Swinburne University of Technology

Faculty of Science, Engineering and Technology

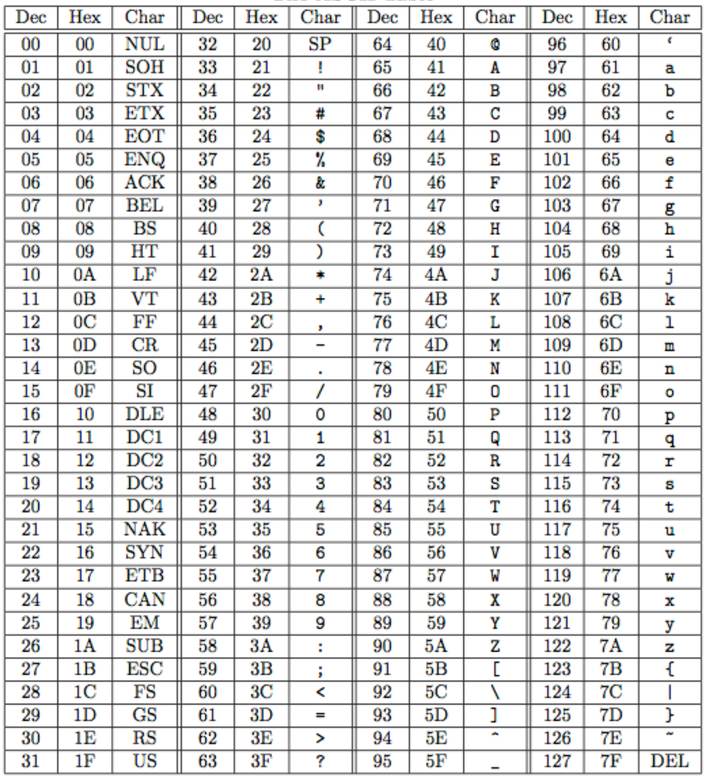
LABORATORY COVER SHEET

Subject Code:	COS30008
Subject Title:	Data Structures and Patterns
Lab number and title:	2, Basic I/O
Lecturer:	Dr. Markus Lumpe

A journey of a thousand miles begins with a single step.

Lao Tsu

The ASCII Table



Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
00	00	NUL	32	20	SP	64	40	@	96	60	‘
01	01	SOH	33	21	!	65	41	A	97	61	a
02	02	STX	34	22	"	66	42	B	98	62	b
03	03	ETX	35	23	#	67	43	C	99	63	c
04	04	EOT	36	24	$	68	44	D	100	64	d
05	05	ENQ	37	25	%	69	45	E	101	65	e
06	06	ACK	38	26	&	70	46	F	102	66	f
07	07	BEL	39	27	’	71	47	G	103	67	g
08	08	BS	40	28	(	72	48	H	104	68	h
09	09	HT	41	29	)	73	49	I	105	69	i
10	0A	LF	42	2A	*	74	4A	J	106	6A	j
11	0B	VT	43	2B	+	75	4B	K	107	6B	k
12	0C	FF	44	2C	,	76	4C	L	108	6C	l
13	0D	CR	45	2D	-	77	4D	M	109	6D	m
14	0E	SO	46	2E	.	78	4E	N	110	6E	n
15	0F	SI	47	2F	/	79	4F	O	111	6F	o
16	10	DLE	48	30	0	80	50	P	112	70	p
17	11	DC1	49	31	1	81	51	Q	113	71	q
18	12	DC2	50	32	2	82	52	R	114	72	r
19	13	DC3	51	33	3	83	53	S	115	73	s
20	14	DC4	52	34	4	84	54	T	116	74	t
21	15	NAK	53	35	5	85	55	U	117	75	u
22	16	SYN	54	36	6	86	56	V	118	76	v
23	17	ETB	55	37	7	87	57	W	119	77	w
24	18	CAN	56	38	8	88	58	X	120	78	x
25	19	EM	57	39	9	89	59	Y	121	79	y
26	1A	SUB	58	3A	:	90	5A	Z	122	7A	z
27	1B	ESC	59	3B	;	91	5B	[	123	7B	{
28	1C	FS	60	3C	<	92	5C	\	124	7C	|
29	1D	GS	61	3D	=	93	5D	]	125	7D	}
30	1E	RS	62	3E	>	94	5E	^	126	7E	~
31	1F	US	63	3F	?	95	5F	_	127	7F	DEL

Basic I/O in C++

The goal of this tutorial session is to develop a small console application that counts the occurrences of each character in a given binary input text stream. The application consists of two parts: a class `CharacterCounter` and a `main` function that drives the counting process.

