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Class: FIT 1047
Tutor's Name: Dr. Tan Chee Keong

**Assignment 1**

**Task 1**

1.1

| X1 | X2 | X3 | X4 | Z1 | Z2 |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 1 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 1 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 | 1 |

First taking Z1 = 1 to produce sum of products by referring $\overline{X} = 0$and $X = 1$.

In Sum of Products

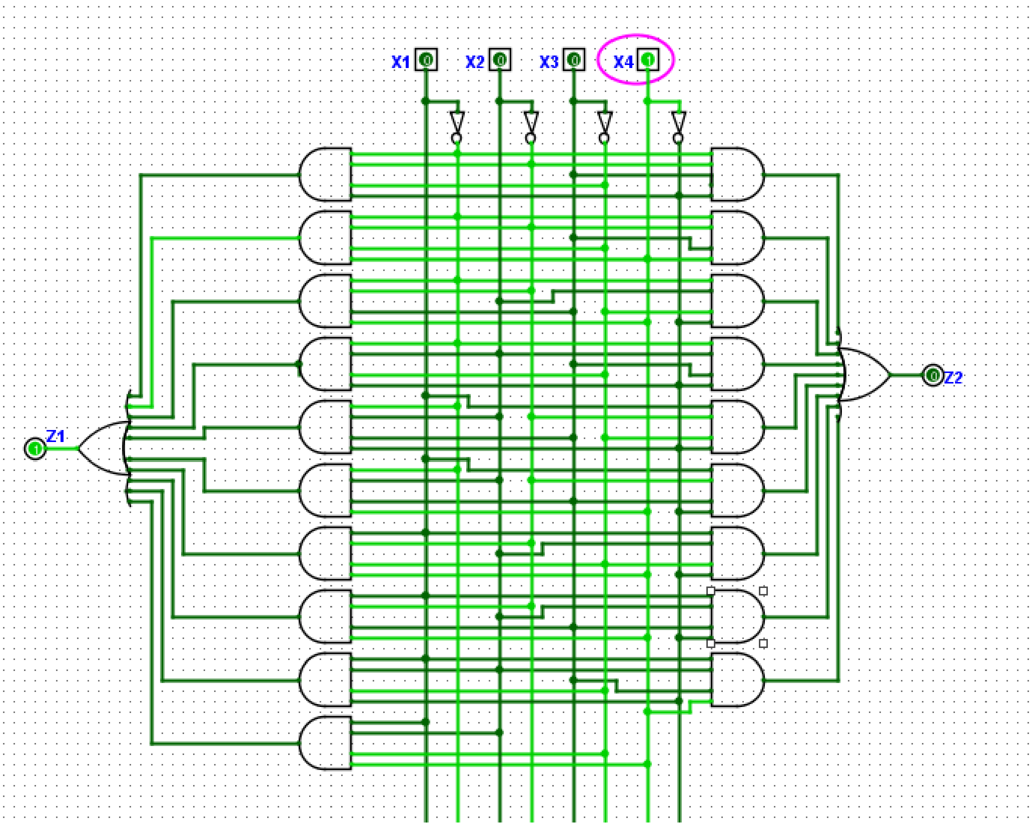
$Z_1$=$(\overline{X1}.\ \overline{X2}.\ \overline{X3}.\ \overline{X4})$+$(\overline{X1}.\ \overline{X2}.\ \overline{X3}.\ X4)$+$(\overline{X1}.\ \overline{X2}.\ X3.\ X4)$+$(\overline{X1}.\ X2.\ \overline{X3}.\ \overline{X4})$+ $(\overline{X1}.\ X2.\ X3.\ \overline{X4})$+$(\overline{X1}.\ X2.\ X3.\ X4)$+$(X1.\ \overline{X2}.\ \overline{X3}.\ X4)$+$(X1.\ \overline{X2}.\ X3.\ X4)$+$(X1.\ X2.\ \overline{X3}.\ \overline{X4})$+$(X1.\ X2.\ \overline{X3}.\ X4)$

