変化している世界を変化しよう

# 双方向プログラミングの理論と実践

## Theory and Practice of Bidirectional Programming

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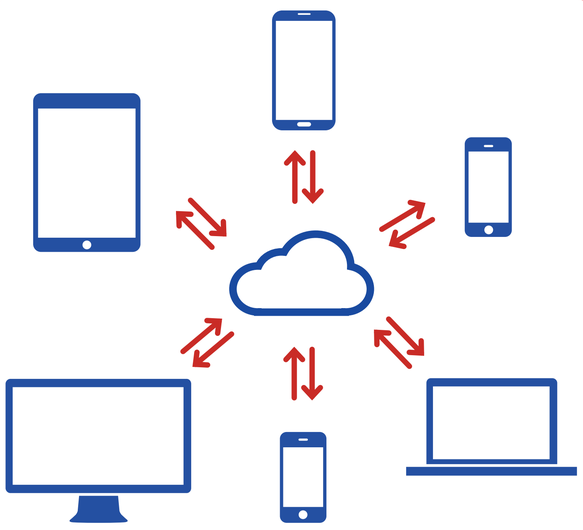
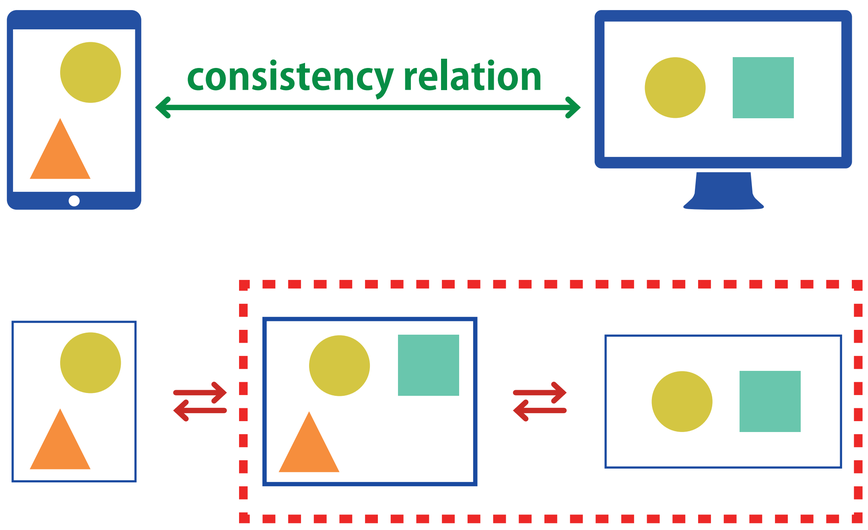
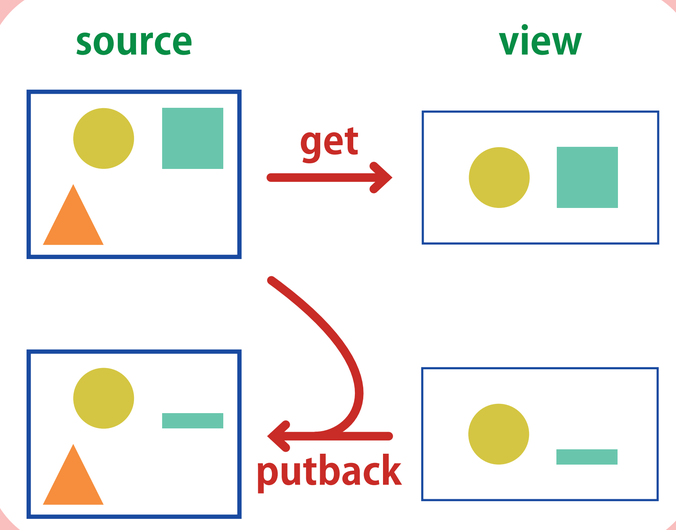


The world needs reliable ways of **synchronisation**.




We can focus on the problem of synchronising two pieces of data, where one side contains more information.




This is studied by the theory of **bidirectional transformations**.

# Programming Bidirectional Transformations

We have developed a programming language **BiGUL**  , in which every program denotes a well-behaved bidirectional transformation.


BiGUL consists of a set of small, carefully designed bidirectional components, whose well-behavedness has been **formally verified**, achieving high reliability.

Personal and business calendar

```
calendar:
  - event:
      name: group meeting
      start: Today 15:00
      end: Today 17:00
      location: ~~Room 2005~~ Room 2006
      note: prepare slides
      private: False
  - event:
      name: lunch
      start: Today 12:00
      end: Today 13:00
      location: Jimbocho
      note:
      private: True
```

View for secretary

```
calendar:
  - event:
      name: group meeting
      start: Today 15:00
      end: Today 17:00
      location: ~~Room 2005~~ Room 2006
```

The components are then used as building blocks of various bidirectional applications.

```
publicEvents :: BiGUL [Event] [(Name, Location)]
publicEvents = Case
  [ $(normalSV [| and . map private |] [p| [] |]
               [| and . map private |])
    ==> $(rearrV [| \[] -> () |])$
          skip ()
  , $(adaptiveSV [| not . and . map private |] [p| [] |])
    ==> \es _ -> filter private es
  , $(normal [| \(e:_) (_:_) -> private e |]
             [p| (private -> True):(and . map private -> False) |])
    ==> $(rearrS [| \(e:es) -> es |])$
          publicEvents
  , $(normal [| \(e:_) ((n, l):_) -> not (private e) && name e == n |]
             [p| (private -> False):_ |])
    ==> $(update [p| (Event n l _):xs |] [p| (n, l):xs |]
                 [d| n = Replace; l = Replace; xs = publicEvents |])
  , $(adaptive [| \es ((n, l):_) -> n `elem` map name (filter (not . private) es) |])
    ==> \es ((n, _):_) ->
          let e = fromJust (find (\e -> not (private e) && name e == n) es)
          in  e : delete e es
  , $(adaptive [| \es ((n, l):_) -> not (n `elem` map name (filter (not . private) es)) |])
    ==> \es ((n, l):_) -> Event n l False : es ]
```

H-S Ko, T Zan, and Z Hu. BiGUL: A formally verified core language for putback-based bidirectional programming. Partial Evaluation and Program Manipulation (PEPM), ACM, 2016. doi: 10.1145/2847538.2847544.

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