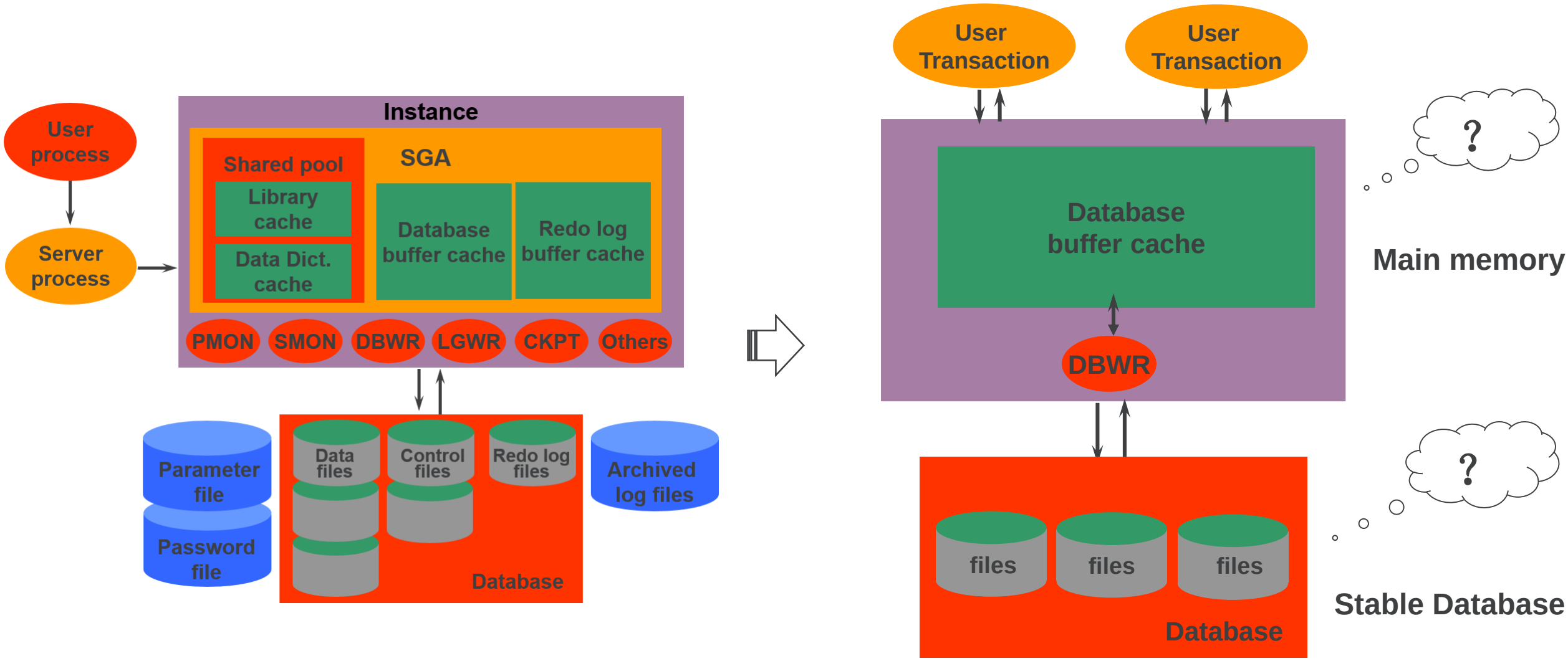
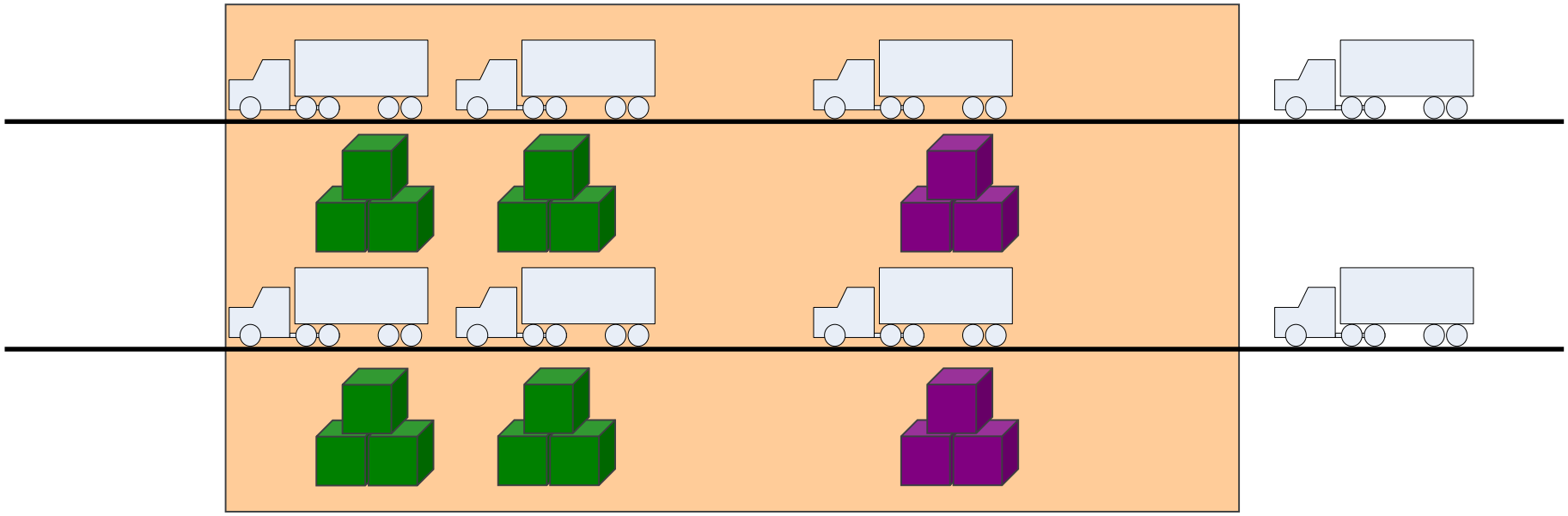
数据库恢复

