

Performance Patterns, Pitfalls, and Approach

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Abstract

Performance Design is based on the application on many performance oriented patterns. Patterns are a way are to consolidate experience: what solution fits to what problem in what situation? Pitfalls are also a way to consolidate experience: what are common design mistakes?

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draft

version: 0.1

Common Platforms and Bloating

Generic nature of platforms

Most SW implementations are way too big

Performance suffers from oversize and generic provisions

Exploring Bloating: Main Causes

>90% of all Software statements are not needed, but caused by:

over-specification

bad design

too generic

dogmatic rules

legacy remains

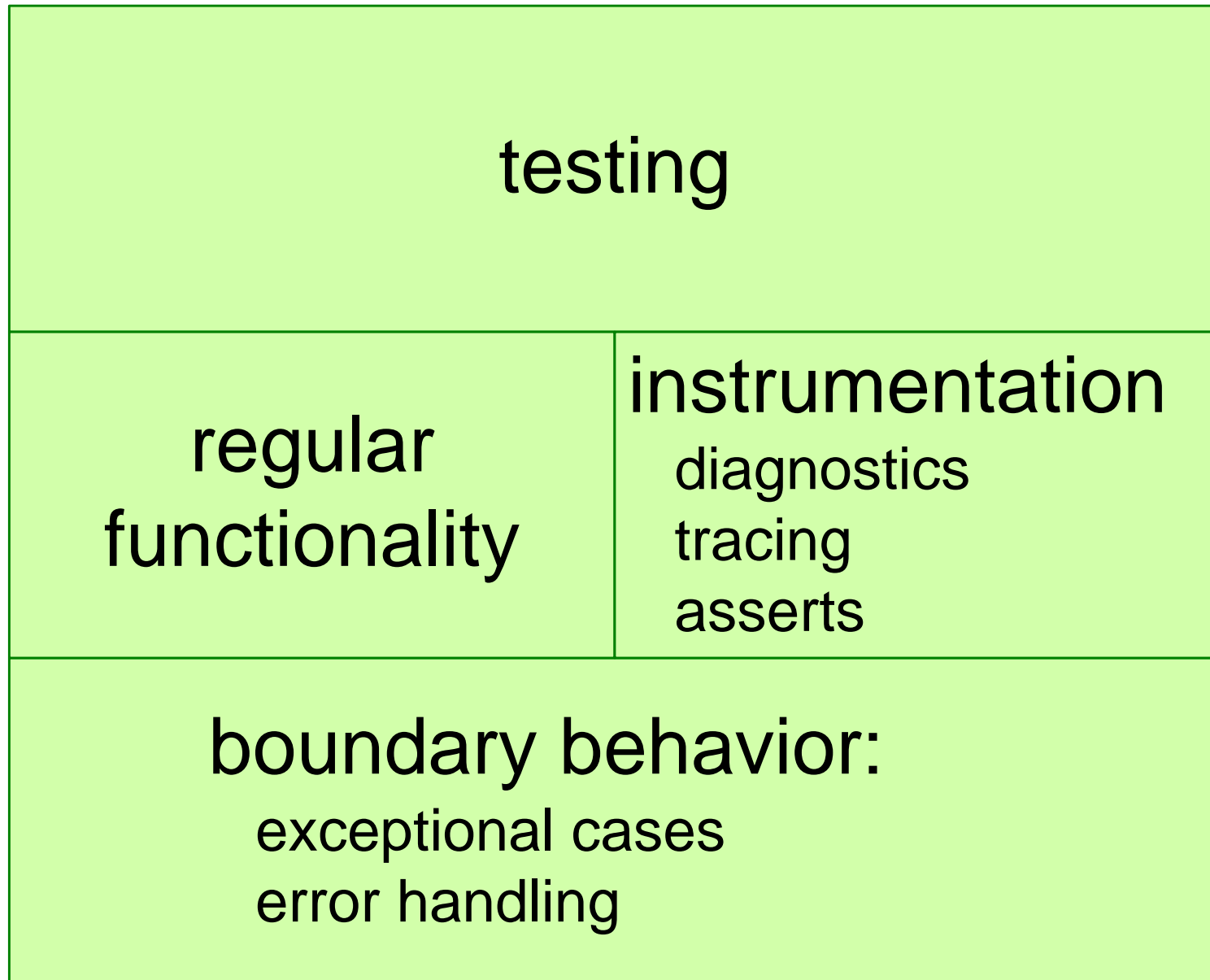
core function
less than 10%

legend

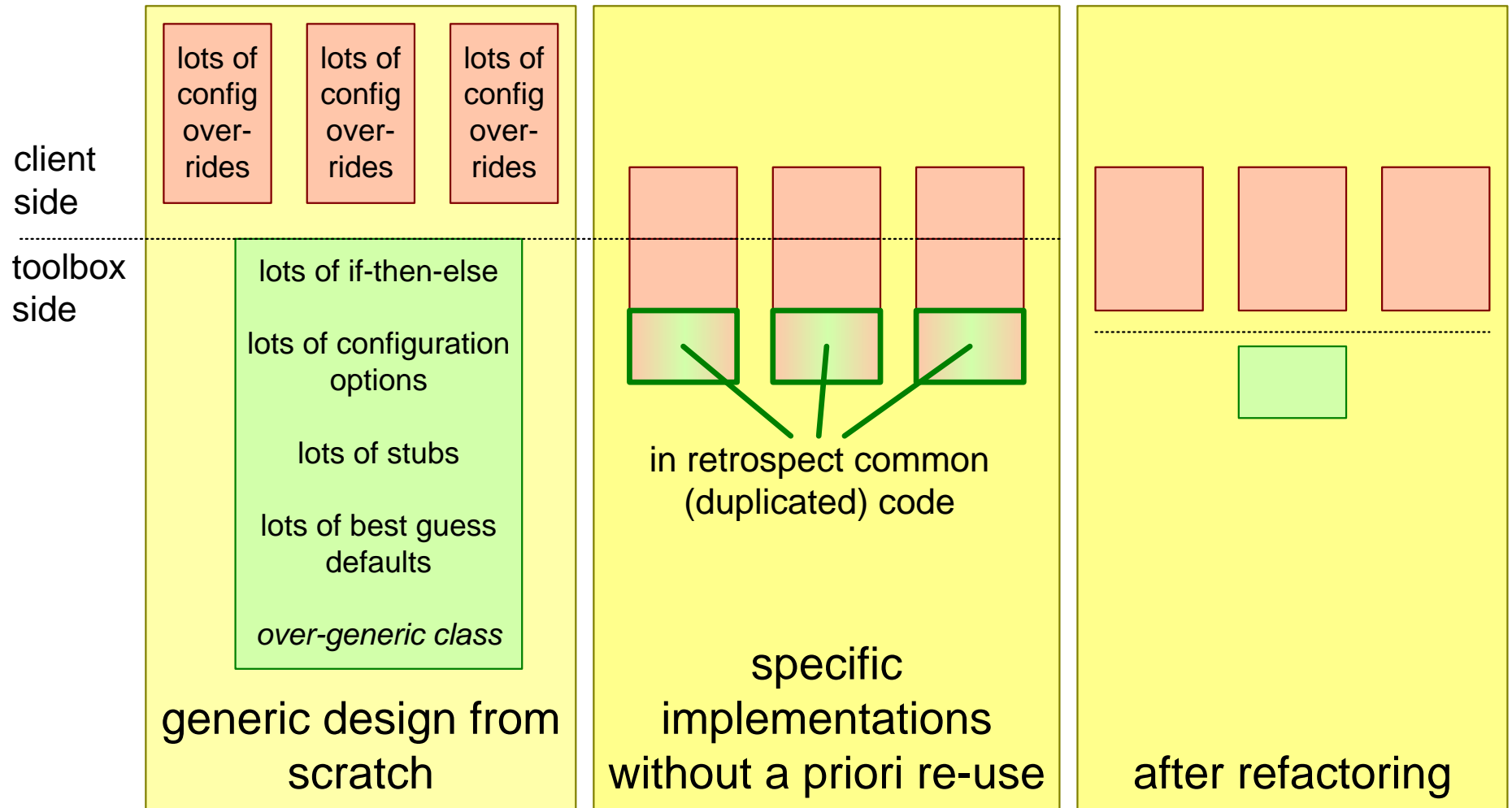
overhead

value

Necessary Functionality \gg Intended Regular Function

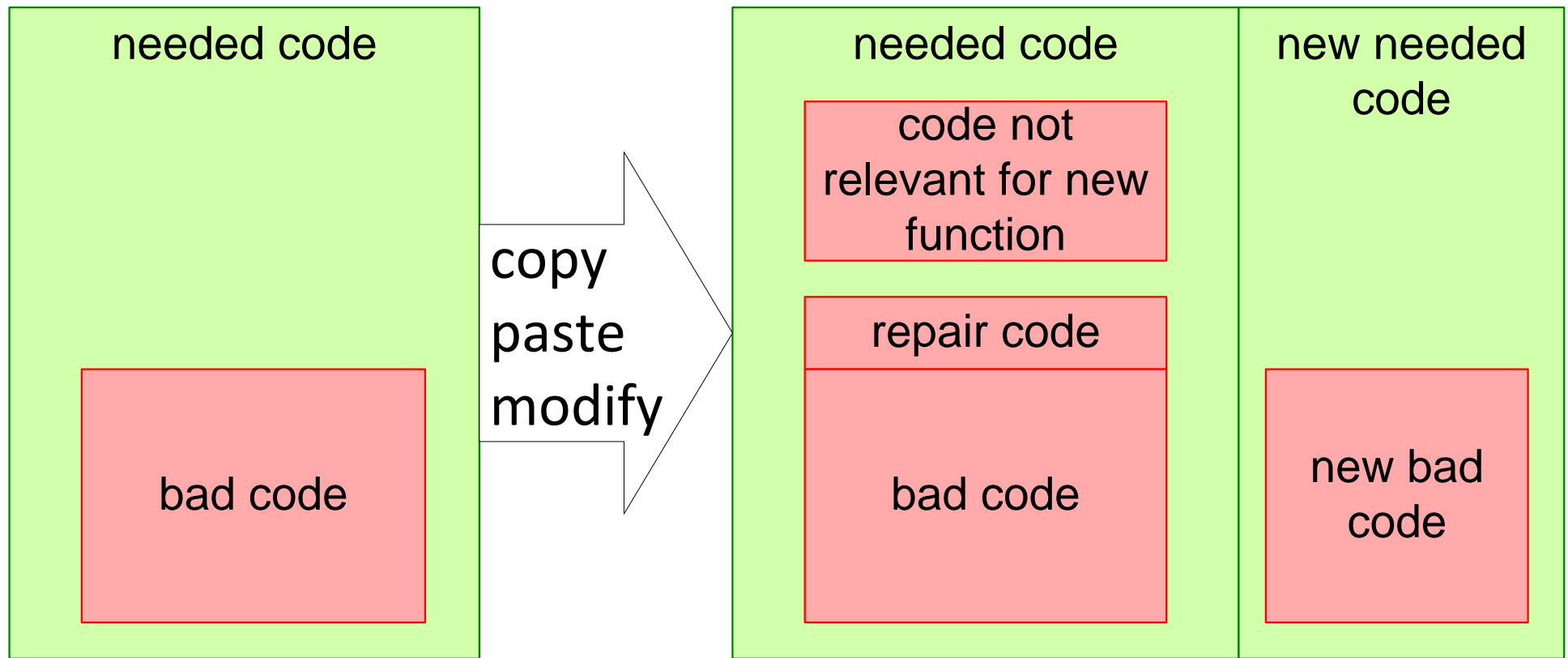


The Danger of Being Generic: Bloating

