

$V$   
 $p \times n$   
 $W$   
 $p \times k$   
 $H$   
 $k \times m$

$$\begin{pmatrix} v_{11} & v_{12} \\ v_{21} & v_{22} \end{pmatrix} = \begin{pmatrix} w_{11} & w_{12} \\ w_{21} & w_{22} \end{pmatrix} \begin{pmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{pmatrix}$$

$$\begin{pmatrix} v_{11} - w_{11}h_{11} - w_{12}h_{21} & v_{12} - w_{11}h_{12} - w_{12}h_{22} \\ v_{21} - w_{21}h_{11} - w_{22}h_{21} & v_{22} - w_{21}h_{12} - w_{22}h_{22} \end{pmatrix}$$

$$v_{ij} = \sum_k w_{ik} h_{kj}$$

$k$   
 $2 \times 2$

(i) Figure out all  $v_{ij} = \sum_k w_{ik} h_{kj}$

(ii) Assign:  $x_k = w_{ik} h_{kj}$  for all  $i, j, k$   
while incrementing  $i$

(iii) For  $(v_{ij} = \sum_k w_{ik} h_{kj})^2$

Substitute with  $x_k$

make\_gules ( )

For The return\_gules will expand the variable list.

Eg  $varnames = [x_1, x_2, x_3]$

will expand to  $[x_{-null}, x_{-2}, x_{-1}, x_{-0}$

$\dots x_{3-null}, x_{3-2}, x_{3-1}, x_{3-0}]$

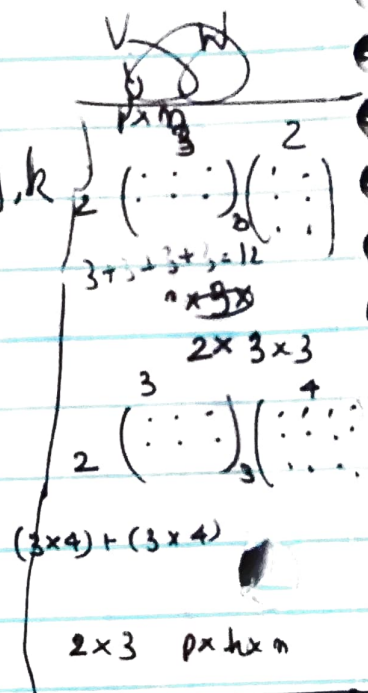
Such that (for eg)

$$x_{-null} = w_{11-null} h_{11}$$

$$x_{-2} = w_{11-2} h_{11}$$

and

so forth



Assign penalty for each  $x_i$

Eg: for  $x_i$ -null

$$Q[w_{ii}=\text{null}, h_{ii}] = 2 \times \delta$$

$$Q[x_i=\text{null}, w_{ii}] = -4 \times \delta$$

$$Q[x_i=\text{null}, h_{ii}] = -4 \times \delta$$

$$Q[x_i=\text{null}, x_i=\text{null}] = Q[x_i=\text{null}, w_{ii}=\text{null}] + (6 \times \delta)$$

when  $\delta$  is a penalty modifier  
by default  $\delta = 1$

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