Atomicity

Failures: 1) Replicate + vote
2) Recoverability

No “partial” state
xfer (from, to, $ amount)

“All or nothing”
Concurrency

\[ S = 1000 \]

\[ \text{xfer} (S, C, 100) : A_1 \]

\[ \text{xfer} (S, C, 200) : A_2 \]

\[ A_1 \text{ before } A_2 \quad \text{OR} \quad A_2 \text{ before } A_1 \]

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
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 \}
    COMMIT()
    \{ post-commit \}
end_ra()

ABORT()
```