MANCHESTER METROPOLITAN UNIVERSITY
COMPUTING, MATHEMATICS AND DIGITAL TECHNOLOGY
ASSIGNMENT COVER SHEET

COURSE UNIT:	6G4Z1002 Computer Systems Fundamentals
LECTURERS:	Darren Dancey
ASSIGNMENT NUMBER:	1
ASSIGNMENT TYPE:	Individual
PROPORTION OF MARKS AVAILABLE FOR THIS ASSIGNMENT:	50% of overall marks for the year.
ISSUE DATE:	See VLE
HAND IN DATE AND TIME:	See VLE
PENALTIES FOR LATE HAND IN OF WORK:	See the University Regulations for Undergraduate Programmes of Study
EXTENUATING CIRCUMSTANCES:	Refer to University Regulations.

All work, including late work, is to be submitted in accordance with the instructions in the Faculty Student Handbook.

Learning Outcomes

This piece of coursework tests your ability to:

1. build sophisticated digital circuits using the fundamental building blocks of digital logic and boolean algebra;
2. write, run and debug a program in assembler language.

Plagiarism

Students found guilty of cheating, plagiarising, or otherwise seeking to gain an unfair advantage, will face severe penalties. See the University Regulations for Undergraduate Programmes of Study for further information.

6G4Z1002 – Computer Systems Fundamentals

Assignment

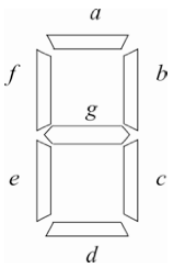
The assignment is worth 50% of your overall unit mark for CSF. The assignment is in two sections. Section A is based on the Digital Logic material covered in the first part of Term 1. Section B is based on the MIPS assembler material that was covered in the second part of Term 1.
Section A is worth 20% and Section B is worth 80% of the assignment mark.

Section A – Seven Segment Display

Using Logisim create a circuit that can drive a 7 –segment display. The circuit should have 4 binary inputs (w,x,y,z) The 4 binary inputs represent the number to display on the 7 segment display. The circuit will need 7 outputs which each control a segment of the display(a-g). The table below shows the expected behaviour for each input pattern. The undefined behaviour means it does not matter what is displayed on the 7 segment display for that input pattern.

z	y	x	w	7 Segment Output
0	0	0	0	Display 0
0	0	0	1	Display 1
0	0	1	0	Display 2
0	0	1	1	Display 3
0	1	0	0	Display 4
0	1	0	1	Display 5
0	1	1	0	Display 6
0	1	1	1	Display 7
1	0	0	0	Display 8
1	0	0	1	Display 9
1	0	1	0	Undefined
1	0	1	1	Undefined
1	1	0	0	Undefined
1	1	0	1	Undefined
1	1	1	0	Undefined
1	1	1	1	Undefined

The 7 segment display is controlled by seven inputs each controlling a segment.
The Figure below shows how the 7 segments are controlled.



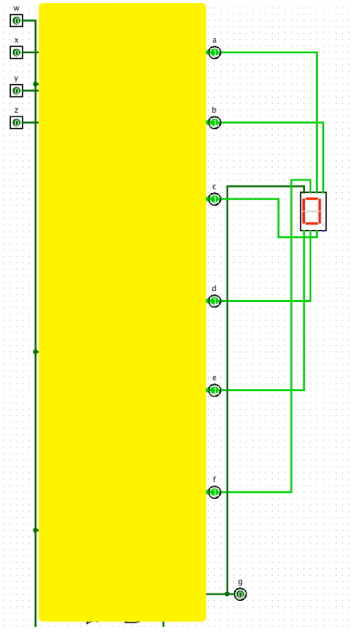
Task A1

Complete the truth table below and use the Karnaugh map technique to create a boolean expression for each of the 7 outputs.

