

# L<sup>A</sup>T<sub>E</sub>X Template for Math and Physics notes

*Kuzma Cosmos (2022)*

## 1 Some complicated math notations

### 1.1 Jacobian

This is the equation for changing variable in double integral:

$$\iint_{\mathcal{S}} f(x, y) dx dy = \iint_{\mathcal{D}} f(x(u, v), y(u, v)) \left| \frac{\partial(x, y)}{\partial(u, v)} \right| du dv \quad (1.1)$$

where  $(x, y) = T(u, v) = (x(u, v), y(u, v))$  with a defined transformation  $T : \mathcal{D} \rightarrow \mathcal{S}$ .  
 $\frac{\partial(x, y)}{\partial(u, v)}$  is called **Jacobian** of  $T$ , denoted by  $\text{Jac}(T)$ :

$$\text{Jac}(T) = \frac{\partial(x, y)}{\partial(u, v)} = \begin{vmatrix} \frac{\partial x}{\partial u} & \frac{\partial x}{\partial v} \\ \frac{\partial y}{\partial u} & \frac{\partial y}{\partial v} \end{vmatrix} \quad (1.2)$$

## 2 Some physics examples

### 2.1 Biot-Savart Law

This is equation for Biot-Savart Law in magnetostatics, from Griffiths' Textbook.

$$\boxed{\vec{B} = \frac{\mu_0}{4\pi} \int_{\mathcal{W}} \frac{\vec{I} \times \hat{\mathbf{r}}}{r^2} dl = \frac{\mu_0 I}{4\pi} \int_{\mathcal{W}} \frac{d\vec{l} \times \hat{\mathbf{r}}}{r^2}} \quad (2.1)$$

### 3 Python codes in L<sup>A</sup>T<sub>E</sub>X

Sample python code.

```

1 def add_one (x: int) -> int:
2     """Return one more than x.
3
4     >>> add_one(1)
5     2
6     >>> add_one(5)
7     6
8     """
9     return x + 1
10
11 def max_of_min(num1: float, num2: float, value1: float, value2: float)
-> float:
12     """Return the maximum of the minimums of the pairs num1 and num2,
13     and value1
14     and value2
15
16     >>> max_of_min (4.0, 3.7, 6.0, 3.5)
17     3.7
18     """
19     min_num = min(num1, num2)
20     min_value = min(value1, value2)
21     return max(min(num1, num2), min(value1, value2))
22
23 def get_distance (x: float, y: float) -> float:
24     """Return the distance between a point with coordinates (x, y) and
25     the
26     origin.
27
28     >>> get_distance (3.0, 4.0)
29     5.0
30     >>> get_distance (0.0, 0.0)
31     0.0
32     """
33     # How about rewriting the function with a pow function instead of
34     # exponatiation?
35     # pow(pow(x, 2) + pow(y, 2) , 2)
36     return (x ** 2 + y ** 2) ** 2
37
38 def repeat_word(word: str, count:int) -> str:
39     """ Return word repeated count times.
40
41     Assume that: count >= 0
42
43     >>>repeat_word('Marcia ', 3)
44     'Marcia Marcia Marcia '
45     >>>repeat_word('Mario', 2)
46     'MarioMario'
47     """
48     return word * count
49
50 def format_name(first_name: str, last_name: str) -> str:
51

```

```

52     """Return name in the format of 'last_name, first_name'.
53
54     >>> format_name('Rin', 'Kagamine')
55     'Kagamine, Rin'
56     >>> format_name('Miku', 'Hatsune')
57     'Hatsune, Miku'
58     """
59     return last_name + ', ' + first_name
60
61 def to_listening(first_name: str, last_name: str, phone_number: str) ->
    str:
62
63     """Return name in the format of 'last_name, first_name,
    phone_number'.
64
65     >>> to_listening('Miku', 'Hatsune', '39393939')
66     'Hatsune, Miku: 39393939'
67     """
68
69     # return last name + ', ' + first_name + ': ' + phone_number
70     return format_name(first_name, last_name) + ': ' + phone_number

```

```

1 import numpy as np
2
3 def incmatrix(genl1, genl2):
4     m = len(genl1)
5     n = len(genl2)
6     M = None #to become the incidence matrix
7     VT = np.zeros((n*m,1), int) #dummy variable
8
9     #compute the bitwise xor matrix
10    M1 = bitxormatrix(genl1)
11    M2 = np.triu(bitxormatrix(genl2),1)
12
13    for i in range(m-1):
14        for j in range(i+1, m):
15            [r,c] = np.where(M2 == M1[i,j])
16            for k in range(len(r)):
17                VT[(i)*n + r[k]] = 1;
18                VT[(i)*n + c[k]] = 1;
19                VT[(j)*n + r[k]] = 1;
20                VT[(j)*n + c[k]] = 1;
21
22            if M is None:
23                M = np.copy(VT)
24            else:
25                M = np.concatenate((M, VT), 1)
26
27            VT = np.zeros((n*m,1), int)
28
29    return M

```

Listing 1: Python example