讲解人：陆伟 教授

DBMS执行环境及潜在故障影响



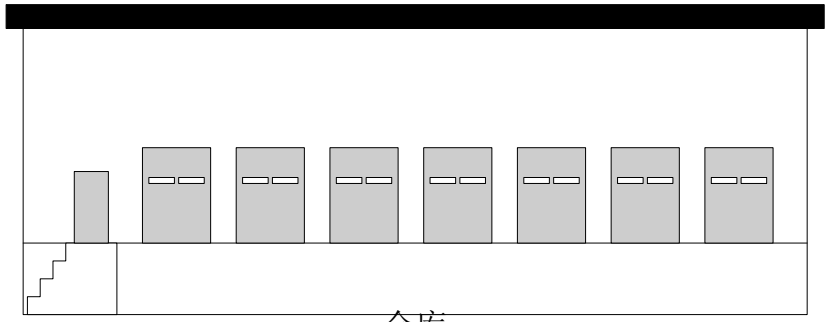
货运仓库转运案例分析



货物临时堆放平台

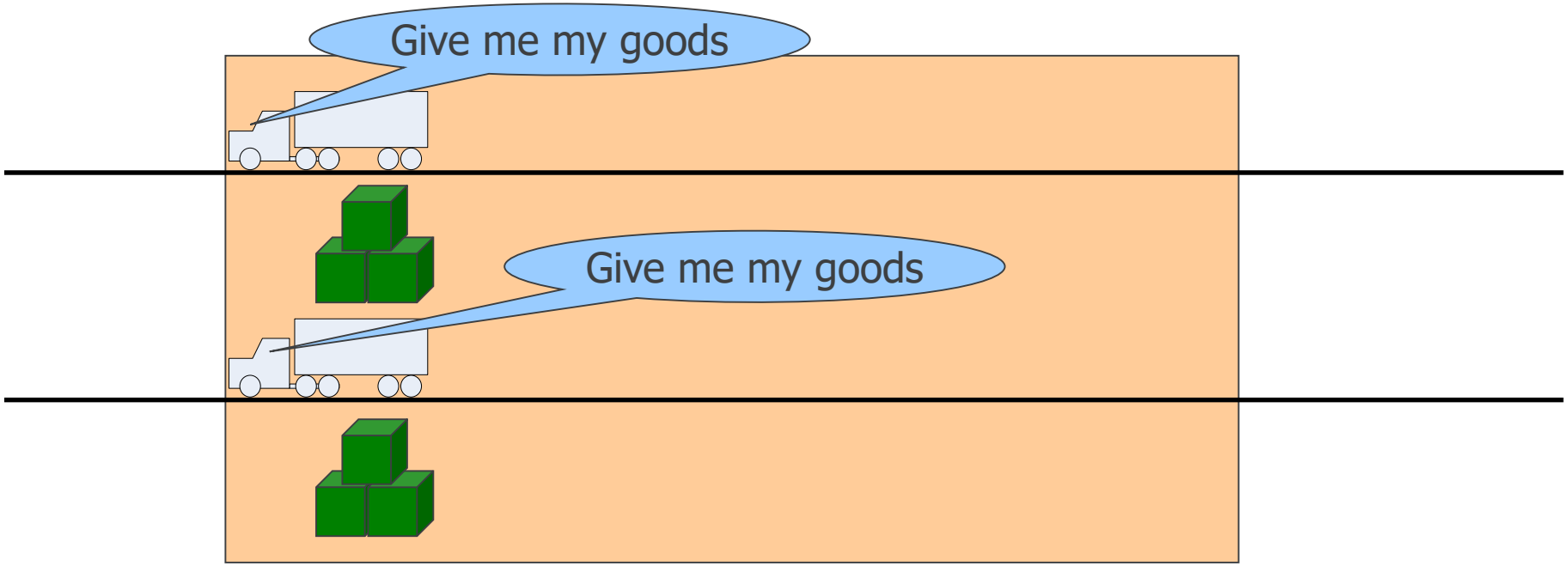
搬运

搬运



仓库

货运仓库转运案例分析



货物临时堆放平台

搬运

