Syntax-directed translation

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A direct path from CHP to gates

- Goal: to provide a direct path from CHP to gates
- “Syntax directed”
  - Translation uses the syntax of the CHP program to generate the circuit
  - Uses structural induction
    - Induction on the *structure* of the program
    - Translations for
      - Base case: assignment, communication, skip, expression evaluation
      - Induction: selections, loops, sequential composition, parallel composition
- History
  - 1988 : paper at Conference on Advanced Research in VLSI (Caltech)
  - 1991 : Tangram language / Haste @ Handshake Solutions (Philips Research)
  - 1998 : Balsa, based on Tangram with extensions (U. Manchester)

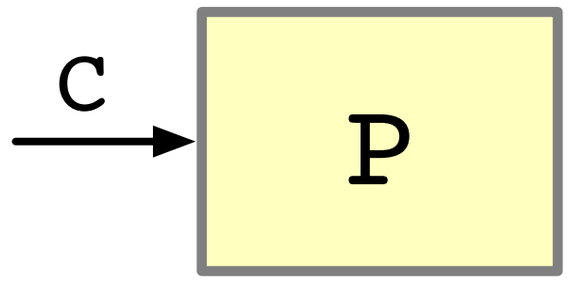
Key idea

- Use a communication *channel* to select a program for execution
- Given a program “P”, we will implement the following

```
*[          // infinite loop
  [#C];     // wait for pending C
  P;        // execute P
  C?        // finish C
]
```

- We execute “P” by simply executing

```
C!
```



- This is sometimes called “process decomposition” or “process call”

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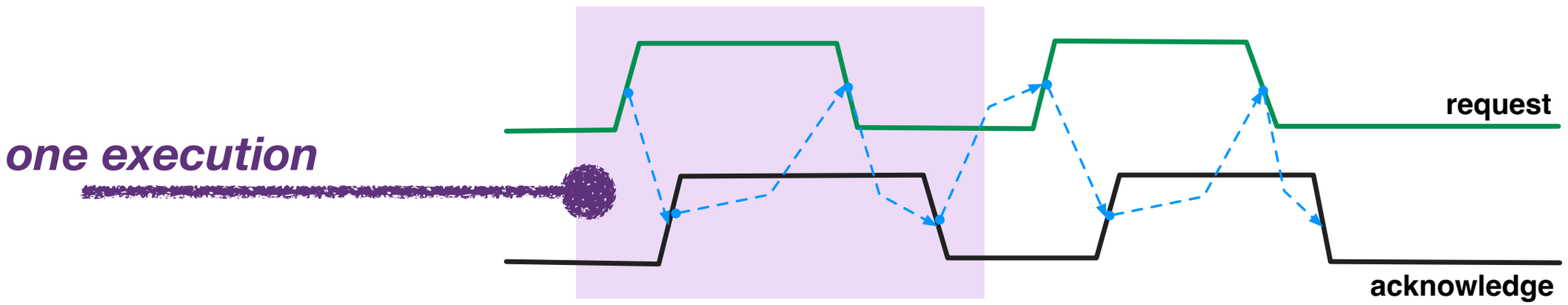
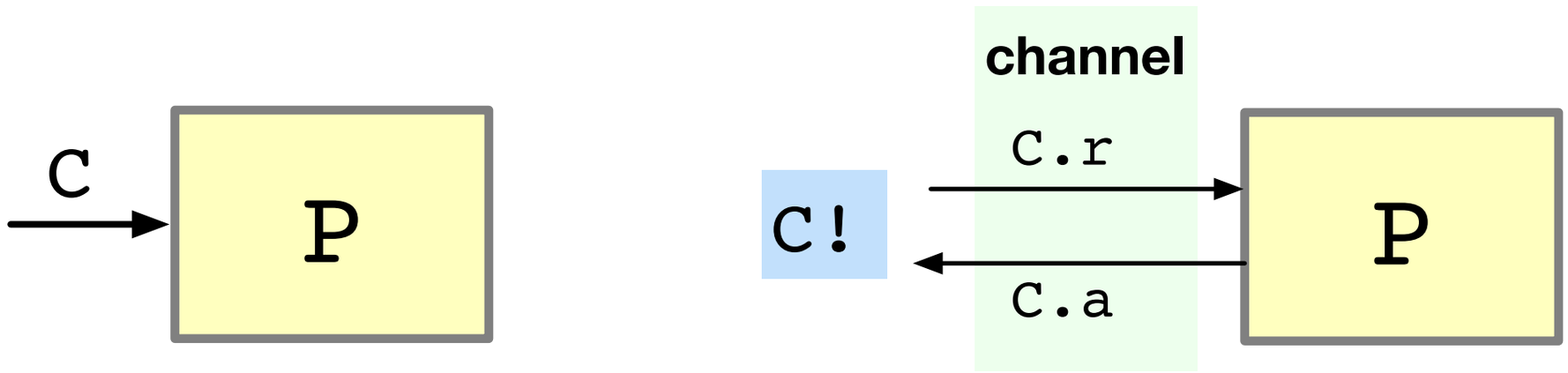
Wire implementation of channels

- Channel “C” that *controls* the execution of a program





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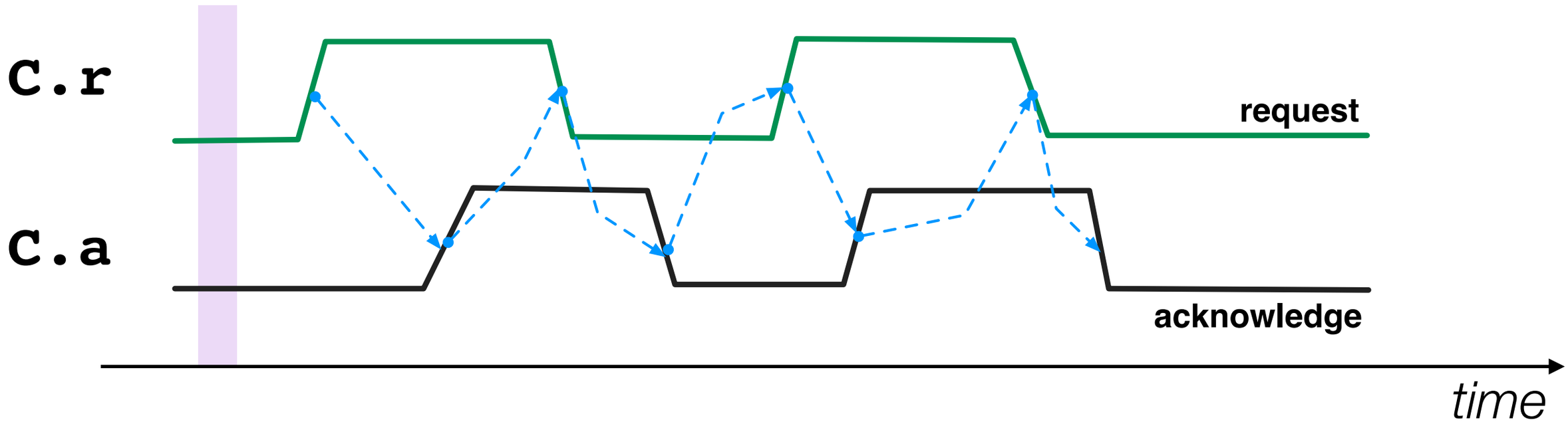
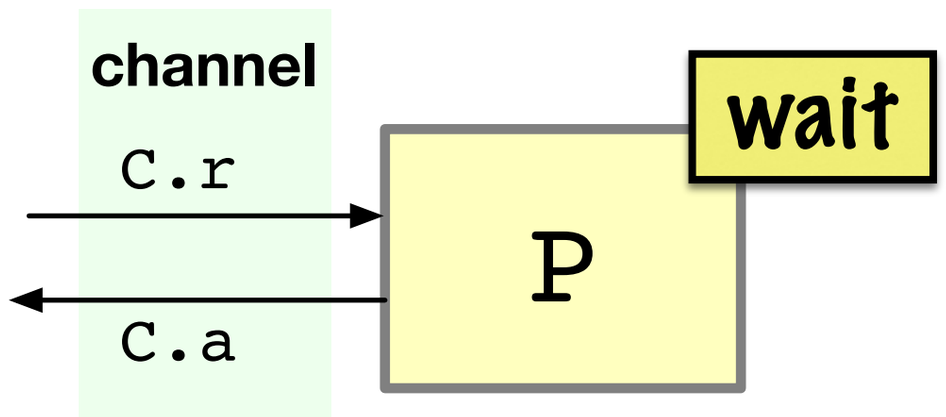
One execution: idle (waiting) state





