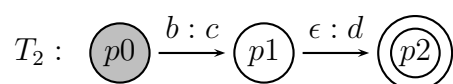
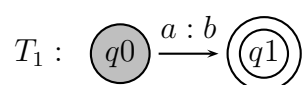




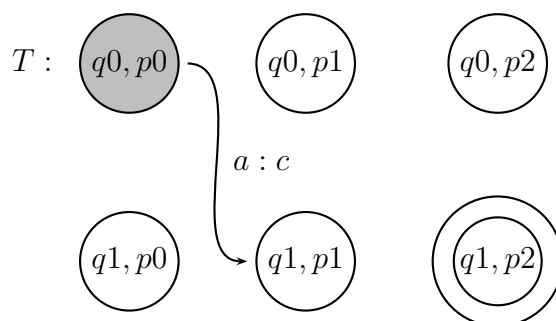
## Challenge 2: Finite state technology

### 1

The construction of composition given in the lecture slides is flawed. Consider the relations  $R_1 = \{ \langle a : b \rangle \}$  and  $R_2 = \{ \langle b : cd \rangle \}$ , trivially defined by the following transducers  $T_1$  and  $T_2$ , respectively:



Applying the definition given in class would yield the following transducer  $T$  for  $R_1 \circ R_2$ :



Clearly, the relation defined by  $T$  is empty, rather than the desired relation  $\{ \langle a : cd \rangle \}$ .

1. Characterize the problem. Define precisely in what cases the given definition will not produce the correct results.
2. Solve the problem. Give a correct construction for transducer composition.

### 2

Re-do Challenge 1 in XFST. That is, define an XFST expression which maps Hebrew prepositions to all their inflected forms.



### 3

The set of decimal numbers is obviously a regular language. The XFST expression

```
[ %0 | [1|2|3|4|5|6|7|8|9] [%0|1|2|3|4|5|6|7|8|9]* ]
```

denotes the infinite set  $\{0, 1, 2, \dots, 10, 11, \dots, 2005 \dots\}$ . It excludes expressions with leading zeros such as 01. The corresponding set of numerals in English and in other languages is also a regular language. In English, this is:

```
{zero, one, two, ...ten, eleven, ...two thousand and  
five, ...}
```

Your task is to define an XFST expression which maps each decimal number (up to one billion) to its counterpart(s) in Hebrew. The general task is more elaborate than mapping decimal numbers to their English representations due to the various expressions of numerals in Hebrew, in particular the variation on gender and status (construct/absolute). For this challenge, however, assume a single Hebrew numeral for each decimal number: the feminine absolute:

... אחת, שתיים, שלוש, ארבע, ... אחת עשרה, שתיים עשרה, ... אלפיים וחמש, ...

If you prefer to work on any other language, discuss it with me.

Then, download Lauri Karttunen's solution for English from:

<http://www.cis.upenn.edu/~cis639/assign/assign8.html>

Combine your solution with the English expression to create a translator of numerals from English to Hebrew and back.

בהצלחה