Fine-grained Transaction Scheduling in Replicated Databases via Symbolic Execution

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Stage: 2nd Year PhD Student

Research Area: Dependable and fault-tolerant systems and networks

Advisors: Miguel Matos
Paolo Romano

Research Questions

- **Problem**:
  - Replication techniques incur non-negligible costs to maintain consistency among replicas
  - 2PC => Distributed *Deadlocks*
  - Classic SMR => Serial execution
  - Parallel SMR => Not to trivial to parallelize txs and maintain consistency

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- **Why is it a problem**:
  - Deadlocks
  - Automatic Conflict Class Prediction => Too Coarse Grained => Level of the table => Low Throughput
  - Manual Prediction => Hard and Not optimal
  - Avoid False negatives => Rollback of Txs, possibly inconsistencies among replicas

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  Symbolic Execution => Recurring to Symbolic Execution, we are able to provide in a ***fine-grained*** and ***automatic*** way the set of objects/tuples accessed in a transaction.

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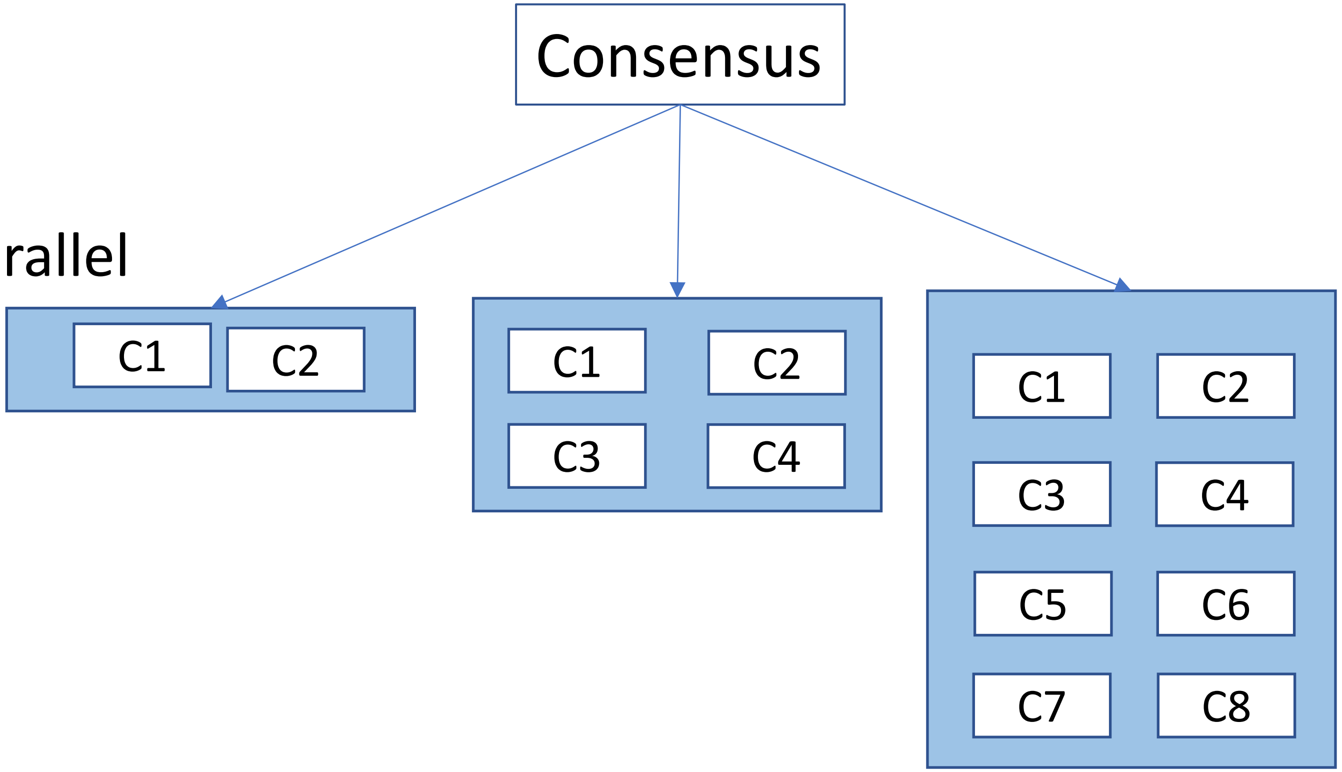
- **Consequences:**
  - Better Parallelism
  - No Runtime Overhead => *offline analysis*
  - No False negatives
  - Determinist Scheduling algorithms benefit from fine-grained information

