My name:Wenhao Lu

Student number:s3810097

- Section 1

Q1

a)

My student number is “s3810097”, so the last four digits are 0097

i)Convert 9710 to binary

Firstly, we find out the largest number of 2^n that less than 97 which is 64, then list of number what we gonna work with: 64 32 16 8 4 2 1

Let 97 subtract 64 we get 33

Then 33 subtract 32 we get 1

64	32	16	8	4	2	1
1	**1**	**0**	**0**	**0**	**0**	**1**

Ans: convert 97_{10} to binary is 1100001_{2}

ii)Convert 97_{10} to octal

97/8=12.125, 12 reminder is 0.125*8=1

12/8=1.5, 1 reminder is 0.5*8 = 4

1/8 0 reminder is 1

We read the number from the bottom, we get 141

Ans: convert 97_{10} to octal is 141_{8}

ii)Convert 97_{10} to hexadecimal

97/16 = 6.0625, 6 reminder is 1

6/16 0 reminder is 6

We read the number from the bottom, we get 61

Ans: convert 97_{10} to hexadecimal is 61_{16}

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b)

My student number is "s3810097", so the last four digits are 0097

Convert 97_{10} to base 13

97/13=7.461538， 7 remainder is 6_{10} ➡️ 6_{13}

7/13 0 remainder is 7_{10} ➡️ 7_{13}

We read the number from the bottom, we get 76

Ans: convert 97_{10} to hexadecimal is 76_{13}

c)

$A_{26}=0_{10}$, $B_{26}=1_{10}$, $C_{26}=2_{10}$, $D_{26}=3$, $E_{26}=4$, $F_{26}=5_{10}$,$G_{26}=6_{10}$, $H_{26}=7_{10}$, $I_{26}= 8_{10}$, $J_{26}=9_{10}$, $K_{26}=10_{10}$, $L_{26}=11_{10}$, $M_{26}=12_{10}$, $N_{26}=13_{10}$, $O_{26}=14_{10}$, $P_{26}=15_{10}$, $Q_{26}=16_{10}$, $R_{26}=17_{10}$, $S_{26}=18_{10}$, $T_{26}=19_{10}$, $U_{26}=20_{10}$, $V_{26}=21_{10}$, $W_{26}=22_{10}$, $X_{26}=23_{10}$, $Y_{26}=24_{10}$, $Z_{26}=25_{10}$

My first name is "Wenhao" and your surname is "Lu",

The first three letter of my given name is WEN , the first three letter of my first name is LUU.

Add up WEN_{26} and LU_{26}

$W_{26} = 22_{10}$， $E_{26} = 4_{10}$， $N_{26} = 13_{10}$， $L_{26}=11_{10}$， $U_{26}=20_{10}$

$WEN_{26} = (22 *26*26) + (4*26)+14=14990_{10}$

$LUU_{26} = (11 * 26 * 26) + (20 * 26) + 20 = 7976_{10}$

Add up 14990_{10} and 7976_{10}, we get 22966_{10}

Then we convert 22966_{10} into base26

22966/26= 883.297692, 883 remainder is 8 ➡️ I_{26}

883/26=33.961538, 33 remainder is 25 ➡️ Z_{26}

33/26 = 1.269231, 1 remainder is 7 ➡️ H_{26}

1/27 0 remainder is 1 ➡️ B_{26}

We read the number from the bottom, we get BHZI

Ans: Add up WEN_{26} and LU_{26} is BHZI

Q2

A)

My student number is “s380097”, the A=9 and B=7

i)

9/2=4.5, 4 remainder is 1

4/2=2, 2 remainder is 0

2/2=1, 1 remainder is 0

1/2 0 remainder is 1

We read the number from the bottom, convert 9_{10} to 4-bit

4-bit binary is 1001_2

ii)

7/2=3.5, 3 remainder is 1

3/2= 1.5, 1 remainder is 1

1/2 0 remainder is 1

We read the number from the bottom, convert 9_{10} to

4-bit binary is 1001_2

A		1	0	0	1
B		0	1	1	1
A+B	1	0	0	0	0

We add up A and B, we get 10000_2, which is a 5-bit binary number, so the answer is not valid to 4bit binary arithmetic.

