



**TECHNISCHE  
UNIVERSITÄT  
DRESDEN**

**Faculty of Computer Science** Institute of Systems Architecture, Operating Systems Group

# **MODELING DISTRIBUTED SYSTEMS**

**HERMANN HÄRTIG, DISTRIBUTED OPERATING SYSTEMS, SS2020**

use models to analyze, prove, predict, ... properties of  
concrete system AND

to **establish fundamental insights**

- abstract from details
- concentrate on functionality, properties, ... considered important for a specific system/application/question
- models in engineering disciplines very common, increasingly in CS as well

## Purpose

- describe the timing requirements of an application
- describe available resources
- question:  
can the application run on/use these resources such that timing requirements are fulfilled

## Model elements:

- periodic tasks, deadlines, worst-case exec time, ...

Hopefully RTS class is offered in future (by my successor)

<u>Model</u>	<u>Objective/Question</u>
■ Failure Trees	are all failures and their combinations taken into account
■ statics models	does a house fall down (snow, quake) what kind of vehicles on a bridge
■ control laws	stability of controllers
■ Ohm's Law	behavior of circuits



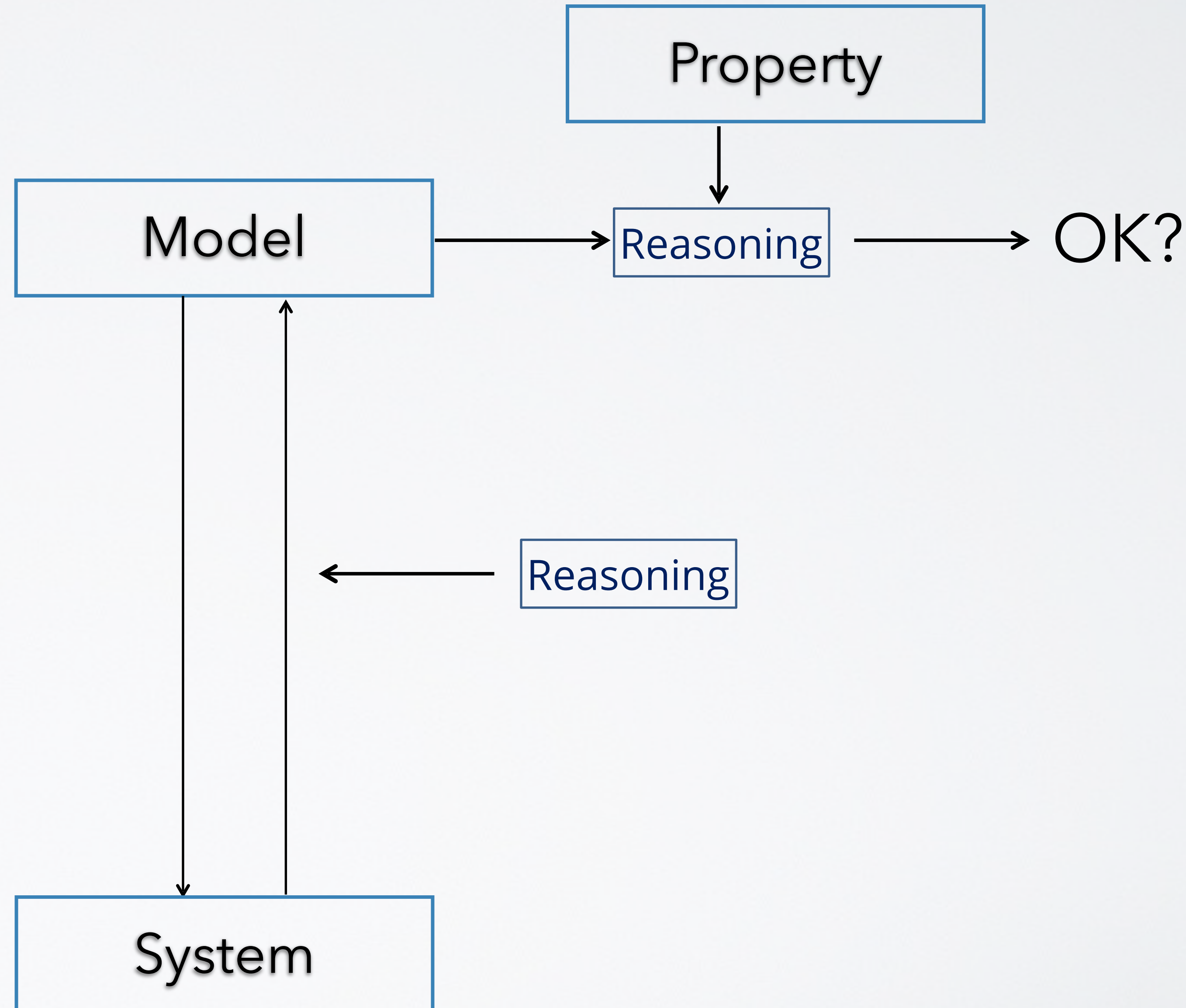
$$I = V/R$$

- Q1: Is it possible to build arbitrarily reliable Systems out of unreliable components?
- Q2: Can we achieve consensus in the presence of faults (consensus: all non-faulty components agree on action)?
- Q3: Is there an algorithm to determine for a system with a given setting of access control permissions, whether or not a Subject A can obtain a right on Object B?

