Effective Teaching Techniques Using MATLAB and Simulink

Arun K. Tangirala

PSE & Data Sciences Group,
Department of Chemical Engineering
IIT Madras

Outline

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- Motivation

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- What involves Engineering Education?

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- Motivation
- What involves Engineering Education?
- Building practice into theory

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OUTLINE

- Motivation
- What involves Engineering Education?
- Building practice into theory
- Few case studies
  - *General computation*
  - *Simulating dynamical systems*
  - *Building approximate linear models*
  - *Frequency-domain (spectral) analysis*
  - *Handling uncertainties and parameter estimation*

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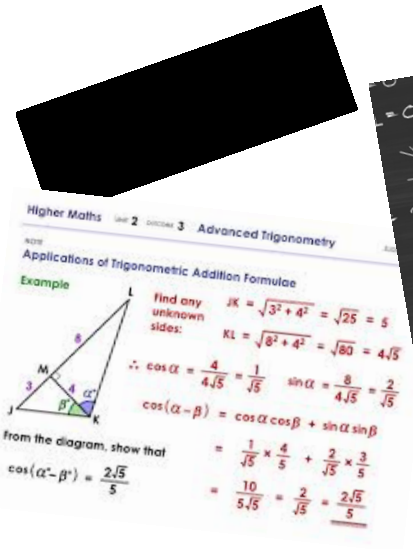
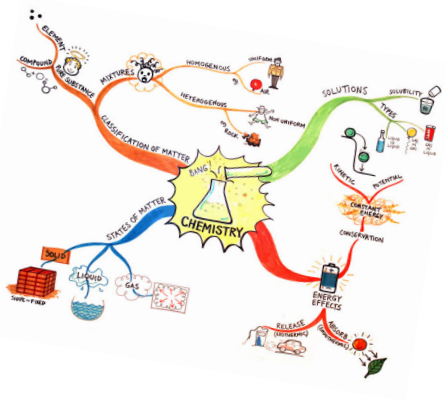
High School Education

Equations

Pure sciences

Trained for solving exact and pure problems





Engineering Education: Current Practice

- Maths & Sciences taught as pure subjects - zero emphasis on applied aspects!
- Theory courses followed up with lab sessions across semesters
- Pure software courses (e.g., in MATLAB, ASPEN, etc.)
- Very little emphasis on intuition and perspectives
- Drawbacks:
  - *Cannot place mathematics and sciences in context*
  - *Disconnect between theory and practice*
  - *Theory is not understood and practice is boring*
  - *Graduation without realisation*

RISKS

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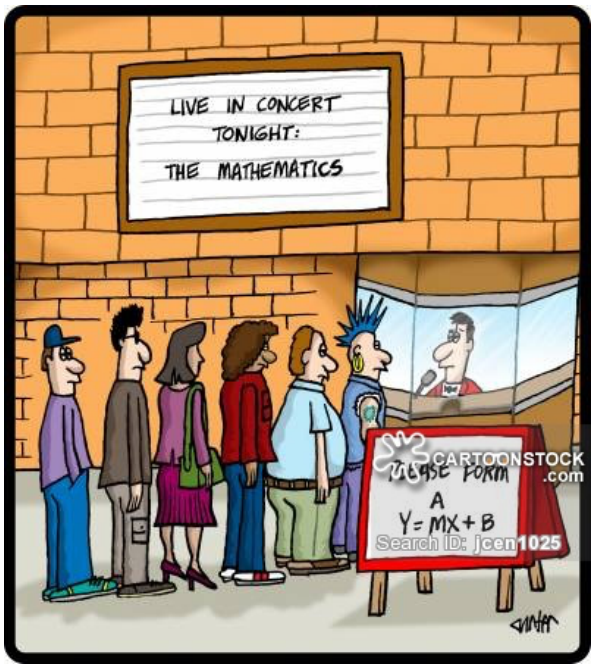