B)

A=9 and B=7

i)

$9_{10}=01001_2$

Flip each bit we get :10110

Add 1:10111

$7_{10}=0111_2$

Flip each bit we get :01000

Add 1 :01001

A-B=A+(-B)=9+(-7)

01001

+01001

10010

ii)translate the binary result back to decimal

10010

(1*2^4)+(0*2^3)+(0*2^2)+(1*2^1)+(0*2^0)

-16+2=-14

Q3

A)

		x	x	x	x	x	x	x	x
bit position		7	6	5	4	3	2	1	0
MASK	AND	0	0	1	1	1	1	0	0
Result		reset	reset	x	x	x	x	reset	reset

B)

		x	x	x	x	x	x	x	x
bit position		7	6	5	4	3	2	1	0
MASK	XOR	0	0	1	1	1	1	0	0
MASK	OR	1	1	0	0	0	0	1	1
Result		set	set	toggle	toggle	toggle	toggle	set	set

Q4

A)

i)

My student number is “s3810097”, the last 3 digits of my user id is 097, then multiply by15, get 1455

ii)

1455/16=90.9375, 90 remainder is 15_{10} ➡️ F_{16}

90/16=5.625 , 5 remainder is 10_{10} ➡️ A_{16}

5/16 , 0 remainder is 5_{10} ➡️ 5_{16}

$1455_{10} = 5AF_{16}$

iii)

It is the rule of 15’s number base 16-1=15

Add digits:5AF/15=5+A+F=1E=1+E=F

The result is F, so it is divisible by F.

iv)

Add digits:5AF/15=5+A+F=1E=1+E=F

F is 15 in base 10 = 3*5

So $5AF_{16}$ is divisible by 3 and 5

B)

The last 3 digits of my user id is 097

Convert 97_{10} to octal ,we get 141_8

Add digits:141/7=1+4+1=6

The result is 6 which can not divisible by 7

C)

The last 3 digits of my user id is 097

i) decimal

97 multiplied by 11, we get 1067

1067/11=7-6+0-1=0

So 1067 is divisible by 11

ii)octal

97 multiplied by 9= 873

Convert 873 to octal, we get 1551

1551/9=1-5+5-1=0

So 873 is divisible by 9

ii)hexadecimal

97 multiplied by 16= 1552

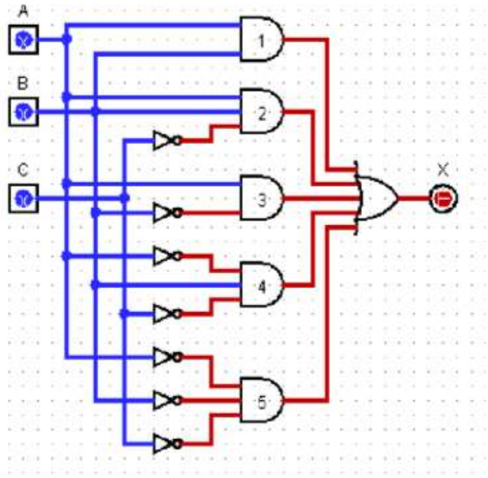
Convert 1552 to hexadecimal, we get 610

610/17=0-1+6=5

So 1552 is not divisible by 17

- **Section 2**

Q1



A)

ANS:A.B + A.B./C+A./B + /A.B./C + /A./B./C

B)

	B/C	00	01	11	10
A		/B./C	/BC	BC	B/C
0	/A	1	0	0	1
1	A	1	1	1	1

C)

Firstly, we have to find the pairs of ones, and selection must be a power of 2.

The first selection is the column of 00 and column 10, which include 000, 100,010 and 110, /C is always 1, so we get /C.

The another selection is the row of 1 , which include 100, 101, 111 and 110. Clearly, A is answer.

