

# CSC369 Week 10 Notes

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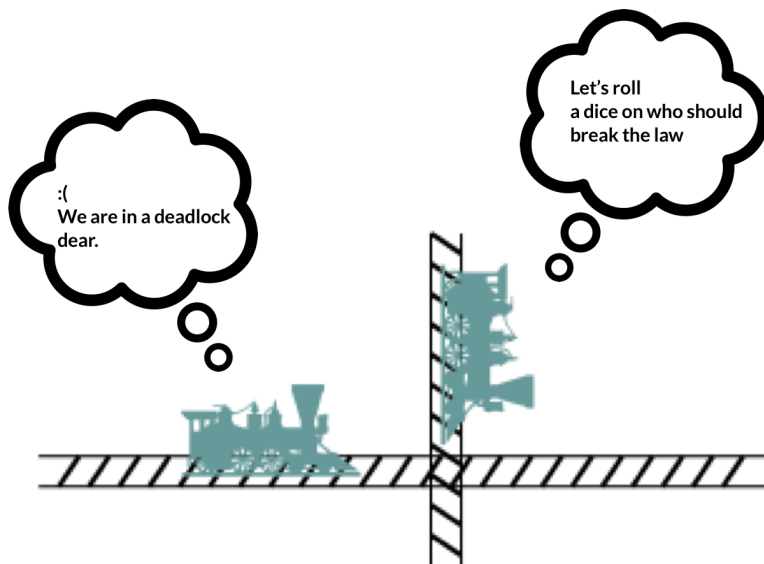
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- Deadlock Defined

- **Google Definition:** Is a situation one typically involving opposing parties, in which no progress can be made.
- Is permanent
- Happens to set of processes that
  - \* Compete for same system resources
  - \* Communicate with each other

- Example of Deadlock

- Law passed by Kansas Legislature in in early 20th century
  - \* “When two trains approach each other at a crossing, both shall come to a full stop and neither shall start upon again until the other is gone”



- Conditions for Deadlock

- Necessary and Sufficient Conditions
  1. Mutual Exclusion
    - \* Only one process may use a resource at a time
  2. Hold and wait
    - \* A process may hold allocated resources while awaiting assignment of others
  3. No preemption
    - \* No Resource can be forcibly removed from a process holding it
  4. Circular wait
    - \* Each process must be waiting for a resource which is being held by another process, which in turn is waiting for the first process to release the resource

### Aside

1. Wait. Necessary condition? <sup>[1]</sup>
  - We say  $N$  is a necessary condition for  $S$  if we don't have  $N$ , we won't have  $S$ .
2. Wait. Sufficient condition? <sup>[1]</sup>
  - We say  $S$  is a necessary condition for  $N$  if we have  $S$ , then we know that  $N$  must follow, i.e.  $S \Rightarrow N$
3. Hold on. How about necessary and sufficient condition? <sup>[2]</sup>
  - Is when necessary and sufficient conditions are put together similar to if and only if <sup>[2]</sup>

**Truth table**

$S$	$N$	$S \Rightarrow N$	$S \Leftarrow N$	$S \Leftrightarrow N$
T	T	T	T	T
T	F	F	T	F
F	T	T	F	F
F	F	T	T	T

Sufficient Condition (points to  $S$ )    Necessary Condition (points to  $N$ )    Is Sufficient (points to  $S \Rightarrow N$ )    Is Necessary (points to  $S \Leftarrow N$ )    Is Necessary and Sufficient (points to  $S \Leftrightarrow N$ )

### References

- 1) Fayetteville State University: Necessary and Sufficient Conditions, link

2) Wikipedia: Necessity and Sufficiency, [link](#)

3) Wikipedia: Deadlock, [link](#)

- Solutions

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- Safe States
- Unsafe States & Algorithm
- What is Atomicity?
- Why would atomicity fail?
- Definitions for Transactions
- How to ensure atomicity in the face of failures?
- Write-ahead logging
- Problems with logging
- Deadlock and Starvation
- Communication Deadlocks
- Livelock