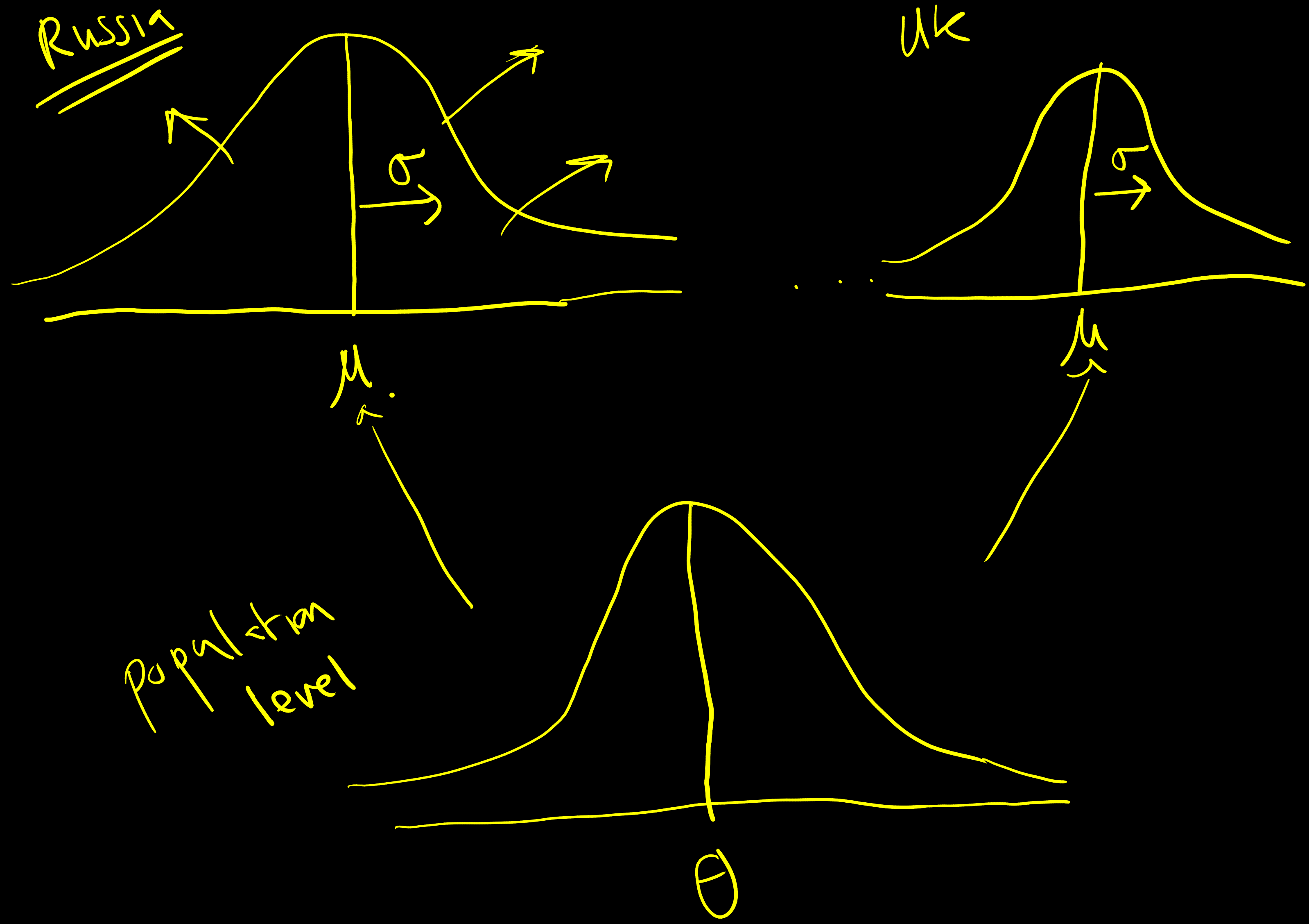
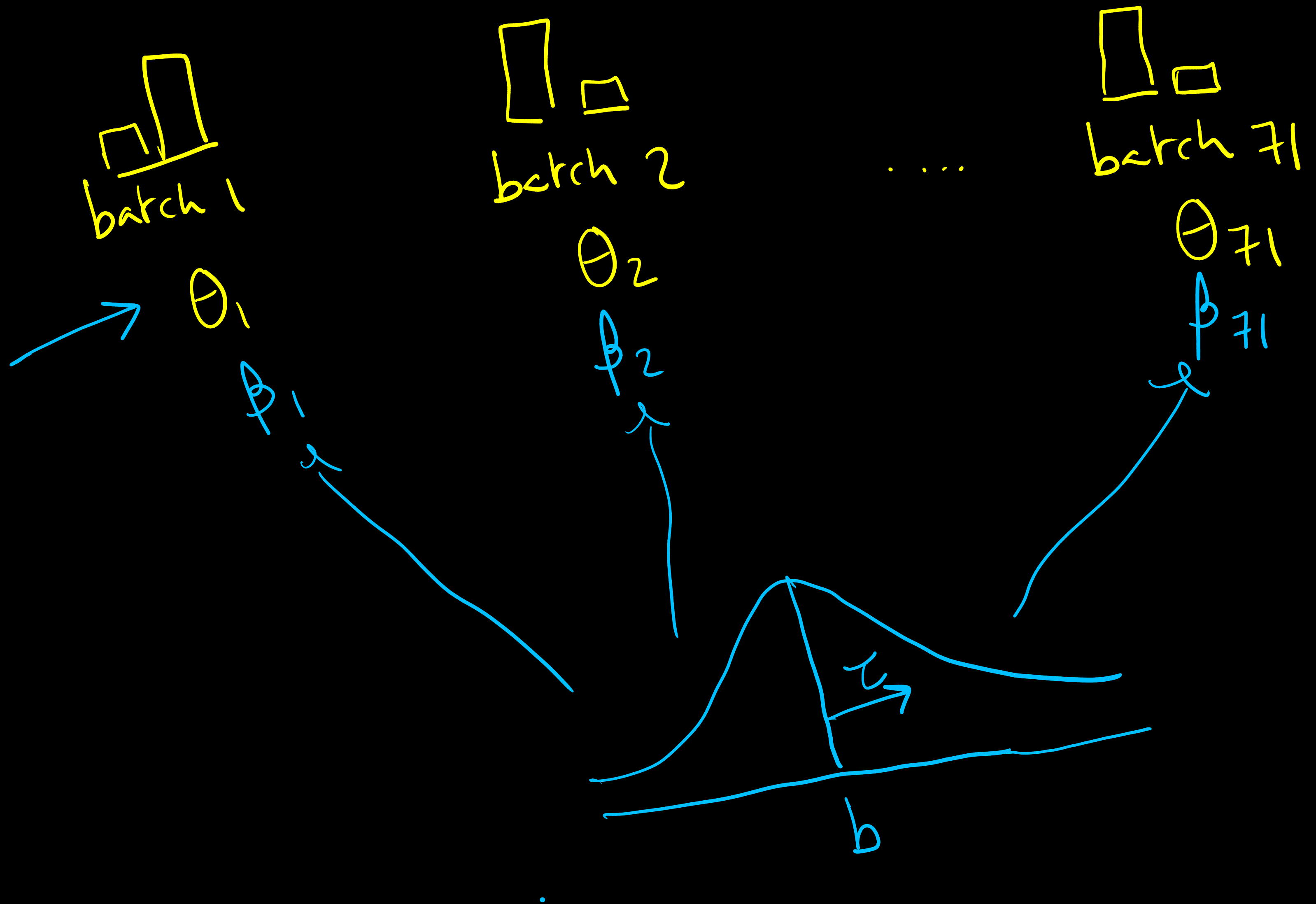
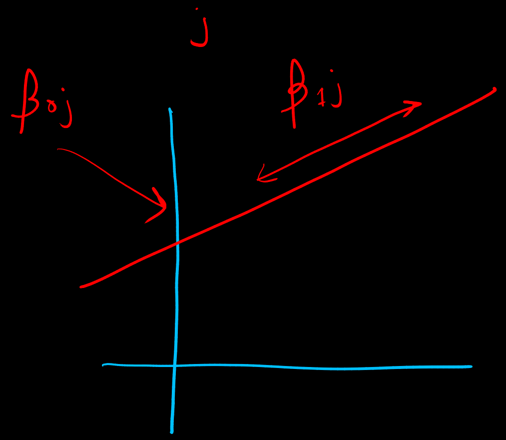
$$x \sim N(\mu, \sigma^2) \qquad \beta \sim N(b, \tau^2)$$

