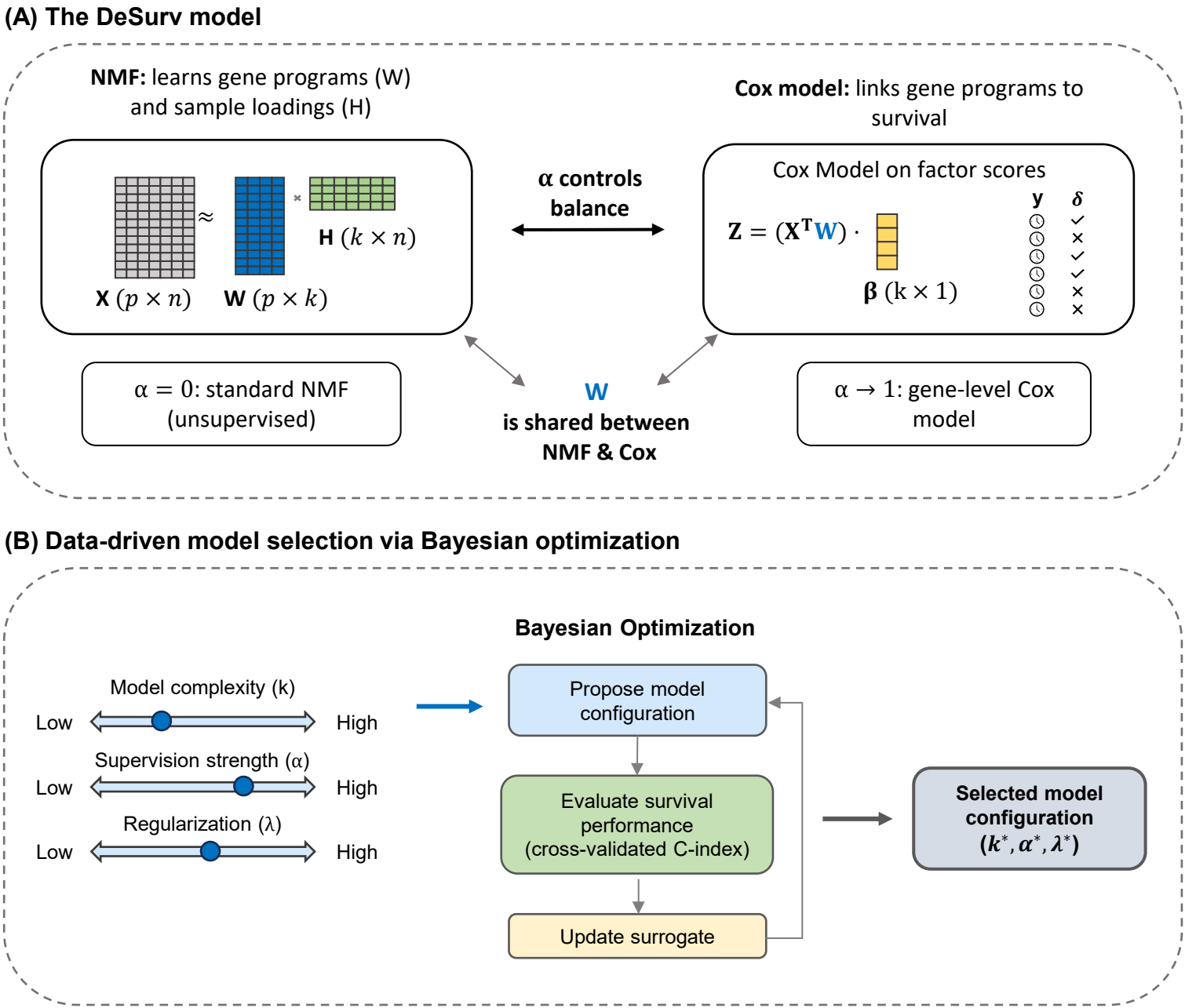
(A) The DeSurv model
NMF: learns gene programs (W) and sample loadings (H)
Cox model: links gene programs to survival
X (p × n)
W (p × k)
H (k × n)
α controls balance
Cox Model on factor scores
Z = (X^T W) ·
β (k × 1)
y
δ
α = 0: standard NMF (unsupervised)
W is shared between NMF & Cox
α → 1: gene-level Cox model
(B) Data-driven model selection via Bayesian optimization
Bayesian Optimization
Model complexity (k)
Low
High
Supervision strength (α)
Low
High
Regularization (λ)
Low
High
Propose model configuration
Evaluate survival performance (cross-validated C-index)
Update surrogate
Selected model configuration (k*, α*, λ*)