Open-Source Simulation with Ciw

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Beale Lecture, February 2021

- Reproducibility in simulation
- Detecting deadlock
- Extending Ciw
- Applications of Ciw

Reproducibility

- R^1: Re-runnable
- R^2: Repeatable
- R^3: Reproducible
- R^4: Reusable

2018. *Benureau, FCY., ac Rougier, NP.*. **Re-run, Repeat, Reproduce, Reuse, Replicate: Transforming Code into Scientific Contributions**. Frontiers in neuroinformatics.

- 2013. *Sandve, GK., et al.*, **Ten simple rules for reproducible computational research**. PLoS Comput Biol 9(10)
- 2014. *Wilson, G., et al.*, **Best practices for scientific computing**. PLoS Biol 21(1)

- Automate!
- Readability
- Access
- Collaboration
- Testing
- Version control

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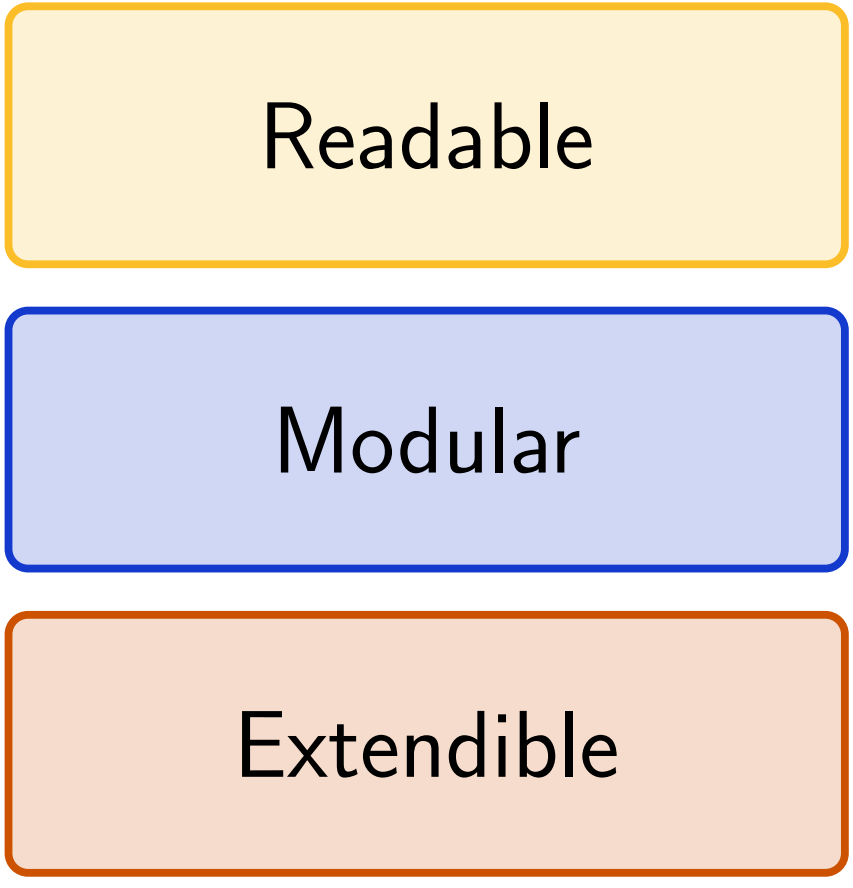
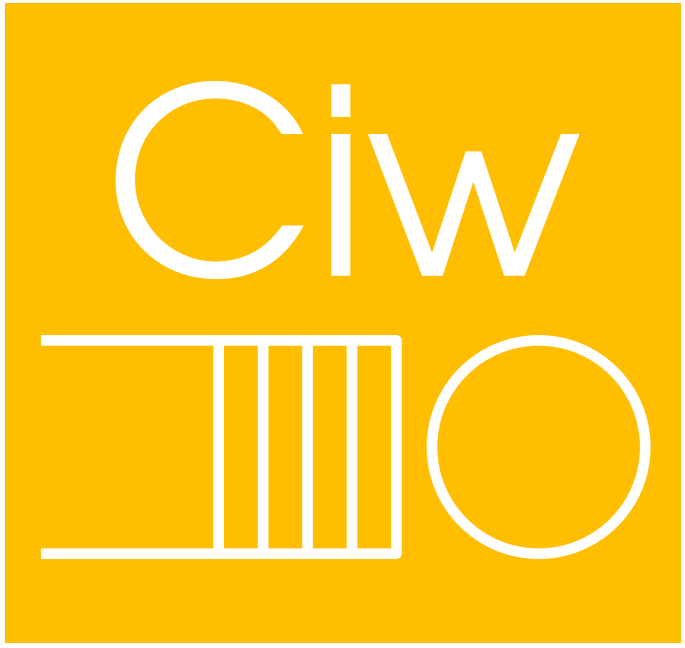
• 2014. *Wilson, G., et al.*, **Best practices for scientific computing**. PLoS Biol 21(1)

- Automate!
- Readability
- Access
- Collaboration
- Testing
- Version control

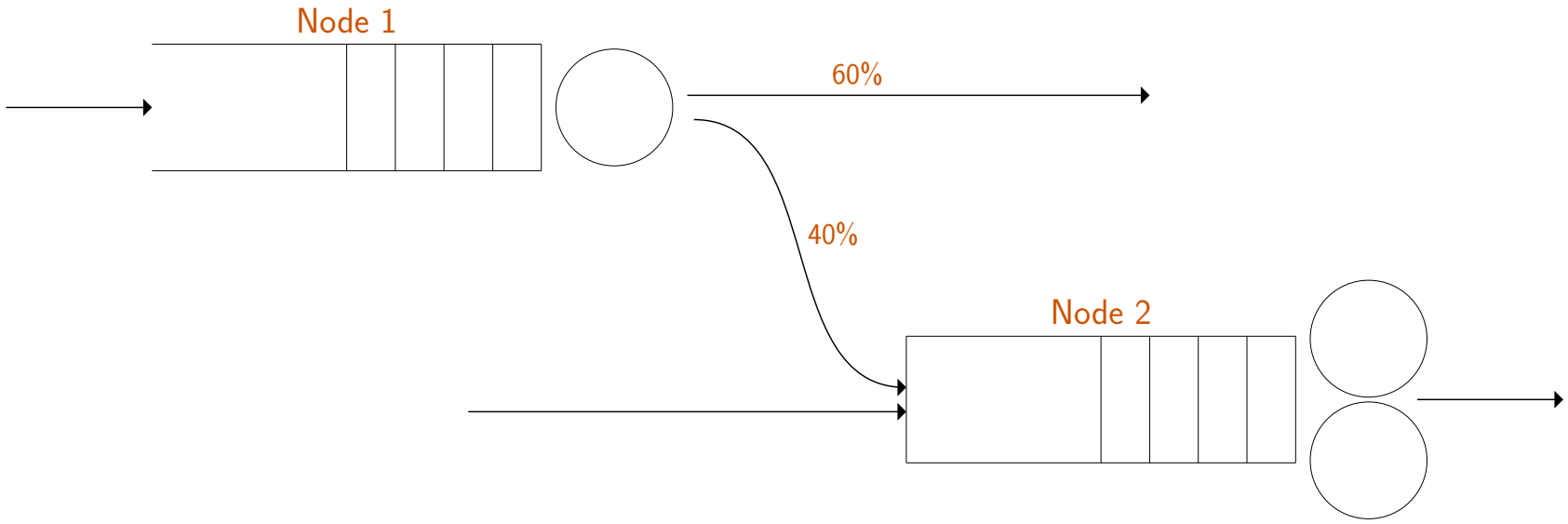


2001. *Kilgore, RA.*. **Open source simulation modeling language (sml)**. In Proceedings of the 33nd conference on Winter simulation (pp. 607–613).

