) = A \begin{bmatrix} 2 & 3 \\ 4 & -5 \end{bmatrix}$$

Output :-

The matrix of the linear transformation is

$$\begin{bmatrix} 2 & 3 \\ 4 & -5 \end{bmatrix}$$

2. $T(x, y, z) = (x+z, x+2y, x+y+z)$

W.L.O.G. $e_1 = (1, 0, 0)$, $e_2 = (0, 1, 0)$, $e_3 = (0, 0, 1)$

$$T(1, 0, 0) = T(e_1) = (1, 1, 1)$$

$$T(0, 1, 0) = T(e_2) = (0, 2, 1)$$

$$T(0, 0, 1) = T(e_3) = (1, 0, 1)$$

i.e. Matrix of linear transformation is given by

$$M(T) = A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 1 & 1 \end{bmatrix}$$

Output :-

The matrix of the linear transformation is

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



9 Find the matrix of linear transformation
 $T : V_3(R) \rightarrow V_3(R)$ defined by $T(x, y, z) = (x+z, 2x+y+z)$

Maxima code:

```

kill(all)\$

T(x):= [x[1]+x[3], x[1]+2*x[2], x[1]+x[2]+x[3]]\$
u1\$: [1,0,0]\$
u2\$: [0,1,0]\$
u3\$: [0,0,1]\$
v1\$: [1,0,0]\$
v2\$: [0,1,0]\$
v3\$: [0,0,1]\$

for i:1 thru 3 do
  eq1[i]:= v1\$*i + v2\$*j + v3\$*k
)for
for k:1 thru 3 do
  C
soln:solve([eq1[1]=T(u1\$)[1], eq1[2]=T(u1\$)[2],
eq1[3]=T(u1\$)[3], eq2[1]=T(u2\$)[1], eq2[2]=T(u2\$)[2],
eq2[3]=T(u2\$)[3], eq3[1]=T(u3\$)[1], eq3[2]=T(u3\$)[2],
eq3[3]=T(u3\$)[3], a1\$:ev(x,y,soln),
b1\$:ev(y,z,soln),
c1\$:ev(z,x,soln)
)\$
```

~~Parent ("the matrix of the linear transformation is")
u: matrix ([a1\$, a2\$, a3\$], [b1\$, b2\$, b3\$]),
[c1\$, c2\$, c3\$]);~~

$$3. T(x, y) = (y, -x)$$

$$\omega \text{ & } T \quad e_1 = (1, 0) \quad e_2 = (0, 1)$$

$$T(1, 0) = T(e_1) = (0, -1)$$

$$T(0, 1) = T(e_2) = (0, 1)$$

∴ Matrix of L.T. is given by

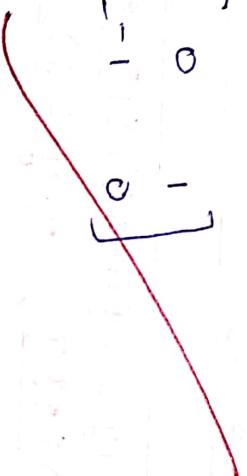
$$M(T) = A = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$$

Output :-

$$T(x) := (x_2, -x_1)$$

The matrix of the linear transformation is

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



3 Find the matrix of the linear transformation
 $T: \mathbb{R}^2 \rightarrow \mathbb{R}^2$ defined by $T(x, y) = (y, -x)$ relative
 to standard basis
 maxima code:

```

k=1000
T[x]:={x[2], -x[1]};
u13: {1, 0}[];
u23: {0, 1}[];
v13: {0, 1}[];
v23: {0, 1}[];

for i:=1 to n-2 do
{
  eq13:=v13*v13*x+v23*v13*y
  v13:=v13+T[u13];
  v23:=v23+T[u23];
  for k:=1 thru n-2 do
  {
    soln:=solve({eq13=T[u13*x]+eq23=T[u23]*x}, {x,y});
    a123:=ev(x,soln),
    b123:=ev(y,soln)
    print ("the matrix of the linear transformation is")
    print ("", a123, b123);
  }
}
  
```

$$4. T(x, y) = (x, x+y)$$

$$\text{Let } T e_1 = (1, 0) \quad e_2 = (0, 1)$$

$$T(1, 0) = T(e_1) = (1, 1)$$

$$T(0, 1) = T(e_2) = (0, 1)$$

∴ Matrix of $L T$ is given by

$$m(T) = A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

Output :-

$$T(x) := [x_1, x_1 + x_2]$$

The matrix of the linear transformation is

$$\begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$$

~~Map index~~



a) find the matrix of the linear transformation
 $T : \mathbb{R}^2 \rightarrow \mathbb{R}^2$ defined by $T(x, y) = (x, xy)$
maxima code:

```
l\$ucall>$
```

```
T(x) := x[1], x[1] + x[2];
```

```
u\$13 := {1, 0};$
```

```
u\$23 := {0, 1};$
```

```
u\$13 : {1, 0};$
```

```
u\$23 : {0, 1};$
```

```
for i:1 thru 2 do
```

```
(
```

```
eq\$13 := u\$13\$13 + u\$23\$13 * y;
```

```
)$
```

```
for k:1 thru 2 do
```

```
(
```

```
soln:solve ({eq\$13 = T(u\$13)\$13, eq\$23 = T(u\$13)\$23},
```

```
{x, y});
```

```
ans13:ev(soln, soln),
```

```
blk13:ev (y, soln)
```

```
)$
```

print ("The matrix of the linear transformation

```
> on rk");$
```

A:matrix ({a\\$11, a\\$12}, {b\\$11, b\\$12});

