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You are required to submit two files by **4pm on Thu 15th May**, as follows:

- a pdf file named `manual.pdf` containing the manual for your language
- a zip file containing five programs, written in **your** language, that solve the five tasks below. The programs should be in files named `t6.cql`, `t7.cql`, `t8.cql`, `t9.cql` and `t10.cql`.

Each task in Submission 2 will be worth 5% of the overall coursework mark (i.e. 2% of the module mark). The language manual will be worth 25% of the overall coursework mark (i.e. 10% of the module mark).

Tasks

Task 6: Multiway Cartesian Product

Assume five inputs **P:3**, **Q:3**, **R:1**, **S:1** and **T:4**. Your program should output the cartesian product of the five files so that each output row is created from the combination of rows from each of **P**, **Q**, **R**, **S** and **T**. The entries should appear in the output in the following order: for each row *p1*, *p2*, *p3* in **P**, each row *q1*, *q2*, *q3* in **Q**, each row *r1* in **R**, each row *s1* in **S** and each row *t1*, *t2*, *t3*, *t4* in **T**, output a row *p1*, *p2*, *p3*, *q1*, *q2*, *q3*, *r1*, *s1*, *t1*, *t2*, *t3*, *t4*. The output arity is 12.

Example

P.csv:

```
1,2,3
4,5,6
7,8,9
```

Q.csv:

```
foo,bar,baz
baz,qux,quux
```

R.csv:

```
aardvark
```

S.csv:

```
23
```

T.csv:

```
a,b,c,d
```

Output:

```
1,2,3,baz,qux,quux,aardvark,23,a,b,c,d
1,2,3,foo,bar,baz,aardvark,23,a,b,c,d
4,5,6,baz,qux,quux,aardvark,23,a,b,c,d
4,5,6,foo,bar,baz,aardvark,23,a,b,c,d
7,8,9,baz,qux,quux,aardvark,23,a,b,c,d
7,8,9,foo,bar,baz,aardvark,23,a,b,c,d
```

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Task 7: Paired Composition

Assume two input symbols **F:3** and **G:3** both of arity three. Your program should output the composition of the relations represented by **F** and **G** as follows: for each row *f1*, *f2*, *f3* in **F** and each row *g1*, *g2*, *g3* in **G**, output a row containing *f1*, *g3* if and only if both of *f2* and *f3* are non-empty, *f2=g1* and *f3=g2*. The output arity is 2.

Example

F.csv:

```
a,b,c
d,e,
g,h,i
j,k,l
```

G.csv:

```
b,c,d
b,c,e
h,,i
k,l,
k,l,l
```

Output:

```
a,d
a,e
j,
j,l
```

Task 8: Right Merge on Last Column

Assume two inputs **P:4** and **Q:4**. Your program should output rows as follows: for each row *p1*, p2, *p3*, *p4* in **P** and each row *q1*, *q2*, *q3*, *q4* in **Q** such that *p4=q4*, the output should contain a row *r1*, *r2*, *r3*, *q4* where *ri* is *pi* if *qi* is empty and *qi* otherwise. The output arity is 4.

Example 1

P.csv:

```
,4,5,1
,2,,2
2,1,7,3
,1,8,4
```

Q.csv:

```
7,4,6,1
3,5,8,2
1,,,2
3,2,,4
```

Output:

```
1,2,,2
3,2,8,4
3,5,8,2
7,4,6,1
```

Example 2

P.csv:

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```
Aaron,foo,,qux
Brenda,,bar,quux
```

Q.csv:

```
Ciara,bar,,quux
Aaron,,baz,qux
```

Output:

```
Aaron,foo,baz,quux
Ciara,bar,bar,quux
```

Example 3

P.csv:

```
1,6,2,3
2,7,4,5
```

Q.csv:

```
3,8,6,6
4,9,5,3
```

Output:

```
4,9,5,3
```

Task 9: Paths of length three

Assume a single input **R:2**. Your program should compute all paths of length 3 in the relation represented by **R**. A path of length 3 in **R** is a sequence *r1*, *r2*, *r3*, *r4* such that *r1*, *r2* is a row in **R**, *r2*, *r3* is a row in **R** and *r3*, *r4* is a row in **R**. For each such path of length 4, the output should contain a row *r1*, *r4*.

Example 1

R.csv:

```
Romsey,Eastleigh
Eastleigh,Southampton Airport Parkway
Southampton Airport Parkway,Southampton Central
Southampton Central,Romsey
Romsey, Salisbury
```

Output:

```
Eastleigh,Romsey
Romsey,Southampton Central
Southampton Airport Parkway,Eastleigh
Southampton Airport Parkway,Salisbury
Southampton Central,Southampton Airport Parkway
```

Example 2

R.csv:

```
foo,foo
```

Outout:

```
foo,foo
```

Task 10: Matching Pairs

Assume two inputs **S:3** and **T:3**. Your program should compute the output as follows: for each row *s1*, *s2*, *s3* in **S** and each row *t1*, *t2*, *t3* in **T** , output *s3*, *t1* if *s1=s2* and *t2=t3*.

Example 1

S.csv:

```
A,A,B
A,B,B
A,B,C
```

T.csv:

```
A,A,B
A,B,B
A,B,C
C,D,D
```

Output:

```
B,A
B,C
```

Example 2

S.csv:

```
A,B,B
B,C,D
,,
```

T.csv:

```
B,B,B
B,C,D
A,,
```

Output:

```
,A
,B
```

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◄ ECS Handin for Submission 1

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