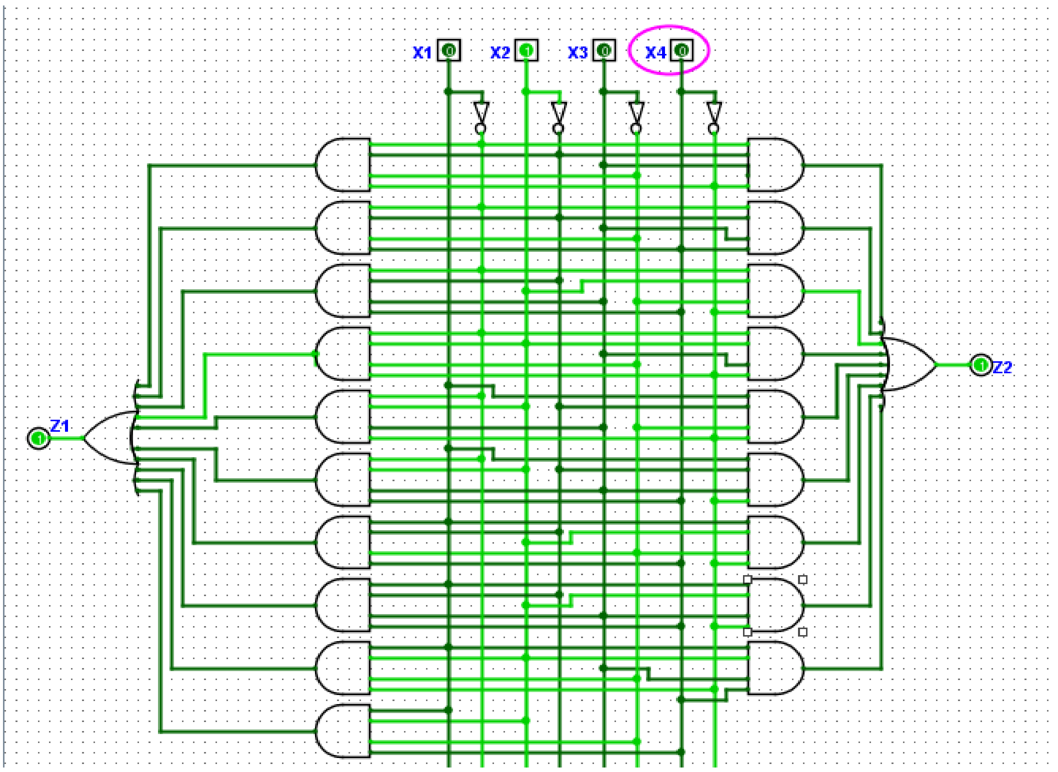
In Sum of Products

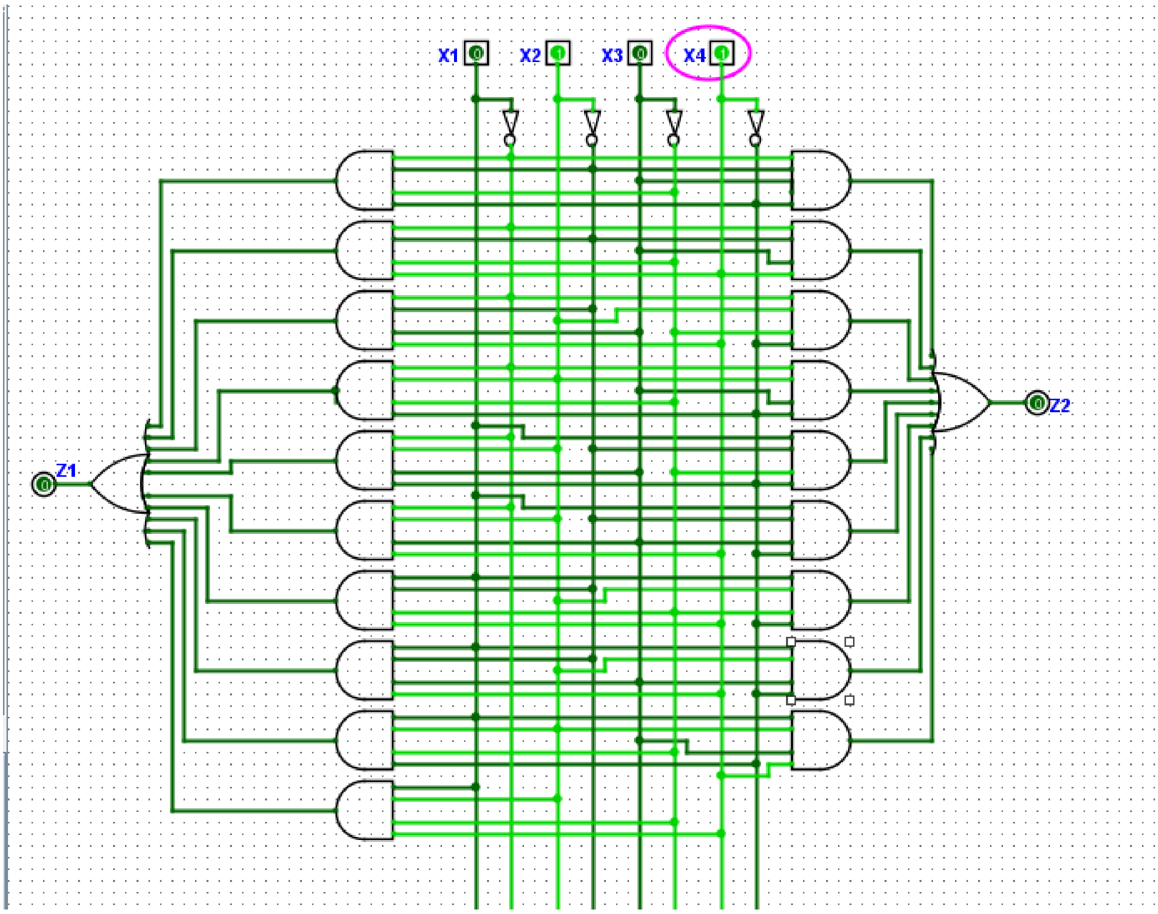
$Z_2$=$(\overline{X1}.\ \overline{X2}.X3\,.\overline{X4})$+$(\overline{X1}.\ \overline{X2}.\ X3.\ X4)$+$(\overline{X1}.\ X2.\ \overline{X3}.\ \overline{X4})$+$(\overline{X1}.\ X2.\ X3.\ \overline{X4})$+$(X1.\ \overline{X2}.\ \overline{X3}.\ \overline{X4})$+$(X1.\ \overline{X2}.\ X3.\ \overline{X4})$+$(X1.\ X2.\ \overline{X3}.\ \overline{X4})$+$(X1.\ X2.\ X3.\ \overline{X4})$+$(X1.X2.\ X3.\ X4)$