https://ciw.readthedocs.io/
https://github.com/CiwPython/Ciw
`pip install ciw`

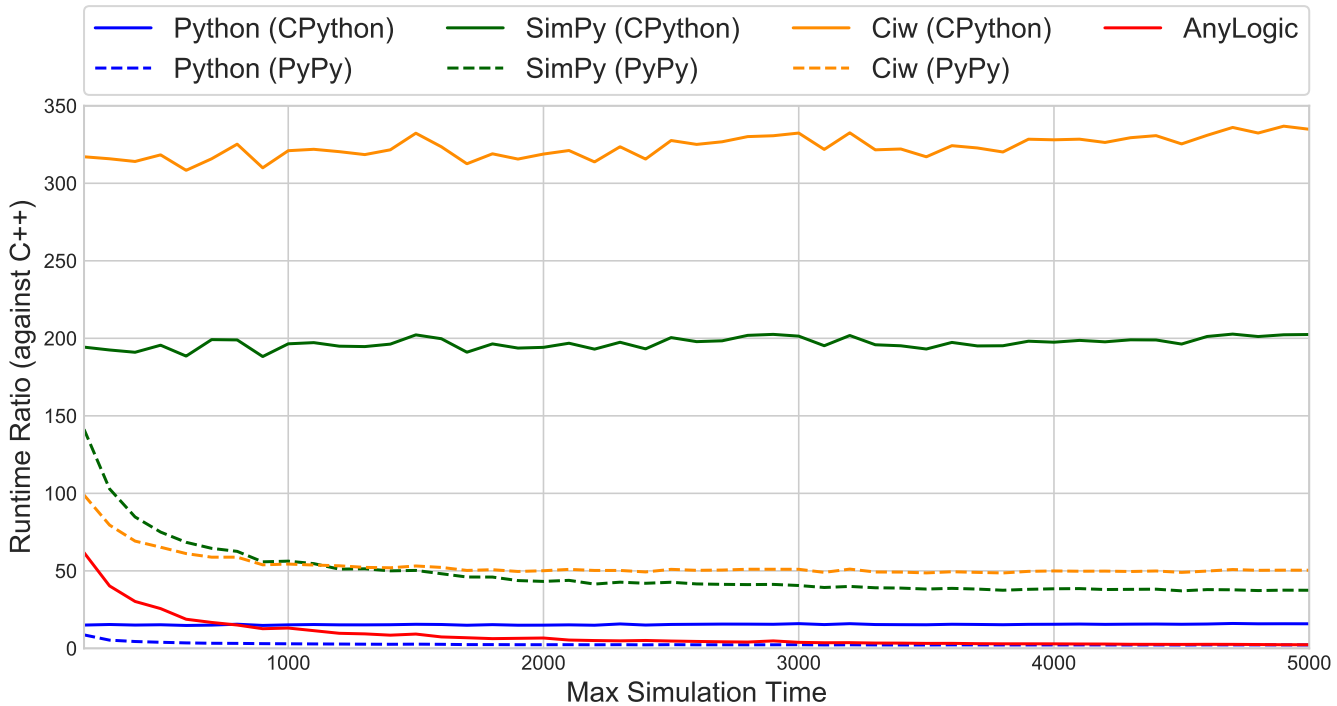


2019. *Palmer, GI., Knight, VA., Harper, PR., and Hawa, AL.*. **Ciw: An Open Source Discrete Event Simulation Library**. Journal of Simulation 13(1) (pp. 68-82).

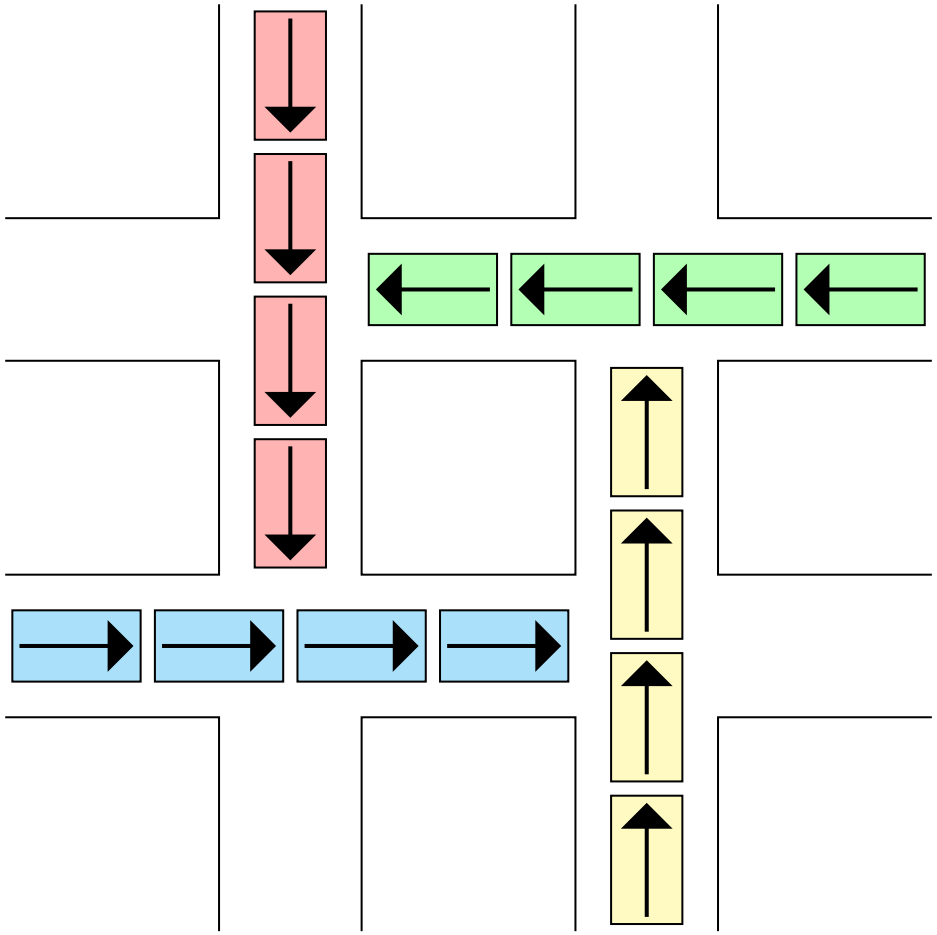


Node 1
External arrivals: Expon(4)
Services: Uniform(0.1, 0.3)
Number servers: 1
Queueing capacity: ∞

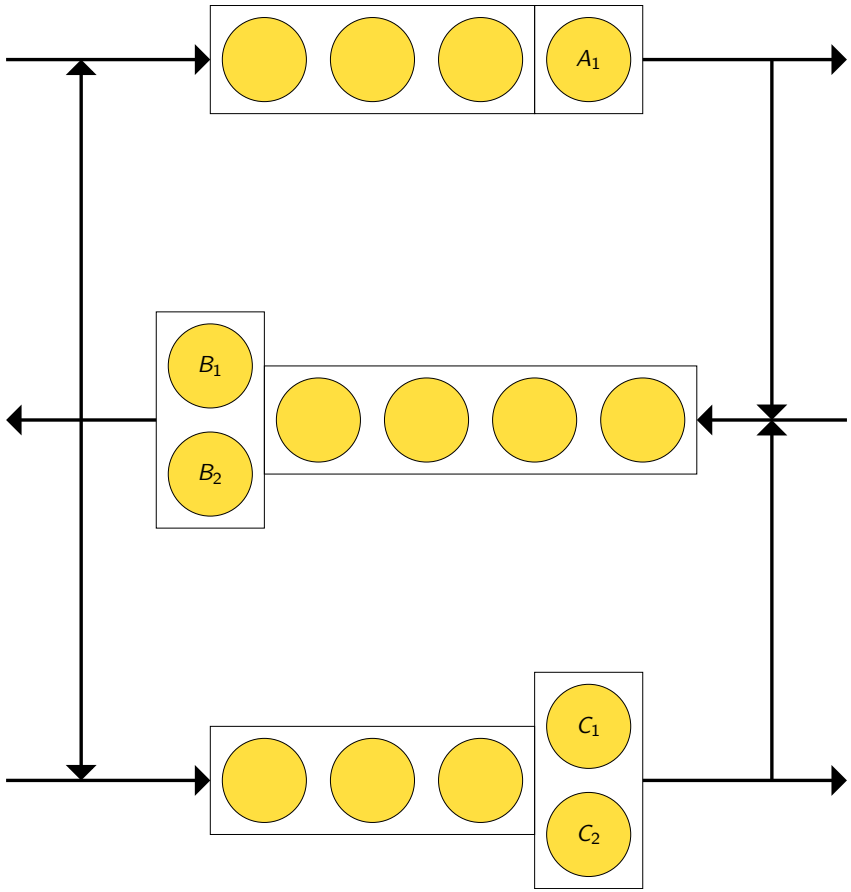
Node 2
External arrivals: Deterministic(1)
Services: Deterministic(1)
Number servers: 2
Queueing capacity: 1


