# Communicating Sequential Processes
# Exercises 1: Processes and Choice
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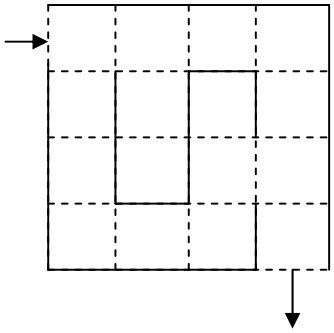
1. Define the alphabet of:
    a. a telephone that has 12 buttons, a handset and a bell. The handset may be lifted or replaced.
    b. a lift system which serves floors 0 to 3 and has an *up* button on each floor (apart from the top), a *down* button on each floor (apart from the top), a *goto.i* button for each floor within the lift, an emergency *halt* button and also doors which open and close at each floor.
2. Write a CSP description of a small fast-food outlet which serves only two itens: burgers at 75p and chicken at 95p. The sequence of interaction involves placing an order one of the items, paying for the order and receiving the order. Only one customer at a time can be handled.
3. Define a process with an interface consisting of the events *press* and *finish.Z*, It accepts a number of press events, and then outputs along the channel finish the number of press events that have occurred, after which it stops.
4. Write a CSP description of a heater that has four power settings, which can be changed by the events *up* and *down*. Give the tree structure of this process.
5. A stack of coins contains up to 30 pennies, which may be removed one at a time by the action *out1p*, until the stack is empty. At any time the number of coins may be brought up again to its maximum of 30 by the single action *refill* . Define the process *Stack*.
6. Each customer of a bank first opens an account. He then makes any number of deposits and withdrawals, and finally may terminate his account. Let us initially ignore the amount of each deposit or withdrawal, and not worry about whether the account is in credit or debit. Define process Acc0 to model the account; it should have alphabet {*open, deposit , withdraw, terminate*}.
7. Now extend the alphabet of process Acc0 from Question 5 to include the events *deposit .n* and *withdraw.n*, for any natural number *n*, in place of the events deposit and withdraw. Include also an event *balance.m*, for integer *m*, that returns the balance of the account. An account has balance 0 when opened and may be closed only when it has balance 0.
    a. Define process Acc1 to model the account in which any deposit and withdrawal are allowed (i.e. unlimited credit is allowed).
    b. Define process Acc2 to model the account in which a withdrawal is allowed only if it does not overdraw the account (i.e. no credit is allowed).

8. Construct a process with alphabet {*east, west, north, south, in, out*} which describes the pattern of choices presented by the following maze:



9. Show that nondeterminism distributes over itself: P|~| (Q |~| R) = (P |~| Q) |~| (P |~| R)

10, Animate the exercises using the ProBE tool.