Task Document - Week 2

***Note to learner**: You MUST complete these exercises and upload your answers to the academy weekly, for your lecturer to review your progress and provide you feedback.*

Chapter 1 Exercise 1

StockSnackz Vending Machine

The University of Stocksfield has installed a StockSnackz brand vending machine in its staff common room for the benefit of the faculty. The University places a high value on its staff, so the machine dispenses free snacks including chocolate, muesli bars, apples, popcorn, and cheese puffs. Drawing upon your own experiences of using vending machines, think about the problems associated with maintaining the StockSnackz machine: How will the user select an item? Which items should be dispensed? What happens when the machine runs out of an item? What information does the machine owner need to know about the number of dispensed snacks? If the snacks were not free, how is money taken and change given?

Chapter 1 Exercise 2

Stocksfield Fire Service: Hazchem Signs

Attached to the back of trucks transporting chemicals in many countries you will find a Hazchem sign (as shown below). The three-character code at the top is the EAC, or Emergency Action Code, which tells firefighters how to deal with a chemical spillage and fire.

Hazchem sign

The first character of the EAC is a number identifying the method to be used for fighting any fire. The second character is a letter identifying the safety precautions to be taken by firefighters, whether a violent or explosive reaction is possible, and whether to dilute or contain any spill. The third character is either blank or an E indicating the existence of a public safety hazard. The four- digit code is the

United Nations substance identification number that is used to find out the exact name of the chemical. The hazard warning diamond gives specific information about the nature of the hazard.

What patterns can you see in Table below? How might these patterns help in solving problems related to the decoding of an Emergency Action Code?

Table of Emergency Action Code: required firefighting methods and precautions

1	Coarse Spray	**3**	Foam
2	Fine Spray	**4**	Dry Agent

P	**V**	LTS(CPC)	Dilute spillage
R			
S	**V**	BA & fire kit	
T			
W	**V**	LTS(CPC)	Contain spillage
X			
Y	**V**	BA & fire kit	
Z			
E	Public safety hazard		

Key:

V = Can be violently or explosively reactive

BA = Breathing apparatus

LTS = Liquid-tight Suit/Chemical Protection Suit and BA required

DILUTE = Spillage may be washed away when greatly diluted with large quantities of water

CONTAIN = Spillage must not enter water courses or drains

DRY AGENT = Water must not be allowed to contact substance

Chapter 1 Exercise 3

Puzzle World: Roman Numerals and Chronograms

We express numbers in base 10 using digits derived from a Hindu-Arabic system. Arithmetic is straightforward in this system. However, consider the Roman Empire that had an altogether different numbering system. In the Roman system, numbers are represented by combinations of the primitives given in the Table below.

Table of Roman numerals

Roman Numeral	Decimal Equivalent
I	1
V	5
X	10
L	50
C	100
D	500
M	1000

The number 51 is written as LI, the number 1,500 is written as MD, and so on. Further, the numbers 4, 9, 40, 90, 400, and 900 are written as IV, IX, XL, XC, CD, and CM respectively. Thus, 14 is XIV, 99 is XCIX, etc. (What is common to the numbers 9, 40, 90, and 900?) In this system, the year 1999 would be written as MCMXCIX and the year 2007 as MMVII.

As you can imagine, arithmetic is not so simple using such numbers. For example, consider the simple sum 1,999 + 2,007 using Roman numerals:

MCMCXIX + MMVII = ?

The answer is MMMMVI. Why do we need to know about Roman numerals today? The media industry still uses them. TV shows have the year of production expressed in Roman numerals, as do some movies, books, and so on. The pages in the front matter of books (before the first chapter) are numbered using Roman numerals with Arabic digits being reserved for the main body (look at the page numbers for the preface of a book). Imagine you are writing software for a media production company that needs a reliable way of dealing with translation of dates into Roman numerals. What sorts of problems might you face in converting between decimal numbers and Roman numerals?

