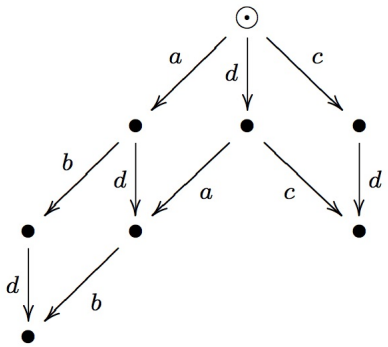
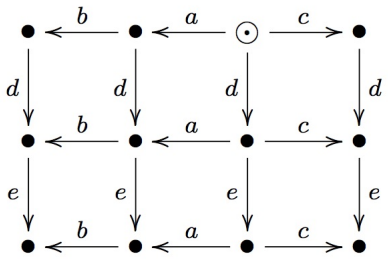
Modelling and Validation of Concurrent System

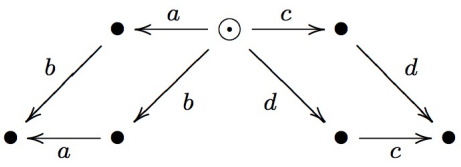
Lab 2: exercises on LTSs and bisimulation

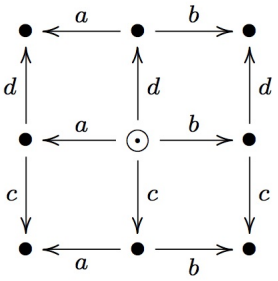
1. Represent graphically the LTSs denoted by the following CCS processes
   (a) $a.c.\mathbf{0} + b.c.\mathbf{0}$
   (b) $a.(d.e.\mathbf{0} + b.c.\mathbf{0})$
   (c) $a.\mathbf{0} \mid b.\mathbf{0}$
   (d) $a.\mathbf{0} \mid (b.\mathbf{0} + \mathbf{0})$

2. Define CCS processes corresponding to the following LTSs:

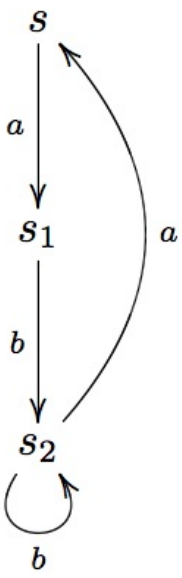


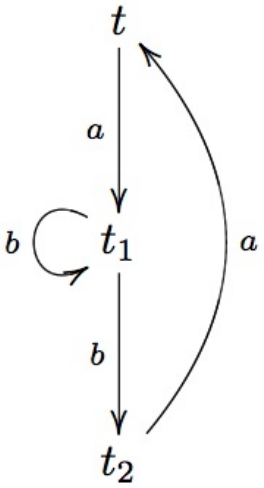


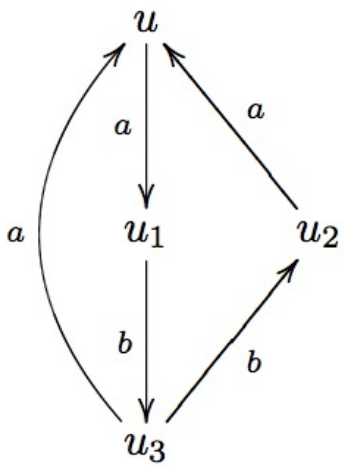




3. Considering the systems presented below, check if the system s is bisimilar to t, u or v.







4. Represent graphically the LTSs denoted by the process *Mutex1* whose behaviour is defined by the following equation:

$$\begin{array}{lcl} \mathit{Mutex1} & = & (\mathbf{new}\, p\ v)(\mathit{User} \mid \mathit{Sem}) \\ \mathit{User} & = & \overline{p}.\mathit{enter}.\mathit{exit}.\overline{v}.\mathit{User} \\ \mathit{Sem} & = & p.v.\mathit{Sem} \end{array}$$

5. Represent graphically the LTSs denoted by the process *Mutex2* whose behaviour is defined by the following equation:

$$\begin{array}{lcl} \mathit{Mutex2} & = & (\mathbf{new}\, p\ v)((\mathit{User} \mid \mathit{Sem}) \mid \mathit{User}) \\ \mathit{User} & = & \overline{p}.\mathit{enter}.\mathit{exit}.\overline{v}.\mathit{User} \\ \mathit{Sem} & = & p.v.\mathit{Sem} \end{array}$$

Would the behaviour of *Mutex2* change if the process *User* would be defined as follows?

$$\mathit{User} \quad = \quad \overline{p}.\mathit{enter}.\overline{v}.\mathit{exit}.\mathit{User}$$

6. Represent graphically the LTSs denoted by the process *FMutex* whose behaviour is defined by the following equation:

$$\begin{array}{lcl} \mathit{FMutex} & = & (\mathbf{new}\, p\ v)((\mathit{User} \mid \mathit{Sem}) \mid \mathit{FUser}) \\ \mathit{User} & = & \overline{p}.\mathit{enter}.\mathit{exit}.\overline{v}.\mathit{User} \\ \mathit{Sem} & = & p.v.\mathit{Sem} \\ \mathit{FUser} & = & \overline{p}.\mathit{enter}.(\mathit{exit}.\overline{v}.\mathit{FUser} + \mathit{exit}.\overline{v}.0) \end{array}$$

Are *Mutex2* and *FMutex* bisimilar? Justify your answer.