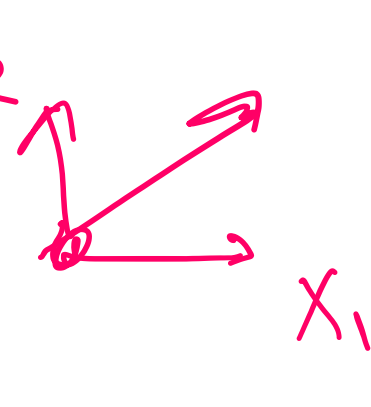


Spatial norm

Temporal norm



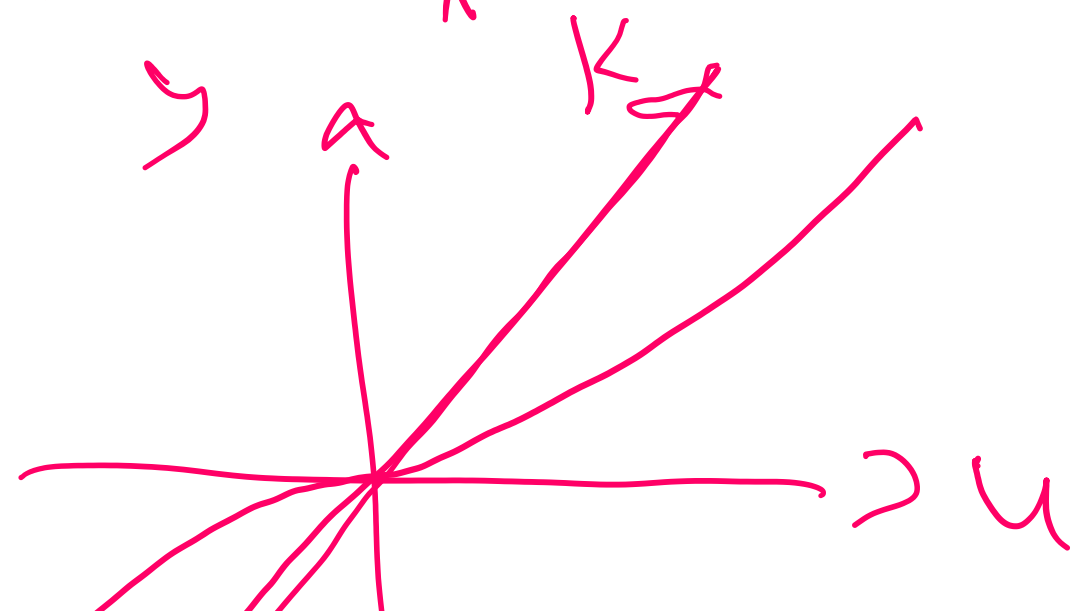
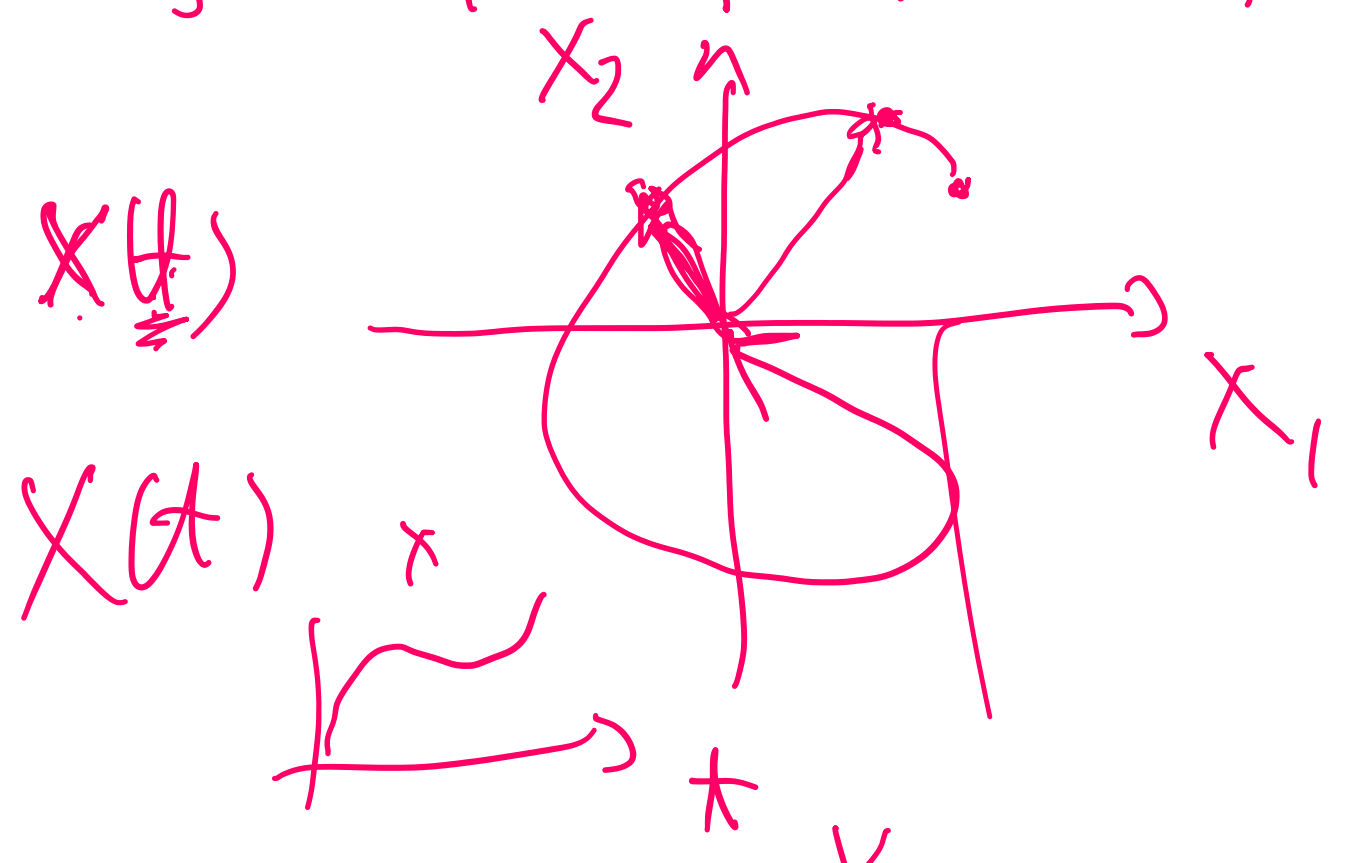
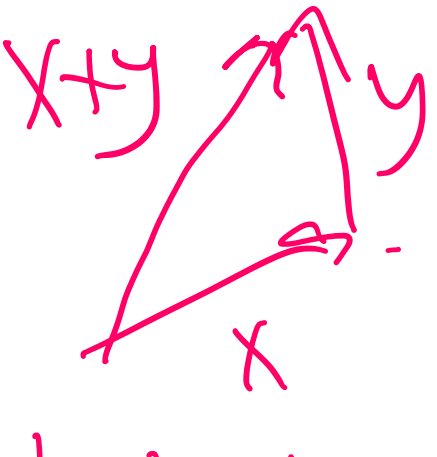
1°  $|x| \geq 0$

