Labelled Transition Systems

1. Let

$$A \stackrel{\text{def}}{=} b.c.\mathbf{0} + b.d.\mathbf{0} \qquad C \stackrel{\text{def}}{=} a.B + a.A$$

$$B \stackrel{\text{def}}{=} A + b.(c.\mathbf{0} + d.\mathbf{0}) \qquad D \stackrel{\text{def}}{=} a.B$$

   (a) Draw a transition system which includes the above states A, B, C and D.

   (b) Explain clearly how the states C and D behave differently.

2. Design a simple change-making process which will initially accept a 5p, 10p or 20p coin, and dispense any sequence of 1p, 2p and 5p coins which sum up to the value of the coin inserted, before returning to its initial state.

   To do this, introduce the process variables C_n for $n \in \{0, 1, 2, \ldots, 20\}$, and the following actions:

$i5$: insert a 5p coin	$d1$: dispense a 1p coin
$i10$: insert a 10p coin	$d2$: dispense a 2p coin
$i20$: insert a 20p coin	$d5$: dispense a 5p coin

   Each variable C_n is to represent the process in the state in which n pence remains to be dispensed. In particular, the process variable C_0 is to represent the initial state of the process, and has the following definition:

$$C_0 \stackrel{\text{def}}{=} i5.C_5 + i10.C_{10} + i20.C_{20}$$

   (a) Give the definitions for the remaining process variables $C_1, C_2, \ldots, C_{20}$.

   (b) Draw the labelled transition system representing this process.