EDITH COWAN UNIVERSITY

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UNIT	NAME OF STUDENT (PRINT CLEARLY)		STUDENT ID. NO.
CODE: **ENS1161** TITLE: **COMPUTER FUNDAMENTALS**	**PONCE** *FAMILY NAME*	**MARTIN** *FIRST NAME*	**10371381**
NAME OF TUTOR (PRINT CLEARLY) **WLODZIMIERZ GORNISIEWICZ**			**DUE DATE** **3-OCT-14**
Topic of assignment **ASSIGNMENT 2**			
Group or tutorial (if applicable) **WLODZIMIERZ GORNISIEWICZ**	**Course** **U67 BACHELOR OF INFORMATION TECHNOLOGY**		**Campus** **ES**

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UNIT	NAME OF STUDENT	STUDENT ID. NO.
NAME OF LECTURER		RECEIVED BY
Topic of assignment		DATE RECEIVED

Edith Cowan University
ENS1161: Computer Fundamentals
Assignment 2

Martin Ponce
ID: 10371381

September 25, 2014

Contents

1 Question 1

Consider the functions f, g and h, all defined on the set $\{0, 1, 2, 3, ..., 12\}$.

Table 1: $f(x)$

x	0	1	2	3	4	5	6	7	8	9	10	11	12
$f(x)$	0	5	10	4	3	1	12	7	11	9	2	8	6

Table 2: $g(x)$

x	0	1	2	3	4	5	6	7	8	9	10	11	12
$g(x)$	5	4	11	0	6	10	2	7	1	12	9	8	3

Table 3: $h(x)$

x	0	1	2	3	4	5	6	7	8	9	10	11	12
$h(x)$	3	6	0	10	9	5	2	12	1	7	11	4	8

1.1 Write down the values of: $g(f(h(7)))$ & $h^{-1}(g^{-1}(3))$

$$g(f(h(7))) = 2$$

$$h(7) = 12$$
$$f(12) = 6$$
$$g(6) = 2$$

$$h^{-1}(g^{-1}(3)) = 7$$

$$g^{-1}(3) = 12$$
$$h^{-1}(12) = 7$$

1.2 Construct a table of values for $h(g^{-1}(x))$

Table 4: $h(g^{-1}(x))$

x	0	1	2	3	4	5	6	7	8	9	10	11	12
$h(g^{-1}(x))$	10	1	2	8	6	3	9	12	4	11	5	0	7

1.3 Construct a table for $f(f(x))$

What can you conclude about the inverse of f?

Function $f(x)$ is it's own inverse, or involution.

Table 5: $f(f(x))$

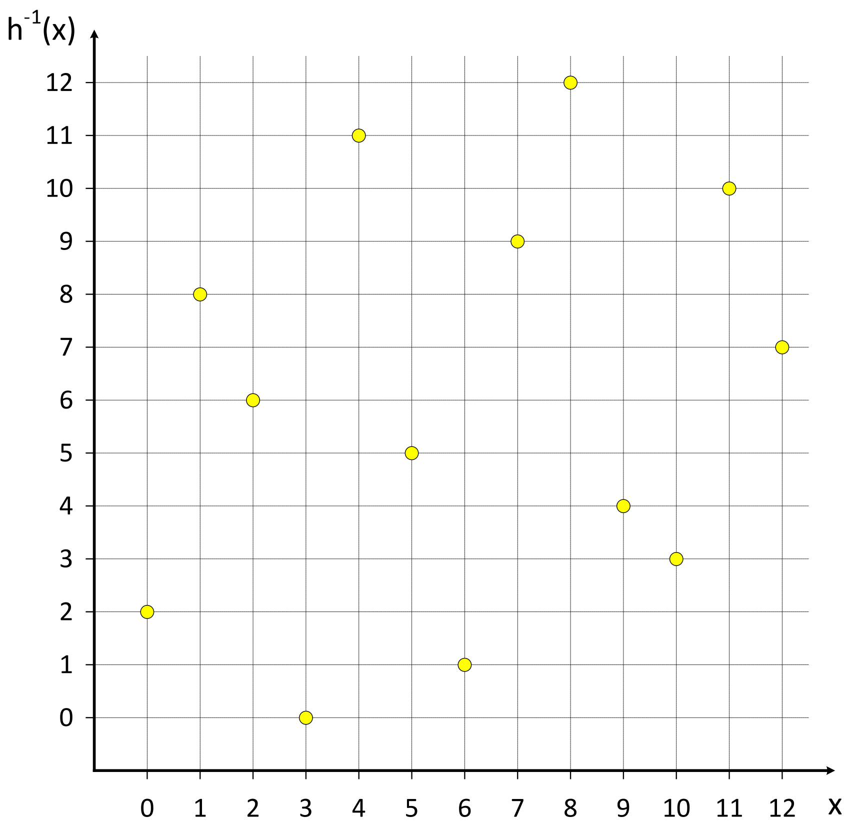
x	0	1	2	3	4	5	6	7	8	9	10	11	12
$f(f(x))$	0	1	2	3	4	5	6	7	8	9	10	11	12

