─────────────────────── MODULE *Database* ───────────────────────

EXTENDS *Integers*, *Sequences*, *TLC*
CONSTANTS *Data*, *NULL*, *Clients*

--algorithm *database*

variables
  $query = [c \in Clients \mapsto NULL]$;
  $ghost\_db\_history = [c \in Clients \mapsto NULL]$;

define
  $Exists(val) \triangleq val \neq NULL$
  $RequestingClients \triangleq \{c \in Clients : Exists(query[c]) \land query[c].type = \text{"request"}\}$
end define ;

macro *wait_for_response*()**begin**
  await $query[self].type = \text{"response"}$;
end macro ;

macro *request*(*data*)**begin**
  $query[self] := [type \mapsto \text{"request"}] @@ data$;
end macro ;

  The response is the value of the database at the time the request was processed.

process *database* = "Database"
variable $db\_value \in Data$;
begin
  DB:
    with $client \in RequestingClients$, $q = query[client]$ **do**
      if $q.request = \text{"write"}$ **then**
        $db\_value := q.data$
      elsif $q.request = \text{"read"}$ **then**
        skip ;
      else
        assert FALSE ;   what did we even pass in
      end if ;
      $ghost\_db\_history[client] := db\_value$;
      $query[client] := [type \mapsto \text{"response"}, result \mapsto db\_value]$;
    end with ;
  goto *DB* ;
end process ;

process *clients* $\in Clients$
variables $result = NULL$;
begin

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Request :
  while TRUE **do**
    either   read
      request([*request* ↦ "read"]) ;
      Confirm :
        wait_for_response() ;
        result := *query*[*self*].*result* ;
        assert *result* = *ghost_db_history*[*self*] ;
    or   write
      with $d \in Data$ **do**
        request([*request* ↦ "write", *data* ↦ *d*]) ;
      end with ;
      Wait :
        wait_for_response() ;
    end either ;
  end while ;

end process ;

end algorithm   ;

VARIABLES *query*, *ghost_db_history*, *pc*

define statement
$Exists(val) \triangleq val \neq NULL$
$RequestingClients \triangleq \{c \in Clients : Exists(query[c]) \land query[c].type = \text{"request"}\}$

VARIABLES *db_value*, *result*

$vars \triangleq \langle query,\ ghost\_db\_history,\ pc,\ db\_value,\ result \rangle$

$ProcSet \triangleq \{\text{"Database"}\} \cup (Clients)$

$Init \triangleq$ Global variables
        $\land\ query = [c \in Clients \mapsto NULL]$
        $\land\ ghost\_db\_history = [c \in Clients \mapsto NULL]$
        Process database
        $\land\ db\_value \in Data$
        Process clients
        $\land\ result = [self \in Clients \mapsto NULL]$
        $\land\ pc = [self \in ProcSet \mapsto \text{CASE}\ self = \text{"Database"} \rightarrow \text{"DB"}$
                                $\Box\quad self \in Clients \rightarrow \text{"Request"}]$

$DB \triangleq\ \land\ pc[\text{"Database"}] = \text{"DB"}$
        $\land\ \exists\ client \in RequestingClients :$
            $\text{LET}\ q \triangleq query[client]\text{IN}$
                $\land\ \text{IF}\ q.request = \text{"write"}$

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\begin{aligned}
&\text{THEN} \quad \wedge \ db\_value' = q.data \\
&\text{ELSE} \quad \wedge \ \text{IF} \ q.request = \text{``read''} \\
&\qquad\qquad\quad \text{THEN} \quad \wedge \ \text{TRUE} \\
&\qquad\qquad\quad \text{ELSE} \quad \wedge \ Assert(\text{FALSE}, \\
&\qquad\qquad\qquad\qquad\qquad\qquad \text{``Failure of assertion at line 38, column 9.''}) \\
&\qquad\qquad\quad \wedge \ \text{UNCHANGED} \ db\_value
\end{aligned}
$$

$\wedge \ ghost\_db\_history' = [ghost\_db\_history \ \text{EXCEPT} \ ![client] = db\_value']$

$\wedge \ query' = [query \ \text{EXCEPT} \ ![client] = [type \mapsto \text{``response''},\ result \mapsto db\_value']]$

$\wedge \ pc' = [pc \ \text{EXCEPT} \ ![\text{``Database''}] = \text{``DB''}]$

$\wedge \ \text{UNCHANGED} \ result$

$database \ \triangleq \ DB$

$Request(self) \ \triangleq \ \wedge \ pc[self] = \text{``Request''}$

$\qquad\qquad\qquad \wedge \ \vee \ \wedge \ query' = [query \ \text{EXCEPT} \ ![self] = [type \mapsto \text{``request''}] \ @@ \ ([request \mapsto \text{``read''}])]$

$\qquad\qquad\qquad\qquad\quad \wedge \ pc' = [pc \ \text{EXCEPT} \ ![self] = \text{``Confirm''}]$

$\qquad\qquad\qquad\quad \vee \ \wedge \ \exists \, d \in Data :$

$\qquad\qquad\qquad\qquad\qquad query' = [query \ \text{EXCEPT} \ ![self] = [type \mapsto \text{``request''}] \ @@ \ ([request \mapsto \text{``write''},\ data$

$\qquad\qquad\qquad\qquad\quad \wedge \ pc' = [pc \ \text{EXCEPT} \ ![self] = \text{``Wait''}]$

$\qquad\qquad\qquad \wedge \ \text{UNCHANGED} \ \langle ghost\_db\_history,\ db\_value,\ result \rangle$

$Confirm(self) \ \triangleq \ \wedge \ pc[self] = \text{``Confirm''}$

$\qquad\qquad\qquad \wedge \ query[self].type = \text{``response''}$

$\qquad\qquad\qquad \wedge \ result' = [result \ \text{EXCEPT} \ ![self] = query[self].result]$

$\qquad\qquad\qquad \wedge \ Assert(result'[self] = ghost\_db\_history[self],$

$\qquad\qquad\qquad\qquad\qquad \text{``Failure of assertion at line 57, column 11.''})$

$\qquad\qquad\qquad \wedge \ pc' = [pc \ \text{EXCEPT} \ ![self] = \text{``Request''}]$

$\qquad\qquad\qquad \wedge \ \text{UNCHANGED} \ \langle query,\ ghost\_db\_history,\ db\_value \rangle$

$Wait(self) \ \triangleq \ \wedge \ pc[self] = \text{``Wait''}$

$\qquad\qquad\quad \wedge \ query[self].type = \text{``response''}$

$\qquad\qquad\quad \wedge \ pc' = [pc \ \text{EXCEPT} \ ![self] = \text{``Request''}]$

$\qquad\qquad\quad \wedge \ \text{UNCHANGED} \ \langle query,\ ghost\_db\_history,\ db\_value,\ result \rangle$

$clients(self) \ \triangleq \ Request(self) \vee Confirm(self) \vee Wait(self)$

$Next \ \triangleq \ database$

$\qquad\qquad \vee \ (\exists \, self \in Clients : clients(self))$

$Spec \ \triangleq \ Init \wedge \Box[Next]_{vars}$

END TRANSLATION
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* Modification History

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