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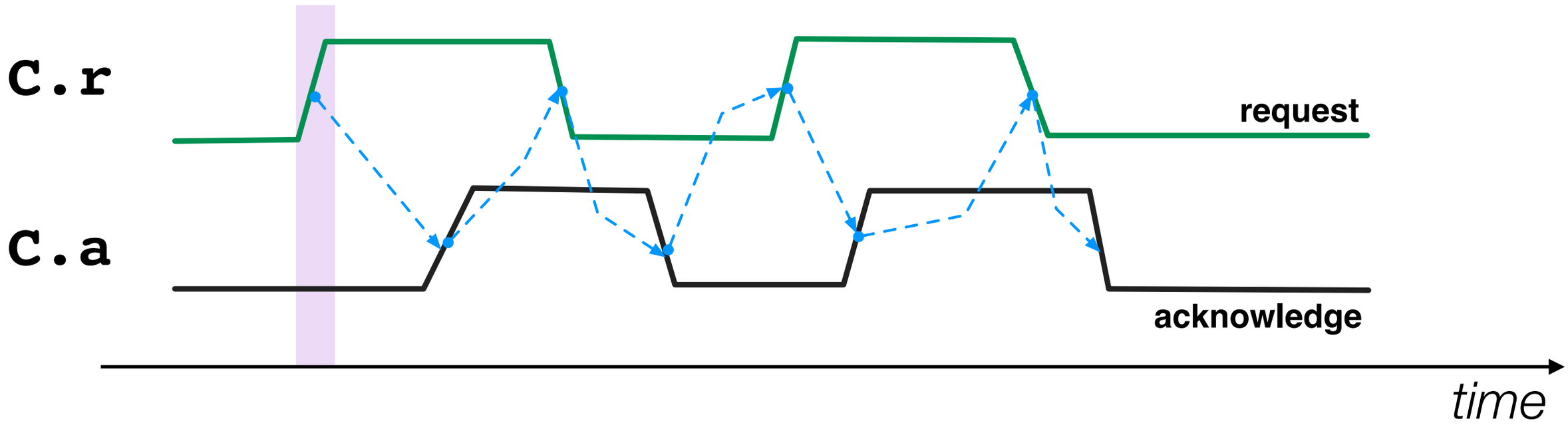
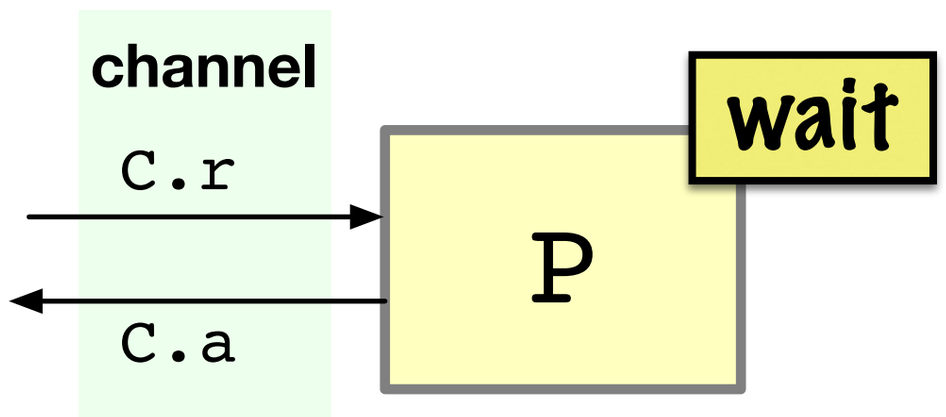
One execution: request execution





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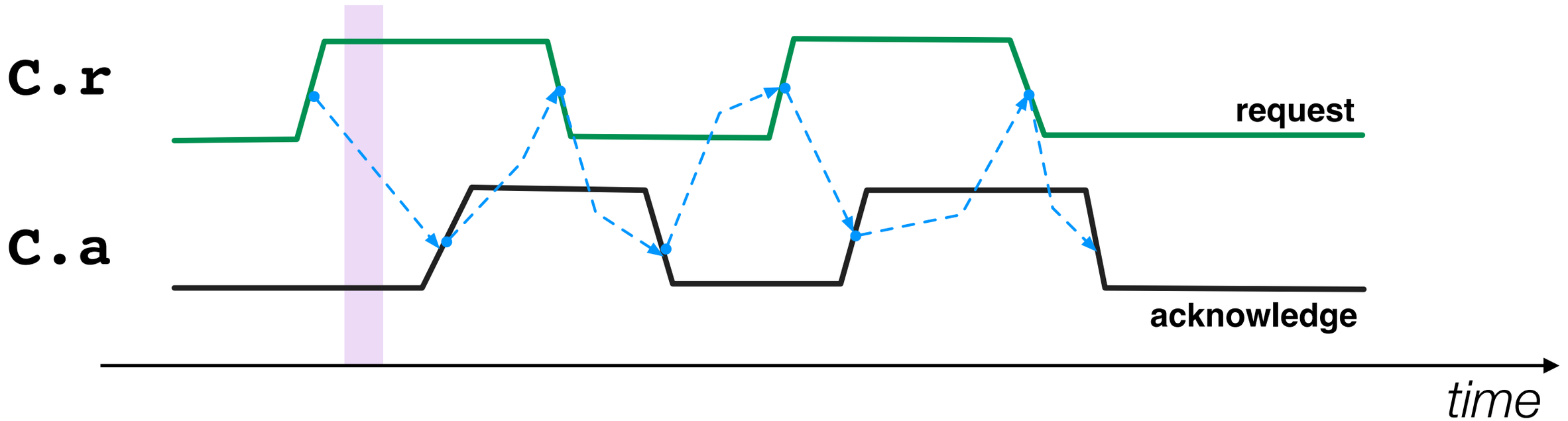
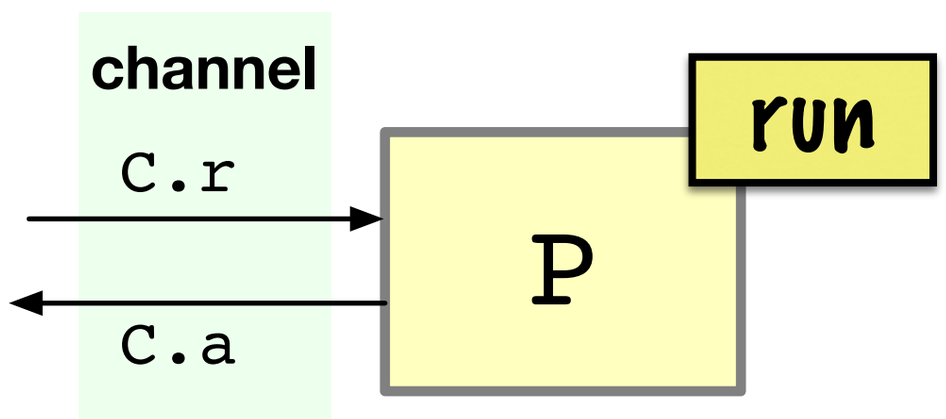
One execution: running





