**《数字逻辑》实验报告**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **姓名** | |  | | **年级** | | 2022级 |
| **学号** | |  | | **专业、班级** | | 计算机科学与技术计卓1班 |
| **实验名称** | **一维卷积运算实验** | | | | | |
| **实验时间** | **2022.12.9** | | **实验地点** | | **竹四** | |
| **实验成绩** |  | | **实验性质** | | **□验证性 □设计性 □综合性** | |
| 教师评价：  □算法/实验过程正确； □源程序/实验内容提交 □程序结构/实验步骤合理；  □实验结果正确； □语法、语义正确； □报告规范；  评语：  评价教师签名（电子签名）： | | | | | | |
| 一、实验目的  1. 学习和了解卷积运算方法及应用  2. 学会利用 FPGA 开发板资源设计实现一维序列的卷积运算  3. 掌握 FPGA 开发板 VGA 显示原理，并设计实现将经过卷积运算处理前  后的两个序列显示到显示器上 | | | | | | |
| 二、实验项目内容  1. 学习卷积运算方法， 掌握一维序列的卷积运算过程。  2. 利用 FPGA 开发板资源设计实现一维序列的卷积运算。  3. 学习 VGA 显示原理及 640x480@60Hz 标准时序，设计实现 VGA 显示时  序控制模块。  4. 设计实现将经过卷积运算处理前后的两个序列波形显示到显示器上。  5、将显示的波形与计算得到的波形比较验证计算的正确性。 | | | | | | |
| 三、实验设计  **实验原理：**  离散卷积定义为，通过将h信号翻转后连续进行移位相乘、相加的操作，最终便可以得到卷积操作后的信号。  **算法图示：**    **设计思想：（以两个信号长度分别为512、4为例）**  1、信号翻转的实现。为了高效的实现信号的翻转，使用右移位寄存器，将来自输入信号源的信号在每个时钟周期内装载进移位寄存器最左端，同时数据整体右移，最终达到翻转的效果。  2、移位相乘、相加操作的实现。使用左移位寄存器储存另外一个信号，开始计算后，每次操作只针对两个信号的前4位进行操作，对两个信号的前4位对应相乘后相加得到一位结果。需要注意的是，经实验发现在两个信号分别为512、4的情况下，一个时钟周期内无法正确同时完成相乘和相加结果的计算，在最终的设计中我们在一个时钟周期内完成储存在寄存器中，在下一个时钟周期内再完成相加，作为这一位的结果。  3、结果的储存。同样使用左移位寄存器储存计算的结果。上述流程中所述得到的一位结果会存入左移位寄存器的最右端，并通过整体移位实现完整处理后信号的储存。  4、波形的显示。根据储存最终结果的寄存器中的数据，利用VGA显示原理显示各个散点的位置。  5、验证。通过初始化RAM并从RAM中按照时钟周期读取信号，形成了信号流的生成，模拟了信号快速接收情况下的计算，同时将最终波形结果与计算的真实结果比较，验证计算的正确性。  FSM状态说明：    S0为初始状态，该状态用于为RAM提供地址，一个时钟周期后状态自动转移到S1，在该状态根据地址将RAM中的数据写入寄存器中，s=1代表计算开始，进入S2状态，该状态完成对应数位的相乘，一个时钟周期后自动进入S3，该状态完成对应数的相加，当z=1时说明完成对整个信号所有位的处理，进入S4状态，代表计算完成。  **逻辑器件：**  移位寄存器：数据通路的主要器件，兼顾对数据的储存和移位的功能，本实验中两个信号和最终结果均以移位寄存器储存和处理。  计数器：本实验中使用倒数计数器计数剩余需要计算的位数，以判断计算是否结束。  乘法器、加法器：完成乘法和加法的基本器件（最终实验生成的电路中利用了DSP资源完成相关计算）。  **资源和能耗：**    资源使用情况    能耗情况 | | | | | | |
| 四、实验过程或算法  注：VGA显示模块的相关代码为使用脚本生成的代码，由于过长附在报告结尾。  module conv(clk,rst,s,done,r,g,b,hs,vs);  parameter S0=3'b000,S1=3'b001,S2=3'b010,S3=3'b011,S4=3'b100;  integer k;  input clk,rst,s;  output reg done;  output reg[3:0]r,g,b;  output hs,vs;  reg [9:0]addra;  reg [2:0]addrb;  reg[2:0]y,Y;  wire [3:0]dataa,datab;  wire z;  wire [9:0]m[3:0];  wire [9:0]p;  reg ena,enb,enm,enr,enc;  reg [9:0]siga[514:0];  reg [9:0]sigb[3:0];  reg [9:0]resultm[3:0];  reg [9:0]result[514:0];  blk\_mem\_gen\_0 bram1(  .addra(addra),.clka(clk),.dina(0),.douta(dataa),.ena(1),.wea(0)  );  blk\_mem\_gen\_1 bram2(  .addra(addrb),.clka(clk),.dina(0),.douta(datab),.ena(1),.wea(0)  );  downcount dcnt1(clk,rst,enc,z);  always @(posedge clk,negedge rst)  begin  if(!rst) y<=S0;  else y<=Y;  end  always @(y,addra,addrb)  begin  ena=0;enb=0;enm=0;enr=0;enc=0;done=0;  case(y)  S0:  begin  done=0;  end      S4:  begin  if(addra==512)ena=0;  else ena=1;  if(addrb==4)enb=0;  else enb=1;  end    S1:  begin  enc=1;  ena=1;  enm=1;  end    S2:  begin  enr=1;  end    S3: done=1;      endcase  end  always @(s,z,clk)  begin  case(y)  S0: Y<=S4;    S4:  begin  if(s)Y<=S1;  else Y<=S0;  end    S1: Y<=S2;    S2:  begin  if(z)Y<=S3;  else Y<=S1;  end    S3:  begin  if(s)Y<=S3;  else Y<=S0;  end  endcase  end  always @(posedge clk,negedge rst)  begin  if(!rst)  begin  addra<=0;  addrb<=0;  end  else if(y==S4)  begin  if(addra<=511)addra<=addra+1;  else addra<=addra;  if(addrb<=3)addrb<=addrb+1;  else addrb<=addrb;  end  end  always @(posedge clk,negedge rst)  begin  if(!rst)for(k=0;k<=514;k=k+1)siga[k]<=0;  else if(ena&(addra<=512))  begin  for(k=514;k>=1;k=k-1)siga[k]<=siga[k-1];  siga[0][3:0]<=dataa;  end  end  always @(posedge clk,negedge rst)  begin  if(!rst)for(k=0;k<=3;k=k+1)sigb[k]<=0;  else if(enb&(addrb<=4))  begin  for(k=0;k<=2;k=k+1)sigb[k]<=sigb[k+1];  sigb[3][3:0]<=datab;  end  end  always @(posedge clk,negedge rst)  begin  if(!rst)for(k=0;k<=514;k=k+1)result[k]<=0;  else if(enr)  begin  for(k=514;k>=1;k=k-1)result[k]<=result[k-1];  result[0]<=p;  end  end  always @(posedge clk,negedge rst)  begin  if(!rst)for(k=0;k<=3;k=k+1)resultm[k]<=0;  else if(enm)  begin  for(k=0;k<=3;k=k+1)resultm[k]<=m[k];  end  end  assign m[3]=siga[514]\*sigb[3];  assign m[2]=siga[513]\*sigb[2];  assign m[1]=siga[512]\*sigb[1];  assign m[0]=siga[511]\*sigb[0];  assign p=m[3]+m[2]+m[1]+m[0];  endmodule  module downcount(clk,rst,en,z);  input clk,rst,en;  output z;  reg [9:0]count;  always @(posedge clk,negedge rst)  begin  if(!rst)count<=515;  else if(en)count<=count-1;  else count<=count;  end  assign z=(count==0);  endmodule | | | | | | |
| 五、实验过程中遇到的问题及解决情况  1、使用vivado提供的RAM IP时存在读取延迟问题。使用RAM IP时发现，给予地址后，必须经过一段时延才能获得正确的数据，为了解决这一问题，本实验中将提供地址和读取数据分别放在了两个时钟周期内，最终正确实现了功能。  2、在一个时钟周期内同时进行乘法和加法时出现时序问题。该问题前文中已有较详细的说明。 | | | | | | |
| 六、实验结果及分析和（或）源程序调试过程  图1为本实验中利用FPGA计算得到的离散卷积运算后的波形    图1 实验波形卷积显示结果  图2为利用python计算并绘出的正确的波形图    图2 正确的波形卷积图示  经比较，二者形状一致，可以验证本实验计算的正确性。  七、小组分工情况说明 | | | | | | |