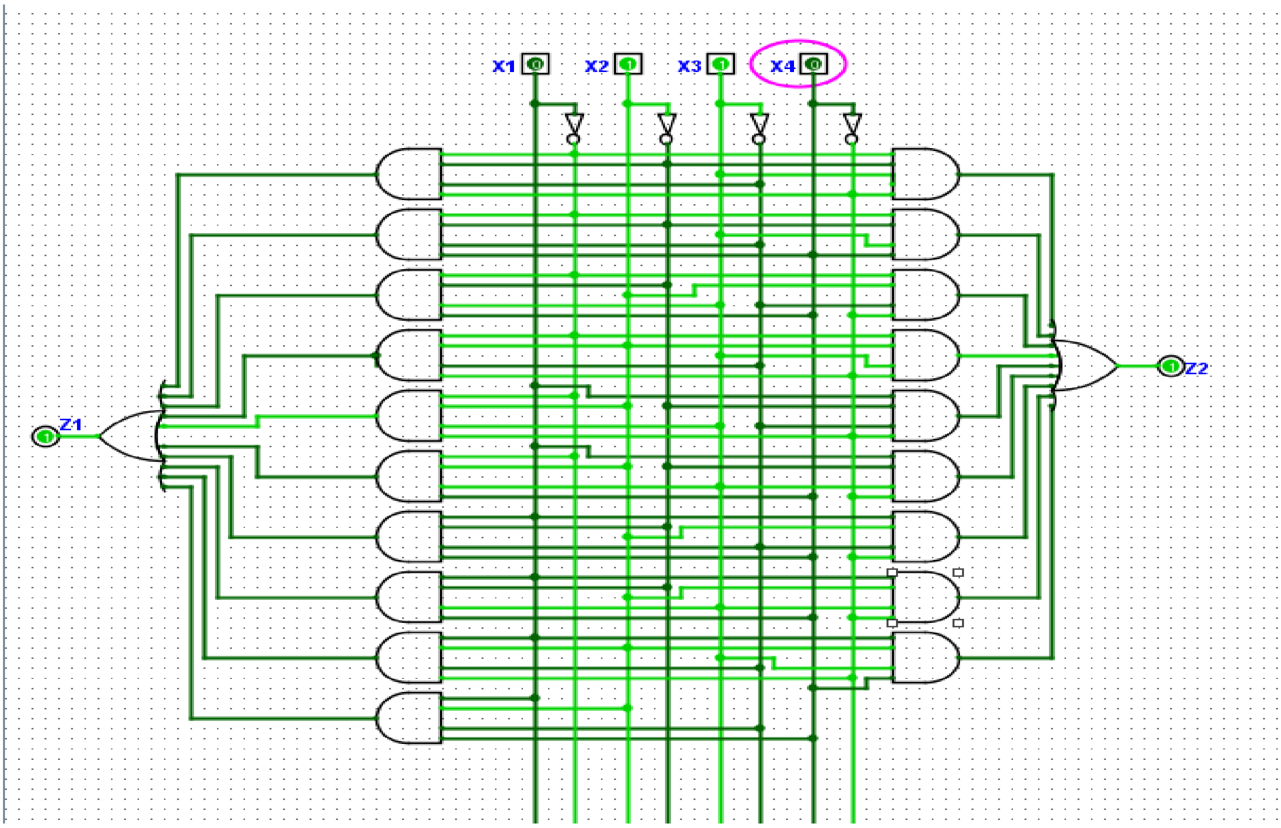
1.2

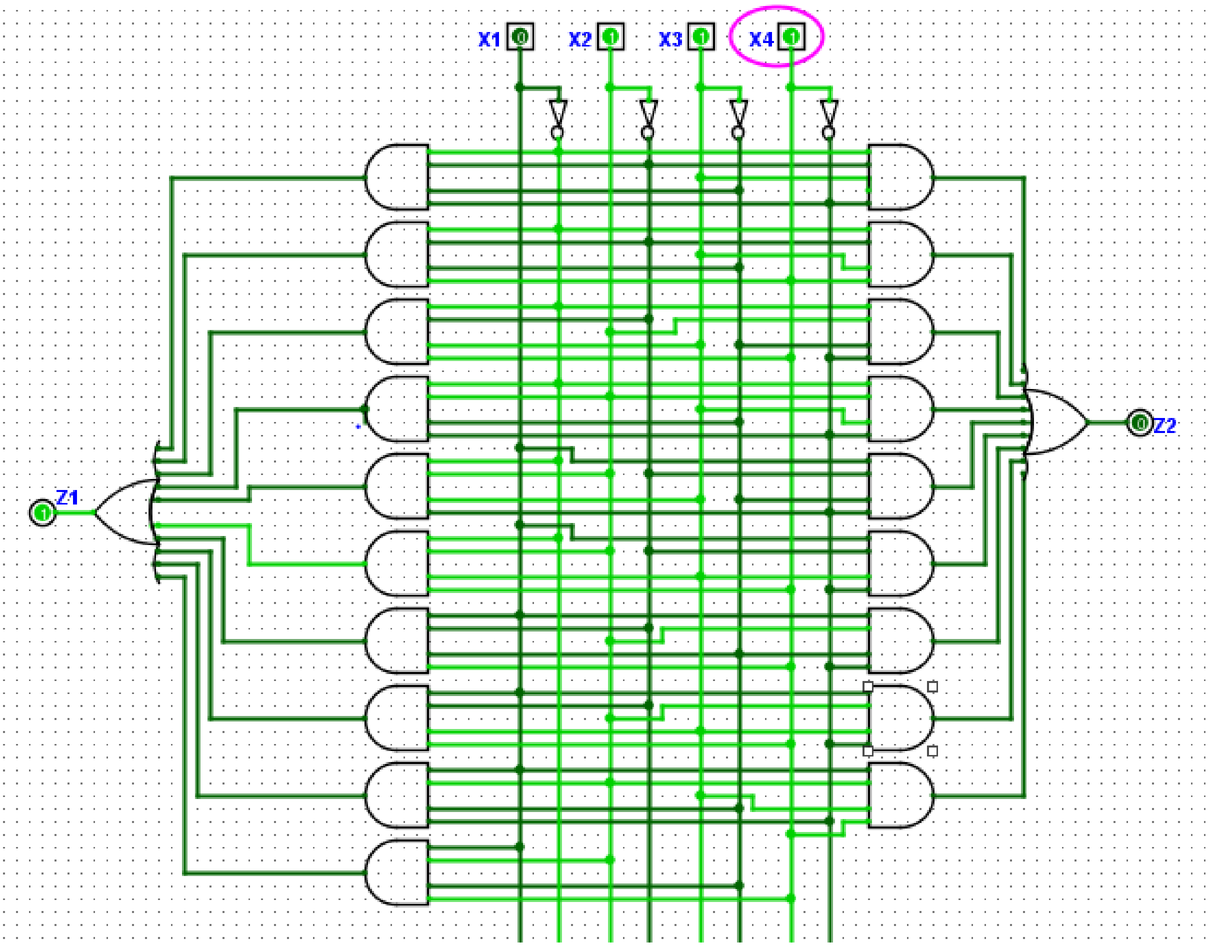
For output it will be Z1 and Z2 for template below and input will be X1~4 respectively in the template.In functions from 1.1 the symbol "." is and gate , "+" is or gate and overline will be not gate in the template.

