# Modeling and Analysis: Analysis

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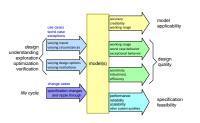
#### **Abstract**

Models only get value when they are actively used. We will focus in this presentation on analysis aspects: accuracy, credibility, sensitivity, efficiency, robustness, reliability and scalability.

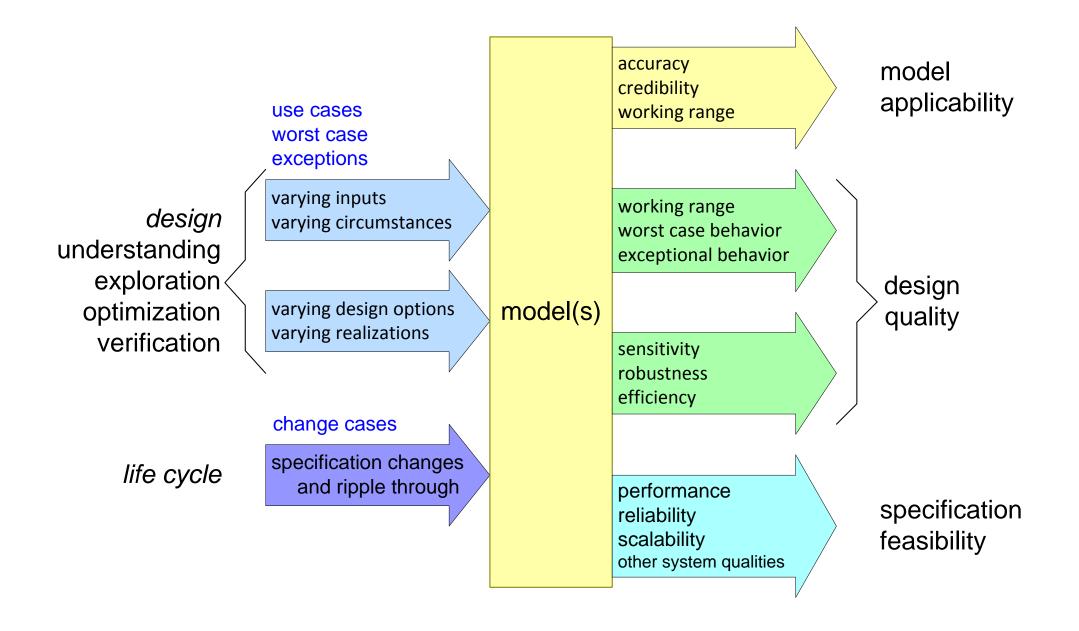
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## What Comes out of a Model





# Applicability of the Model

+**ε**1 - **ε**2

input accuracy credibility measurements abstraction assumptions facts

accuracy

credibility

working range

abstraction credibility working range

abstraction

model(s)

usage context specifications designs realizations

model realization credibility propagation



# How to Determine Applicability

### try out models

be aware of accuracy, credibility and working range

## simple and small models

1. Estimate accuracy of results

based on most significant inaccuracies of inputs and assumed model propagation behavior

2. Identify top 3 credibility risks

identify biggest uncertainties in inputs, abstractions and realization

3. Identify relevant working range risks

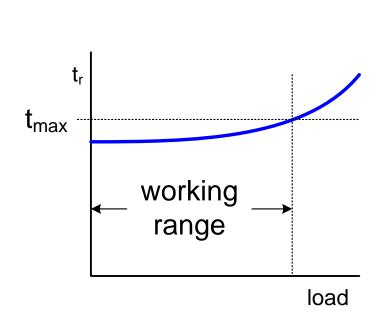
identify required (critical) working ranges and compare with model working range

