CoE 165

Lecture 9
12 November 2024

Modeling with state machines

- How to use FSM to represent systems
  - ↳ systematic analysis
  - ↳ manipulate → simulate
- model the environment

- how to use FSM models to make bigger systems
- check if the system satisfies / meets specifications

Composition of State Machines

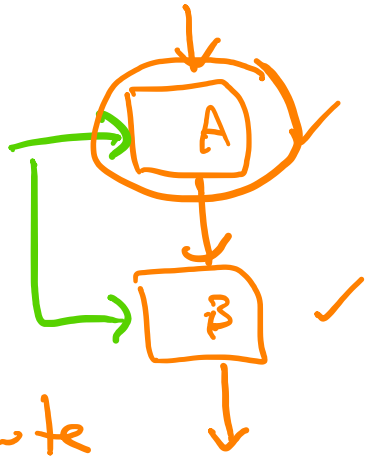
- How do we construct complex state machines out of simpler blocks

- make up class → wait for arrivals

2 kinds of composition

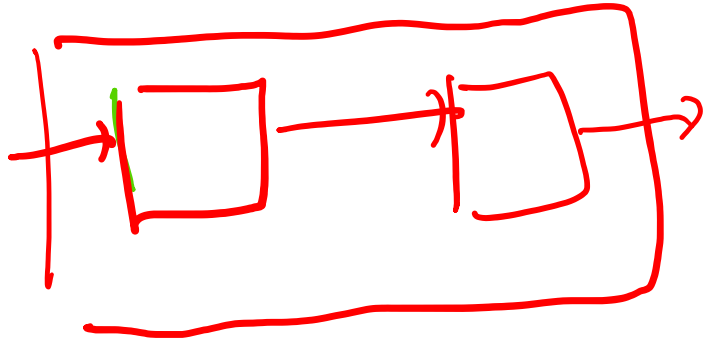
1. spatial → how do the components communicate

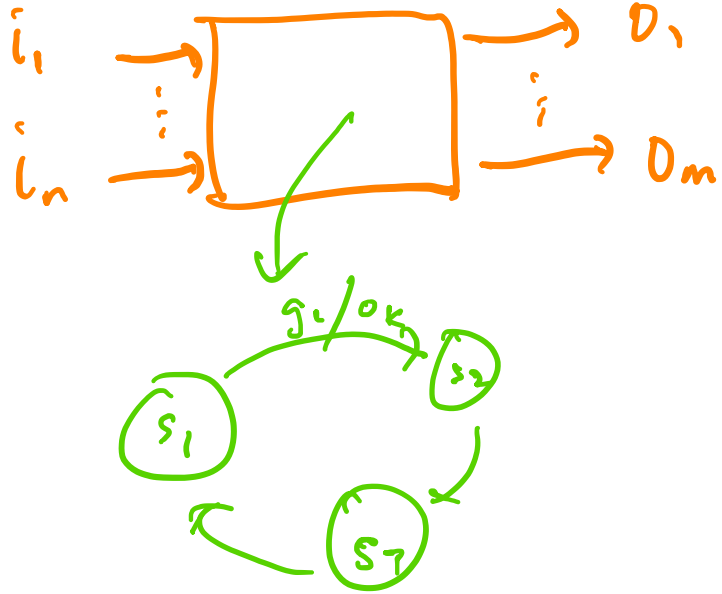
2. temporal → when do they execute relative to each other



