Manchester Metropolitan University

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Assignment Part 1 – Digital Logic

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Computer Systems Fundamentals

# The 7 Segment Display Truth Table

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DISPLAY | Z | Y | X | W |  | a | b | c | d | e | f | g |
| 0 | 0 | 0 | 0 | 0 |  | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 |  | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 1 | 0 |  | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 3 | 0 | 0 | 1 | 1 |  | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| 4 | 0 | 1 | 0 | 0 |  | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 5 | 0 | 1 | 0 | 1 |  | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| 6 | 0 | 1 | 1 | 0 |  | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 7 | 0 | 1 | 1 | 1 |  | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 8 | 1 | 0 | 0 | 0 |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 9 | 1 | 0 | 0 | 1 |  | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| A | 1 | 0 | 1 | 0 | UNDEFINED | X | X | X | X | X | X | X |
| B | 1 | 0 | 1 | 1 | UNDEFINED | X | X | X | X | X | X | X |
| C | 1 | 1 | 0 | 0 | UNDEFINED | X | X | X | X | X | X | X |
| D | 1 | 1 | 0 | 1 | UNDEFINED | X | X | X | X | X | X | X |
| E | 1 | 1 | 1 | 0 | UNDEFINED | X | X | X | X | X | X | X |
| F | 1 | 1 | 1 | 1 | UNDEFINED | X | X | X | X | X | X | X |

KEYS

X = UNDEFINED

A – F = UNDEFINED

**Karnaugh Maps for Seven-Segment Display**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | ZY |  |  |  |  |
| XW |  | 00 | 01 | 11 | 10 |
|  | 00 | 1 | 0 | X | 1 |
|  | 01 | 0 | 1 | X | 1 |
|  | 11 | 1 | 1 | X | X |
|  | 10 | 1 | 1 | X | X |
| Output a | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | ZY |  |  |  |  |
| XW |  | 00 | 01 | 11 | 10 |
|  | 00 | 1 | 1 | X | 1 |
|  | 01 | 1 | 0 | X | 1 |
|  | 11 | 1 | 1 | X | X |
|  | 10 | 1 | 0 | X | X |
| Output b | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | ZY |  |  |  |  |
| XW |  | 00 | 01 | 11 | 10 |
|  | 00 | 1 | 1 | X | 1 |
|  | 01 | 1 | 1 | X | 1 |
|  | 11 | 1 | 1 | X | X |
|  | 10 | 0 | 1 | X | X |
| Output c | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | ZY |  |  |  |  |
| XW |  | 00 | 01 | 11 | 10 |
|  | 00 | 1 | 0 | X | 1 |
|  | 01 | 0 | 1 | X | 1 |
|  | 11 | 1 | 0 | X | X |
|  | 10 | 1 | 1 | X | X |
| Output d | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | ZY |  |  |  |  |
| XW |  | 00 | 01 | 11 | 10 |
|  | 00 | 0 | 1 | X | 1 |
|  | 01 | 0 | 1 | X | 1 |
|  | 11 | 1 | 0 | X | X |
|  | 10 | 1 | 1 | X | X |
| Output e | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | ZY |  |  |  |  |
| XW |  | 00 | 01 | 11 | 10 |
|  | 00 | 1 | 1 | X | 1 |
|  | 01 | 0 | 1 | X | 1 |
|  | 11 | 0 | 0 | X | X |
|  | 10 | 0 | 1 | X | X |
| Output f | | | | | |