附录：

1、相关数据

RAM.coe

memory\_initialization\_radix=2;

memory\_initialization\_vector=

1110,

1000,

0111,

0111,

0011,

1000,

1101,

1101,

0111,

1100,

1001,

0001,

0100,

1111,

1110,

0010,

0001,

1011,

0101,

1010,

1010,

1100,

0011,

0010,

1100,

1000,

1001,

1010,

1001,

0010,

1101,

0000,

1001,

1101,

0100,

0101,

0011,

0010,

0111,

1100,

0100,

1110,

0010,

1001,

0010,

1100,

0111,

1010,

0001,

0101,

1101,

0111,

1111,

1000,

0100,

1111,

0010,

0000,

1110,

0010,

0111,

0001,

1100,

0101,

0111,

1110,

0101,

0001,

1111,

1110,

1011,

1000,

1011,

0111,

1011,

0001,

1010,

0110,

0100,

1000,

1110,

0011,

1110,

1010,

0010,

1100,

0101,

0110,

0001,

1100,

0010,

0011,

1110,

1000,

0100,

1011,

0001,

1111,

1110,

0101,

0001,

1000,

0001,

1011,

0100,

0011,

0111,

1011,

0010,

1101,

1101,

1011,

0100,

1010,

0010,

1101,

1100,

1010,

1011,

0101,

1100,

1000,

0100,

1010,

0001,

1001,

1110,

1001,

1011,

0101,

1011,

1001,

1110,

0100,

1100,

0001,

1100,

0111,

1001,

1011,

1101,

1110,

0010,

1010,

0011,

1001,

1111,

1101,

0100,

1110,

1010,

0100,

1101,

0010,

0010,

1110,

1110,

1010,

0111,

1000,

1110,

1110,

0001,

1001,

1101,

1101,

0111,

1110,

1001,

1100,

1001,

1110,

1100,

0001,

0001,

1010,

0101,

1100,

0110,

0111,

0111,

1110,

1111,

1010,

0011,

1101,

1001,

0110,

1001,

0010,

1101,

1011,

1011,

1011,

0010,

1111,

1100,

0000,

0010,

0101,

0000,

1011,

0000,

0010,

0010,

1000,

0101,

0011,

0010,

1110,

1101,

1011,

1010,

1010,

0100,

0110,

0111,

1011,

1000,

0100,

0101,

0101,

0110,

0010,

1100,

0101,

0001,

1101,

0110,

0010,

1101,

0010,

0011,

1111,

1001,

1111,

0110,

0101,

1010,

0011,

0110,

1101,

1100,

1010,

1111,

0100,

1001,

0010,

0001,

1111,

0001,

0100,

1001,

1101,

0010,

1110,

0111,

0101,

1001,

0010,

0110,

1100,

0010,

1000,

0000,

1110,

1001,

0110,

0110,

0110,

1100,

0111,

0010,

0011,

0010,

1011,

0001,

0001,

0100,

0000,

1010,

0001,

1100,

1100,

0001,

0011,

0000,

1011,

0110,

1111,

1001,

1100,

1001,

0001,

0000,

0100,

1011,

0100,

1101,

0111,

0111,

0010,

0110,

0101,

1111,

0110,

1111,

1111,

1010,

1110,

1100,

1000,

0011,

0101,

1011,

0010,

0100,

0001,

1111,

0011,

1011,

1001,

0111,

1011,

1111,

0101,

1001,

0011,

1101,

0100,

1011,

1010,

1111,

0101,

1110,

0111,

0010,

1001,

1101,

0010,

1011,

1010,

0111,

0011,

1100,

0011,

1100,

0000,

1001,

0000,

0111,

1011,

0100,

1101,

0001,

1001,

1010,

1111,

0101,

0001,

0101,

1111,

0010,

1000,

0110,

0011,

1111,

1111,

1111,

0001,

0110,

0111,

0110,

0000,

0001,

1001,

0100,

1001,

1110,

0010,

1111,

1100,

1010,

0010,

1111,

1101,

1110,

1110,

1010,

0100,

0111,

1111,

1100,

0110,

1101,

0101,

1001,

0111,

1001,

1001,

0100,

0010,

1001,

1110,

0111,

0010,

0100,

1010,

1011,

0010,

0000,

0101,

0101,

1100,

0100,

0010,

1110,

0101,

0010,

0101,

0101,

1101,

1111,

0100,

1011,

1011,

1010,

0000,

0110,

0101,

0101,

0010,

0110,

0010,

0101,

1101,

1001,

1110,

0110,

0011,

0000,

1100,

0110,

1110,

0110,

1111,

0100,

1110,

1111,

1111,

0110,

1100,

1110,

1011,

0001,

0001,

0011,

1111,

0101,

0111,

1110,

0111,

1000,

0111,

0010,

1000,

1101,

1101,

1000,

0000,

0011,

0010,

0100,

1000,

1111,

0010,

1011,

1101,

1100,

0101,

0111,

1011,

1000,

1111,

1010,

0111,

0100,

1100,

1000,

1011,

0101,

0101,

1010,

0111,

1110,

0101,

0010,

0111,

0101,

1011,

1000,

1000,

0000,

1100,

1000,

0011,

1100,

1010,

0001,

1110,

1100,

0100;

RAM1.coe

memory\_initialization\_radix=2;

memory\_initialization\_vector=

0010,

1010,

0110,

1001;

2、VGA显示相关代码

parameter UP\_BOUND = 31;

parameter DOWN\_BOUND = 510;

parameter LEFT\_BOUND = 144;

parameter RIGHT\_BOUND = 783;

parameter up\_pos = 211;

parameter down\_pos = 330;

parameter left\_pos = 384;

parameter right\_pos = 543;

wire pclk;

reg [1:0] count;

reg [9:0] hcount, vcount;

assign pclk = count[1];

always @ (posedge clk or negedge rst)

begin

if (!rst)

count <= 0;

else

count <= count+1;

end

assign hs = (hcount < 96) ? 0 : 1;

always @ (posedge pclk or negedge rst)

begin

if (!rst)

hcount <= 0;

else if (hcount == 799)

hcount <= 0;

else

hcount <= hcount+1;

end

assign vs = (vcount < 2) ? 0 : 1;

always @ (posedge pclk or negedge rst)

begin

if (!rst)

vcount <= 0;

else if (hcount == 799) begin

if (vcount == 520)

vcount <= 0;

else

vcount <= vcount+1;

end

else

vcount <= vcount;

end

always @ (posedge pclk or negedge rst)

begin

if (!rst) begin

r <= 0;

g <= 0;

b <= 0;

