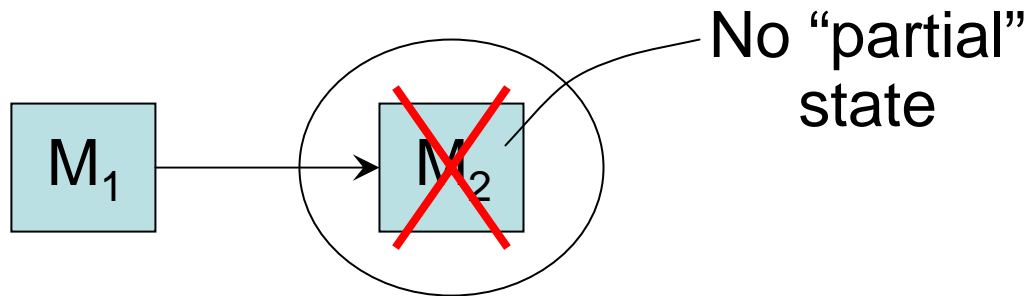


# Atomicity

Failures:

- 1) Replicate + vote
- 2) Recoverability



xfer (from, to, \$ amount)

“All or nothing”

RECOVERABILITY

## Concurrency

S = 1000

xfer (S, C, 100) : A<sub>1</sub>

xfer (S, C, 200) : A<sub>2</sub>

A<sub>1</sub> before A<sub>2</sub>

OR

A<sub>2</sub> before A<sub>1</sub>

ISOLATION

## Atomicity

- Hide compositeness of actions
  - REC + ISO
- 
- Consistency → Invariant
  - Durability

## Recoverability

- Fail-fast
- Repair (recover)
- Restarts

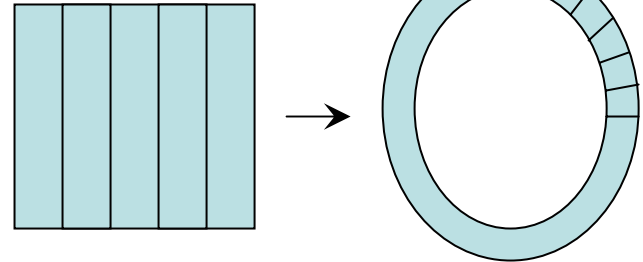
- 1) Recoverable sector
- 2) Version history
- 3) Logs

## Model

- No concurrency
- No hardware errors
- Software errors

App

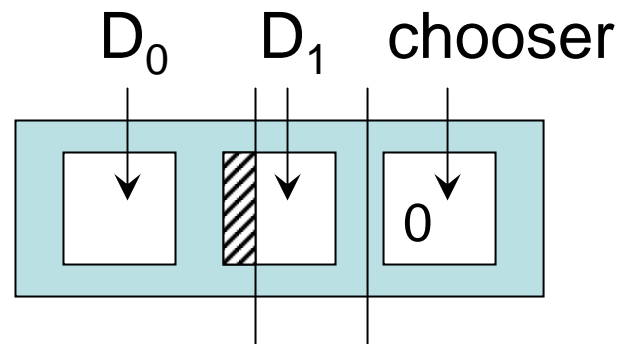
OS Buffer



## Model

```
careful_put (sec, data)
"         _get
```

Solution: Copy



Golden Rule:  
Never modify only copy.

## Commit point

- Before → not visible
- After → visible



# Generalize

`begin_ra()`



`pre-commit`

`ABORT()`

`COMMIT()`



`post-commit`

`end_ra()`