10/1/2022

Output

Matrix

Ans

$$1) 2x+5y, 4x+3y$$

$$\begin{bmatrix} 2 & 5 \\ 4 & 3 \end{bmatrix}$$

$$|A - \lambda I| = 0$$
$$\left| \begin{bmatrix} 2 & 5 \\ 4 & 3 \end{bmatrix} - \lambda \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \right| = 0$$

$$\left| \begin{bmatrix} 2-\lambda & 5 \\ 4 & 3 \end{bmatrix} - \begin{bmatrix} \lambda & 0 \\ 0 & \lambda \end{bmatrix} \right| = 0$$

$$(2-\lambda)(3-\lambda) - 20 = 0$$

$$6 - 2\lambda - 3\lambda + \lambda^2 - 20 = 0$$

$$\lambda^2 - 5\lambda + 6 - 20 = 0$$

$$\lambda^2 - 5\lambda - 14 = 0$$

$$\lambda^2 - 7\lambda + 2\lambda - 14 = 0$$

$$\lambda(\lambda - 7) + 2(\lambda - 7) = 0$$

$$(\lambda - 7)(\lambda + 2) \Rightarrow \langle \lambda = 7 \rangle \wedge \langle \lambda = -2 \rangle$$

$$\lambda \neq 7$$

$$\begin{bmatrix} 2-\lambda & 5 \\ 4 & 3-\lambda \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} 2-7 & 5 \\ 4 & 3-7 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} -5 & 5 \\ 4 & -4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$-5x_1 + 5x_2 = 0 \rightarrow \textcircled{1}$$

$$4x_1 - 4x_2 = 0 \rightarrow \textcircled{2}$$

$$4x_1 = 4x_2$$

$$x_1 = x_2$$

$$\text{Let } x_1 = k,$$

$$x_2 = k$$

(Ans)

EXPERIMENT - 06

EIGEN VALUES AND EIGEN VECTORS

1 Find the Eigen values and Eigen vectors of the transformation $T(x, y) = (2x+5y, 4x+3y)$

~~Killall();~~

```
T(x) := [ 2*x [ 5*x [ 2], 4*x [ 1] + 3*x [ 2] ] ]
```

```
u13 := [ 1, 0 ]
```

```
u23 := [ 0, 1 ]
```

```
v13 := [ 1, 0 ]
```

```
v23 := [ 0, 1 ]
```

```
for i:=1 thru 2 do
```

```
    L := T(u[i]) - v[i];
```

```
    eq13 := v[1]*L[1]*x + v[2]*L[2]*y;
```

```
    2;
```

```
for k:=1 thru 2 do
```

```
    L := T(u[k]);
```

```
Soln := solve([eq13=0, L[1], L[2]]);
```

```
as13 := ev(x, Soln),
```

```
as23 := ev(y, Soln)
```

```
)9
```

Print("The matrix of the linear transformation!k")\$

```
M := matrix([1, 2, 3, 0, 1, 3, 6, 2, 3]);
```

```
charpoly(M, x);
```

```
eigenvalues(M);
```

```
eigenvectors(M);
```

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$$\begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} = \begin{bmatrix} \kappa \\ \kappa \end{bmatrix}$$

Eigen vectors

$$\text{If } \lambda = -2 \quad \begin{bmatrix} 2+2 & 5 \\ 4 & 3+2 \end{bmatrix} \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$4\alpha_1 + 5\alpha_2 = 0$$

$$4\alpha_1 = -5\alpha_2$$

$$\alpha_1 = -5/4 \alpha_2 \quad \text{or} \quad \alpha_2 = -\frac{4}{5} \alpha_1$$

$$\text{Let } \alpha_1 = k_1, \quad \alpha_2 = -\frac{4}{5} k_1$$

$$\text{Eigen vectors} \quad \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} = \begin{bmatrix} \kappa \\ -4/5 \kappa \end{bmatrix}$$

Output :-

$$T(\alpha) := [3\alpha_1 + 3\alpha_2, 4\alpha_1 + 3\alpha_2]$$

The matrix of the linear transformation is $\begin{pmatrix} 2 & 3 \\ 4 & 3 \end{pmatrix}$

$$(2-\lambda)(3-\lambda) - 2 = 0$$

$$[[2, -2], [1, 1]]$$

$$[[2, -2], [1, 1]], [[2, 1], [1, 1]], [[1, -4/5], [1, 1]]$$

$$2) \quad 3x + 3y, \quad x + 5y$$

$$\begin{bmatrix} 3 & 3 \\ 1 & 5 \end{bmatrix}$$

$$|A - \lambda I| = 0$$

$$\left| \begin{bmatrix} 3 & 3 \\ 1 & 5 \end{bmatrix} - \lambda \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \right| = 0$$

$$\left| \begin{bmatrix} 3-\lambda & 3 \\ 1 & 5-\lambda \end{bmatrix} \right| = 0$$