end

else if (vcount>=UP\_BOUND && vcount<=DOWN\_BOUND

&& hcount>=LEFT\_BOUND && hcount<=RIGHT\_BOUND) begin

if(vcount==300||((hcount==150+0)&&(vcount==300-result[0]/8))||((hcount==150+2)&&(vcount==300-result[1]/8))||((hcount==150+4)&&(vcount==300-result[2]/8))||((hcount==150+6)&&(vcount==300-result[3]/8))||((hcount==150+8)&&(vcount==300-result[4]/8))||((hcount==150+10)&&(vcount==300-result[5]/8))||((hcount==150+12)&&(vcount==300-result[6]/8))||((hcount==150+14)&&(vcount==300-result[7]/8))||((hcount==150+16)&&(vcount==300-result[8]/8))||((hcount==150+18)&&(vcount==300-result[9]/8))||((hcount==150+20)&&(vcount==300-result[10]/8))||((hcount==150+22)&&(vcount==300-result[11]/8))||((hcount==150+24)&&(vcount==300-result[12]/8))||((hcount==150+26)&&(vcount==300-result[13]/8))||((hcount==150+28)&&(vcount==300-result[14]/8))||((hcount==150+30)&&(vcount==300-result[15]/8))||((hcount==150+32)&&(vcount==300-result[16]/8))||((hcount==150+34)&&(vcount==300-result[17]/8))||((hcount==150+36)&&(vcount==300-result[18]/8))||((hcount==150+38)&&(vcount==300-result[19]/8))||((hcount==150+40)&&(vcount==300-result[20]/8))||((hcount==150+42)&&(vcount==300-result[21]/8))||((hcount==150+44)&&(vcount==300-result[22]/8))||((hcount==150+46)&&(vcount==300-result[23]/8))||((hcount==150+48)&&(vcount==300-result[24]/8))||((hcount==150+50)&&(vcount==300-result[25]/8))||((hcount==150+52)&&(vcount==300-result[26]/8))||((hcount==150+54)&&(vcount==300-result[27]/8))||((hcount==150+56)&&(vcount==300-result[28]/8))||((hcount==150+58)&&(vcount==300-result[29]/8))||((hcount==150+60)&&(vcount==300-result[30]/8))||((hcount==150+62)&&(vcount==300-result[31]/8))||((hcount==150+64)&&(vcount==300-result[32]/8))||((hcount==150+66)&&(vcount==300-result[33]/8))||((hcount==150+68)&&(vcount==300-result[34]/8))||((hcount==150+70)&&(vcount==300-result[35]/8))||((hcount==150+72)&&(vcount==300-result[36]/8))||((hcount==150+74)&&(vcount==300-result[37]/8))||((hcount==150+76)&&(vcount==300-result[38]/8))||((hcount==150+78)&&(vcount==300-result[39]/8))||((hcount==150+80)&&(vcount==300-result[40]/8))||((hcount==150+82)&&(vcount==300-result[41]/8))||((hcount==150+84)&&(vcount==300-result[42]/8))||((hcount==150+86)&&(vcount==300-result[43]/8))||((hcount==150+88)&&(vcount==300-result[44]/8))||((hcount==150+90)&&(vcount==300-result[45]/8))||((hcount==150+92)&&(vcount==300-result[46]/8))||((hcount==150+94)&&(vcount==300-result[47]/8))||((hcount==150+96)&&(vcount==300-result[48]/8))||((hcount==150+98)&&(vcount==300-result[49]/8))||((hcount==150+100)&&(vcount==300-result[50]/8))||((hcount==150+102)&&(vcount==300-result[51]/8))||((hcount==150+104)&&(vcount==300-result[52]/8))||((hcount==150+106)&&(vcount==300-result[53]/8))||((hcount==150+108)&&(vcount==300-result[54]/8))||((hcount==150+110)&&(vcount==300-result[55]/8))||((hcount==150+112)&&(vcount==300-result[56]/8))||((hcount==150+114)&&(vcount==300-result[57]/8))||((hcount==150+116)&&(vcount==300-result[58]/8))||((hcount==150+118)&&(vcount==300-result[59]/8))||((hcount==150+120)&&(vcount==300-result[60]/8))||((hcount==150+122)&&(vcount==300-result[61]/8))||((hcount==150+124)&&(vcount==300-result[62]/8))||((hcount==150+126)&&(vcount==300-result[63]/8))||((hcount==150+128)&&(vcount==300-result[64]/8))||((hcount==150+130)&&(vcount==300-result[65]/8))||((hcount==150+132)&&(vcount==300-result[66]/8))||((hcount==150+134)&&(vcount==300-result[67]/8))||((hcount==150+136)&&(vcount==300-result[68]/8))||((hcount==150+138)&&(vcount==300-result[69]/8))||((hcount==150+140)&&(vcount==300-result[70]/8))||((hcount==150+142)&&(vcount==300-result[71]/8))||((hcount==150+144)&&(vcount==300-result[72]/8))||((hcount==150+146)&&(vcount==300-result[73]/8))||((hcount==150+148)&&(vcount==300-result[74]/8))||((hcount==150+150)&&(vcount==300-result[75]/8))||((hcount==150+152)&&(vcount==300-result[76]/8))||((hcount==150+154)&&(vcount==300-result[77]/8))||((hcount==150+156)&&(vcount==300-result[78]/8))||((hcount==150+158)&&(vcount==300-result[79]/8))||((hcount==150+160)&&(vcount==300-result[80]/8))||((hcount==150+162)&&(vcount==300-result[81]/8))||((hcount==150+164)&&(vcount==300-result[82]/8))||((hcount==150+166)&&(vcount==300-result[83]/8))||((hcount==150+168)&&(vcount==300-result[84]/8))||((hcount==150+170)&&(vcount==300-result[85]/8))||((hcount==150+172)&&(vcount==300-