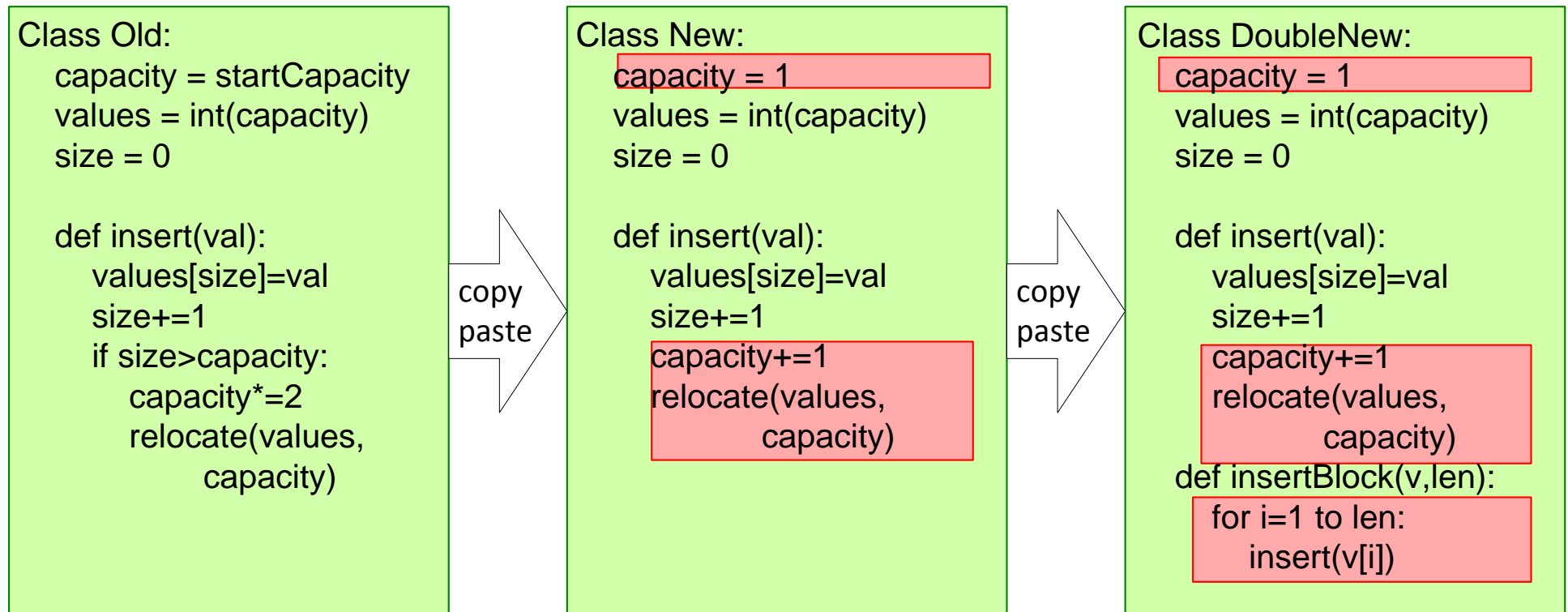


"Real-life" example: redesigned *Tool* super-class and descendants, ca 1994

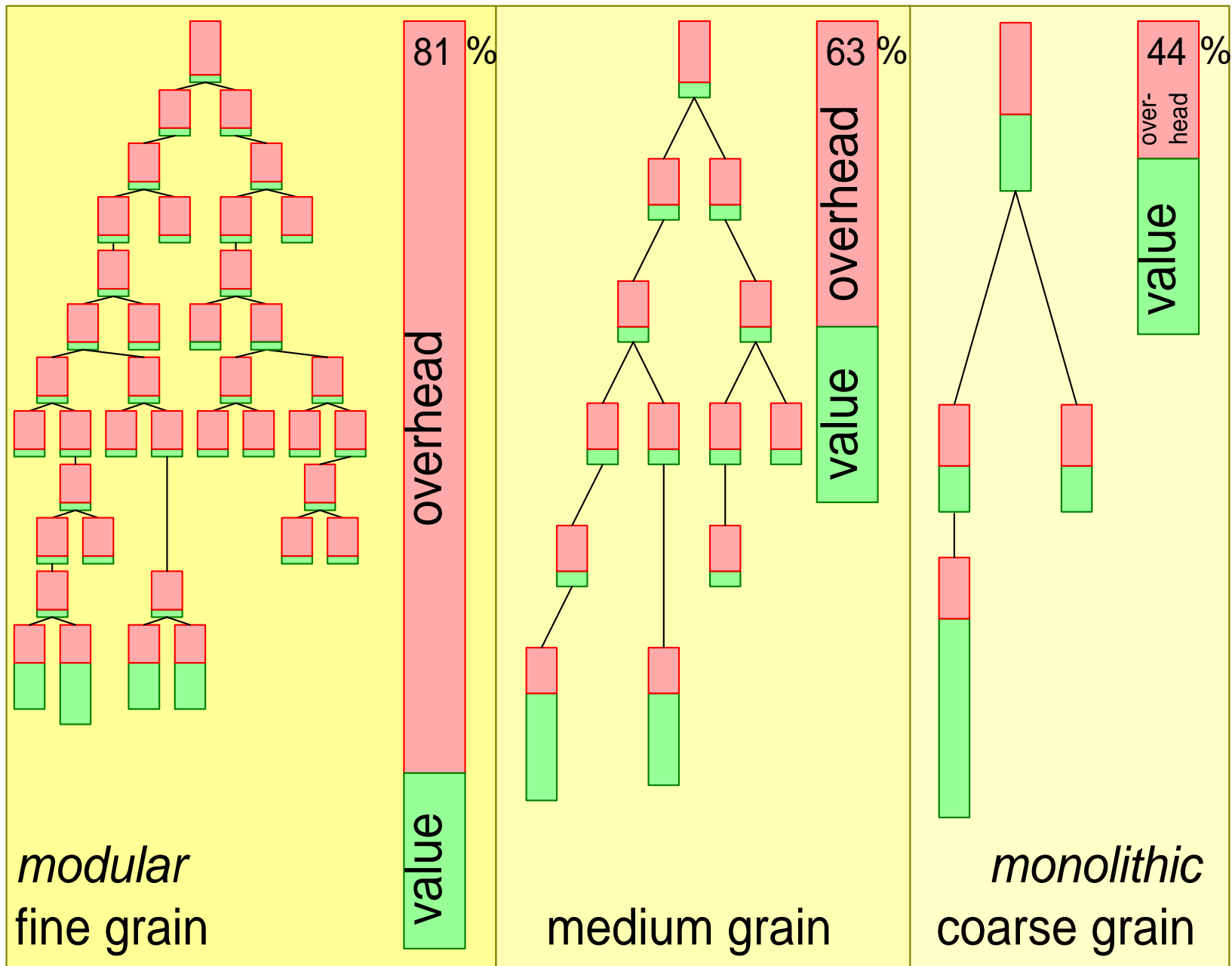
Problem Propagation via Copy & Paste



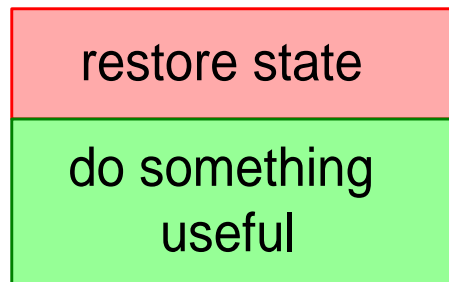
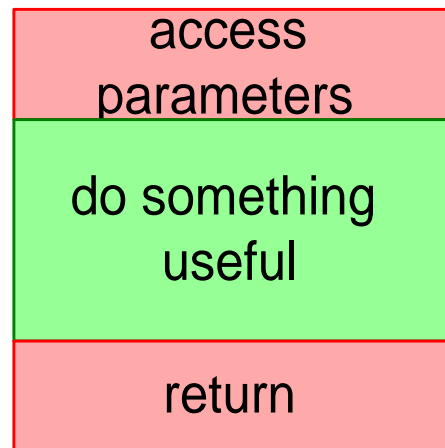
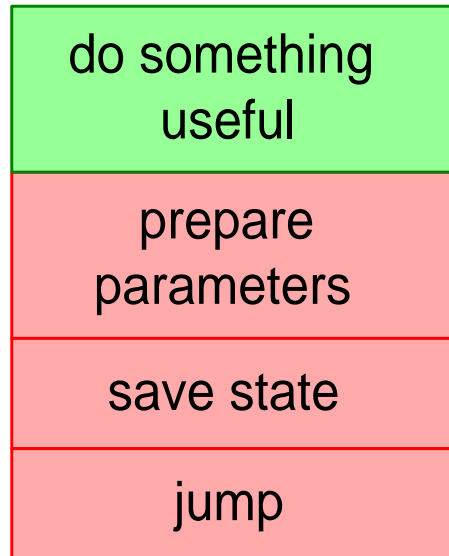
Example of Problem Propagation



Overhead Penalty of Modularity

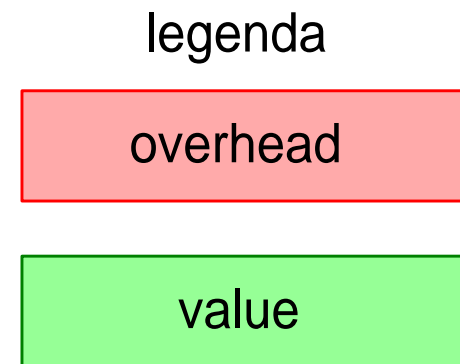


Function Call Overhead



Load and depth dependent
(hidden) side effects

pipeline flush
I-cache disturbance
D-cache disturbance



Suppose:

Call Overhead = $10\mu\text{s}$

Call graph branching factor = 2

Depth = 12

What is the Call overhead
when all branches are followed?

Suppose:

Function call = $10\mu\text{s}$

Call layer depth = 20

1024 calls per image

What is the maximum frame rate possible assuming that the complete CPU time is available for function calls?

Common Platforms and Bloating

Platforms are overprovisioned and very generic

Are benefits > disadvantages?

Performance loss is significant and can be measured and modelled

Multi-Dimensional Viewing of many Images: Greedy and Lazy Design Patterns

Greedy and Lazy systems



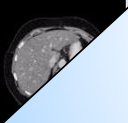




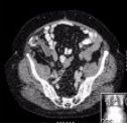
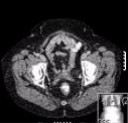
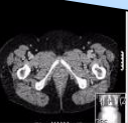
Greedy: pre-fetched lots of data:

System tries to have data available for the requesting system

Lazy: hardly of no pre-fetching of data:

System tries to set data available for the requesting system
only when asked for

Example Greedy / Lazy (1)