Python (CPython)
Python (PyPy)
SimPy (CPython)
SimPy (PyPy)
Ciw (CPython)
Ciw (PyPy)
AnyLogic
Runtime Ratio (against C++)
0
50
100
150
200
250
300
350
1000
2000
3000
4000
5000
Max Simulation Time

Deadlock



2018. *Palmer, GI., Harper, PR., and Knight, VA.*. **Modelling Deadlock in Open Restricted Queueing Networks**. European Journal of Operational Research 266(2) (pp. 609-621).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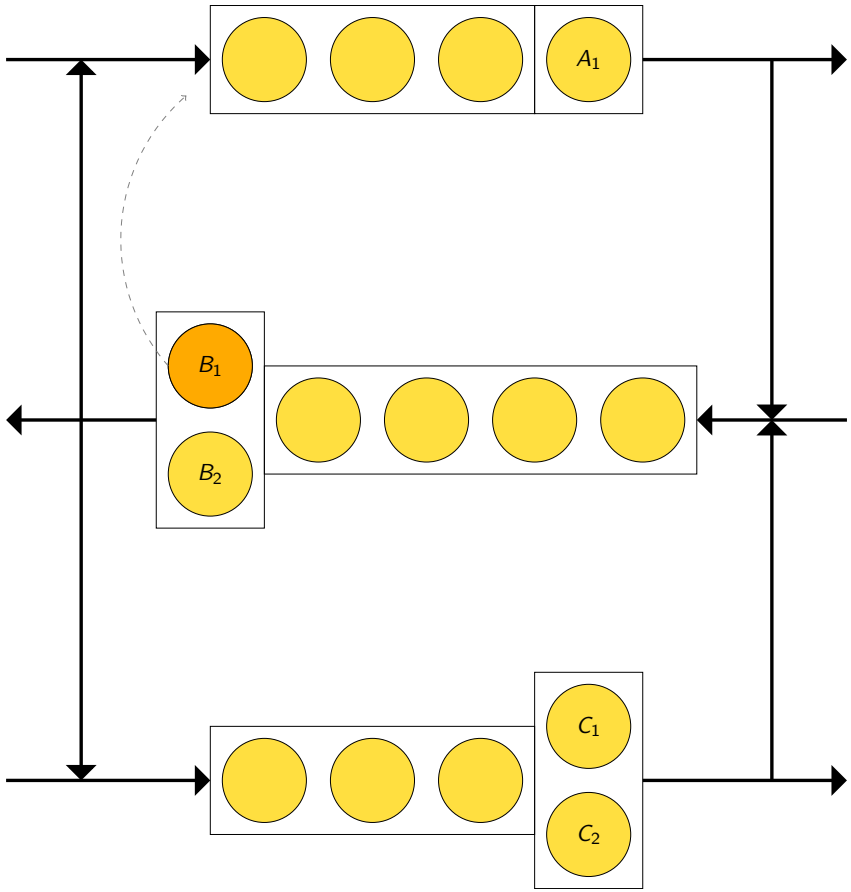
B_1
B_2
C_1
