CSP and ADA

Guarded Commands

- Monitor/Serializer: begin executing every call as soon as possible, waiting if the object is not in a proper state and signaling when the state is proper
- CSP/Ada: the called object establishes conditions under which the call is accepted; calls not satisfying these conditions are held pending (no need for programmed wait/signal operations).

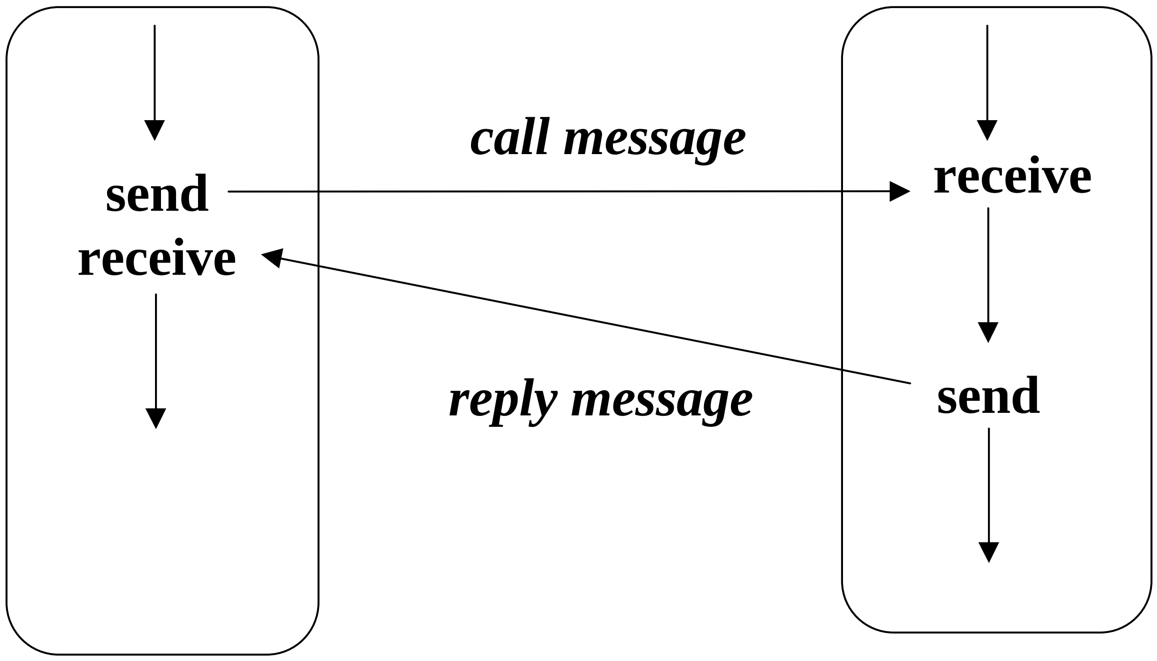
Rendezvous

- Monitor/Serializer: the monitor/ synchronizer is passive (has no independent task/thread/activity)
- CSP/Ada: synchronization between peer, autonomous activities.