result[86]/8))||((hcount==150+174)&&(vcount==300-result[87]/8))||((hcount==150+176)&&(vcount==300-result[88]/8))||((hcount==150+178)&&(vcount==300-result[89]/8))||((hcount==150+180)&&(vcount==300-result[90]/8))||((hcount==150+182)&&(vcount==300-result[91]/8))||((hcount==150+184)&&(vcount==300-result[92]/8))||((hcount==150+186)&&(vcount==300-result[93]/8))||((hcount==150+188)&&(vcount==300-result[94]/8))||((hcount==150+190)&&(vcount==300-result[95]/8))||((hcount==150+192)&&(vcount==300-result[96]/8))||((hcount==150+194)&&(vcount==300-result[97]/8))||((hcount==150+196)&&(vcount==300-result[98]/8))||((hcount==150+198)&&(vcount==300-result[99]/8))||((hcount==150+200)&&(vcount==300-result[100]/8))||((hcount==150+202)&&(vcount==300-result[101]/8))||((hcount==150+204)&&(vcount==300-result[102]/8))||((hcount==150+206)&&(vcount==300-result[103]/8))||((hcount==150+208)&&(vcount==300-result[104]/8))||((hcount==150+210)&&(vcount==300-result[105]/8))||((hcount==150+212)&&(vcount==300-result[106]/8))||((hcount==150+214)&&(vcount==300-result[107]/8))||((hcount==150+216)&&(vcount==300-result[108]/8))||((hcount==150+218)&&(vcount==300-result[109]/8))||((hcount==150+220)&&(vcount==300-result[110]/8))||((hcount==150+222)&&(vcount==300-result[111]/8))||((hcount==150+224)&&(vcount==300-result[112]/8))||((hcount==150+226)&&(vcount==300-result[113]/8))||((hcount==150+228)&&(vcount==300-result[114]/8))||((hcount==150+230)&&(vcount==300-result[115]/8))||((hcount==150+232)&&(vcount==300-result[116]/8))||((hcount==150+234)&&(vcount==300-result[117]/8))||((hcount==150+236)&&(vcount==300-result[118]/8))||((hcount==150+238)&&(vcount==300-result[119]/8))||((hcount==150+240)&&(vcount==300-result[120]/8))||((hcount==150+242)&&(vcount==300-result[121]/8))||((hcount==150+244)&&(vcount==300-result[122]/8))||((hcount==150+246)&&(vcount==300-result[123]/8))||((hcount==150+248)&&(vcount==300-result[124]/8))||((hcount==150+250)&&(vcount==300-result[125]/8))||((hcount==150+252)&&(vcount==300-result[126]/8))||((hcount==150+254)&&(vcount==300-result[127]/8))||((hcount==150+256)&&(vcount==300-result[128]/8))||((hcount==150+258)&&(vcount==300-result[129]/8))||((hcount==150+260)&&(vcount==300-result[130]/8))||((hcount==150+262)&&(vcount==300-result[131]/8))||((hcount==150+264)&&(vcount==300-result[132]/8))||((hcount==150+266)&&(vcount==300-result[133]/8))||((hcount==150+268)&&(vcount==300-result[134]/8))||((hcount==150+270)&&(vcount==300-result[135]/8))||((hcount==150+272)&&(vcount==300-result[136]/8))||((hcount==150+274)&&(vcount==300-result[137]/8))||((hcount==150+276)&&(vcount==300-result[138]/8))||((hcount==150+278)&&(vcount==300-result[139]/8))||((hcount==150+280)&&(vcount==300-result[140]/8))||((hcount==150+282)&&(vcount==300-result[141]/8))||((hcount==150+284)&&(vcount==300-result[142]/8))||((hcount==150+286)&&(vcount==300-result[143]/8))||((hcount==150+288)&&(vcount==300-result[144]/8))||((hcount==150+290)&&(vcount==300-result[145]/8))||((hcount==150+292)&&(vcount==300-result[146]/8))||((hcount==150+294)&&(vcount==300-result[147]/8))||((hcount==150+296)&&(vcount==300-result[148]/8))||((hcount==150+298)&&(vcount==300-result[149]/8))||((hcount==150+300)&&(vcount==300-result[150]/8))||((hcount==150+302)&&(vcount==300-result[151]/8))||((hcount==150+304)&&(vcount==300-result[152]/8))||((hcount==150+306)&&(vcount==300-result[153]/8))||((hcount==150+308)&&(vcount==300-result[154]/8))||((hcount==150+310)&&(vcount==300-result[155]/8))||((hcount==150+312)&&(vcount==300-result[156]/8))||((hcount==150+314)&&(vcount==300-result[157]/8))||((hcount==150+316)&&(vcount==300-result[158]/8))||((hcount==150+318)&&(vcount==300-result[159]/8))||((hcount==150+320)&&(vcount==300-result[160]/8))||((hcount==150+322)&&(vcount==300-result[161]/8))||((hcount==150+324)&&(vcount==300-result[162]/8))||((hcount==150+326)&&(vcount==300-result[163]/8))||((hcount==150+328)&&(vcount==300-result[164]/8))||((hcount==150+330)&&(vcount==300-result[165]/8))||((hcount==150+332)&&(vcount==300-result[166]/8))||((hcount==150+334)&&(vcount==300-result[167]/8))||((hcount==150+336)&&(vcount==300-result[168]/8))||((hcount==150+338)&&(vcount==300-result[169]/8))||((hcount==150+340)&&(vcount==300-result[170]/8))||((hcount==150+342)&&(vcount==300-result[171]/8))||((hcount==150+344)&&(vcount==300-result[172]/8))||((hcount