

**Approximate  $\sin(x_1+x_2)$  function  
using eight tanh functions with  
37 adaptable parameters**

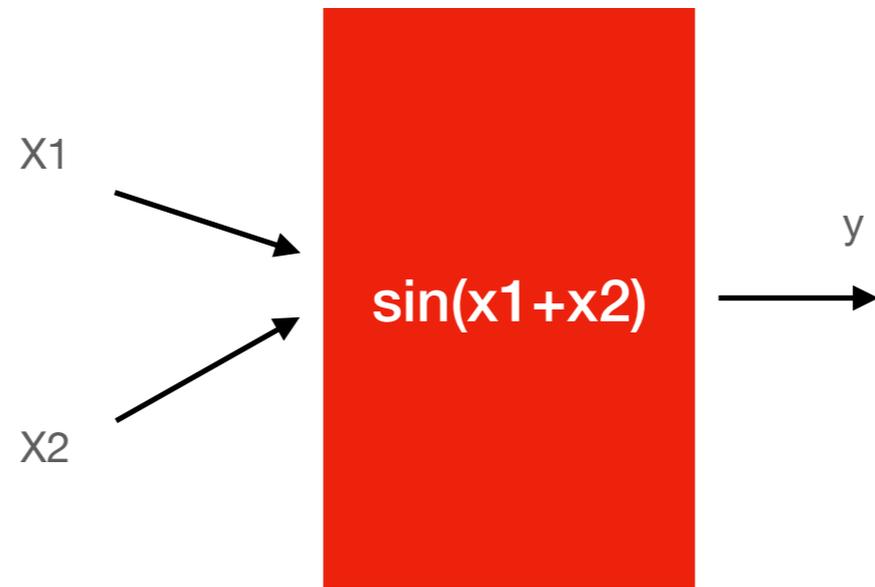
**Range :  $[-2\pi, 2\pi]$**

```
>> Net
```

```
Net =
```

```
struct with fields:
```

```
    a0: [5x2 double]
    b0: [5x1 double]
    a: [3x5 double]
    b: [3x1 double]
    r: [-16.787227815675617  7.290542145115003 ... ]
    M: 3
    d: 5
    d_out: 1
    d0: 2
    layer_no: 2
    out_type: 0
```



