1 `restart;maple_mode(1);cas_setup(0,0,0,1,0,1e-10,10,[1,50,0,25],0,0,0);`
`#radians,pas de cmplx, pas de Sqrt`

$$[], \text{Warning: some commands like subs might change arguments order}, 0, 0, 0, 1, 0, 0.000000, 10, [1, 50, 0, 25], 0, 0 \quad (1)$$

2 ——————-*Polynome caracteristique et mineurs diagonaux*——————————————————————————

3 `n:=5; In:={seq(i,i=1..n)}; In minus {2,4};`

$$5, \{1,2,3,4,5\}, \{1,3,5\} \quad (2)$$

4
```
extr:=proc(A,II,JJ)
matrix([seq([seq(A[i,j],j=JJ)],i=II)]);
end_proc;
```
// Warning: i j declared as global variable(s)
// End defining extr

$$\text{expr}\left(\text{proc(A,II,JJ)matrix(seq([seq(A[i,j],j=JJ)],i=II));end;}, 1\right) \quad (3)$$

5 *Attention, diff(f,x,y) derive en x puis y, alors que diff(f,[x,y]) donne la liste des derive en x et en y.*

6 `diff(x*y,x,y);diff(x*y,[x,y]);`

$$1, [y, x] \quad (4)$$

7 `purge(a,x);`

$$\text{No such variable a}, \text{No such variable x} \quad (5)$$

8 `n:=5;A:=matrix(n,n,(i,j)->a[i,j]);`
// Warning: a declared as global variable(s)

$$5, \begin{pmatrix} a[1,1] & a[1,2] & a[1,3] & a[1,4] & a[1,5] \\ a[2,1] & a[2,2] & a[2,3] & a[2,4] & a[2,5] \\ a[3,1] & a[3,2] & a[3,3] & a[3,4] & a[3,5] \\ a[4,1] & a[4,2] & a[4,3] & a[4,4] & a[4,5] \\ a[5,1] & a[5,2] & a[5,3] & a[5,4] & a[5,5] \end{pmatrix} \quad (6)$$

9 `d:=diag(seq(x[i],i=1..n));`

$$\begin{pmatrix} x[1] & 0 & 0 & 0 & 0 \\ 0 & x[2] & 0 & 0 & 0 \\ 0 & 0 & x[3] & 0 & 0 \\ 0 & 0 & 0 & x[4] & 0 \\ 0 & 0 & 0 & 0 & x[5] \end{pmatrix} \quad (7)$$

10 `II:=In minus {1,3};# on essaye (i,j)=(1,3)`

$$\{2,4,5\} \quad (8)$$

11 `extr(A,II,II);`

$$\begin{pmatrix} a[2,2] & a[2,4] & a[2,5] \\ a[4,2] & a[4,4] & a[4,5] \\ a[5,2] & a[5,4] & a[5,5] \end{pmatrix} \quad (9)$$

12 `dij:=diff(det(A-d),x[1],x[3]);`

$$a[2,2]a[4,4]a[5,5]-(a[2,2]a[4,4]x[5])-(a[2,2]a[4,5]a[5,4])-(a[2,2]a[5,5]x[4])+a[2,2]x[4]x[5]-(a[2,4]a[4,2]a[5,5 \quad (10)$$

13 `normal(det( extr(A,II,II)) - subs(x=[0,0,0,0,0],dij));`

$$0 \quad (11)$$

14 `II:=In minus {2,3};# on essaye (i,j)=(2,3)`

$$\{1,4,5\} \quad (12)$$

15 `extr(A,II,II);`

$$\begin{pmatrix} a[1,1] & a[1,4] & a[1,5] \\ a[4,1] & a[4,4] & a[4,5] \\ a[5,1] & a[5,4] & a[5,5] \end{pmatrix} \quad (13)$$

16 `dij:=diff(det(A-d),x[2],x[3]);`

$$a[1,1]a[4,4]a[5,5]-(a[1,1]a[4,4]x[5])-(a[1,1]a[4,5]a[5,4])-(a[1,1]a[5,5]x[4])+a[1,1]x[4]x[5]-(a[1,4]a[4,1]a[5,5 \quad (14)$$

17 `normal(det( extr(A,II,II)) - subs(x=[0,0,0,0,0],dij));`

$$0 \quad (15)$$

18 `II:=In minus {4,5};# on essaye (i,j)=(4,5)`

$$\{1,2,3\} \quad (16)$$

19 `extr(A,II,II);`

$$\begin{pmatrix} a[1,1] & a[1,2] & a[1,3] \\ a[2,1] & a[2,2] & a[2,3] \\ a[3,1] & a[3,2] & a[3,3] \end{pmatrix} \quad (17)$$

