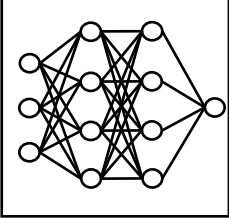


Tutorial 3.3b: Regression with Late Integration



(i) Import libraries

*Import numpy, pandas, sklearn and tensorflow*

(ii) Build regression models

*Define structure of two single view models and one multi-modal model*

(iii) Load flux and gene expression values

*Read fluxes and gene\_expression\_data*

(iv) Split data into training and test sets

*Specify proportion of test set*

(v) Normalize training and test sets

*Perform feature scaling on training samples and use same parameters to normalize test samples*

(vi) Define optimization procedure

*Define number of epochs, batches, learning rate and validation set split  
Define stochastic gradient descent algorithm with early stopping*

(vii) Initialize single view models

*Initialize separate single-view models for the gene expression and flux datasets*

(viii) Fit single view models

*Fit both single-view models on training samples  
Evaluate models on validation sets at the end of each epoch*

(ix) Initialize multimodal model

*Initialize multimodal neural network with hidden neurons from single view models*

(x) Fit multimodal model

*Fit multimodal model with training samples*

(xi) Generate multimodal predictions

*Make predictions with multimodal model using test data*

(xii) Evaluate performance

*Evaluate quality of multimodal estimator by calculating mean squared error*