Table of Contents

微積分

微分

In [1]:
```
from sympy import *
init_printing()
```

In [2]:
```
x = symbols('x',positive = True)
# x = symbols('x')

y = asin((x**2-1)/(x**2+1))
y
```

Out[2]:
$$\operatorname{asin}\left(\frac{x^2-1}{x^2+1}\right)$$

In [3]:
```
dy = diff(y,x)
dy
```

Out[3]:
$$\frac{-\frac{2x\left(x^2-1\right)}{\left(x^2+1\right)^2}+\frac{2x}{x^2+1}}{\sqrt{-\frac{\left(x^2-1\right)^2}{\left(x^2+1\right)^2}+1}}$$

In [4]:
```
simplify(dy)
```

Out[4]:
$$\frac{2}{x^2+1}$$

2重積分

In [10]:
```
x,y = symbols('x,y')

f = sqrt(x**2+4*y**2)
f
```

Out[10]:
$$\sqrt{x^2+4y^2}$$

In [11]:
```
dx = integrate(f,(y,0,x))
dx
```

Out[11]:
$$\frac{x^2}{4}\operatorname{asinh}(2)+\frac{\sqrt{5}x^2}{2}$$

In [12]:
```
integrate(dx,(x,0,1))
```

Out[12]:
$$\frac{1}{12}\operatorname{asinh}(2)+\frac{\sqrt{5}}{6}$$

線形代数

写像のIm, Ker

これ以降init_printing()していますが，Kernel->restartも忘れずに実行してください．

In [14]:
```
from sympy import *
init_printing()
A = Matrix([[1,1,3,3],[0,1,1,2],[1,0,2,1]])
A
```

Out[14]:
$$\begin{bmatrix}1 & 1 & 3 & 3\\0 & 1 & 1 & 2\\1 & 0 & 2 & 1\end{bmatrix}$$

In [15]:
```
A.nullspace()
```
Out[15]:
$$\left[\begin{bmatrix} -2 \\ -1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} -1 \\ -2 \\ 0 \\ 1 \end{bmatrix} \right]$$

In [16]:
```
A.columnspace()
```
Out[16]:
$$\left[\begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix} \right]$$

In [17]:
```
A.rref()
```
Out[17]:
$$\left(\begin{bmatrix} 1 & 0 & 2 & 1 \\ 0 & 1 & 1 & 2 \\ 0 & 0 & 0 & 0 \end{bmatrix}, [0, 1] \right)$$

行列の対角化

In [18]:
```
from sympy import *
init_printing()
A = Matrix([[1/2,0,1/2],[0,1/2,1/2],[1/2,1/2,0]])
A
```
Out[18]:
$$\begin{bmatrix} 0.5 & 0 & 0.5 \\ 0 & 0.5 & 0.5 \\ 0.5 & 0.5 & 0 \end{bmatrix}$$

In [19]:
```
P,D = A.diagonalize()
```

In [20]:
```
P.inv()*A*P
```
Out[20]:
$$\begin{bmatrix} -0.5 & 0 & -5.55111512312578 \cdot 10^{-17} \\ 0 & 0.5 & 0 \\ 0 & 0 & 1.0 \end{bmatrix}$$

数式変形

(1-a) センター試験オリジナル

In [21]:
```
%matplotlib inline
from sympy import *
init_printing()

a,x,t = symbols('a,x,t')
```

In [22]:
```
y_1 = x**2+1
y_1 #放物線Cの関数
```
Out[22]: $x^2 + 1$

In [23]:
```
l_a = 2*x
l_a #Pの軌跡
```
Out[23]: $2x$

In [24]:
```
m = diff(y_1,x)
m
```
Out[24]: $2x$

In [25]:
```
x0 = t
y0 = y_1.subs({x:x0})
l0 = m.subs({x:t})*(x-x0)+y0
expand(l0) #アイ, 接線の方程式
```
Out[25]: $-t^2 + 2tx + 1$

In [26]:
```
eq1 = -(l0.subs({x:a})-l_a.subs({x:a}))
expand(eq1) #ウエオ, tの方程式
```
Out[26]: $-2at + 2a + t^2 - 1$

In [27]:
```
s1 = solve(eq1,t)
s1 #カキク, tの値
```
Out[27]: $[1, 2a - 1]$

In [28]:
```
l_1 = collect(expand(l0.subs({t:s1[1]})),x)
l_1
```
Out[28]: $-4a^2 + 4a + x(4a - 2)$

In [29]:
```
l_0 = l0.subs({t:s1[0]})
l_0 #
```
Out[29]: $2x$

(1-b)