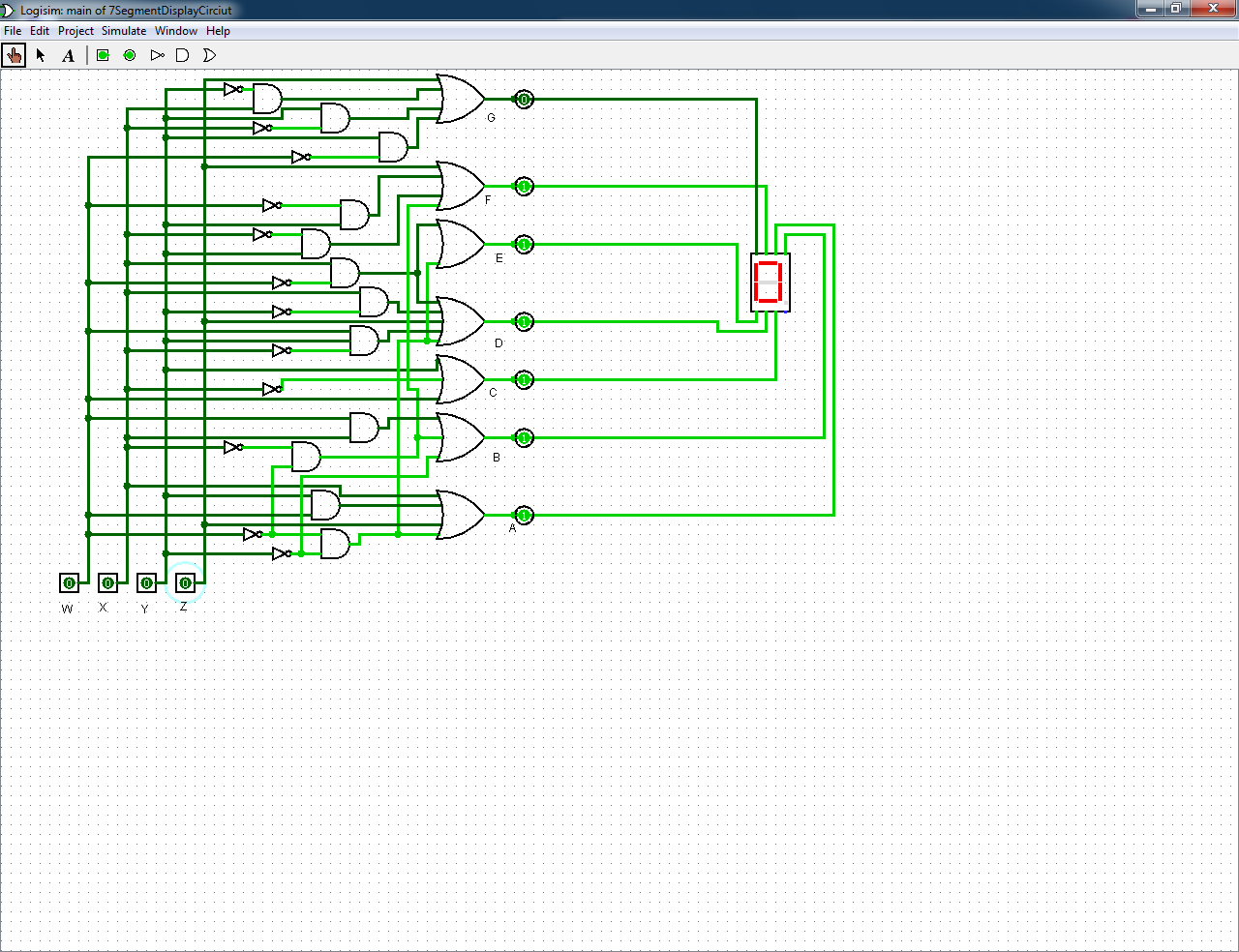
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | ZY |  |  |  |  |
| XW |  | 00 | 01 | 11 | 10 |
|  | 00 | 0 | 1 | X | 1 |
|  | 01 | 0 | 1 | X | 1 |
|  | 11 | 1 | 0 | X | X |
|  | 10 | 1 | 1 | X | X |
| Output g | | | | | |

# The Simplified Sum of Product Expressions for Seven Segment Circuit the Use of Karnaugh Map

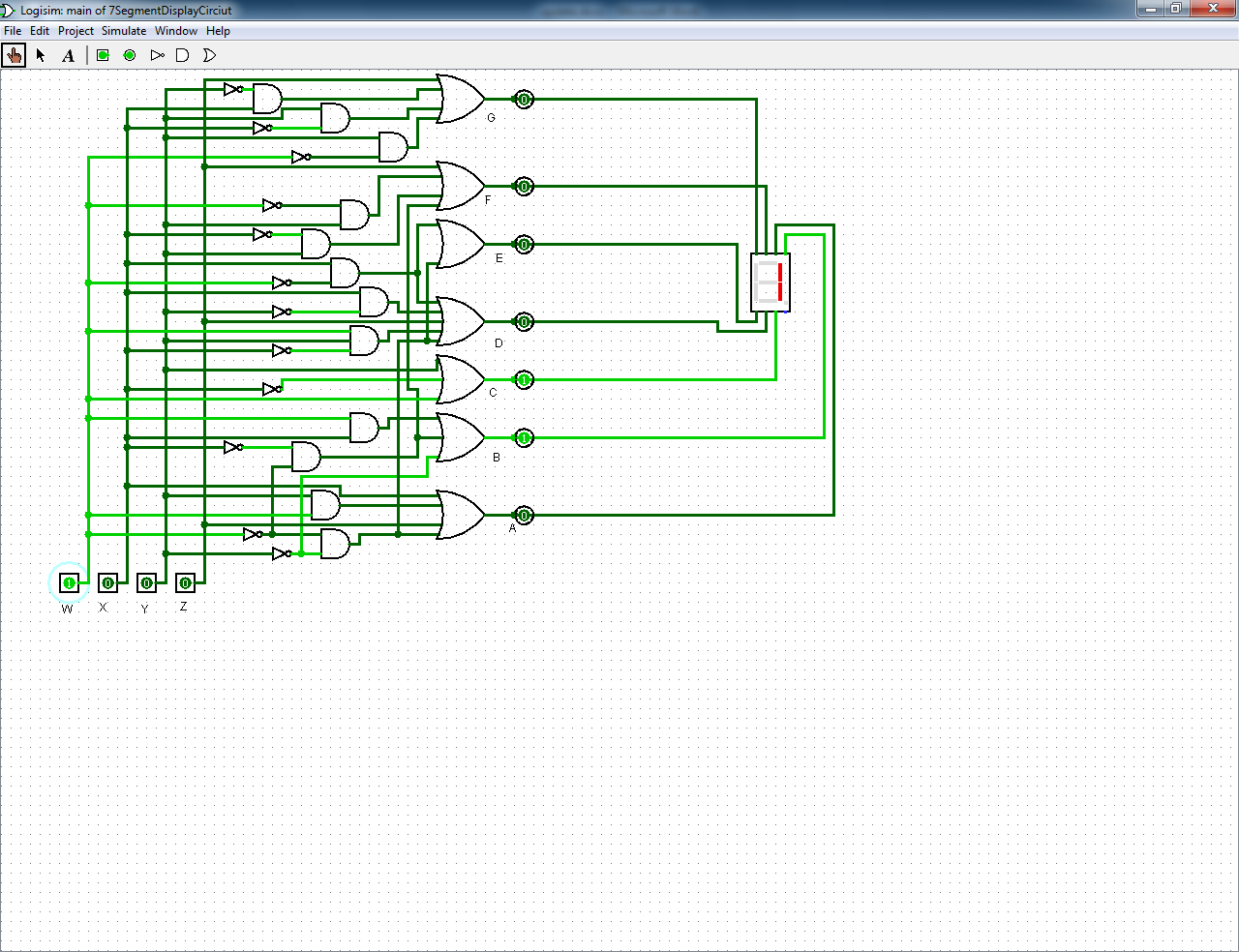
The karnaugh map is a form of Boolean simplification. The functions from the truth table are used to plot the map and then putting the functions into possible groups of 1, 2, 4, 8 or 16.

