

# Performance Evaluation of Computer Systems



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# Textbook

- **Main:**

- Giordano, Frank, William P. Fox, and Steven Horton. *A first course in mathematical modeling*. Nelson Education, 2014.

- **Side books:**

- Obaidat, S. M., and N. A. Boudriga., *Fundamentals of Performance Evaluation Computer Telecommunications* 2010.
- Bolch, Gunter, Stefan Greiner, Hermann de Meer, and Kishor S. Trivedi. *Queueing networks and Markov chains: modeling and performance evaluation with computer science applications*. John Wiley & Sons, 2006.

- نظریه صف، دکتر محمد مدرس، دکتر ابراهیم تیموری، انتشارات دانشگاه علم و صنعت ایران، ۱۳۹۵

- مدلسازی و ارزیابی سیستم‌های کامپیوتری، دکتر محمد جعفر تارخ، نص، ۱۳۸۱

# Points:

<b>Final Exam:</b>	<b>40</b>
<b>mini-projects:</b>	<b>20</b>
<b>Mid-Term (take home):</b>	<b>30</b>
<b>Class activities + presenting assignments:</b>	<b>10</b>

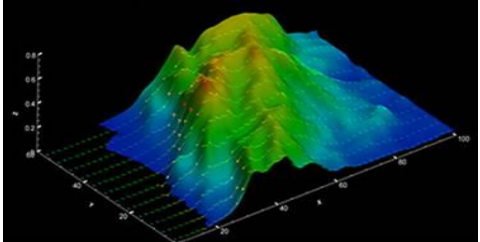


**MATLAB**<sup>®</sup>

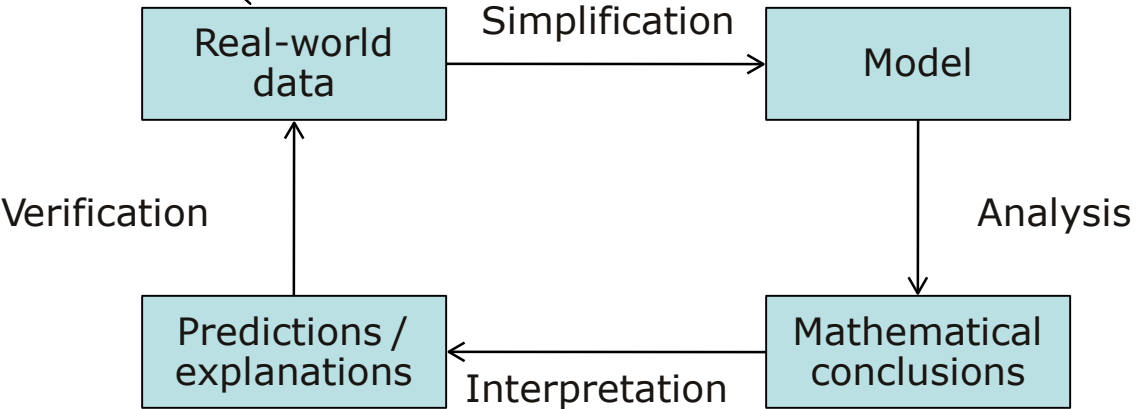
# The blind men and the elephant

- **First man (feeling the side): like a wall**
- **Second (the tusk): like a spear**
- **Third (the trunk): like a snake**
- **Fourth (the knee): like a tree**
- **Fifth (the ear): like a fan**
- **Sixth (the tail): like a rope**

# Modeling



Start here



**Evaluation**

- OUTSTANDING
- Excellent
- Very Good
- Average
- Below Average

# Modeling

- **What is a model?**
  - A (partial) view of the reality
  - An abstraction of the reality
  - A representation of the (supposedly) main features of the reality, including the connections among them
  
  - For a given object of study, many models may be given, possibly focusing on different features of the object
- **What a model is not**
  - A model is not the reality
  - A model is not certain!
- **Many types of models exist!**
- **“All models are wrong, some are useful”**
  - *Box, G.E.P., Robustness in the strategy of scientific model building, in Robustness in Statistics, R.L. Launer and G.N. Wilkinson, Editors. 1979, Academic Press: New York.*

# Examples

- **Models of a building**

- **The foundation plan**
- **The water pipes plan**
- **The electricity plan**
- **The ventilation plan**
- **The room division plan**
- **Division of people into rooms**

- **Maps**

- **Geographic map**
- **Political map**
- **Road map**
- ...

- **Models of morality**
- **Family models**
- **Role models**

- **Models of society**
- **Political models**
- **Election models**
- **Political representation models**

- **Weather models**
- **Traffic models**

- **Infection models**

- **Company development models**
- ...

# Types of models

- **Mental models:**
  - E.g., He is trustable
- **Verbal models:**
  - E.g., expert systems
- **Physical models:**
  - E.g., building, airplane,...
- **Mathematical models:**
  - Mathematical models for input and output of a system
  - E.g., relationship between variables or parameters, like Ohm's law



# Mathematical and computational modeling

- **We focus in this course on mathematical and computational models**
  - As we saw, many other types of models exist
  - “Model” is indeed a very overloaded word
  - In this way, we define a model as a *mathematical* representation of the reality
  - Models that mimic the reality by using the language of mathematics
  
- **Goal of the course**
  - An introduction to the process of mathematical modeling
  - Give a number of techniques used for:
    - Building a model
    - Analyzing a model
    - Using a model
    - Simulating a model
  - Not a course in mathematics, rather in the use of some mathematical techniques for the purpose of modeling
    - How to use various tools (specifically Matlab)
    - Little on the math properties of the tools

# Mathematical models

- **Starting point for modeling: divide the world into 3 parts**
  - Things whose effects are neglected
    - Ignore them in the model
  - Things that affect the model but the model is not designed to study their behavior
    - External variables, considered as parameters, input, or independent variables
  - Things the model is designed to study their behavior of
    - Internal (or dependent) variables of the model
- **Deciding what to model and what not is difficult**
  - **Wrong things neglected:** the model is no good
  - **Too much included:** complex model
  - **Choose the internal variables wrongly:** the model will not capture its target

# Modeling approaches in this course

- **Mathematical models**
  - **Continuous vs. discrete mathematics**
  - **Deterministic vs. stochastic mathematics**
- **Different methods:**
  - **Probability Models and Stochastic Processes**
  - **Differential equations**
  - **Graph theory**
  - **Decision theory (Decision trees)**
  - **Game theory**
  - **Queueing theory**
  - **Marcov chain**
  - **Petri Net**
  - **Cellular automata**

# For the next session

- Install the last version of Matlab
- Learn the basic coding