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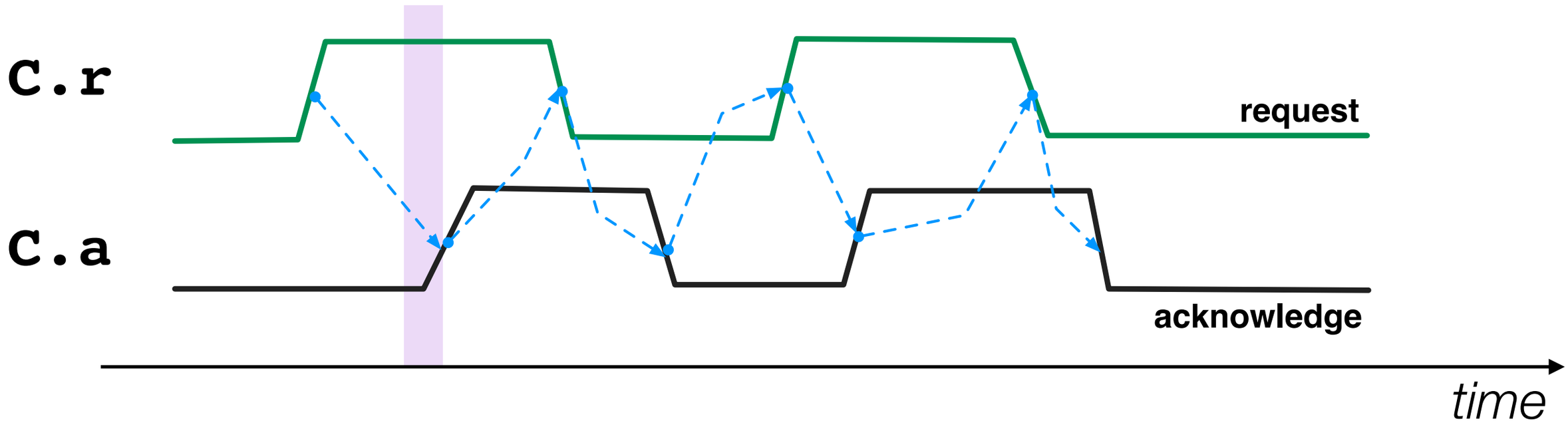
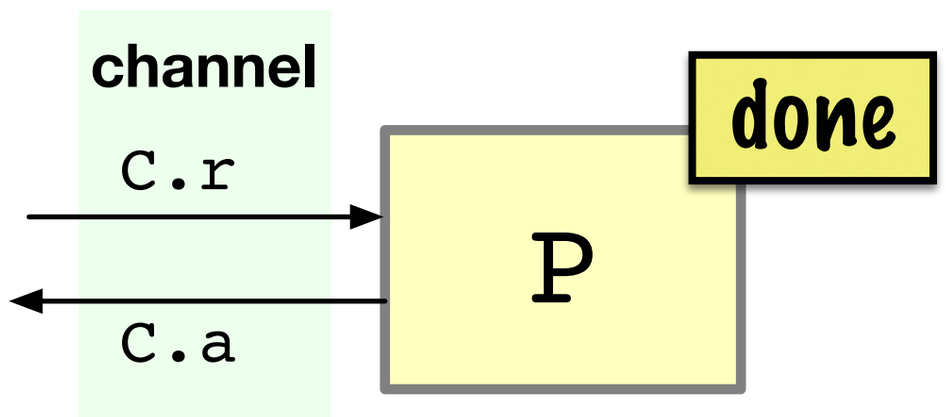
One execution: done





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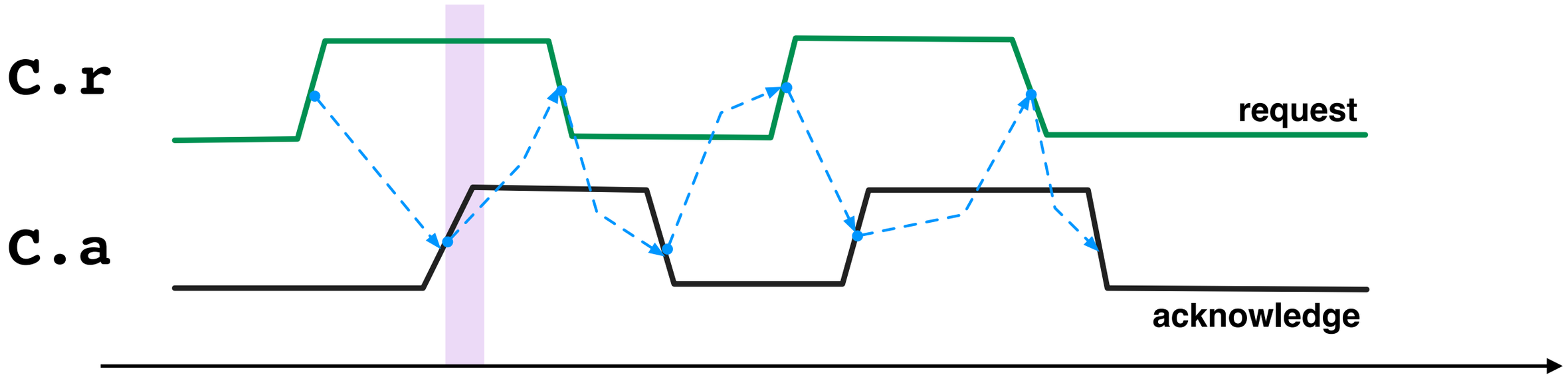
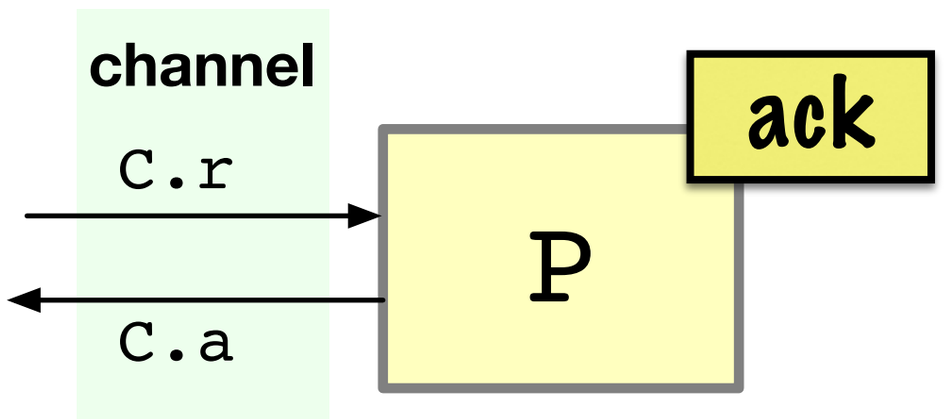
One execution: respond to requester





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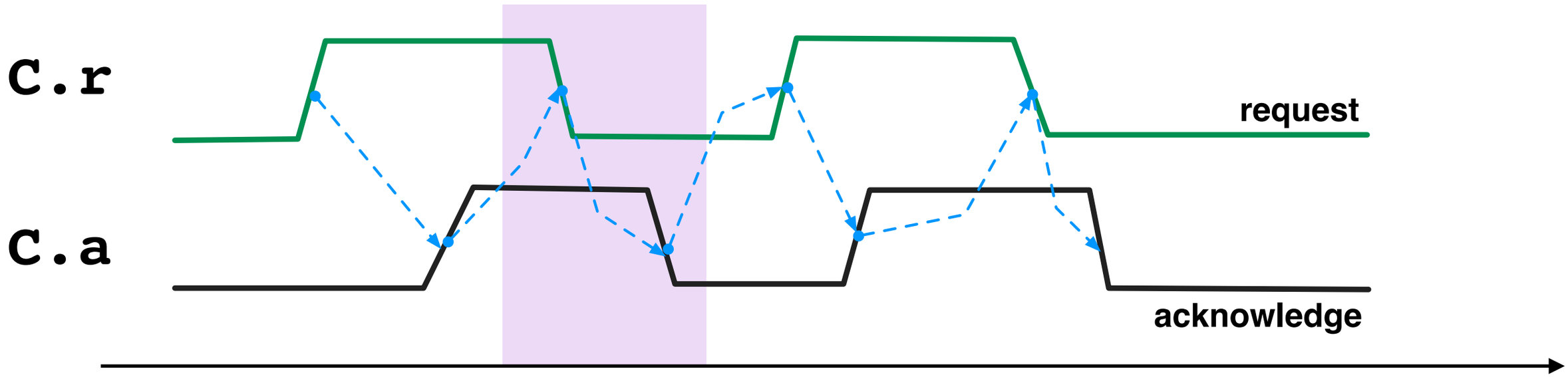
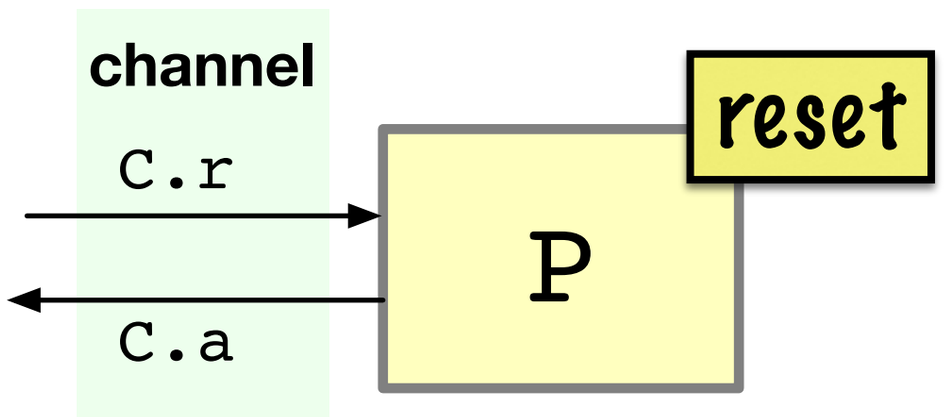
One execution: reset phase