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$$(3-\lambda)(5-\lambda) - 3 = 0$$

$$15 - 3\lambda - 5\lambda + \lambda^2 - 3 = 0$$

$$\lambda^2 - 8\lambda + 12 = 0$$

$$\lambda^2 - 6\lambda - 2\lambda + 12 = 0$$

$$\lambda(\lambda - 6) - 2(\lambda - 6) = 0$$

$$(\lambda - 6)(\lambda - 2) = 0$$

$$\lambda = 6, \lambda = 2$$

put $\lambda = 6$

$$\begin{vmatrix} 3-\lambda & 3 \\ 1 & 5-\lambda \end{vmatrix} = 0$$

$$\begin{vmatrix} 3-\lambda & 3 \\ 1 & 5-\lambda \end{vmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} -3 & 3 \\ 1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$-3x_1 + 3x_2 = 0$$

$$x_1 - x_2 = 0$$

consider $x_1 - x_2 = 0$

let $x_1 = k$

$$x_2 = k$$

$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} k \\ k \end{bmatrix}$$

or $x_1 = k$ & $x_2 = k$

or $x_1 = k$ & $x_2 = k$

$$\begin{vmatrix} 3-\lambda & 3 \\ 1 & 5-\lambda \end{vmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$\begin{vmatrix} 1 & 3 \\ 1 & 3 \end{vmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$x_1 + 3x_2 = 0$$