==150+346)&&(vcount==300-result[173]/8))||((hcount==150+348)&&(vcount==300-result[174]/8))||((hcount==150+350)&&(vcount==300-result[175]/8))||((hcount==150+352)&&(vcount==300-result[176]/8))||((hcount==150+354)&&(vcount==300-result[177]/8))||((hcount==150+356)&&(vcount==300-result[178]/8))||((hcount==150+358)&&(vcount==300-result[179]/8))||((hcount==150+360)&&(vcount==300-result[180]/8))||((hcount==150+362)&&(vcount==300-result[181]/8))||((hcount==150+364)&&(vcount==300-result[182]/8))||((hcount==150+366)&&(vcount==300-result[183]/8))||((hcount==150+368)&&(vcount==300-result[184]/8))||((hcount==150+370)&&(vcount==300-result[185]/8))||((hcount==150+372)&&(vcount==300-result[186]/8))||((hcount==150+374)&&(vcount==300-result[187]/8))||((hcount==150+376)&&(vcount==300-result[188]/8))||((hcount==150+378)&&(vcount==300-result[189]/8))||((hcount==150+380)&&(vcount==300-result[190]/8))||((hcount==150+382)&&(vcount==300-result[191]/8))||((hcount==150+384)&&(vcount==300-result[192]/8))||((hcount==150+386)&&(vcount==300-result[193]/8))||((hcount==150+388)&&(vcount==300-result[194]/8))||((hcount==150+390)&&(vcount==300-result[195]/8))||((hcount==150+392)&&(vcount==300-result[196]/8))||((hcount==150+394)&&(vcount==300-result[197]/8))||((hcount==150+396)&&(vcount==300-result[198]/8))||((hcount==150+398)&&(vcount==300-result[199]/8))||((hcount==150+400)&&(vcount==300-result[200]/8))||((hcount==150+402)&&(vcount==300-result[201]/8))||((hcount==150+404)&&(vcount==300-result[202]/8))||((hcount==150+406)&&(vcount==300-result[203]/8))||((hcount==150+408)&&(vcount==300-result[204]/8))||((hcount==150+410)&&(vcount==300-result[205]/8))||((hcount==150+412)&&(vcount==300-result[206]/8))||((hcount==150+414)&&(vcount==300-result[207]/8))||((hcount==150+416)&&(vcount==300-result[208]/8))||((hcount==150+418)&&(vcount==300-result[209]/8))||((hcount==150+420)&&(vcount==300-result[210]/8))||((hcount==150+422)&&(vcount==300-result[211]/8))||((hcount==150+424)&&(vcount==300-result[212]/8))||((hcount==150+426)&&(vcount==300-result[213]/8))||((hcount==150+428)&&(vcount==300-result[214]/8))||((hcount==150+430)&&(vcount==300-result[215]/8))||((hcount==150+432)&&(vcount==300-result[216]/8))||((hcount==150+434)&&(vcount==300-result[217]/8))||((hcount==150+436)&&(vcount==300-result[218]/8))||((hcount==150+438)&&(vcount==300-result[219]/8))||((hcount==150+440)&&(vcount==300-result[220]/8))||((hcount==150+442)&&(vcount==300-result[221]/8))||((hcount==150+444)&&(vcount==300-result[222]/8))||((hcount==150+446)&&(vcount==300-result[223]/8))||((hcount==150+448)&&(vcount==300-result[224]/8))||((hcount==150+450)&&(vcount==300-result[225]/8))||((hcount==150+452)&&(vcount==300-result[226]/8))||((hcount==150+454)&&(vcount==300-result[227]/8))||((hcount==150+456)&&(vcount==300-result[228]/8))||((hcount==150+458)&&(vcount==300-result[229]/8))||((hcount==150+460)&&(vcount==300-result[230]/8))||((hcount==150+462)&&(vcount==300-result[231]/8))||((hcount==150+464)&&(vcount==300-result[232]/8))||((hcount==150+466)&&(vcount==300-result[233]/8))||((hcount==150+468)&&(vcount==300-result[234]/8))||((hcount==150+470)&&(vcount==300-result[235]/8))||((hcount==150+472)&&(vcount==300-result[236]/8))||((hcount==150+474)&&(vcount==300-result[237]/8))||((hcount==150+476)&&(vcount==300-result[238]/8))||((hcount==150+478)&&(vcount==300-result[239]/8))||((hcount==150+480)&&(vcount==300-result[240]/8))||((hcount==150+482)&&(vcount==300-result[241]/8))||((hcount==150+484)&&(vcount==300-result[242]/8))||((hcount==150+486)&&(vcount==300-result[243]/8))||((hcount==150+488)&&(vcount==300-result[244]/8))||((hcount==150+490)&&(vcount==300-result[245]/8))||((hcount==150+492)&&(vcount==300-result[246]/8))||((hcount==150+494)&&(vcount==300-result[247]/8))||((hcount==150+496)&&(vcount==300-result[248]/8))||((hcount==150+498)&&(vcount==300-result[249]/8))||((hcount==150+500)&&(vcount==300-result[250]/8))||((hcount==150+502)&&(vcount==300-result[251]/8))||((hcount==150+504)&&(vcount==300-result[252]/8))||((hcount==150+506)&&(vcount==300-result[253]/8))||((hcount==150+508)&&(vcount==300-result[254]/8))||((hcount==150+510)&&(vcount==300-result[255]/8))||((hcount==150+512)&&(vcount==300-result[256]/8))||((hcount==150+514)&&(vcount==300-result[257]/8))||((hcount==150+516)&&(vcount==300-result[258]/8))||((hcount==150+518