1.4 Construct a table for $h^{-1}(x)$, and draw its graph

Table 6: $h^{-1}(x)$

x	0	1	2	3	4	5	6	7	8	9	10	11	12
$h^{-1}(x)$	2	8	6	0	11	5	1	9	12	4	3	10	7

Figure 1: $h^{-1}(x)$ graph



2 Question 2

Suppose there is a set of growers $G = \{a, b, c, d\}$, a set of retailers $R = \{e, f, g\}$, and a set of customers $C = \{m, n, p, q, r\}$.

There are two relations A and B on $G \times R$ and $R \times C$ respectively, defined by:

$aAe, aAg, bAf, cAf, cAg, dAe$ and eBn, eBq, fBp, gBm, gBr

xAy means "grower x sold goods to retailer y", and
$yA^{-1}x$ means "retailer y bought goods from grower x"

2.1 Find the matrices $M(A)$ and $M(B)$ that represent the relations A and B

Figure 2: $M(A)$ and $M(B)$ matrices

$$M(A) = \begin{pmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \end{pmatrix} \quad M(B) = \begin{pmatrix} 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 \end{pmatrix}$$

2.2 Find the matrices $M(A)^T$ and $M(B)^T$ that represent the relations A^{-1} and B^{-1}

Figure 3: $M(A)^T$ and $M(B)^T$ matrices

$$M(A)^T = \begin{pmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 0 \end{pmatrix} \quad M(B)^T = \begin{pmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

2.3 Consider the two queries

Which customers have received goods that came from the same grower/s as those goods received by A: customer p? B: customer q?

Find the logical matrix products $M(A)M(B)$ and then $M(B)^T M(A)^T$, and finally $M(B)^T M(A)^T M(A)M(B)$, and hence answer the queries.

Figure 4: $M(A)M(B)$ and $M(B)^T M(A)^T$ matrices

$$M(A)M(B) = \begin{pmatrix} 1 & 1 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \end{pmatrix} \quad M(B)^T M(A)^T = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 \end{pmatrix}$$

Figure 5: $M(B)^T M(A)^T M(A)M(B)$ matrix

$$M(B)^T M(A)^T\, M(A)M(B) = \begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{pmatrix}$$

2.3.1 A: Customer p

Customers p, m and r received goods from Growers b and c.

2.3.2 B: Customer q

Customers q, m, n and r received goods from Growers a and d.

3 Question 3

3.1 A: Base number conversion

Consider the following table:

Figure 6: Question 3 table

decimal	octal	binary	hexadecimal
133			
102			

3.1.1 Convert each of the decimal numbers in the first column to octal

Table 7: Decimal to octal

Decimal	Octal	Binary	Hexadecimal
133_{10}	205_8		
102_{10}	146_8		

3.1.2 Convert the two octal numbers to binary

Table 8: Octal to binary

Decimal	Octal	Binary	Hexadecimal
133_{10}	205_8	$1000\ 0101_2$	
102_{10}	146_8	$0110\ 0110_2$	

3.1.3 Convert the two binary numbers to hexadecimal

Table 9: Binary to hexadecimal

Decimal	Octal	Binary	Hexadecimal
133_{10}	205_8	$1000\ 0101_2$	85_{16}
102_{10}	146_8	$0110\ 0110_2$	66_{16}