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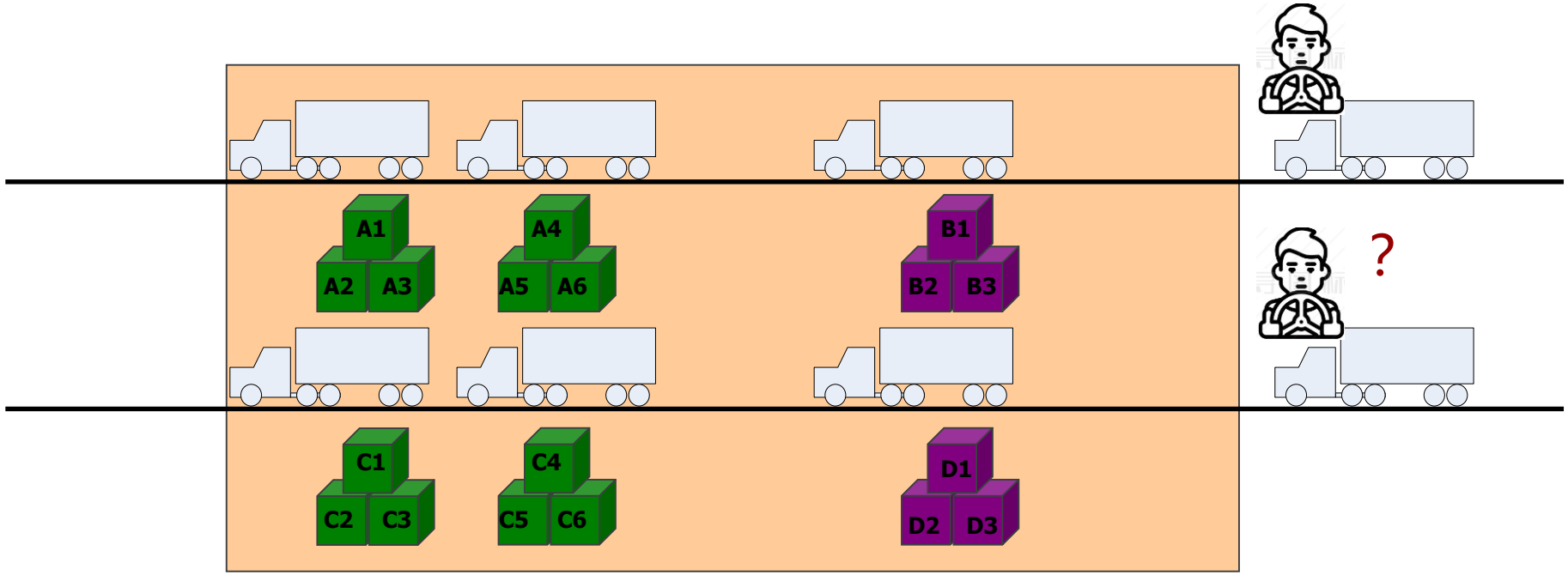
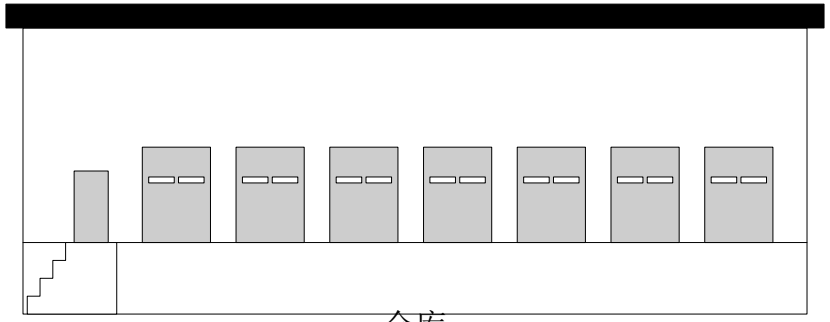


货物临时堆放平台

搬运

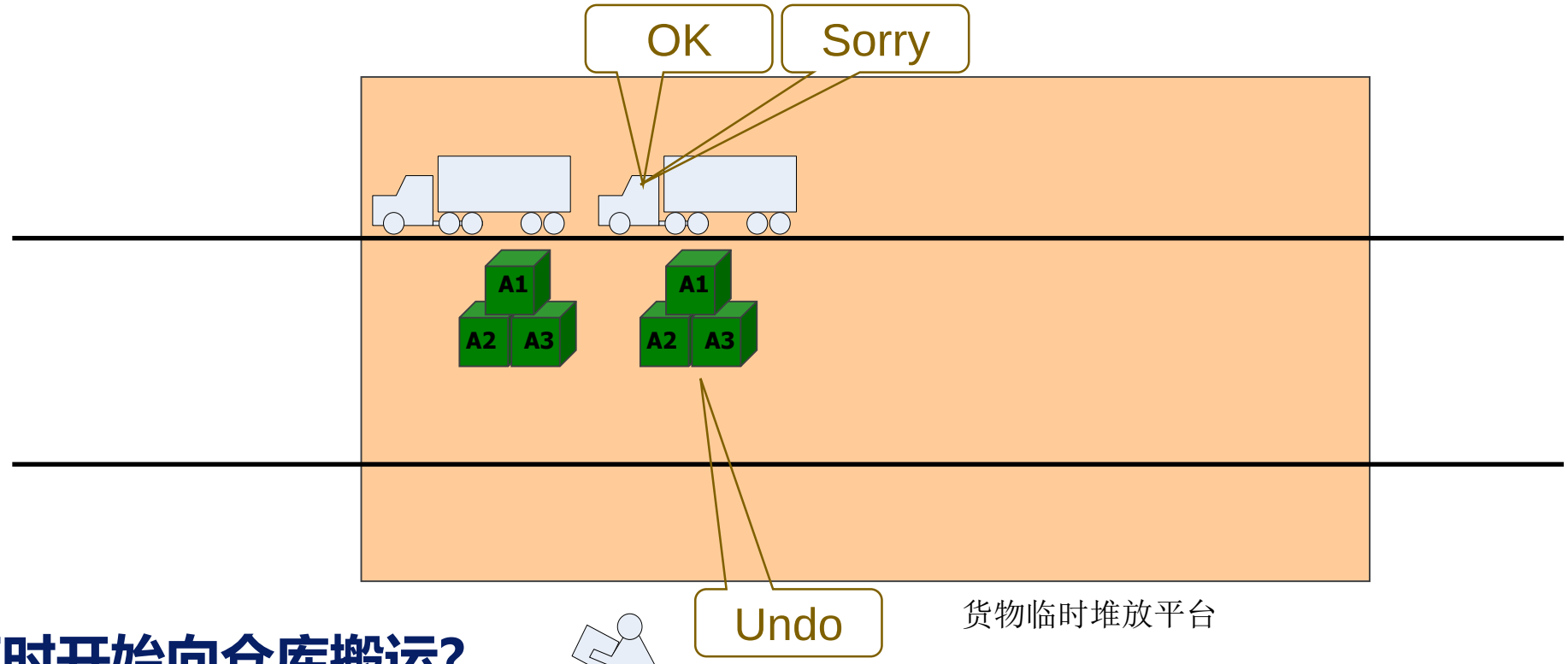
?