2°  $|x| = 0 \Rightarrow x = 0$

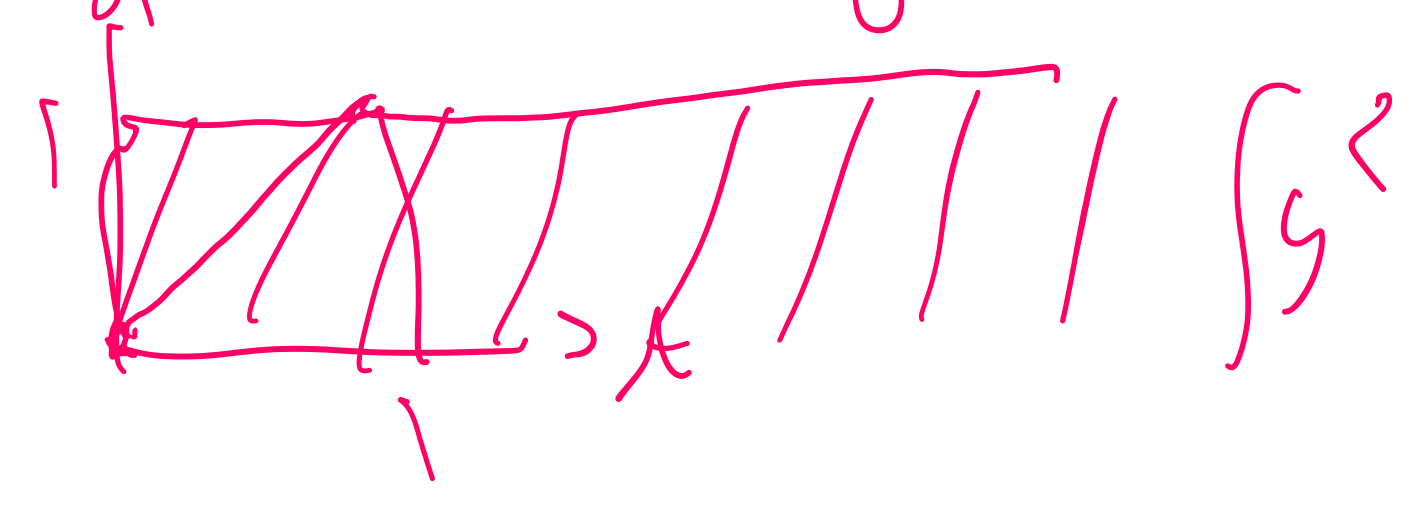
3°  $|\alpha x| = |\alpha| |x|$   $|AB| \leq |A| |B|$