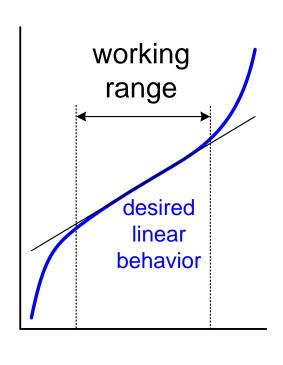
#### substantial models

systematic analysis and documentation of accuracy, credibility and working range



# Working Range examples



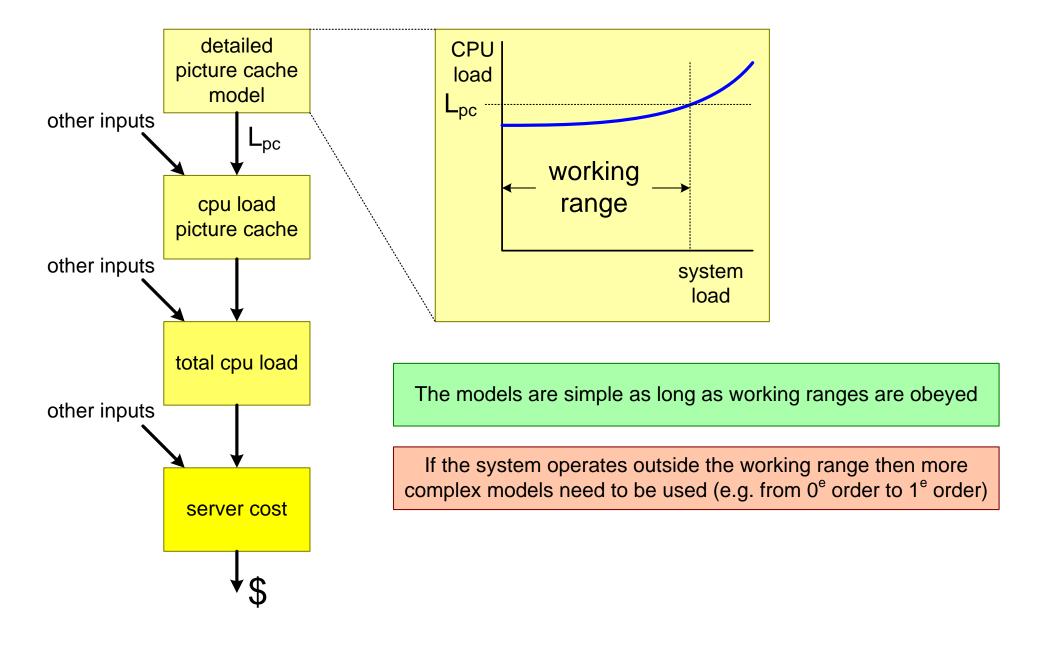


A system design assumption is often:
the performance of this function
{ is constant | is linear | doesn't exceed x | ...}

The working range is the interval where this assumption holds



# Example of Picture Cache Working Range





#### Common Pitfalls

discrete events in continuous world

discretization artefacts e.g. stepwise simulations

(too) systematic input data

random data show different behavior e.g. memory fragmentation

fragile model

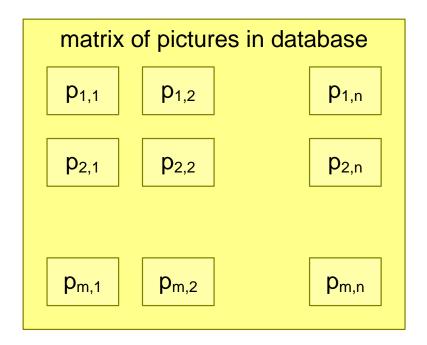
small model change results in large shift in results

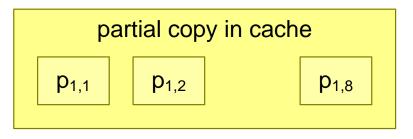
self fulfilling prophecy

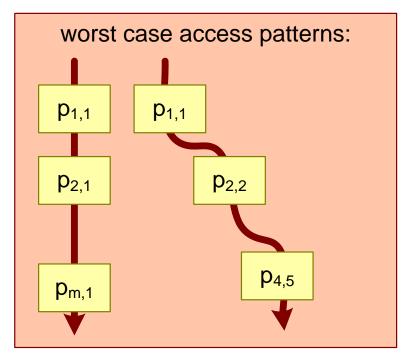
price erosions + cost increase (inflation) -> bankruptcy



# Example of Worst Case Picture Cache







What is the system behavior and performance for worst case access patterns?



### **Worst Case Questions**

Which design assumptions have a big impact on system performance?