ANS:A+ /C

D)

A.B + A.B./C+A./B + /A.B./C + /A./B./C

=A(B+/B)+A.B./C + /A./C(B+/B)

=A(1)+A.B./C + /A./C(1)

=A+A.B./C + /A./C

=A(1+B./C)+/A./C

=A(1)+/A./C

=A+/C

The result is the same as the part a) answer.

E)

In my opinion, K-map is the easier way to simplify the logic expression, because we don't need to remember any Boolean Algebraic formula. One thing we have to do is generate a K-map and K-map provide a good visual way to simplify the logic expression.

F)

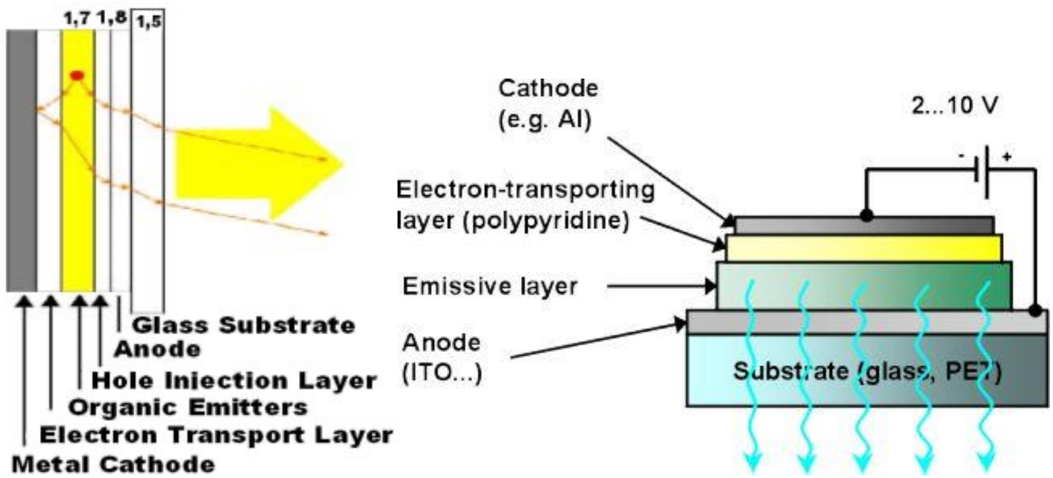
However , I do not agree K-map is always better than boolean algebra. With increment of number of variables, like more than 4, k-map will be become more complicated and hard to analyse the table.

Section 3 — Review of State of the Art (10+10+30+50 = 100 marks)

My student number is s3810097. The category I choice is Displays .

1.With the competition of various mobile phone manufacturers in the market，people is gradually getting to know the screens of mobile phones.The current trend of mobile phones is getting thinner, lighters and more creative. But the traditional LCD screen is limited by its own technology. Therefore, more and more mobile phones use OLED screens to attract consumers, like Samsung Galaxy Z Fold 2
, which is a foldable smart phone.

2.
The OLED technology is active meaning that it is able to emit light unlike the LCD technology that is dependent on backlight unit to create light. Light is emitted from the smaller OLED pixels with the help of a very thin organic film layer. A layer of organic material is sandwiched between two conductors (an anode and a cathode), which in turn are sandwiched between a glass top plate (seal) and a glass bottom plate (substrate).
When electric Current is applied to the two conductors, a bright, electro-luminescent light is produced directly from the organic material as it shown in Fig. 1 (a) [3] and Fig. 1 (b) . The OLED technology is very dynamic when it comes to light meaning that it can emit all the steps between 0 % to 100 % light. With the help of color films OLED utilize three sub- pixels in red, green and blue to produce any desired color including white . （Srećko Kunić, Zoran Šego , 2012）