Chapter 1 Exercise 4

Pangrams: Holoalphabetic Sentences

Pangrams are holoalphabetic, that is words or sentences that contain every letter in the alphabet. Here is a famous one used by computers to show how text looks in different fonts: *The quick brown fox jumps over the lazy dog*. Pangrams are useful in digital typography because they demonstrate all the letters in a font within a more meaningful context than just writing the alphabet - the interactions between the letters are also easier to see. The "perfect" pangram is *isogrammatic*, that is, it uses each letter only once. It is extremely hard to produce meaningful isogrammatic pangrams in English. For example, here is one that uses only 26 letters:

> *Quartz glyph job vex'd cwm finks*.

It is not terribly meaningful even if they are all real words. Most pangrams are not isogrammatic, so the next goal is to make them as close to being isogrammatic as possible. Here are some more pangrams with their letter count shown in parentheses.

Pack my box with five dozen liquor jugs (32, *e, i,* and *o* repeated).

Waltz, bad nymph, for quick jigs vex (28, only *a* and *i* repeated - not as meaningful though).

Six plump boys guzzled cheap raw vodka quite joyfully (46).

Sympathizing would fix Quaker objectives (36).

Quick waxy bugs jump the frozen veldt (31).

Brick quiz whangs jumpy veldt fox (27).

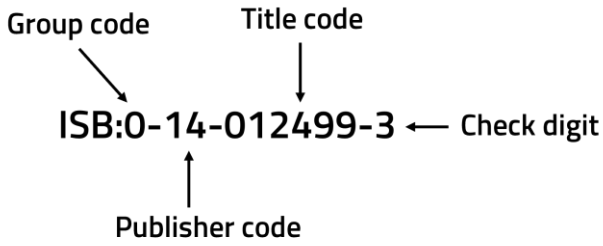
Think about what problems exist in constructing a pangram and in determining whether a sentence is a pangram. If it is, determine if it is isogrammatic.

Chapter 1 Exercise 5

Online Bookstore: ISBNs

The International Standard Book Number (ISBN) is a unique 10- or 13-digit number used to identify books. The system was invented in 1966 (then simply called SN - Standard Book Numbering by W.H. Smith (the UK bookseller and stationer) and was adopted as an international standard (ISO 2108) in 1970. From January 2007, ISBNs have 13 rather than 10 digits.

Anatomy of the International Standard Book Number (ISBN)



The number comprises four parts:

1. The country of origin or language code (called the group code)
2. The publisher's code
3. A number for the book title
4. A check digit

The different parts can have different lengths and usually are printed with hyphens separating the blocks (the hyphens are not part of the number). The check digit is introduced to ensure that the previous nine digits have been correctly transcribed. It can be a digit (0 – 9) or the character 'X' (representing the value 10 - it is not necessary yet to understand how the check digit is calculated). Until January 2007 all ISBNs were 10 digits. A new 13-digit format was introduced in January 2007 (known as ISBN-13 or "Bookland EAN"). All 10-digit ISBNs can be converted to ISBN-13 by adding a prefix of 978 and re calculating the check digit. The 10-digit ISBN 0-14-012499-3 becomes 978-0-14-012499-6 and 0-003-22371-X becomes 978-0-003-22371-2. In the following chapters you will find exercises focusing on three specific problems related to ISBNs.

I. Validating an ISBN (checking it is correct)

2. Converting a 10-digit ISBN to ISBN-13 format

3. Displaying a raw ISBN such as 0140124993 with the correct hyphenation:

The following table shows correct hyphenations for a few ISBNs.

Raw ISBN	Hyphenated ISBN	Book Title
0140124993	0-14-012499-3	How to solve it
999361419X	99936-14-19-X	Gross National Happiness and Development
8466605037	84-666-0503-7	Los Simpson ¡Por Siempre!

Thinking of the three ISBN-related problems stated above, what sub-problems can you identify? That is, what things would you have to do to be able to solve the three problems for any ISBN?