搬运



仓库

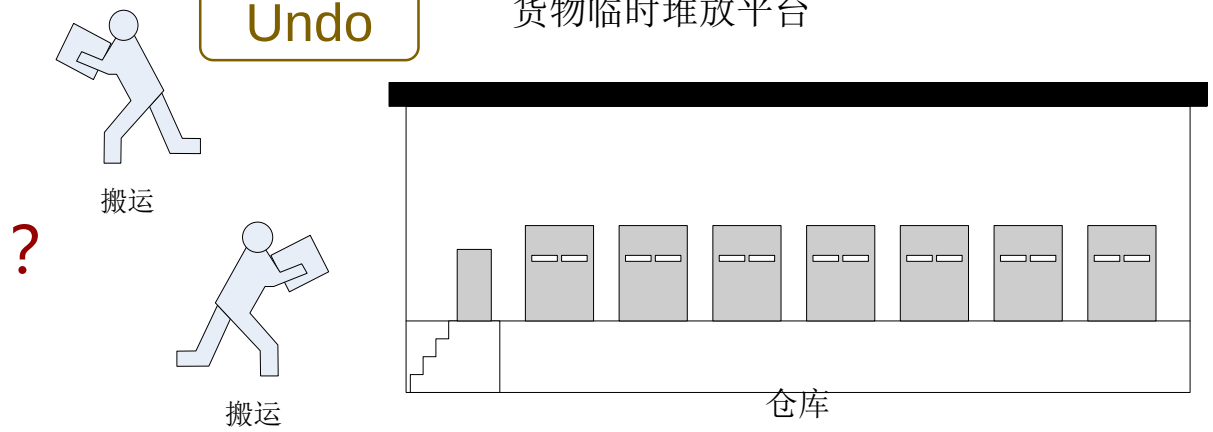
货运仓库转运案例分析



搬运工何时开始向仓库搬运?

The first way

-Immediate



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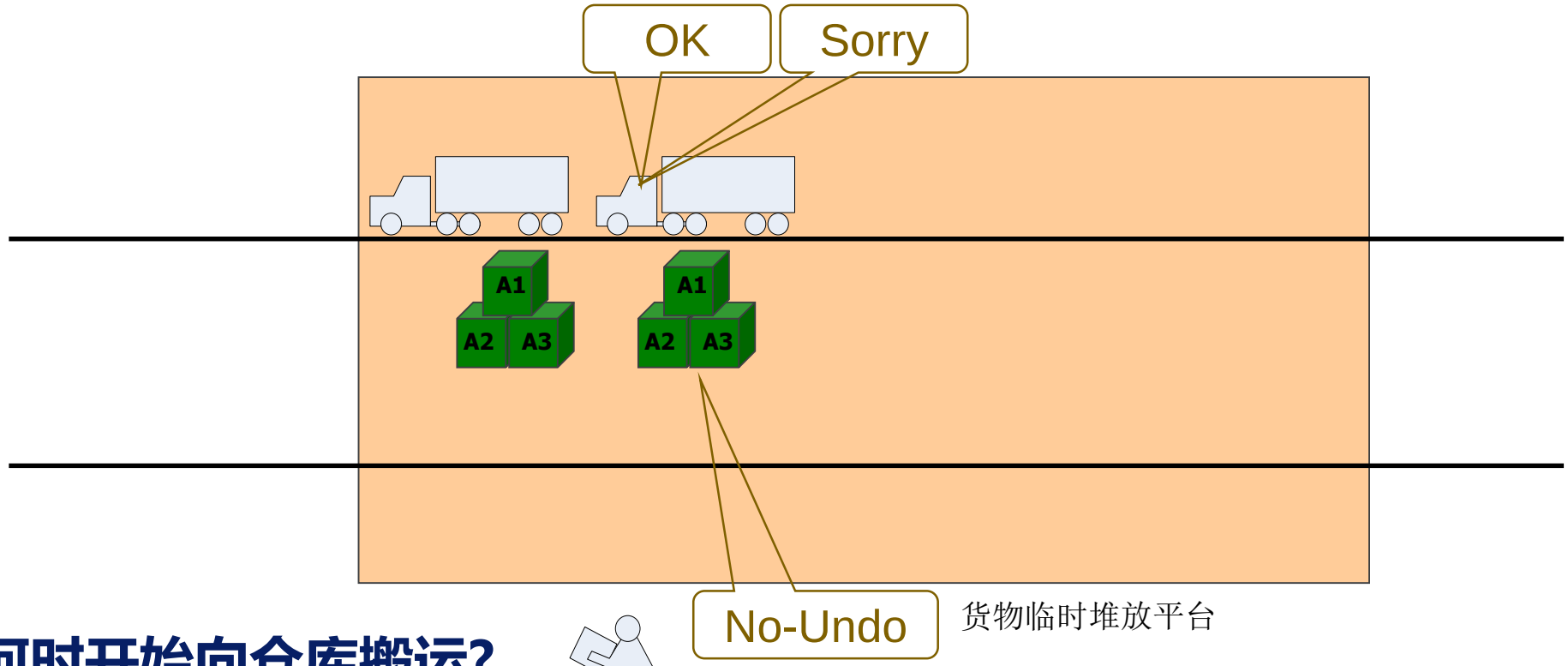
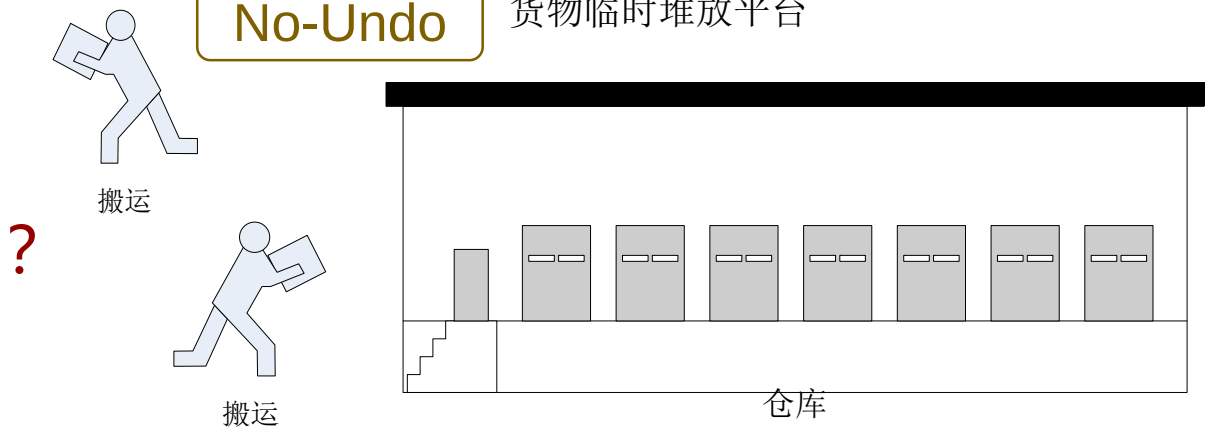


