

Computer Architecture

Richard Röttger – SDU, Fall 2017

Exercise Sheet 2

Exercise sheet 2 – Arithmetic and Digital Logic

- 1) Use the Booth algorithm to multiply 23 (multiplicand) by 29 (multiplier), where each number is represented using 6 bits.
- 2) The following numbers use the IEEE 32-bit floating-point format. What is the equivalent decimal value?
 - a) 1 10000011 1100000000000000000000
 - b) 0 01111110 1010000000000000000000
 - c) 0 10000000 1100000000000000000000
- 3) Consider a floating-point format with 8 bits for the biased exponent and 23 bits for the significand. Show the bit pattern for the following numbers in this format:
 - a) -720
 - b) 0.645
- 4) Any floating-point representation used in a computer can represent only certain real numbers exactly; all others must be approximated. If A' is the stored value approximating the real value A , then the relative error, r , is expressed as $r = \frac{A-A'}{A}$. Represent the decimal quantity 0.4 in the following floating-point format: exponent: biased, 4 bits; significand, 7 bits. What is the relative error?
- 5) One of the most serious errors in computer calculations occurs when two nearly equal numbers are subtracted. Consider $A = 0.22288$ and $B = 0.22211$. The computer truncates all values to four decimal digits. Thus $A' = 0.2228$ and $B' = 0.2221$.
 - a) What are the relative errors for A' and B' ?
 - b) What is the relative error for $C' = A' - B'$?
- 6) Show how the following floating-point calculations are performed (where significands are truncated to 4 decimal digits). Show the results in normalized form.
 - a) $7.286 \cdot 10^2 + 7.847 \cdot 10^2$

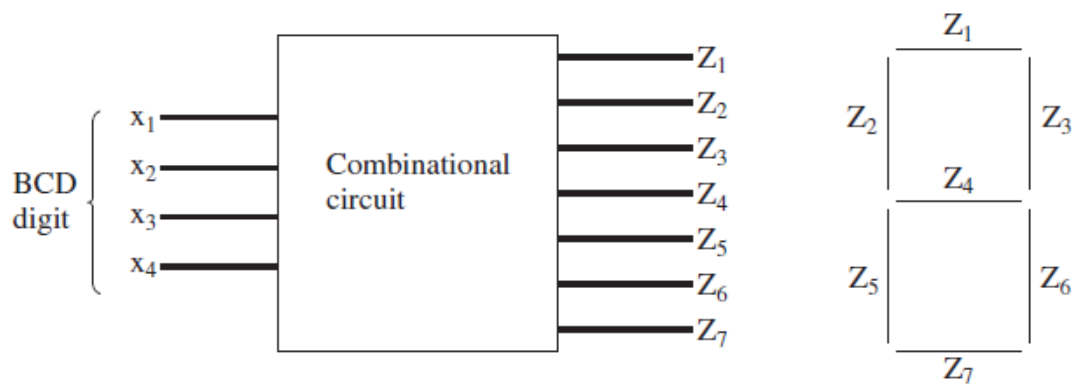
- b) $3.314 \cdot 10^1 + 8.227 \cdot 10^{-2}$
- c) $9.784 \cdot 10^{-3} - 4.666 \cdot 10^{-3}$
- d) $9.844 \cdot 10^{-3} - 8.233 \cdot 10^{-4}$
- e) $8.954 \cdot 10^1 \times 1.324 \cdot 10^0$
- f) $9.633 \cdot 10^2 \div 5.554 \cdot 10^4$

7) Construct a truth table for the following Boolean Expressions:

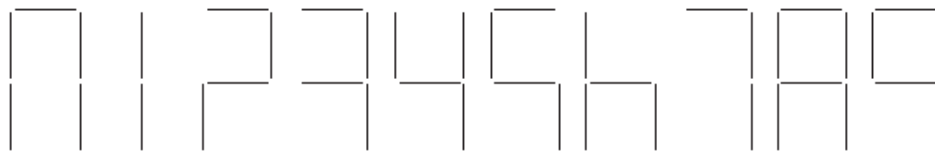
- a) $ABC + \bar{A}\bar{B}\bar{C}$
- b) $ABC + A\bar{B}\bar{C} + \bar{A}B\bar{C}$
- c) $A(\bar{B}\bar{C} + \bar{B}C)$
- d) $(A + B)(A + C)(\bar{A} + \bar{B})$

8) A combinational circuit is used to control a seven-segment display of decimal digits, as shown in the figure. The circuit has four inputs, which provide the four-bit code used in packed decimal representation. The seven outputs define which segments will be activated to display a given decimal digit. Note that some combinations of inputs and outputs are not needed.

- a) Develop a truth table for this circuit.
- b) Express the truth table in SOP form.
- c) Express the truth table in POS form.
- d) Provide a simplified expression.



(a)



(b)