Institut for Matematik og Datalogi Syddansk Universitet August 29, 2014 JFB

## Introduction to Computer Science E14 - Discussion Sections 2 - Week 37

1. Produce formulas and circuits for the following functions:

	W	Х	у	Z
	0	0	0	1
	0	0	1	1
	0	1	0	1
(a)	0	1	1	0
	1	0	0	1
	1	0	1	1
	1	1	0	1
	1	1	1	0
	W	х	у	Z
	w 0	x 0	у 0	z 0
	w 0 0	x 0 0	y 0 1	z 0 0
	w 0 0 0	x 0 0 1	y 0 1 0	z 0 0 1
(b)	w 0 0 0 0	x 0 0 1 1	y 0 1 0 1	z 0 0 1 1
(b)	w 0 0 0 0 1	x 0 1 1 0	y 0 1 0 1 0	2 0 1 1 1
(b)	W 0 0 0 0 1 1	x 0 1 1 0 0	y 0 1 0 1 0 1 0 1	z 0 1 1 1 1 1
(b)	W 0 0 0 1 1 1	x 0 1 1 0 0 1	y 0 1 0 1 0 1 0	z 0 1 1 1 1 1 1
(b)	w 0 0 0 1 1 1 1 1	x 0 1 1 0 0 1 1 1	y 0 1 0 1 0 1 0 1 0 1	z 0 1 1 1 1 1 1 1 1

	a	b	С	d	z
	0	0	0	0	1
	0	0	0	1	0
	0	0	1	0	0
	0	0	1	1	0
	0	1	0	0	1
	0	1	0	1	0
	0	1	1	0	0
(c)	0	1	1	1	0
	1	0	0	0	1
	1	0	0	1	1
	1	0	1	0	0
	1	0	1	1	0
	1	1	0	0	1
	1	1	0	1	1
	1	1	1	0	0
	1	1	1	1	0
	a	b	С	d	z
	a 0	<i>b</i> 0	<i>c</i> 0	$\frac{d}{0}$	$\left  \begin{array}{c} z \\ 1 \end{array} \right $
	a 0 0	b 0 0	с 0 0	<i>d</i> 0 1	$\begin{vmatrix} z \\ 1 \\ 0 \end{vmatrix}$
	a 0 0 0	b 0 0 0	c 0 0 1	$\begin{array}{c} d \\ 0 \\ 1 \\ 0 \end{array}$	$\begin{array}{ c c }\hline z\\1\\0\\0\\\end{array}$
	a 0 0 0 0	b 0 0 0 0	c 0 0 1 1	d 0 1 0 1	$\begin{array}{ c c }\hline z\\1\\0\\0\\0\\\end{array}$
	a 0 0 0 0 0	b 0 0 0 0 1	c 0 1 1 0	$\begin{array}{c} d \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 0 \end{array}$	$\begin{array}{ c c }\hline z\\1\\0\\0\\0\\0\\0\end{array}$
	$egin{array}{c} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{array}$	b 0 0 0 1 1	$\begin{array}{c} c \\ 0 \\ 0 \\ 1 \\ 1 \\ 0 \\ 0 \end{array}$	$\begin{array}{c} d \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 1 \end{array}$	$egin{array}{c c} z \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \end{array}$
	$egin{array}{c} a \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{array}$	b 0 0 0 1 1 1	$\begin{array}{c} c \\ 0 \\ 1 \\ 1 \\ 0 \\ 0 \\ 1 \\ 1 \end{array}$	$\begin{array}{c} d \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \end{array}$	$egin{array}{c c} z \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 0 \end{array}$
(d)	$egin{array}{c} a \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{array}$	$b \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1$	$egin{array}{c} c \\ 0 \\ 1 \\ 1 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1 \end{array}$	$egin{array}{c} d \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \end{array}$	$egin{array}{c c} z \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{array}$
(d)	$egin{array}{c} a \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \end{array}$	$b \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1 \\ 0$	$egin{array}{c} c \\ 0 \\ 1 \\ 1 \\ 0 \\ 0 \\ 1 \\ 1 \\ 0 \end{array}$	$egin{array}{c} d \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \end{array}$	$egin{array}{c} z \\ 1 \\ 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \\ 1 \end{array}$
(d)	$\begin{array}{c} a \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 1$	b 0 0 0 1 1 1 1 0 0	c 0 1 1 0 0 1 1 0 0 0	$\begin{array}{c} d \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 1$	$egin{array}{c c} z \\ 1 \\ 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \end{array}$
(d)	$egin{array}{ccc} a \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1$	$\begin{array}{c} b \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0$	c 0 1 1 0 0 1 1 0 0 1 1 0 0 1	$\begin{array}{c} d \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ \end{array}$	z 1 0 0 0 1 0 1 0 1 0 1 0 1
(d)	$\begin{array}{c} a \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1$	b 0 0 1 1 1 1 0 0 0 0 0	$egin{array}{c} c \\ 0 \\ 1 \\ 1 \\ 0 \\ 0 \\ 1 \\ 1 \\ 0 \\ 0 \\ 1 \\ 1$	$\begin{array}{c} d \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ \end{array}$	z       1       0       0       0       0       0       0       1       0       1       0       1       0       1       0       1       0       1       0       1       0       1       0
(d)	$\begin{array}{c} a \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1$	$\begin{array}{c} b \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0$	$egin{array}{c} c \\ 0 \\ 1 \\ 1 \\ 0 \\ 0 \\ 1 \\ 1 \\ 0 \\ 0 \\ 1 \\ 1$	$\begin{array}{c} d \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ \end{array}$	z       1       0       0       0       1       0       1       0       1       0       1       0       0       1       0       0       0       0       0       0
(d)	$\begin{array}{c} a \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1$	$\begin{array}{c} b \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0$	$egin{array}{c} c \\ 0 \\ 1 \\ 1 \\ 0 \\ 0 \\ 1 \\ 1 \\ 0 \\ 0 \\ 1 \\ 1$	$\begin{array}{c} d \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ \end{array}$	z       1       0       0       0       1       0       1       0       1       0       1       0       1       0       1       0       1       0       1       0       1
(d)	$\begin{array}{c} a \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1$	$\begin{array}{c} b \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1 \\ 1 \\ 0 \\ 0 \\ 0$	$egin{array}{c} c \\ 0 \\ 1 \\ 1 \\ 0 \\ 0 \\ 1 \\ 1 \\ 0 \\ 0 \\ 1 \\ 1$	$\begin{array}{c} d \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 0 \\ \end{array}$	z   1   0   0   0   1   0   1   0   1   0   1   1   1   1

2. Produce a truth table and circuit for the following function:

 $((x \wedge y) \vee (\bar{x} \wedge \bar{y})) \vee z$ 

- 3. Discuss the ease or difficulty of going from a formula to a circuit, vs. the ease or difficulty of going from a circuit to a formula. Create a circuit where the corresponding formula would naturally be larger than the formula.
- 4. From the textbook, pages 60–61: Problems 1c, 2c, 3b, 4c, 5.
- 5. From the textbook, page 71: Problems 1b, 1c, 2b, 2d (for these problems use the floating-point format discussed in class, which is the same as in the textbook except that it uses an implicit bit in the mantissa).
- 6. From the textbook, page 84: Problem 39 (again use the format discussed in class).
- 7. Choose two floating point numbers and add them together. If you cannot express the result in the same format, try two other numbers.
- 8. Choose a number which cannot be expressed exactly in the floating point format we use, but could be expressed exactly if there were more bits. How many more bits do you need?