Session 4: Exercises

Exercise 1

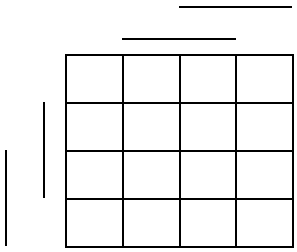
A circuit has three light sensors placed at different heights, high, middle and low, SA, SM and SB. If a diamond is big, it interferes with the three light signals, if it is average size, two (SM and SB), if it is small, one (SB) and if it is tiny, none. The carat weight sensor (SP) is set to 1 if it is over 3 carats and 0 otherwise. The conditions are:

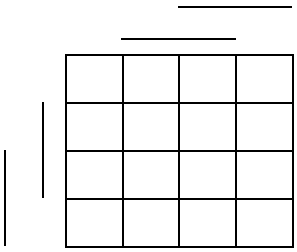
- A big diamond (G) or average one (M) has to weigh at least 3 carats, otherwise, it is rejected (R).
- If it is small, it never has to weigh more than 3 carats, otherwise it is rejected (R).
- The tiny diamonds are rejected (R).
- The unreal conditions are considered impossible.

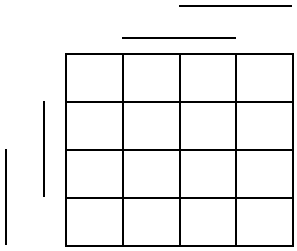
SA	SM	SB	SP	P	M	G	R
0	0	0	0				
0	0	0	1				
0	0	1	0				
0	0	1	1				
0	1	0	0				
0	1	0	1				
0	1	1	0				
0	1	1	1				
1	0	0	0				
1	0	0	1				
1	0	1	0				
1	0	1	1				
1	1	0	0				
1	1	0	1				
1	1	1	0				
1	1	1	1				

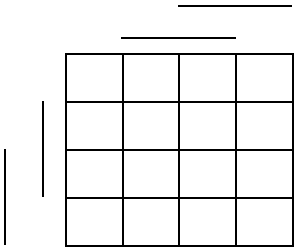
Write down the sum of its miniterms:

Complete and minimize the Veitch-Karnaugh maps









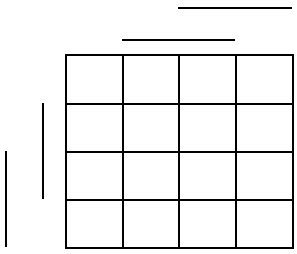
Draw the simplified expression of the logic circuit

Exercise 2 Design a combinational circuit able to detect an error in the coding of a decimal number in BCD.

B3	B2	B1	B0	E
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	
0	1	1	0	
0	1	1	1	
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

Write each sum of miniterms:

Complete and minimize the Veitch-Karnaugh maps



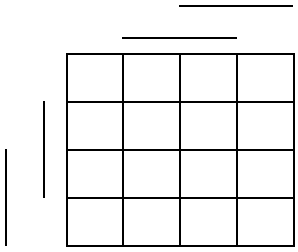
Draw the logic circuit of the simplified expression

Exercise 3 We have four tanks (A, B, C y D). The tanks A and B have a sensor which is activated when the level is too high. On the other hand, the tanks C and D have a sensor which is activated when the temperature is too low. Construct the logic map that activates the alarm when A or B have a too high level or when the C or D temperature is too low.

A	B	C	D	AL
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	
0	1	1	0	
0	1	1	1	
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

Write down each sum of miniterms:

Complete and minimize the Veitch-Karnaugh maps:



Draw the logic circuit of the simplified expression

Exercise 4 Two pumps B1 and B2 have to be controlled, depending on the amount of water in their depots. The sensors B (low water level) and A (high water level) submit a logic 1 when the water overflows a given threshold. The sensors TB1 and TB2 indicate through a 1 if the temperature of pumps B1 and B2 has overflowed the functioning limit. If the level is:

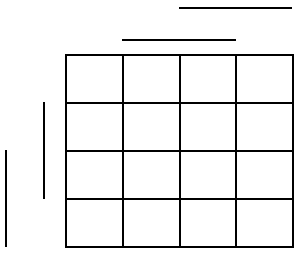
- Below B the two pumps have to be activated;
- Over B but below A one pump has to be activated, preferably B1 (having into account their temperature);
- Over A B1 and B2 have to be deactivated;
- If the temperature of the engine grows over the limit, the engine should be stopped.

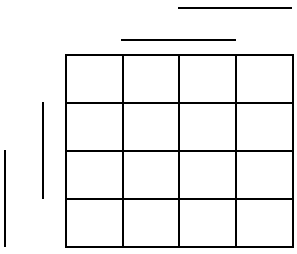
Any anomalous situation in the sensor values will imply the stop of both pumps for security purposes.

TB1	TB2	B	A	B1	B2
0	0	0	0		
0	0	0	1		
0	0	1	0		
0	0	1	1		
0	1	0	0		
0	1	0	1		
0	1	1	0		
0	1	1	1		
1	0	0	0		
1	0	0	1		
1	0	1	0		
1	0	1	1		
1	1	0	0		
1	1	0	1		
1	1	1	0		
1	1	1	1		

Write down each sum of miniterms:

Complete and minimize the Veitch-Karnaugh maps:





Draw the logic circuit of the simplified expression