Chapter 2 Exercise 1

StockSnackz Vending Machine

A StockSnackz vending machine is being installed in the staff common room at the University of Stocksfield for the free use of the faculty. The machine has 10 numbered buttons. Pushing Button 1 dispenses a milk chocolate bar, Button 2 a muesli bar, Button 3 a pack of cheese puffs, Button 4 an apple, Button 5 a pack of popcorn, while pushing Button 6 displays on the machine's small screen a summary of how many of each item have been dispensed. Pushing Buttons 0, 7, 8, or 9 has no effect.

Using the HTTLAP strategy write down the series of steps needed to install the new machine, fill it with supplies, and let people obtain snacks from it over the course of the first day. You may assume that the machine can store unlimited supplies of each item. At the end of the day, the dean of faculty will want to know how many snacks have been dispensed. For now, treat the problem of lots of people obtaining lots of snacks over the course of a day as a single abstract activity "Dispense snacks."

Chapter 2 Exercise 2

Stocksfield Fire Service

The Stocksfield Fire Service has asked you to write a program for identifying the precautions to take when dealing with chemical spillages. The program is to be installed on palm-top computers used by the fire fighters who will tap in the Emergence Action Code and be told what to do by the computer. For example, if they tapped in the code 2WE they would receive the instructions:

FIRE FIGHTING - Use Fine Spray.

PRECAUTIONS - Substance is prone to violent or explosive reaction.

Wear liquid-tight suit/chemical protection clothing.
Contain the spillage.

PUBLIC SAFETY - Public safety hazard: Warn people to stay indoors with doors windows shut.

Use HTTLAP to write down the overall series of steps needed to translate each character of the three-character EAC.

Chapter 2 Exercise 3

Puzzle World: Roman Numerals and Chronograms

There are rules governing how Roman numerals can be written (though these rules are not universally applied). Look at the Roman numbers in the Table below and see how far you can get in inferring the rules. Use the questions in HTTLAP to structure your thinking.

Without any other information, what steps might you perform in the process of converting a decimal number to Roman numerals? Or a Roman number to decimal? Outline the overall stages of the process now.

Conversions of Some Numbers in Roman Numerals

Roman Numeral	Decimal Equivalent
III	3
IV	4
CIX	109
LVIII	58
XCIX	99 (why not IC?)
D	500
M	1000
MCMC	Invalid

Chapter 2 Exercise 4

Pangrams: Holoalphabetic Sentences

Consider how you would go about systematically determining whether a sentence is a pangram. You might want to use a bag of scrabble tiles as an aid. Write down the basic sequence of actions you would take. As before, make use of the HTTLAP questions to guide you.

Chapter 2 Exercise 5

Online Bookstore: ISBNs

To begin our investigation of ISBNs, think about how you would approach the problem of adding hyphens to an unformatted ISBN. Doing this makes them easier to read and so would make an Internet bookshop more user-friendly. Go back to Chapter 1 Exercise 5 of this document and look again at the Anatomy of the ISBN image and the table, Hyphenating an ISBN.

What patterns you can spot in the way the numbers are hyphenated? Write down the sequence of actions necessary to write out the various parts of the ISBN with hyphens in between.

Chapter 3 Exercise 1

StockSnackz Vending Machine

Take your existing solution from Chapter 2 and write it using pseudo-code. Does drawing a diagram of the vending machine and its principal components help?

Chapter 3 Exercise 2

Stocksfield Fire Service

Take your existing solution from Chapter 2 and write it using pseudo-code.

Chapter 3 Exercise 3

Puzzle World: Roman Numerals and Chronograms

Take your existing solution from Chapter 2 and write it using pseudo-code.

Chapter 3 Exercise 4

Pangrams: Holoalphabetic Sentences

Take your existing solution from Chapter 2 and write it using pseudo-code.

Chapter 3 Exercise 5

Online Bookstore: ISBNs

Take your existing solution from Chapter 2 and write it using pseudo-code.