C_2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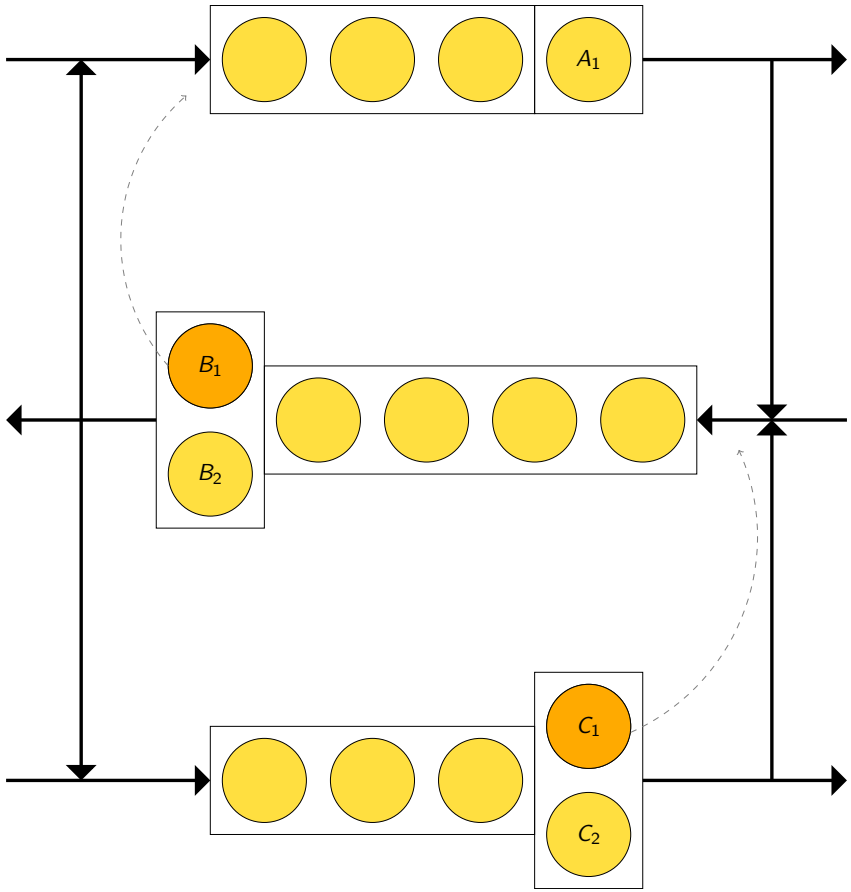
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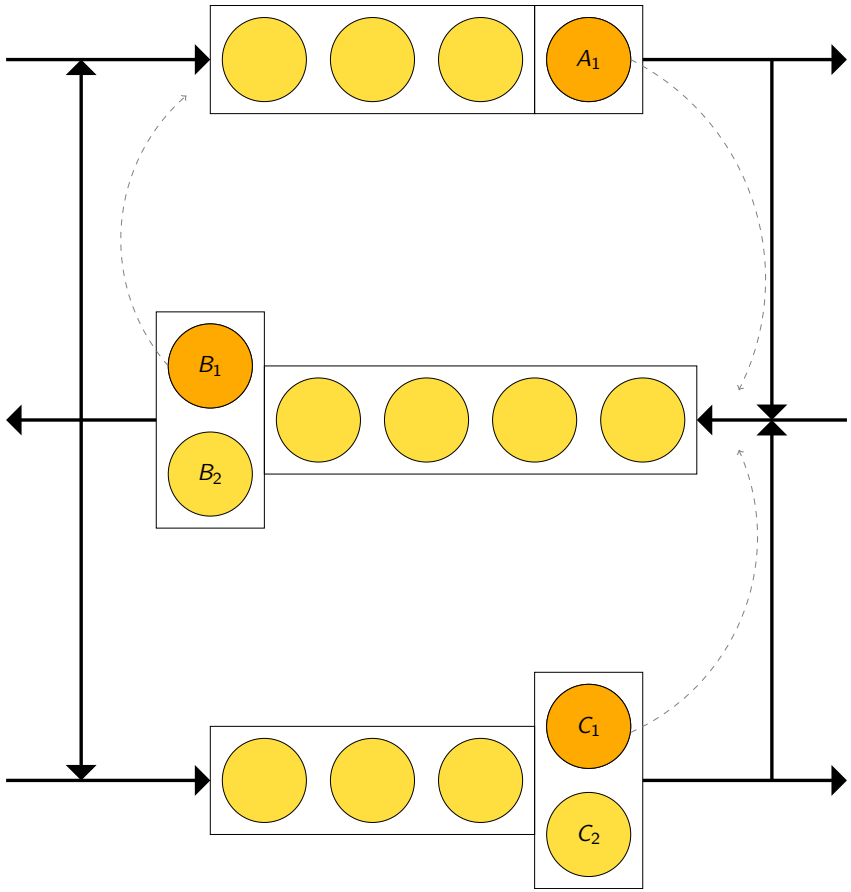
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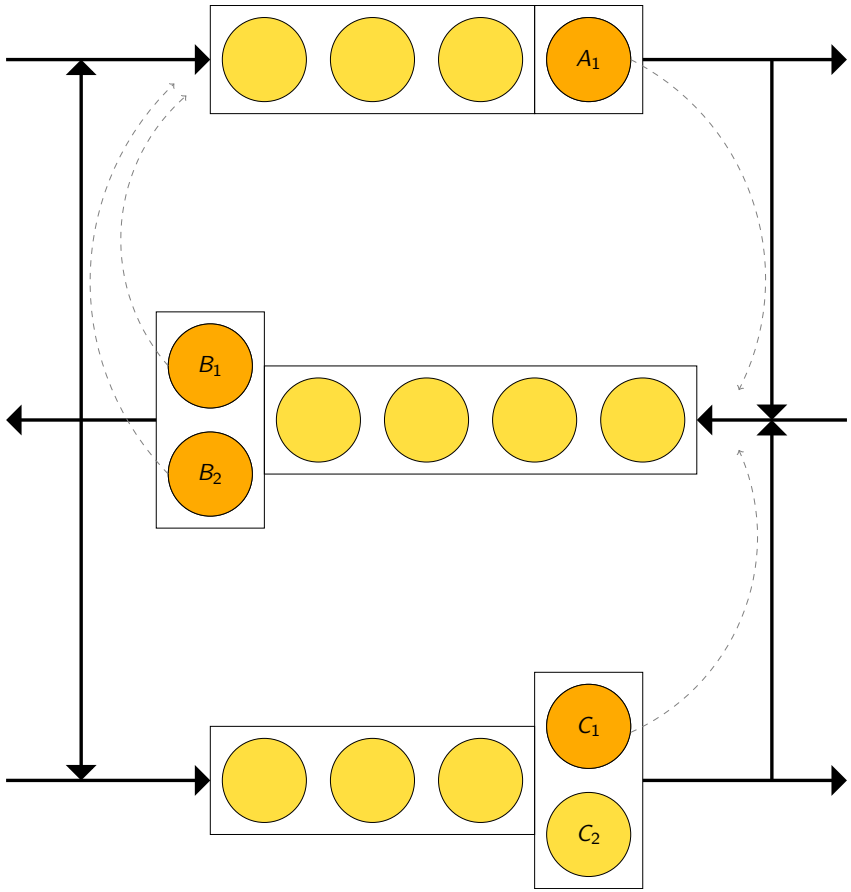
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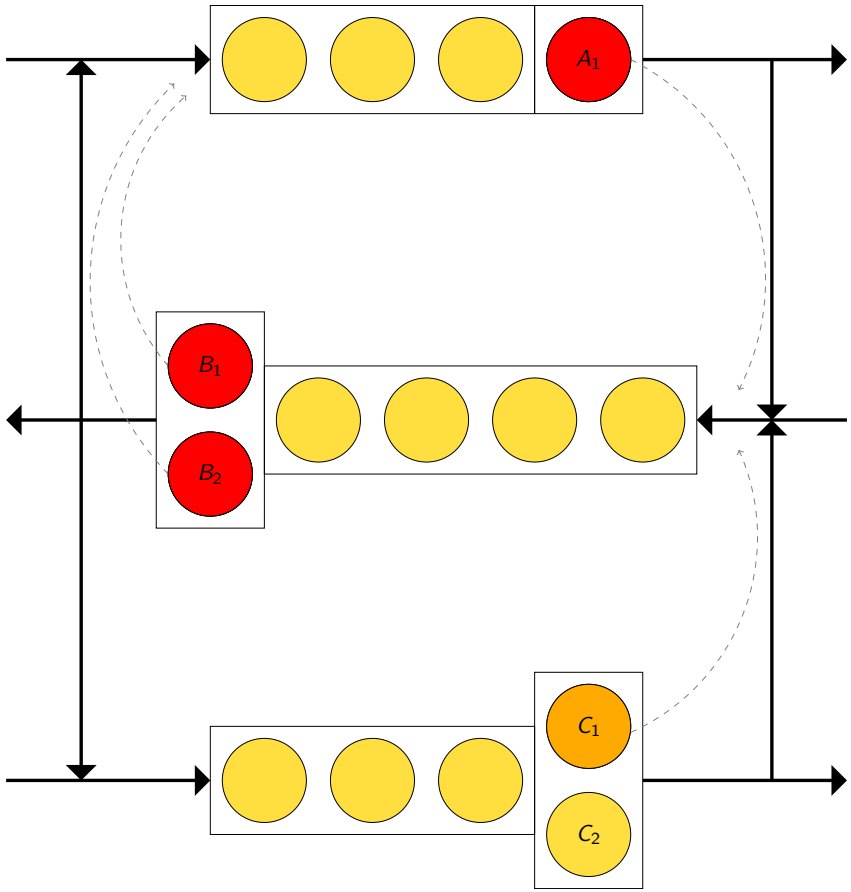
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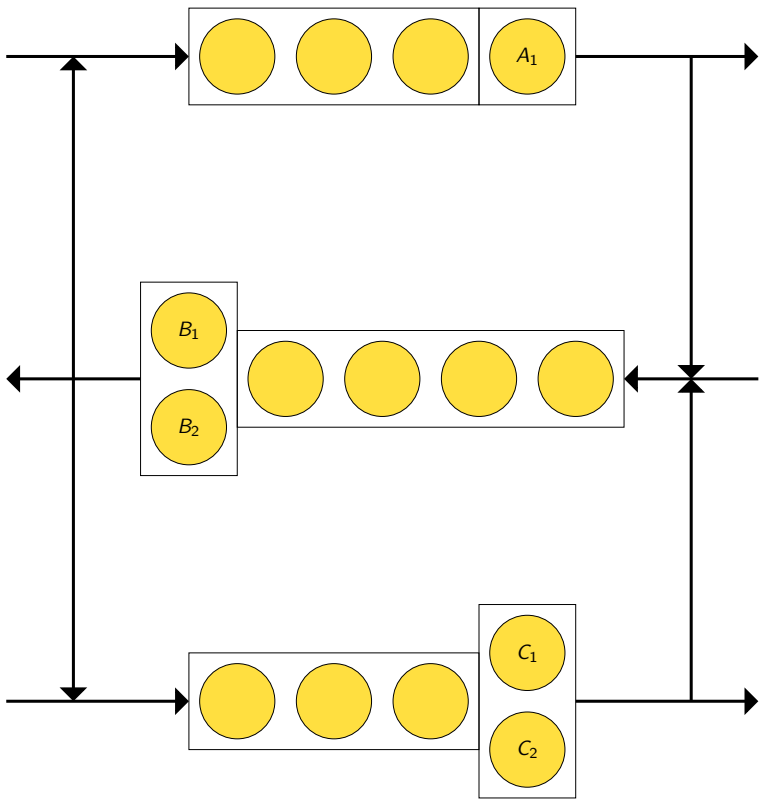
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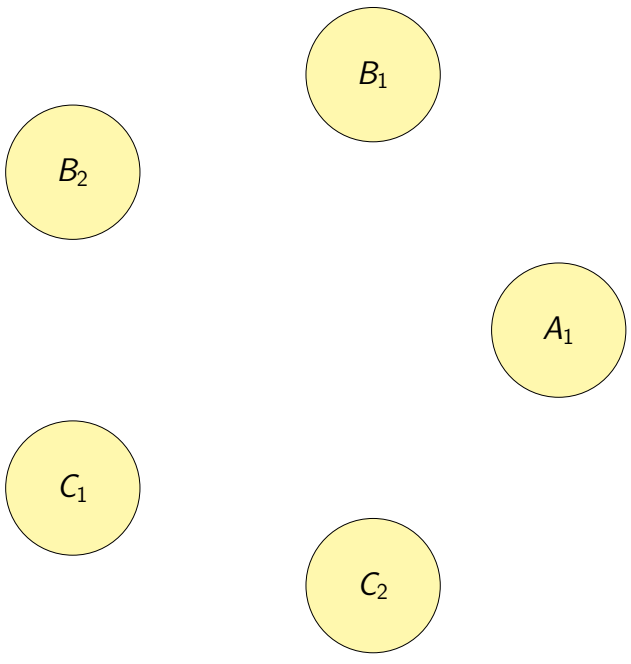
C_1
C_2