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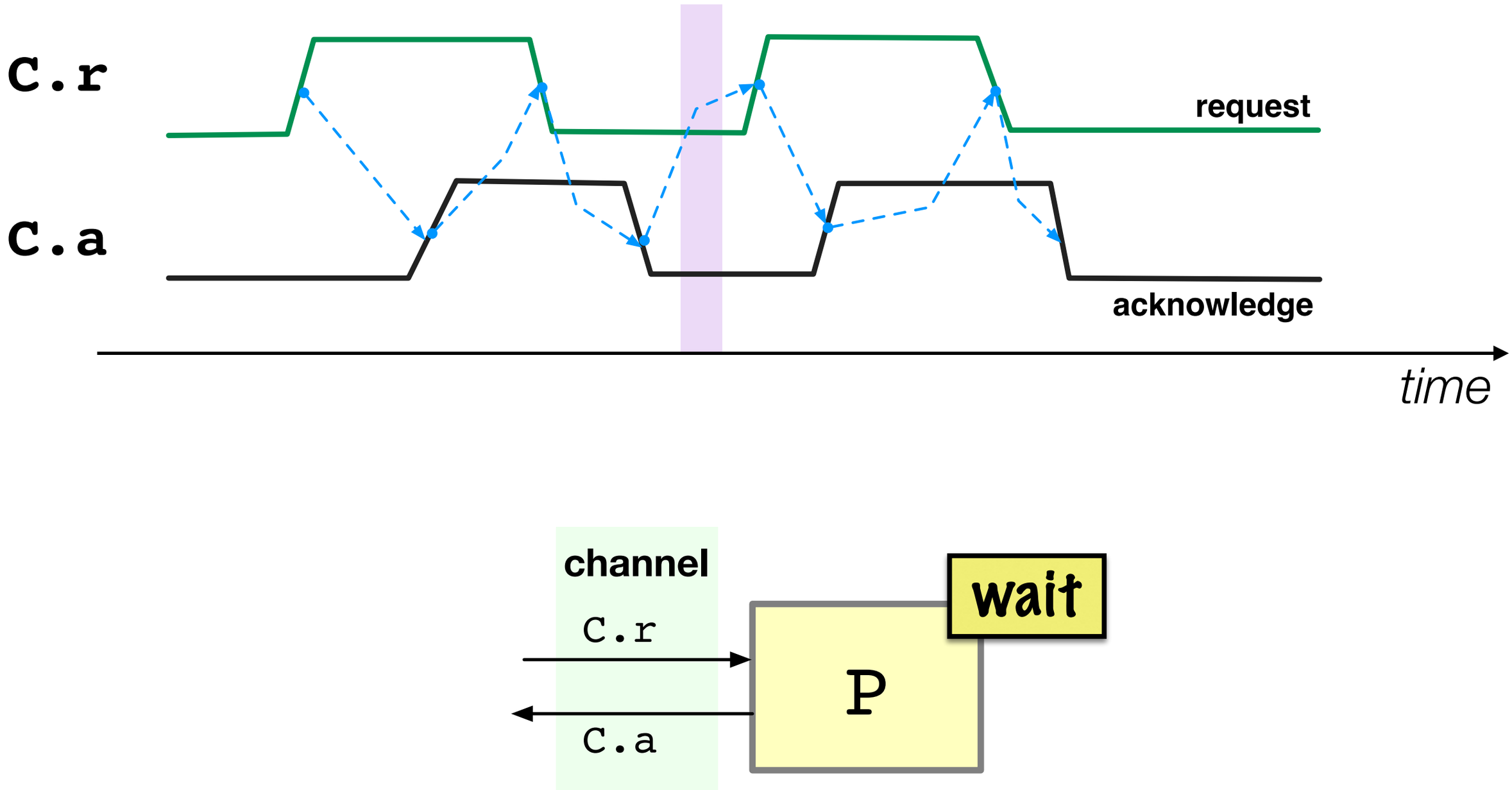
One execution: reset phase



Variables

- Two operations
  - ❖ Write a value to the variable

```
W!value
```

  - ❖ Read the current value of the variable

```
R?x
```

- The variable itself is “passive”
  - ❖ It waits for the environment to either write or read its value

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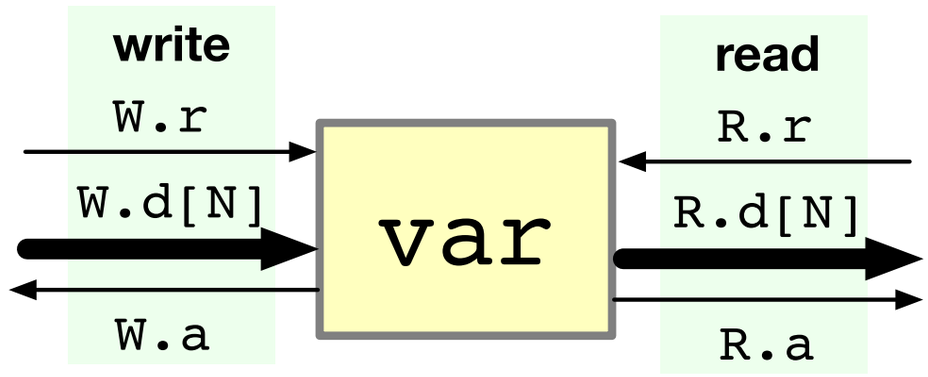
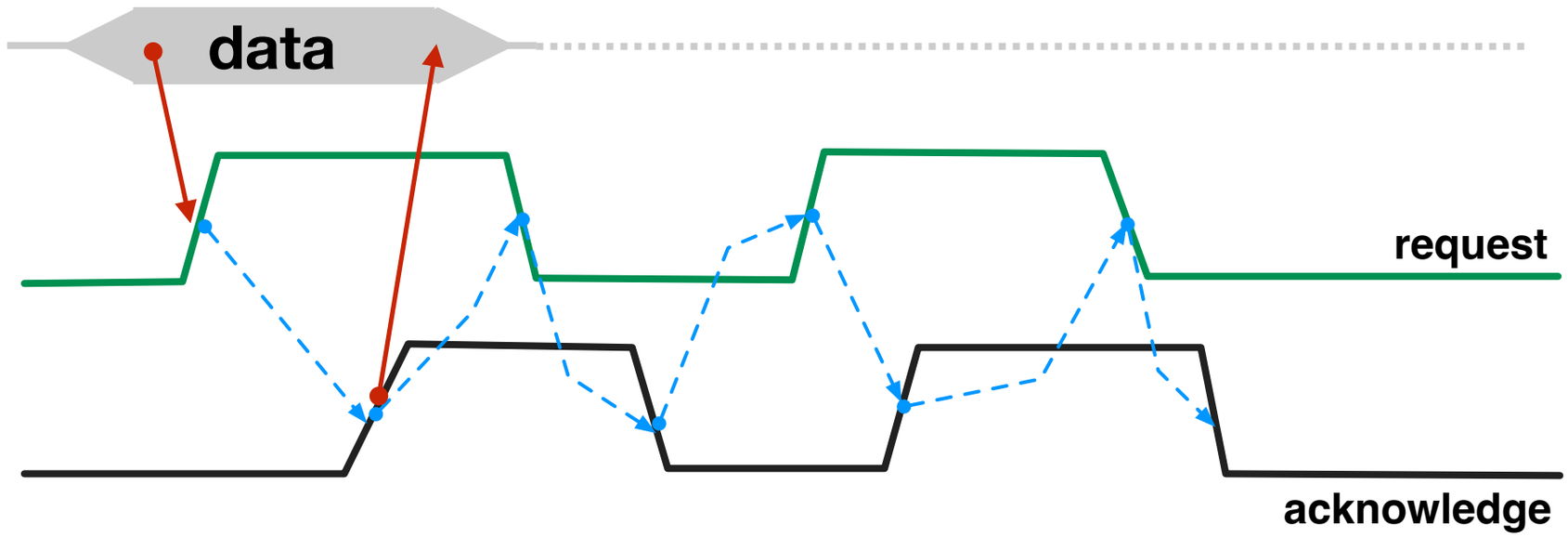
Writing and reading a variable





