Cross-Modal TF→Gene Regulatory Inference & Cross-Species Comparison

\*A practical summary for integrating RNA-based GRN inference (GENIE3/GRNBoost2) with scATAC motif evidence, peak–gene linking, and extending to human–mouse comparisons.\*

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# Scoring: Motif Evidence Score (MES) and Combined Regulatory Confidence (CRC)

Motif Evidence Score:

\[

\mathrm{MES}\_{t,g,c} = \sum\_{p \in P(g)} \mathbf{1}[\text{motif}(t) \in p] \times A\_{p,c} \times L\_{p,g} \times M\_{t,p}

\]

Combined Regulatory Confidence:

\[

\mathrm{CRC}\_{t,g,c} = z(\mathrm{GENIE3\ weight}\_{t,g}) \times z(1 + \mathrm{MES}\_{t,g,c})

\]

Motif Conservation:

\[

\mathrm{Motif\ Conservation}(g) = \frac{|\mathcal{F}\_\text{human}(g) \cap \mathcal{F}\_\text{mouse}(g)|}{|\mathcal{F}\_\text{human}(g) \cup \mathcal{F}\_\text{mouse}(g)|}

\]

Hypothesis Score:

\[

\mathrm{HypothesisScore}\_{t,g} = \Delta \mathrm{CRC} + w\_1\, \Delta \mathrm{MotifPresence} + w\_2\, \Delta \mathrm{Accessibility}

\]