Linear operation: inner product

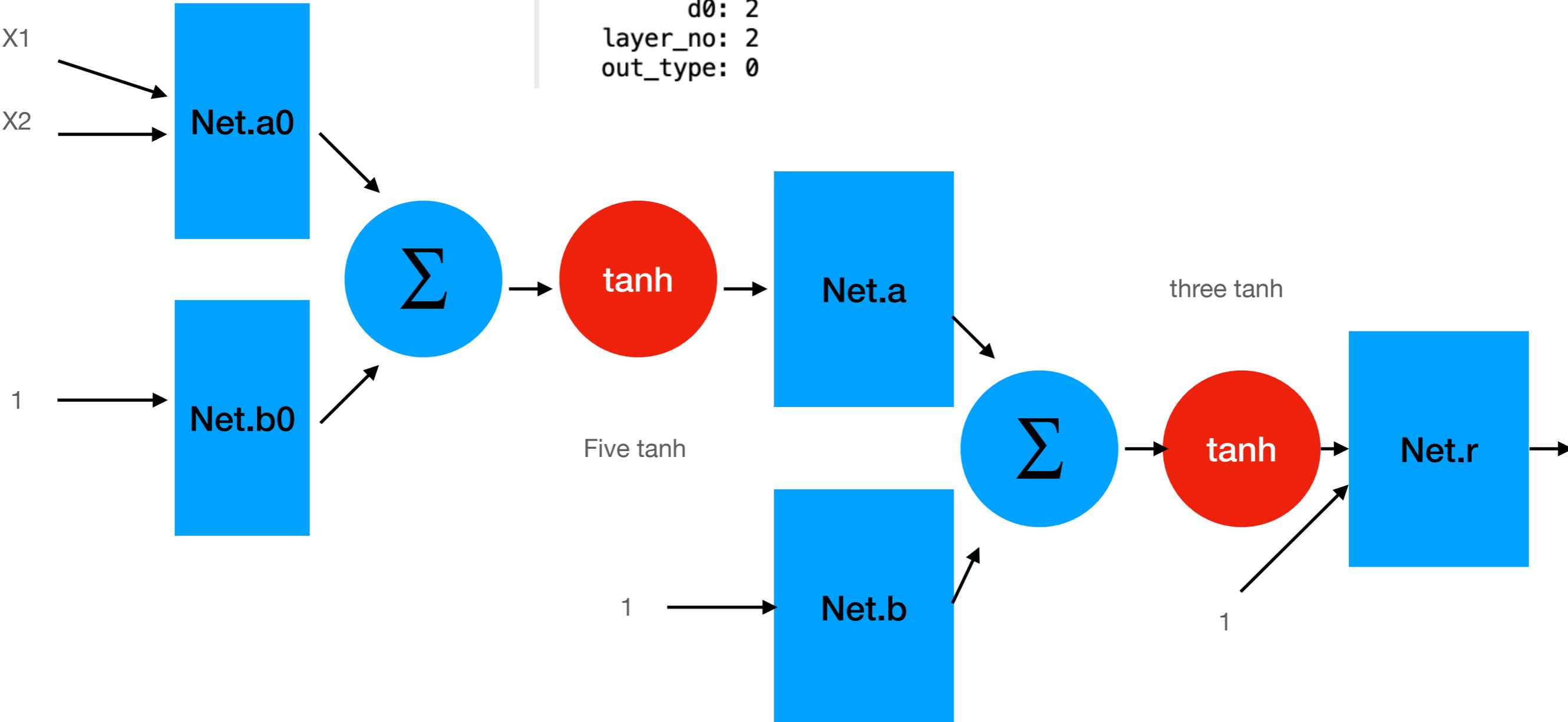
```
>> Net
```

```
Net =
```

```
struct with fields:
```

```
  a0: [5x2 double]  
  b0: [5x1 double]  
  a: [3x5 double]  
  b: [3x1 double]  
  r: [-16.787227815675617  7.290542145115003 ... ]  
  M: 3  
  d: 5  
  d_out: 1  
  d0: 2  
  layer_no: 2  
  out_type: 0
```

Non-linear



Net.a0

ans =

```
-0.391882844531372 -0.391815368780597  
-0.097549960703095 -0.097525873426670  
-0.330480322292035 -0.330313443069054  
-0.218652441676948 -0.218556342766130  
-0.347299453595297 -0.347240606183253
```

```
a0=[-0.391882844531372 -0.391815368780597;  
-0.097549960703095 -0.097525873426670;  
-0.330480322292035 -0.330313443069054;  
-0.218652441676948 -0.218556342766130;  
-0.347299453595297 -0.347240606183253;]
```

Net.b0

ans =

```
-3.590399025897957  
0.104341295741531  
1.960990510199096  
1.194455403608168  
-1.092766188831663
```

```
b0 = [-3.590399025897957;  
0.104341295741531;  
1.960990510199096;  
1.194455403608168;  
-1.092766188831663]
```

Net.a

ans =

Columns 1 through 3

```
-0.698820319715370 -0.131262663142914 0.555456956724617  
-0.273694496420216 -4.379824799779313 0.764337561315912  
0.499252302362431 -3.273179027861816 -0.827278855150259
```

