جامعة بيرزيت

BIRZEIT UNIVERSITY

ANSWER BOOKLET

Student: Digital Number 1

Course: Department: Number:

Division: Instructor:

Date: Day Month Year

For Instructor's Use

Question	Grade
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
Total	

Numbers:-

1991

10^3 10^2 10^1 10^0

binary

~~+0 2 4 5 6~~

1 0 1 1 1 0 1

2^6 2^5 2^4 2^3 2^2 2^1 2^0

(base ≡ radix = 2)

binary

~~radix~~ base = 8 → octal

16 → hexadecimal

$(0.1)_2 \rightarrow (1)(2^{-1}) = (0.5)_{10}$

---

addition

1 + 0 = 0 + 1 = 1

1 + 1 = 0 + 0 = 0

$(53)_{10}$

$(53)/2$

26	1
13	0
6	1
3	0
1	1
0	1

$(1\ 1\ 0\ 1\ 0\ 1)_2$

32 16 4 1

~~$(\quad)_{10} \equiv (??)_8$~~

~~$(153)_{10} = (??)_8$~~

$153/8$

19	1
2	3
0	2 ↑

$\Rightarrow (153)_{10} = (231)_8$

Example:- convert

$(0.6875)_{10} \rightarrow (\quad)_2$

$0.6875 \times 2 = 1.375$ → 1 ↓

$0.375 \times 2 = 0.75$ → 0

$0.75 \times 2 = 1.5$ → 1

$0.5 \times 2 = 1.0$ → 1

$\rightarrow (0.6875)_{10} = (0.1011)_2$

Example

~~$(0.333\ldots)_{10}$~~ $(0.3)_{10}$

~~$(0.333) * 2 = 0.666$~~ 0

~~$0.666 * 2 =$~~

$(0.3)_{10} =$

$(0.3) * 2 = 0.6$ 0

$(0.6) * 2 = 1.2$ 1

$(0.2) * 2 = 0.4$ 0

$(0.4) * 2 = 0.8$ 0

$0.8 * 2 = 1.6$ 1

0.6

0 0 1 0 0 1

Octal & hexadecimal & binary

111 010 101 110 . 111 101

(7 2 5 6 . 7 5)$_8$

hexadecimal

0 1 2 ... 9 A B C D E F

F = 1111

G 5 2 . 1 3 7

110 101 010 . 001 011 111

(1111 1010 1110)$_2$

(F A E)$_H$

Complements

9's complement

(2 3 4)

→ ~~complement~~ 9's complement =

999 − 234 = 765

2 3 7

7 6 5

9's complement

0 1 2 3 → 9 8 7 6

(1 0 1 1 0) 1's compl

= 0 1 0 0 1

~~10's~~ 10's complement = 9's + 1

2 4 6 7 0 0

9's 7 5 3 2 9 9

10's 7 5 3 3 0 0

0 1 1 0

1's 1 0 0 1

2's 1 0 1 0

In computer hardware it is better to implement the subtraction as addition

example:

7 2 5 3 2 - 3 2 5 0

M N

M = 7 2 5 3 2

10's Comp. of N = + (9) 6 7 5 0

Same no. of digits (1) 6 9 2 8 2

→ answ = 6 9 2 8 2

opposite

3 2 5 0 - 7 2 5 3 2

M = 0 3 2 5 0

10's complement of N = 2 7 4 6 8

3 0 2 1 8

10's Complement = (-) 6 9 2 8 2

same thing for binary

* * * section 1 → 2

1.6 Signed Binary Numbers

* (+) & (−) are not used in hardware?
* by convention (bit 0 for +ve, 1 for −ve).
* binary numbers: signed & unsigned

left most for sign

e.g. 1 1 0 0 1

unsigned = 25
signed = −9

} signed-magnitude

* positive numbers (signed) are presented by one way

e.g. 7 = 111

00000111

+ve sign.

* There are three different ways to represent negative numbers
  * signed-magnitude +7 = 00000 111
    −7 = 10000 111
  * signed-1's-complement rep.
    +7 = 00000 111
    −7 = 11111000
  * signed-2's-complement rep → −7 = 11111001

* Arithmetic operations
  - Addition & subtraction

9 - 15 = -(15 - 9)

= -(6)

sign

This is not the case in the hardware.