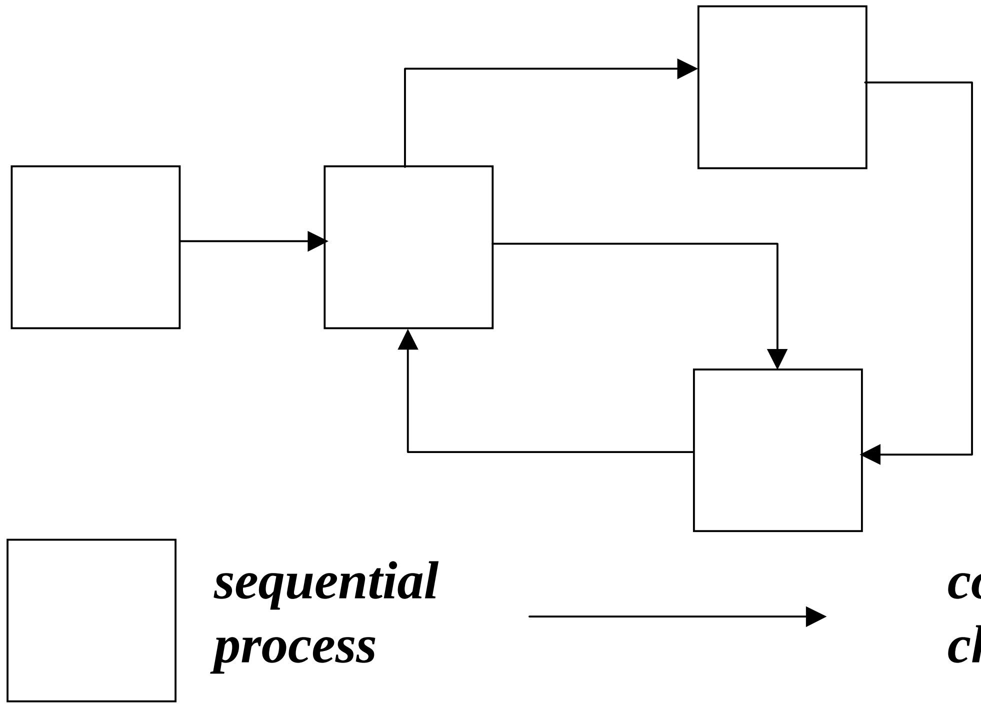
CSP and ADA

Distribution:

- Monitor/Serializer: inherently non-distributed in outlook and implementation
- CSP/Ada: possibility for distributed programming using synchronous message passing



Communicating Sequential Processes (CSP)



- single thread of control
- autonomous
- encapsulated
- named
- static

- synchronous
- reliable
- unidirectional
- point-to-point
- fixed topology

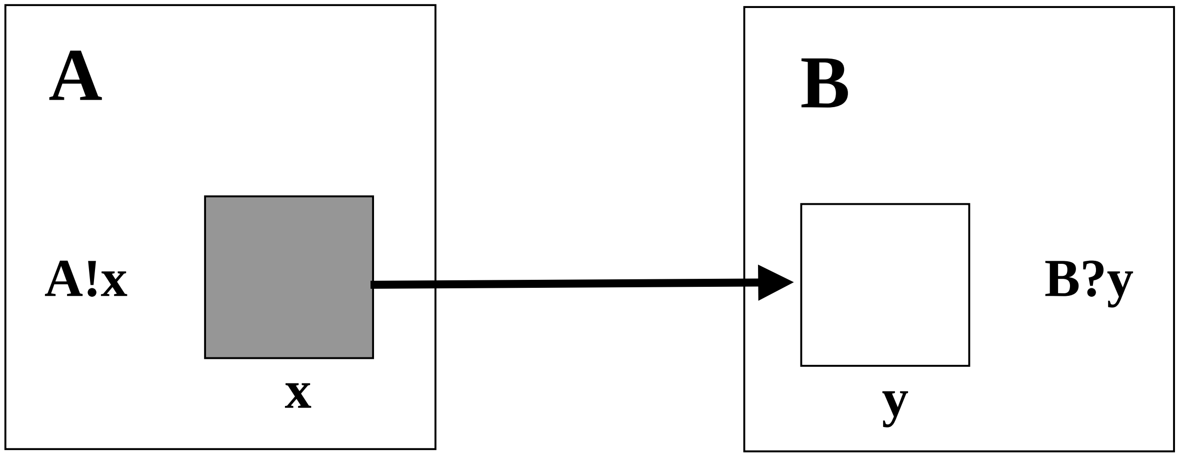
Communicating Sequential Processes (CSP)

operators: **! (send)**

? (receive)