2 Models per Question !

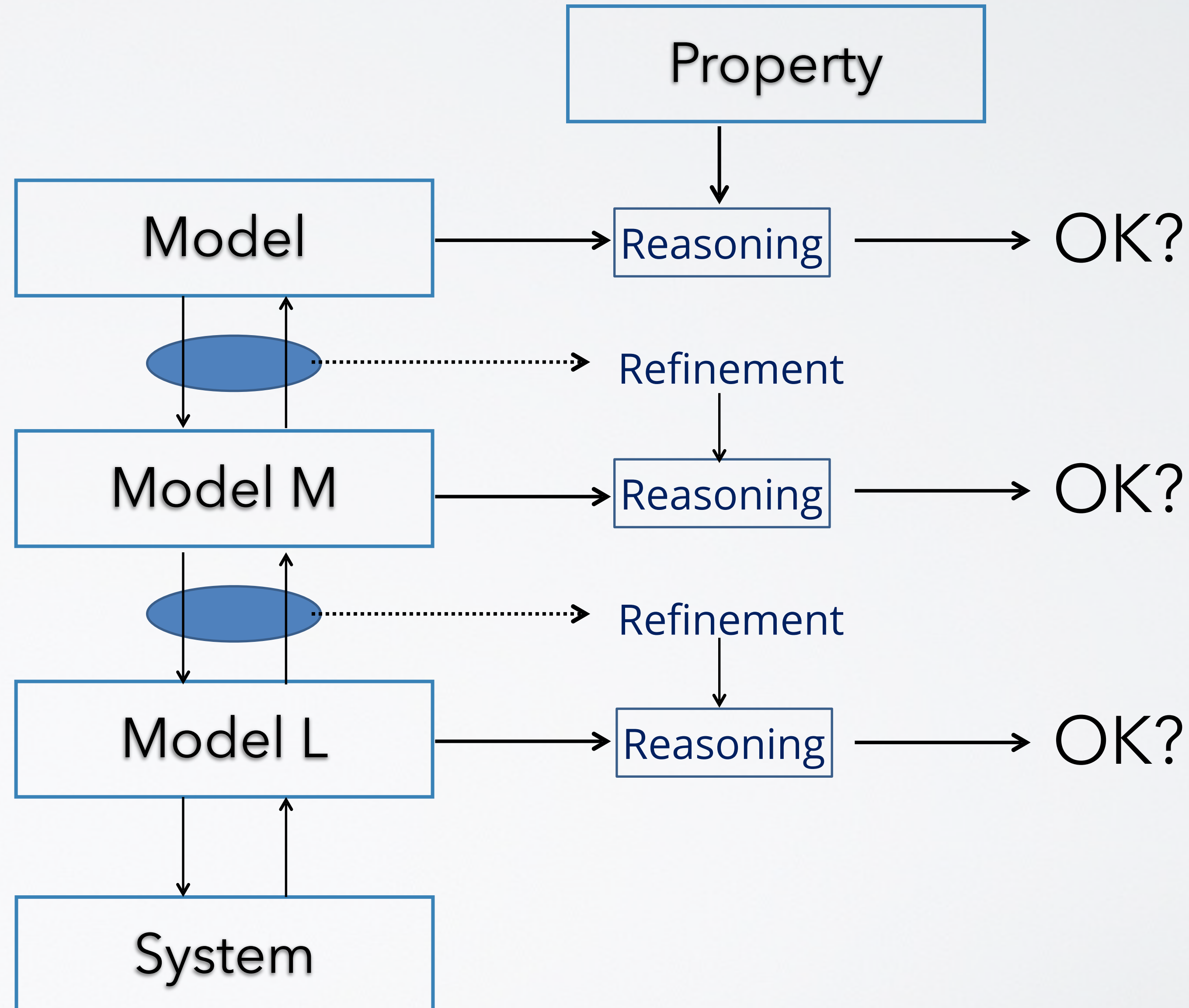
## Reasoning:

- Common sense
- Formal Verification
- Careful Inspection
- Mathematics



## Reasoning:

- Common sense
- Formal Verification
- Careful Inspection
- Mathematics ...
- **“Refinement”:**
  - Abstraction
  - Implementation
  - Formal Refinement





<u>Model</u>	<u>Objective/Question</u>
■ Amdahl's Law	Scalability
■ Turing Machine	Halting problem, Decidability
■ Logic	Correctness, Precision, ...

- Objective of lecture:  
understand the power of models and the need for their careful understanding
- models in detail, but math results by intuition not proofs
- Try to find answers to question Q1 ... Q3  
BEFORE viewing the other pieces of the lecture and the full slide set

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