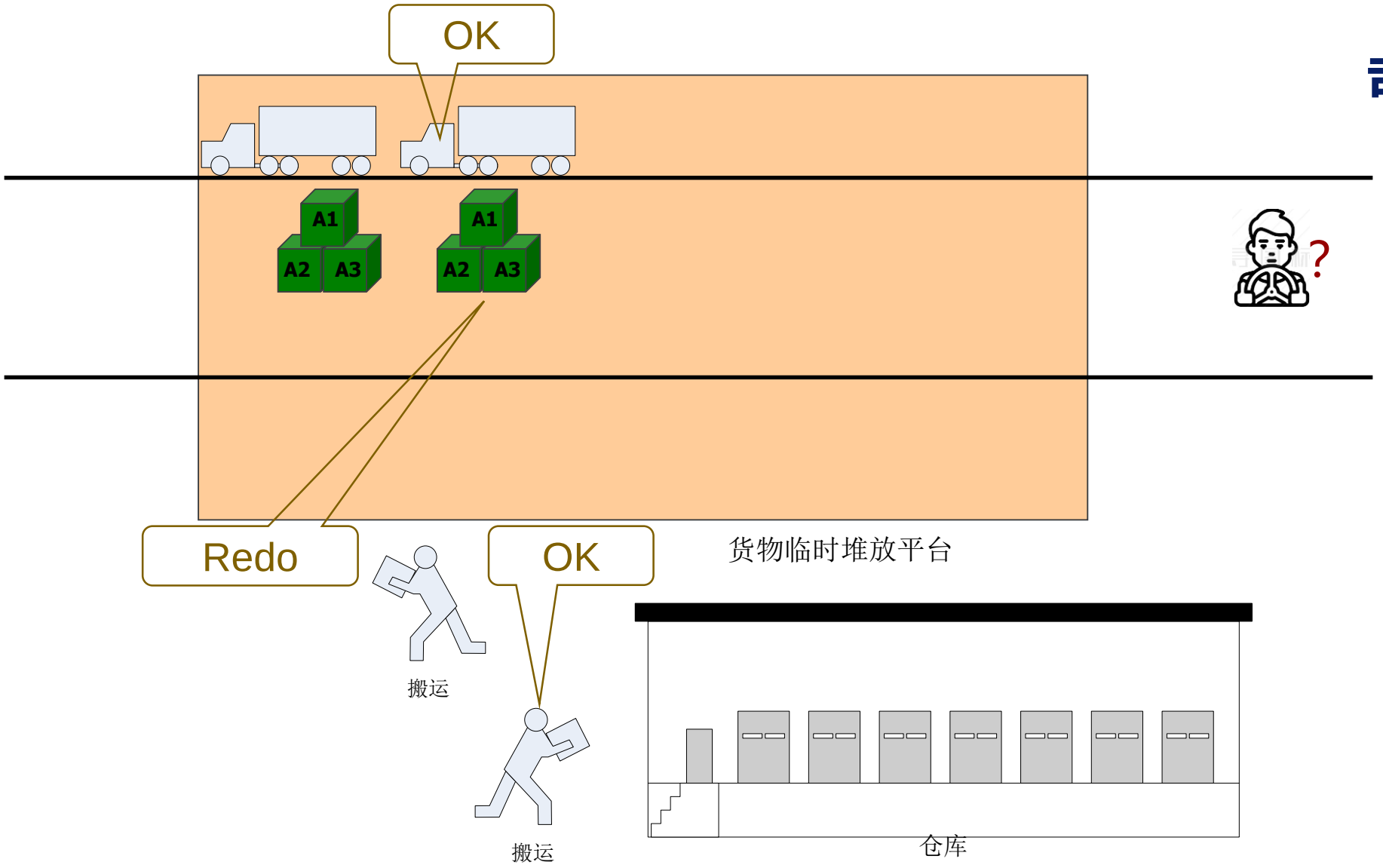
搬运工何时开始向仓库搬运?