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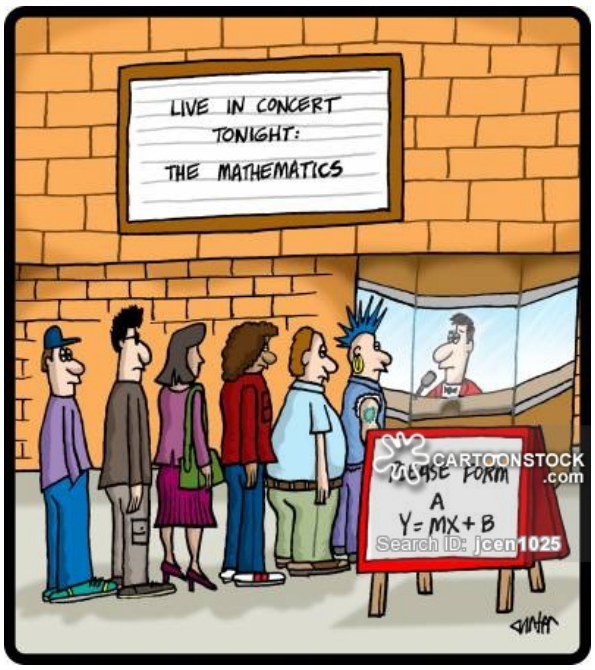
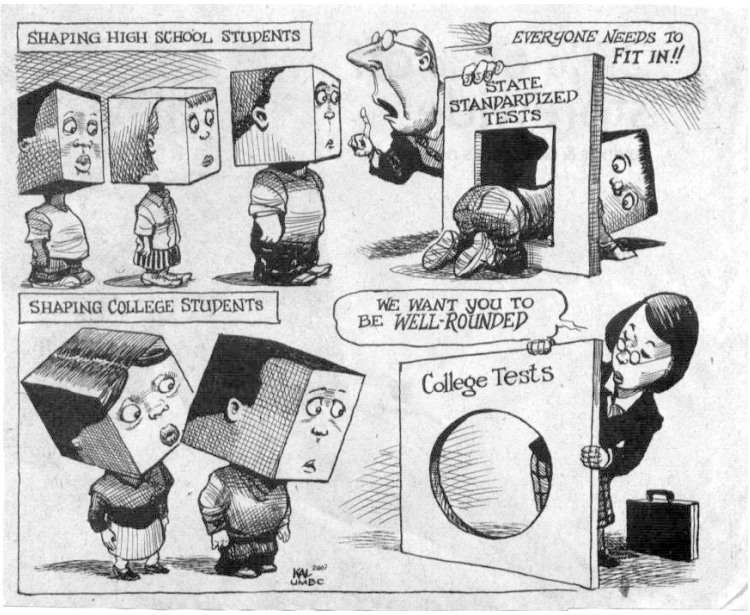
Risks





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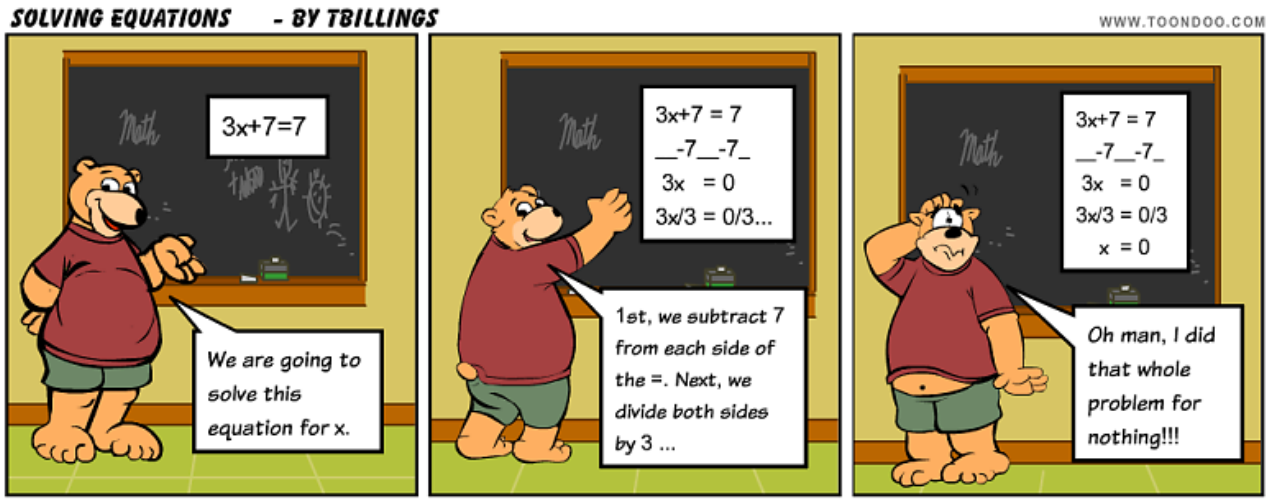

