

Description of Additional Supplementary Files:

Supplementary Data 1: Model performance of SVEN annotation module in predicting 4,516 genomic signals.

Supplementary Data 2: Model performance of SVEN in predicting gene expression in 365 tissues and cell lines.

Supplementary Data 3: Top 5 deletions with the strongest regulatory impacts predicted by SVEN from large-scale SV datasets for experimental validation.

Supplementary Data 4: Ablation study's results for testing each module's contribution of SVEN.

Supplementary Data 5: Guide RNA and PCR primers used for experimental validation.