(same thing for signed-magnitude)

but in signed complement no need for comparison between the numbers (it is only addition process

* A carry out of the sign-bit position is discarded

Examples (from book):

+6	00000110
+13	00001101
+19	00010011

-6	11111010
+13	00001101
+7	(1) 00000111

+6 : 0 0 0 0 0 1 1 0

-13 : 1 1 1 0 0 1 1

-7 : 1 1 1 1 0 0 1

↙ -(0 0 0 0 0 1 1 1) = -7

↘ 2's complement since the sign is -ve

* * *

Binary Codes:

n-bit binary code (is a group of n bits) $a_1\ a_2\ a_3 \ldots a_n$

a_i either 0 or 1

- 2^n distinct combination can be presented with n bits.

- to represent m combination we need $\lceil \log_2 m \rceil$ bits

e.g by 3 bits we can make 8 combination

for ~~7~~ ~~8~~ 5 combination we need $\lceil \log_2 5 \rceil = 3$ (at least)

$\log_a x = \frac{\log_{10} x}{\log_{10} a}$??

~~⇒ by n bits ... can~~

from 0 to $2^n - 1$ can be presented by n- bits

* BCD Code (binary Coded decimal).

- BCD coding is a way to represent the decimal digits by means of a code that contains 1's & 0's, by this, it will be possible to perform the arithmetic operations directly with decimal numbers when they are stored in the computer in coded form.

- There are some unassigned bit combinations if the number of elements in the set is not a multiple power of 2. (as in BCD) (in BCD 6 states are not assigned)

Decimal	BCD digit
0	0 0 0 0
1	0 0 0 1
2	0 0 1 0
3	0 0 1 1
:	
9	1 0 0 1

(as normal binary) up to now bout

If we want to represent more than 1 digit then it will be different from binary conversion

eg $(9)_{10} = (1001)_{BCD} = (1001)_2$

but $(15)_{10} = (0001\ 0101)_{BCD} = (1111)_2$

BCD is decimal not binary.

* BCD Addition

example 1

	2	0010
+	3	0011
	+5	0101

(addition result is OK as well as the sum is less than or equal 9).

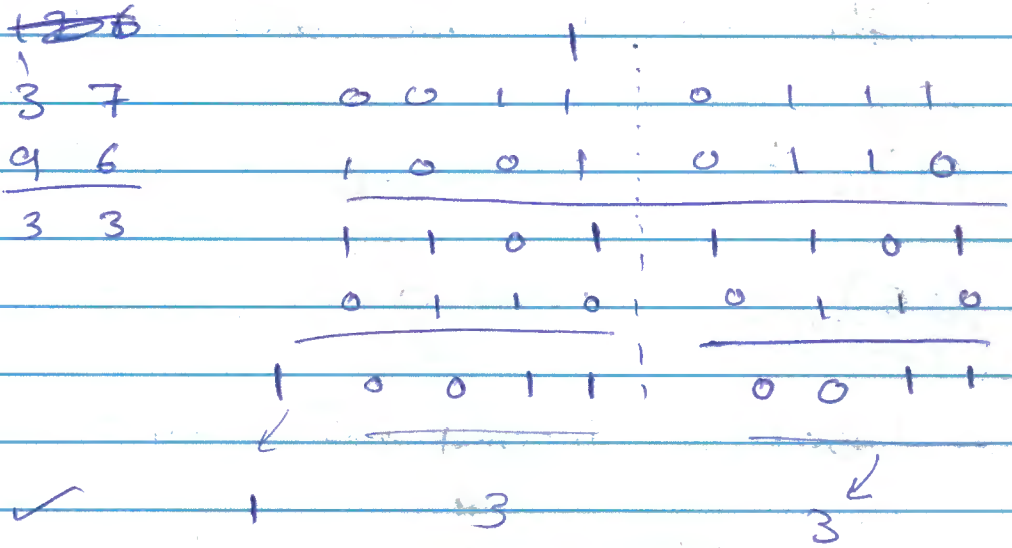
Example 2:

	7	0111
+	3	0011
	10	1010
		0110 ← 6
		10000

(10 in binary but this is not BCD.)