$$x - \mu \sim N(0, \sigma^2) \qquad \beta - b \sim N(0, \tau^2)$$

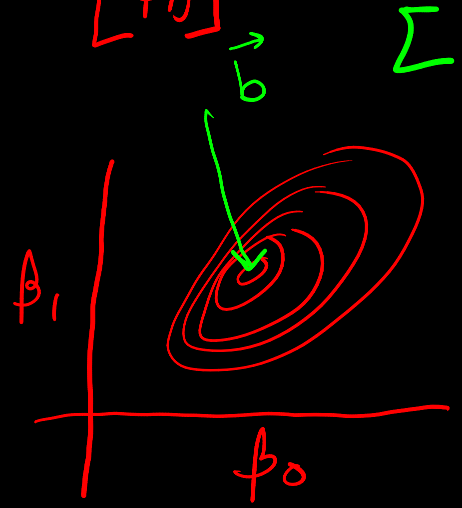

Russia
σ
μ
UK
σ
μ
population level
θ

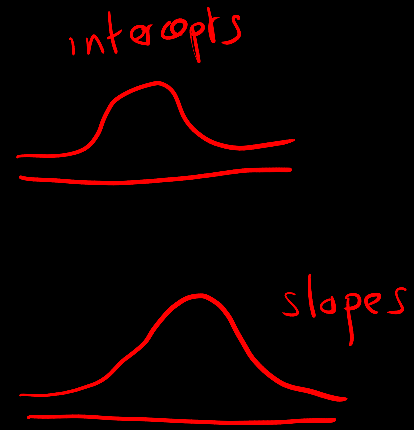


batch 1
batch 2
batch 71
θ_1
θ_2
θ_{71}
β_1
β_2
β_{71}
τ
b



$$\vec{\beta}_j = \begin{bmatrix} \beta_{0j} \\ \beta_{1j} \end{bmatrix}$$





for j in 1 . . . J

$$\vec{\beta}_j \sim N_2(\vec{b}, \Sigma)$$

$$\beta_{j0} = b_0 + Z_{j0} \qquad \beta_{j1} = b_1 + Z_{j1}$$

$$\mu_i = \beta_{[s_i]0} + \beta_{[s_i]1} x_i$$

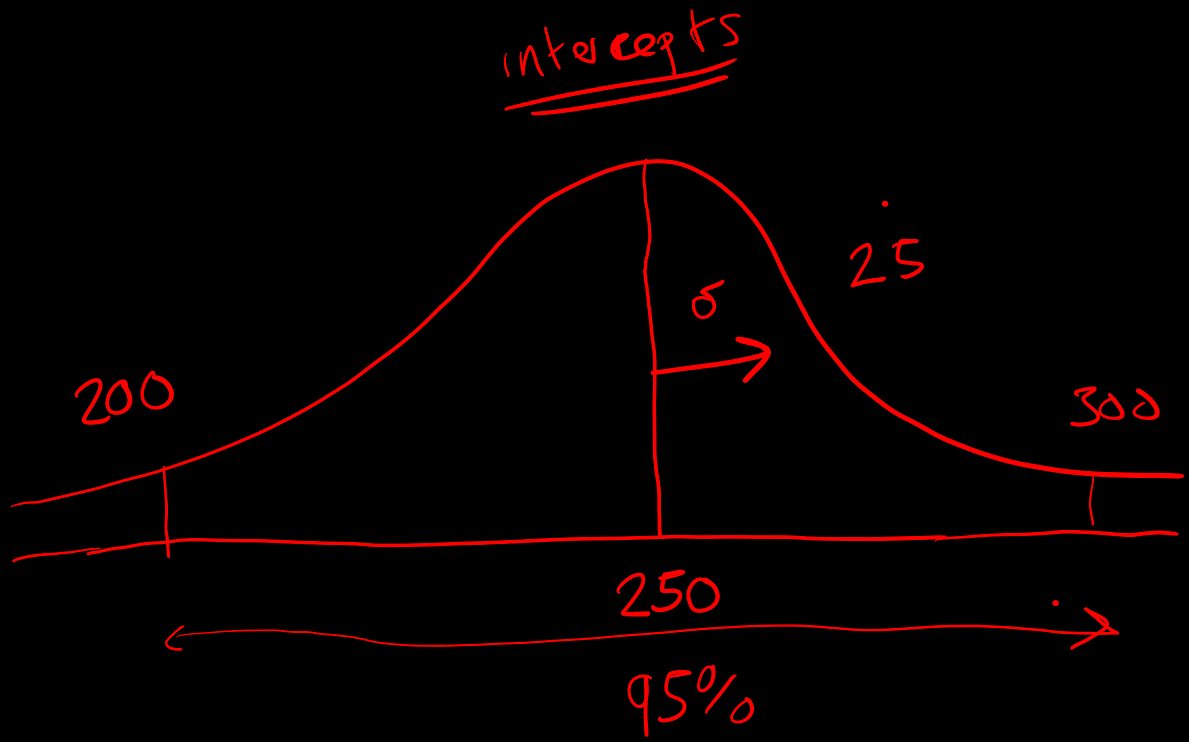
$$= [b_0 + Z_{[s_i]0}] + [b_1 + Z_{[s_i]1}] x_i$$

$$\begin{bmatrix} \beta_{j0} \\ \beta_{j1} \end{bmatrix} \sim N(\vec{b}, \Sigma) \qquad \underbrace{[b_0 + b_1 x_i]}_{\text{fixed}} + \underbrace{Z_{[s_i]0} + Z_{[s_i]1} x_i}_{\text{random}}$$