Write

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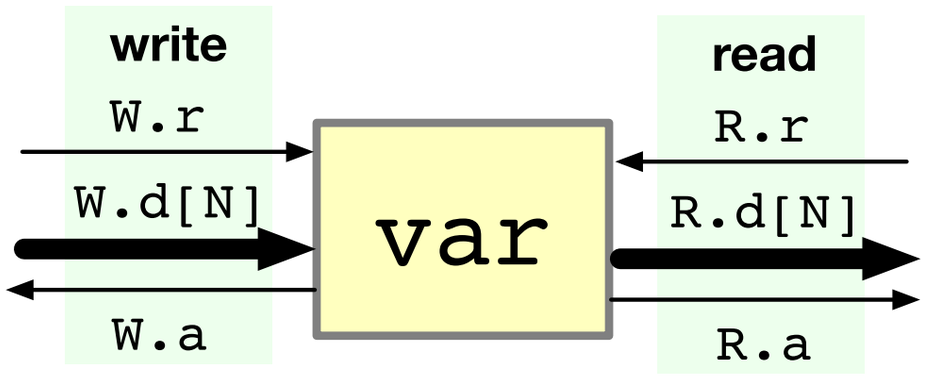
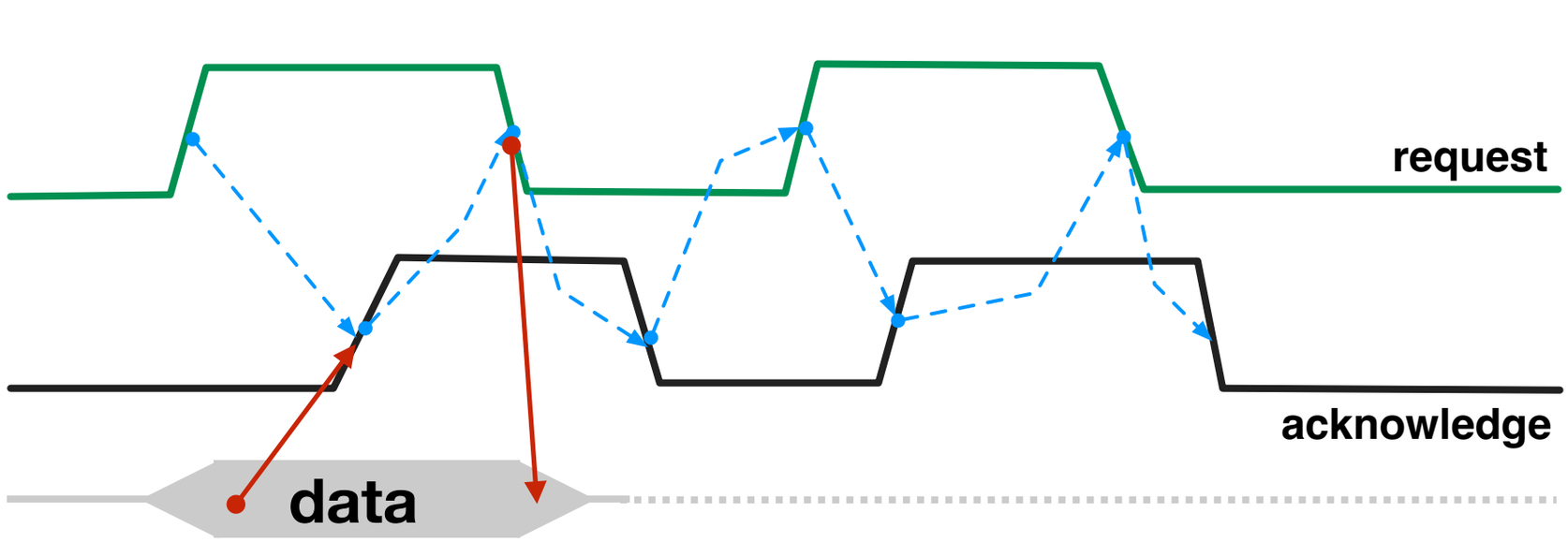
Writing and reading a variable





Read

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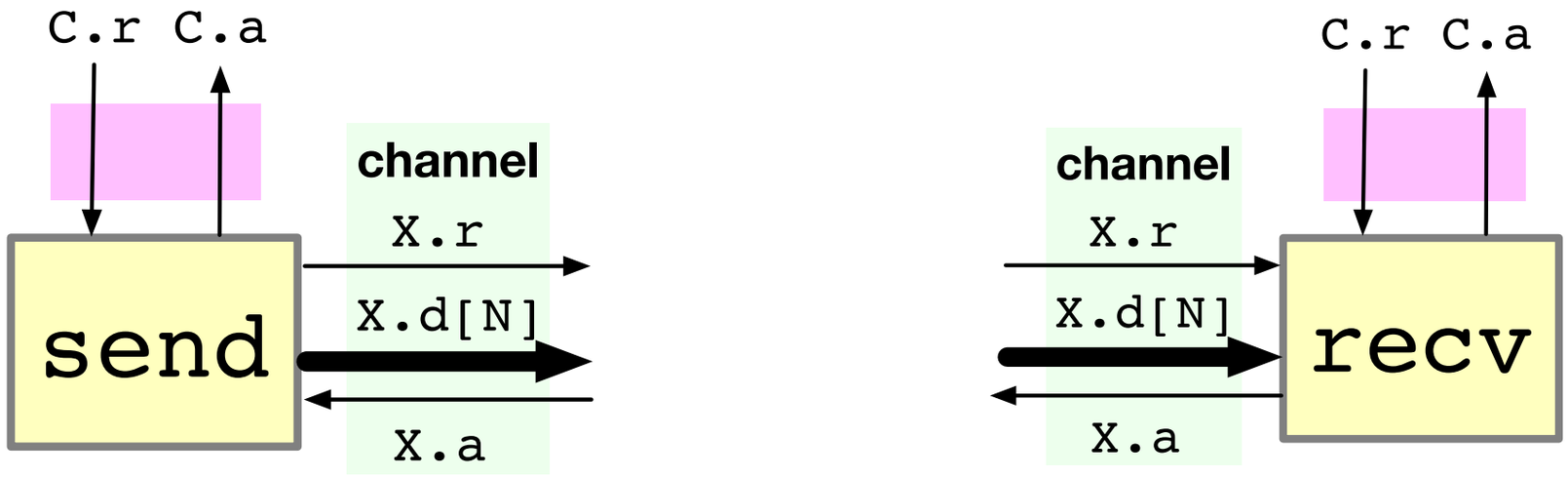
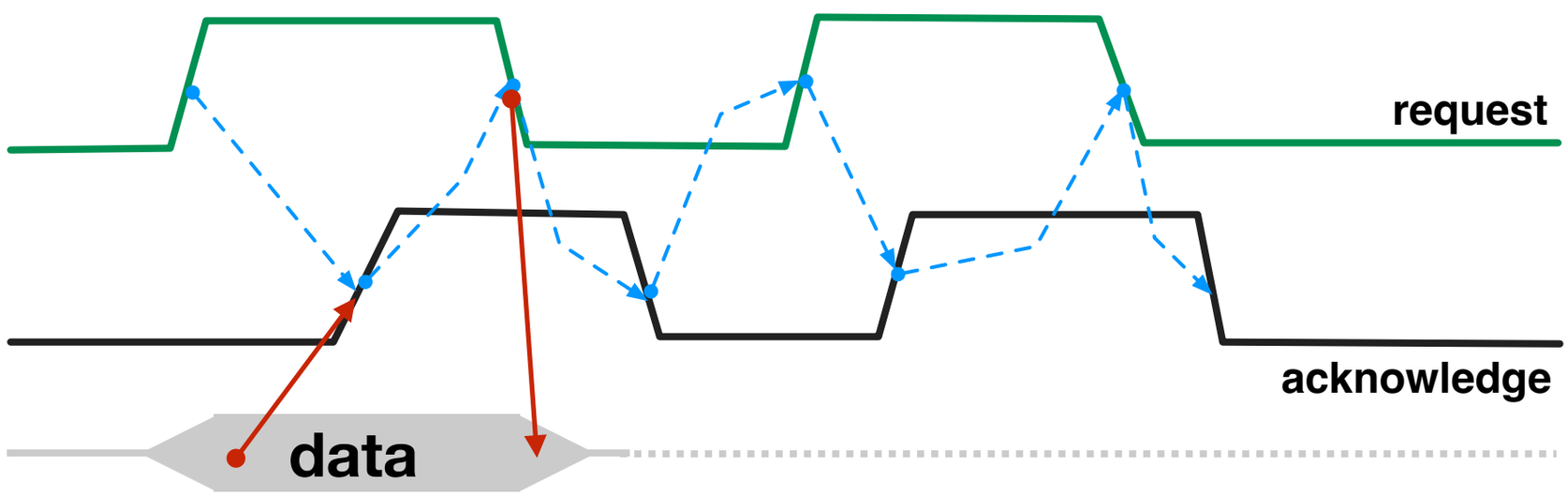
Sending and receiving on a channel