note : see page 10 to 14 for the boolean simplification

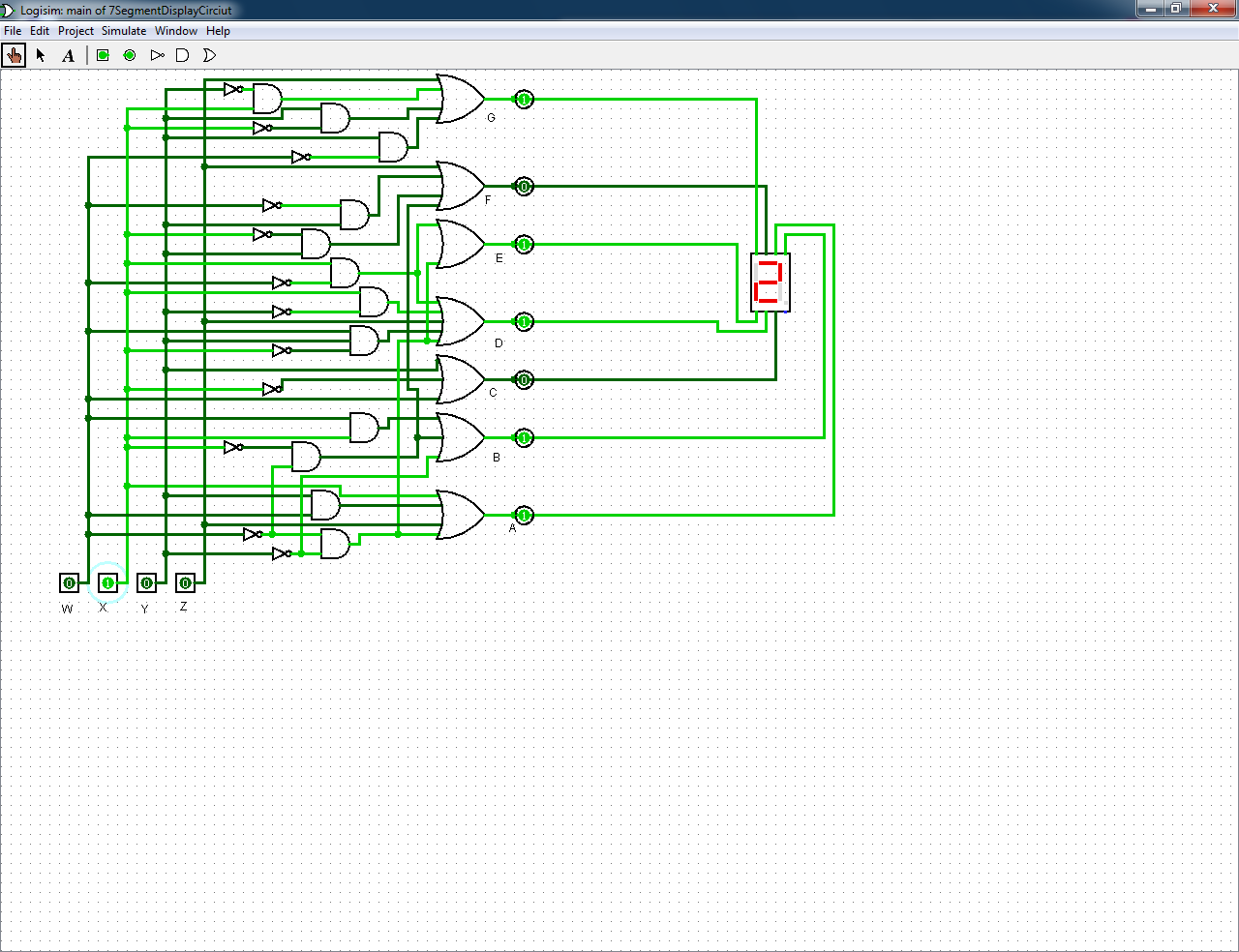
Display = 0



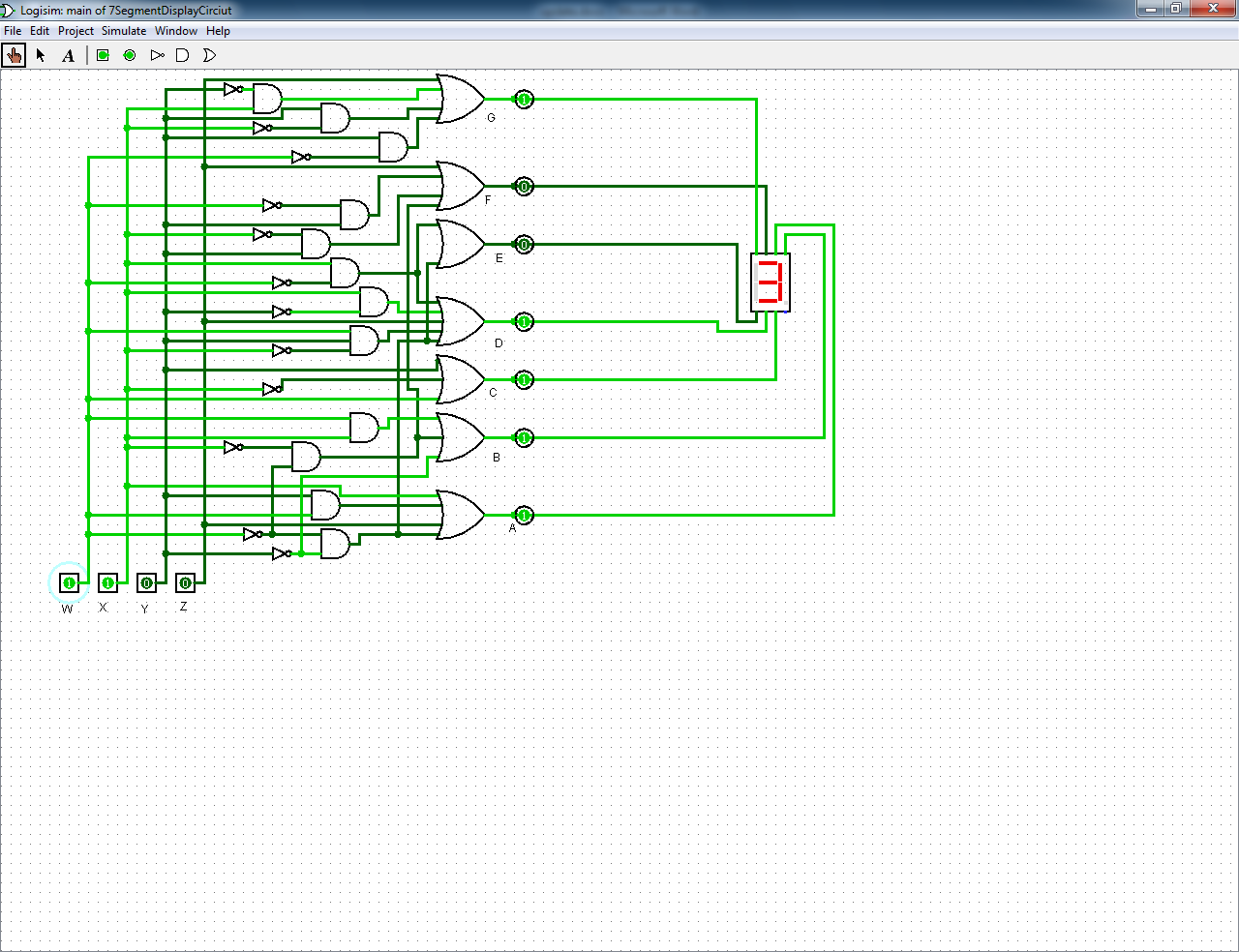
Display = 1



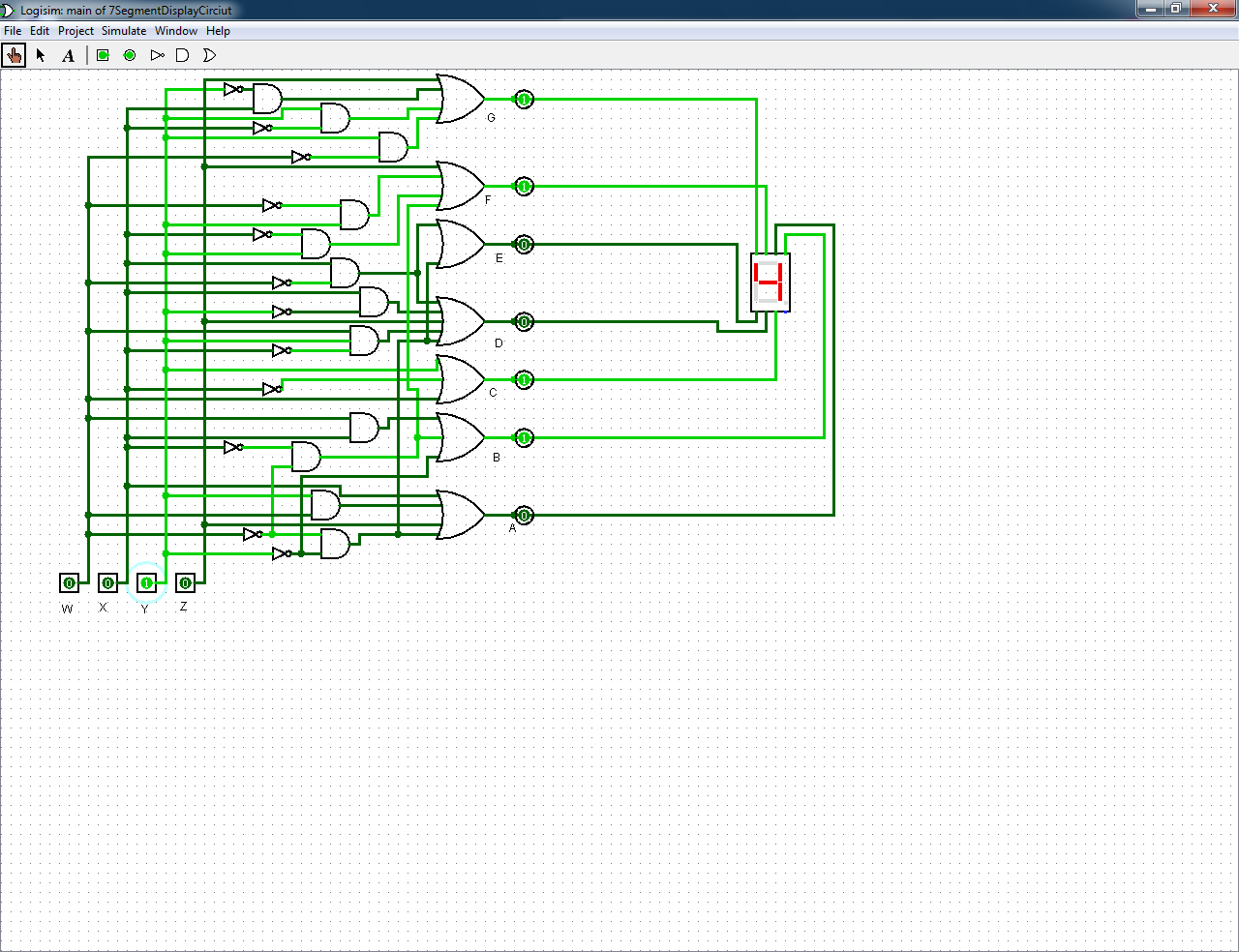