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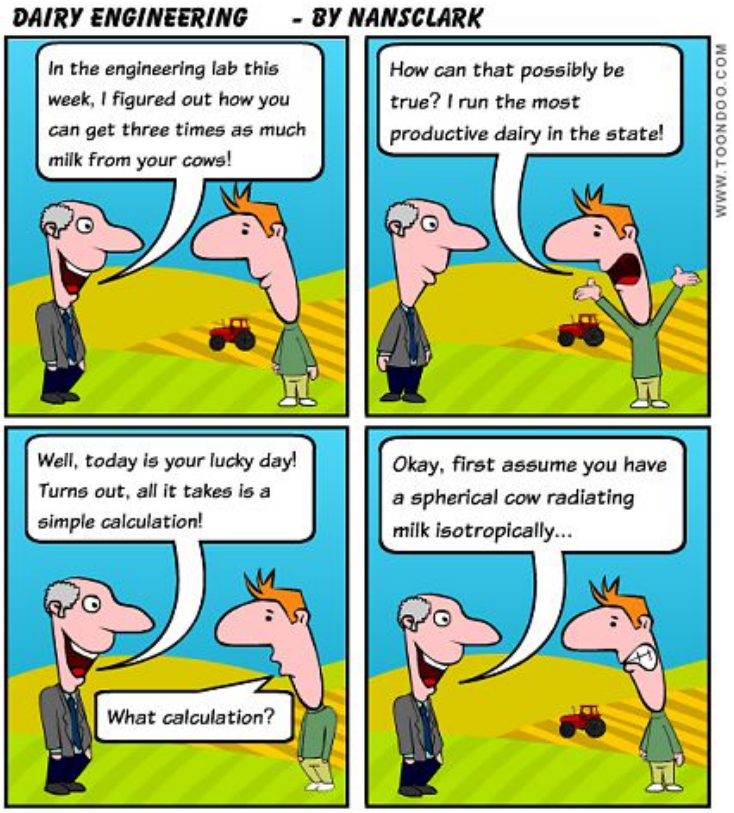

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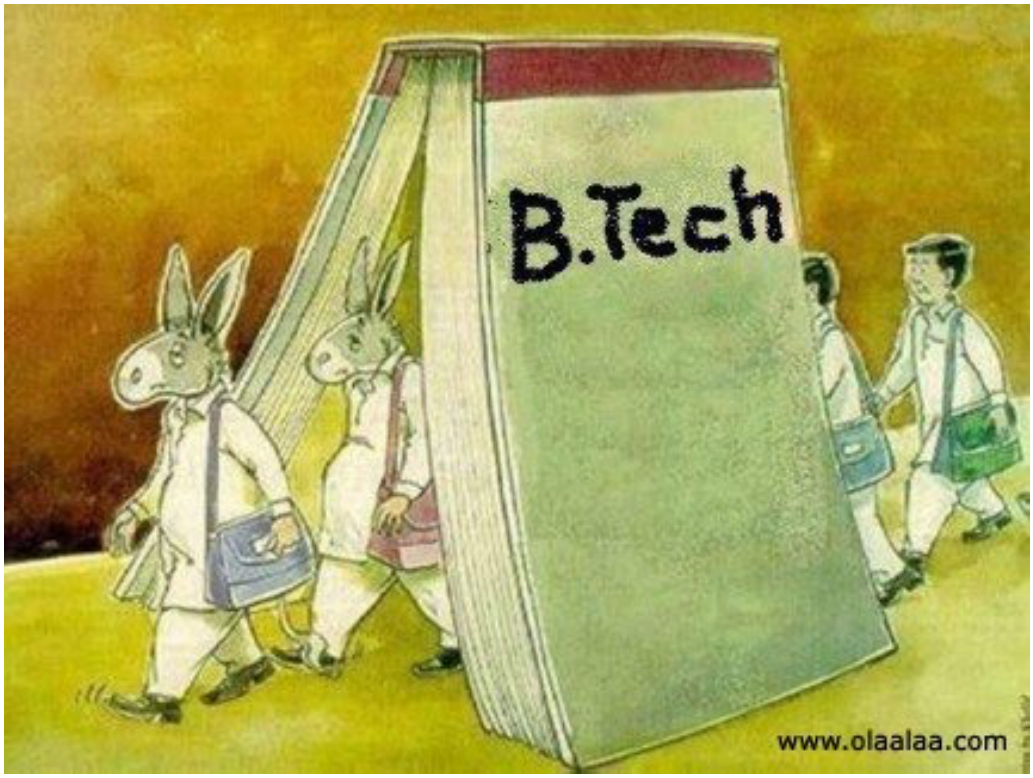

