پروژه دی اس دی

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سوال هشتم

ورودی و خروجی ماژول ما و همچنین مقادیر اولیه‌ی آن‌ها به شکل زیر می‌باشد.

```
module parking (clk, rst, car_entered, car_exited, is_uni_car_entered,
is_uni_car_exited,
 uni_parked_car, parked_car, uni_vacated_space, vacated_space,
uni_is_vacated_space, is_vacated_space, t
);
    input clk, rst, car_entered, car_exited, is_uni_car_entered,
is_uni_car_exited;
    output reg [9:0] uni_parked_car, parked_car, uni_vacated_space,
vacated_space;
    output reg uni_is_vacated_space,  is_vacated_space;
    output reg [4:0] t; //show hour

    reg [9:0] max_vacated_space;

    always @(posedge clk or posedge rst) begin
        if (rst) begin
            t <= 9;
            uni_parked_car <= 0;
            parked_car <= 0;
            uni_vacated_space <= 500;
            vacated_space <= 200;
            max_vacated_space <= 200;
            uni_is_vacated_space <= 1;
            is_vacated_space <= 1;
```

حال برای طراحی این پارکینگ ما نیاز به سه بخش محاسبات داریم:

محاسبات اول مربوط به ساعت کار پارکینگ و تخصیص فظای مورد نیاز ازاد و کارکنان بر اساس ساعت می‌باشد.

```
            if (t < 16 && t >= 13) begin
                uni_vacated_space = uni_vacated_space - 50;
                vacated_space = vacated_space + 50;
                max_vacated_space = max_vacated_space + 50;
            end
            else if ( t == 16) begin
                uni_vacated_space = uni_vacated_space - 150;
                vacated_space = vacated_space + 150;
                max_vacated_space = 500;
            end
            else if (t == 8) begin
                uni_vacated_space = uni_vacated_space + 300;
                vacated_space = vacated_space - 300;
                max_vacated_space = 200;
            end
```

در بخش دوم ما بر اساس ورود یا خروج و نوع ماشین، ظرفیت پارکینگ رو محاسبه می‌کنیم

```
            if (car_exited && !is_uni_car_exited && parked_car > 0) begin
                    parked_car = parked_car - 1;
                    vacated_space = vacated_space + 1;
            end else if (car_exited && is_uni_car_exited && uni_parked_car > 0)
begin
                    uni_parked_car = uni_parked_car - 1;
                    uni_vacated_space = uni_vacated_space + 1;
            end else if (car_entered && !is_uni_car_entered && (parked_car +
uni_parked_car < 700 && parked_car < max_vacated_space)) begin
                    vacated_space = vacated_space - 1;
                    parked_car = parked_car + 1;
            end else  if (car_entered && is_uni_car_entered && (uni_parked_car <
500 && uni_parked_car + parked_car < 700)) begin
                    uni_parked_car = uni_parked_car + 1;
                    uni_vacated_space = uni_vacated_space - 1;
            end
```

در بخش سوم محاسبه می کنیم که ایا امکان وارد شدن ماشین جدید وجود دارد ویا خیر.

```
            if (uni_parked_car < 500 && uni_parked_car + parked_car < 700)
                uni_is_vacated_space = 1;
            else
                uni_is_vacated_space = 0;
```

```
            if (parked_car < max_vacated_space && uni_parked_car + parked_car <
700)
                is_vacated_space = 1;
            else
                is_vacated_space = 0;
```