)&&(vcount==300-result[259]/8))||((hcount==150+520)&&(vcount==300-result[260]/8))||((hcount==150+522)&&(vcount==300-result[261]/8))||((hcount==150+524)&&(vcount==300-result[262]/8))||((hcount==150+526)&&(vcount==300-result[263]/8))||((hcount==150+528)&&(vcount==300-result[264]/8))||((hcount==150+530)&&(vcount==300-result[265]/8))||((hcount==150+532)&&(vcount==300-result[266]/8))||((hcount==150+534)&&(vcount==300-result[267]/8))||((hcount==150+536)&&(vcount==300-result[268]/8))||((hcount==150+538)&&(vcount==300-result[269]/8))||((hcount==150+540)&&(vcount==300-result[270]/8))||((hcount==150+542)&&(vcount==300-result[271]/8))||((hcount==150+544)&&(vcount==300-result[272]/8))||((hcount==150+546)&&(vcount==300-result[273]/8))||((hcount==150+548)&&(vcount==300-result[274]/8))||((hcount==150+550)&&(vcount==300-result[275]/8))||((hcount==150+552)&&(vcount==300-result[276]/8))||((hcount==150+554)&&(vcount==300-result[277]/8))||((hcount==150+556)&&(vcount==300-result[278]/8))||((hcount==150+558)&&(vcount==300-result[279]/8))||((hcount==150+560)&&(vcount==300-result[280]/8))||((hcount==150+562)&&(vcount==300-result[281]/8))||((hcount==150+564)&&(vcount==300-result[282]/8))||((hcount==150+566)&&(vcount==300-result[283]/8))||((hcount==150+568)&&(vcount==300-result[284]/8))||((hcount==150+570)&&(vcount==300-result[285]/8))||((hcount==150+572)&&(vcount==300-result[286]/8))||((hcount==150+574)&&(vcount==300-result[287]/8))||((hcount==150+576)&&(vcount==300-result[288]/8))||((hcount==150+578)&&(vcount==300-result[289]/8))||((hcount==150+580)&&(vcount==300-result[290]/8))||((hcount==150+582)&&(vcount==300-result[291]/8))||((hcount==150+584)&&(vcount==300-result[292]/8))||((hcount==150+586)&&(vcount==300-result[293]/8))||((hcount==150+588)&&(vcount==300-result[294]/8))||((hcount==150+590)&&(vcount==300-result[295]/8))||((hcount==150+592)&&(vcount==300-result[296]/8))||((hcount==150+594)&&(vcount==300-result[297]/8))||((hcount==150+596)&&(vcount==300-result[298]/8))||((hcount==150+598)&&(vcount==300-result[299]/8))||((hcount==150+600)&&(vcount==300-result[300]/8))||((hcount==150+602)&&(vcount==300-result[301]/8))||((hcount==150+604)&&(vcount==300-result[302]/8))||((hcount==150+606)&&(vcount==300-result[303]/8))||((hcount==150+608)&&(vcount==300-result[304]/8))||((hcount==150+610)&&(vcount==300-result[305]/8))||((hcount==150+612)&&(vcount==300-result[306]/8))||((hcount==150+614)&&(vcount==300-result[307]/8))||((hcount==150+616)&&(vcount==300-result[308]/8))||((hcount==150+618)&&(vcount==300-result[309]/8))||((hcount==150+620)&&(vcount==300-result[310]/8))||((hcount==150+622)&&(vcount==300-result[311]/8))||((hcount==150+624)&&(vcount==300-result[312]/8))||((hcount==150+626)&&(vcount==300-result[313]/8))||((hcount==150+628)&&(vcount==300-result[314]/8))||((hcount==150+630)&&(vcount==300-result[315]/8))||((hcount==150+632)&&(vcount==300-result[316]/8))||((hcount==150+634)&&(vcount==300-result[317]/8))||((hcount==150+636)&&(vcount==300-result[318]/8))||((hcount==150+638)&&(vcount==300-result[319]/8))||((hcount==150+640)&&(vcount==300-result[320]/8))||((hcount==150+642)&&(vcount==300-result[321]/8))||((hcount==150+644)&&(vcount==300-result[322]/8))||((hcount==150+646)&&(vcount==300-result[323]/8))||((hcount==150+648)&&(vcount==300-result[324]/8))||((hcount==150+650)&&(vcount==300-result[325]/8))||((hcount==150+652)&&(vcount==300-result[326]/8))||((hcount==150+654)&&(vcount==300-result[327]/8))||((hcount==150+656)&&(vcount==300-result[328]/8))||((hcount==150+658)&&(vcount==300-result[329]/8))||((hcount==150+660)&&(vcount==300-result[330]/8))||((hcount==150+662)&&(vcount==300-result[331]/8))||((hcount==150+664)&&(vcount==300-result[332]/8))||((hcount==150+666)&&(vcount==300-result[333]/8))||((hcount==150+668)&&(vcount==300-result[334]/8))||((hcount==150+670)&&(vcount==300-result[335]/8))||((hcount==150+672)&&(vcount==300-result[336]/8))||((hcount==150+674)&&(vcount==300-result[337]/8))||((hcount==150+676)&&(vcount==300-result[338]/8))||((hcount==150+678)&&(vcount==300-result[339]/8))||((hcount==150+680)&&(vcount==300-result[340]/8))||((hcount==150+682)&&(vcount==300-result[341]/8))||((hcount==150+684)&&(vcount==300-result[342]/8))||((hcount==150+686)&&(vcount==300-result[343]/8))||((hcount==150+688)&&(vcount==300-result[344]/8))||((hcount==150+690)&&(vcount