```
> #Please do NOT post homework
> #Jeton Hida, Assignment 12, October 18, 2021
  read "/Users/jeton/Desktop/Math 336/M11.txt"
> #Number 1
> #i.
> solve(x=x^3-6*x^2+12*x-6,x)
```

$$1, 2, 3 \tag{1}$$

```
> diff(x^3-6*x^2+12*x-6,x)
```

$$3x^2 - 12x + 12 \tag{2}$$

```
> subs(x=1,%)
```

$$3 \tag{3}$$

```
> subs(x=2,%%)
```

$$0 \tag{4}$$

```
> subs(x=3,%%%)
```

$$3 \tag{5}$$

```
> #2 is a stable fixed point, but 1 and 3 are not
> #ii.
> solve(x=x^4-((13*x^2)/36)+x+(1/36))
```

$$\frac{1}{3}, -\frac{1}{2}, \frac{1}{2}, -\frac{1}{3} \tag{6}$$

```
> diff(x^4-((13*x^2)/36)+x+(1/36),x)
```

$$4x^3 - \frac{13}{18}x + 1 \tag{7}$$

```
> subs(x=1/3,diff(x^4-((13*x^2)/36)+x+(1/36),x))
```

$$\frac{49}{54} \tag{8}$$

```
> subs(x=-1/2,diff(x^4-((13*x^2)/36)+x+(1/36),x))
```

$$\frac{31}{36} \tag{9}$$

```
> subs(x=1/2,diff(x^4-((13*x^2)/36)+x+(1/36),x))
```

$$\frac{41}{36} \tag{10}$$

```
> subs(x=-1/3,diff(x^4-((13*x^2)/36)+x+(1/36),x))
```

$$\frac{59}{54} \tag{11}$$

```
> #1/3 & -1/2 are stable fixed points, 1/2 & -1/3 are not
> #Number 2
> #i.
  f:=sqrt(x+4*y)
```

$$f := \sqrt{x + 4y} \tag{12}$$

```
> diff(f,x)
```

(13)

$$\frac{1}{2\sqrt{x+4y}} \quad (13)$$

```
> A:=subs([x=1,y=2],diff(f,x))
```

$$A := \frac{\sqrt{9}}{18} \quad (14)$$

```
> diff(f,y)
```

$$\frac{2}{\sqrt{x+4y}} \quad (15)$$

```
> B:=subs([x=1,y=2],diff(f,y))
```

$$B := \frac{2\sqrt{9}}{9} \quad (16)$$

```
> subs([x=1,y=2],f)
```

$$\sqrt{9} \quad (17)$$

```
> L:=evalf(sqrt(9)+A*(x-1)+B*(y-2))
```

$$L := 1.500000000 + 0.1666666667\,x + 0.6666666666\,y \quad (18)$$

```
> subs([x=.95,y=1.02],evalf(sqrt(9)+(1/6)*(x-1)+(1/3)*(y-2)));
  subs([x=.95,y=1.02],sqrt(x+4*y));
```

$$2.665000000$$

$$2.242766149 \quad (19)$$

```
> #ii.
  f:=x^3*y^4*z^5
```

$$f := x^3\,y^4\,z^5 \quad (20)$$

```
> diff(f,x)
```

$$3\,x^2\,y^4\,z^5 \quad (21)$$

```
> A:=subs([x=1,y=1,z=1],diff(f,x))
```

$$A := 3 \quad (22)$$

```
> diff(f,y)
```

$$4\,x^3\,y^3\,z^5 \quad (23)$$

```
> B:=subs([x=1,y=1,z=1],diff(f,y))
```

$$B := 4 \quad (24)$$

```
> diff(f,z)
```

$$5\,x^3\,y^4\,z^4 \quad (25)$$

```
> C:=subs([x=1,y=1,z=1],diff(f,z))
```

$$C := 5 \quad (26)$$

```
> evalf(subs([x=1,y=1,z=1],f))
```

$$1. \quad (27)$$

```
> L:=evalf(1+A*(x-1)+B*(y-1)+C*(z-1))
```

$$L := -11. + 3.\,x + 4.\,y + 5.\,z \quad (28)$$

```
> subs([x=1.01,y=1.02,z=.99],L)
```

$$1.06 \quad (29)$$

```
> subs([x=1.01,y=1.02,z=.99],f)
```

$$1.060573524 \quad (30)$$

```
> #iii.
> f:=sqrt(x1+x2+x3+x4)
```

$$f := \sqrt{x1 + x2 + x3 + x4} \tag{31}$$

```
> diff(f,x1)
```

$$\frac{1}{2\sqrt{x1 + x2 + x3 + x4}} \tag{32}$$

```
> A:=subs([x1=1,x2=1,x3=1,x4=1],diff(f,x1))
```