Display = 2



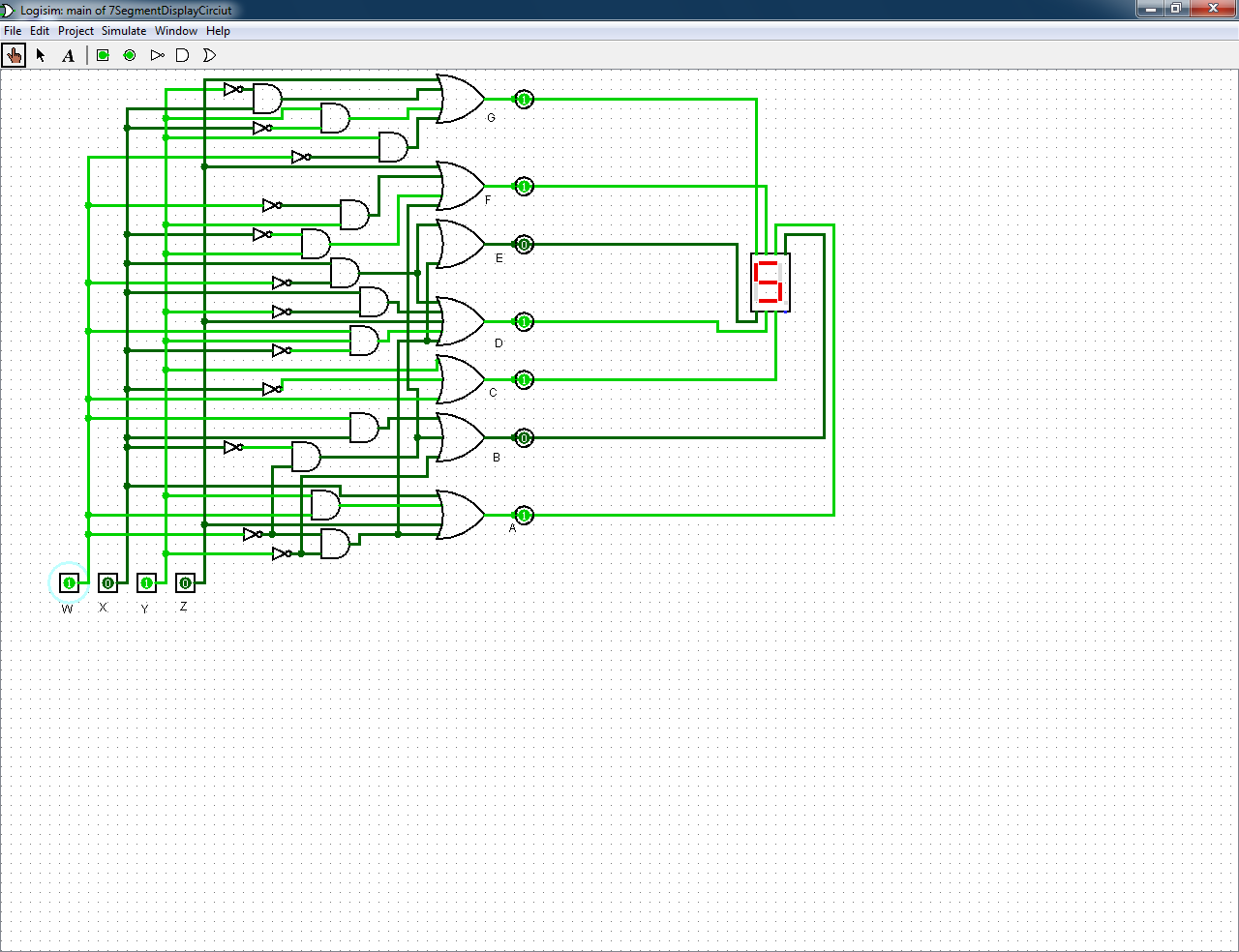
Display = 3



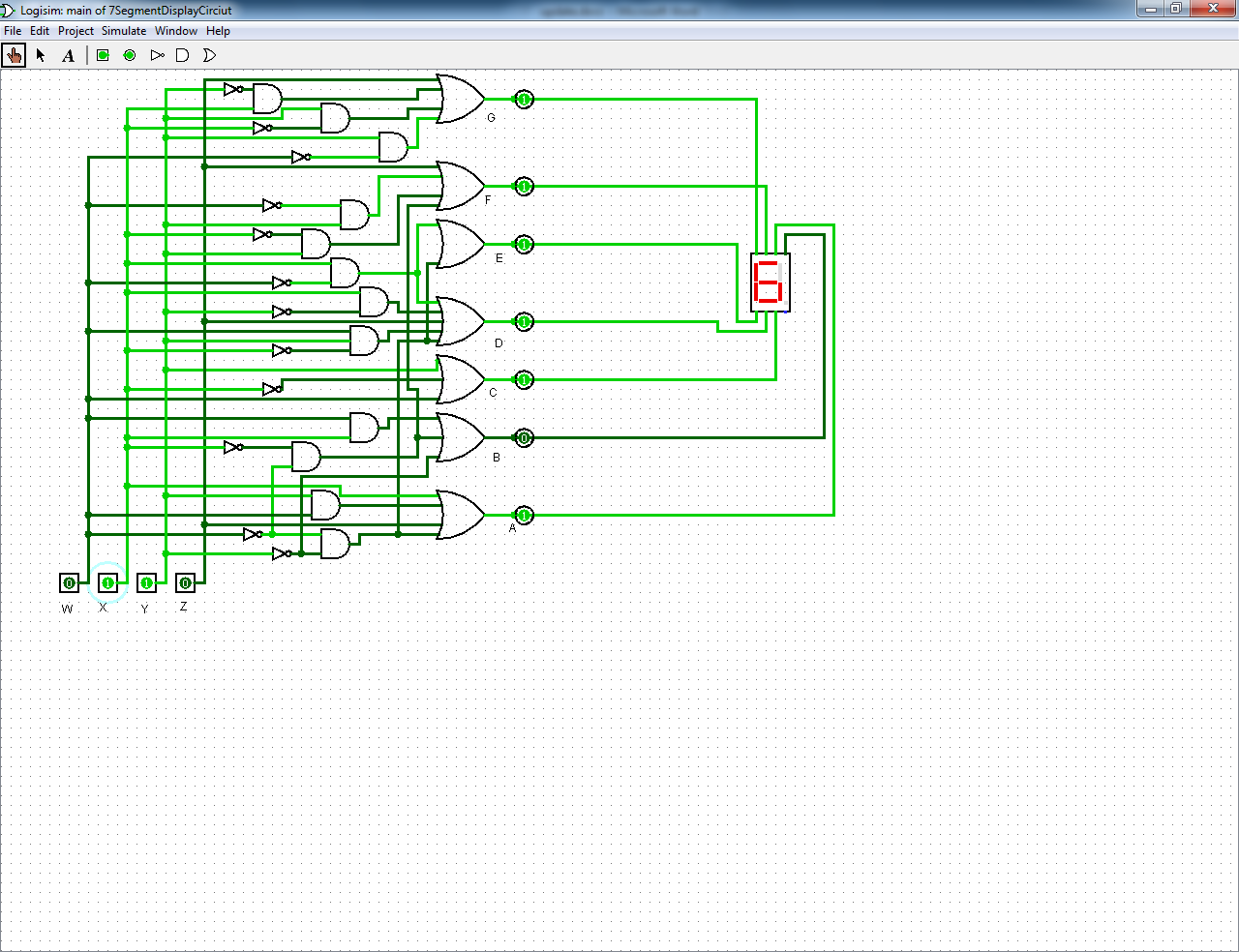
Display = 4



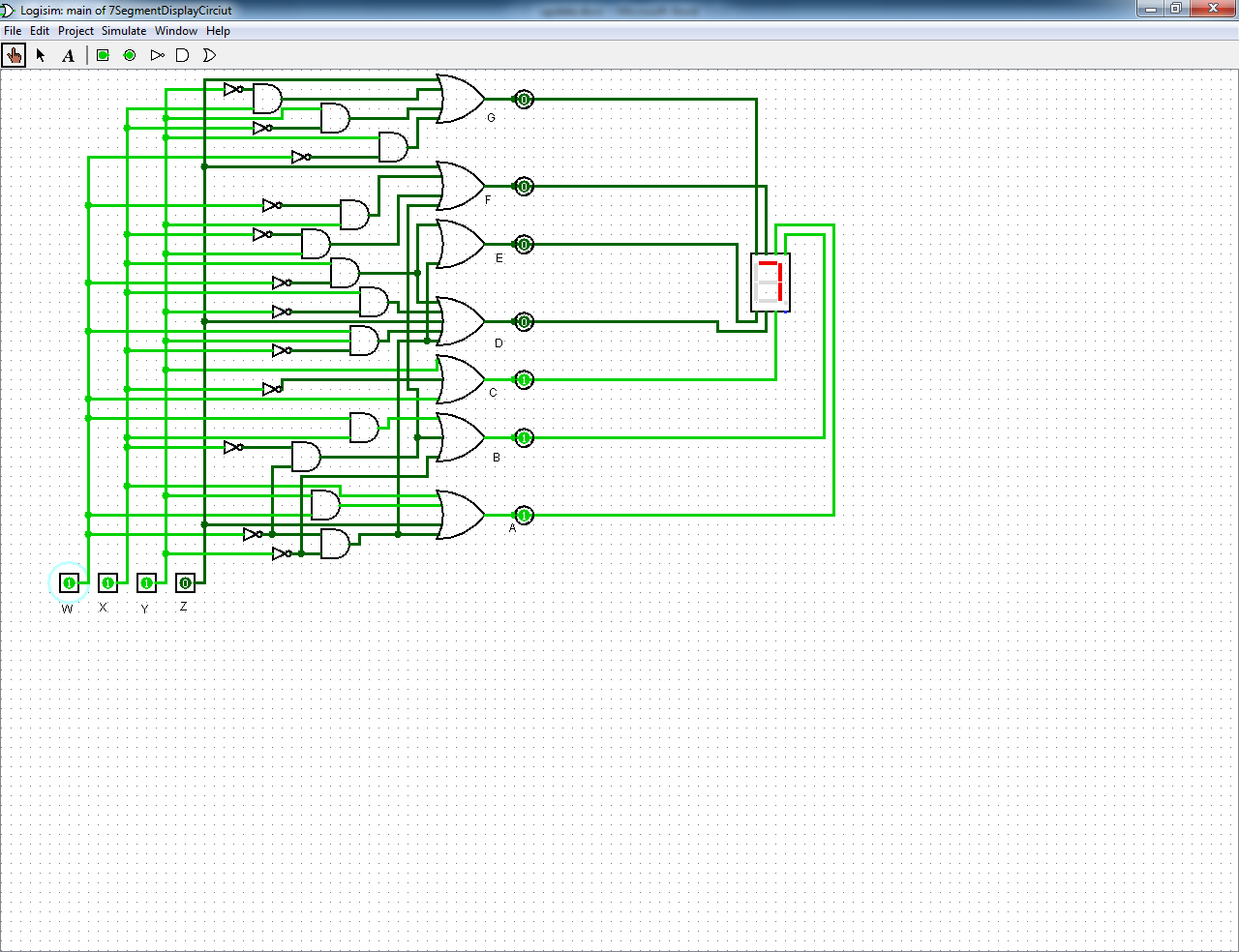
Display = 5



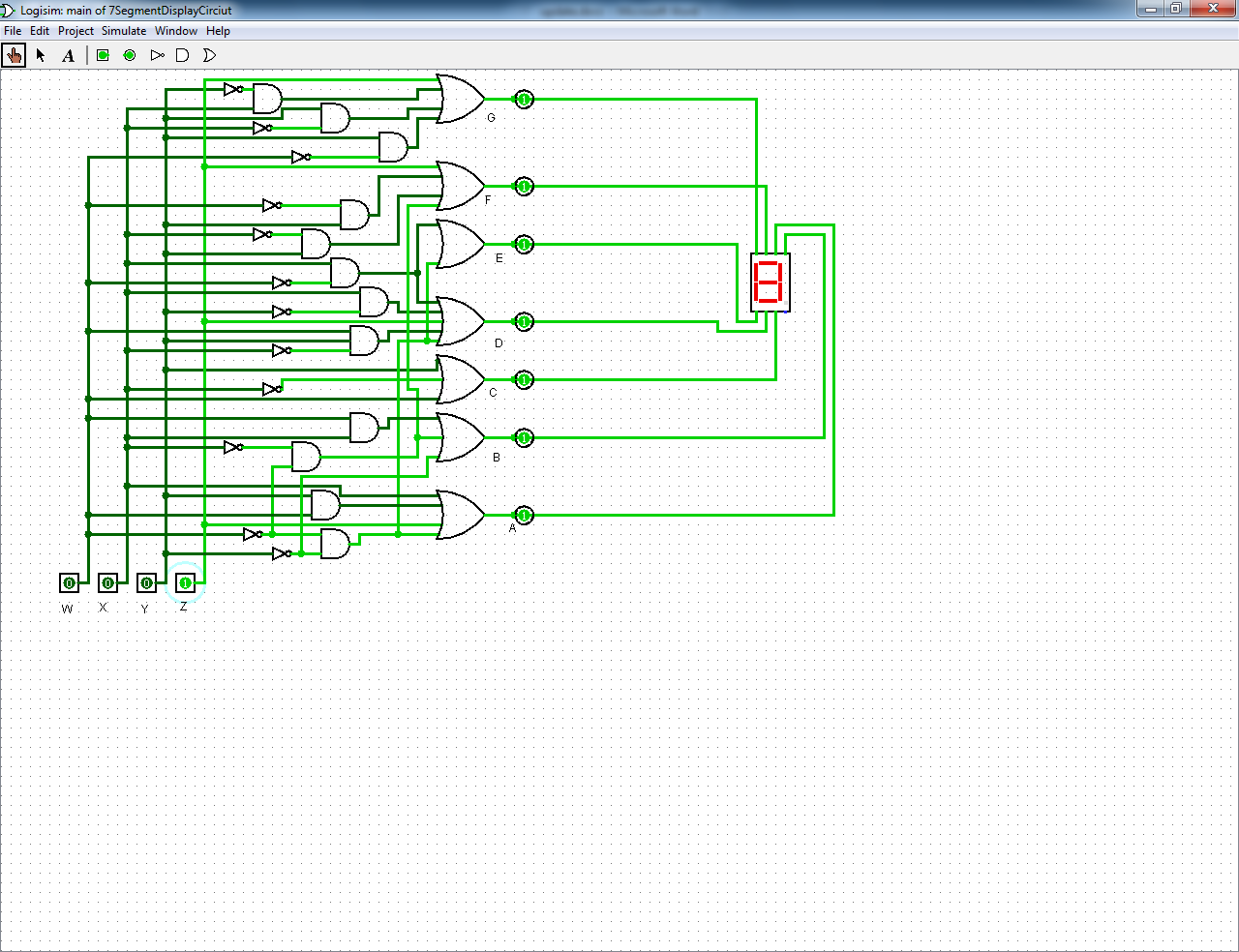
