

# Synchronous Message Passing

## CSE 6490A

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# Communicating Sequential Processes (CSP)

C.A.R. Hoare. Communicating sequential processes. *Communications of the ACM*, 21(8):666-677, August 1978.



sir Charles Antony Richard (Tony) Hoare

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# Syntax of CSP

CSP has static process creation.

```
[name :: command || ... || name :: command]
```

CSP uses synchronous message passing to communicate.

- Receive command  
name?pattern
- Send command  
name!expression

# Communication in CSP

$[sender :: receiver!(1,2) \parallel receiver :: sender?(1,x)]$

As a result of the communication, the variable  $x$  is assigned the value 2.

$[\text{sender} :: \text{receiver}!(1,2) \parallel \text{receiver} :: \text{sender}?(3,x)]$

No communication takes place since the expression  $(1,2)$  does not match the pattern  $(3,x)$ .

Conditional command

$[guard \rightarrow command \square \dots \square guard \rightarrow command]$

guard

- Boolean expression
- receive command
- Boolean expression ; guard



Iteration command

\*[guard  $\rightarrow$  command  $\square$   $\dots$   $\square$  guard  $\rightarrow$  command]

guard

- Boolean expression
- receive command
- Boolean expression ; guard

# Examples in CSP

Express a semaphore and a process using that semaphore to protect its critical section.

# Examples in CSP

Express the consumer-producer problem. The producer produces the integers  $1, \dots, 100$  and the consumer prints the integers it consumes.

# Examples in CSP

What is wrong with

```
phil(i) ::  
*[THINK;  
  fork(i)!pickup(); fork((i+1) mod N)!pickup();  
  EAT;  
  fork(i)!putdown(); fork((i+1) mod N)!putdown();]
```

```
fork(i) ::  
*[  phil(i)?pickup()  
    → phil(i)?putdown()  
  □  phil((i-1) mod N)?pickup()  
    → phil((i-1) mod N)?putdown();]
```

The sieve of Eratosthenes is a simple, ancient algorithm for finding all prime numbers up to a specified integer.



Eratosthenes