==300-result[345]/8))||((hcount==150+692)&&(vcount==300-result[346]/8))||((hcount==150+694)&&(vcount==300-result[347]/8))||((hcount==150+696)&&(vcount==300-result[348]/8))||((hcount==150+698)&&(vcount==300-result[349]/8))||((hcount==150+700)&&(vcount==300-result[350]/8))||((hcount==150+702)&&(vcount==300-result[351]/8))||((hcount==150+704)&&(vcount==300-result[352]/8))||((hcount==150+706)&&(vcount==300-result[353]/8))||((hcount==150+708)&&(vcount==300-result[354]/8))||((hcount==150+710)&&(vcount==300-result[355]/8))||((hcount==150+712)&&(vcount==300-result[356]/8))||((hcount==150+714)&&(vcount==300-result[357]/8))||((hcount==150+716)&&(vcount==300-result[358]/8))||((hcount==150+718)&&(vcount==300-result[359]/8))||((hcount==150+720)&&(vcount==300-result[360]/8))||((hcount==150+722)&&(vcount==300-result[361]/8))||((hcount==150+724)&&(vcount==300-result[362]/8))||((hcount==150+726)&&(vcount==300-result[363]/8))||((hcount==150+728)&&(vcount==300-result[364]/8))||((hcount==150+730)&&(vcount==300-result[365]/8))||((hcount==150+732)&&(vcount==300-result[366]/8))||((hcount==150+734)&&(vcount==300-result[367]/8))||((hcount==150+736)&&(vcount==300-result[368]/8))||((hcount==150+738)&&(vcount==300-result[369]/8))||((hcount==150+740)&&(vcount==300-result[370]/8))||((hcount==150+742)&&(vcount==300-result[371]/8))||((hcount==150+744)&&(vcount==300-result[372]/8))||((hcount==150+746)&&(vcount==300-result[373]/8))||((hcount==150+748)&&(vcount==300-result[374]/8))||((hcount==150+750)&&(vcount==300-result[375]/8))||((hcount==150+752)&&(vcount==300-result[376]/8))||((hcount==150+754)&&(vcount==300-result[377]/8))||((hcount==150+756)&&(vcount==300-result[378]/8))||((hcount==150+758)&&(vcount==300-result[379]/8))||((hcount==150+760)&&(vcount==300-result[380]/8))||((hcount==150+762)&&(vcount==300-result[381]/8))||((hcount==150+764)&&(vcount==300-result[382]/8))||((hcount==150+766)&&(vcount==300-result[383]/8))||((hcount==150+768)&&(vcount==300-result[384]/8))||((hcount==150+770)&&(vcount==300-result[385]/8))||((hcount==150+772)&&(vcount==300-result[386]/8))||((hcount==150+774)&&(vcount==300-result[387]/8))||((hcount==150+776)&&(vcount==300-result[388]/8))||((hcount==150+778)&&(vcount==300-result[389]/8))||((hcount==150+780)&&(vcount==300-result[390]/8))||((hcount==150+782)&&(vcount==300-result[391]/8))||((hcount==150+784)&&(vcount==300-result[392]/8))||((hcount==150+786)&&(vcount==300-result[393]/8))||((hcount==150+788)&&(vcount==300-result[394]/8))||((hcount==150+790)&&(vcount==300-result[395]/8))||((hcount==150+792)&&(vcount==300-result[396]/8))||((hcount==150+794)&&(vcount==300-result[397]/8))||((hcount==150+796)&&(vcount==300-result[398]/8))||((hcount==150+798)&&(vcount==300-result[399]/8))||((hcount==150+800)&&(vcount==300-result[400]/8))||((hcount==150+802)&&(vcount==300-result[401]/8))||((hcount==150+804)&&(vcount==300-result[402]/8))||((hcount==150+806)&&(vcount==300-result[403]/8))||((hcount==150+808)&&(vcount==300-result[404]/8))||((hcount==150+810)&&(vcount==300-result[405]/8))||((hcount==150+812)&&(vcount==300-result[406]/8))||((hcount==150+814)&&(vcount==300-result[407]/8))||((hcount==150+816)&&(vcount==300-result[408]/8))||((hcount==150+818)&&(vcount==300-result[409]/8))||((hcount==150+820)&&(vcount==300-result[410]/8))||((hcount==150+822)&&(vcount==300-result[411]/8))||((hcount==150+824)&&(vcount==300-result[412]/8))||((hcount==150+826)&&(vcount==300-result[413]/8))||((hcount==150+828)&&(vcount==300-result[414]/8))||((hcount==150+830)&&(vcount==300-result[415]/8))||((hcount==150+832)&&(vcount==300-result[416]/8))||((hcount==150+834)&&(vcount==300-result[417]/8))||((hcount==150+836)&&(vcount==300-result[418]/8))||((hcount==150+838)&&(vcount==300-result[419]/8))||((hcount==150+840)&&(vcount==300-result[420]/8))||((hcount==150+842)&&(vcount==300-result[421]/8))||((hcount==150+844)&&(vcount==300-result[422]/8))||((hcount==150+846)&&(vcount==300-result[423]/8))||((hcount==150+848)&&(vcount==300-result[424]/8))||((hcount==150+850)&&(vcount==300-result[425]/8))||((hcount==150+852)&&(vcount==300-result[426]/8))||((hcount==150+854)&&(vcount==300-result[427]/8))||((hcount==150+856)&&(vcount==300-result[428]/8))||((hcount==150+858)&&(vcount==300-result[429]/8))||((hcount==150+860)&&(vcount==300-result[430]/8))||((hcount==150+862)&&(vcount==300-result