The second way

-Defered



货运仓库转运案例分析

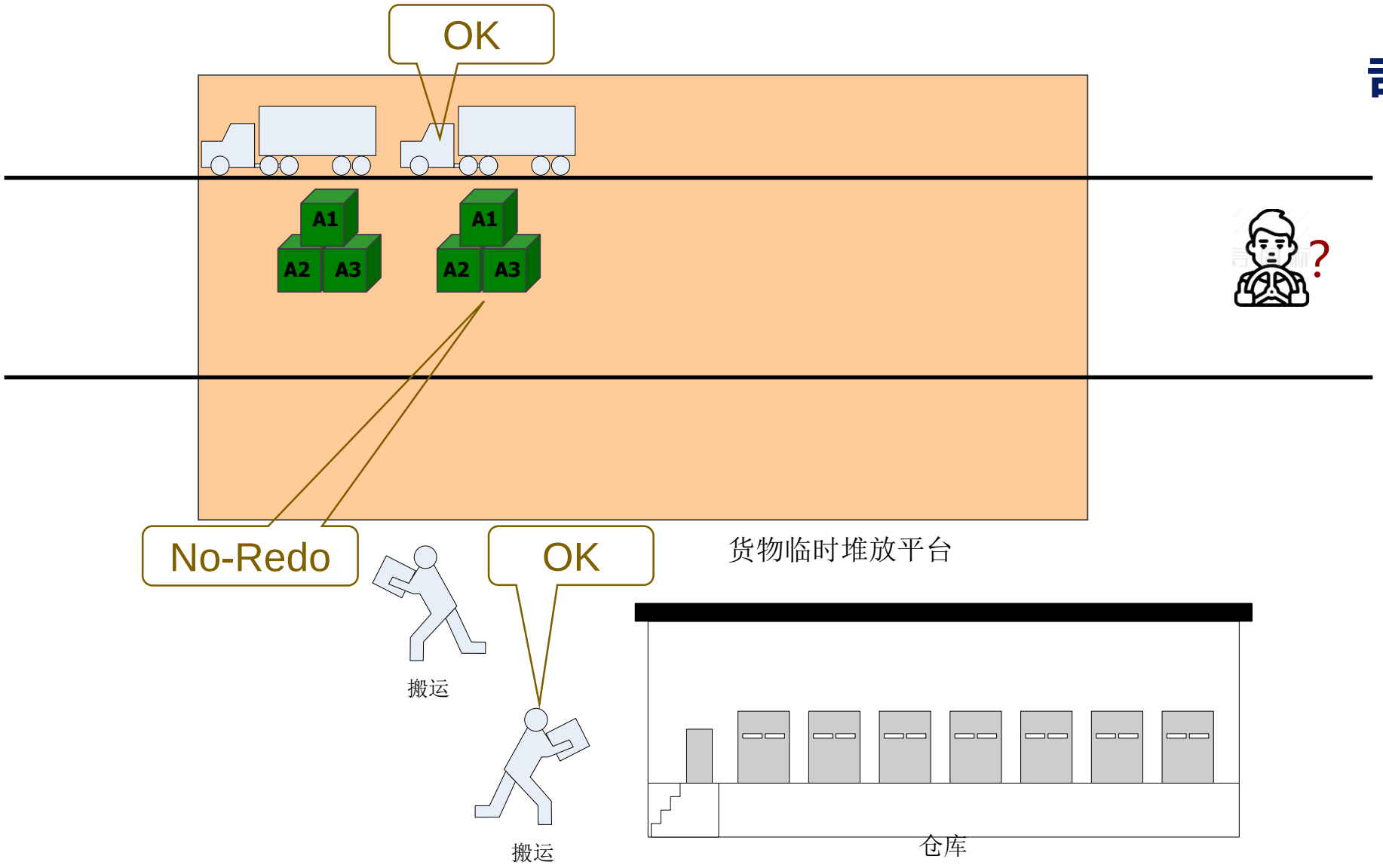


司机何时可以离开?

The first way

-No-Force

货运仓库转运案例分析



司机何时可以离开?

The second way

-Force

货运仓库转运案例分析

- Update policy when data come
  - Immediate – Undo
  - Deferred – No-Undo
- Propagation policy at commit point
  - Force – No-Redo
  - No-Force - Redo

Immediate/No-Force	⇨	**Undo/Redo**
Immediate/Force	⇨	**Undo/No-Redo**
Deferred/No-Force	⇨	**No-Undo/Redo**
Deferred/Force	⇨	**No-Undo/No-Redo**

失败发生时该如何做

- Recovery protocols usually implement two basic actions that are performed on the state of the stable database, namely, the undo action and the redo action.
  - undo action：This is required for atomicity. It undoes the effects that aborted transactions have had on the stable database.
  - redo action：This is required for durability. It redoes the effects that committed transactions have had on the stable database.