Actor Models

- inputs / outputs





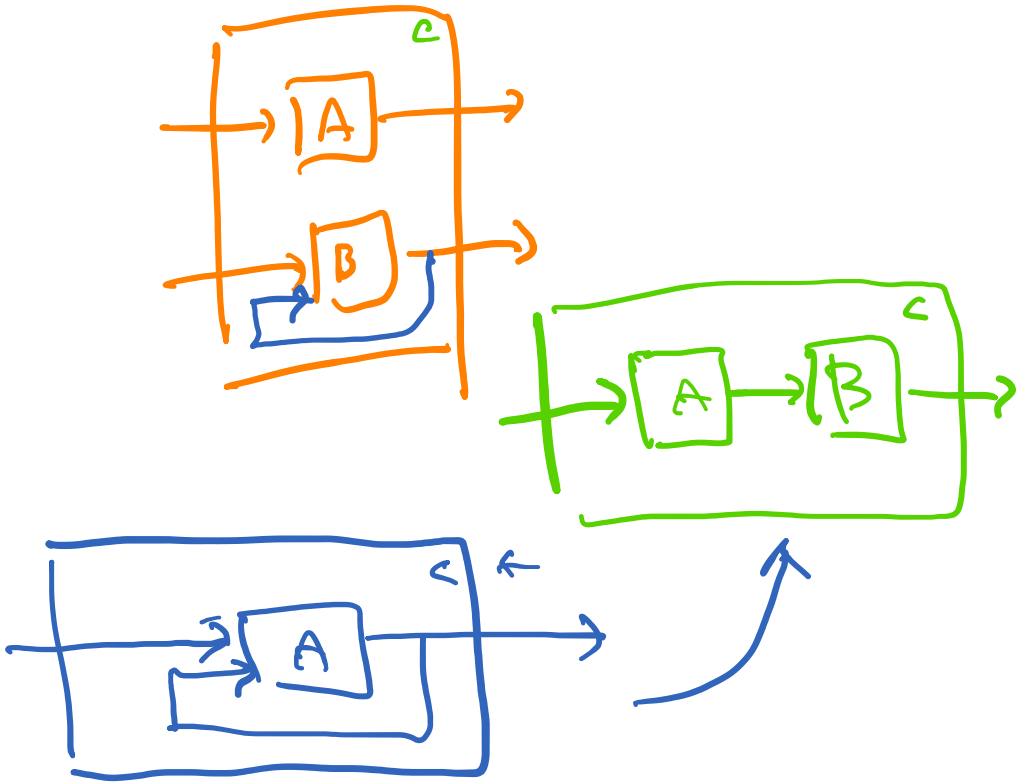
→ compose / build layer blocks

Spatial Composition

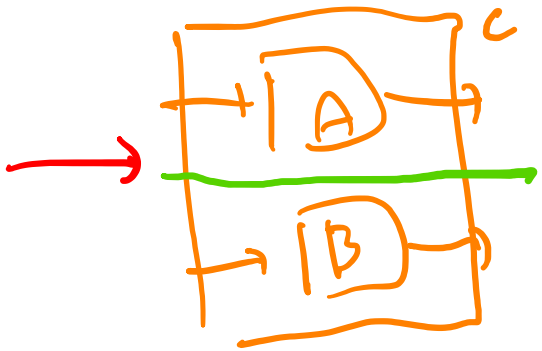
1. side-by-side
   → no information exchange

2. cascade

3. feedback



Side-by-Side Composition

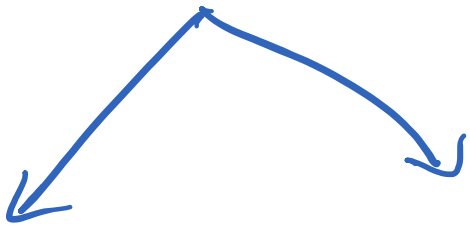


time? → when do these machines react?