The class `CharacterCounter` is specified as follows:

```
#pragma once

#include <iostream>

class CharacterCounter
{
private:
  size_t fTotalNumberOfCharacters;
  size_t fCharacterCounts[256];              // We count all 256 byte values

public:
  CharacterCounter();

  void count( unsigned char aCharacter );

  friend std::ostream& operator<<( std::ostream& aOStream,
                                   const CharacterCounter& aCharacterCounter );
};
```

The class `CharacterCounter` records the total number of counted characters and the frequencies of those characters. The class has one constructor to properly initialize the data members, a `count` method that takes a character (an `unsigned char` value), and declares the stream output `operator<<` for `CharacterCounter` as a friend of class `CharCounter`.

The implementations of the constructor and the `count` method are straightforward. The constructor initializes all data members with 0, whereas `count` has to increment the corresponding data members.

The **`operator<<`** is a bit more complex. First, the **`operator<<`** should only print those characters that actually occur in the binary input text stream (i.e., you need to filter the 0s). Second, you need to use a simple trick to print an integer value as a character value. You can achieve this using the cast operator **`static_cast<type>`**`(value)`. For example, if you program defines an integer variable `lIntValue`, then **`static_cast<char>`**`(lIntValue)` yields a character value, possibly shorten the value to the range between 0 and 255.

The `main` function receives a command line argument with the name of the input file, sets up a corresponding **binary** input file object (see File I/O), declares an object of type `CharacterCounter`, an `unsigned char` variable, and performs the counting process:

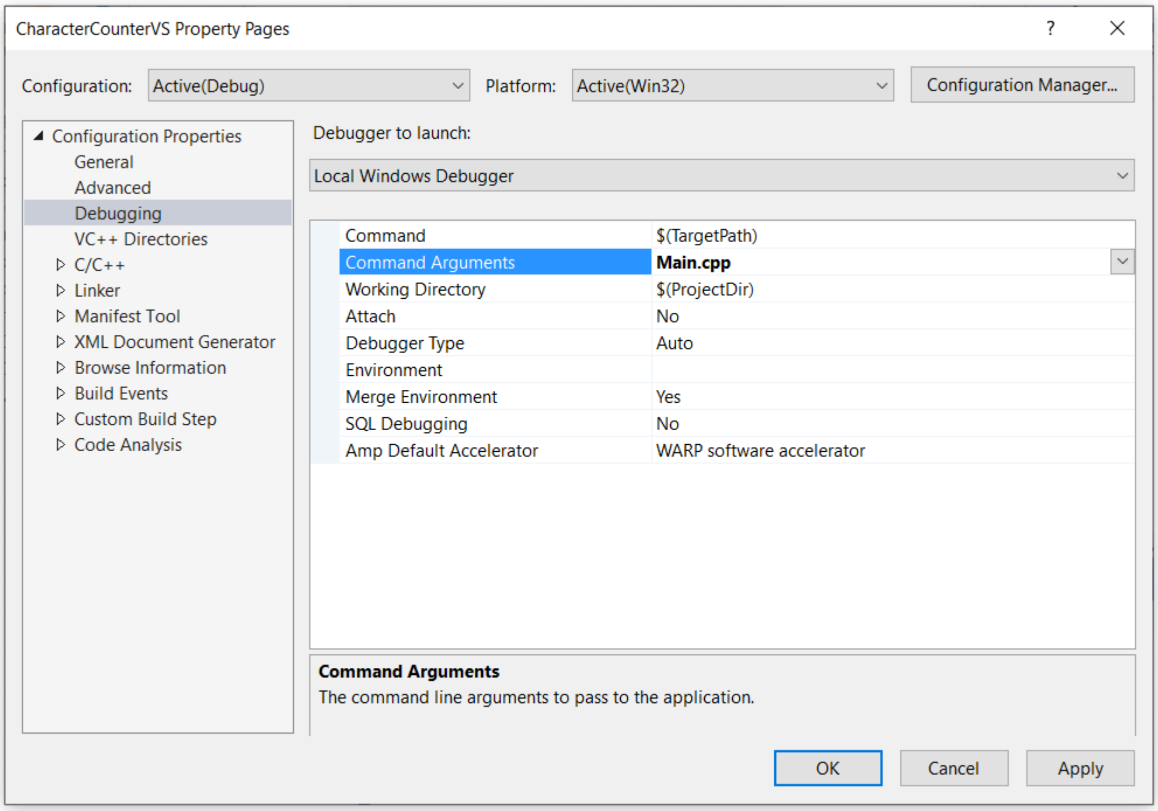
```
CharacterCounter lCounter;

unsigned char lChar;

while ( lInput >> lChar )
{
    lCounter.count( lChar );
}

cout << lCounter;
```