Send / receive

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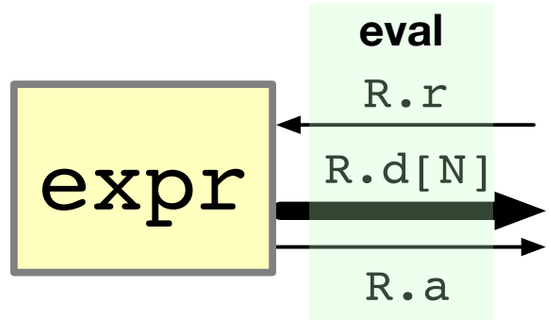
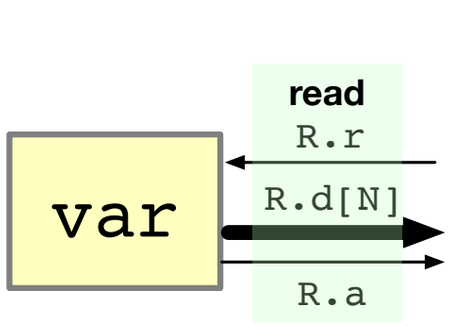
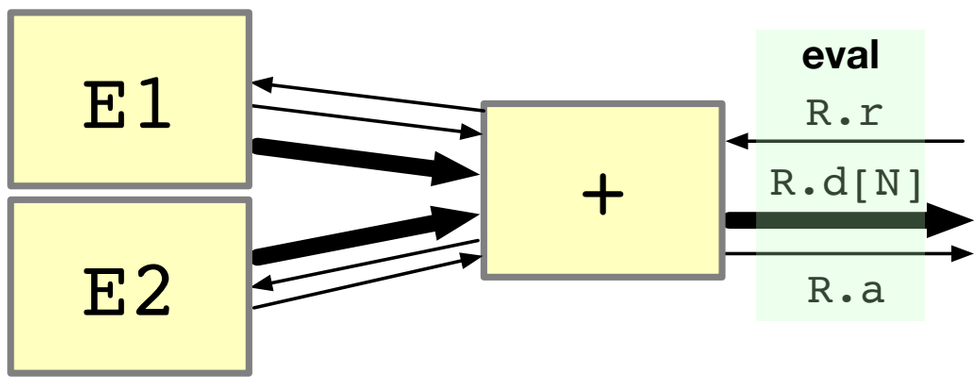
Expression evaluation



- Example of expression de-composition





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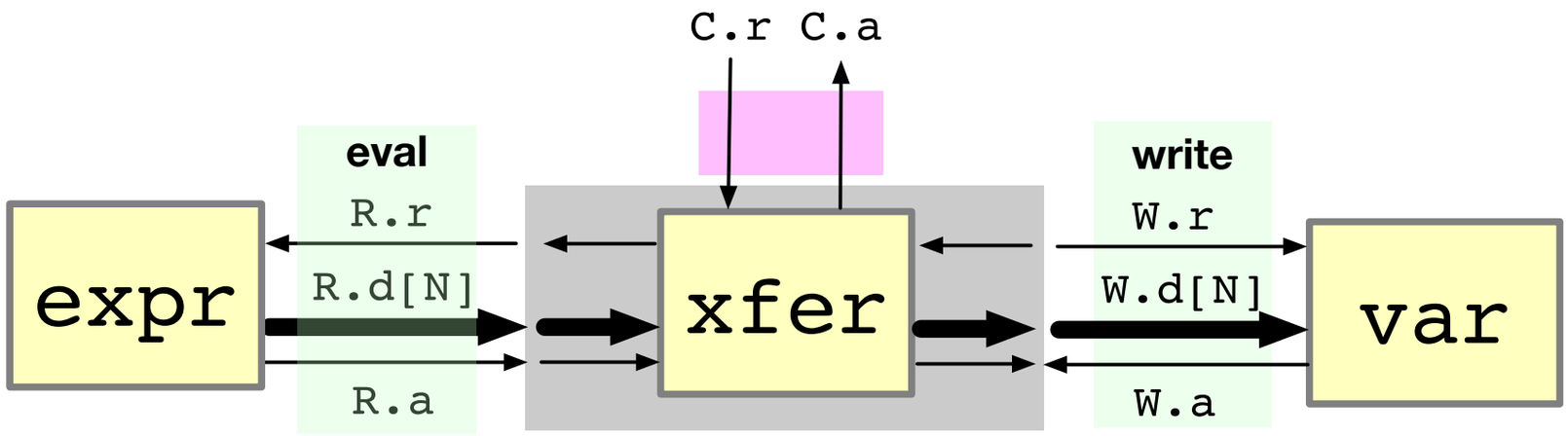
Assignment



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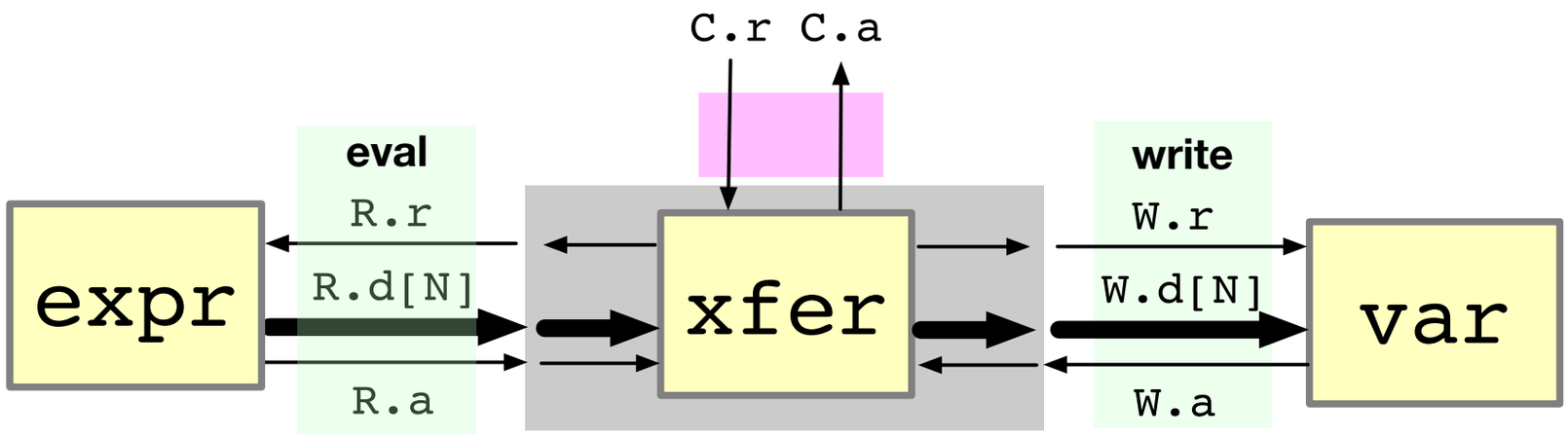
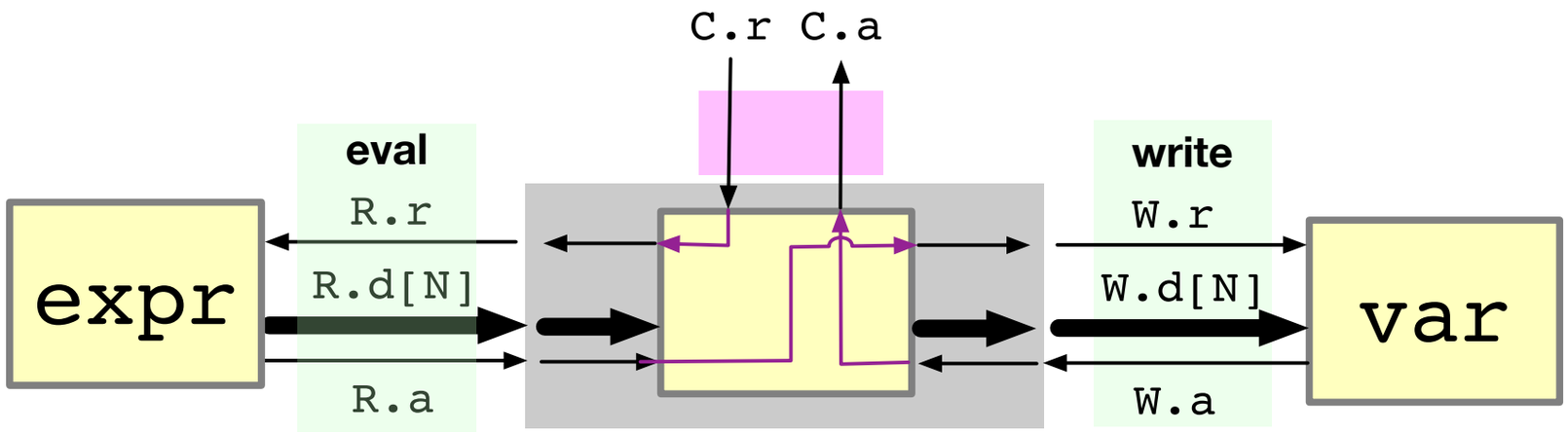
Assignment