Columns 4 through 5

```
-2.167814298241668 -0.138003183577331  
5.004834251430107 -2.207292555813077  
2.250243011979852 0.567708334958238
```

```
a = [-0.698820319715370 -0.131262663142914 0.555456956724617 -2.167814298241668 -0.138003183577331;  
-0.273694496420216 -4.379824799779313 0.764337561315912 5.004834251430107 -2.207292555813077;  
0.499252302362431 -3.273179027861816 -0.827278855150259 2.250243011979852 0.567708334958238]
```

```
Net.b0
ans =
-3.590399025897957
0.104341295741531
1.960990510199096
1.194455403608168
-1.092766188831663
```

```
b = [ 0.634749258246437;
      -0.389192304833868;
      -0.128917655448361 ]
```

```
Net.r
ans =
Columns 1 through 3
-16.787227815675617  7.290542145115003  36.407711040590925
Column 4
7.404847520200573
```

```
r = [-16.787227815675617  7.290542145115003  36.407711040590925  7.404847520200573]
```

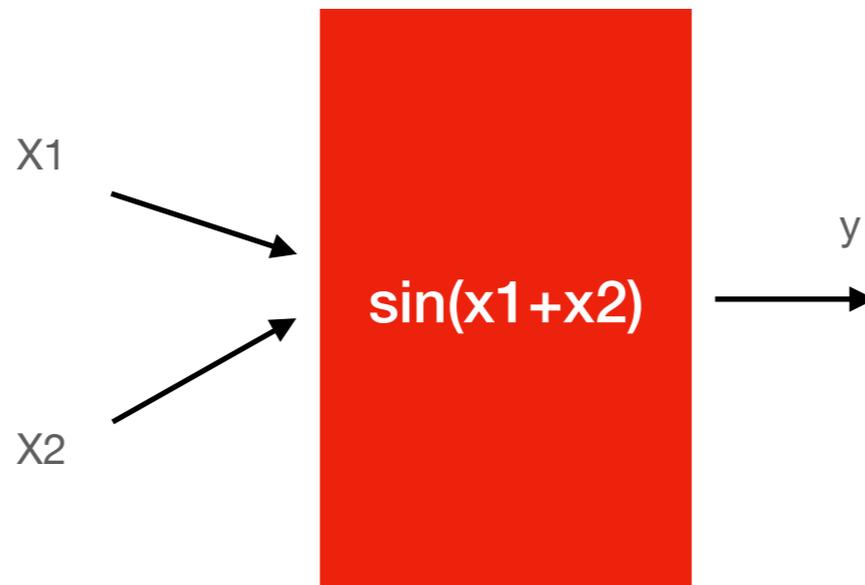


**Excercise 10.19**

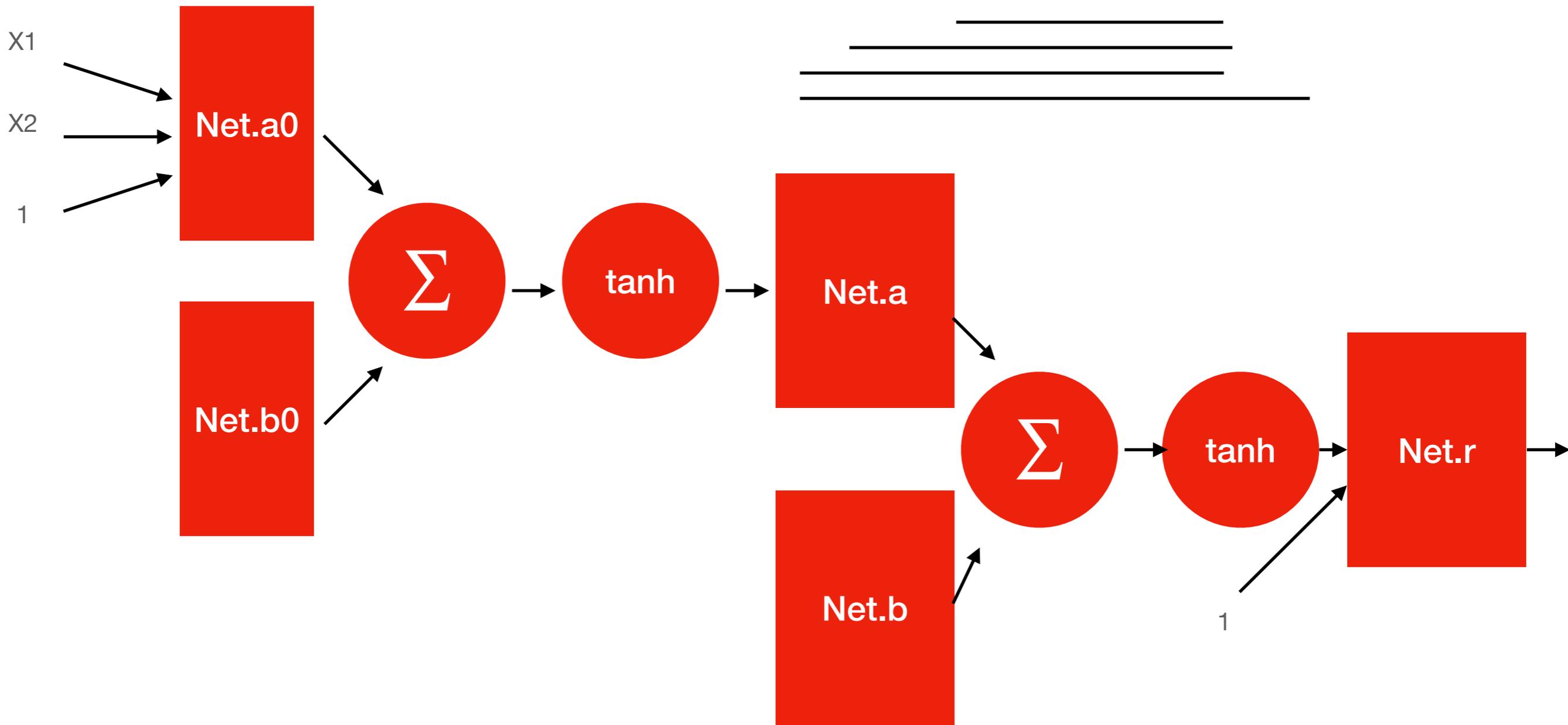
```
x = rand(1,2) * 4 * pi - 2*pi;  
y = sin(x(1,1)+x(1,2))
```

```
y_hat = r(1:3)*tanh(a*tanh(a0*x(1,:)+b0)+b)+r(4)  
(y-y_hat).^2
```