B_1
B_2
A_1
C_1
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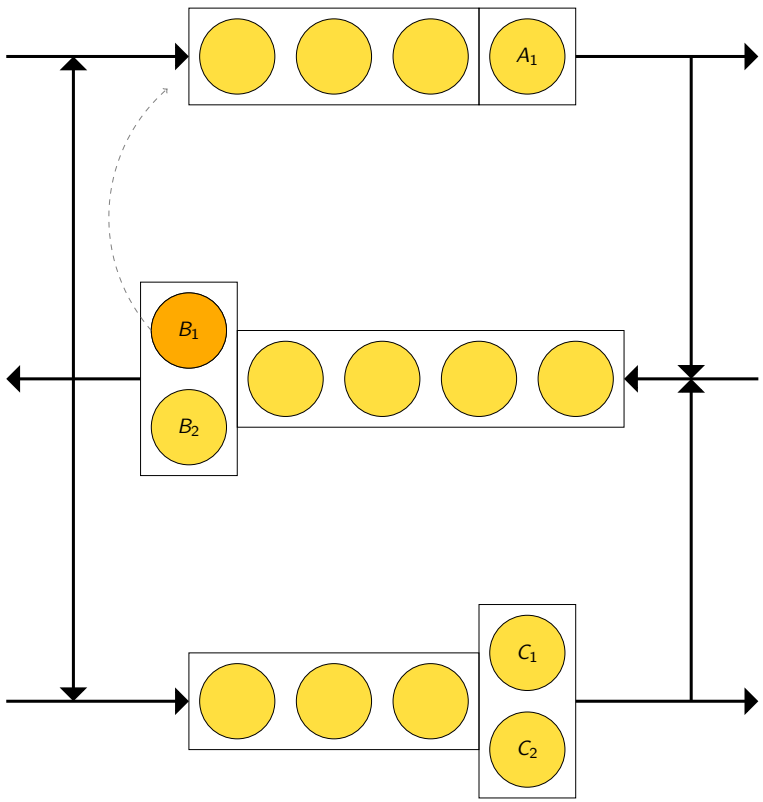
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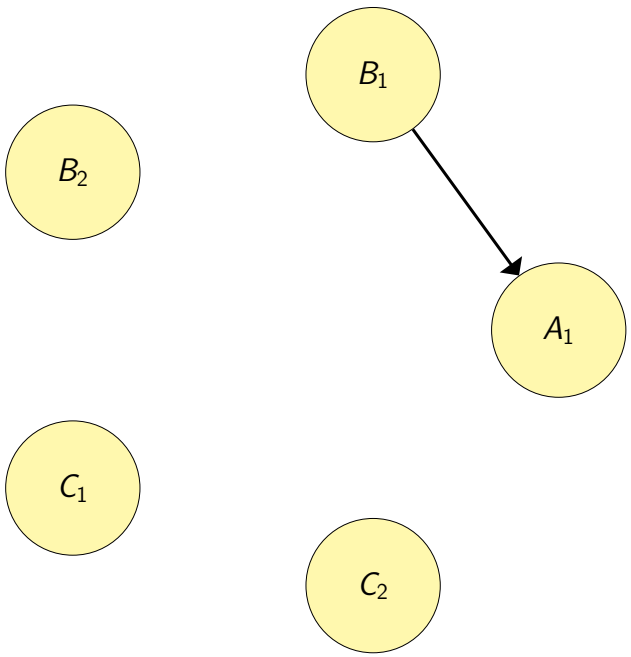
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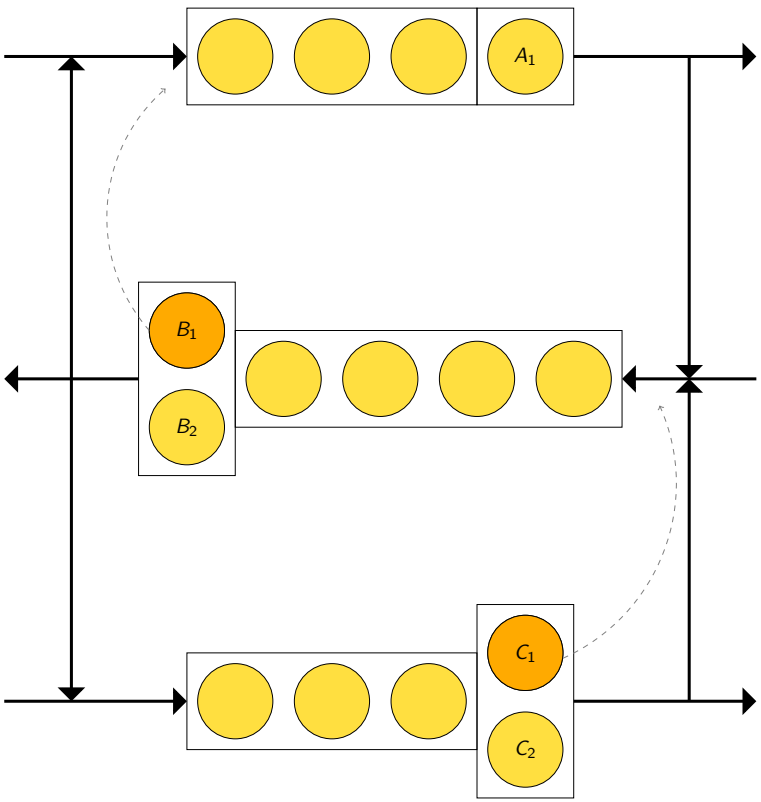
A_1
C_1
C_2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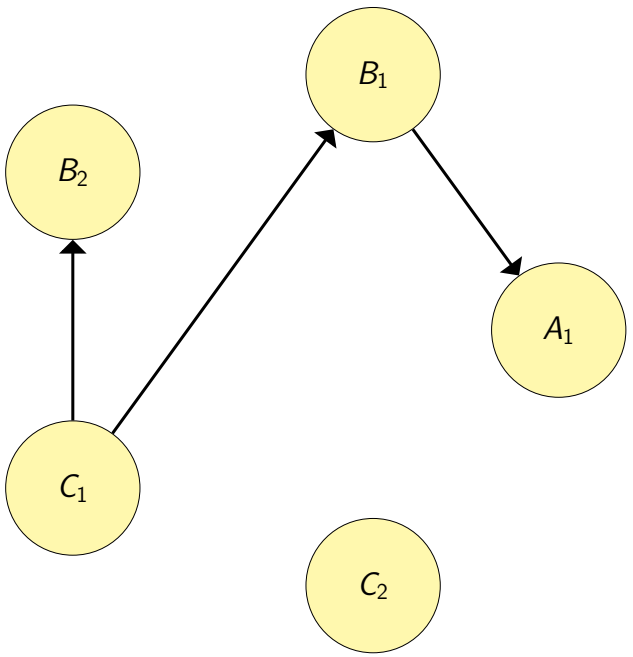