A B

Figure 1. OLED Structure

（Srećko Kunić, Zoran Šego , 2012）

In the early 1950s, Bernanose and co-workers at Université de Nancy, France, first produced electroluminescence in organic materials. They proposed a mechanism of either direct excitation of the dye molecules or excitation of electrons [5]. In 1977 Heeger, Shirakawa Mac Diarmid discovered a high conductivity in iodine-doped polyacetylene, who later in the year 2000 were awarded the Nobel Prize in Chemistry for "the discovery and development of conductivity in organic polymers." Eastman Kodak Company in 1985 developed bilayer devices based on vapor deposited molecular films consisting of a hole transport layer and a layer electroluminescence generating station. The first diode device was reported in 1987. Finally in 1990 JH Burroughes in the Cavendish Laboratory in Cambridge reported a high efficiency green light emitting polymers using sheets of 100 nanometres thick. In 1998 Kodak, Sanyo Show Full-Color Active Matrix Organic Display and Green Organic LED Shows High Efficiency. In 2003 Sony demonstrated a 24.2 inch OLED panel. In 2007 Sony has started to sell the XEL-1, the world's first OLED TV in Japan. In 2008 Samsung shows a 40 inch HD AMOLED and shows interesting flexible and transparent OLEDs. In 2010 Samsung is showing a new 7 inch Super-AMOLED display [6]. Interestingly, they are showing it in a new phone prototype. In 2011 Panasonic Electric Works announced that they developed a new highly efficient OLED device - featuring 128 lm/W efficiency. In 2012 LG presents TV 55 inch display （Srećko Kunić, Zoran Šego , 2012）

3.

One of the main problems of OLED displays is the limited lifetime of OLED materials.Since OLED relies on organic LEDs, it may cause color degradation. Therefore, it will affect brightness and color balance. Over time, color accuracy will deteriorate, especially for blue pixels, because it degrades faster than green and red pixels. In the past few years, many experts in this area are working out solutions. Stephen R. ForrestYifan Zhang try to extended OLED operational lifetime through phosphorescent dopant profile management. They show that the lifetime of a blue PHOLED with a stacked PHOLED structure and two EMLs with graded phosphorescent dopant concentrations has been increased tenfold. The grading used in combination with the engineered frontier orbital energy of the dopant and the host material significantly reduces the exciton density in the entire emission region. In turn, this will increase the external efficiency of the blue PHOLED while reducing harmful TPA, thus shortening the device life. Taking into account the brightness of the different color sub-pixels used in the display, under normal operating conditions, the life of the improved blue PHOLED is close to that of the green PHOLED. (Zhang, Lee and Forrest, 2014)

Figure 2 shows the constant current density of D1, D3 and D3S at room temperature and two initial luminances: L0 = 1,000 and 3,000 cd m-2. In addition, for D2 and D1S tested at L0 = 3,000 cd m-2, we show these same characteristics. The life span is increasing from D1 to D3. When L0 = 3,000 cdm-2, D1-D3 are T80 = 11.5, 24.5, and 39 h, respectively, which is consistent with the widening of the exciton formation region of the latter two devices (Figure 3b). Please note that the T80 of the control T1 is consistent with the previously reported similar results for

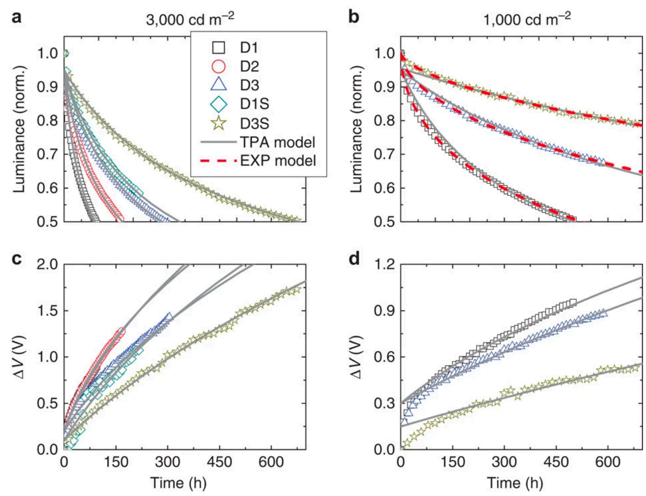


Figure 2: Operational lifetime of the PHOLEDs.