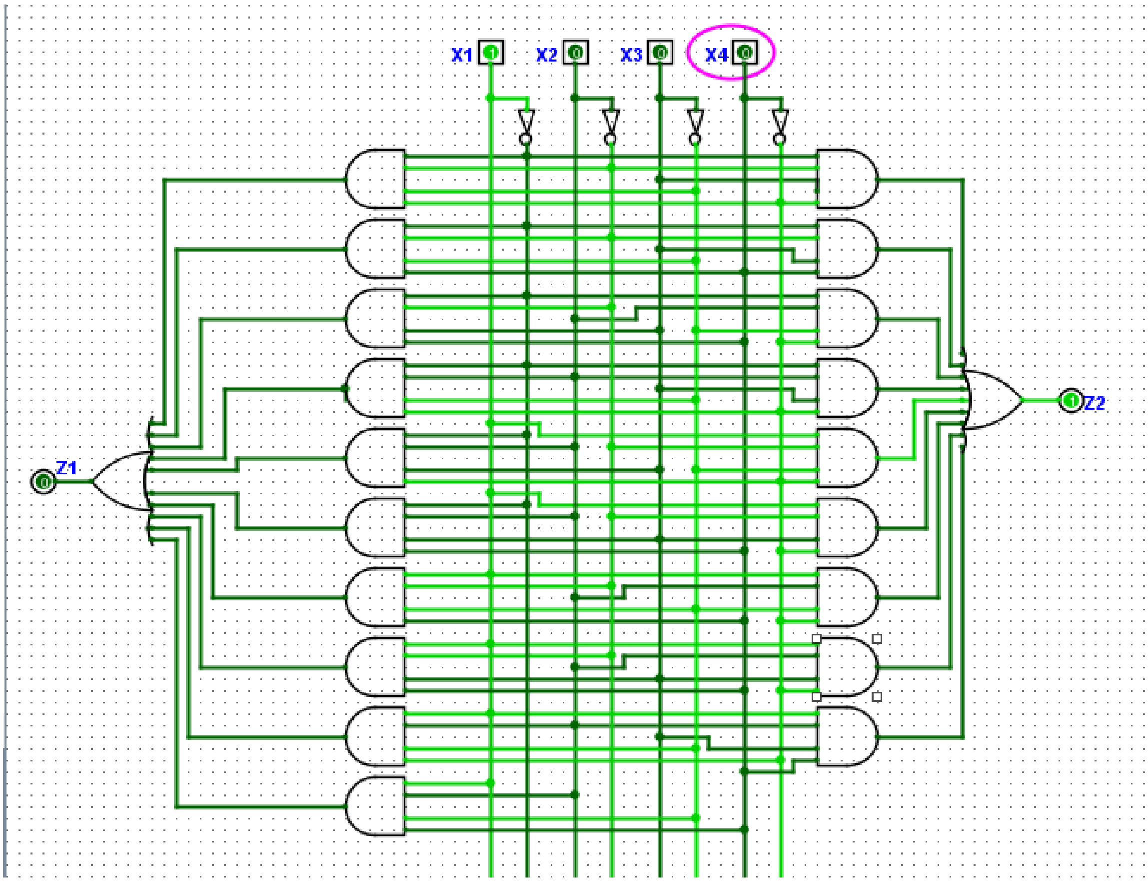

X1
X2
X3
X4
Z1
Z2


X1
X2
X3
X4
Z1
Z2


X1
X2
X3
X4
Z1
Z2


X1
X2
X3
X4
Z1
Z2


X1
X2
X3
X4
Z1
Z2


X1
X2
X3
X4
Z1
Z2

1.3

Z1 K-Map

| | $\overline{X3}.\overline{X4} \rightarrow 00$ | $\overline{X3}.X4 \rightarrow 01$ | $X3.X4 \rightarrow 11$ | $X3.\overline{X4} \rightarrow 10$ |
|---|---|---|---|---|
| $\overline{X1}.\overline{X2} \rightarrow 00$ | 1 | 1 | 1 | 0 |
| $\overline{X1}.X2 \rightarrow 01$ | 1 | 0 | 1 | 1 |
| $X1.X2 \rightarrow 11$ | 1 | 1 | 0 | 0 |
| $X1.\overline{X2} \rightarrow 10$ | 0 | 1 | 1 | 0 |

Z1=$(\overline{X1}.\ \overline{X3}.\ \overline{X4})$+$(\overline{X1}.\ X2.\ X3)$+$(X1.\ X2.\ \overline{X3})$+$(\overline{X2}.\ X4)$

Boolean identity

$Z_1$=$(\overline{X1}.\ \overline{X2}.\ \overline{X3}.\ \overline{X4})$+$(\overline{X1}.\ \overline{X2}.\ \overline{X3}.\ X4)$+$(\overline{X1}.\ \overline{X2}.\ X3.\ X4)$+$(\overline{X1}.\ X2.\ \overline{X3}.\ \overline{X4})$+ $($ $\overline{X1}.\ X2.\ X3.\ \overline{X4})$+$(\overline{X1}.\ X2.\ X3.\ X4)$+$(X1.\ \overline{X2}.\ \overline{X3}.\ X4)$+$(X1.\ \overline{X2}.\ X3.\ X4)$+$($ $X1.\ X2.\ \overline{X3}.\ \overline{X4})$+$(X1.\ X2.\ \overline{X3}.\ X4)$

using commutative law

=$(\overline{X1}.\ \overline{X2}.\ \overline{X3}.\ \overline{X4})$+$(\overline{X1}.\ X2.\ \overline{X3}.\ \overline{X4})$+$(\overline{X1}.\ \overline{X2}.\ \overline{X3}.\ X4)$+$(\overline{X1}.\ \overline{X2}.\ X3.\ X4)$+ $($ $\overline{X1}.\ X2.\ X3.\ \overline{X4})$+$(\overline{X1}.\ X2.\ X3.\ X4)$+$(X1.\ \overline{X2}.\ \overline{X3}.\ X4)$+$(X1.\ \overline{X2}.\ X3.\ X4)$+$($ $X1.\ X2.\ \overline{X3}.\ \overline{X4})$+$(X1.\ X2.\ \overline{X3}.\ X4)$

Using distributive law

=$(\overline{X1}.\ \overline{X3}.\ \overline{X4})(\ \overline{X2}\ +\ X2)$+$(\overline{X1}.\ \overline{X2}.\ X4)(\ \overline{X3}\ +\ X3)$ + $(\overline{X1}.\ X2.\ X3)(\overline{X4}\ +\ \ X4)$+$($ $X1.\ \overline{X2}.\ X4)(\overline{X3}\ +\ X3)$+$(X1.\ X2.\ \overline{X3})(\overline{X4}\ +\ \ X4)$

Using inverse law & identity law

=$(\overline{X1}.\ \overline{X3}.\ \overline{X4})$+$(\overline{X1}.\ \overline{X2}.\ X4)$+$(\overline{X1}.\ X2.\ X3)$+$(X1.\ \overline{X2}.\ X4)$+$(X1.\ X2.\ \overline{X3})$

Using distributive law

=$(\overline{X1}.\overline{X3}.\ \overline{X4})$+$(\overline{X1}.\ X2.\ X3)$+$(X1.\ X2.\ \overline{X3})$+$(\overline{X1}\ +\ \ X1)(\overline{X2}.\ X4)$

Using inverse law & identity law

Z1=$(\overline{X1}.\overline{X3}.\ \overline{X4})$+$(\overline{X1}.\ X2.\ X3)$+$(X1.\ X2.\ \overline{X3})$+$(\overline{X2}.\ X4)$

From K-map and Boolean identity

Z1=$(\overline{X1}.\ \overline{X3}.\ \overline{X4})$+$(\overline{X1}.\ X2.\ X3)$+$(X1.\ X2.\ \overline{X3})$+$(\overline{X2}.\ X4)$

Z2 K-Map

| | $\overline{X3}\,\overline{X4} \rightarrow 00$ | $\overline{X3}.X4 \rightarrow 01$ | $X3.X4 \rightarrow 11$ | $X3.\overline{X4} \rightarrow 10$ |
|---|---|---|---|---|
| $\overline{X1}.\overline{X2} \rightarrow 00$ | 0 | 0 | 1 | 1 |
| $\overline{X1}.X2 \rightarrow 01$ | 1 | 0 | 0 | 1 |
| $X1.X2 \rightarrow 11$ | 1 | 0 | 1 | 1 |
| $X1.\overline{X2} \rightarrow 10$ | 1 | 0 | 0 | 1 |

Z2=$(X1.\ \overline{X4})$+$(X2.\ \overline{X4})$+$(\overline{X1}.\ \overline{X2}.\ X3)$+$(X1.\ X2.\ X3)$

Boolean identity

Z2=$(\overline{X1}.\ \overline{X2}.X3\,.\overline{X4})$+$(\overline{X1}.\ \overline{X2}.\ X3.\ X4)$+$(\overline{X1}.\ X2.\ \overline{X3}.\ \overline{X4})$+$(\overline{X1}.\ X2.\ X3.\ \overline{X4})$+$(X1.\ \overline{X2}.\ \overline{X3}.\ \overline{X4})$+$(X1.\ \overline{X2}.\ X3.\ \overline{X4})$+$(X1.\ X2.\ \overline{X3}.\ \overline{X4})$+$(X1.\ X2.\ X3.\ \overline{X4})$+$(X1.X2.\ X3.\ X4)$