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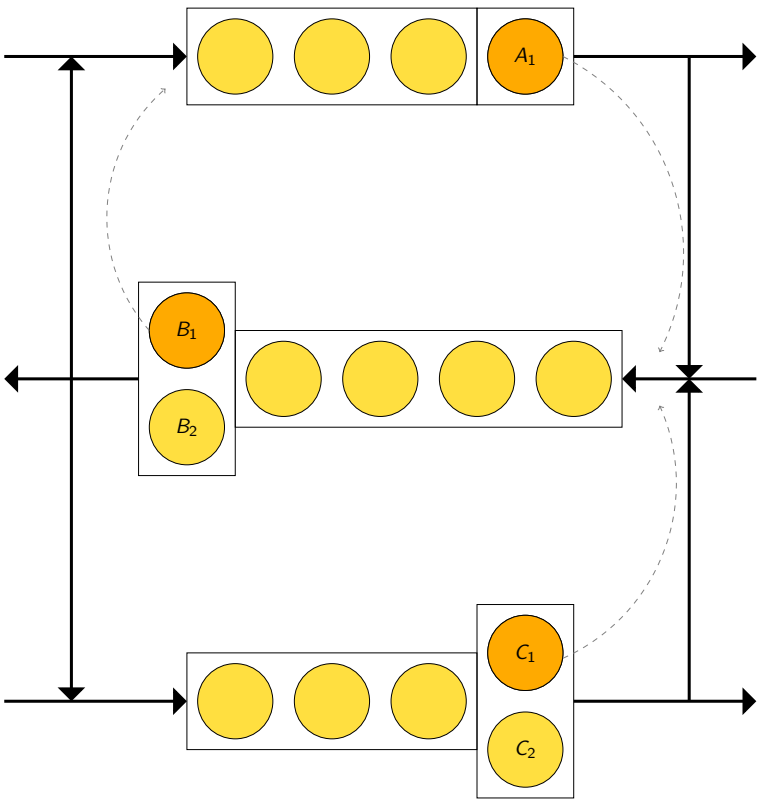
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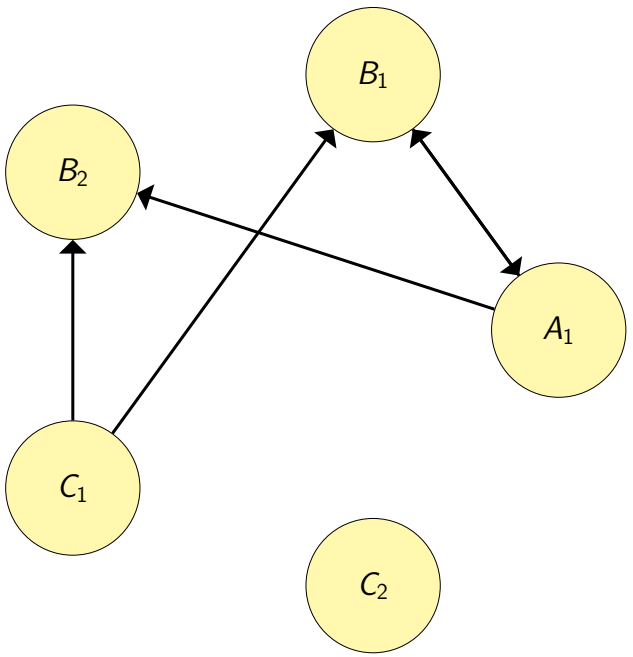
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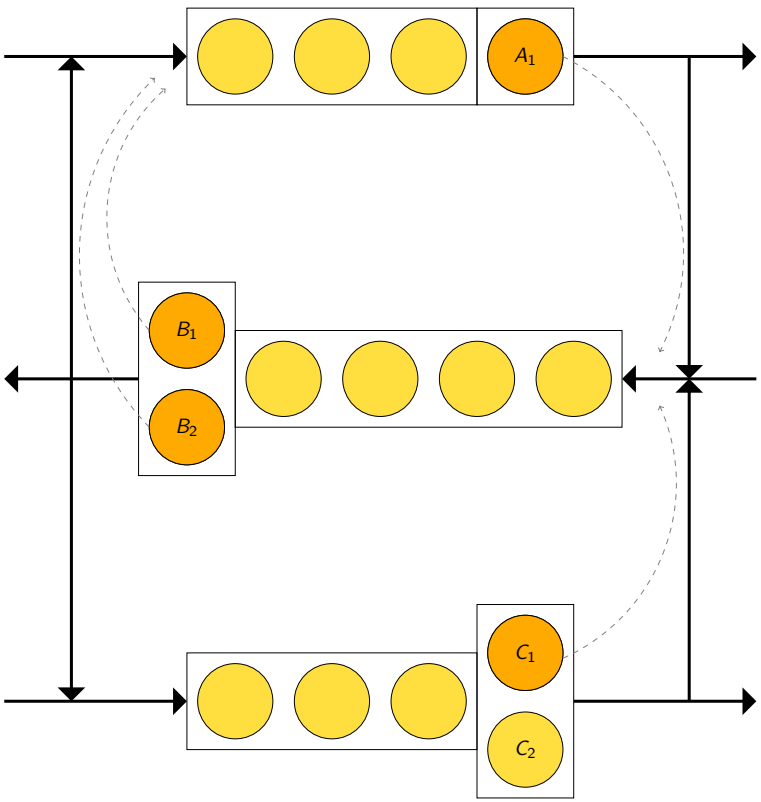
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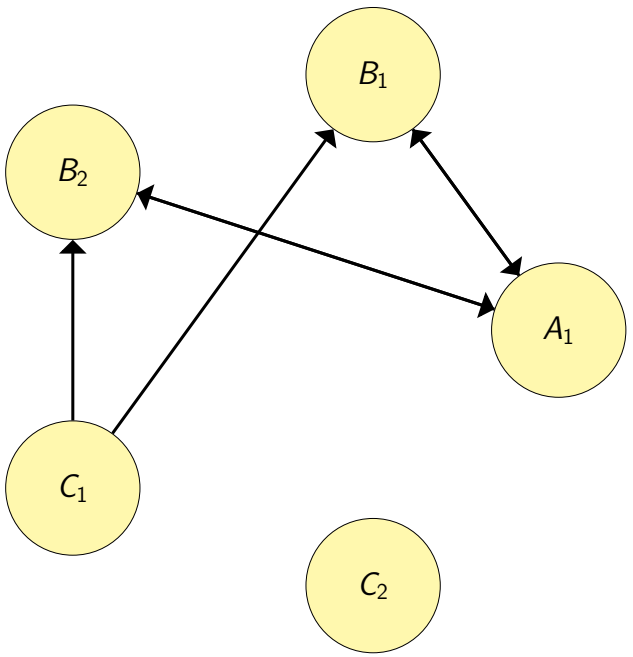