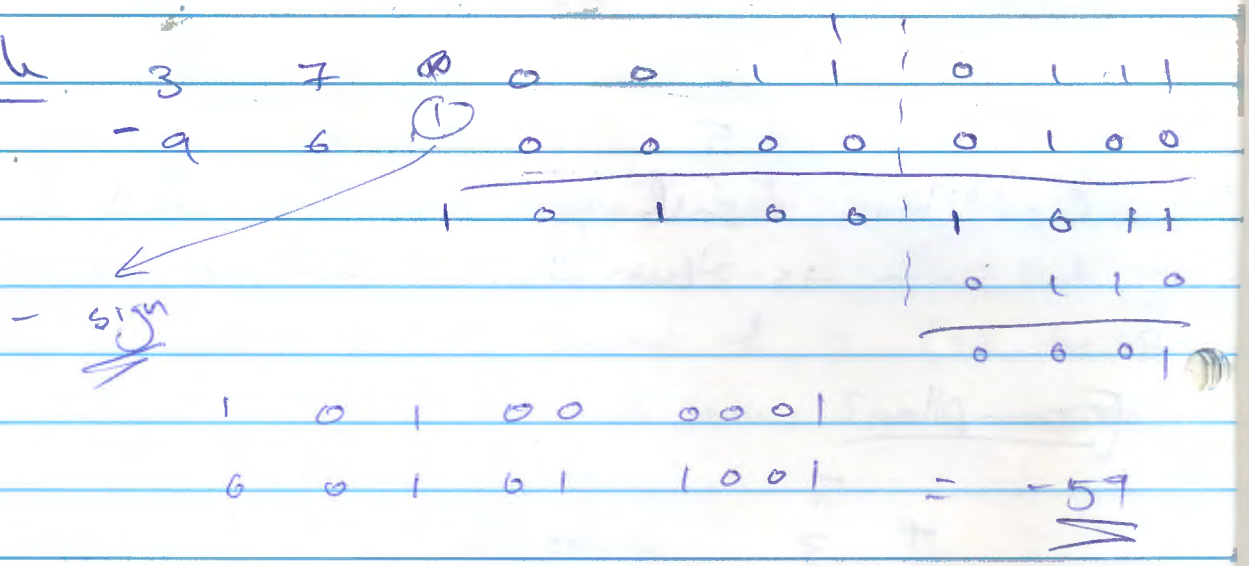
(0001 0000)$_{BCD}$

Example



~~**~~ section 8-9

Example



Other decimal codes

- BCD 8421 ✓

- 2421 code

0000	0
0001	1
0010	2
0011	3

} more than one possibility for coding

(BCD & 2421 codes are examples of weighted codes ∵ adding the weight of digits will 1 binary

e.g 2 4 2 1

1 0 1 1 = 2 + 2 + 0 + 1

= 5

- The advantage of 2421 is self complementing code

e.g 7 2 4 2 1

0 1 1 1

1 0 0 0 → complement

↳ 2 complement of 7

- Excess 3 Code

0 → 0 0 1 1

1 → 0 1 0 0

⋮

9 → 1 1 0 0

advantage: self complement code

-9

1 → 0 1 0 0

8 ← 1 0 1 1

- 8 4 -2 -1 code

(include negative)

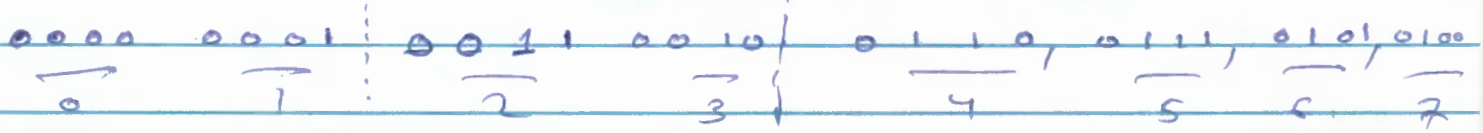
→

in all codes there are some unused states.

* * *

Section 1:00 - 2:00

Gray code



Advantage: one change only for consequent numbers.

it will be used ~~table~~ a lot in ~~this~~ ~~subject~~ course.

ASCII character code

128 char 7 bits

e.g A 1000001

B :

ASCII (American standard Code for Information Interchange). is

* Also control chars are included (e.g DEL) for delete

⊛ Error Detecting Code

- it mainly used for error-check in data communication (parity check)

- two types of parity check: even & odd.

even

ASCII A = 1 000 0001

with even A will be sent like

0 1 000 0001

with odd parity it will be sent

1 1 000 0001

⊛ even parity is more common

⊛ error detection (eg even parity)

A will be sent 0 1 000 0001

if it received as 0 0000 0001

→ error will be detected since parity is odd.

but even number of errors will not be detected (only odd no. will be detected).