20 `dij:=diff(det(A-d),x[4],x[5]);`

$$a[1,1]a[2,2]a[3,3]-(a[1,1]a[2,2]x[3])-(a[1,1]a[2,3]a[3,2])-(a[1,1]a[3,3]x[2])+a[1,1]x[2]x[3]-(a[1,2]a[2,1]a[3,3 \quad (18)$$

21 `normal(det( extr(A,II,II)) - subs(x=[0,0,0,0,0],dij));`

$$0 \tag{19}$$

22 `B:=A-x*identity(n);`

$$\begin{pmatrix} a[1,1]-x & a[1,2] & a[1,3] & a[1,4] & a[1,5] \\ a[2,1] & a[2,2]-x & a[2,3] & a[2,4] & a[2,5] \\ a[3,1] & a[3,2] & a[3,3]-x & a[3,4] & a[3,5] \\ a[4,1] & a[4,2] & a[4,3] & a[4,4]-x & a[4,5] \\ a[5,1] & a[5,2] & a[5,3] & a[5,4] & a[5,5]-x \end{pmatrix} \tag{20}$$

23 `d:=seq(normal(subs(x=0,diff(det(B),x,i))/i!),i=n..1);`

$$-1, a[1,1]+a[2,2]+a[3,3]+a[4,4]+a[5,5], -(a[1,1]a[2,2])-(a[1,1]a[3,3])-(a[1,1]a[4,4])-(a[1,1]a[5,5])+a[1,2] \tag{21}$$

24 `P:=charpoly(A);`

Done

25

26

```
monpolyfaddeev:=proc(A)
local a,n,B,P;
n:=dim(A)[1];a:=1:B:=identity(n);P:=[a];
for i from n-1 to 0 by -1 do
B:=normal(B*A);
a:=trace(B)/(i-n);
P:=[op(P),a];B:=B+a*identity(n) od;
P;
end proc:
```

// Warning: i declared as global variable(s)
// End defining monpolyfaddeev

$$\text{Done} \tag{22}$$

27 `n:=30;A:=matrix(n,n,(i,j)->rand(21)-10):`
// Success

$$30, \text{Done} \tag{23}$$

28 `normal(poly2symb(monpolyfaddeev(A),x));`

$$x^{30}+-7x^{29}+-387x^{28}+-8113x^{27}+360369x^{26}+-1130723x^{25}+-8725679x^{24}+4428175555x^{23}+23222948659x^{22}+ \tag{24}$$

29 `charpoly(A)-monpolyfaddeev(A);`

$$0 \tag{25}$$

30 `time(monpolyfaddeev(A));`

$$0.260000 \tag{26}$$

31 `time(charpoly(A));`

$$0.085000 \tag{27}$$

32 `coeff(3*x^4+2*x^3+y^3,x,3);`

$$2 \tag{28}$$

33 `A:=matrix(3,4,2);matrix(op(dim(A)));`

$$\begin{pmatrix} 2 & 2 & 2 & 2 \\ 2 & 2 & 2 & 2 \\ 2 & 2 & 2 & 2 \end{pmatrix}, \begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} \tag{29}$$

34

35

```
cf:=proc(P,k)
local i,j;
matrix(op(dim(P)),(i,j)->coeff(P[i,j],x,k));
end_proc;
```

// Warning: P x k declared as global variable(s)
// Warning: x declared as global variable(s)
// End defining cf

expr (proc(P,k)local i,j;matrix(op(dim(P)), (i,j)->coeff(P[i,j],x,k));end;, 1) (30)

36 `P:=matrix(3,3,(i,j)->add(rand(7)*x^l,l=0..4));`
// Warning: x l declared as global variable(s)

$$\begin{pmatrix} 5+3x+x^3+5x^4 & 2+6x+6x^2+2x^3+2x^4 & 5+6x+5x^2+x^3+x^4 \\ 3+2x^2+3x^3+6x^4 & 3+4x+x^2+x^3+3x^4 & 6+5x+2x^2+x^3+3x^4 \\ 6+5x+2x^2+4x^3+4x^4 & 6x+5x^2+x^3+2x^4 & 6+5x^2+3x^3+2x^4 \end{pmatrix} \tag{31}$$