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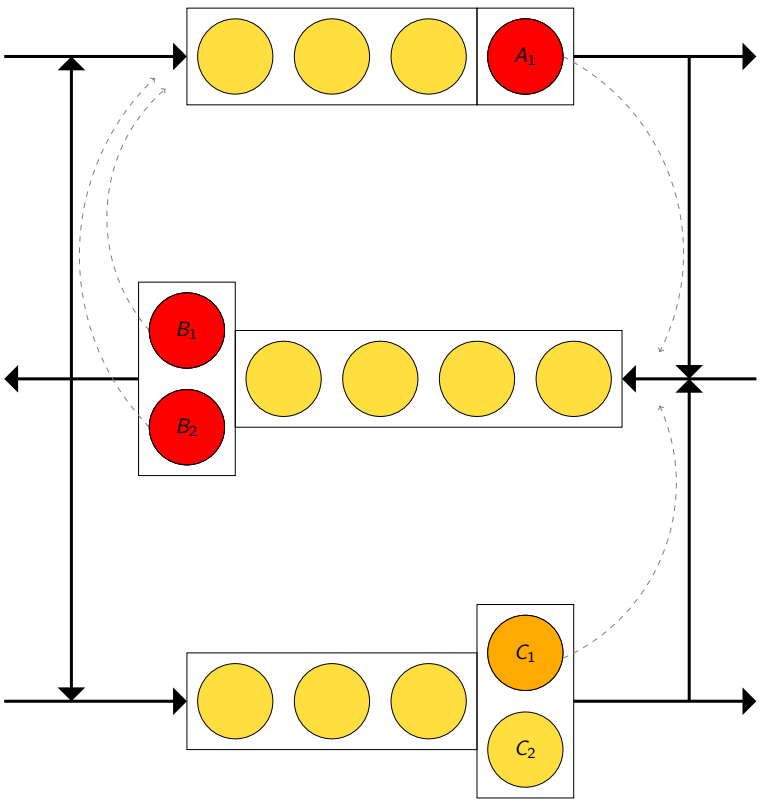
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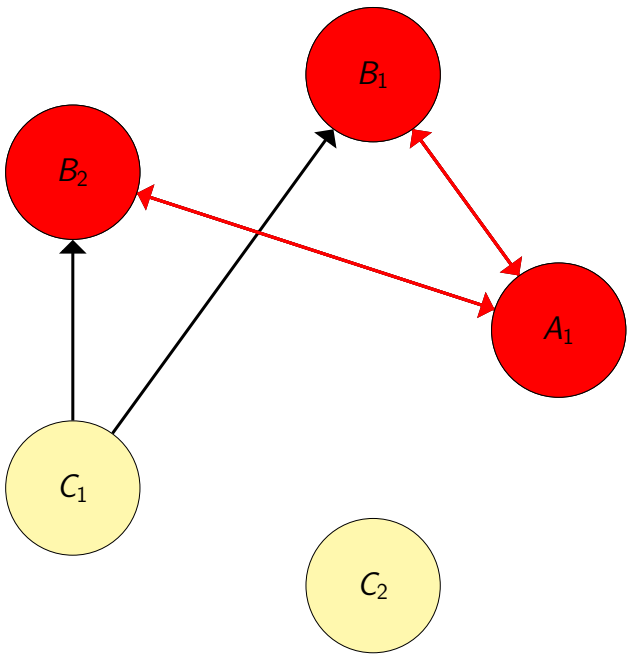
B_1
B_2
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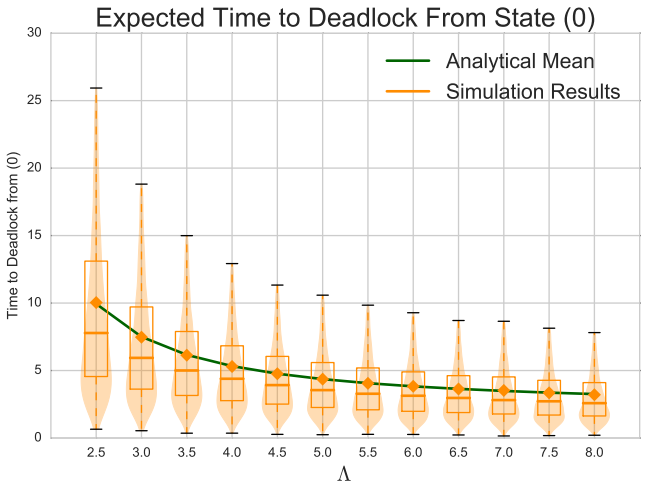
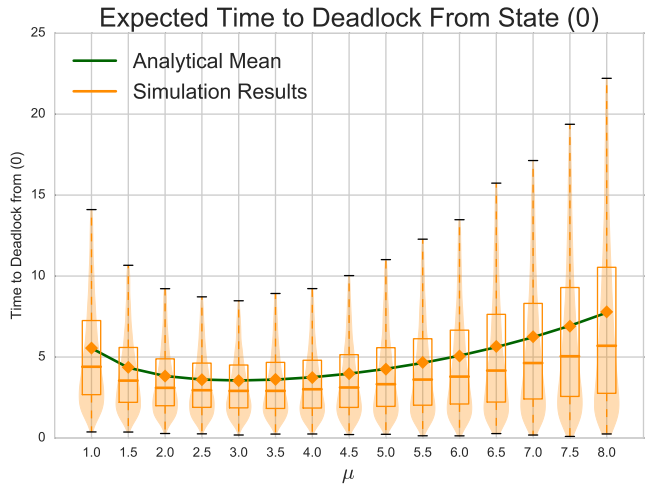
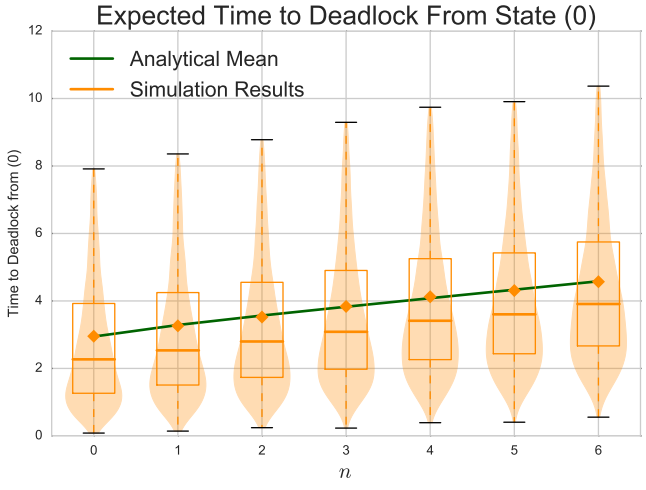
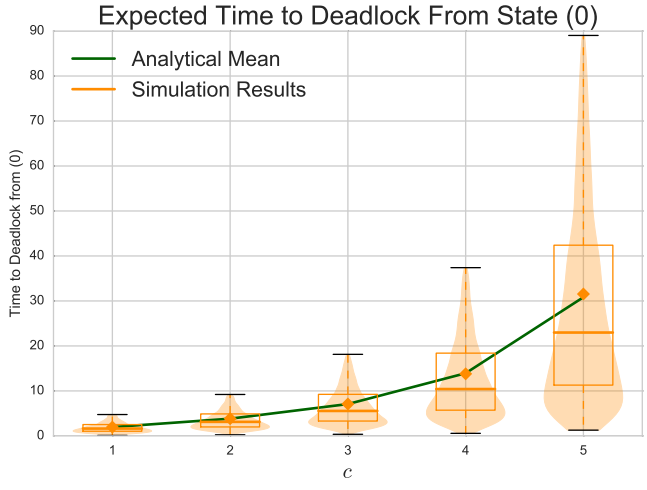
Times to Deadlock