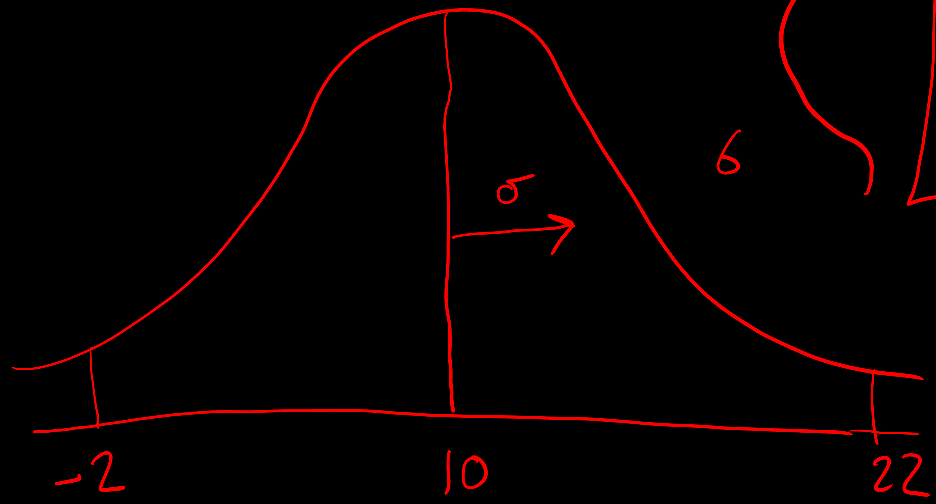
$$\begin{bmatrix} \beta_{j0} \\ \beta_{j1} \end{bmatrix} = \begin{bmatrix} b_0 \\ b_1 \end{bmatrix} + \begin{bmatrix} Z_{j0} \\ Z_{j1} \end{bmatrix}$$

$$\vec{Z}_j \sim N(0, \Sigma)$$

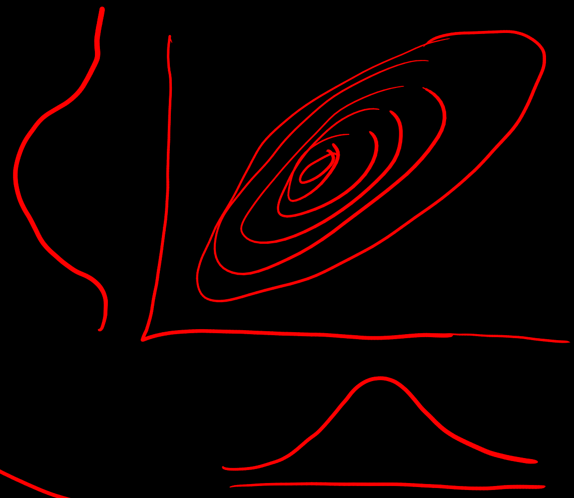
$$\Sigma = \begin{bmatrix} \sigma_0^2 & \sigma_0\sigma_1\rho \\ \sigma_0\sigma_1\rho & \sigma_1^2 \end{bmatrix}$$