حال به وسیله‌ی دو حلقه که در اولی در هر ساعت یک ماشین از نوع رندوم وارد میشود و حلقه‌ای دیگر که در هر ساعت یک ماشین از نوع رندوم خارج می شود، ماژول خود را تحریک می‌کنیم.

```
module parkingTB;
  reg clk, rst;
  reg car_exited, is_uni_car_exited;
  reg car_entered, is_uni_car_entered;
  wire [9:0] uni_vacated_space, vacated_space;
  wire [9:0] uni_parked_car, parked_car;
  wire uni_is_vacated_space,  is_vacated_space;
  wire [4:0] t; // for hour

  integer i = 0;
  always begin
    #5 clk = ~clk;
  end

  parking park(
    .rst(rst),
    .clk(clk),
    .car_exited(car_exited),
    .uni_vacated_space(uni_vacated_space),
    .vacated_space(vacated_space),
    .parked_car(parked_car),
    .is_uni_car_exited(is_uni_car_exited),
    .uni_parked_car(uni_parked_car),
    .uni_is_vacated_space(uni_is_vacated_space),
    .is_vacated_space(is_vacated_space),
    .car_entered(car_entered),
    .is_uni_car_entered(is_uni_car_entered),
    .t(t)
  );

  initial begin
    $monitor("Time: %d -> (uni_vacated_space: %d vacated_space: %d) ->
(uni_parked_car: %d parked_car: %d) , is_uni_space: %d is_space: %d",
```

```
              t, uni_vacated_space, vacated_space, uni_parked_car,
parked_car,  uni_is_vacated_space, is_vacated_space);

    car_exited = 0;
    is_uni_car_exited = 0;
    clk = 0;
    car_entered = 0;
    is_uni_car_entered = 0;
    rst = 1;
    #10 rst = 0;

    for (i = 0; i < 10 ; i = i + 1) begin
        #10 car_entered = 1; is_uni_car_entered = $random;
        #10 car_entered = 0;
    end

    for (i = 0; i < 10 ; i = i + 1) begin
        #10 car_exited = 1; is_uni_car_exited = $random;
        #10 car_exited = 0;
    end
    #40 $stop;
  end
endmodule
```

```
# Time:  9 -> (uni_vacated_space:  500 vacated_space:  200) -> (uni_parked_car:    0 parked_car:    0) , is_uni_space: 1 is_space: 1
# Time: 10 -> (uni_vacated_space:  500 vacated_space:  200) -> (uni_parked_car:    0 parked_car:    0) , is_uni_space: 1 is_space: 1
# Time: 11 -> (uni_vacated_space:  500 vacated_space:  199) -> (uni_parked_car:    0 parked_car:    1) , is_uni_space: 1 is_space: 1
# Time: 12 -> (uni_vacated_space:  500 vacated_space:  199) -> (uni_parked_car:    0 parked_car:    1) , is_uni_space: 1 is_space: 1
# Time: 13 -> (uni_vacated_space:  499 vacated_space:  199) -> (uni_parked_car:    1 parked_car:    1) , is_uni_space: 1 is_space: 1
# Time: 14 -> (uni_vacated_space:  449 vacated_space:  249) -> (uni_parked_car:    1 parked_car:    1) , is_uni_space: 1 is_space: 1
# Time: 15 -> (uni_vacated_space:  398 vacated_space:  299) -> (uni_parked_car:    2 parked_car:    1) , is_uni_space: 1 is_space: 1
# Time: 16 -> (uni_vacated_space:  348 vacated_space:  349) -> (uni_parked_car:    2 parked_car:    1) , is_uni_space: 1 is_space: 1
# Time: 17 -> (uni_vacated_space:  197 vacated_space:  499) -> (uni_parked_car:    3 parked_car:    1) , is_uni_space: 1 is_space: 1
# Time: 18 -> (uni_vacated_space:  197 vacated_space:  499) -> (uni_parked_car:    3 parked_car:    1) , is_uni_space: 1 is_space: 1
# Time: 19 -> (uni_vacated_space:  196 vacated_space:  499) -> (uni_parked_car:    4 parked_car:    1) , is_uni_space: 1 is_space: 1
# Time: 20 -> (uni_vacated_space:  196 vacated_space:  499) -> (uni_parked_car:    4 parked_car:    1) , is_uni_space: 1 is_space: 1
# Time: 21 -> (uni_vacated_space:  195 vacated_space:  499) -> (uni_parked_car:    5 parked_car:    1) , is_uni_space: 1 is_space: 1
# Time: 22 -> (uni_vacated_space:  195 vacated_space:  499) -> (uni_parked_car:    5 parked_car:    1) , is_uni_space: 1 is_space: 1
# Time: 23 -> (uni_vacated_space:  194 vacated_space:  499) -> (uni_parked_car:    6 parked_car:    1) , is_uni_space: 1 is_space: 1
# Time:  0 -> (uni_vacated_space:  194 vacated_space:  499) -> (uni_parked_car:    6 parked_car:    1) , is_uni_space: 1 is_space: 1
# Time:  1 -> (uni_vacated_space:  194 vacated_space:  498) -> (uni_parked_car:    6 parked_car:    2) , is_uni_space: 1 is_space: 1
# Time:  2 -> (uni_vacated_space:  194 vacated_space:  498) -> (uni_parked_car:    6 parked_car:    2) , is_uni_space: 1 is_space: 1
# Time:  3 -> (uni_vacated_space:  193 vacated_space:  498) -> (uni_parked_car:    7 parked_car:    2) , is_uni_space: 1 is_space: 1
# Time:  4 -> (uni_vacated_space:  193 vacated_space:  498) -> (uni_parked_car:    7 parked_car:    2) , is_uni_space: 1 is_space: 1
# Time:  5 -> (uni_vacated_space:  192 vacated_space:  498) -> (uni_parked_car:    8 parked_car:    2) , is_uni_space: 1 is_space: 1
# Time:  6 -> (uni_vacated_space:  192 vacated_space:  498) -> (uni_parked_car:    8 parked_car:    2) , is_uni_space: 1 is_space: 1
# Time:  7 -> (uni_vacated_space:  192 vacated_space:  499) -> (uni_parked_car:    8 parked_car:    1) , is_uni_space: 1 is_space: 1
# Time:  8 -> (uni_vacated_space:  192 vacated_space:  499) -> (uni_parked_car:    8 parked_car:    1) , is_uni_space: 1 is_space: 1
```

همانطوری که در عکس بالا می‌بینید در فاصله‌ی ساعت ۱۳ تا ۱۶ در هر ساعت، ظرفیت آزاد پارکینگ ۵۰ تا زیاد شده و بعد از ساعت ۱۶ به ۵۰۰ تا رسیده است البته که اگر ماشینی در این ساعات وارد پارکینگ شده باشد باعث کم شدن ظرفیت می‌شود.