1(a)

```
> int(sin(x)^4*cos(x)^2,x);
```

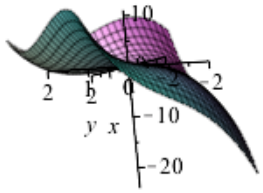
$$-\frac{1}{6}\sin(x)^3\cos(x)^3-\frac{1}{8}\sin(x)\cos(x)^3+\frac{1}{16}\cos(x)\sin(x)+\frac{1}{16}x \qquad (1.1)$$

1(b)

```
> f:=unapply(x^3+y^3-2*x*y,(x,y));
```

$$f:=(x,y)\rightarrow x^3+y^3-2xy \qquad (2.1)$$

```
> plot3d(f(x,y),x=-2..2,y=-2..2);
```




```
> solve([diff(f(x,y),x)=0,diff(f(x,y),y)=0],{x,y});
```

$$\{x=0,y=0\},\left\{x=\frac{2}{3},y=\frac{2}{3}\right\},\left\{x=\frac{2}{3}\,RootOf\left(\_Z^2+\_Z+1\right),y=-\frac{2}{3}-\frac{2}{3}\,RootOf\left(\_Z^2+\_Z+1\right)\right\} \qquad (2.2)$$

```
> fxx:=unapply(diff(f(x,y),x,x),(x,y));
  fyy:=unapply(diff(f(x,y),y,y),(x,y));
  fxy:=unapply(diff(f(x,y),x,y),(x,y));
```

$$fxx:=(x,y)\rightarrow 6x$$
$$fyy:=(x,y)\rightarrow 6y$$
$$fxy:=(x,y)\rightarrow -2 \qquad (2.3)$$

```
> x0:=0;
  y0:=0;
  fxy(x0,y0)^2-fxx(x0,y0)*fyy(x0,y0);
```

$$x0:=0$$
$$y0:=0$$
$$4 \qquad (2.1.1)$$

Dが正なので極値でない．

```
> x0:=2/3;
  y0:=2/3;
  fxy(x0,y0)^2-fxx(x0,y0)*fyy(x0,y0);
```

$$x0:=\frac{2}{3}$$
$$y0:=\frac{2}{3}$$
$$-12 \qquad (2.2.1)$$

```
> fxx(x0,y0);
```

$$4 \qquad (2.2.2)$$

Dが負，fxxが正なので極小値．plot3dも参照せよ．

2(a)

```
> with(LinearAlgebra):
> A:=Matrix([[1,-1,0],[-1,2,1],[0,1,1]]);
```

$$A:=\begin{bmatrix}1&-1&0\\-1&2&1\\0&1&1\end{bmatrix} \qquad (3.1)$$

```
> l,V:=Eigenvectors(A);
```

$$l,V:=\begin{bmatrix}0\\3\\1\end{bmatrix},\begin{bmatrix}-1&-1&1\\-1&2&0\\1&1&1\end{bmatrix} \qquad (3.2)$$

```
> v1:=Column(V,1);
  v2:=Column(V,2);
  v3:=Column(V,3);
```

$$v1:=\begin{bmatrix}-1\\-1\\1\end{bmatrix}$$
$$v2:=\begin{bmatrix}-1\\2\\1\end{bmatrix}$$
$$v3:=\begin{bmatrix}1\\0\\1\end{bmatrix} \qquad (3.3)$$

```
> v1.v2;
  v1.v3;
  v3.v2;
```

$$\begin{matrix} 0 \\ 0 \\ 0 \end{matrix} \tag{3.4}$$

2(b)

```
> restart;
  with(LinearAlgebra):
  A:=Matrix([[1,2,3,2,2],
  [-1,-2,-3,-2,-2],[-1,-1,-3,-2,-1],
  [2,4,6,2,2]]);
```

$$A := \begin{bmatrix} 1 & 2 & 3 & 2 & 2 \\ -1 & -2 & -3 & -2 & -2 \\ -1 & -1 & -3 & -2 & -1 \\ 2 & 4 & 6 & 2 & 2 \end{bmatrix} \tag{4.1}$$

```
> LUDecomposition(A,output='R');
```

$$\begin{bmatrix} 1 & 0 & 3 & 0 & -2 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \tag{4.2}$$

