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library IEEE;
use IEEE.STD_LOGIC_1164.ALL;

entity register_file is
    Port ( load : in  STD_LOGIC;
          Clk : in  STD_LOGIC;
          dest_sel : in  STD_LOGIC_VECTOR (2 downto 0);
          a_sel : in  STD_LOGIC_VECTOR (2 downto 0);
          b_sel : in  STD_LOGIC_VECTOR (2 downto 0);
          data : in  STD_LOGIC_VECTOR (15 downto 0);
          a_out : out  STD_LOGIC_VECTOR (15 downto 0);
          b_out : out  STD_LOGIC_VECTOR (15 downto 0));
end register_file;

architecture Behavioral of register_file is

    --register module
    COMPONENT reg_16 is
        PORT(
            D : in std_logic_vector(15 downto 0);
            load, Clk : in std_logic;
            Q : out std_logic_vector(15 downto 0)
        );
    END COMPONENT;

    --3 to 8 decoder for destination select
    COMPONENT decoder_3_8 is
        PORT(
            A0 : in  STD_LOGIC;
            A1 : in  STD_LOGIC;
            A2 : in  STD_LOGIC;
            Q0 : out  STD_LOGIC;
            Q1 : out  STD_LOGIC;
            Q2 : out  STD_LOGIC;
            Q3 : out  STD_LOGIC;
            Q4 : out  STD_LOGIC;
            Q5 : out  STD_LOGIC;
            Q6 : out  STD_LOGIC;
            Q7 : out  STD_LOGIC
        );
    END COMPONENT;

    --8 to 1 multiplexer for output select
    COMPONENT mux_8_1_16bit is
        PORT(
            In0 : in STD_LOGIC_VECTOR(15 downto 0);
            In1 : in STD_LOGIC_VECTOR(15 downto 0);
            In2 : in STD_LOGIC_VECTOR(15 downto 0);
            In3 : in STD_LOGIC_VECTOR(15 downto 0);
            In4 : in STD_LOGIC_VECTOR(15 downto 0);
            In5 : in STD_LOGIC_VECTOR(15 downto 0);
            In6 : in STD_LOGIC_VECTOR(15 downto 0);
            In7 : in STD_LOGIC_VECTOR(15 downto 0);
            S0 : in STD_LOGIC;
            S1 : in STD_LOGIC;
            S2 : in STD_LOGIC;
            Z : out STD_LOGIC_VECTOR(15 downto 0)
        );
    END COMPONENT;

    --signals
    signal load_reg0, load_reg1, load_reg2, load_reg3, load_reg4, load_reg5, load_reg6, load_reg7 : STD_LOGIC;
    signal reg0_q, reg1_q, reg2_q, reg3_q, reg4_q, reg5_q, reg6_q, reg7_q, data_src_mux_out, src_reg :
    STD_LOGIC_VECTOR(15 downto 0);
    signal sel_reg0, sel_reg1, sel_reg2, sel_reg3, sel_reg4, sel_reg5, sel_reg6, sel_reg7 : STD_LOGIC;

begin
    --port maps
    --registers
    --register 0
    reg00: reg_16 PORT MAP(
        D => data,
        load => load_reg0,
        Clk => Clk,
        Q => reg0_q
    );
    --register 1

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reg01: reg_16 PORT MAP(
    D => data,
    load =>load_reg1,
    Clk => Clk,
    Q => reg1_q
);
--register 2
reg02: reg_16 PORT MAP(
    D => data,
    load =>load_reg2,
    Clk => Clk,
    Q => reg2_q
);
--register 3
reg03: reg_16 PORT MAP(
    D => data,
    load =>load_reg3,
    Clk => Clk,
    Q => reg3_q
);
--register 4
reg04: reg_16 PORT MAP(
    D => data,
    load =>load_reg4,
    Clk => Clk,
    Q => reg4_q
);
--register 5
reg05: reg_16 PORT MAP(
    D => data,
    load =>load_reg5,
    Clk => Clk,
    Q => reg5_q
);
--register 6
reg06: reg_16 PORT MAP(
    D => data,
    load =>load_reg6,
    Clk => Clk,
    Q => reg6_q
);
--register 7
reg07: reg_16 PORT MAP(
    D => data,
    load =>load_reg7,
    Clk => Clk,
    Q => reg7_q
);

--multiplexers for output selection
--mux A
muxA: mux_8_1_16bit PORT MAP(
    In0 => reg0_q,
    In1 => reg1_q,
    In2 => reg2_q,
    In3 => reg3_q,
    In4 => reg4_q,
    In5 => reg5_q,
    In6 => reg6_q,
    In7 => reg7_q,
    S0 => a_sel(2), --need to flip these because definition of MSB/LSB is vague
    S1 => a_sel(1),
    S2 => a_sel(0),
    Z => a_out
);
--mux B
muxB: mux_8_1_16bit PORT MAP(
    In0 => reg0_q,
    In1 => reg1_q,
    In2 => reg2_q,
    In3 => reg3_q,
    In4 => reg4_q,
    In5 => reg5_q,
    In6 => reg6_q,
    In7 => reg7_q,
    S0 => b_sel(2), --same as above
    S1 => b_sel(1),

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        S2 => b_sel(0),
        Z => b_out
    );

    --decoder for load selection
    --decoder
    decoder: decoder_3_8 PORT MAP(
        A0 => dest_sel(2),
        A1 => dest_sel(1),
        A2 => dest_sel(0),
        Q0 => sel_reg0,
        Q1 => sel_reg1,
        Q2 => sel_reg2,
        Q3 => sel_reg3,
        Q4 => sel_reg4,
        Q5 => sel_reg5,
        Q6 => sel_reg6,
        Q7 => sel_reg7
    );

    --AND gates for load thingys
    load_reg0 <= sel_reg0 and load;
    load_reg1 <= sel_reg1 and load;
    load_reg2 <= sel_reg2 and load;
    load_reg3 <= sel_reg3 and load;
    load_reg4 <= sel_reg4 and load;
    load_reg5 <= sel_reg5 and load;
    load_reg6 <= sel_reg6 and load;
    load_reg7 <= sel_reg7 and load;

end Behavioral;
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