4°  $|x+y| \leq |x| + |y|$

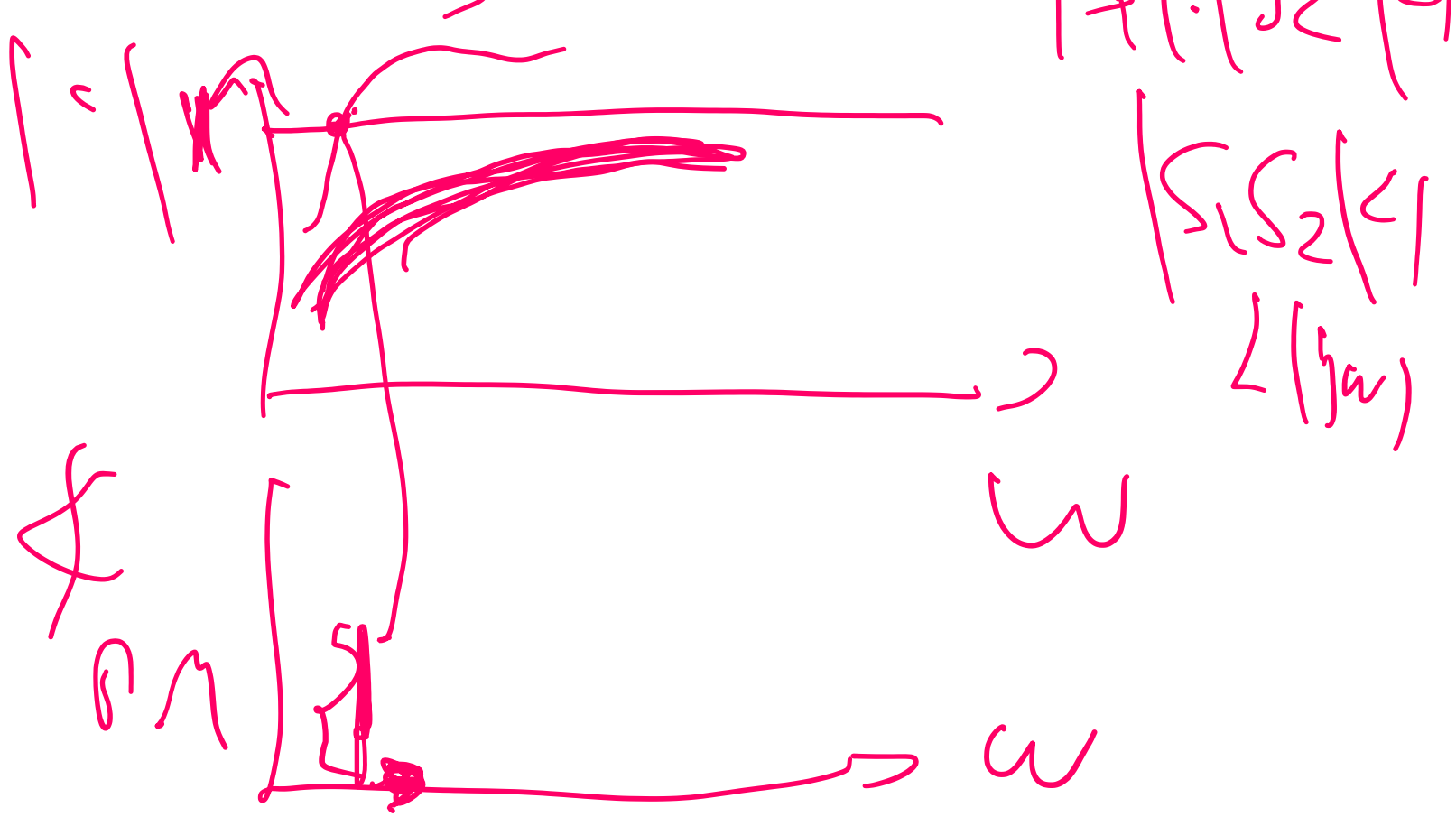
5°  $|xy| \leq |x| |y|$



$$y = \int_0^x u(\tau) d\tau$$



$$\|S_1 S_2\| < \|S_1\| \|S_2\| < 1$$



Matrix exponential

$$e^{At} = I + At + \frac{1}{2!} (At)^2 + \frac{1}{3!} (At)^3 + \dots$$

$$\frac{d}{dt} e^{At} = A e^{At} = e^{At} A$$

$$\dot{x}(t) = Ax(t) + By(t), x(0) = x_0$$

$$\dot{x} - Ax = By$$

$$e^{-At} (\dot{x} - Ax) = e^{-At} By$$

$$\frac{d}{dt} (e^{-At} x) = e^{-At} By dt$$

$$\int_0^t e^{-A\tau} x(\tau) = \int_0^t e^{-A\tau} By(\tau) d\tau$$

$$e^{-At} x(t) - x(0) = \int_0^t e^{-A\tau} By(\tau) d\tau$$

$$x(t) = e^{At} x(0) + e^{At} \int_0^t e^{-A\tau} By(\tau) d\tau$$

$$x(t) = e^{At} x_0 + \int_0^t e^{A(t-\tau)} By(\tau) d\tau$$