$$x_1 + 3x_2 = 0$$



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```

c
eq1 := v1*x + v2*y
> for k:=1 to 20 do
    soln := solve ({eq1 = T(u[k]) v1, eq2 = T(u[k]) v2}),
    {x,y},
    a1v := ev (v1, soln),
    b1v := ev (v2, soln),
    b1v := ev (y, soln),
)

```

point ("The matrix of the linear transformation in"
 $\text{matrix}[[a1v, a2v], [b1v, b2v]]$);

~~charpoly (M, u);~~

~~eigenvalues (M);~~

~~eigenvectors (M);~~

$$\alpha = \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}$$

$$\beta = \begin{pmatrix} 1 & -1 \\ 1 & 1 \end{pmatrix}$$

$$\alpha^{-1} = \begin{pmatrix} 1 & -1 \\ 1 & 1 \end{pmatrix}$$

$$\beta^{-1} = \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}$$

$$\alpha^{-1} \beta = \begin{pmatrix} 0 & 2 \\ 2 & 0 \end{pmatrix}$$

$$\beta^{-1} \alpha = \begin{pmatrix} 0 & 2 \\ 2 & 0 \end{pmatrix}$$

$$\alpha^{-1} \beta^{-1} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$\beta^{-1} \alpha^{-1} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$\alpha^{-1} \beta^{-1} \alpha = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$\beta^{-1} \alpha^{-1} \beta = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

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$$\langle \alpha_1 = -3\alpha_2 \rangle \text{ or } \alpha_1 = 3$$

$$\text{Let } \alpha_1 = k$$

$$\langle \alpha_2 = \frac{-1}{3}k \rangle$$

Output :-

$$T(\alpha) := [3\alpha_1 + 3\alpha_2, \alpha_1 + 5\alpha_2]$$

The matrix of the linear transformation in $\begin{bmatrix} 3 \\ 5 \\ -5 \end{bmatrix}$

$$(3-\lambda)(5-\lambda) - 3$$

$$[[6, 2], [1, 13]]$$

$$[[6, 2], [1, 13], [[1, 13], [[1, -13], [-13]]]]$$

$$3) x+y, y$$

$$\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} = 0$$

$$|A - \lambda I| = 0$$

$$\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} - \lambda \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = 0$$

$$\begin{vmatrix} 1-\lambda & 1 \\ 0 & 1-\lambda \end{vmatrix} = 0$$

$$(1-\lambda)(1-\lambda) = 0$$

$$(1-\lambda)^2 = 0$$

$$1 + \lambda^2 - 2\lambda = 0$$

$$\lambda^2 - \lambda - \lambda + 1 = 0$$

$$\lambda(\lambda - 1) - 1(\lambda - 1) = 0$$

$$(\lambda - 1)(\lambda - 1) = 0$$

$$\langle \lambda = 1 \rangle$$

$$\text{Put } \lambda = 1$$

$$\begin{bmatrix} 1-1 & 1 \\ 0 & 1-1 \end{bmatrix} \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$\alpha_2 = 0 \quad \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$



3 Find the eigen values and eigen vectors of the linear transformation $T(x,y) = (x+y, y)$

klcawd\$

$T(x) : \{x_1, y_1\} + \{x_2, y_2\}$;

$x_1, y_1 : \{1, 0\} \neq$

$x_2, y_2 : \{0, 1\} \neq$

$x_1, y_1 : \{1, 0\} \neq$

$x_2, y_2 : \{0, 1\} \neq$

for i=1 then 2 do

c

eq_{i,j} : $\nabla x_1 \cdot \{1, 0\} \neq x_1 + \nabla x_2 \cdot \{0, 1\} \neq y$

do

for k:1 then 2 do

{
soln : solve[eq_{i,j} = T(x_{k,l})_{1,j}, eq_{i,2} = T(x_{k,l})_{2,j}],

{x, y}],

sol_{k,l} : ev(x, soln),

sol_{k,l} : ev(y, soln),

} \$

print ("The matrix of the linear transformation is")

Expt. No. 4.1	
Date	Page No. 34
4.1 Cauchy's Riemann Equations in Cartesian Form	

Given function is not analytic
$\frac{\partial u}{\partial x} \neq \frac{\partial v}{\partial y}$ and $\frac{\partial u}{\partial y} \neq -\frac{\partial v}{\partial x}$
\therefore Function is not analytic
$\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$
$\frac{\partial v}{\partial y} = 0$
$v = y^2$
$u = xy$
$u + iv = xy + iy^2$
$(u + iv)(v) = (xy + iy^2)(y^2)$
$z^2 + (x^2 + y^4)v = w = z \operatorname{Im}(z)$
$\operatorname{Im}(z)$

Given function is not analytic
$\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$ and $\frac{\partial u}{\partial y} = -\frac{\partial v}{\partial x}$
\therefore Function is not analytic
$\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y} + \frac{\partial v}{\partial x} = -\frac{\partial u}{\partial y}$
$\frac{\partial u}{\partial x} = \cos(x+y)$
$\frac{\partial v}{\partial x} = -\sin(x+y)$
$u = \cos x \cos y$
$v = -\sin x \sin y$
$u + iv = \cos x \cos y - i \sin x \sin y$