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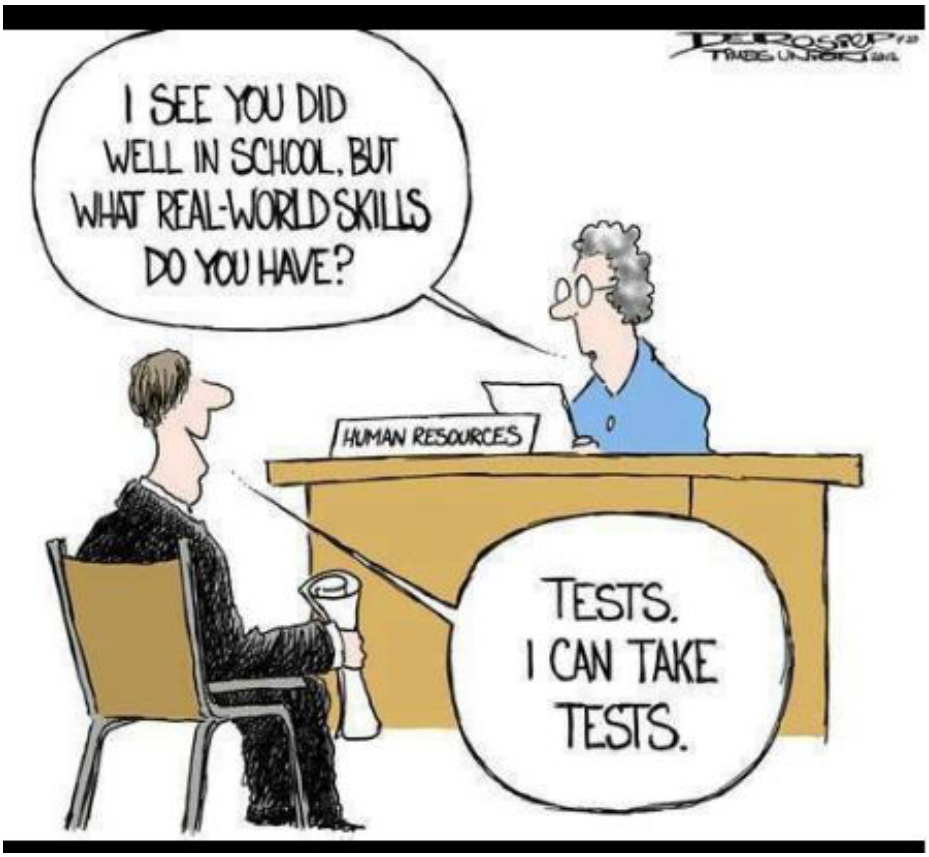

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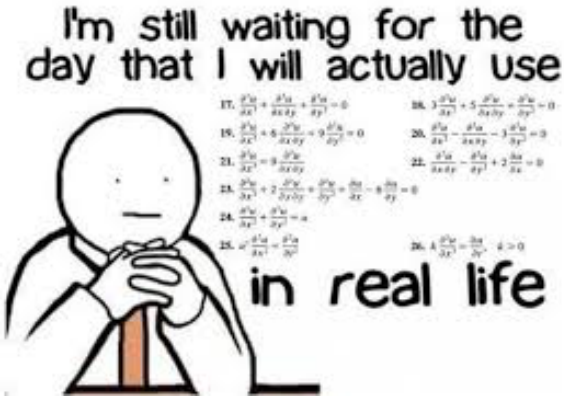

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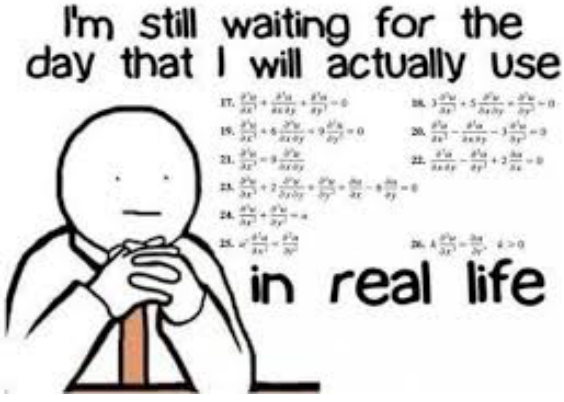

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Teach how probability and statistics are useful!

