EE434

Note Title 2/26/2004

$$Ax = \lambda x \;;\quad (\lambda 1_n - A)x = 0_n \Leftarrow \text{zero vector}$$

find λ = eigenvalue for $\det(\lambda 1_n - A) = 0 \Leftarrow$ zero scalar

$$P(\lambda) = \lambda^n + b_{n-1}\lambda^{n-1} + \cdots + b_1\lambda + b_0 = \det(\lambda 1_n - A)$$

has n roots $\Rightarrow$ n eigenvalues

Eq. (7.9) $\Rightarrow$ $W = TP^T$ use $T = P$

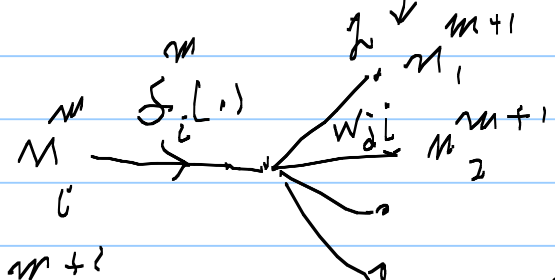
$$\begin{bmatrix} t_{11} & t_{12} \\ t_{21} & t_{22} \\ & \vdots \end{bmatrix}\begin{bmatrix} t_{11} & t_{21} & \cdots \\ t_{12} & t_{22} & \end{bmatrix} = \begin{bmatrix} t_{11}^2 + t_{12}^2 & t_{11}t_{21} + t_{12}t_{22} \\ & t_{21}^2 + t_{22}^2 \end{bmatrix}$$

$W = PP^T - Q\,1$; assume entries of $P = T$ are ± 1

here $Q = 2$

p. 11-12: $s^m = \dot{F}^m(n^m)(W^{m+1})^T s^{m+1}$; $\hat{F} = (t-a^M)^T(t-a^M)$

$$\frac{\partial \hat{F}}{\partial n_i^m} = s_i^m = \sum_{j=1} \frac{\partial n_j^{m+1}}{\partial n_i^m} \cdot \frac{\partial \hat{F}}{\partial n_j^{m+1}} = \sum_{j=1} \frac{\partial n_j^{m+1}}{\partial n_i^m} \cdot s_j^{m+1}$$



$$n_j^{m+1} = W_{ji}^{m+1} \cdot f_i^m(n_i^m)$$

$$\frac{\partial n_j^{m+1}}{\partial n_i^m} = W_{ji}^{m+1} \cdot \frac{d f_i^m(n_i^m)}{d n_i^m} ;$$

Ex: $f(x) = \frac{1}{1+e^{-x}}$

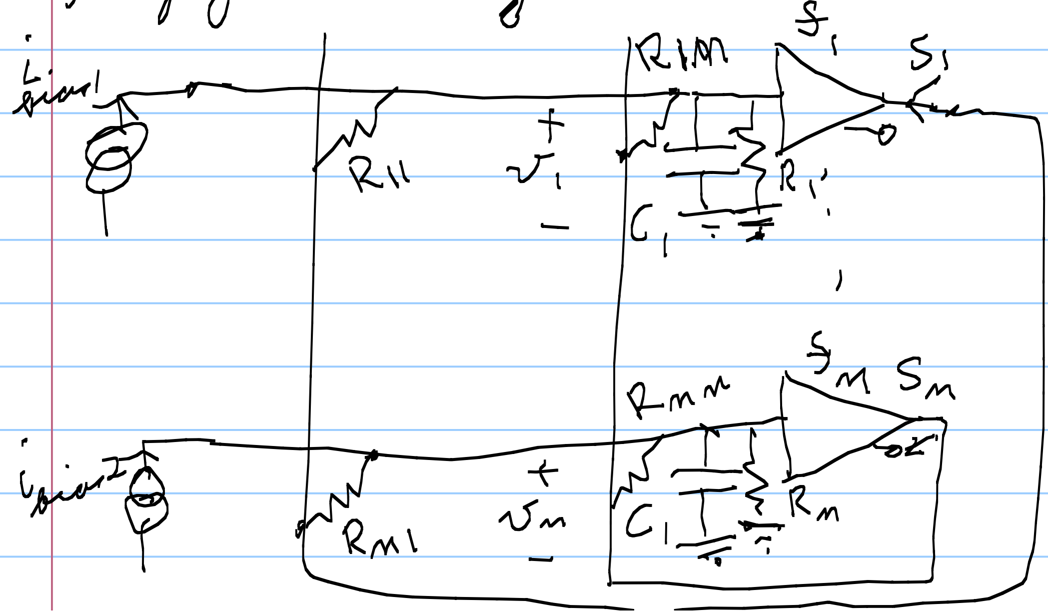
$$\frac{df}{dx} = \frac{1}{(1+e^{-x})^2} \cdot -e^{-x}$$

$$\therefore \quad s^m = \begin{bmatrix} df_i/dx_i & \\ & \ddots \end{bmatrix} (W^{m+1})^T s^{m+1} \Rightarrow \dot{F} = \begin{bmatrix} \frac{df_1}{dx_1} & 0 & \cdots & 0 \\ 0 & df_2/dx_2 & 0 \cdots & 0 \\ & \text{diagonal} & & \end{bmatrix}$$

given s^M can work backwards $\Rightarrow$ back prop.

$$\frac{d\,F(G(x))}{dx} = \left.\frac{d\,F(y)}{dy}\right|_{G(x)} \cdot \frac{dy}{dx} = \left.\frac{d\,F(y)}{dy}\right|_{y=G(x)} \cdot \frac{dG(x)}{dx}$$

Hopfield dynamic neural network:



$a_1 = f_1(v_1)$

$\vdots$

f's are monotonic activation function if use BJT diff. pairs get ~~tanh~~ tanh(.)

$a_M = f_M(v_M) \Rightarrow v = f^{-1}(a)$

P.18-3

leads to the Hopfield eqs (drops dependence on R_{ij} by v_{cj})

1 $$i_c = C\frac{dv_c}{dt} = Wa + b - Gv_c \;;\quad a = f(v_c)$$

Set up a Lyapunov function $\Rightarrow$ Energy functions Eq. (18.8)

$$V(a) = \cancel{-}\, a^T W a - ba + \underbrace{\sum_{i=1}^{M}\int_0^{a} f_i^{-1}(a_0)\,da_0}_{\text{power into unit resistors}} = \text{Eq. } (18.8)$$