以下のようにして方程式系や係数行列が作られる.

```
> e1:=GenerateEquations(A,[x,y,z,u]);
```

$$e1 := [x + 2y + 3z + 2u = 2,\ -x - 2y - 3z - 2u = -2,\ -x - y - 3z - 2u = -1,\ 2x + 4y + 6z + 2u = 2] \tag{4.1.1}$$

```
> solve(GenerateEquations(A,[x,y,z,u]),[x,y,z,u]);
```

$$[[x = -2 - 3z,\ y = 1,\ z = z,\ u = 1]] \tag{4.1.2}$$

```
> GenerateMatrix(e1,[x,y,z,u]);
```

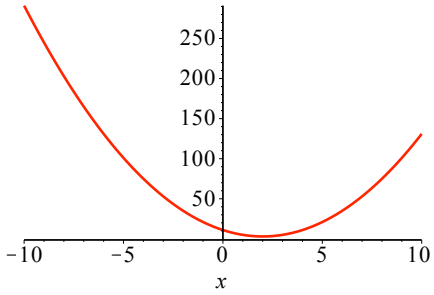
$$\begin{bmatrix} 1 & 2 & 3 & 2 \\ -1 & -2 & -3 & -2 \\ -1 & -1 & -3 & -2 \\ 2 & 4 & 6 & 2 \end{bmatrix}, \begin{bmatrix} 2 \\ -2 \\ -1 \\ 2 \end{bmatrix} \tag{4.1.3}$$

3 & 4

```
> restart;
  f:=unapply(2*x^2-4*(a+1)*x+10*a+1,(x,a));
```

$$f := (x, a) \rightarrow 2x^2 - 4(a+1)x + 10a + 1 \tag{5.1}$$

```
> plot(f(x,1),x);
```




```
> x0:=solve(diff(f(x,a),x)=0,x);
```

$$x0 := a + 1 \tag{5.2}$$

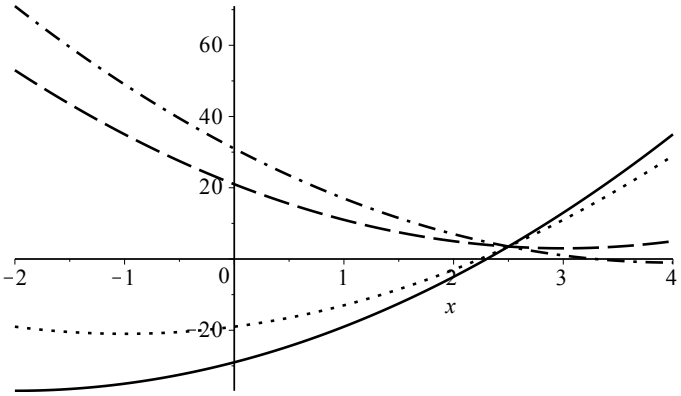
```
> eq1:=expand(f(x0,a));
```

$$eq1 := -2a^2 + 6a - 1 \tag{5.3}$$

```
> solve(eq1=0,a);
```

$$\frac{3}{2} - \frac{1}{2}\sqrt{7},\ \frac{3}{2} + \frac{1}{2}\sqrt{7} \tag{5.4}$$

```
> ?plot[options];
> plot([f(x,-3),f(x,-2),f(x,2),f(x,3)],x=-2..4,linestyle=[solid,dot,dash,dashdot],
  color=black);
```




```
> f(-1,a);
```

$$7 + 14a \tag{5.5}$$

```
> f(3,a);
```

$$7 - 2a \tag{5.6}$$

```
> solve(eq1=7/9,a);
```

$$\frac{1}{3},\ \frac{8}{3} \tag{5.7}$$

```
> solve(f(3,a)=7/9,a);
```

$$\frac{28}{9} \tag{5.8}$$