[431]/8))||((hcount==150+864)&&(vcount==300-result[432]/8))||((hcount==150+866)&&(vcount==300-result[433]/8))||((hcount==150+868)&&(vcount==300-result[434]/8))||((hcount==150+870)&&(vcount==300-result[435]/8))||((hcount==150+872)&&(vcount==300-result[436]/8))||((hcount==150+874)&&(vcount==300-result[437]/8))||((hcount==150+876)&&(vcount==300-result[438]/8))||((hcount==150+878)&&(vcount==300-result[439]/8))||((hcount==150+880)&&(vcount==300-result[440]/8))||((hcount==150+882)&&(vcount==300-result[441]/8))||((hcount==150+884)&&(vcount==300-result[442]/8))||((hcount==150+886)&&(vcount==300-result[443]/8))||((hcount==150+888)&&(vcount==300-result[444]/8))||((hcount==150+890)&&(vcount==300-result[445]/8))||((hcount==150+892)&&(vcount==300-result[446]/8))||((hcount==150+894)&&(vcount==300-result[447]/8))||((hcount==150+896)&&(vcount==300-result[448]/8))||((hcount==150+898)&&(vcount==300-result[449]/8))||((hcount==150+900)&&(vcount==300-result[450]/8))||((hcount==150+902)&&(vcount==300-result[451]/8))||((hcount==150+904)&&(vcount==300-result[452]/8))||((hcount==150+906)&&(vcount==300-result[453]/8))||((hcount==150+908)&&(vcount==300-result[454]/8))||((hcount==150+910)&&(vcount==300-result[455]/8))||((hcount==150+912)&&(vcount==300-result[456]/8))||((hcount==150+914)&&(vcount==300-result[457]/8))||((hcount==150+916)&&(vcount==300-result[458]/8))||((hcount==150+918)&&(vcount==300-result[459]/8))||((hcount==150+920)&&(vcount==300-result[460]/8))||((hcount==150+922)&&(vcount==300-result[461]/8))||((hcount==150+924)&&(vcount==300-result[462]/8))||((hcount==150+926)&&(vcount==300-result[463]/8))||((hcount==150+928)&&(vcount==300-result[464]/8))||((hcount==150+930)&&(vcount==300-result[465]/8))||((hcount==150+932)&&(vcount==300-result[466]/8))||((hcount==150+934)&&(vcount==300-result[467]/8))||((hcount==150+936)&&(vcount==300-result[468]/8))||((hcount==150+938)&&(vcount==300-result[469]/8))||((hcount==150+940)&&(vcount==300-result[470]/8))||((hcount==150+942)&&(vcount==300-result[471]/8))||((hcount==150+944)&&(vcount==300-result[472]/8))||((hcount==150+946)&&(vcount==300-result[473]/8))||((hcount==150+948)&&(vcount==300-result[474]/8))||((hcount==150+950)&&(vcount==300-result[475]/8))||((hcount==150+952)&&(vcount==300-result[476]/8))||((hcount==150+954)&&(vcount==300-result[477]/8))||((hcount==150+956)&&(vcount==300-result[478]/8))||((hcount==150+958)&&(vcount==300-result[479]/8))||((hcount==150+960)&&(vcount==300-result[480]/8))||((hcount==150+962)&&(vcount==300-result[481]/8))||((hcount==150+964)&&(vcount==300-result[482]/8))||((hcount==150+966)&&(vcount==300-result[483]/8))||((hcount==150+968)&&(vcount==300-result[484]/8))||((hcount==150+970)&&(vcount==300-result[485]/8))||((hcount==150+972)&&(vcount==300-result[486]/8))||((hcount==150+974)&&(vcount==300-result[487]/8))||((hcount==150+976)&&(vcount==300-result[488]/8))||((hcount==150+978)&&(vcount==300-result[489]/8))||((hcount==150+980)&&(vcount==300-result[490]/8))||((hcount==150+982)&&(vcount==300-result[491]/8))||((hcount==150+984)&&(vcount==300-result[492]/8))||((hcount==150+986)&&(vcount==300-result[493]/8))||((hcount==150+988)&&(vcount==300-result[494]/8))||((hcount==150+990)&&(vcount==300-result[495]/8))||((hcount==150+992)&&(vcount==300-result[496]/8))||((hcount==150+994)&&(vcount==300-result[497]/8))||((hcount==150+996)&&(vcount==300-result[498]/8))||((hcount==150+998)&&(vcount==300-result[499]/8))||((hcount==150+1000)&&(vcount==300-result[500]/8))||((hcount==150+1002)&&(vcount==300-result[501]/8))||((hcount==150+1004)&&(vcount==300-result[502]/8))||((hcount==150+1006)&&(vcount==300-result[503]/8))||((hcount==150+1008)&&(vcount==300-result[504]/8))||((hcount==150+1010)&&(vcount==300-result[505]/8))||((hcount==150+1012)&&(vcount==300-result[506]/8))||((hcount==150+1014)&&(vcount==300-result[507]/8))||((hcount==150+1016)&&(vcount==300-result[508]/8))||((hcount==150+1018)&&(vcount==300-result[509]/8))||((hcount==150+1020)&&(vcount==300-result[510]/8))||((hcount==150+1022)&&(vcount==300-result[511]/8))||((hcount==150+1024)&&(vcount==300-result[512]/8))||((hcount==150+1026)&&(vcount==300-result[513]/8))||((hcount==150+1028)&&(vcount==300-result[514]/8)))

begin

r <= 4'b0000;

g <= 4'b1111;

b <= 4'b0000;

end

else

begin

r <= 4'b0000;

g <= 4'b0000;

b <= 4'b0000;

end

end

end