"Model of Computation" → how the reactions of composed FSM is coordinated

Temporal Composition of FSMs

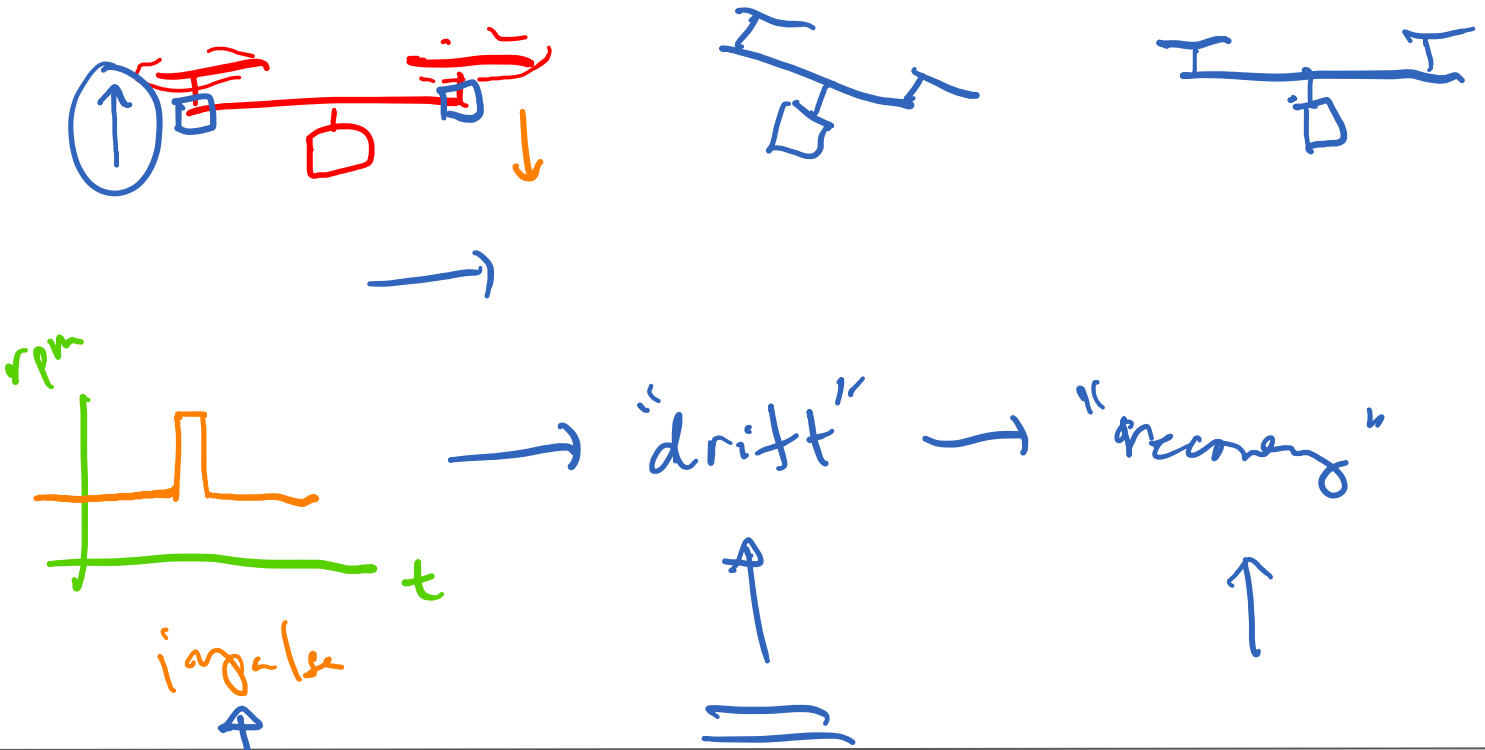
1. Sequential vs. concurrent (parallel)