By using idempotent law

=$(\overline{X1}.\ \overline{X2}.X3\,.\overline{X4})$+$(\overline{X1}.\ \overline{X2}.\ X3.\ X4)$+$(\overline{X1}.\ X2.\ \overline{X3}.\ \overline{X4})$+$(\overline{X1}.\ X2.\ X3.\ \overline{X4})$+$(X1.\ \overline{X2}.\ \overline{X3}.\ \overline{X4})$+$(X1.\ \overline{X2}.\ X3.\ \overline{X4})$+$(X1.\ X2.\ \overline{X3}.\ \overline{X4})$+$(X1.\ X2.\ X3.\ \overline{X4})$+$(X1.\ X2.\ \overline{X3}.\ \overline{X4})$+$(X1.\ X2.\ X3.\ \overline{X4})$+$(X1.\ X2.\ X3.\ \overline{X4})$+$(X1.X2.\ X3.\ X4)$

By using distributive law

=$(\overline{X1}.\ \overline{X2}.X3)(\overline{X4} + X4)$+$(\overline{X1}.\ X2.\ \overline{X4})(\overline{X3} + X3)$+$(X1.\ \overline{X2}.\ \overline{X4})(\overline{X3} + X3)$+$(X1.\ X2.\ \overline{X4})(\overline{X3} + X3)$+$(X1.\ X2.\ \overline{X4})(\overline{X3} + X3)$+$(X1.\ X2.\ X3)(\overline{X4} + X4)$

By using inverse law & identity law

=$(\overline{X1}.\ \overline{X2}.X3)$+$(\overline{X1}.\ X2.\ \overline{X4})$+$(X1.\ \overline{X2}.\ \overline{X4})$+$(X1.\ X2.\ \overline{X4})$+$(X1.\ X2.\ \overline{X4})$+$(X1.\ X2.\ X3)$

By using associative law & distributive law

=$(\overline{X1}.\ \overline{X2}.X3)$+$(X1.\ X2.\ X3)$+$(X2.\ \overline{X4})(\overline{X1} + X1)$+$(X1.\ \overline{X4})(\overline{X2} + X2)$

By using inverse & identity law

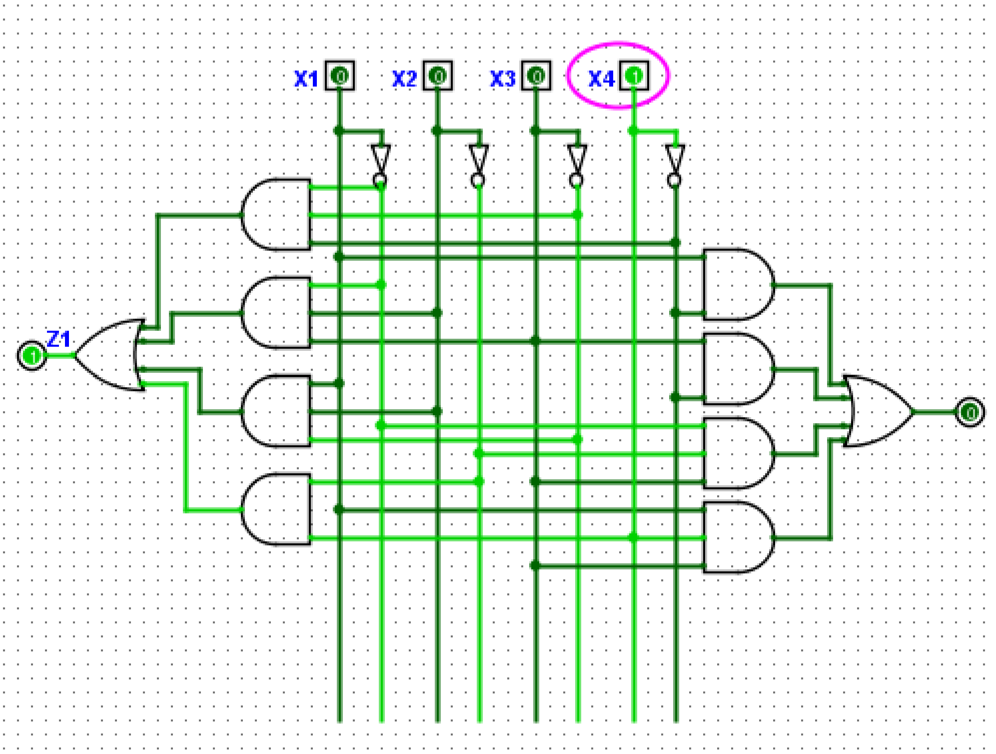
=$(\overline{X1}.\ \overline{X2}.X3)$+$(X1.\ X2.\ X3)$+$(X2.\ \overline{X4})$+$(X1.\ \overline{X4})$