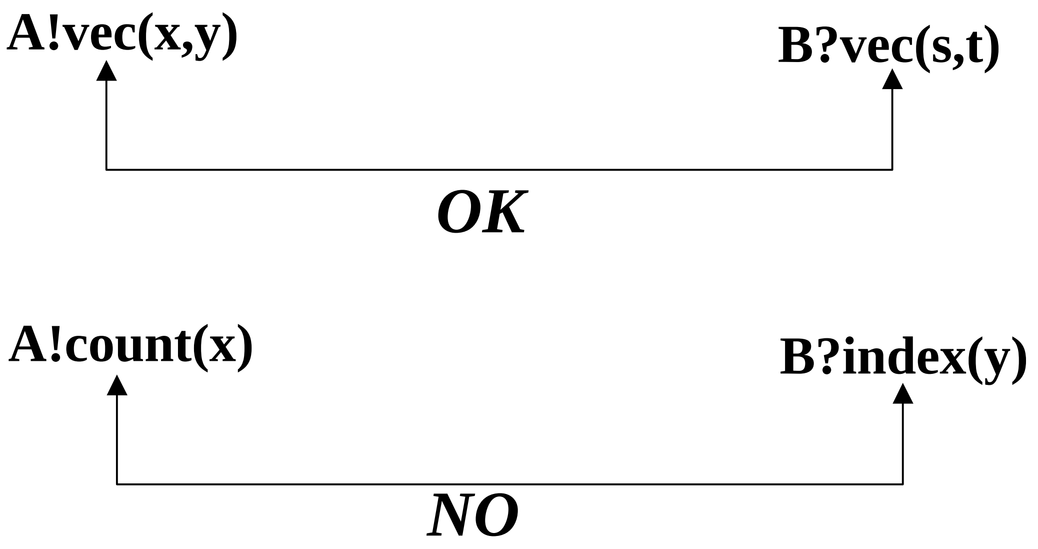
usage:

$$\begin{array}{ccc} \textit{Send to} & & \textit{receive from} \\ \downarrow & & \downarrow \\ \mathbf{A!x} & & \mathbf{B?y} \\ \uparrow & & \uparrow \\ \textit{message} & & \textit{buffer} \end{array}$$



Communicating Sequential Processes (CSP)

- rendezvous semantics: senders (receivers) remain blocked at send (receive) operation until a matching receive (send) operation is made.
- typed messages: the type of the message sent by the sender and the type of the message expected by the receiver must match (otherwise abort).



Communicating Sequential Processes (CSP)

Guarded Commands

<guard> --> <command list>

boolean expression

only one ? , must be at end of guard,
considered true iff message pending

Examples

n < 10 --> A!index(n); n := n + 1;
n < 10; A?index(n) --> next = A(n);

Communicating Sequential Processes (CSP)

Alternative Command

[G1 --> S1 [] G2 --> S2 [] ... [] Gn --> Sn]

1. evaluate <u>all</u> guards

2. if more than on guard is true, <u>nondeterministically</u> select one.

3. if no guard is true, <u>terminate</u>.

Note: if all true guards end with an input command for which there is no pending message, then delay the evaluation until a message arrives. If all senders have terminated, then the alternative command terminates.

Repetitive Command

*** [G1 --> S1 [] G2 --> S2 [] ... [] Gn --> Sn]**

repeatedly execute the alternative command

until it terminates

Communicating Sequential Processes (CSP)

Examples:

```
    [x >= y --> m := x [] y >= x --> m ;+ y ]
    i := 0; * [ i < size; content(i) != n --> i := i + 1 ]
* [ c: character; west?c --> east!c ]
* [ n : integer; X?insert(n) --> INSERT
    []
    n : integer; X?has(n) --> SEARCH; X!(i < size) ]

BoundedBuffer::
    buffer: (0..9) portion;
    in, out : integer; in := 0; out := 0;
    * [ in < out + 10; producer?buffer(in mod 10)
             --> in := in + 1;
          []
          out < in; consumer?more()
             --> consumer!buffer(out mod 10);
              out := out + 1;
    ]
```

ADA Example

```
task bounded-buffer is
    entry store(x : buffer);
    entry remove(y: buffer);
end;
task body bounded-buffer is
...declarations...
begin
  loop
      select
            when head < tail + 10 =>
            accept store(x : buffer) ... end store;
      or
            when tail < head =>
            accept remove(y: buffer) ... end remove;
      end select;
  end loop
end
```