$= \cos(x+y) - i \sin(x+y)$
$= \cos(x+y)$
$\therefore \cos z$

Given function is not analytic
$\frac{\partial u}{\partial x} \neq \frac{\partial v}{\partial y}$ and $\frac{\partial u}{\partial y} \neq -\frac{\partial v}{\partial x}$
\therefore Function is not analytic
$\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$
$\frac{\partial v}{\partial y} = 0$
$v = y^2$
$u = xy$
$u + iv = xy + iy^2$
$(u + iv)(v) = (xy + iy^2)(y^2)$
$z^2 + (x^2 + y^4)v = w = z \operatorname{Im}(z)$
$\operatorname{Im}(z)$

Given function is not analytic
$\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$ and $\frac{\partial u}{\partial y} = -\frac{\partial v}{\partial x}$
\therefore Function is not analytic
$\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y} + \frac{\partial v}{\partial x} = -\frac{\partial u}{\partial y}$
$\frac{\partial u}{\partial x} = \cos(x+y)$
$\frac{\partial v}{\partial x} = -\sin(x+y)$
$u = \cos x \cos y$
$v = -\sin x \sin y$
$u + iv = \cos x \cos y - i \sin x \sin y$
$= \cos(x+y) - i \sin(x+y)$
$= \cos(x+y)$
$\therefore \cos z$

Print ("Given function is not analytic")

else

print ("By CE equation given function is not analytic")

if diff (u,x) = diff (v,y) and diff (u,y) = -diff (v,x) then

writeln ("Input point (w);")

w := readpoint (w);

u := evalpoint (w);

v := evalpoint (w);

z1,

end if

else

print ("Input point (w);")

w := readpoint (w);

u := evalpoint (w);

v := evalpoint (w);

z1,

end if

print ("Given function is not analytic")

else

print ("By CE equation given function is not analytic")

if diff (u,x) = diff (v,y) and diff (u,y) = -diff (v,x) then

writeln ("Input point (w);")

w := readpoint (w);

u := evalpoint (w);

v := evalpoint (w);

z,

end if

else

print ("Input point (w);")

w := readpoint (w);

u := evalpoint (w);

v := evalpoint (w);

z,

$$\frac{x^2 + y^2}{h-i} = \frac{x^2 - (i)^2}{x-i} =$$

$$\frac{(h-i)}{x-i} = \frac{h+i}{x-i} =$$

$$\frac{h+i}{1} = \frac{z}{1} = w = z_1 -$$

$$z_1 -$$

By CE equation given function is not analytic

%.e, %.g, %.f

Output :-

-. function is not analytic

$$\therefore \frac{\partial u}{\partial x} = \frac{\partial v}{\partial y} = -\frac{\partial v}{\partial x}$$

$$\frac{\partial v}{\partial x} = \frac{\partial u}{\partial y} = \frac{\partial u}{\partial y}$$

$$\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y} = \frac{\partial v}{\partial x}$$

$$u = e^{x \cos y} + i e^{x \sin y}$$

$$= e^x (\cos y + i \sin y)$$

$$= e^x \cdot e^{iy} = e^{x+iy}$$

$$(3) e^x$$

$$y \\ x \\ a \\ b \\ output :-$$

$$y \\ x \\ a \\ b \\ output :-$$

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Expt. No.	Date	Page No. 41
1	10/08/2018	Teacher's Signature : <i>[Signature]</i>
2	10/08/2018	date P.C. "The function is not analytic"
3	10/08/2018	date P.C. "The function is analytic"
4	10/08/2018	if $u_r = \operatorname{realpart}(u, r)$ and $u_t = \operatorname{imagpart}(u, r)$
5	10/08/2018	$u_r : \operatorname{realpart}(\operatorname{diff}(u, r))$;
6	10/08/2018	$u_t : \operatorname{realpart}(\operatorname{diff}(u, t))$;
7	10/08/2018	$u_r : \operatorname{realpart}(u_r)$;
8	10/08/2018	$u_t : \operatorname{realpart}(u_t)$;
9	10/08/2018	$w : 1/r + \cos(t) - i/r + (\sin(t))$
10	10/08/2018	calculation
11	10/08/2018	! sign
12	10/08/2018	calc the analyticity of the function $1/\cos\theta$ -
13	10/08/2018	
14	10/08/2018	
15	10/08/2018	
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18	10/08/2018	
19	10/08/2018	
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The function is Analytic
Output:

\therefore Hence it is Analytic

$$\frac{\partial u}{\partial x} = -e \left(\frac{1}{1-e^{2x}} \right) = -e \left(\frac{1}{1-e^{2x}} \right) = -e \left(\frac{1}{1-e^{2x}} \right)$$

$$\frac{\partial v}{\partial x} = -\frac{2}{1-e^{2x}}$$

$$\frac{\partial u}{\partial y} = -\frac{2}{1-e^{2y}}$$

$$\frac{\partial v}{\partial y} = -\frac{2}{1-e^{2y}}$$

$$u = \frac{1}{2} \cos \theta$$

$$v = \frac{1}{2} \sin \theta$$

$$\frac{\partial u}{\partial x} = -\frac{1}{2} \cos \theta$$

