// **neuron_cluster.v**


```
// Cluster of 32 neurons

module neuroncluster (input clk, input reset_l, input ds, input read, input [3:0]register, input [15:0]data_in, input SR,input KNN, input oktolearn_in, input dci,
output dco, output id, output unclearn, output [15:0]data_out, output ready);
//
// Ready lines tree
wire ready1, ready2, ready3, ready4, ready5, ready6, ready7, ready8, ready9, ready10,  ready11, ready12 , ready13, ready14, ready15, ready16,
ready17, ready18, ready19, ready20, ready21, ready22, ready23, ready24, ready25, ready26,  ready27, ready28 , ready29, ready30, ready31, ready32;
//
assign ready= ready1 & ready2 & ready3 & ready4 & ready5 & ready6 & ready7 & ready8 & ready9 & ready10 & ready11 & ready12 & ready13 & ready14 & ready15 & ready16 &
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ready17 & ready18 & ready19 & ready20 & ready21 & ready22 & ready23 & ready24 & ready25 & ready26 & ready27
& ready28 & ready29 & ready30 & ready31 & ready32;
// Uncertain_learn lines tree
wire unclearn1, unclearn2,  unclearn3, unclearn4, unclearn5,  unclearn6, unclearn7, unclearn8, unclearn9,
unclearn10, unclearn11, unclearn12, unclearn13, unclearn14, unclearn15, unclearn16,
unclearn17, unclearn18, unclearn19, unclearn20, unclearn21,  unclearn22, unclearn23, unclearn24,
unclearn25, unclearn26, unclearn27, unclearn28, unclearn29, unclearn30, unclearn31, unclearn32;
//
assign unclearn= unclearn1 & unclearn1 & unclearn2 & unclearn3 & unclearn4 & unclearn5 & unclearn6 &
unclearn7 & unclearn8 & unclearn9 & unclearn10 & unclearn11 & unclearn12 & unclearn13 & unclearn14 &
unclearn15 & unclearn16
& unclearn17 & unclearn18 & unclearn19 & unclearn20 & unclearn21 & unclearn22 & unclearn23 & unclearn24 &
unclearn25 & unclearn26 & unclearn27 & unclearn28 & unclearn29 & unclearn30 & unclearn31 & unclearn32;
// IDentified lines tree
wire id1, id2, id3, id4, id5, id6, id7, id8, id9, id10, id11, id12, id13, id14, id15, id16,
id17, id18, id19, id20, id21, id22, id23, id24, id25, id26, id27, id28, id29, id30, id31, id32;
//
assign id= id1 | id2 | id3 | id4 | id5 | id6 | id7 | id8 | id9 | id10 | id11 | id12 | id13 | id14 | id15 |
id16 |
id17 | id18 | id19 | id20 | id21 | id22 | id23 | id24 | id25 | id26 | id27 | id28 | id29 | id30 | id31 |
id32;
// DATA Output merge it perform the global AND of each neuron output in the cluster
wire [15:0]data_out1; wire [15:0]data_out2; wire [15:0]data_out3;wire [15:0]data_out4; wire
[15:0]data_out5;wire [15:0]data_out6; wire [15:0]data_out7; wire [15:0]data_out8;
wire [15:0]data_out9; wire [15:0]data_out10;wire [15:0]data_out11; wire [15:0]data_out12;wire
[15:0]data_out13; wire [15:0]data_out14;wire [15:0]data_out15;wire [15:0]data_out16;
wire [15:0]data_out17; wire [15:0]data_out18; wire [15:0]data_out19;wire [15:0]data_out20; wire
[15:0]data_out21;wire [15:0]data_out22; wire [15:0]data_out23; wire [15:0]data_out24;
wire [15:0]data_out25; wire [15:0]data_out26;wire [15:0]data_out27; wire [15:0]data_out28;wire
[15:0]data_out29; wire [15:0]data_out30;wire [15:0]data_out31;wire [15:0]data_out32;
//
assign data_out[15:0]= data_out1[15:0] & data_out2[15:0] & data_out3[15:0] & data_out4[15:0] &
data_out5[15:0] & data_out6[15:0] & data_out7[15:0] & data_out8[15:0] & data_out9[15:0]
& data_out10[15:0] & data_out11[15:0] & data_out12[15:0] & data_out13[15:0] & data_out14[15:0] &
data_out15[15:0]& data_out16[15:0] &
data_out17[15:0] & data_out18[15:0] & data_out19[15:0] & data_out20[15:0] & data_out21[15:0] &
data_out22[15:0] & data_out23[15:0] & data_out24[15:0] & data_out25[15:0]
& data_out26[15:0] & data_out27[15:0] & data_out28[15:0] & data_out29[15:0] & data_out30[15:0] &
data_out31[15:0]& data_out32[15:0];
// Daisy chain link
```

```
wire dc1,dc2,dc3,dc4,dc5,dc6,dc7,dc8,dc9,
dc10,dc11,dc12,dc13,dc14,dc15,dc16,dc17,dc18,dc19,dc20,dc21,dc22,dc23,dc24,dc25,dc26,dc27,dc28,dc29,dc30,dc
31;
//
// Neurons body
neuron n1(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dci), .dco(dc1), .id(id1), .unclearn(unclearn1),
.data_out(data_out1), .ready(ready1));
//
neuron n2(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc1), .dco(dc2), .id(id2), .unclearn(unclearn2),
.data_out(data_out2), .ready(ready2));
//
neuron n3(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc2), .dco(dc3), .id(id3), .unclearn(unclearn3),
.data_out(data_out3), .ready(ready3));
//
neuron n4(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc3), .dco(dc4), .id(id4), .unclearn(unclearn4),
.data_out(data_out4), .ready(ready4));
//
neuron n5(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc4), .dco(dc5), .id(id5), .unclearn(unclearn5),