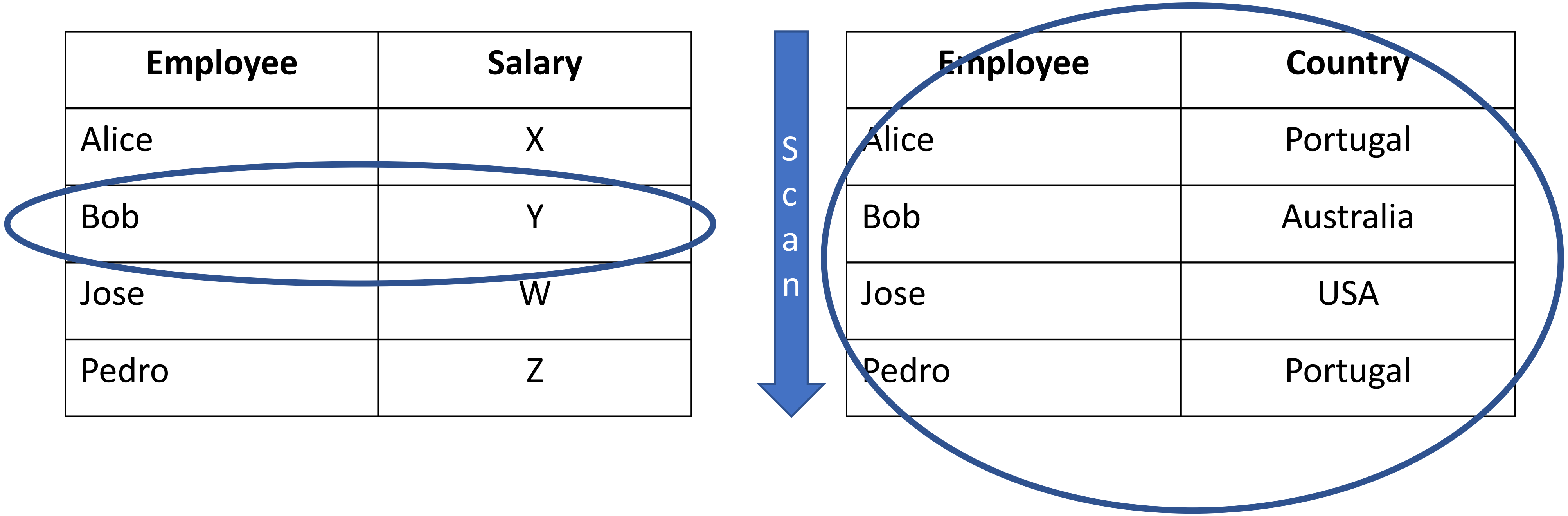
Approach

- *Most* CPUs are multicore!!!
  - Some Transactions can be run in Parallel
  - Replicas must remain consistent
  - Schedule must be deterministic



Approach

- *Compile-Time*
  - SE gives the set of keys/tuples accessed



Employee	Salary
Alice	X
Bob	Y
Jose	W
Pedro	Z

Employee	Country
Alice	Portugal
Bob	Australia
Jose	USA
Pedro	Portugal

Tx A: Sum of Australia's Sallary : Entire Table Employee's Countries && Bob

Approach

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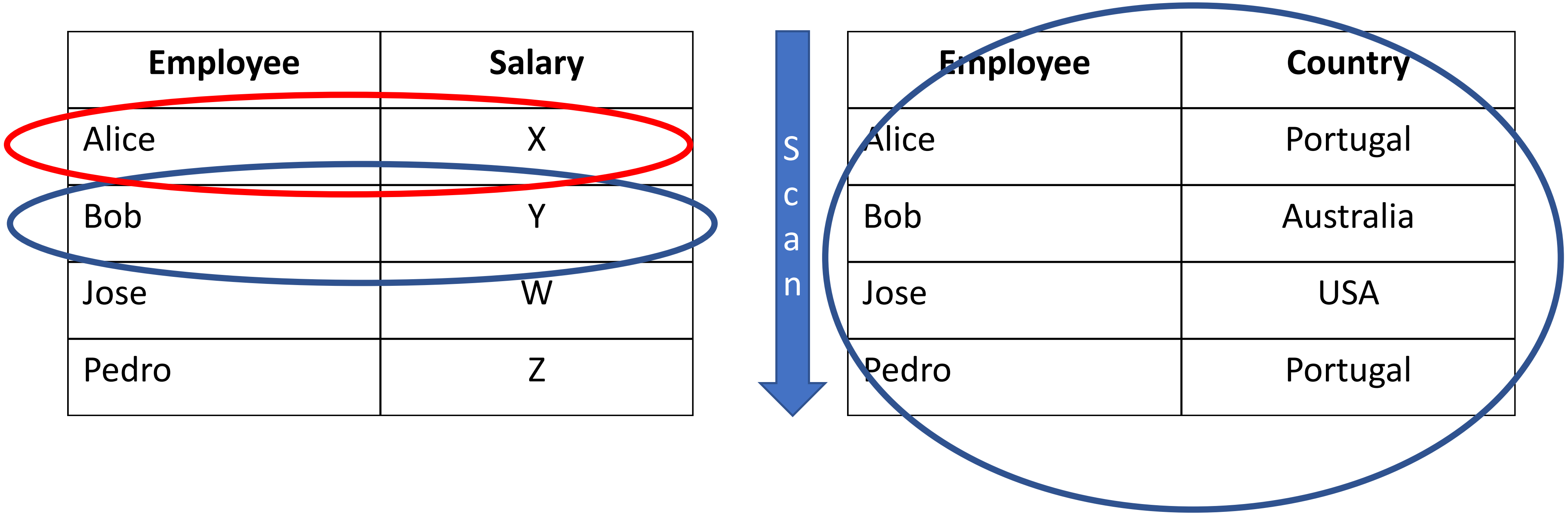