You can use the main implementation file (i.e., .cpp file) of your project as input. If the name of that file is `Main.cpp`, then you can use the following setting of the Command Arguments:


CharacterCounterVS Property Pages

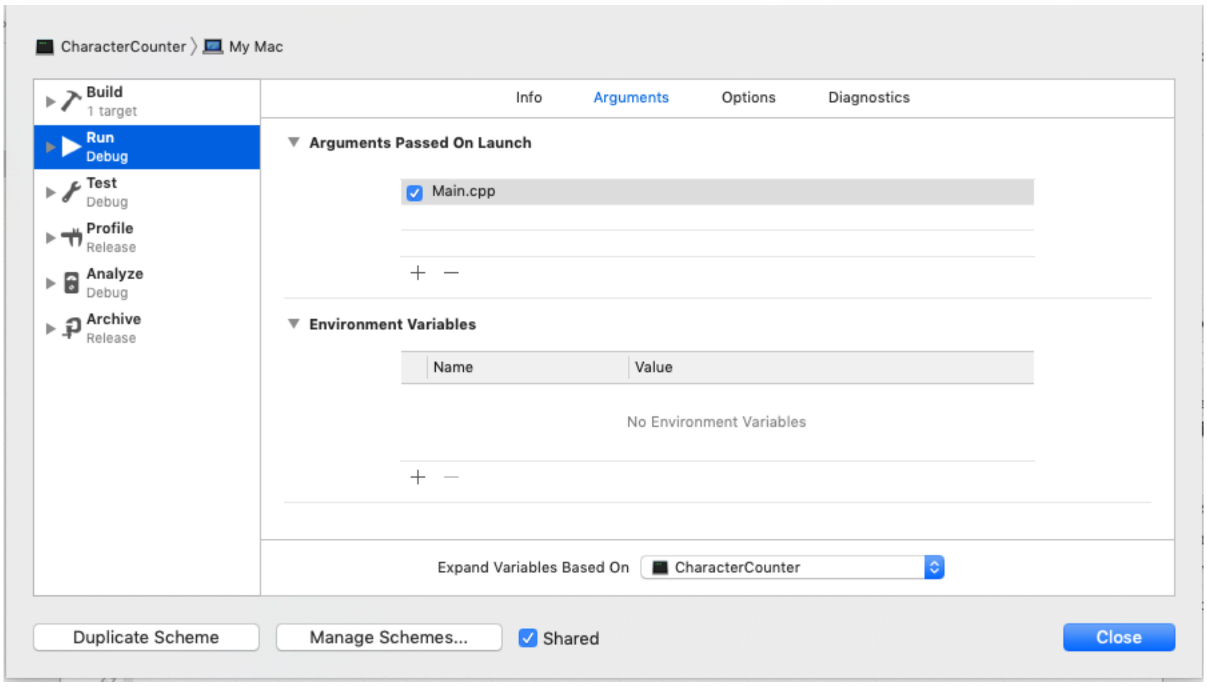
Configuration: Active(Debug) Platform: Active(Win32)

Debugger to launch: Local Windows Debugger

Command	$(TargetPath)
Command Arguments	**Main.cpp**
Working Directory	$(ProjectDir)
Attach	No
Debugger Type	Auto
Environment	
Merge Environment	Yes
SQL Debugging	No
Amp Default Accelerator	WARP software accelerator

Command Arguments
The command line arguments to pass to the application.

Xcode users must use **edit scheme** and also set the working directory to the location of Main.cpp (in Options).


