Framework of scDecipher

a Schematic Diagram

Sender cell type (S1) Reciver cell type (R) Sender cell type (S2)

LR pairs 1   LR pairs 2

Downstream functional effects

Gene expression (E) in R

$$E = E_0 + \Delta E$$

Functional status (F) of R

$$F = F_0 + \Delta F$$
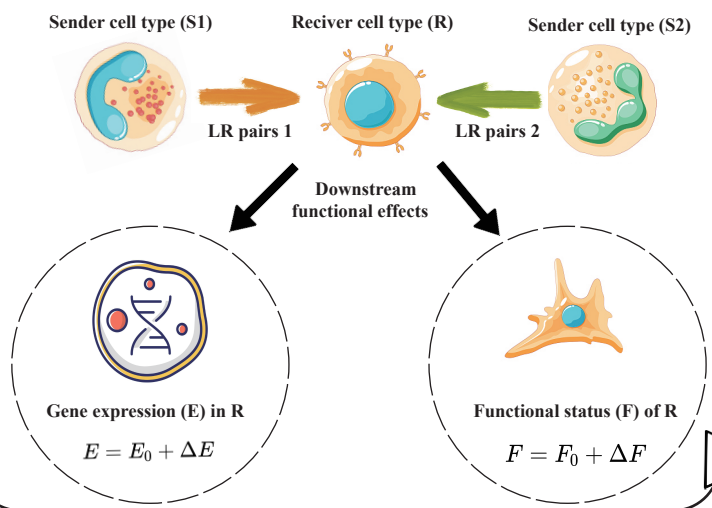
b Multi-view CCC construction

Expression profiles
Cells

Genes

CCC tools

Edge weighting strategy

Communication strength
Cells

Cells

A cell

Graph 1   Cell type combination 1   View 1

Graph 2   Cell type combination 2   View 2

Graph n   Cell type combination n   View n

Filtering edges with low specificity
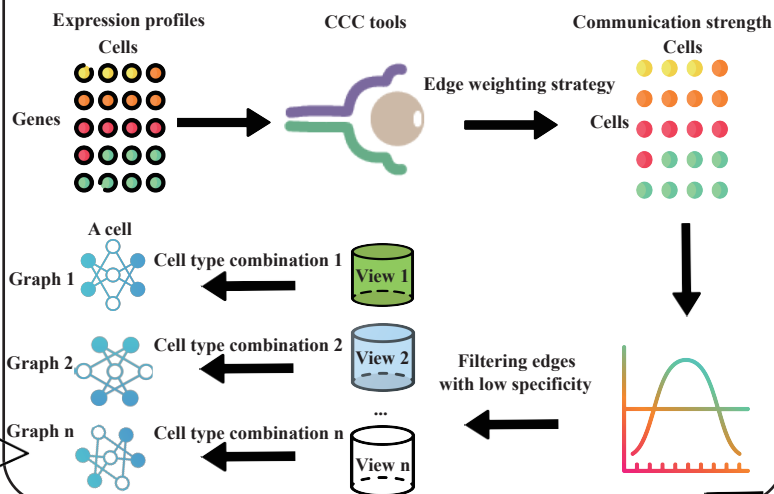
c Multi-view graph attention learning

View n: CCC between single cells of cell types n-1 and n

View 2: CCC between single cells of cell types 2 and 3

View 1: CCC between single cells of cell types 1 and 2

Adjacency matrix
Cells

Cells

Cell-type matrix
Cells

Cell type

GCN for view n

GCN for view 2

GCN for view 1

+ ReLU

View attention

MLP

Target gene/cell state
Cells

E_0/F_0

Gene expression

$\bigoplus$ E/F

Cell functional state

Cell-type matrix
Cells

All cell type

MLP

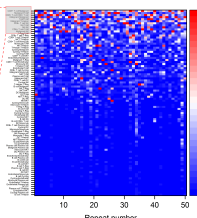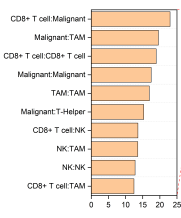Target gene/cell state
Cells

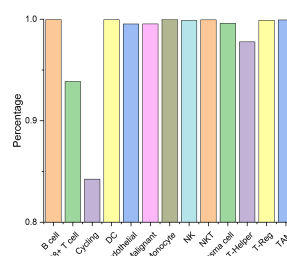$\Delta E/\Delta F$

d Function of scDecipher

Characterizing the influence of CCC on gene expression pattern
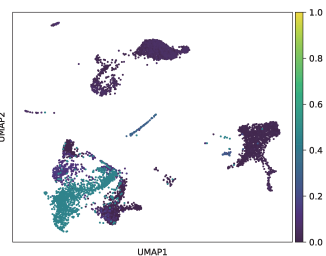
Dominant CCC regulated the key factors in specific cell type

The ratio of CCC for specific target gene expression

Dominant CCC affected tumor cell functional states