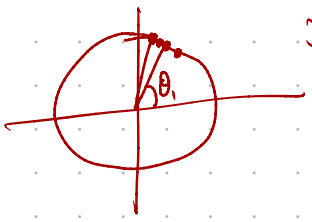
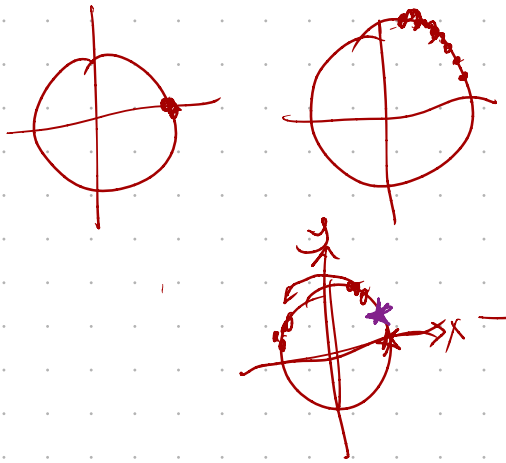
Week 2:

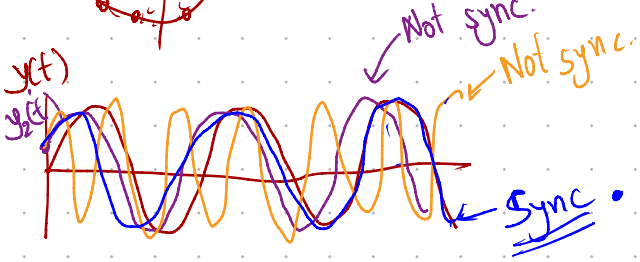
Phase oscillators:

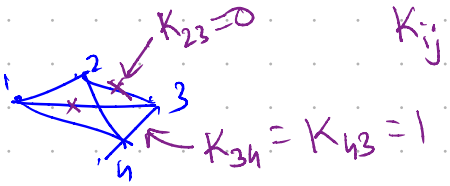


$$x \to \dot{\theta}_1 = \omega_1 + \sin(\theta_2 - \theta_1)$$
$$y \to \dot{\theta}_2 = \omega_2 + \sin(\theta_1 - \theta_2)$$
$$z \to \vdots$$
$$\dot{\theta}_N = \omega_N$$



← No sync.





Kuramoto model:

$$\dot{\theta}_1 = \omega_1 + \sin(\theta_2 - \theta_1) + \sin(\theta_3 - \theta_1) + \cdots$$
$$\dot{\theta}_2 = \cdots$$

Coupling const.

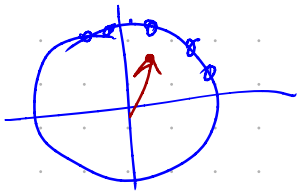
$$\dot{\theta}_i = \omega_i + K \sum_{j=1}^{N} K_{ij} \sin(\theta_j - \theta_i) \quad \checkmark$$

TASKS:

1. Read paper. Sec 1-3 (4* is optional)
2. Simulate Kuramoto: $N = 100$ oscillators.
   ($\omega \to$ Gaussian ($\mu = 0$, $\sigma = 1$))
   (a) K is small (0.01)
   (b) K large (10)

(3) Plot r vs. K.

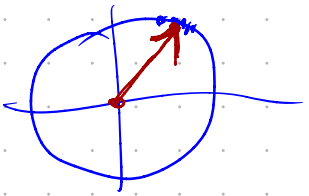
↳ Order parameter.

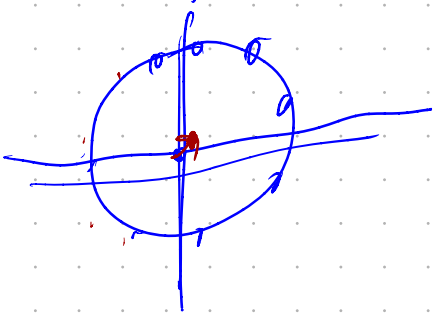


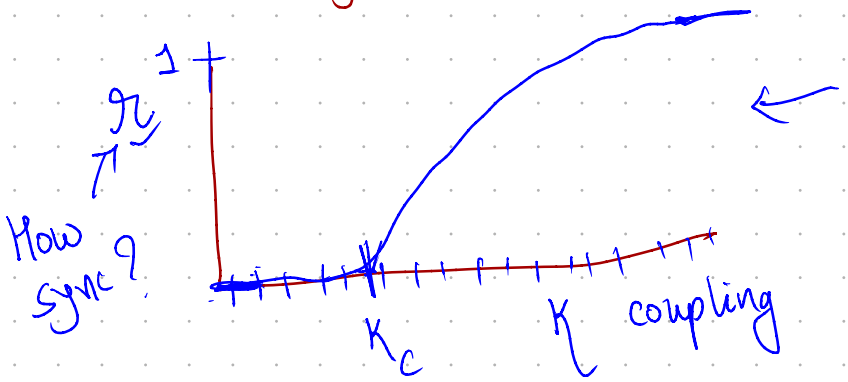
$$r = \frac{1}{N}\left|\sum e^{i\theta_j}\right|$$

↳ $[0, 1]$

↙ No sync ↘ Complete sync.







(4)* Repeat with Lorenzian. → Check 4.7.

(5)** (i) instead of sin, use something else