3.1.4 Add the two hexadecimal numbers

Table 10: Hexadecimal sum

Decimal	Octal	Binary	Hexadecimal
133_{10}	205_8	$1000\ 0101_2$	85_{16}
102_{10}	146_8	$0110\ 0110_2$	66_{16}
			EB_{16}

3.1.5 Convert the hexadecimal sum to binary, then to octal and then to decimal

Table 11: Sum to binary, octal and decimal

Decimal	Octal	Binary	Hexadecimal
133_{10}	205_8	$1000\ 0101_2$	85_{16}
102_{10}	146_8	$0110\ 0110_2$	66_{16}
235_{10}	353_8	$1110\ 1011_2$	EB_{16}

3.2 B: Fractions

3.2.1 Convert the decimal fraction 0.21875 to binary

$$\begin{aligned}0.21875 * 2 &= 0.4375\\ 0.4375 * 2 &= 0.875\\ 0.875 * 2 &= 1.75\\ 0.75 * 2 &= 1.5\\ 0.5 * 2 &= 1.0\end{aligned}$$

$$0.21875_{10} = 0.00111_2$$

3.2.2 Convert the decimal fraction 0.40625 to binary

$$\begin{aligned}0.40625 * 2 &= 0.8125\\ 0.8125 * 2 &= 1.625\\ 0.625 * 2 &= 1.25\\ 0.25 * 2 &= 0.5\\ 0.5 * 2 &= 1.0\end{aligned}$$

$$0.40625_{10} = 0.01101_2$$

3.2.3 Add the two binary fractions from 3.2.1 and 3.2.2

$$\begin{array}{cccccc l} & 1 & 1 & 1 & 1 & & \textit{carry} \\ & 0 & 0 & 1 & 1 & 1 & \\ + & 0 & 1 & 1 & 0 & 1 & \\ \hline 0. & 1 & 0 & 1 & 0 & 0 & \end{array}$$

3.2.4 Convert the binary fraction from 3.2.3 to decimal

$$10100_2 = 20_{10}$$

$$20_{10} * 2^5 = 0.625_{10}$$

$$0.10100_2 = 0.625_{10}$$

$$0.21875_{10} + 0.40625_{10} = 0.625_{10}$$

3.3 C: Addition

Add the following, given that 3.3.1 is binary, 3.3.2 is octal and 3.3.3 is hexadecimal:

3.3.1 Binary addition

$$\begin{array}{ccccccccc l} & 1 & 0 & 0 & 0 & 0 & 1 & 1 & & \textit{carry} \\ & & 1 & 0 & 0 & 1 & 0 & 1 & 1 & \\ + & & 1 & 1 & 0 & 0 & 0 & 1 & 1 & \\ \hline & 1 & 0 & 1 & 0 & 1 & 1 & 1 & 0 & \end{array}$$

3.3.2 Octal addition

$$\begin{array}{cccccc l} & 1 & 1 & 1 & 1 & & \textit{carry} \\ & & 3 & 3 & 7 & 5 & \\ + & & 6 & 7 & 4 & 3 & \\ \hline & 1 & 2 & 3 & 4 & 0 & \end{array}$$

3.3.3 Hexadecimal addition

$$\begin{array}{cccccc l} & 1 & 1 & 0 & 0 & & \textit{carry} \\ & 3 & D & E & 8 & C & \\ + & 7 & A & 5 & 5 & 2 & \\ \hline & B & 8 & 3 & D & E & \end{array}$$

3.4 D: BCD additions

Perform "BCD additions" on the following pairs of hexadecimal numbers. Show all your working.

3.4.1 23267 + 49684

$$\begin{array}{cccccccl}
 & 1 & 0 & 1 & 1 & & & \textit{carry} \\
 & 2 & 3 & 2 & 6 & 7 & & \\
+ & 4 & 9 & 6 & 8 & 4 & & \\
\hline
 & 7 & C & 9 & F & B & & \\
+ & 0 & 6 & 0 & 6 & 6 & & \\
\hline
 & 7 & 2 & 9 & 5 & 1 & &
\end{array}$$

3.4.2 592778 + 183983

$$\begin{array}{cccccccl}
 & 1 & 0 & 1 & 1 & 1 & & \textit{carry} \\
 & 5 & 9 & 2 & 7 & 7 & 8 & \\
+ & 1 & 8 & 3 & 9 & 8 & 3 & \\
\hline
 & 7 & 1 & 6 & 1 & 0 & B & \\
+ & 0 & 6 & 0 & 6 & 6 & 6 & \\
\hline
 & 7 & 7 & 6 & 7 & 6 & 1 &
\end{array}$$

4 Question 4

For each of the following, suppose that two 8-bit binary numbers have been added. In each case the 8-bit output is given and the values of the N, V and C flags. For each case give the correct answer as a decimal number:

A: If the result is interpreted as the sum of **unsigned** integers

B: If the result is interpreted as the sum of **signed** integers.