In [39]:
```
%matplotlib inline
from sympy import *
init_printing()
```

In [40]:
```
a,x,t = symbols('a,x,t')
```

In [41]:
```
y_1 = x**2+2
y_1
```
Out[41]: $x^2 + 2$

In [42]:
```
l_a = sqrt(8)*x
l_a
```
Out[42]: $2\sqrt{2}x$

In [43]:
```
m = diff(y_1,x)
m
```
Out[43]: $2x$

In [44]:
```
x0 = t
y0 = y_1.subs({x:x0})
l0 = m.subs({x:t})*(x-x0)+y0
expand(l0) #アイ, 接線の方程式
```
Out[44]: $-t^2 + 2tx + 2$

In [45]:
```
eq1 = -(l0.subs({x:a})-l_a.subs({x:a}))
expand(eq1) #ウエオ, tの方程式
```
Out[45]: $-2at + 2\sqrt{2}a + t^2 - 2$

In [46]:
```
s1 = solve(eq1,t)
s1 #カキク, tの値
```
Out[46]: $\left[a - \sqrt{a^2 - 2\sqrt{2}a + 2},\quad a + \sqrt{a^2 - 2\sqrt{2}a + 2}\right]$

3-(a) 以降のpythonによる導出

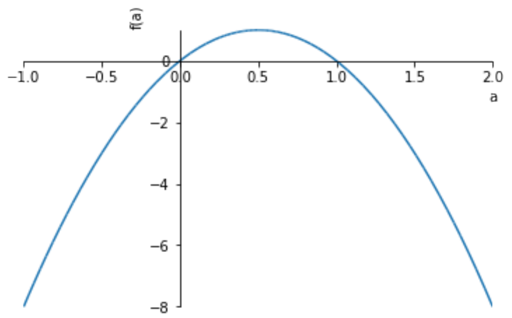
順番が前後しているので，入力の順序を間違えないように．ここは3-(a)からの続きになる．

In [30]:
```
# l1 = -4*a**2+4*a+x*(4*a-2)

rr = l_1.subs({x:0})
rr #シス
```
Out[30]: $-4a^2 + 4a$

In [31]:
```
%matplotlib inline

plot(rr,(a,-1,2))
```

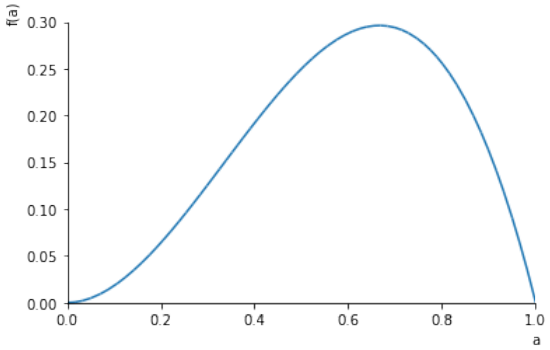


Out[31]: <sympy.plotting.plot.Plot at 0x11885a710>

In [32]:
```
S = simplify(a*rr/2)
S #チツテ
```
Out[32]: $2a^2(-a + 1)$

In [33]:
```
%matplotlib inline

plot(S,(a,0,1))
```



Out[33]: <sympy.plotting.plot.Plot at 0x119840b00>

In [34]:
```
s2 = solve(diff(S,a),a)
s2
```

Out[34]: $\left[0, \quad \frac{2}{3}\right]$

In [35]:
```
s2[1] # ト, ナ
```

Out[35]: $\frac{2}{3}$

In [36]:
```
S.subs({a:s2[1]}) # ニヌネ
```

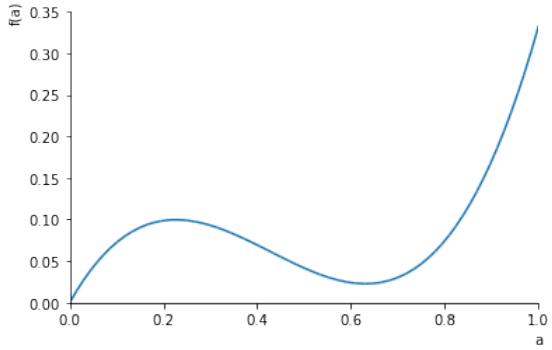
Out[36]: $\frac{8}{27}$

In [37]:
```
T = expand(integrate(y_1-l_1,(x,0,a)))
T # ノハヒフ
```

Out[37]: $\frac{7a^3}{3} - 3a^2 + a$

In [38]:
```
%matplotlib inline

plot(T,(a,0,1))
```



Out[38]: <sympy.plotting.plot.Plot at 0x1197a3e10>

In [ ]:
```

```