(Zhang, Lee and Forrest, 2014)

this device6, which is only 29% of the graded device D3. In addition, due to the reduced triplet density in stacked OLEDs, the T80 of D1S and D3S = 48 and 106 h. When L0 = 1,000 cd m-2, the T80 of D3S = 616±10 h, which is more than 10 times better than the control D1 in the previous study. For D3S, the improvement of T50 is not as significant as that of T80, resulting in an approximately seven-fold increase from D1.
When the initial brightness L0 = 3,000 cd m-2 (a, b) and 1,000 cd m-2 (c, d), the time evolution of the normalised brightness L and working voltage ΔV (offset zero) of the blue PHOLED Variety). The data was fitted to the TPA model using the exciton density curve in Figure 3b. The brightness of L0 = 1,000 cd m-2(c) is also applied to the adjusted empirical exponent (EXP) model to estimate T50 (ie, the degradation time that causes L to decrease by 50%).(Zhang, Lee and Forrest, 2014)

Another solution is from Yu et al, they found the effect of ITO surface modification on the lifetime of OLED devices.The lifetime of the device was measured under a constant drive current. Under a constant drive current, the initial brightness obtained by each device was approximately the same. As shown in Figure 3, compared with FPA-modified ITO, the brightness of devices with O2 plasma treated ITO decreased rapidly in all cases, even if the difference depends on the color of the device. It is also interesting that even if higher luminous efficiency is obtained using these devices, PEDOT:PSS coated ITO usually has the shortest service life. Table 1 lists the inferred half-life values (@ 500nits). For green devices, depending on whether NPB or DPAPF is used as HTL, for green devices, the observed improvement is 3 to 14 times that of devices with FPA-modified ITO as the anode compared to devices with O2 plasma treated ITO. For blue equipment, the service life is increased by more than 500 times. For red devices, the service life is about 7 times. On the contrary, for devices with a PEDOT:PSS layer inserted, no matter if PEDOT:PSS requires higher luminous efficiency and lower driving current, its lifetime can be comparable to or shorter than that of ITO electrodes treated with O2 plasma. The inserted device. Therefore, when different materials are used in devices of different colors, a general trend of extended service life is observed for devices using FPA-modified ITO. The different degree of life extension may be due to the different stability of materials in different equipment. This proves the role of the interface between the ITO electrode and the organic layer.(Yu et al., 2014)

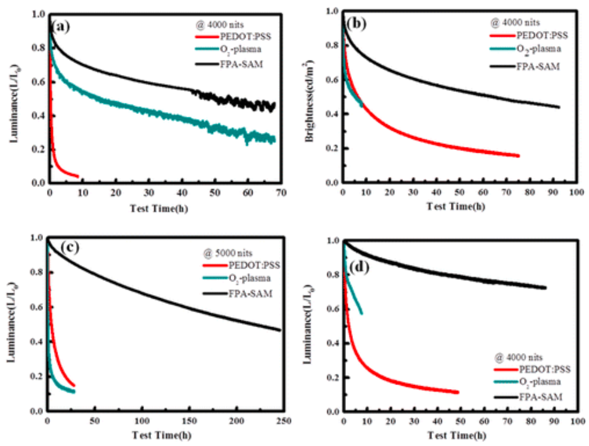


Figure 3. Normalized luminance under constant current density for three kinds of modified ITO-based OLEDs: (a) device A, (b) device B, (c) device C, and (d) device D.(Yu et al., 2014)

Reference:

Zhang, Y., Lee, J. and Forrest, S., 2014. Tenfold increase in the lifetime of blue phosphorescent organic light-emitting diodes. Nature Communications, 5(1).

Yu, S., Chang, J., Wang, P., Wu, C. and Tao, Y., 2014. Effect of ITO Surface Modification on the OLED Device Lifetime. *Langmuir*, 30(25), pp.7369-7376.

S. Kunić and Z. Šego, "OLED technology and displays," Proceedings ELMAR-2012, Zadar, 2012, pp. 31-35.