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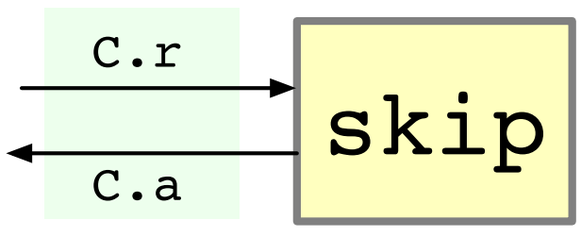
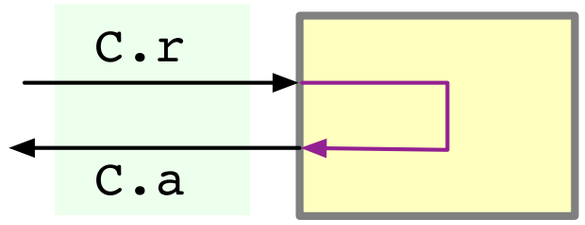
Building blocks





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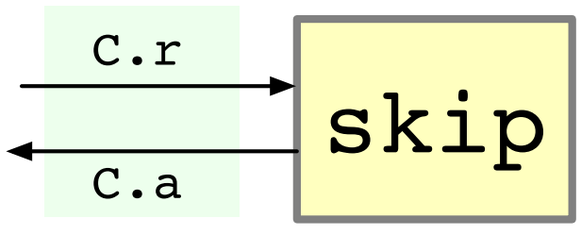
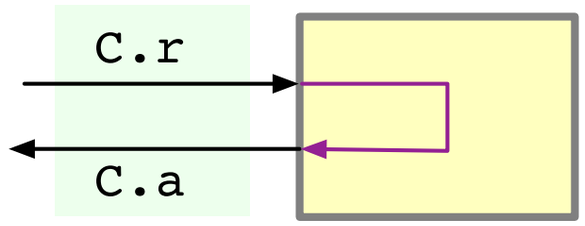
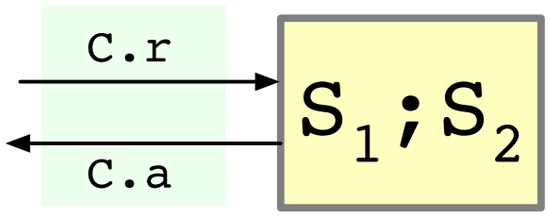
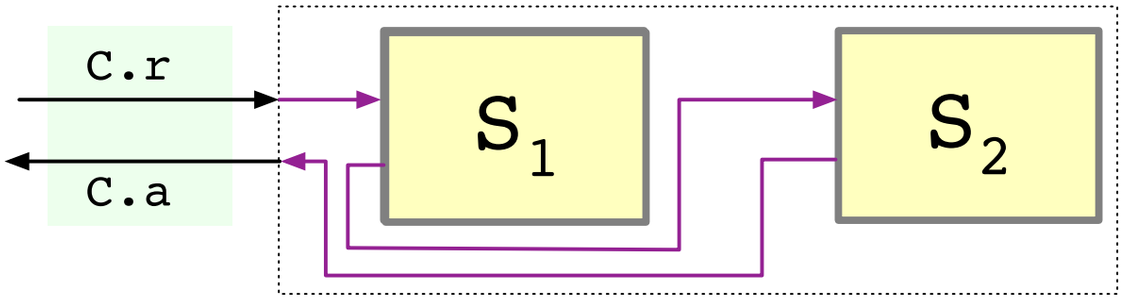
Building blocks









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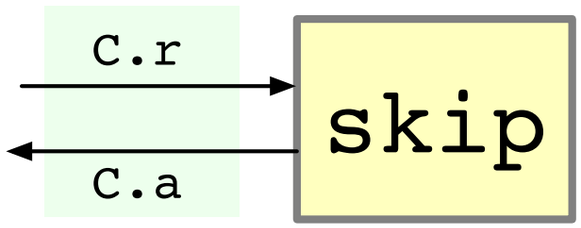
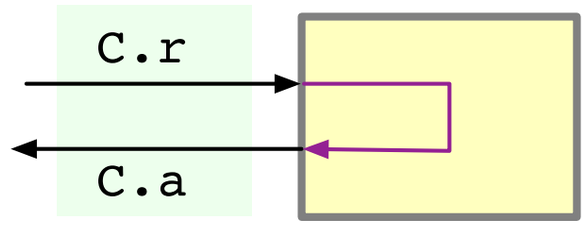
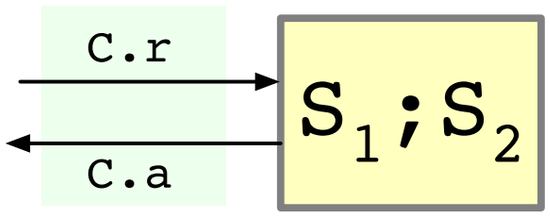
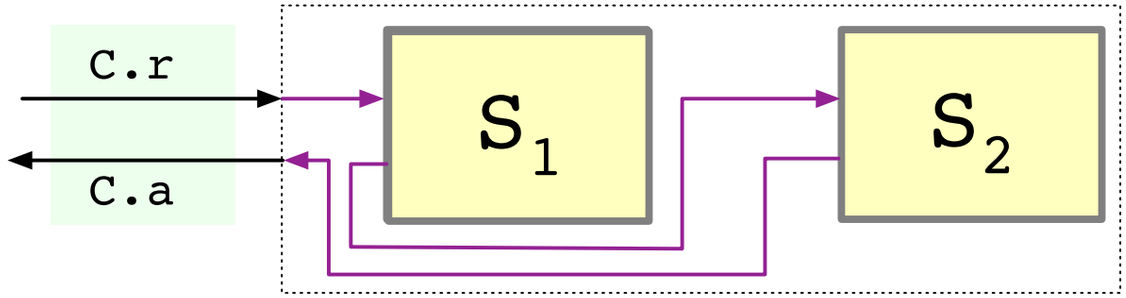
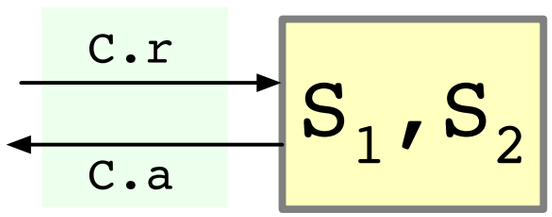
Building blocks