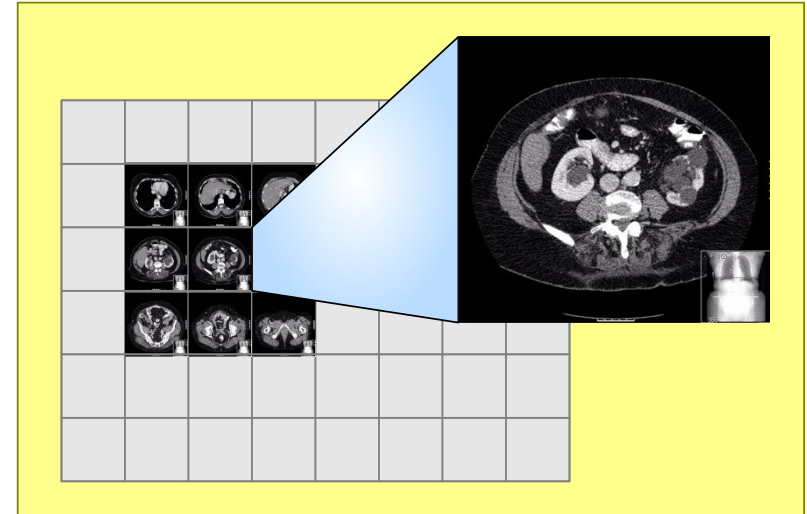
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META DATA=
Patient name
Slice nr. / position
annotation
explanation
date / time

Example Greedy / Lazy (2)

Lazy: Fetch only
the requested image

Greedy: Fetch all the images
in the set



In between options:

- Fetch requested image + surrounding images
- Fetch requested image + only meta information of images

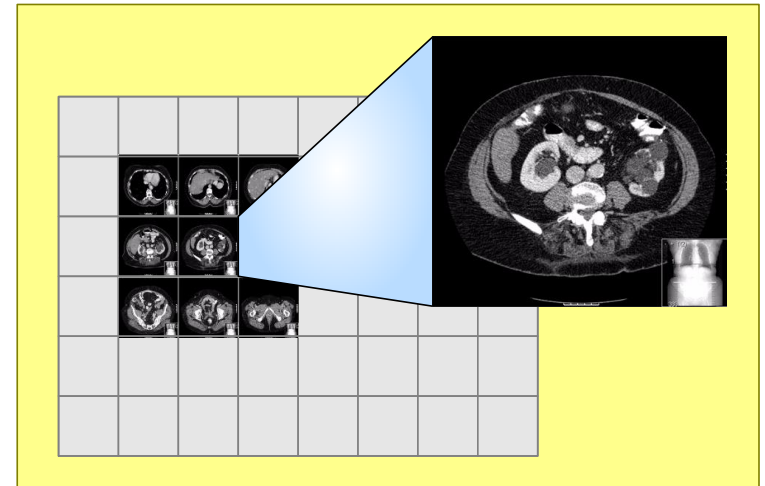
Example Greedy / Lazy (3)

Lazy:

- low load on system
- long waiting time for next image

Greedy:

- high load on system
- possible long initial wait
- short response time in steady state