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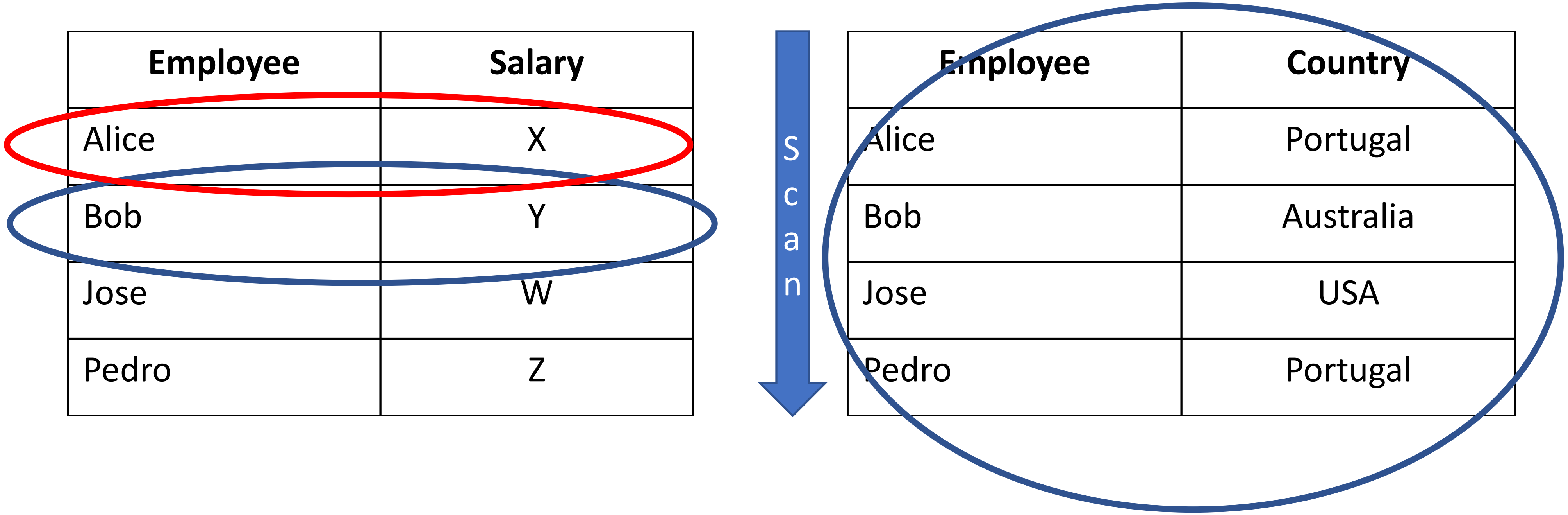