CharacterCounter 〉 My Mac

Arguments Passed On Launch
✓ Main.cpp

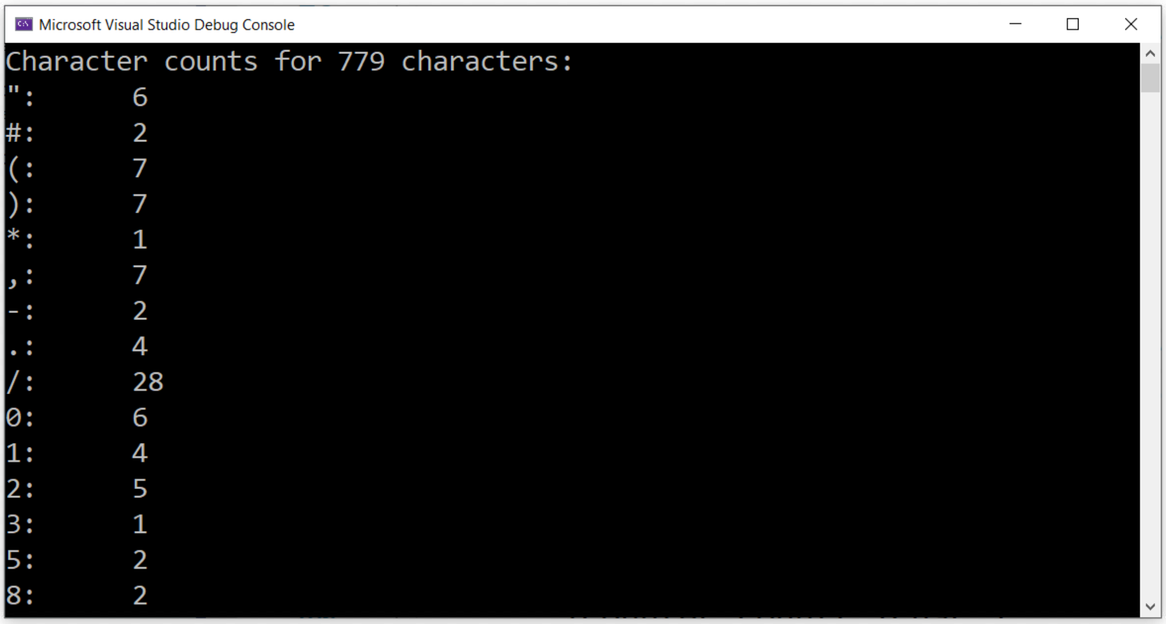
Environment Variables

Name	Value

No Environment Variables

Expand Variables Based On CharacterCounter

Running the program (Start Without Debugging) produces an output similar to the following sample:



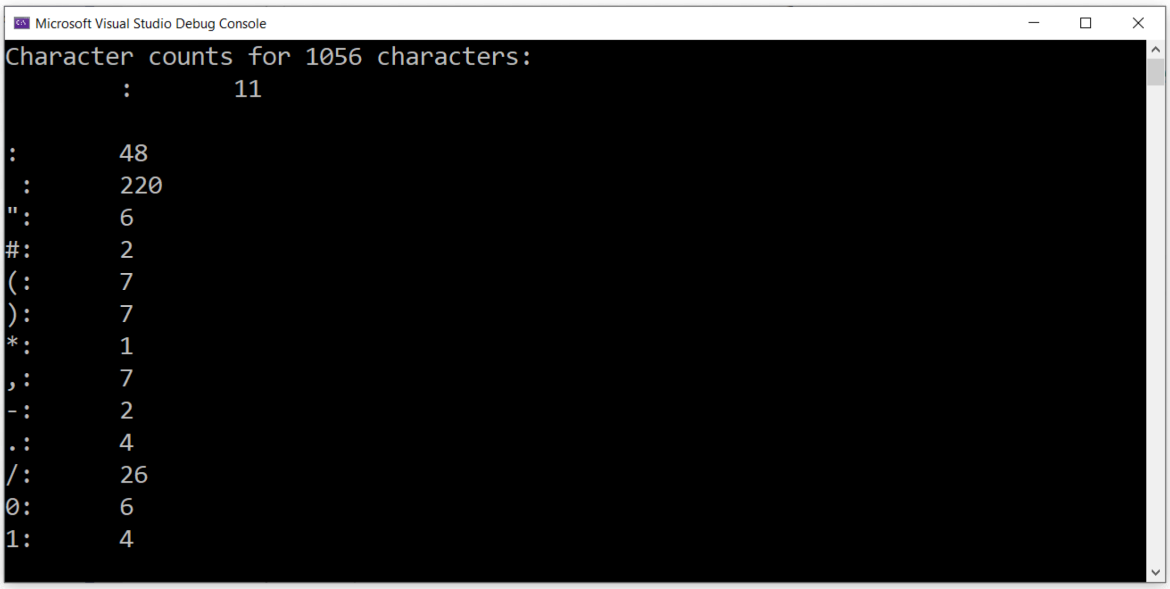
```
Character counts for 779 characters:
":       6
#:       2
(:       7
):       7
*:       1
,:       7
-:       2
.:       4
/:       28
0:       6
1:       4
2:       5
3:       1
5:       2
8:       2
```

Where are the whitespace " ", "\t", and "\n"?

Initially, no whitespace characters are counted, even though we used `ifstream::binary` as the input file mode. By default, the operator `>>` skips all whitespace characters. We can change this by adding the following line before the while loop:

```
    lInput.unsetf( ios::skipws );
```

The stream method `unsetf` allows us to programmatically clear internal flags in the input stream object. Here, `ios::skipws` means that we clear the skip whitespace flag. Now our program also records whitespace characters.



```
Character counts for 1056 characters:
        :       11

:       48
 :      220
":      6
#:      2
(:      7
):      7
*:      1
,:      7
-:      2
.:      4
/:      26
0:      6
1:      4
```

This exercise requires approximately 70 lines of low-density C++ code.