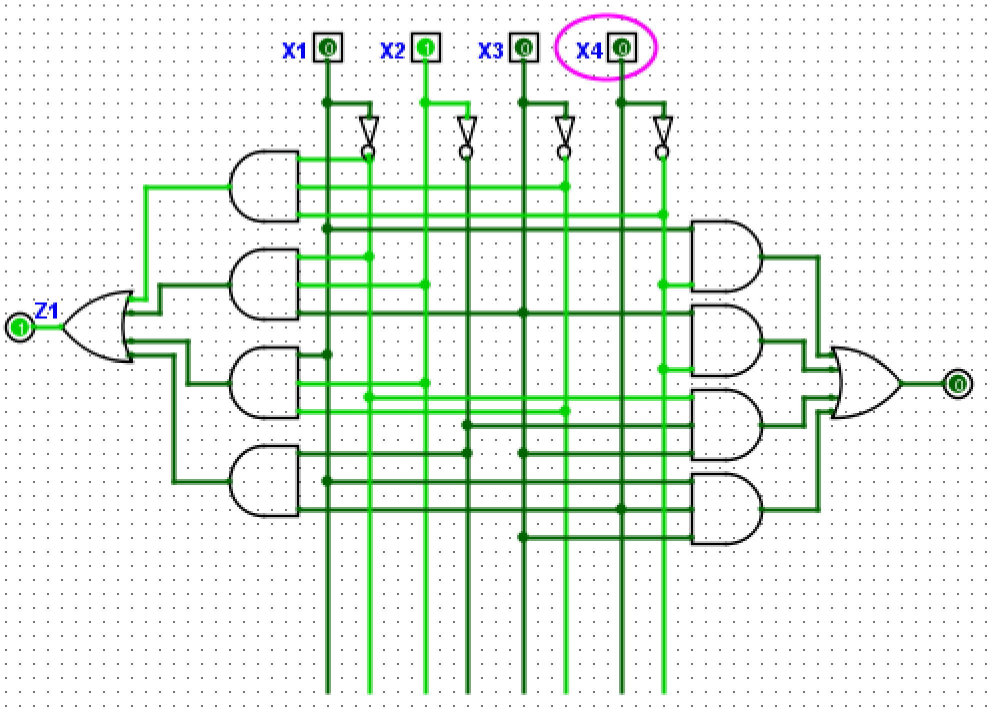
By using associative law

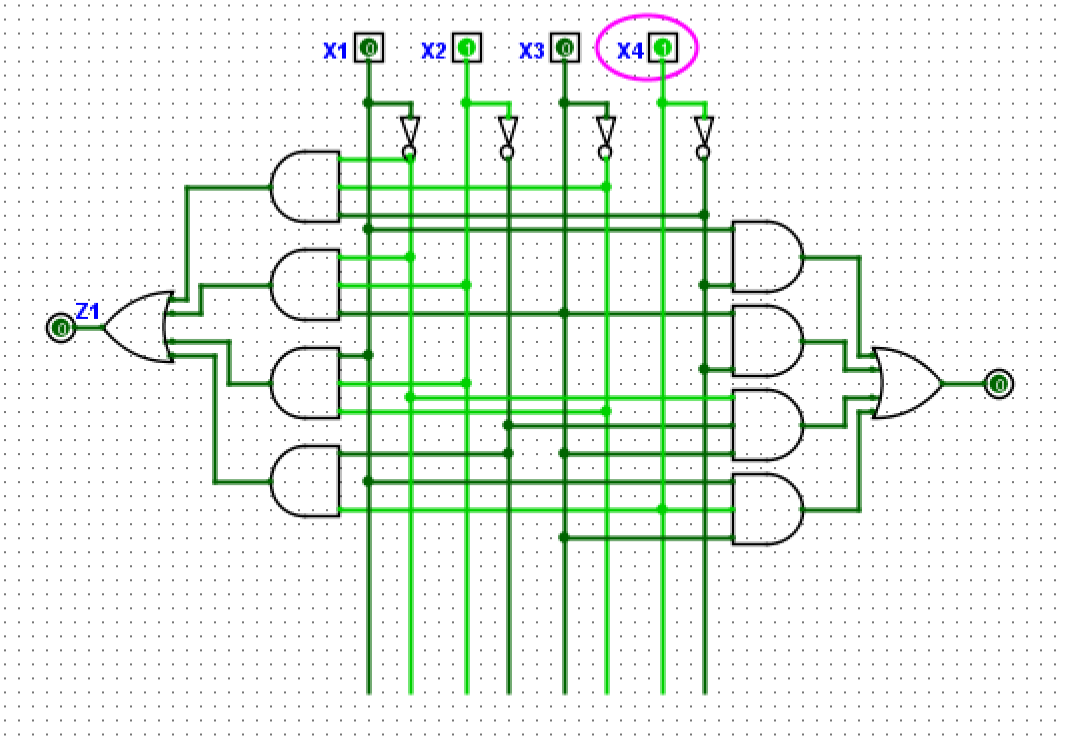
=$(X1.\ \overline{X4})$+$(X2.\ \overline{X4})$+$(\overline{X1}.\ \overline{X2}.\ X3)$+$(X1.\ X2.\ X3)$

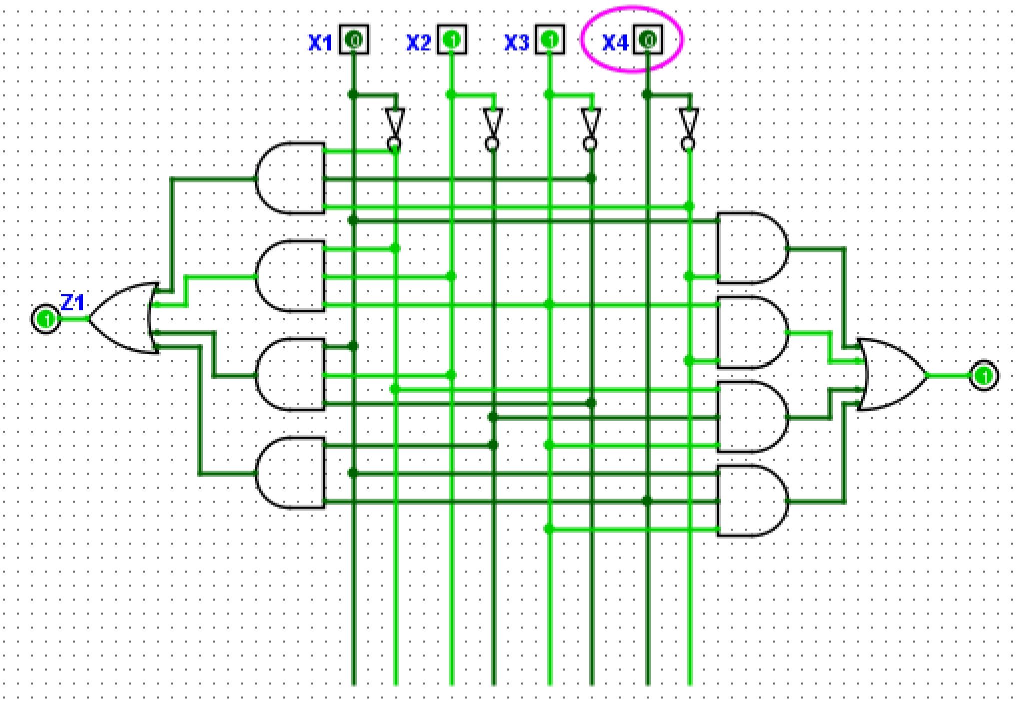
From K-map and boolean identity

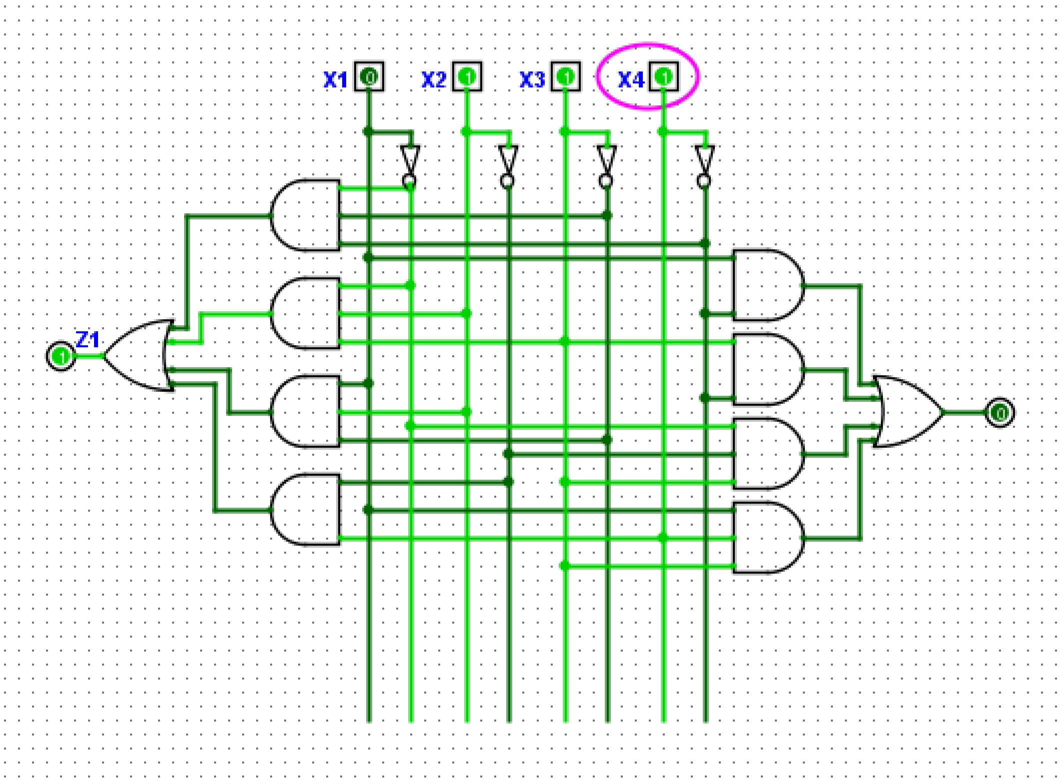
Z2=$(X1.\ \overline{X4})$+$(X2.\ \overline{X4})$+$(\overline{X1}.\ \overline{X2}.\ X3)$+$(X1.\ X2.\ X3)$