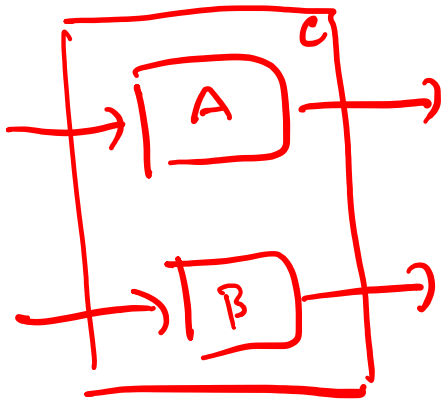
asynchronous
↳ independent

synchronous
↳ lock-step

Sequential Composition



Side-by-side, parallel composition



set-def'n of FSM

$A = \{S_A, I_A, O_A, u_A, i_A\}$

$B = \{S_B, I_B, O_B, u_B, i_B\}$

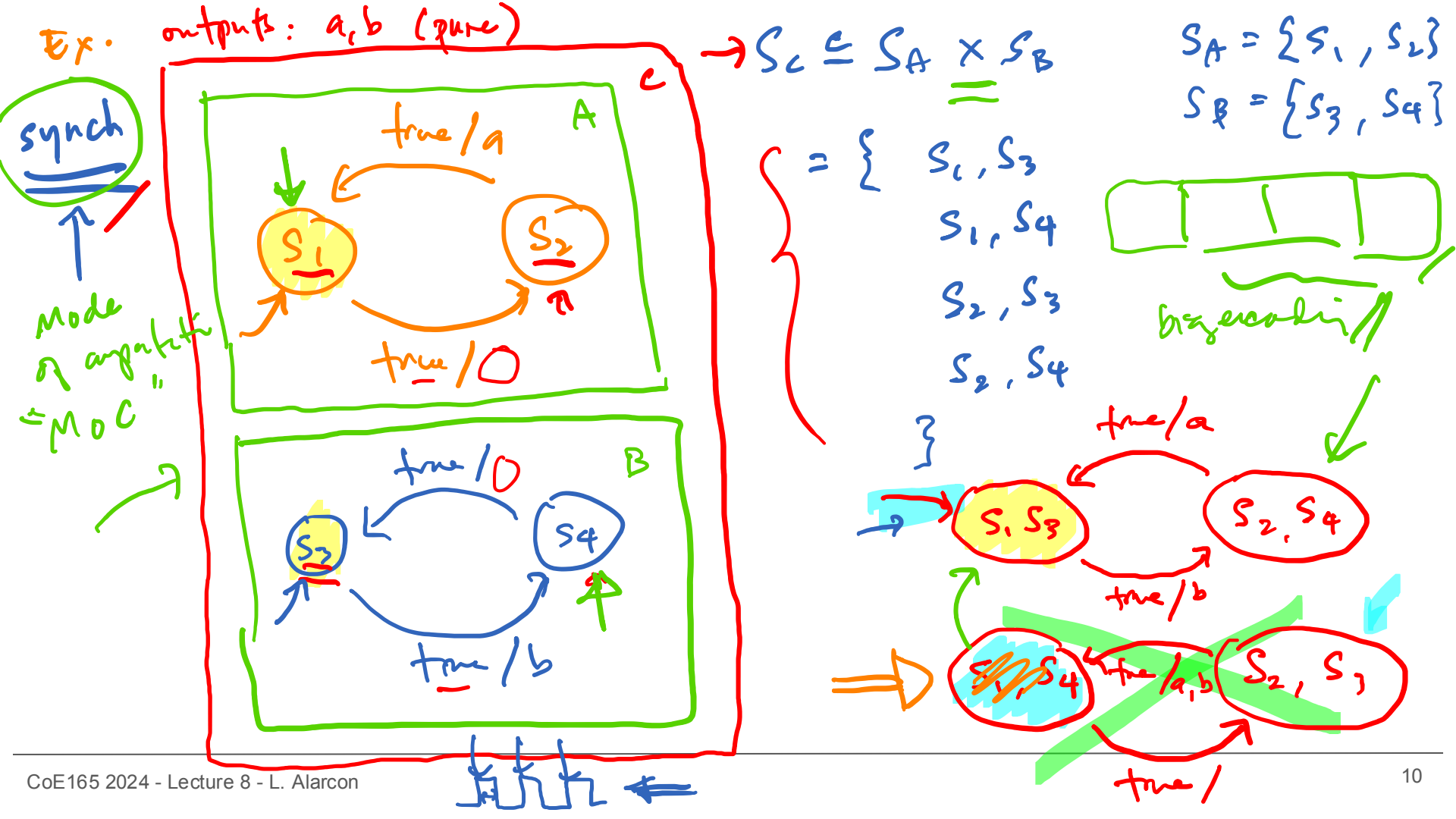
$S_C \subseteq S_A \times S_B$

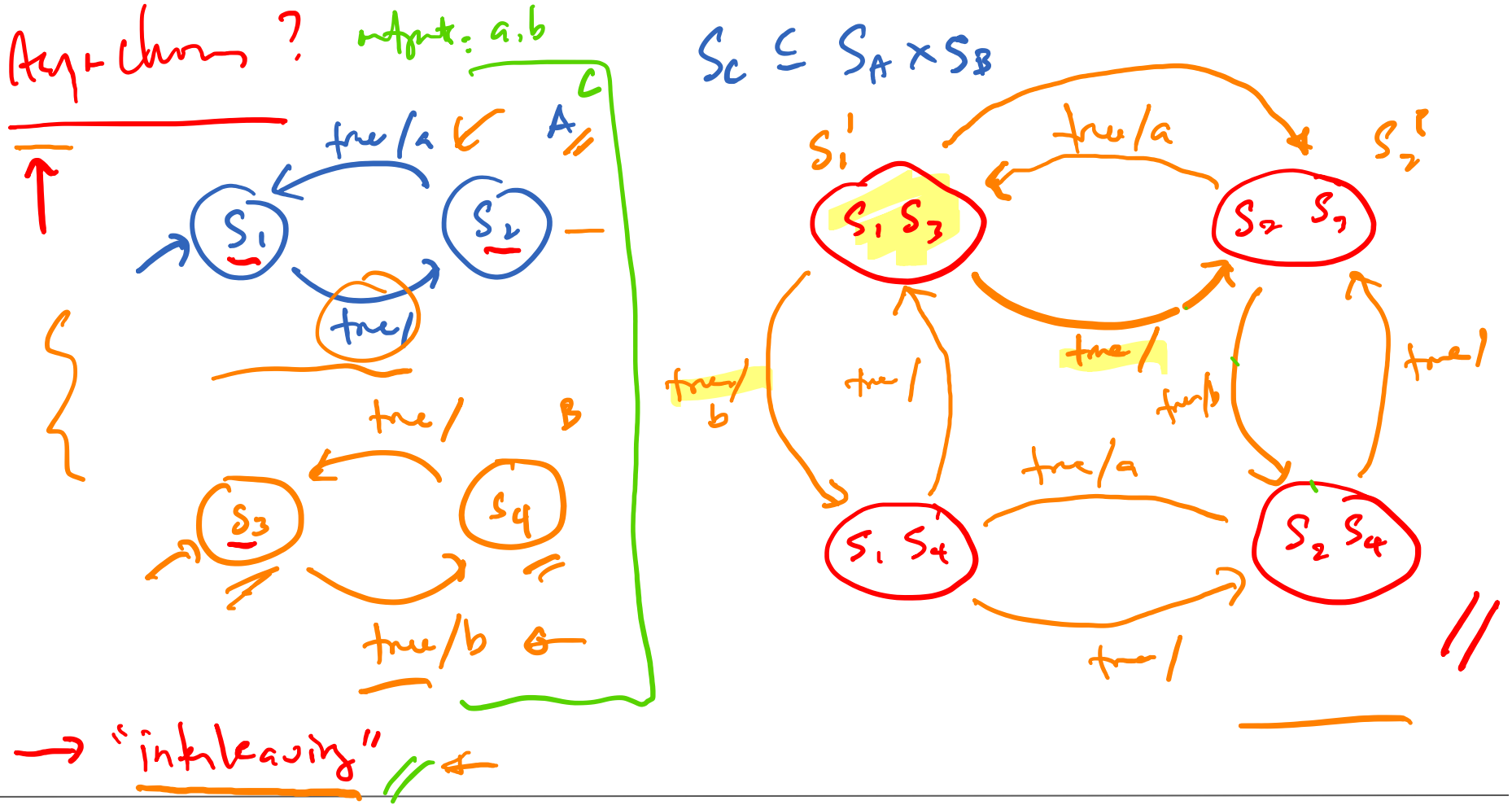
When do these machines react?

2 possibilities:

1) together, in lock-step (synch, concurrent)

2) independently (asynch, concurrent)


Ex.
outputs: a, b (pure)
synch
Mode
= MoC
C
A
true/a
S1
S2
true/0
B
true/0
S2
S4
true/b
$S_C \subseteq S_A \times S_B$
$S_A = \{S_1, S_2\}$
$S_B = \{S_3, S_4\}$
$= \{ S_1, S_3 \; S_1, S_4 \; S_2, S_3 \; S_2, S_4 \}$
bisimulation
true/a
S1, S3
S2, S4
true/b
S1, S4
true/a,b
S2, S3
true/


Async chans ?
output: a, b
C
A
true/a
S1
S2
true
B
true
S3
S4
true/b
Sc ⊆ SA × SB
S1'
S2'
true/a
S1 S3
S2 S1
true
true
true
true/b
true
true/a
S1 S4
S2 S4
true
"interleaving"