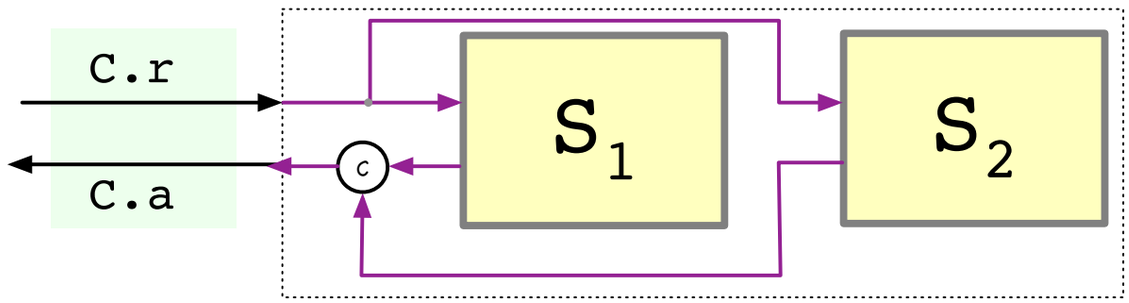












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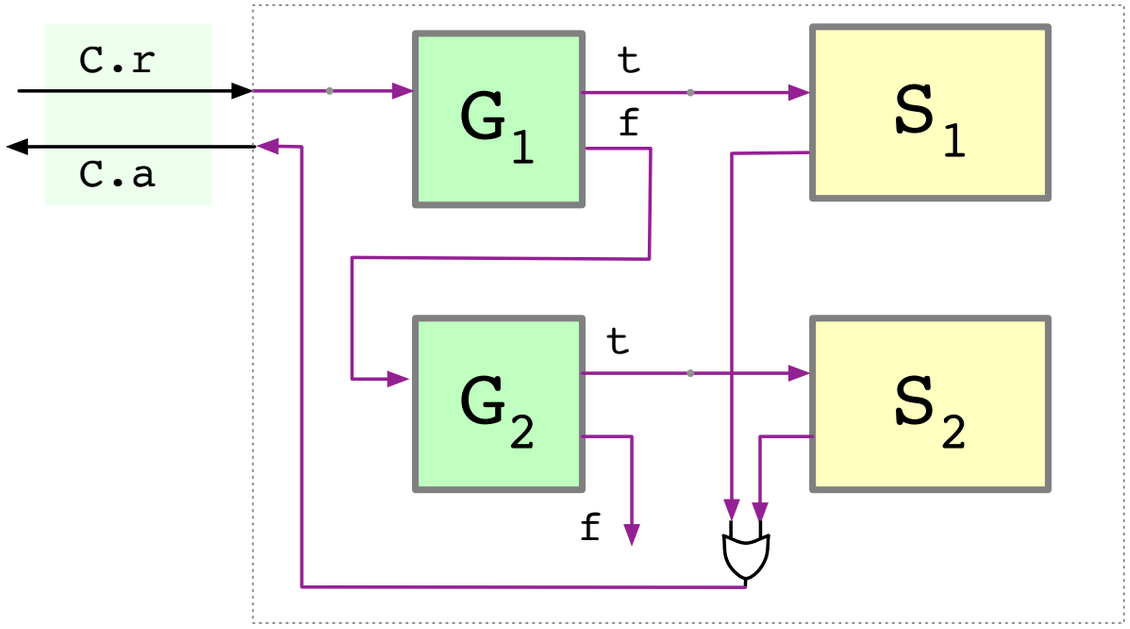
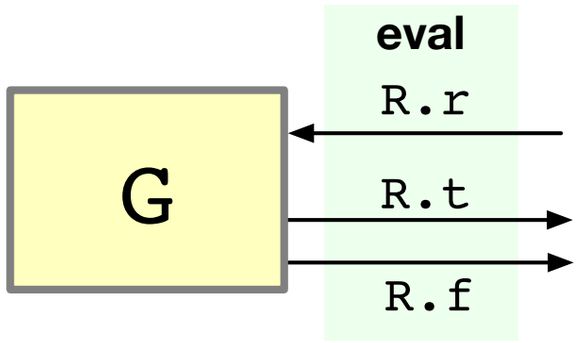
Selections and loops




```
[   G1 -> S1
[ ] G2 -> S2
]
```

Selection



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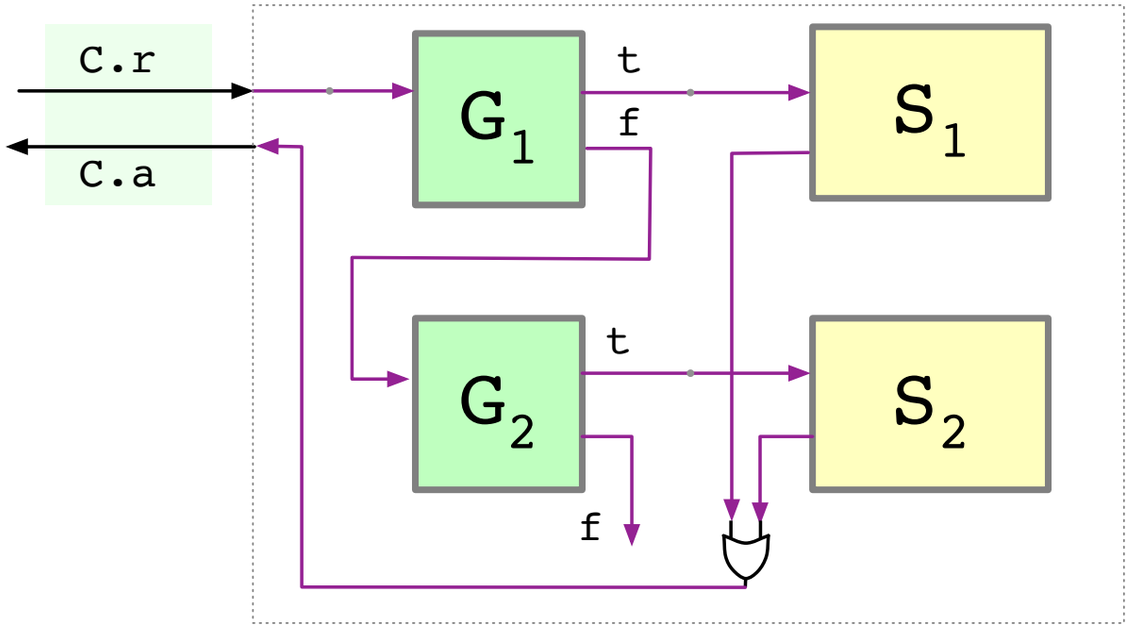
Selections and loops

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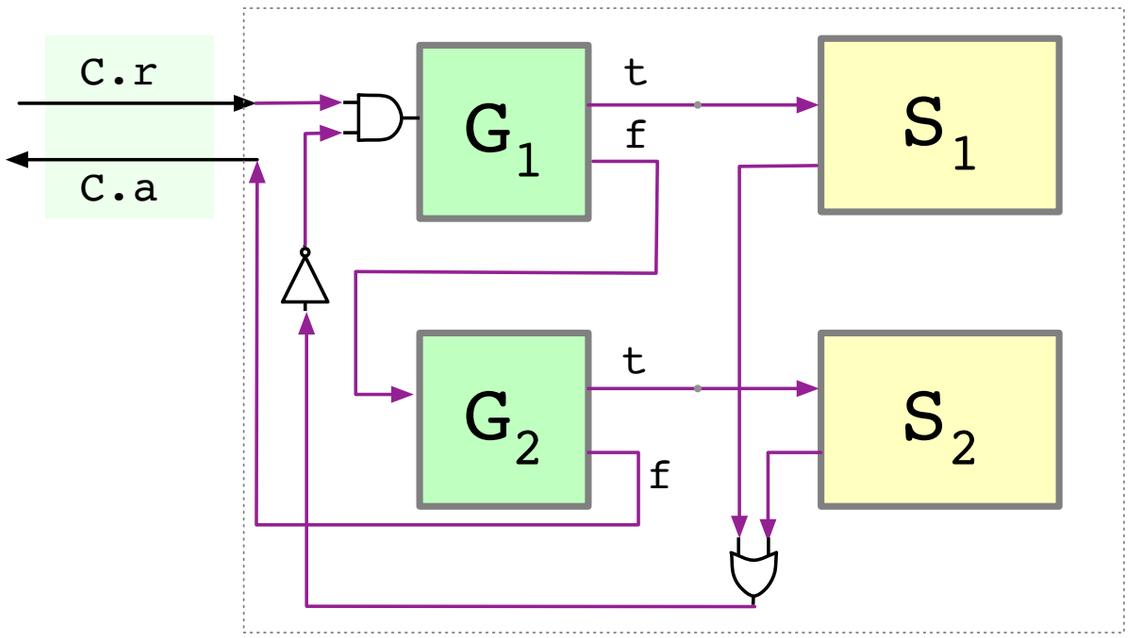
Selection




```
*[   G1 -> S1
 [ ] G2 -> S2
 ]
```

Loop

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