Exercise 3.44.

Consider the problem of transferring an amount from one account to another. Ben Bitdiddle claims that this can be accomplished with the following procedure, even if there are multiple people concurrently transferring money among multiple accounts, using any account mechanism that serializes deposit and withdrawal transactions, for example, the version of make-account in the text above.

```
(define (transfer from-account to-account amount)
  ((from-account 'withdraw) amount)
  ((to-account 'deposit) amount))
```

Louis Reasoner claims that there is a problem here, and that we need to use a more sophisticated method, such as the one required for dealing with the exchange problem. Is Louis right? If not, what is the essential difference between the transfer problem and the exchange problem? (You should assume that the balance in `from-account` is at least `amount`.)

Answer.

Louis is wrong. The transfer operation fetches a designated amount of money from one account and deposits it into the other one. The timing diagram in figure depicts an order of events where the `balance`s of three account $a1$, $a2$ and $a3$ starts at \$10, \$20 and \$30 respectively, Peter transfers \$10 from $a1$ to $a2$ exactly the same moment when Paul tries to transfer the same amount of money from $a3$ to $a1$ and, Paul completes his transaction just before Peter is able to complete the transfer.

We see that the essential difference between the transfer operation here and the exchange operation above is that the amount of money been transferred between two account is specified by the account owner, which is irrelevant with the account balances involved, whereas the exchange operation swaps balances in two account based on their difference, whose value is highly hinged on the current balances of the accounts. This indicates that the transfer problem here is free from the consistency problem related to the account status, while the exchange problem above is inconsistency-prone, as we saw in exercise 3.43.

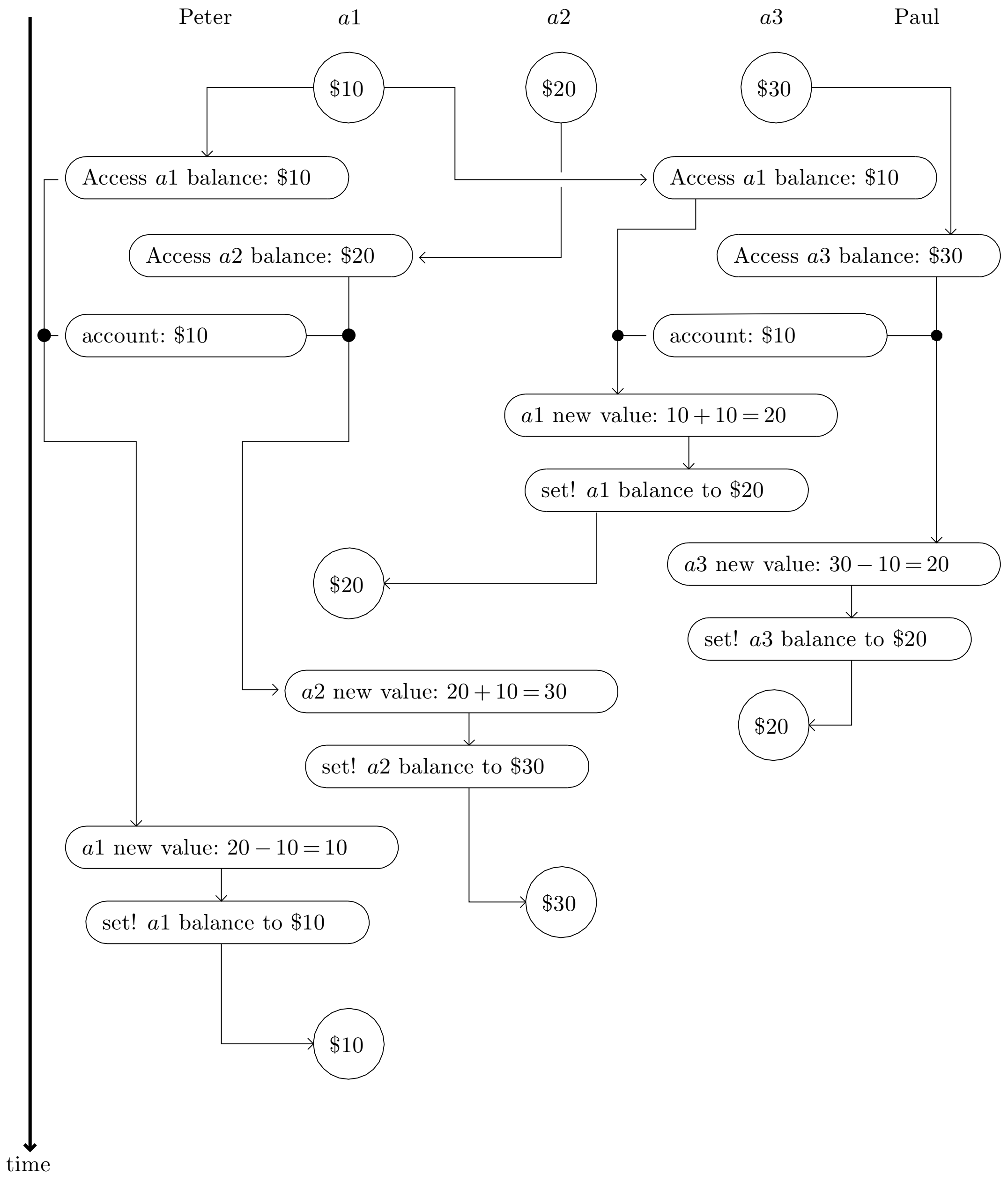
Peter
$a1$
$a2$
$a3$
Paul
$10
$20
$30
Access $a1$ balance: $10
Access $a1$ balance: $10
Access $a2$ balance: $20
Access $a3$ balance: $30
account: $10
account: $10
$a1$ new value: $10+10=20$
set! $a1$ balance to $20
$20
$a3$ new value: $30-10=20$
set! $a3$ balance to $20
$20
$a2$ new value: $20+10=30$
set! $a2$ balance to $30
$30
$a1$ new value: $20-10=10$
set! $a1$ balance to $10
$10
time

Figure 1.