z	y	x	w	a	b	c	d	e	f	g
0	0	0	0	?	?	?	?	?	?	?
0	0	0	1	?	?	?	?	?	?	?
0	0	1	0	?	?	?	?	?	?	?
0	0	1	1	?	?	?	?	?	?	?
0	1	0	0	?	?	?	?	?	?	?
0	1	0	1	?	?	?	?	?	?	?
0	1	1	0	?	?	?	?	?	?	?
0	1	1	1	?	?	?	?	?	?	?
1	0	0	0	?	?	?	?	?	?	?
1	0	0	1	?	?	?	?	?	?	?
1	0	1	0	?	?	?	?	?	?	?
1	0	1	1	?	?	?	?	?	?	?
1	1	0	0	?	?	?	?	?	?	?
1	1	0	1	?	?	?	?	?	?	?
1	1	1	0	?	?	?	?	?	?	?
1	1	1	1	?	?	?	?	?	?	?

Task A2

Using Logisim create the circuit that drives the 7 segment display. The 7-segment display can be found under Input/Output in LogiSim. The partially obscured circuit below shows how the circuit should be laid out.



Section A Assessment Criteria

The marks will be allocated as follows:
20% for the completed truth table, 40% for the Karnaugh maps and expressions, 40% for the Logisim circuit controlling the 7 segment display.

Section B – MIPS Assembler Program

The program will be a piece of software that is a menu based number manipulation system.

The program will display a menu and wait for an option to be selected. Once an option is selected the program will process that option which may involve requesting more input and/or producing output. After the option has been processed the program will again display the menu. The user should be able to exit the program by choosing the last option.

Program Details

Task B1

Produce a menu such as the one below:

```
M E N U

1,  Enter Number 1
2,  Enter Number 2
3,  Display num1 and num2
4,  Display sum of num1 and num2
5,  Display product of num1 and num2
6,  Divide num 1 by num 2
7,  Exchange numbers 1 and 2
8,  Display Numbers between num 1 and num 2
9,  Sum numbers between num1 and num2
10, Raise num 1 to the power of num2
11, Display prime numbers between num1 and num2
12, Quit
```

Choose an Option:

Task B2 – Input and Output

The first two options allow the user to enter two integer numbers (num1 and num2) that should be stored by the program. The third option should print the numbers previously entered.

```
Please enter menu option 3
Number 1 is 100
Number 2 is 200
```

Task B3 – Arithmetic

Options 3,4,5 and 6 should display the results of adding, multiplying, and dividing num1 and num2. Division should display both the quotient and the remainder.

```
num 1 divided by num 2 = 5 remainder 0
```

Task B4 – Exchange

Option 7 should exchange the values of num1 and num2.

Task B5 – Ranges

The eighth option should display all the numbers between num1 and num2 inclusive.

```
numbers between num 1 and num 2 = 10 11 12 13 14 15
```

The ninth option should display the sum of all the numbers between num1 and num2 inclusive

```
Sum of numbers between num1 and num 2 = 75
```

Task B6 - Power

Option 10 will raise one num1 to the power of num2 ($num1^{num2}$) and display the result.

Task B7 - Primes

Option 11 will display only the prime numbers between num1 and num2.

Section B Assessment Criteria

The final mark will be based upon the following criteria:

Working implementation of options 1 and 2 and 12 are worth a combined maximum of 10%. Each further option implemented is worth a max of 10% for a possible total of 100% for Section B.

Marks will be awarded or subtracted based on appropriate code structure, readability, and robustness.

Handing-In

Section A
You are required to submit a document via the Virtual Learning Environment (VLE) that contains a completed truth table for the seven segment display, the Karnaugh maps for each output segment and a screenshot of the circuit. The document should also contain 9 screenshots of your circuit displaying the numbers 1-9 on the 7 segment display for the appropriate input.
You are also to submit the Logisim circuit for your completed circuit via the VLE.

Section B
You are required to submit your assignment via the Virtual Learning Environment. The program should include your name, and ID number as comments at the beginning of your program. The program should be named using the following pattern id.asm e.g. 55991231.asm. **Your program should include a comment at the beginning stating which options have been implemented**

```
#Darren Dancey, 123456789, Options 1,2,3,4,7 implemented.
```