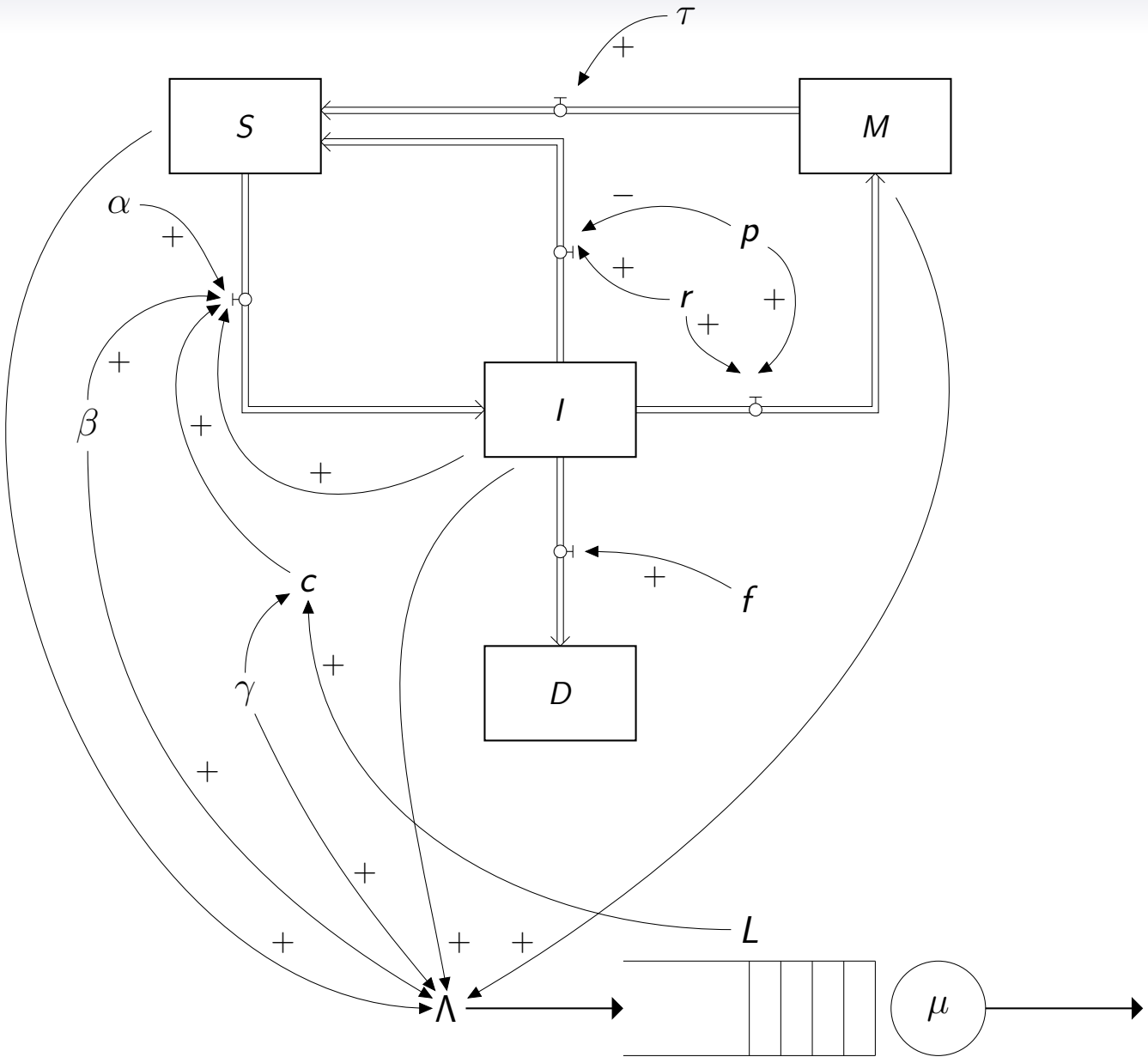








Extendible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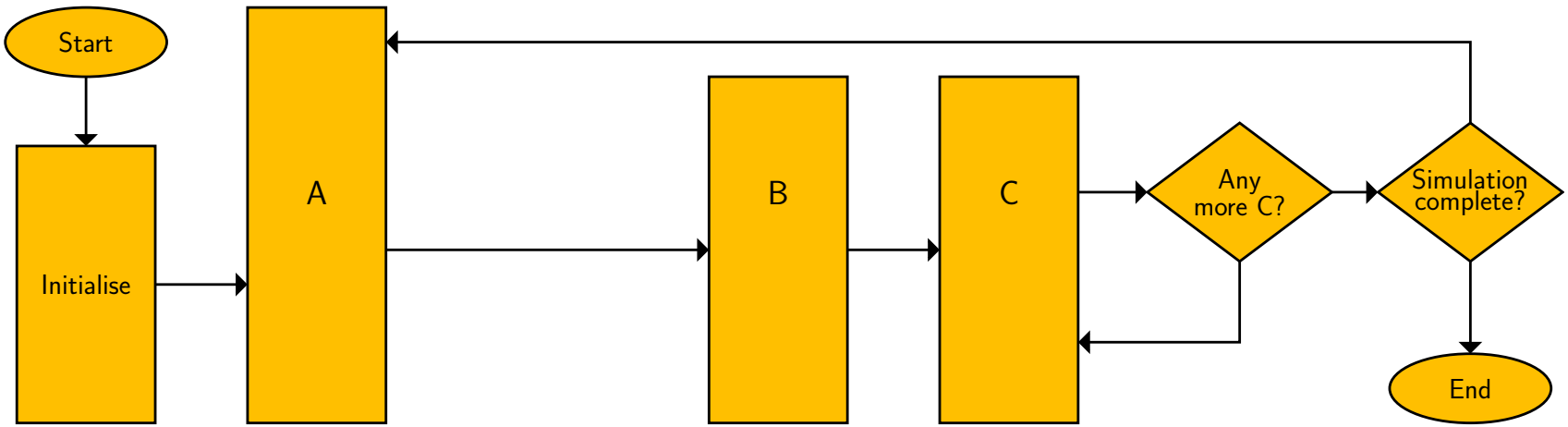
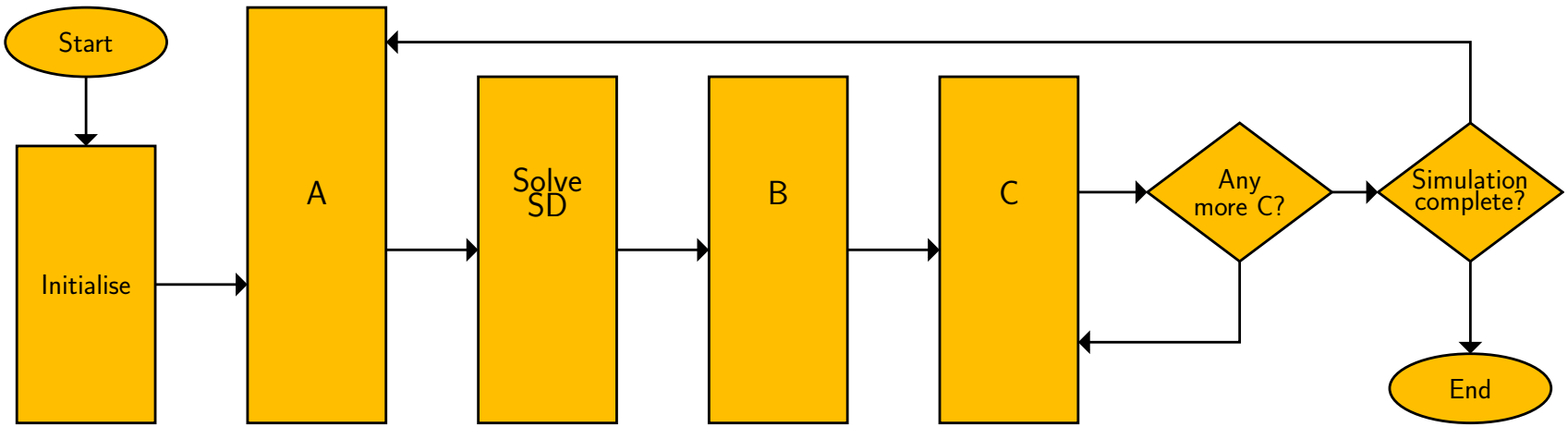
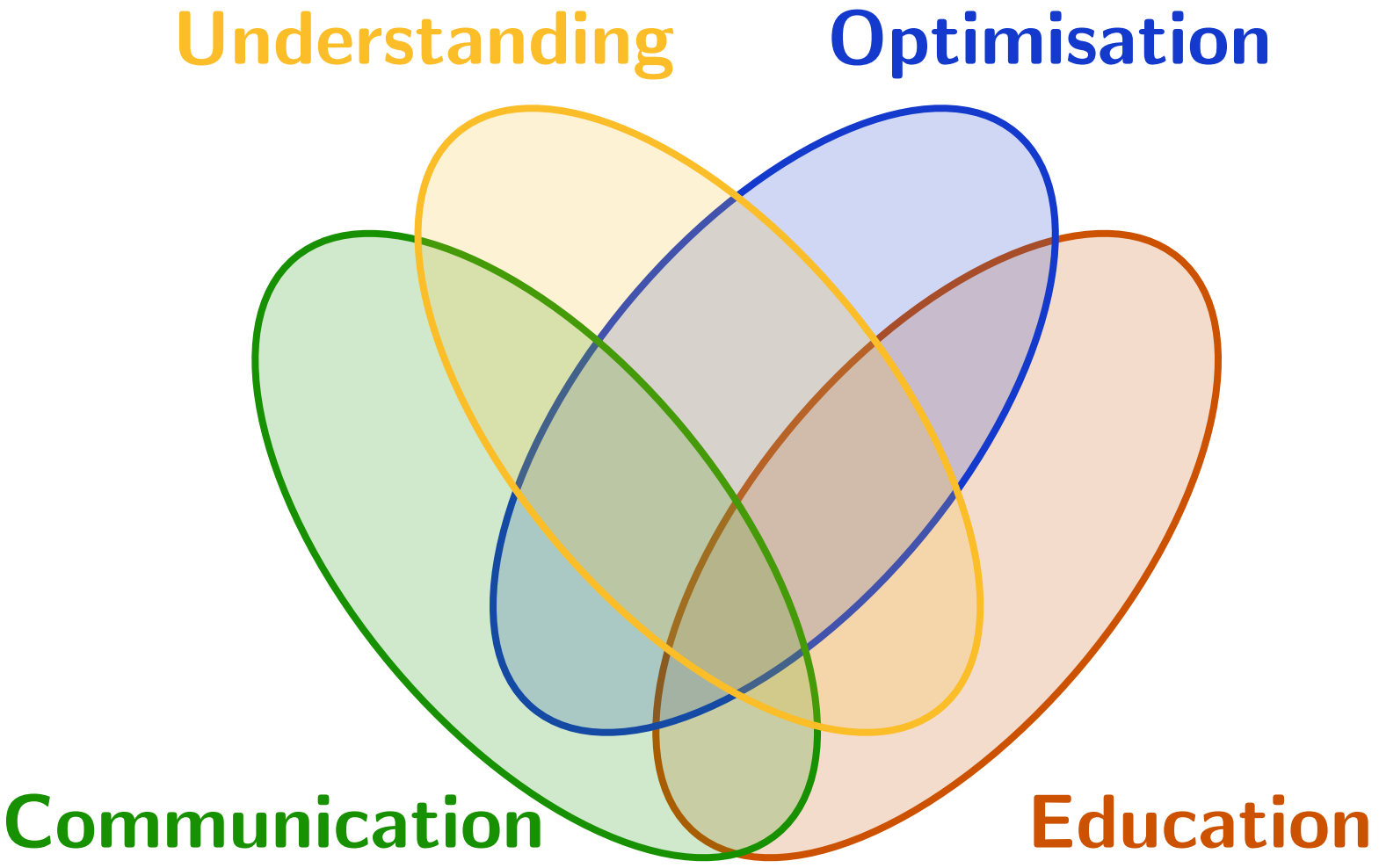

Start
Initialise
A
B
C
Any more C?
Simulation complete?
End


Start
Initialise
A
Solve SD
B
C
Any more C?
Simulation complete?
End

Applications of Ciw



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