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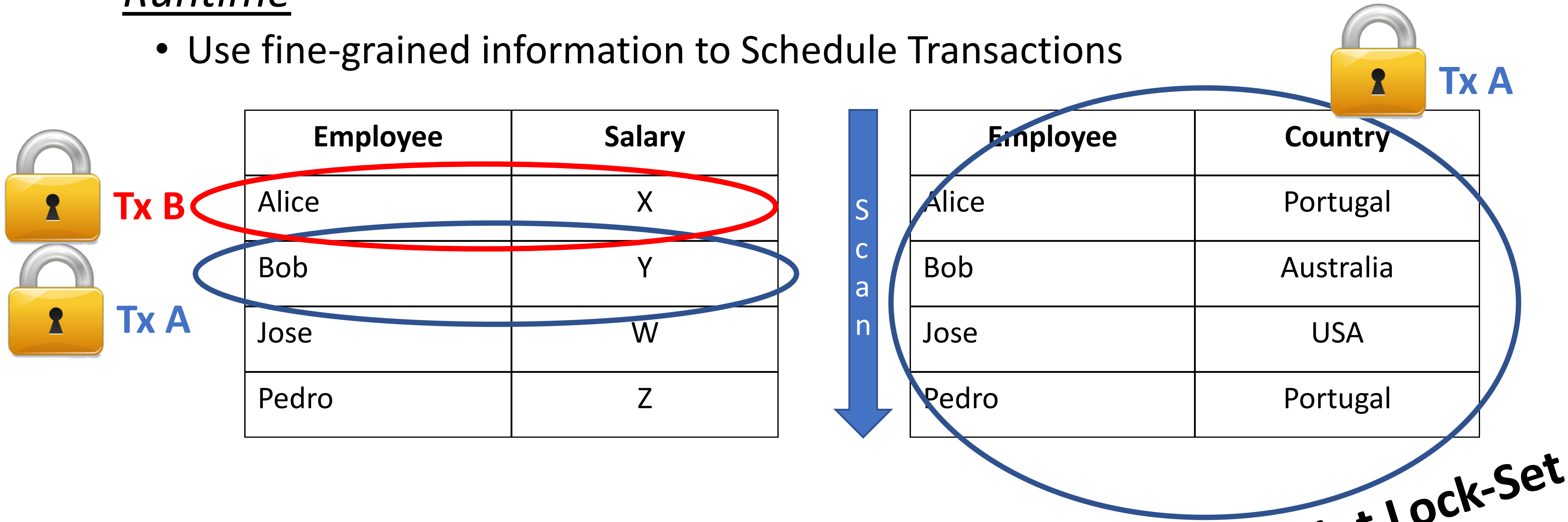
Disjoint!!!!!

Approach

- *Runtime*
  - Use fine-grained information to Schedule Transactions



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Disjoint Lock-Set
Run in parallel

Approach

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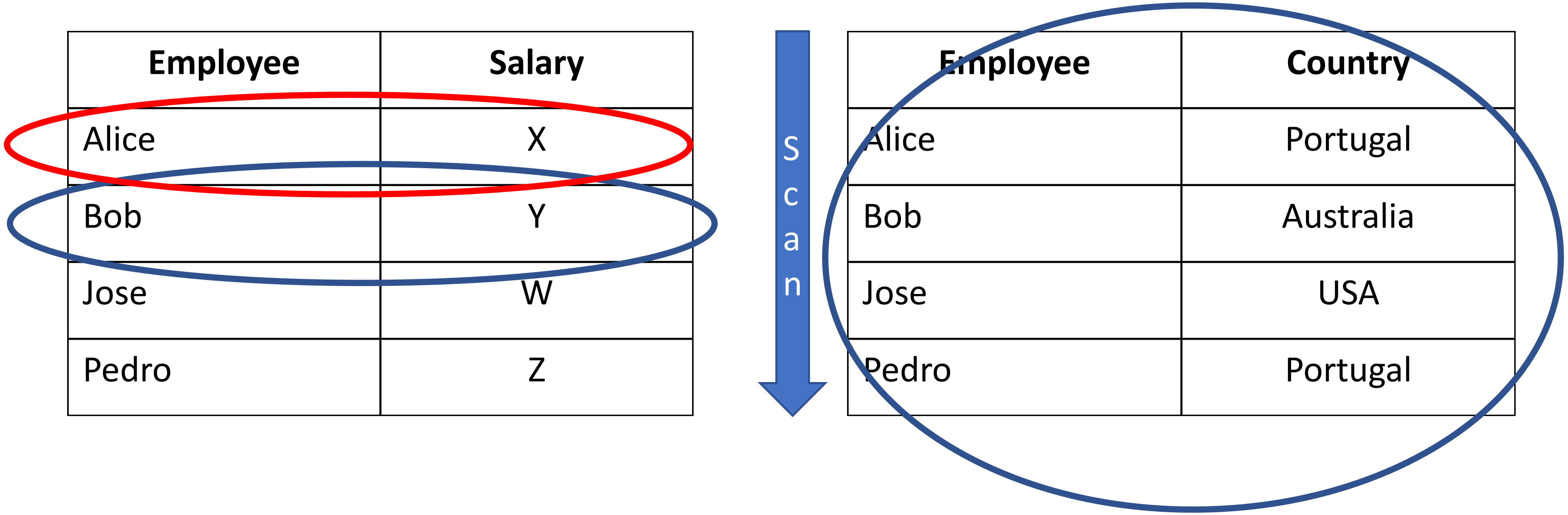

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Solver

Approach

Lock-based:

+ Simple

+ No runtime overhead

- Not trivial to parallelize lock table

Solver:

+ Provides the optimal schedule for batch

- Imposes runtime overhead

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Thanks for the attention

Q&A