Table 12: 8-bit output

	8-bit output	N	V	C
1	1100 0000	1	1	0
2	0011 1111	0	1	1
3	0010 1011	0	0	1
4	1100 1010	1	0	0
5	1100 1011	1	0	1

4.1 1100 0000

4.1.1 Unsigned

1100 0000 with flag C = 0: 8-bit output.

$$\begin{aligned} & 1100\ 0000_2 \\ =\ & \mathrm{C0}_{16} \\ =\ & 192_{10} \end{aligned}$$

4.1.2 Signed

1100 0000 with flags N = 1 and V = 1: Positive 16-bit output.

$$\begin{aligned} & 0000\ 0000\ 1100\ 0000_2 \\ =\ & \mathrm{00C0}_{16} \\ =\ & +192_{10} \end{aligned}$$

4.2 0011 1111

4.2.1 Unsigned

0011 1111 with flag C = 1: 16-bit output

$$\begin{aligned} & 0000\ 0001\ 0011\ 1111_2 \\ =\ & \mathrm{13F}_{16} \\ =\ & 319_{10} \end{aligned}$$

4.2.2 Signed

0011 1111 with flags N = 0 and V = 1: Negative 16-bit output.

$$\begin{aligned} & 1111\ 1111\ 0011\ 1111_2 \\ \text{1's complement} =\ & 0000\ 0000\ 1100\ 0000_2 \\ +1 =\ & 0000\ 0000\ 1100\ 0001_2 \\ =\ & \mathrm{C1}_{16} \\ =\ & -193_{10} \end{aligned}$$

4.3 0010 1011

4.3.1 Unsigned

0010 1011 with flag C = 1: 16-bit output

$$\begin{aligned} & 0000\ 0001\ 0010\ 1011_2 \\ =\ & \mathrm{12B}_{16} \\ =\ & 299_{10} \end{aligned}$$

4.3.2 Signed

0010 1011 with flags N = 0 and V = 0: Positive 8-bit output.

$$\begin{aligned} & 0010\ 1011_2 \\ = & \ 2B_{16} \\ = & \ +43_{10} \end{aligned}$$

4.4 1100 1010

4.4.1 Unsigned

1100 1010 with flag C = 0: 8-bit output

$$\begin{aligned} & 1100\ 1010_2 \\ = & \ CA_{16} \\ = & \ 202_{10} \end{aligned}$$

4.4.2 Signed

1100 1010 with flags N = 1 and V = 0: Negative 8-bit output.

$$\begin{aligned} & 1100\ 1010_2 \\ \text{1's complement} = & \ 0011\ 0101_2 \\ +1 = & \ 0011\ 0110_2 \\ = & \ 36_{16} \\ = & \ -54_{10} \end{aligned}$$

4.5 1100 1011

4.5.1 Unsigned

1100 1011 with flag C = 1: 16-bit output.

$$\begin{aligned} & 0000\ 0001\ 1100\ 1011_2 \\ = & \ 1CB_{16} \\ = & \ 459_{10} \end{aligned}$$

4.5.2 Signed

1100 1011 with flag N = 1 and V = 0: Negative 8-bit output.

$$\begin{aligned} &1100\ 1011_2 \\ \text{1's complement} &= 0011\ 0100_2 \\ +1 &= 0011\ 0101_2 \\ &= 35_{16} \\ &= -53_{10} \end{aligned}$$

4.6 Question 5

Table 13: Question 5 answers

No.	Cols in array	Row No.	Col No.	Seq. Pos.
1	14	5	11	67
2	36	1	27	27
3	9	4	8	35
4	28	17	11	459
5	30	4	8	98
6	45	7	30	300
7	24	4	13	85