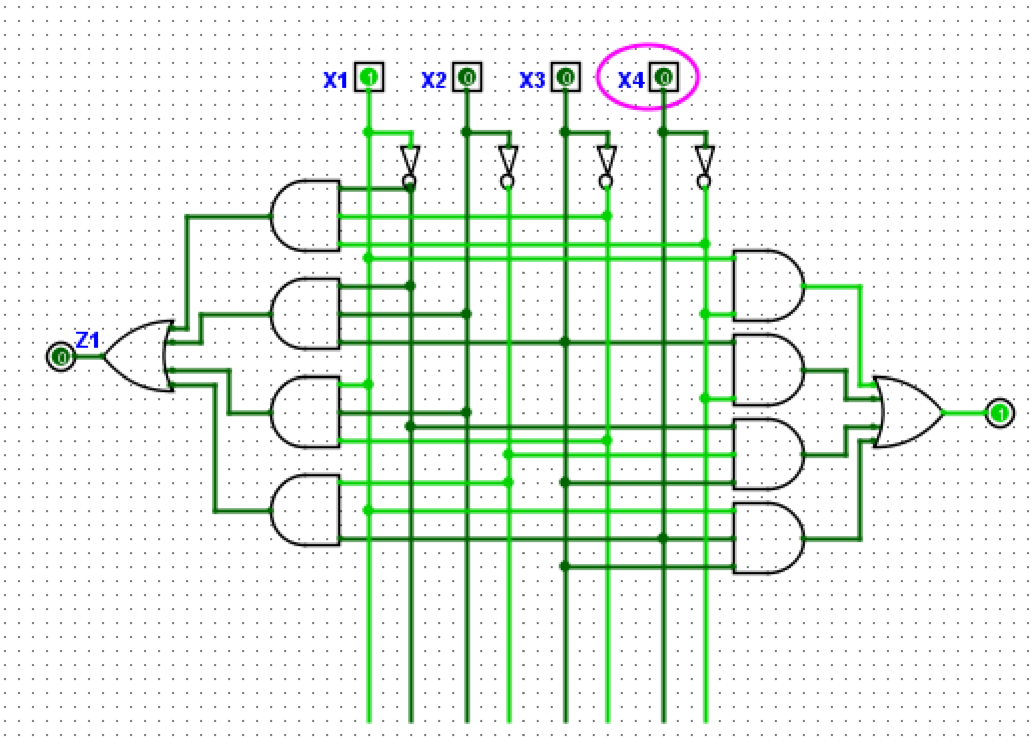

X1
X2
X3
X4
Z1


X1
X2
X3
X4
Z1


X1
0
X2
1
X3
0
X4
1
Z1
0
0


X1
0
X2
1
X3
1
X4
0
Z1
1
1




From the logisim we can compare with the logisim circuit in task 1.1 we get the same output and it is not so complicated and complex.

**Task 2**

Task 2.1

Input: hongg,boooo.$

OUTPUT MODE: UNICODE (UTF-16BE)

hongg boooo

Input: hongg,boooo.

Bongs,bongs.

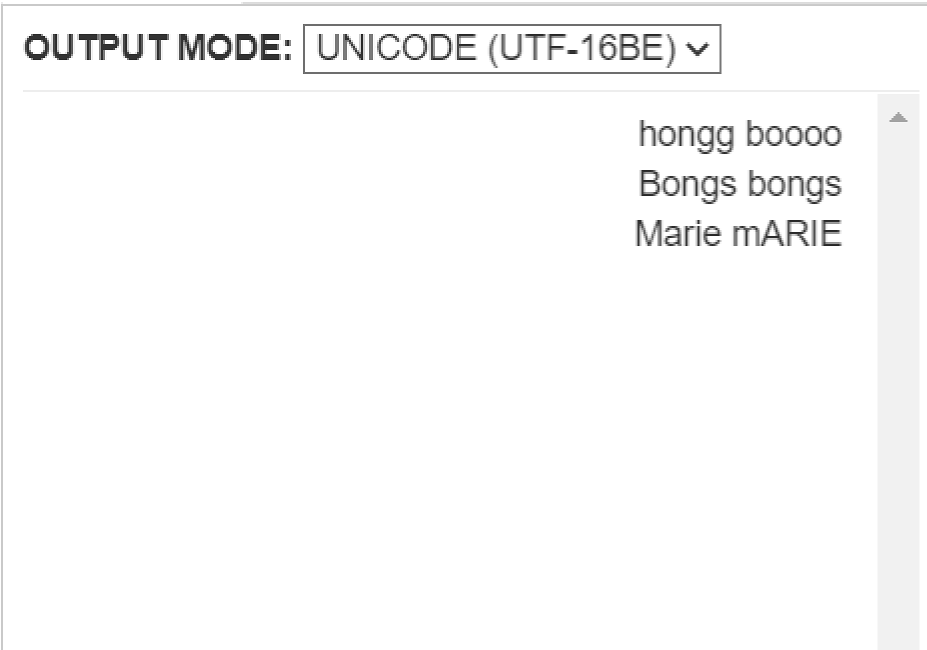
$

OUTPUT MODE: UNICODE (UTF-16BE)