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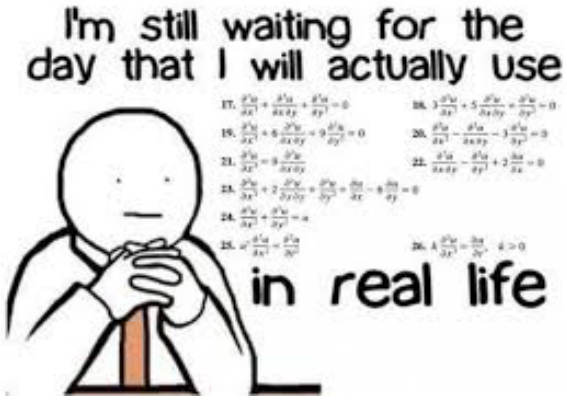
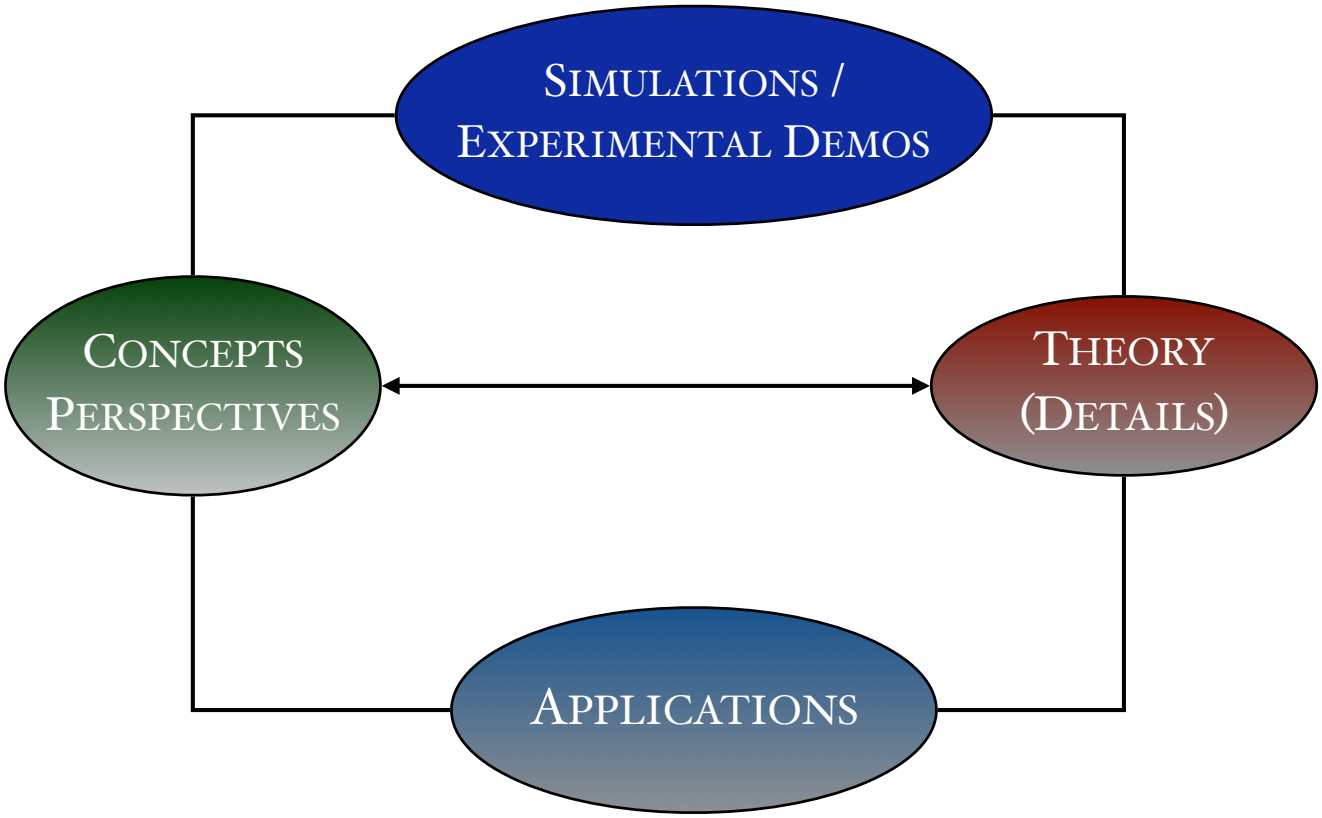


Show how math and sciences, blend and get into action.