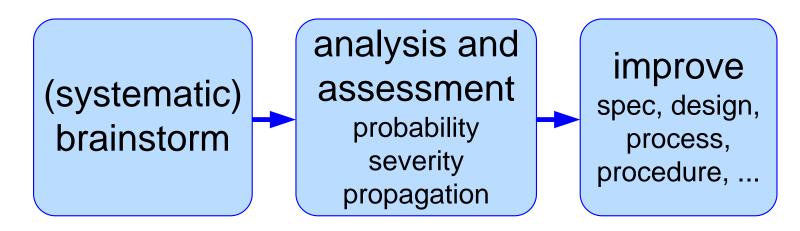
What are the worst cases for these assumptions?

How does the system behave in the worst case?

- a. poor performance within spec
- b. poor performance not within spec
- c. failure -> reliability issue



# FMEA-like Analysis Techniques



safety hazard analysis	potential hazards	damage	measures
reliability FMEA	failure modes exceptional cases	effects	measures
security	vulnerability risks	consequences	measures
maintainability	change cases	impact, effort, time	decisions
performance	worst cases	system behavior	decisions



# **Brainstorming Phases**

wave 1: the obvious

wave 2: more of the same

wave 3: the exotic, but potentially important

don't stop too early with brainstorming!



# Different Viewpoints for Analysis

# usage context

new product
e.g. WoW extension
merger
automated access

new functions new interfaces new media new standards

# system

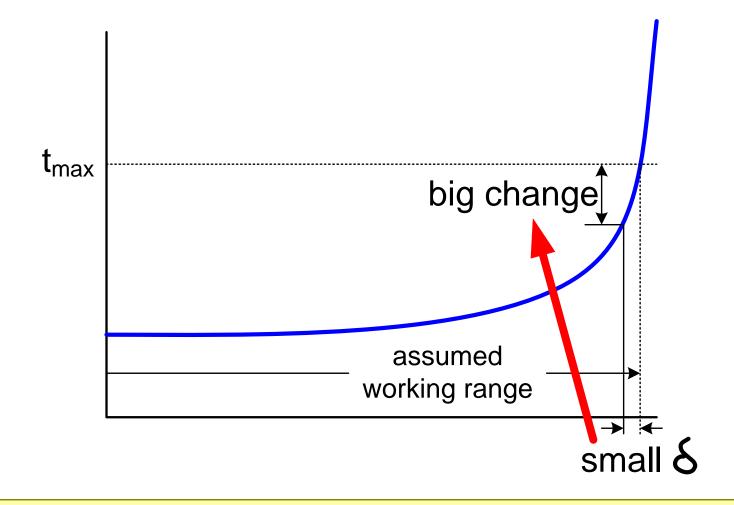
cache/memory trashing garbage collection critical sections local peak loads intermittent HW failure

power failure network failure new SW release roll back to old SW release

life cycle context



# **Example Sensitivity**

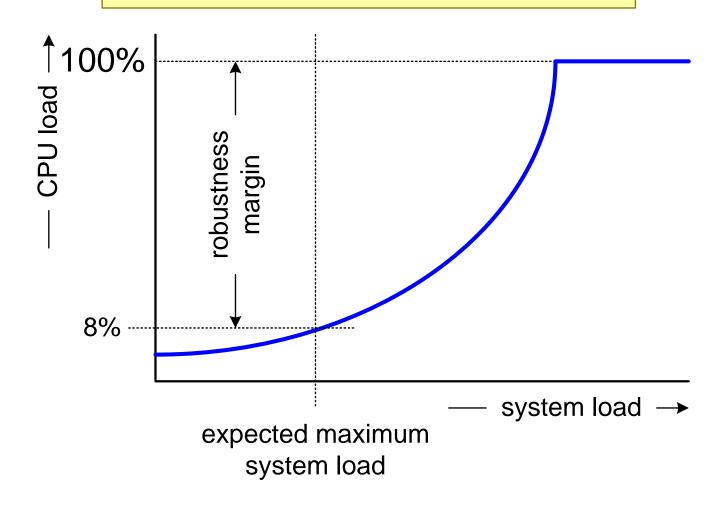


sensitivity: how sensitive is the system output for small changes in input or realization?



# Example of CPU Utilization and Efficiency

CPU utilization is "only" 8% what is the efficiency?





# Efficiency is Context Dependent!