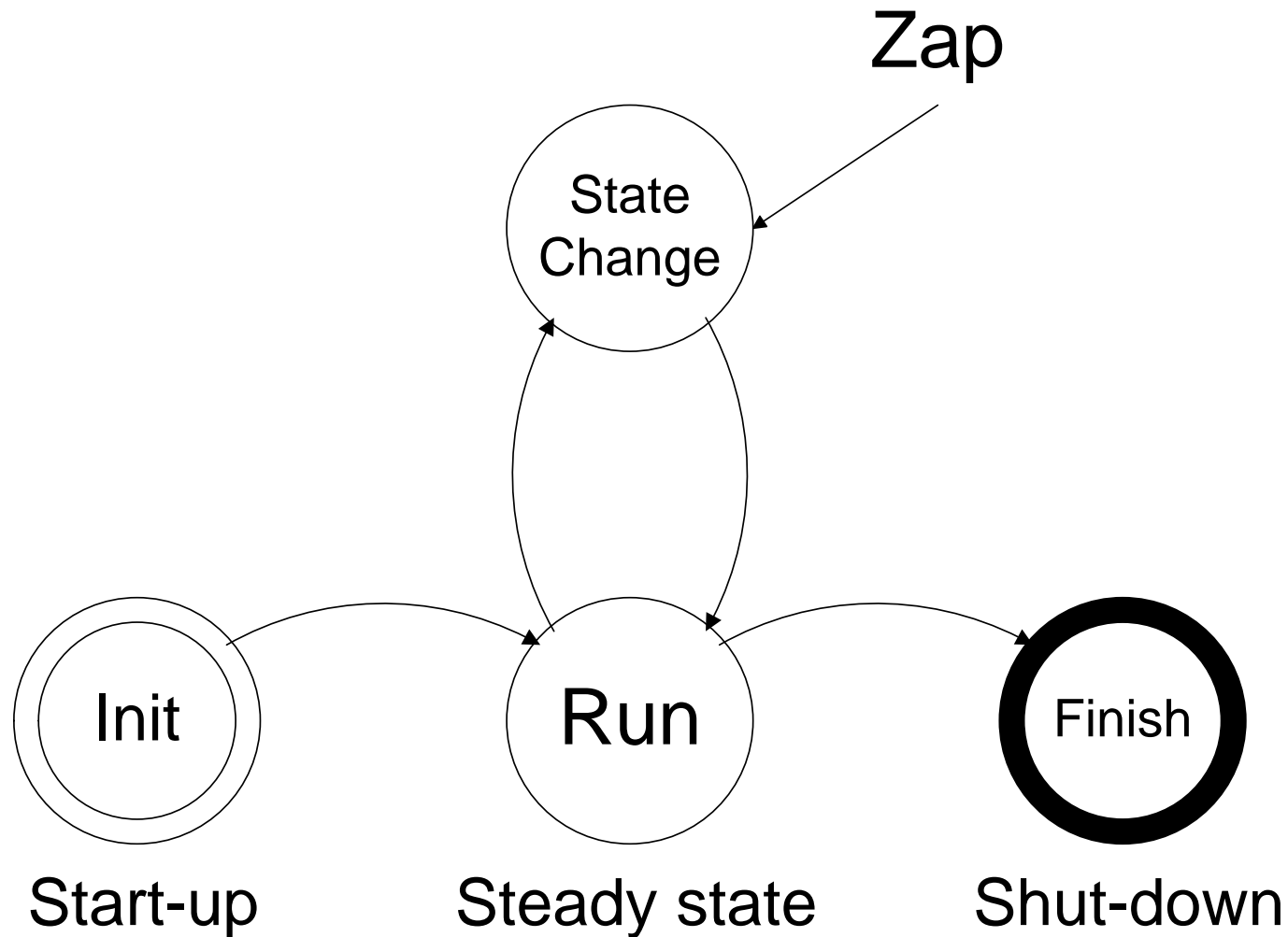


In between options:

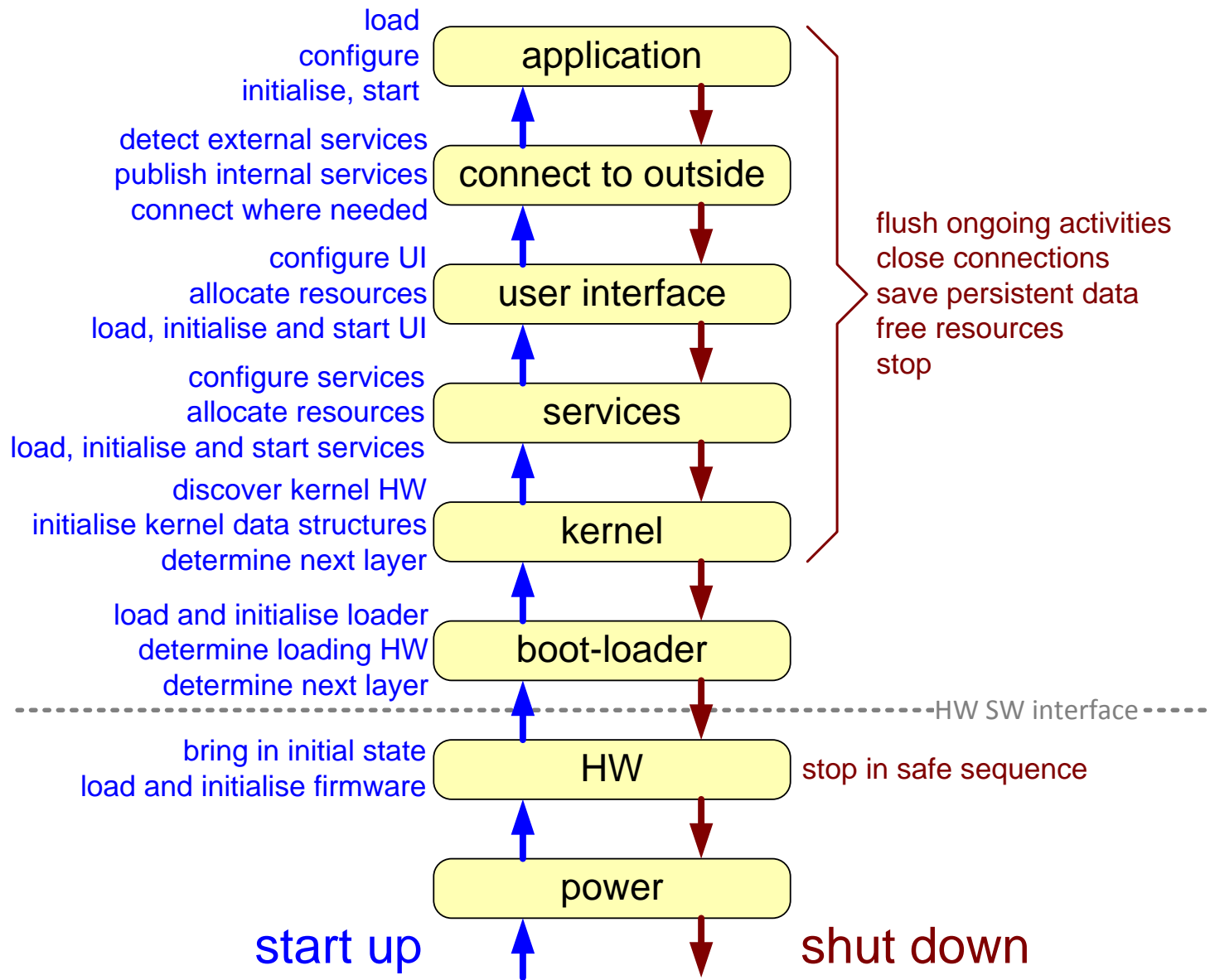
- medium system load
- fast response for initialization and common image fetches