$$A := \frac{\sqrt{4}}{8} \tag{33}$$

```
> diff(f,x2)
```

$$\frac{1}{2\sqrt{x1 + x2 + x3 + x4}} \tag{34}$$

```
> B:=subs([x1=1,x2=1,x3=1,x4=1],diff(f,x2))
```

$$B := \frac{\sqrt{4}}{8} \tag{35}$$

```
> diff(f,x3)
```

$$\frac{1}{2\sqrt{x1 + x2 + x3 + x4}} \tag{36}$$

```
> C:=subs([x1=1,x2=1,x3=1,x4=1],diff(f,x3))
```

$$C := \frac{\sqrt{4}}{8} \tag{37}$$

```
> diff(f,x4)
```

$$\frac{1}{2\sqrt{x1 + x2 + x3 + x4}} \tag{38}$$

```
> E:=subs([x1=1,x2=1,x3=1,x4=1],diff(f,x4))
```

$$E := \frac{\sqrt{4}}{8} \tag{39}$$

```
> evalf(subs([x1=1,x2=1,x3=1,x4=1],f))
```

$$2.000000000 \tag{40}$$

```
> L:=evalf(2+A*(x1-1)+B*(x2-1)+C*(x3-1)+E*(x4-1))
```

$$L := 1.000000000 + 0.2500000000\,x1 + 0.2500000000\,x2 + 0.2500000000\,x3 + 0.2500000000\,x4 \tag{41}$$

```
> subs([x1=1.01,x2=1.01,x3=.99,x4=.99],L)
```

$$2.000000000 \tag{42}$$

```
> subs([x1=1.01,x2=1.01,x3=.99,x4=.99],f)
```

$$2.000000000 \tag{43}$$

```
> #Number 3
> f:=x/(y+1)
```

$$f := \frac{x}{y + 1} \tag{44}$$

```
> g:=y/(x+1)
```

$$g := \frac{y}{x+1} \quad (45)$$

```
> diff(f,x)
```

$$\frac{1}{y+1} \quad (46)$$

```
> diff(f,y)
```

$$-\frac{x}{(y+1)^2} \quad (47)$$

```
> diff(g,x)
```

$$-\frac{y}{(x+1)^2} \quad (48)$$

```
> diff(g,y)
```

$$\frac{1}{x+1} \quad (49)$$

```
> A:=subs(y=1,diff(f,x))
```

$$A := \frac{1}{2} \quad (50)$$

```
> B:=subs([x=1,y=1],diff(f,y))
```

$$B := -\frac{1}{4} \quad (51)$$

```
> C:=subs([x=1,y=1],diff(g,x))
```

$$C := -\frac{1}{4} \quad (52)$$

```
> E:=subs(x=1,diff(g,y))
```

$$E := \frac{1}{2} \quad (53)$$

```
> J:=Matrix([[A,B],[C,E]])
```

$$J := \begin{bmatrix} \frac{1}{2} & -\frac{1}{4} \\ -\frac{1}{4} & \frac{1}{2} \end{bmatrix} \quad (54)$$

```
> #Number 4
  f:=x+y+z
```

$$f := x + y + z \quad (55)$$

```
> g:=x^2+y^2+z^2
```

$$g := x^2 + y^2 + z^2 \quad (56)$$

```
> h:=x^3+y^3+z^3
```

$$h := x^3 + y^3 + z^3 \quad (57)$$

```
> diff(f,x)
```

$$1 \quad (58)$$

```
> diff(f,y)
```

$$1 \quad (59)$$

```
> diff(f,z)
```

$$1 \quad (60)$$

```
> diff(g,x)
```

$$2\,x \quad (61)$$

```
> diff(g,y)
```

$$2\,y \quad (62)$$

```
> diff(g,z)
```

$$2\,z \quad (63)$$

```
> diff(h,x)
```

$$3\,x^2 \quad (64)$$

```
> diff(h,y)
```

$$3\,y^2 \quad (65)$$

```
> diff(h,z)
```

$$3\,z^2 \quad (66)$$

```
> J:=Matrix([[1,1,1],[2,2,2],[3,3,3]])
```

$$J := \begin{bmatrix} 1 & 1 & 1 \\ 2 & 2 & 2 \\ 3 & 3 & 3 \end{bmatrix} \quad (67)$$

```
> #Number 5
  #This reasoning makes sense as several iterations with eigenvalues
  less than 1 indicate that the system does not grow uncontrollably.
  The system will actually instead get closer and closer to this
  stable fixed point. As long as you start at a point around the
  stable fixed point, that is where you will reach.
```