

# Programming Language Concepts

## CQL Program Language Manual

Elliot Alexander - 28561716

Harry Brown - 28338804

23<sup>rd</sup> April 2018

# 1 Introduction

CQL is a domain specific programming language designed to implement the expressive power of *conjunctive queries*; a system of first order logic formulas which relation symbols, equality, conjunction and existential qualification, all of which are explained in more detail in section **TODO**. CQL is written in Haskell, and depends upon parsing/lexing tools Alex and Happy.

## 2 Hello World - an introduction to the syntax

CQL is strictly a language designed to implement conjunctive queries on local data, so a hello world program may appear slightly odd, however in this section the syntax of the language will be introduced.

### 2.1 Writing your first program

At it's core, CQL allows the selection and manipulation of data in CSV files. In this first example program, we'll be loading data from two CSV files, P.csv and Q.csv, and outputting all rows in the file where the first value of each row is equal. For example, given two CSV files:

P.csv	Q.csv
1 1	1 1
2 2	2 2
3 3	3 2
4 4	4 Sofa

We can use the equality operator `=` to output only rows where P.csv and Q.csv have the same value. We will introduce the full syntax for conjunctive queries later, but formally this is written as:

$$x_1, x_2 \vdash P(x_1) \wedge Q(x_2) \wedge x_1 = x_2$$

In order to implement this in CQL, we need a program as below:

```
1 // This is an example of our first program!  
2 1,2 where P(1) and Q(2) and 1 = 2
```

Now that we've got an extremely simple first program, we can begin to run programs using our interpreter.

### 2.2 Running your first program

CQL programs are saved with the file extension `.cql`, and are run by placing the executable interpreter in the same directory as your data (in the form of `.CSV` files), and executing your program as:

```
$. /CQL HelloWorld.cql
```

Where CQL.exe is the name of your executable, and HelloWorld.cql the name of your program we wrote in section 2.1. Note that on Windows based systems, running the executable will have the syntax:

```
CQL.exe HelloWorld.cql
```

If all goes well, we should be expecting an output identical to the one below; if your program throws errors, some common troubleshooting steps are ensuring that the CSV files, CQL programs and executable are all in the same directory, and that your executable has executable permission on Unix based systems.

```
1 1,1
2 2,2
3 2,2
```

Congratulations! You've run and executed your first CQL program.

## 3 Appendix

### 3.1 Example Problems

#### 3.1.1 Problem 1

```
1 1,3,2,4 where A(1,2) and B(3,4)
```

#### 3.1.2 Problem 2

```
1 1,2,3 where A(1,2) and B(2,3)
```

#### 3.1.3 Problem 3

```
1 1,2 where P(1) and Q(2) and 1 = 2
```

#### 3.1.4 Problem 3

```
1 1,2 where P(1) and Q(2) and 1 = 2
```

#### 3.1.5 Problem 4

```
1 1 where R(1,2)
```

### 3.1.6 Problem 5

1 1,2 where A(1,3) and B(3,2)

### 3.1.7 Problem 5

1 1,2 where A(1,3) and B(3,2)

### 3.1.8 Problem 6

1 1 where R(1) and S(2)

### 3.1.9 Problem 7

1 1,4 where R(1,2) and R(2,3) and R(3,4)

### 3.1.10 Problem 8

1 1,2,3,4,1 where R(4,1) and R(3,4) and R(2,3) and R(1,2)

### 3.1.11 Problem 9

1 1,2 where A(1,3) and B(3,4) and C(4,2)

### 3.1.12 Problem 10

1 1,2,3 where S(1,2,3) and S(4,4,5) and S(4,5,5)