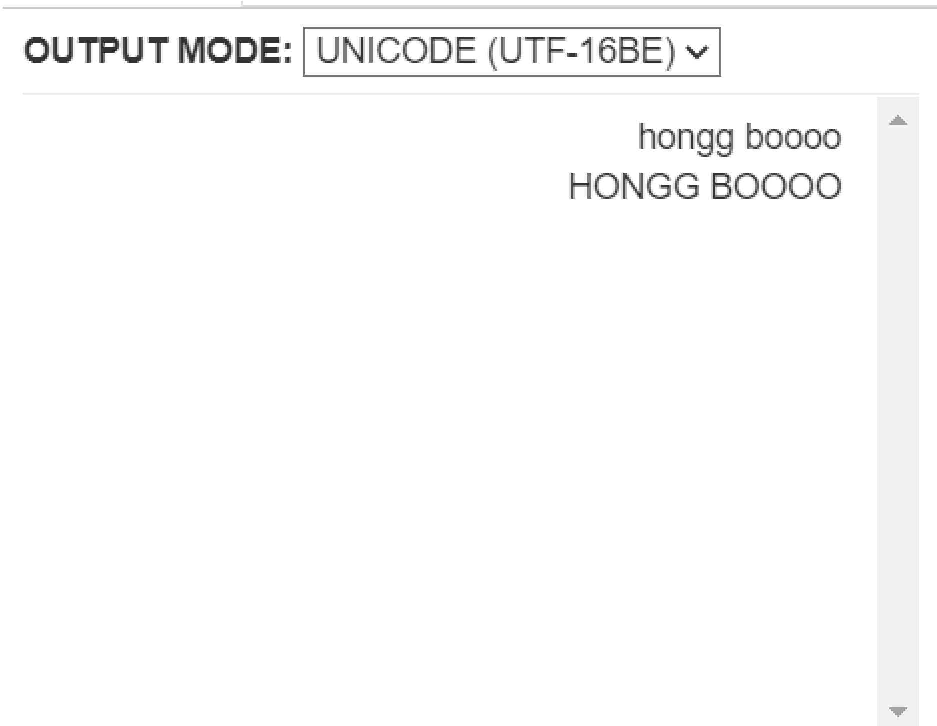
hongg boooo

Bongs BONGS

Input: hongg,boooo.
Bongs,bongs.
Marie,mARIE.
$




Task2.2
Input: hongg,boooo.$



Input: hongg,boooo.
Bongs,bongs.
$

**OUTPUT MODE:** UNICODE (UTF-16BE)

```
hongg boooo
Bongs bongs
HONGG BOOOO
bONGS BONGS
```

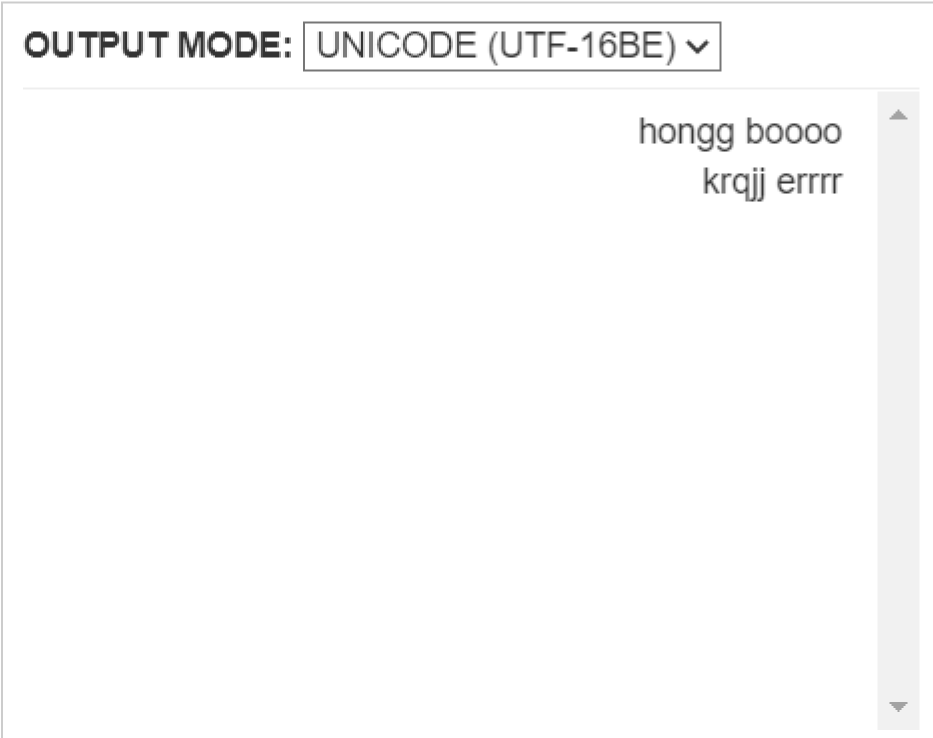
Input: hongg,boooo.
Bongs,bongs.
Marie,mARIE.
$

**OUTPUT MODE:** UNICODE (UTF-16BE)

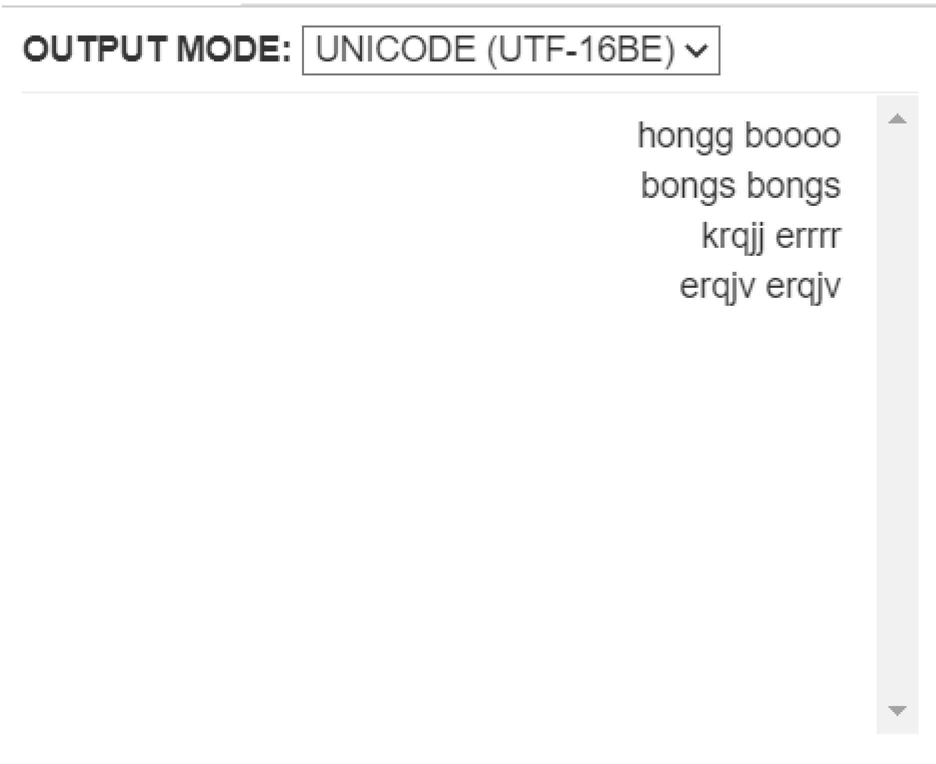
```
hongg boooo
Bongs bongs
Marie mARIE
HONGG BOOOO
bONGS BONGS
mARIE Marie
```

Task2.3

Input: hongg,boooo.$




Input: hongg,boooo.
bongs,bongs.
$



Input: hongg,boooo.
bongs,bongs.
marie,marie.
$