$$\frac{\partial v}{\partial x} = -\frac{1}{2} \sin \theta$$

$$\therefore \text{The function is analytic}$$

The function is analytic
Output:

\therefore Hence analytic

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = \frac{1}{1-a^2} + \frac{1}{1-b^2} = 0$$

$$\frac{1}{1-a^2} = 0 \Rightarrow a = 1$$

$$\frac{1}{1-b^2} = 0 \Rightarrow b = 1$$

$$a = \frac{1}{1-a^2}$$

$$b = \frac{1}{1-b^2}$$

$$a = \log e + i\theta$$

$$b = \log e + i\theta$$

$$z = \log e + i\theta$$

Probability of a tie

41: $\text{quab3t}([x = x, y = 0], \sqrt{x})$ + $(x^2 - 1) \sqrt{x}$

$$Vx : \text{diff}(u, x); \quad Vy : \text{diff}(v, y);$$

বুক প্রেস এবং স্কুল প্রিণ্টিং - হালতা মেডিয়া এবং কোম্পানি

புது பார்லிமெண்ட் - தமிழக சட்டம்

Construct an analytic function whose

10. *What is the name of the author of the book you are reading?*

.....

Digitized by srujanika@gmail.com

1972-1973 *1973-1974*

$$f_2: \text{subsat}(\{\bar{x} = \bar{z}, y = \bar{y}\}, \text{true})$$

$$f(x) = \frac{1}{2}x^2 - 3x + 4$$

def: def $\#$ (a, y):

$$u := \log(x_1^2 + y_1^2) \quad (12)$$

$$(\frac{1}{2} \ln^2 x + \frac{1}{2} \ln x) \Big|_1^{\infty} = \infty$$

construct an ordinary function f on \mathbb{R} such that $f(x) = \ln x$ for all $x > 0$.

Miller. Johnson method

8. Construction of Analytic Functions

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— No. 08 —

$$\begin{aligned}
 & \text{Given: } z = x + iy \\
 & \text{Find: } \frac{\partial z}{\partial x} + \frac{\partial z}{\partial y} \\
 & \text{Using the definition of partial derivatives:} \\
 & \frac{\partial z}{\partial x} = \lim_{h \rightarrow 0} \frac{z(x+h, y) - z(x, y)}{h} = \lim_{h \rightarrow 0} \frac{(x+h) + i(y+h) - (x + iy)}{h} = \lim_{h \rightarrow 0} \frac{h + ih}{h} = 1 \\
 & \frac{\partial z}{\partial y} = \lim_{h \rightarrow 0} \frac{z(x, y+h) - z(x, y)}{h} = \lim_{h \rightarrow 0} \frac{(x + iy) - (x + iy)}{h} = \lim_{h \rightarrow 0} 0 = 0 \\
 & \therefore \frac{\partial z}{\partial x} + \frac{\partial z}{\partial y} = 1 + 0 = 1
 \end{aligned}$$

On Entegraleen leq qf
 $f(x) = \log(x) + c$
 $\text{Output} = \log z + c$

$$\frac{x}{1} = \left(\frac{z}{x} \right) : - \frac{x}{z} = (z), \text{ it}$$

Put $x = a + bi$ in the above equation

$$\frac{a+bi}{1} = \frac{a+bi}{a^2+b^2}$$

$$\frac{h}{\pi}! - \frac{x}{\pi} = (x), \pm$$

$$\frac{h_0}{\pi}! - \frac{x_0}{\pi} =$$

$$\frac{\partial \varphi}{\partial x} = \frac{x_0}{\lambda_0}$$

$$u = \frac{1}{2} \log(x^2 + y^2)$$

construct an auxiliary function whose graph

is symmetric about the line $y = x$.

\Rightarrow $y = f(x)$ is odd if $f(-x) = -f(x)$

\Rightarrow $y = f(x)$ is even if $f(-x) = f(x)$

\Rightarrow $y = f(x)$ is periodic if $f(x+T) = f(x)$

\Rightarrow $y = f(x)$ is increasing if $f'(x) > 0$

\Rightarrow $y = f(x)$ is decreasing if $f'(x) < 0$

\Rightarrow $y = f(x)$ is concave up if $f''(x) > 0$

\Rightarrow $y = f(x)$ is concave down if $f''(x) < 0$

\Rightarrow $y = f(x)$ has a local maximum at (x_0, y_0) if $f'(x_0) = 0$ and $f''(x_0) < 0$

\Rightarrow $y = f(x)$ has a local minimum at (x_0, y_0) if $f'(x_0) = 0$ and $f''(x_0) > 0$

~~matlabmp(Funegmata([x1, x2] - 0.5 * Funegmata([x2, x3]));~~

#2 : subsf([x2=x, y=0], m2);

#1 : subsf([x=x, y=0], m1);

uy : diff(u, y);

ux : diff(u, x);

u : 2*x - x*y^3 + 3*x*y - y*x^2;

funct : u = 2*x - x*y^3 + 3*x*y;

3. Construction on a mobile phone home real

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$$\begin{aligned} & \text{Output: } z + zh \\ & z = z + he \\ & \text{Pade approx: } f(z) = 1 - \frac{e^{-z} \sin(z)}{e^{-z} \cos(z) + i} \\ & Pade \quad x = z, y = 0 \\ & \frac{ze}{e - he} + \frac{he}{e - he} = \frac{ze}{e - he} + \frac{ze}{e - he} = (z), z \\ & \text{Hence } z - 1 = \frac{he}{e - he} \\ & h \cos z = \frac{ze}{e - he} \\ & h \cos z + h = 0 \quad (1) \end{aligned}$$

$$Z_1 = -Z_2 \cos(\theta) + Z_3 \sin(\theta)$$

Range Space = $\{T(\alpha) \mid \alpha \in V\}$
 $= \text{Span} \{ (1, 0, 0), (0, 1, 0), (0, 0, 1) \}$
 ~~$= \{ \alpha_1 + \alpha_2 + \alpha_3 \mid \alpha_1, \alpha_2, \alpha_3 \in \mathbb{R} \}$~~