37 `A:=matrix(3,3,(i,j)->a[i,j]);`
// Warning: a declared as global variable(s)

$$\begin{pmatrix} a[1,1] & a[1,2] & a[1,3] \\ a[2,1] & a[2,2] & a[2,3] \\ a[3,1] & a[3,2] & a[3,3] \end{pmatrix} \tag{32}$$

38 `cf(P,4);`

$$\begin{pmatrix} 5 & 2 & 1 \\ 6 & 3 & 3 \\ 4 & 2 & 2 \end{pmatrix} \tag{33}$$

39 `R:=P;k:=4;Q:=0;`

$$\begin{pmatrix} 5+3x+x^3+5x^4 & 2+6x+6x^2+2x^3+2x^4 & 5+6x+5x^2+x^3+x^4 \\ 3+2x^2+3x^3+6x^4 & 3+4x+x^2+x^3+3x^4 & 6+5x+2x^2+x^3+3x^4 \\ 6+5x+2x^2+4x^3+4x^4 & 6x+5x^2+x^3+2x^4 & 6+5x^2+3x^3+2x^4 \end{pmatrix}, 4, 0 \tag{34}$$

40 `R:=normal(R-cf(R,k)*x^(k-1)*(x*identity(3)-A));Q:=cf(R,k)*x^(k-1)+Q:k:=k-1;`

$$\left(\begin{matrix} 5x^3a[1,1]+2x^3a[2,1]+x^3a[3,1]+x^3+3x+5 & 5x^3a[1,2]+2x^3a[2,2]+x^3a[3,2]+2x^3+6x^2+6x \\ 6x^3a[1,1]+3x^3a[2,1]+3x^3a[3,1]+3x^3+2x^2+3 & 6x^3a[1,2]+3x^3a[2,2]+3x^3a[3,2]+x^3+x^2+4x \\ 4x^3a[1,1]+2x^3a[2,1]+2x^3a[3,1]+4x^3+2x^2+5x+6 & 4x^3a[1,2]+2x^3a[2,2]+2x^3a[3,2]+x^3+5x^2+ \end{matrix} \right. \tag{35}$$

41 `R:=normal(R-cf(R,k)*x^(k-1)*(x*identity(3)-A));Q:=cf(R,k)*x^(k-1)+Q:k:=k-1;`

$$\left(\begin{matrix} 5x^2\left(a[1,1]\right)^2+2x^2a[1,1]a[2,1]+x^2a[1,1]a[3,1]+x^2a[1,1]+5x^2a[1,2]a[2,1]+5x^2a[1,3]a[3,1]+2x^2a \\ 6x^2\left(a[1,1]\right)^2+3x^2a[1,1]a[2,1]+3x^2a[1,1]a[3,1]+3x^2a[1,1]+6x^2a[1,2]a[2,1]+6x^2a[1,3]a[3,1]+3x^2a \\ 4x^2\left(a[1,1]\right)^2+2x^2a[1,1]a[2,1]+2x^2a[1,1]a[3,1]+4x^2a[1,1]+4x^2a[1,2]a[2,1]+4x^2a[1,3]a[3,1]+2x^2a[2, \end{matrix} \right. \tag{36}$$

42 `R:=normal(R-cf(R,k)*x^(k-1)*(x*identity(3)-A));Q:=cf(R,k)*x^(k-1)+Q:k:=k-1;`

$$\left(\begin{matrix} 5x\left(a[1,1]\right)^3+2x\left(a[1,1]\right)^2a[2,1]+x\left(a[1,1]\right)^2a[3,1]+x\left(a[1,1]\right)^2+10xa[1,1]a[1,2]a[2,1]+10xa \\ 6x\left(a[1,1]\right)^3+3x\left(a[1,1]\right)^2a[2,1]+3x\left(a[1,1]\right)^2a[3,1]+3x\left(a[1,1]\right)^2+12xa[1,1]a[1,2]a[2,1]+12xa[1,1]a \\ 4x\left(a[1,1]\right)^3+2x\left(a[1,1]\right)^2a[2,1]+2x\left(a[1,1]\right)^2a[3,1]+4x\left(a[1,1]\right)^2+8xa[1,1]a[1,2]a[2,1]+8xa[1,1]a[1,3]a \end{matrix} \right. \tag{37}$$

43 `R:=normal(R-cf(R,k)*x^(k-1)*(x*identity(3)-A));Q:=cf(R,k)*x^(k-1)+Q:k:=k-1;`

Done

44 `R2:=add(cf(P,i)*A^i,i=0..4);`

Done

45 `normal(R2-R);`

$$\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \tag{38}$$

$\boxed{46}$