日志Log

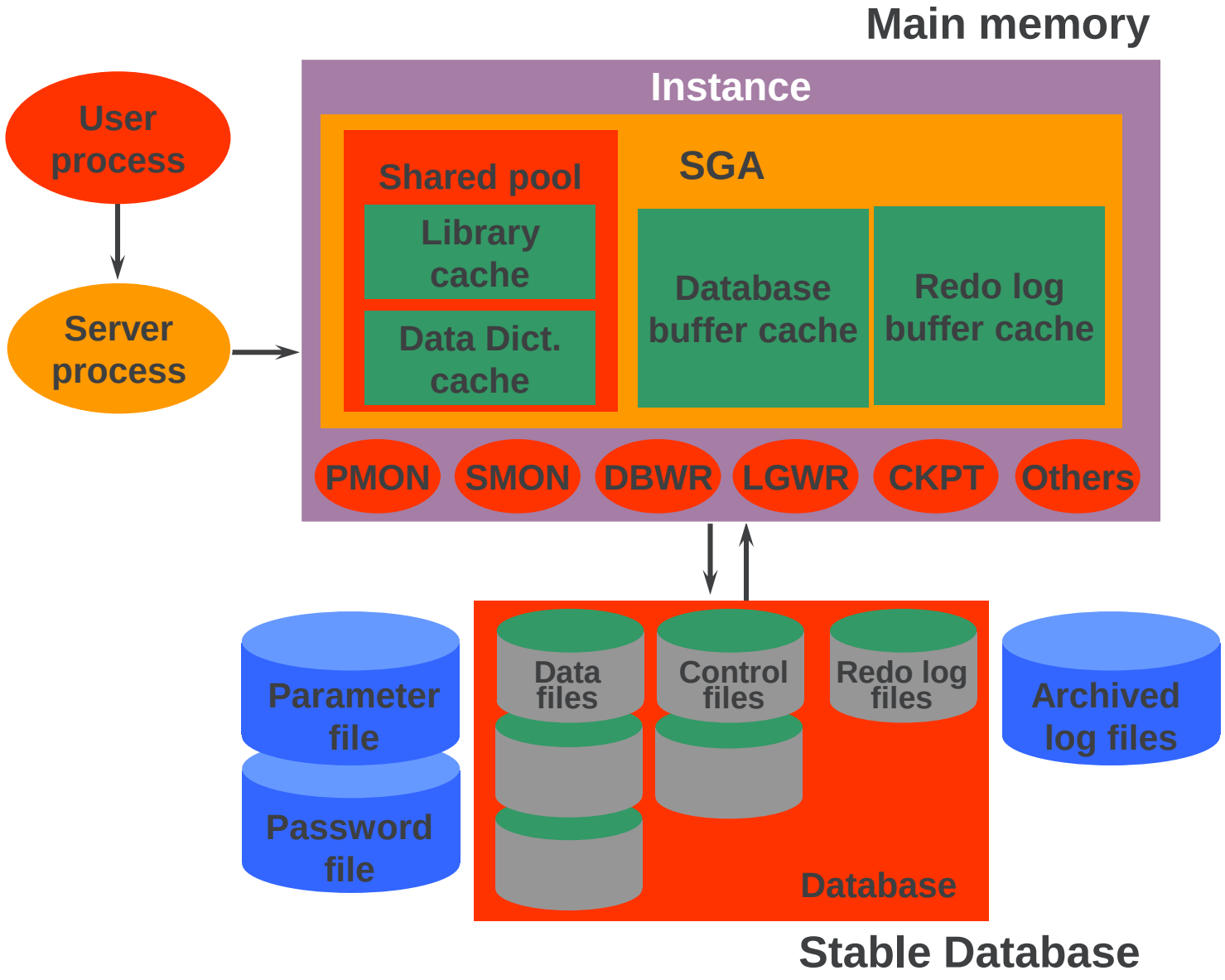
- 日志Log记录了Undo和Redo行为所需要的信息

In a sense, the log represents the history of the transaction execution with respect to its updates. The order in which updates appear is the same as the order in which they actually occurred.

日志Log

The DBMS maintains the log in a log buffer in main memory.

In order to ensure that a log contains the needed information for recovery, it saves the log on secondary storage that survives systems failures.



日志Log

- The log is made stable, i.e., written on secondary storage, following two rules.
- Undo Rule or WAL (Write-Ahead Logging) principle：
  - The updates of a transaction are not applied in the stable database until after the log records that correspond to the updates show up in stable storage.
- Redo Rule
  - A transaction is not committed until after the part of the log pertaining to the transaction is in stable storage.

数据库恢复过程

[… …] [Ti, D, b, a] [Tj, OP, OP Parameters, INV, INV parameters] [… …] [Ti, commit] [… …] [Tj, abort] [… …]

分析阶段：The log is scanned backwards from the end of the log in order to determine the following: (1) Which transactions have committed; (2) Which transactions have aborted; (3) Which transactions were active at the time of the crash.

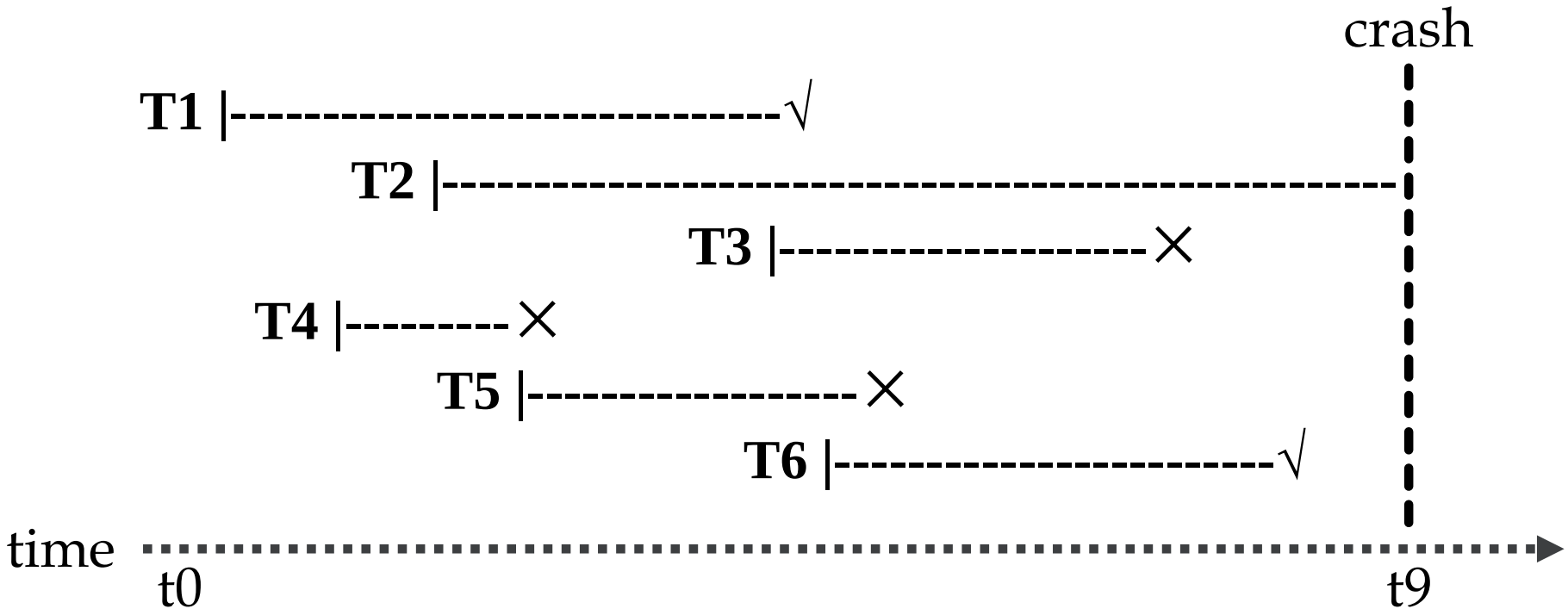
Undo list: T_1 → T_2 → …

Redo list: T_1 → T_2 → …

Undo 阶段:

Redo 阶段:

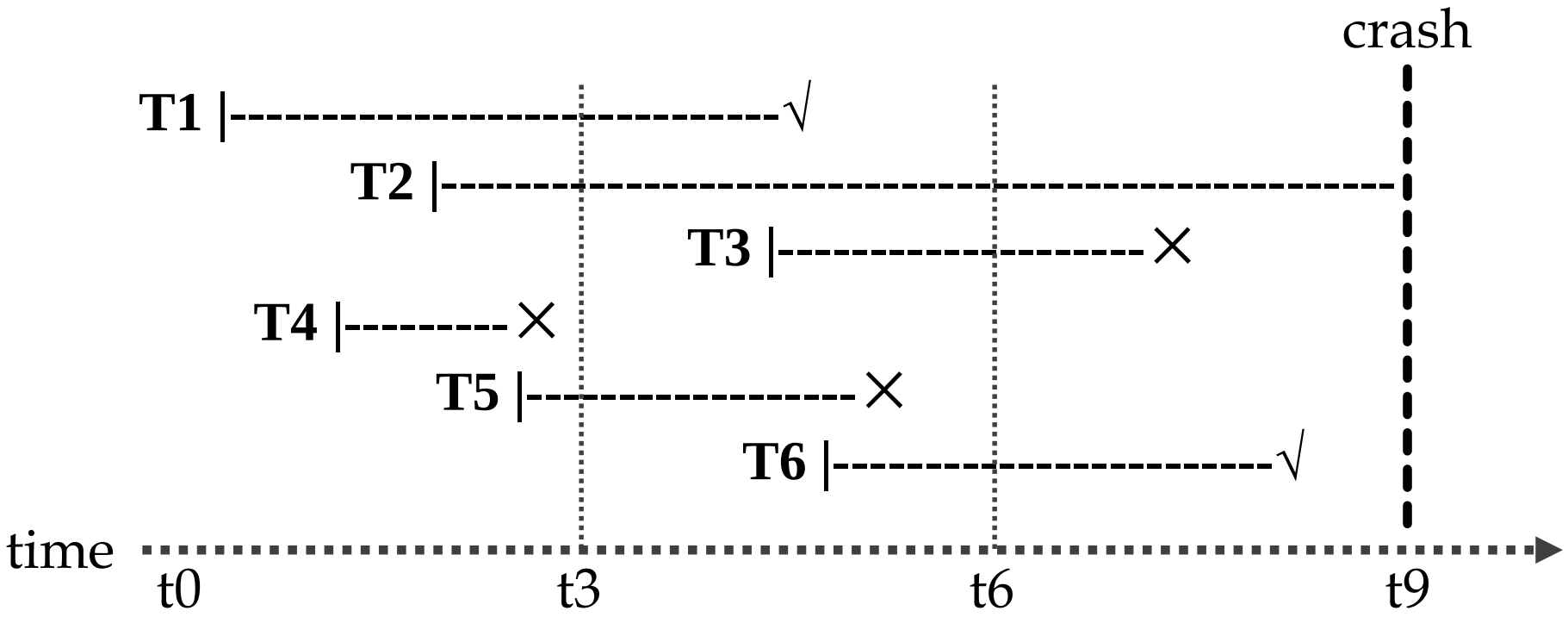
关于检查点(Checkpoint)

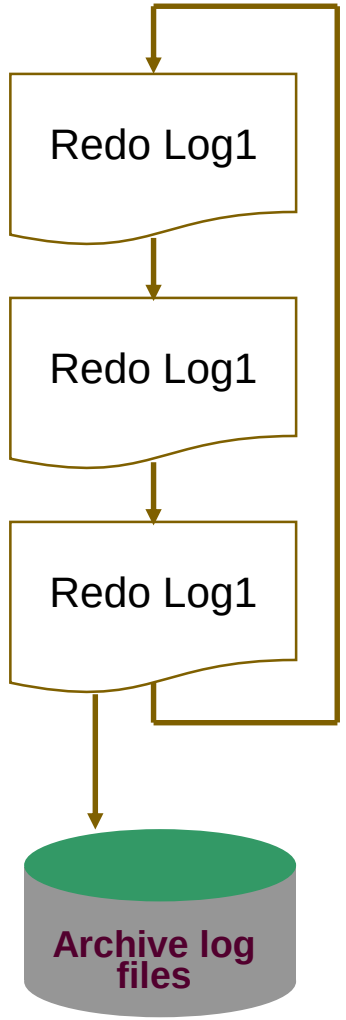


[… …] [Ti, D, b, a] [Tj, OP, OP Parameters, INV, INV parameters] [… …] [Ti, commit] [… …] [Tj, abort] [… …]

The basic UNDO/REDO recovery assumes that all the effects of the aborted and active transactions—and none of the effects of the committed transactions—were propagated to the stable database. As a result, it needs to scan the entire log!

关于检查点(Checkpoint)





The effects of all transactions that are committed or aborted by the time of a certain checkpoint are propagated to the stable database, thereby eliminating the need to redo or undo these transactions after a system failure. Hence, their associated log records are not needed and can be discarded from the stable log.

关于二级存储设备故障情况下的恢复

- Approaches for recovering the database from non-volatile storage failure:
  - Static backup
  - Dynamic backup
  - Archive log
  - Redo

关于本讲内容

祝各位学习愉快！

感谢观看！

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