$$A = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 1 & 0 \\ 0 & 1 & 1 \end{bmatrix}$$

$$\leftarrow$$

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} =$$

$$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \end{bmatrix}$$

$$\text{Nullity} = 1$$

$$\text{rank} = 2$$

$$\therefore \text{Echelon form}$$

$$\text{det}(\text{domain}) = 3$$

$$\text{Nullity} + \text{rank} = \text{det}(\text{domain})$$

1) CO- Efficient cut mala

Teacher's Signature:

~~as: matrix (m)~~

~~etc. long (m);~~

~~dim: 3;~~

~~[C1, C2, C3];~~

~~M: matrix ([A11, A12, A13], [A21, A22, A23], [A31, A32, A33]);~~

~~perf("The matrix is of the linear transformation ");~~

~~24~~

~~C[i]: ev (z, g0[i]);~~

~~B[i]: ev (y, g0[i]);~~

~~A[i]: ev (x, g0[i]);~~

~~eq1 := T (u[i]) [3] = T (u[i]) [1], eq2 := T (u[i]) [2],~~

~~g0[i] := solve ([eq1, eq2] = T (u[i]) [1], eq2 = T (u[i]) [2],~~

~~(~~

~~for k := 1 to 3 do~~

~~24~~

~~eq3 := V[3][i] - x + V[2][i] * y + V[3][i] * z~~

~~(~~

~~for i := 1 to 3 do~~

~~V[3][i] := [0, 0, 1][i]~~

~~V[2][i] := [0, 1, 0][i]~~

~~V[1][i] := [1, 0, 0][i]~~

~~u[3][i] := [0, 0, 1][i]~~

~~u[2][i] := [0, 1, 0][i]~~

~~u[1][i] := [1, 0, 0][i]~~

~~T(x) := [x, 1, 3][i] + 2 * [x, 2][i] + 3 * [x, 3][i];~~

~~eval (a[i])~~

~~T(x, y, z) = (x, 2y, 3z).~~

3 Find the range, nullity, rank, kernel, nullity and rank of the linear transformation

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~~N(T) = {0, 0, 0}~~

~~= {x=0, y=0, z=0}~~

~~N(T) = f(x, y, z) = (0, 0, 0)~~

~~N(T) = g(x, y, z) = 0~~

~~N(T) = g(x, y, z) = b~~

~~so, T~~

~~P(T) = (x, y, z) : 0 <= x <= 1, 0 <= y <= 1, 0 <= z <= 1~~

~~= (x, y, 0) + (0, y, 0) + (0, 0, z)~~

~~P(T) = x (1, 0, 0) + y (0, 1, 0) + z (0, 0, 1),~~

~~so P(T) =~~

~~P(T) is spanned by (1, 0, 0), (0, 1, 0), (0, 0, 1)~~

~~P(T) = g(T(x)) / det(g)~~

~~rank~~

~~∴ Rank and nullity theorem is verified.~~

~~nullity = 3~~

~~rank = 3~~



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Teacher's Signature : -

~~Print ("Dimensions of range space is " n);
nullSpace (n);~~

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The nature of the linear transformation is as follows:

Q

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Tea

$$u = \frac{1}{2} \log(x^2 + y^2)$$

$$\frac{\partial u}{\partial x} = \frac{2x}{x^2 + y^2}$$

$$\frac{\partial u}{\partial x^2} = \frac{y^2 - x^2}{(x^2 + y^2)^2}$$

$$\frac{\partial u}{\partial y} = \frac{y}{x^2 + y^2}$$

$$\frac{\partial^2 u}{\partial y^2} = \frac{x^2 - y^2}{(x^2 + y^2)^2}$$

$$v = 2xy$$

$$\frac{\partial v}{\partial x} = 2y \quad \frac{\partial^2 v}{\partial x^2} = 0$$

$$\frac{\partial v}{\partial y} = 2x \quad \frac{\partial^2 v}{\partial y^2} = 0$$

$$\therefore \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0 \quad \frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} = 0$$

$$\therefore \Delta^2 u = 0 \quad \therefore \Delta^2 v = 0$$

$\frac{1}{4} u$

$\therefore u$ is harmonic

$\therefore u$ and v are harmonic

Output:-

$$\frac{1}{2} \log(x^2 + y^2)$$

$$2xy$$

u and v are harmonic

$$4) 2x^2 - iy^3$$

$$2(x+iy)^2 - i(x+iy)^3$$

$$2(x^2 + i2xy - y^2) - i(x^3 - iy^3 + 3x^2iy - 3xy^2)$$

$$2x^2 + i4xy - 2y^2 - x^3 - y^3 + 3x^2y + 3ixy^2$$

$$(2x^2 - 2y^2 - y^3 + 3x^2y) + i(4xy - x^3 + 3xy^2)$$

$$u = 2x^2 - 2y^2 - y^3 + 3x^2y$$

$$\frac{\partial u}{\partial x} = 4x + 6xy$$

$$\frac{\partial^2 u}{\partial x^2} = 4 + 6y$$

$$\frac{\partial u}{\partial y} = -4y - 3y^2 + 6x^2$$

$$\frac{\partial^2 u}{\partial y^2} = -4 - 6y$$

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$$

$$v = 4xy - x^3 + 3xy^2$$

$$\frac{\partial v}{\partial x} = 4y - 3x^2 + 3y^2$$

$$\frac{\partial^2 v}{\partial x^2} = -6x$$

$$\frac{\partial v}{\partial y} = 4x + 6xy$$

$$\frac{\partial^2 v}{\partial y^2} = 6x$$

$$\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} = 0$$

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3) $\text{defn}(u)$ {

$u = \frac{1}{2} \log(x^2 + y^2);$

$v = 2xy;$

$uxx:$