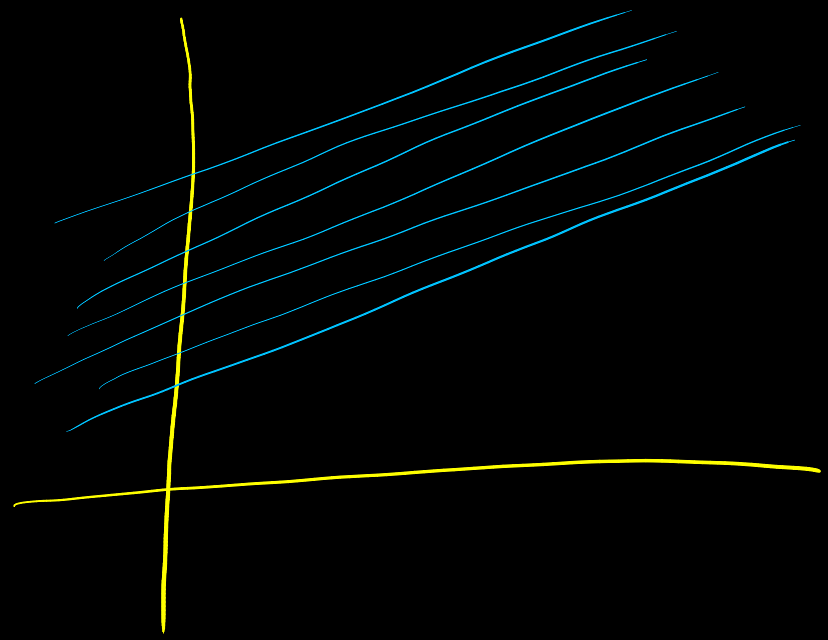

intercepts
25
σ
200
300
250
95%

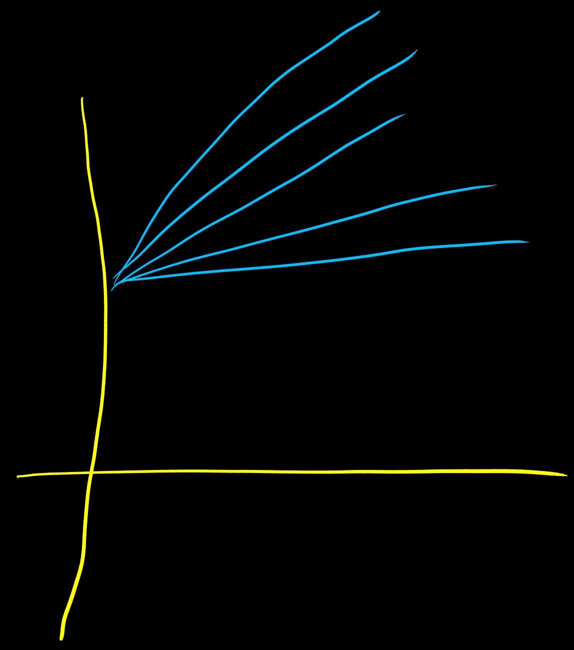
slopes

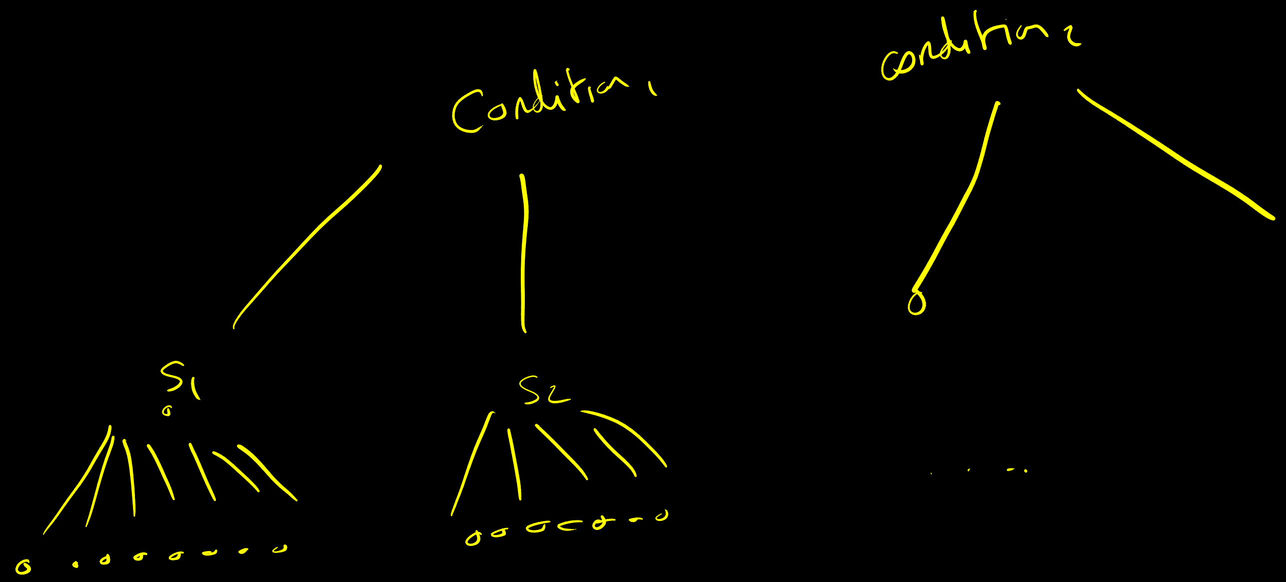


6









Condition 1
condition 2
S1
S2