In [3]:
```
x=var('x')
y=function('y')(x)
deq=x*diff(y,x,2)-(x+1)*diff(y,x)-2*(x-1)*y==0
y1 =function('y1')(x)
y1(x)=exp(2*x)
ans=x*diff(y1,x,2)-(x+1)*diff(y1,x)-2*(x-1)*y1==0
ans(x)
```

Out[3]:
```
-2*(x + 1)*e^(2*x) - 2*(x - 1)*e^(2*x) + 4*x*e^(2*x) == 0
```

In [4]:
```
expand(ans(x))
```

Out[4]:
```
0 == 0
```

In [5]:
```
y2 =function('y2')(x)
y2(x)= x^2 + 1
ans=x*diff(y2,x,2)-(x+1)*diff(y2,x)-2*(x-1)*y2==0
ans(x)
```

Out[5]:
```
-2*(x^2 + 1)*(x - 1) - 2*(x + 1)*x + 2*x == 0
```

In [6]:
```
expand(ans(x))
```

Out[6]:
```
-2*x^3 - 2*x + 2 == 0
```

In [7]:
```
x=var('x')
y=function('y')(x)
deq=diff(y,x,2)-tan(x)*diff(y,x)+2*y==0
y1 =function('y1')(x)
y1(x)=cos(x)
ans=diff(y1,x,2)-tan(x)*diff(y1,x)+2*y1==0
ans(x)
```

Out[7]:
```
sin(x)*tan(x) + cos(x) == 0
```

In [16]:
```
expand(ans(x))
ans.simplify_full()
```

Out[16]:
```
0 == 0
```

In [ ]:
```

```

In [14]:
```
y2 =function('y2')(x)
y2(x)=sin(x)
ans=diff(y2,x,2)-tan(x)*diff(y2,x)+2*y2==0
expand(ans(x))
```

Out[14]:
```
-cos(x)*tan(x) + sin(x) == 0
```

In [15]:
```
ans.simplify_full()
```

Out[15]:
```
0 == 0
```

In [17]:
```
def L(y):
 a(x)=x^3*diff(y,x,3)-3*x^2*diff(y,x,2)+6*x*diff(y,x)-6*y
 return a(x)
```

In [18]:
```
y1 = x
L(y1).simplify_full()
```

Out[18]: 0

In [19]:
```
y2 = x^2
L(y2).simplify_full()
```

Out[19]: 0

In [20]:
```
reset()
x=var('x')
y=function('y')(x)
deq=x*diff(y,x,2)-(2*x+1)*diff(y,x)+2*y==0
a = var('a')
u=function('u')(x)
u(x)=exp(a*x)
def L(y):
    a(x)=expand(x*diff(y,x,2)-(2*x+1)*diff(y,x)+2*y)
    return a(x)
L(u)
```

Out[20]: a^2*x*e^(a*x) - 2*a*x*e^(a*x) - a*e^(a*x) + 2*e^(a*x)

In [21]:
```
L(u).simplify_full()
```

Out[21]: ((a^2 - 2*a)*x - a + 2)*e^(a*x)

In [22]:
```
ans=L(u)/exp(a*x)
ans
```

Out[22]: (a^2*x*e^(a*x) - 2*a*x*e^(a*x) - a*e^(a*x) + 2*e^(a*x))*e^(-a*x)

In [23]:
```
ans.log_simplify()
```

Out[23]: (a^2 - 2*a)*x - a + 2

In [24]:
```
ans = ans.log_simplify()
coeff = ans.coefficients(x)
coeff
```

Out[24]: [[-a + 2, 0], [a^2 - 2*a, 1]]

In [25]:
```
c0=coeff[0][0]
c1=coeff[1][0]
solve([c0==0],a)
```

Out[25]: [a == 2]

In [27]:
```
solve([c1==0],a)
```

Out[27]:
```
[a == 0, a == 2]
```

In [28]:
```
u =function('u')(x)
u(x)=exp(2*x)
L(u)
```

Out[28]:
```
0
```

In [29]:
```
reset()
x=var('x')
y=function('y')(x)
a = var('a')
b = var('b')
u=function('u')(x)
u(x)=a*x+b
def L(y):
    a(x) = expand(diff(y,x,2)+diff(y,x)-y/x)
    return a(x)
L(u)
```

Out[29]:
```
-b/x
```

In [30]:
```
ans=L(u)
ans.coefficients(x)
```

Out[30]:
```
[[-b, -1]]
```

In [35]:
```
coeff = ans.coefficients(x)
c0=coeff[0][0]
solve([c0==0],a,b)
```

Out[35]:
```
[[a == r1, b == 0]]
```

In [36]:
```
u(x) = x
L(u)
```

Out[36]:
```
0
```

In [40]:
```
def L(y):
 a(x)=expand((x-1)*diff(y,x,2)-x*diff(y,x)+y)
 return a(x)
y1=function('y1')(x)
y2=function('y2')(x)
y1(x)=x
y2(x)=exp(x)
```

In [ ]:
```

```

In [41]:
```
L(y1).simplify_full()
```

Out[41]:
```
0
```

In [42]:
```
L(y2).simplify_full()
```

Out[42]:
```
0
```

In [43]:
```
W = matrix([[y1(x),y2(x)], [diff(y1,x)(x),diff(y2,x)(x)]])
W
```

Out[43]:
```
[  x e^x]
[  1 e^x]
```

In [44]:
```
det(W)
```

Out[44]:
```
x*e^x - e^x
```

In [45]:
```
def L(y):
 a(x)=expand(x*diff(y,x,2)+2*diff(y,x)-x*y)
 return a(x)
y1=function('y1')(x)
y2=function('y2')(x)
y1(x)=exp(x)/x
y2(x)=exp(-x)/x
```

In [46]:
```
L(y1).simplify_full()
```

Out[46]:
```
0
```

In [47]:
```
L(y2).simplify_full()
```

Out[47]:
```
0
```

In [48]:
```
W = matrix([[y1(x),y2(x)], [diff(y1,x)(x),diff(y2,x)(x)]])
det(W)
```

Out[48]:
```
-(e^x/x - e^x/x^2)*e^(-x)/x - (e^(-x)/x + e^(-x)/x^2)*e^x/x
```

In [49]:
```
det(W).simplify_full()
```

Out[49]:
```
-2/x^2
```

In [54]:
```
y1=function('y1')(x)
y2=function('y2')(x)
y1(x)=cos(x)
y2(x)=sin(x)
W = matrix([[y(x),y1(x),y2(x)], [diff(y,x)(x), diff(y1,x)(x),diff(y2,x)(x)],[d
iff(y(x),x,x),diff(y1(x),x,x),diff(y2(x),x,x)]])
W
```

Out[54]:
```
[           y(x)           cos(x)           sin(x)]
[   diff(y(x), x)         -sin(x)           cos(x)]
[diff(y(x), x, x)         -cos(x)         -sin(x)]
```

In [ ]:
```

```

In [55]:
```
det(W)==0
```

Out[55]:
```
(cos(x)^2 + sin(x)^2)*y(x) + (cos(x)^2 + sin(x)^2)*diff(y(x), x, x) == 0
```

In [ ]:

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