$uyy:$

$vxx:$

$vyy:$

if $\text{ratimp}(uxx + uyy) = 0$ and $\text{ratimp}(vxx + vyy) = 0$

then

print ("u and v are harmonic")

else

print ("u and v are not harmonic") }\$

4) $\text{defn}(u)$ {

$x = x + \%i * y$ }

$w = 2x + 2y - \%i * 2z;$

$u = \text{real part}(w)$

$v = \text{imag part}(w)$

$uxx = \text{diff}(u, x, 2)$

$uyy = \text{diff}(u, y, 2)$

$vxx = \text{diff}(v, x, 2)$

$vyy = \text{diff}(v, y, 2)$

if $\text{ratimp}(uxx + uyy) = 0$ and $\text{ratimp}(vxx + vyy) = 0$ then

print ("u and v are harmonic")

else

print ("u and v are not harmonic") }\$

Teacher's Signature : _____



$\therefore u$ is Harmonic

$$-6x + 6x = 0$$

$\therefore u$ and v are Harmonic

$\therefore v$ is Harmonic

Output :-

$$2(y^2 + x)^2 - 10(y^2 + x)^3$$

u and v are Harmonic

~~10/08/2021~~

11. Current Ratio

$$\begin{aligned} & 1, -1, i, -i \\ \Rightarrow & z_1 = 1, z_2 = -1, z_3 = i, z_4 = -i \\ \text{Coke ratio} &= \frac{(z_1 - z_2)(z_3 - z_4)}{(z_1 - z_4)(z_3 - z_2)} \end{aligned}$$

$$\begin{aligned} &= \frac{(1+i)(i+i)}{(1+i)(i+i)} = \frac{2(z_1)}{(1+i)^2} \\ &= \frac{2i}{1+i^2+2i} = \frac{2i}{1-i+2i} = 2 \end{aligned}$$

$$z_4 : -1, i$$

$$z_4 : 1, -i$$

~~CR : rect form (full marking) $((z_1 - z_2) * (z_3 - z_4))$~~

Output :- 2

$$2) z_1, z_2, -1, i$$

$$z_1 = 2, z_2 = 2i, z_3 = -1, z_4 = -i$$

$$\text{Coke ratio} = \frac{(z_1 - z_2)(z_3 - z_4)}{(z_1 - z_4)(z_3 - z_2)}$$

$$= \frac{(2 - 2i)(-1 + i)}{(2 + i)(-1 - 2i)} = \frac{-2 + 2i + 2i - 2i^2}{-2 - 4i - i - 2i^2}$$

$$= \frac{-2 + 4i + 2i}{-2 - 5i + 2} = \frac{-4i}{-5}$$

Output :- -4/5

3

$$z = x + iy$$

$$= \frac{(4i - 2)}{(-1 + i)} \times \frac{-1 - i}{-1 - i} = -4i + 4 + 2 + 2i$$

$$= \frac{(4i - 2)(-1 - i)}{(-1)^2 - (i)^2} = \frac{-2i + 6}{1 + 1} = \frac{2(-i + 3)}{2} = 3 - i$$

Output :- 3 - i

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12. Bilinear Transformation

$$1) \frac{z-1}{z+1}$$

Let $w = z$ be the fixed point then we have

$$w = \frac{z-1}{z+1}$$

$$z(z+1) = z-1$$

$$z^2 + z = z - 1$$

$$z^2 + z - z + 1 = 0$$

$$z^2 + 1 = 0$$

$$z^2 = -1$$

$$z = \sqrt{-1}$$

$$z = \pm i$$

$$z = -i, i$$

Output :- $\frac{z-1}{z+1} = z$

$$\left[z = -i, i \right]$$

$$2) w = \frac{3z-4}{z}$$

Let $w = z$ be the fixed point then we have

$$z = \frac{3z-4}{z}$$

$$z^2 = 3z - 4$$

$$= \frac{b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{3 \pm \sqrt{9-4 \times 4}}{2 \times 1}$$

$$= \frac{3 \pm \sqrt{9-16}}{2}$$

3

02 Find the fixed points of the transformation

$$w = \frac{3z-4}{z}$$

Let $w = z$

$$w(z) = (3z - 4)$$

$$FP: \text{rectform}(fullratioimp}(w=z))$$

$$\text{Solve } (FP, z);$$

$$(FP, z) = \frac{3 \pm \sqrt{9-4 \times 4}}{2 \times 1}$$

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~~Output :-~~

$$3z - 4$$

$$z$$

$$3z - 4 = z$$

$$z = \frac{3-i\sqrt{7}}{2}, \quad \frac{3+i\sqrt{7}}{2}$$

$$3 w = \frac{2z-5}{z+4}$$

Let $w = z$ be the fixed point then we have

$$z = \frac{2z-5}{z+4}$$

$$z(z+4) = 2z-5$$

$$z^2 + 4z = 2z - 5$$

$$z^2 + 4z = -2z + 5 = 0$$

$$z^2 + 2z + 5 = 0$$

$$= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-2 \pm \sqrt{4 - 4 \times 5}}{2}$$

$$= -2 \pm \sqrt{4 - 20}$$

$$= -2 \pm \sqrt{-16}$$

$$z = -\frac{2 \pm 4i}{2}$$

$$z = \frac{2(-1 \pm 2i)}{2}$$

3 Find fixed points of the transformation

$$w = \frac{2z-5}{z+4}$$

$$\text{Output :-}$$

$$w : (2z - 5) | (z + 4)$$

FP in rectangular form (full calculation ($w = z$)) ;

Solve 1 FP, z :

$$\text{Output :-} \\ \frac{2z-5}{z+4} = z$$

$$2z - 5 = z(z+4)$$

$$2z - 5 = z^2 + 4z$$

$$z^2 + 4z - 2z + 5 = 0 \\ z^2 + 2z + 5 = 0$$

$$z = -1$$

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$$z = -1 + 2i$$

$$z = 2i - 1$$

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4) $w = 3z$ be the fixed point then we have
Let $w = 3z$
 $z = 3z$
 $3z - z = 0$
 $2z = 0$
 $z = 0$

Find fixed points of the transformation $w = 3z$
using
 $w = 3z$
FP: rectform(fullmatrix(w=z));
Solve(FP, z);

Output:-
3z

$$3z = z$$

$$z = 0$$

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