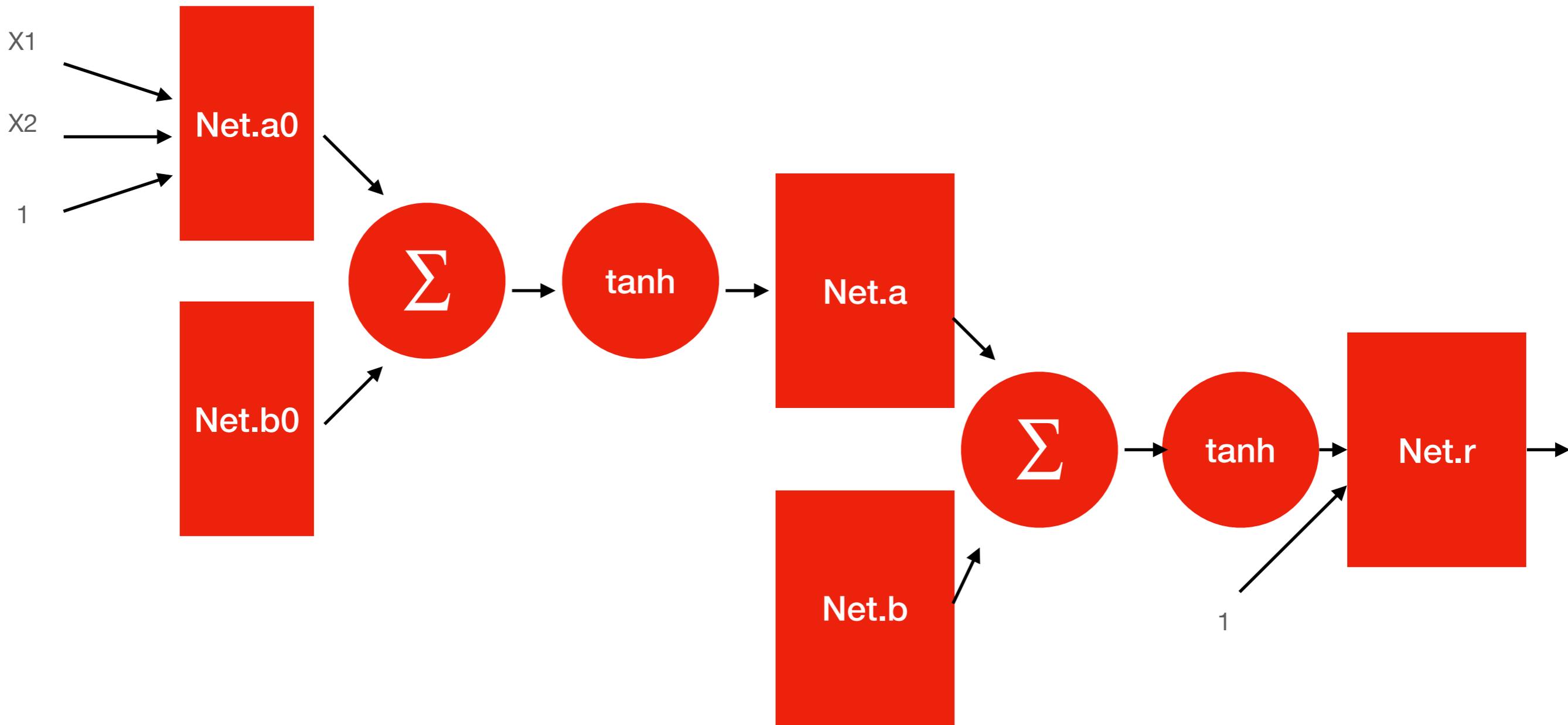
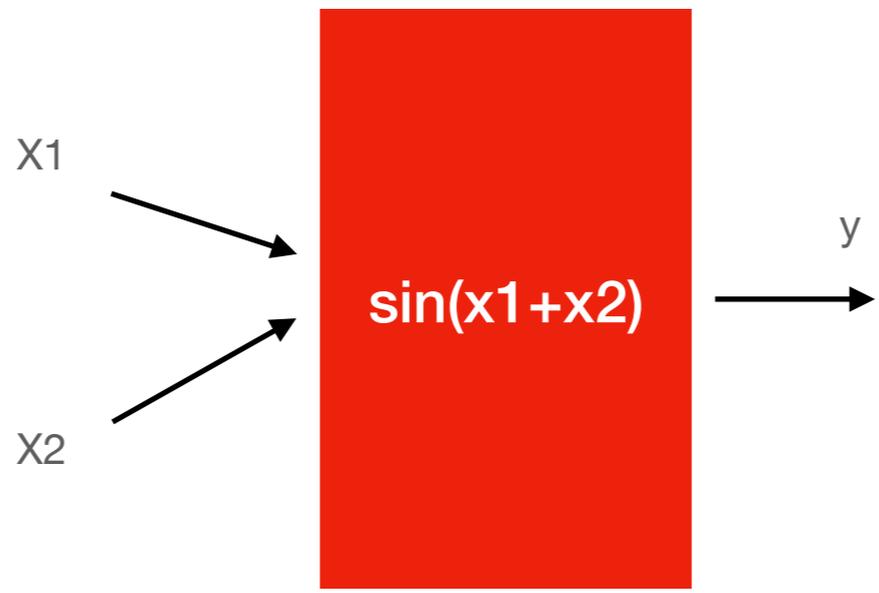
Mean square error  $10^{-6}$



$$y\_hat = r(1:3)*\tanh(a*\tanh(a0*x(1,:)'+b0)+b)+r(4)$$



Mean square error  $10^{-6}$



# 37 Adaptable parameters or synapses