.data_out(data_out5), .ready(ready5));
//
neuron n6(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc5), .dco(dc6), .id(id6), .unclearn(unclearn6),
.data_out(data_out6), .ready(ready6));
//
neuron n7(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc6), .dco(dc7), .id(id7), .unclearn(unclearn7),
.data_out(data_out7), .ready(ready7));
//
```

```
neuron n8(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc7), .dco(dc8), .id(id8), .unclearn(unclearn8),
.data_out(data_out8), .ready(ready8));
//
neuron n9(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc8), .dco(dc9), .id(id9), .unclearn(unclearn9),
.data_out(data_out9), .ready(ready9));
//
neuron n10(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc9), .dco(dc10), .id(id10), .unclearn(unclearn10),
.data_out(data_out10), .ready(ready10));
//
neuron n11(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc10), .dco(dc11), .id(id11), .unclearn(unclearn11),
.data_out(data_out11), .ready(ready11));
//
neuron n12(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc11), .dco(dc12), .id(id12), .unclearn(unclearn12),
.data_out(data_out12), .ready(ready12));
//
neuron n13(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc12), .dco(dc13), .id(id13), .unclearn(unclearn13),
.data_out(data_out13), .ready(ready13));
//
neuron n14(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc13), .dco(dc14), .id(id14), .unclearn(unclearn14),
.data_out(data_out14), .ready(ready14));
//
neuron n15(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc14), .dco(dc15), .id(id15), .unclearn(unclearn15),
.data_out(data_out15), .ready(ready15));
//
```

```
neuron n16(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc15), .dco(dc16), .id(id16), .unclearn(unclearn16),
.data_out(data_out16), .ready(ready16));
//
neuron n17(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc16), .dco(dc17), .id(id17), .unclearn(unclearn17),
.data_out(data_out17), .ready(ready17));
//
neuron n18(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc17), .dco(dc18), .id(id18), .unclearn(unclearn18),
.data_out(data_out18), .ready(ready18));
//
neuron n19(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc18), .dco(dc19), .id(id19), .unclearn(unclearn19),
.data_out(data_out19), .ready(ready19));
//
neuron n20(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc19), .dco(dc20), .id(id20), .unclearn(unclearn20),
.data_out(data_out20), .ready(ready20));
//
neuron n21(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc20), .dco(dc21), .id(id21), .unclearn(unclearn21),
.data_out(data_out21), .ready(ready21));
//
neuron n22(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc21), .dco(dc22), .id(id22), .unclearn(unclearn22),
.data_out(data_out22), .ready(ready22));
//
neuron n23(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc22), .dco(dc23), .id(id23), .unclearn(unclearn23),
.data_out(data_out23), .ready(ready23));
//
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```
neuron n24(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc23), .dco(dc24), .id(id24), .unclearn(unclearn24),
.data_out(data_out24), .ready(ready24));
//
neuron n25(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc24), .dco(dc25), .id(id25), .unclearn(unclearn25),
.data_out(data_out25), .ready(ready25));
//
neuron n26(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc25), .dco(dc26), .id(id26), .unclearn(unclearn26),
.data_out(data_out26), .ready(ready26));
//
neuron n27(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc26), .dco(dc27), .id(id27), .unclearn(unclearn27),
.data_out(data_out27), .ready(ready27));
//
neuron n28(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc27), .dco(dc28), .id(id28), .unclearn(unclearn28),
.data_out(data_out28), .ready(ready28));
//
neuron n29(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc28), .dco(dc29), .id(id29), .unclearn(unclearn29),
.data_out(data_out29), .ready(ready29));
//
neuron n30(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc29), .dco(dc30), .id(id30), .unclearn(unclearn30),
.data_out(data_out30), .ready(ready30));
//
neuron n31(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc30), .dco(dc31), .id(id31), .unclearn(unclearn31),
.data_out(data_out31), .ready(ready31));
//
```

```
neuron n32(.clk(clk),.reset_l(reset_l),.ds(ds), .read(read), .register(register), .data_in(data_in),
.SR(SR), .KNN(KNN),
    .oktolearn_in(oktolearn_in), .dci(dc31), .dco(dco), .id(id32), .unclearn(unclearn32),
.data_out(data_out32), .ready(ready32));
//
endmodule
```