class1

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1 algebra and symbolic math with sympy

1.0.1 defining symbols using sympy

```python
from sympy import Symbol , symbols

x = Symbol("x")
y = Symbol("y")

x , y = symbols("x,y")

s = x*y + y*x

s
```

[ ]: $2xy$

```python
p = x*(x+x)
p
```

[ ]: $2x^2$

1.0.2 Factorisation

```python
from sympy import factor

exp = x**2 - y**2

factor(exp)
```

[ ]: $(x - y)(x + y)$

```python
exp1 = x**2 + y**2 + y*2*x

factor(exp1)
```

[ ]: $(x + y)^2$

```
[ ]: exp2 = x**2 + y**2 - y*2*x

     factor(exp2)
```

[ ]: $(x-y)^2$

```
[ ]: exp3 = x*(x+x)

     factor(exp3)
```

[ ]: $2x^2$

1.0.3 Expanding

```
[ ]: from sympy import expand

     expand((x - y)**2)
```

[ ]: $x^2 - 2xy + y^2$

```
[ ]: expand((x + y)**2)
```

[ ]: $x^2 + 2xy + y^2$

1.0.4 pprint

```
[ ]: from  sympy import pprint
     pprint(x**2 + 2*x*y + y**2)
```

```
  2           2
 x  + 2 x y + y
```

```
[ ]: from sympy import init_printing

     init_printing(order = "rev-lex")

     pprint(exp2)
```

```
  2           2
 y  - 2 x y + x
```

1.0.5 fact_list

```
[ ]: from sympy import *

     x , y, z = symbols("x,y,z")

     factor_list(x**2 - y**2)
```

[ ]:
$(1,\ [(-y+x,\ 1),\ (y+x,\ 1)])$

1.0.6 collect

[ ]:
```
exp = x*y + (x-3) + 2*x**2 - z*x**2 + x**3

c = collect(exp,x)

c
```

[ ]:
$-3 + x(1 + y) + x^2 \cdot (2 - z) + x^3$

1.0.7 coeff

[ ]:
```
c.coeff(x,2)
```

[ ]:
$2 - z$

1.0.8 cancel

[ ]:
```
cancel((2*x**2 - 2)/(x**2 - 2*x + 1))
```

[ ]:
$\dfrac{2 + 2x}{-1 + x}$

[ ]:
```
cancel((x**2 + 2*x + 1)/(x**2 + x))
```

[ ]:
$\dfrac{1 + x}{x}$

excercise

- Factorize

  - x^3 - y^3
  - 2x^2 + 5x = 12
  - x^2 - 3x - 10 = 0

- Expand obtained above

- Simplify

  - x^3 + 3x^2 + 3x + 1 / x^2 - x - 2
  - x^2 - 9 / x^2 + 5x + 6
  - x^2 + 3x / x^2 + 5x

factorize

[ ]:
```
factor(x**3 - y**3)
```

[ ]:
$(-y + x)(y^2 + xy + x^2)$

```
[ ]: factor(2*x**2 + 5*x)
```

[ ]:
$$x\left(5 + 2x\right)$$

```
[ ]: factor(x**2 - 3*x - 10)
```

[ ]:
$$\left(-5 + x\right)\left(2 + x\right)$$

expand

```
[ ]: expand((- y +x)*(y**2+x*y+x**2))
```

[ ]:
$$-y^3 + x^3$$

```
[ ]: expand(x*(5 + 2*x))
```

[ ]:
$$5x + 2x^2$$

```
[ ]: expand((-5 + x)*(2 + x))
```

[ ]:
$$-10 - 3x + x^2$$

simplify

```
[ ]: cancel(x**3 + 3*x**2 + 3*x + 1 / x**2 - x - 2)
```

[ ]:
$$\frac{1 - 2x^2 + 2x^3 + 3x^4 + x^5}{x^2}$$

```
[ ]: cancel(x**2 - 9 / x**2 + 5*x + 6)
```

[ ]:
$$\frac{-9 + 6x^2 + 5x^3 + x^4}{x^2}$$

```
[ ]: cancel(x**2 + 3*x / x**2 + 5*x)
```

[ ]:
$$\frac{3 + 5x^2 + x^3}{x}$$