Initialization, Steady State and Finalization

Start-up, Steady State, Shut Down



Start-up, Steady State, Shut Down Scheme

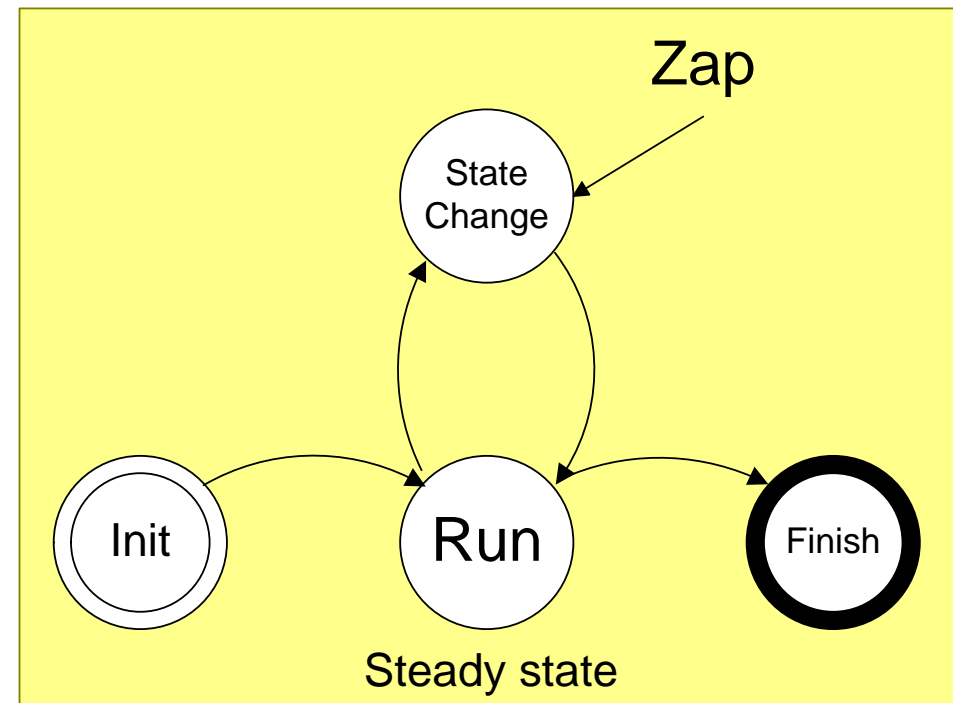


Start-up, Steady State, Shut Down Trade off

Trade-off:

Optimize on steady state
may result in
poor performance for initialization
and process finish

**Optimize on Initialization
and/or finish**
may result in
poor steady state performance



Common Performance Pitfalls

- Overhead
- Data bloating
- Cache thrashing
- Layering
- Process communication
- Conversions
- Serialization
- Backfiring optimisations
- Hidden loads (bus, DMA etc)
- Poor algorithms
- Wrong dimensioning

The ASP™ course is partially derived from the EXARCH course developed at *Philips CTT* by *Ton Kostelijk* and *Gerrit Muller*.

Extensions and additional slides have been developed at *ESI* by *Teun Hendriks*, *Roland Mathijssen* and *Gerrit Muller*.