Display = 6



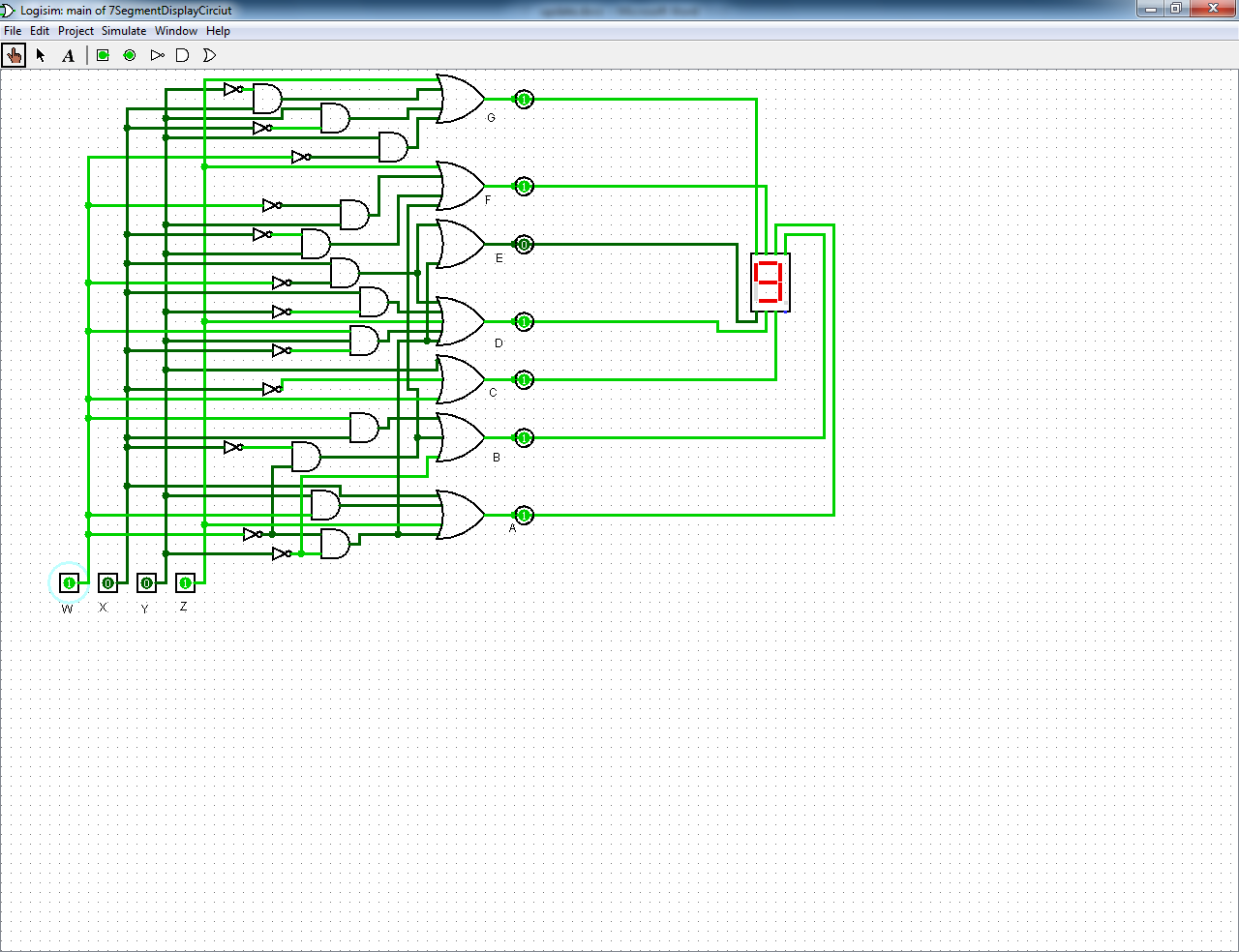
Display = 7



Display = 8



Display = 9



# The Simplified Sum of Product Expressions for Seven Segment Circuit the Use of Karnaugh Map

{Distributive law}

{Inverse law}

{Identity law}

{Commutative &

Distributive laws}

{Distributive law}

{Inverse and identity laws}

{Distributive and absorption laws}

{Distributive, Inverse

And identity laws}

{Distributive, Inverse

And identity laws}

{Distributive law}

{Inverse law}

{Identity law}

{Distributive law}

{Inverse and identity laws}

{Distributive and absorption laws}

{Distributive, commutative and

Associative laws}

{Inverse and identity laws}

# Reference

Alan Clements. (2006). Gates, circuits, and combinational logic. In: Principles of Computer Hardware. 4th ed. United States: Oxford University Press. p69-87.