Teach how probability and statistics are useful!

1. How do equations get into action! (**Equactions**?)
2. How to deal with **uncertainties?**
3. How to **estimate?**

Connecting Concepts with Details



To Remember

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A lecture is worth thousand reads

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Simulation is worth thousand lectures!

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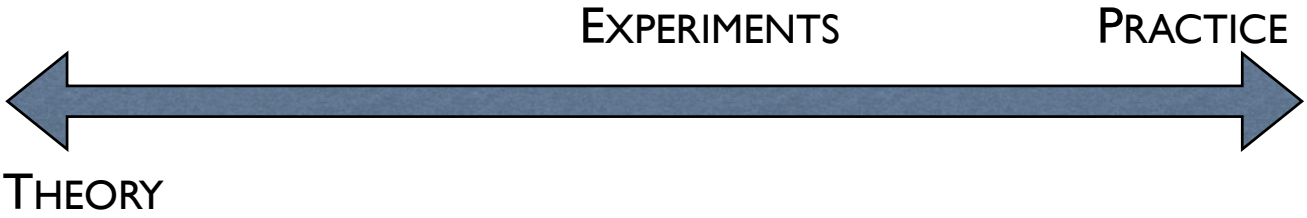
Simulation is worth thousand lectures!

Healthy blend of **technology, analogies, similitudes, theory and practice** makes a complete package

Role of Simulations

ROLE OF SIMULATIONS



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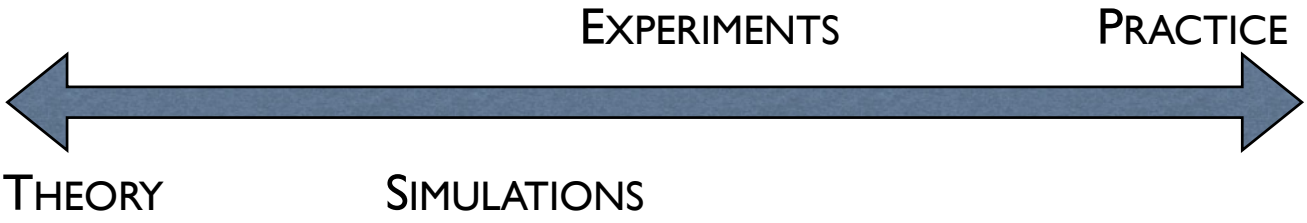

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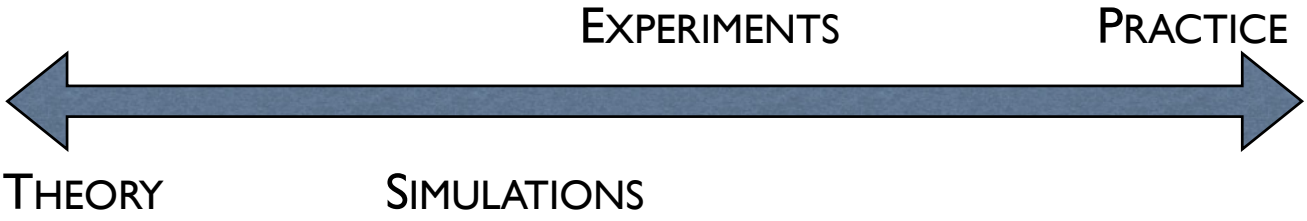

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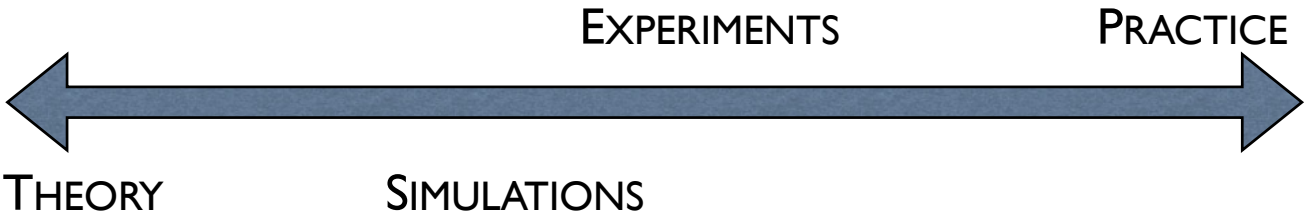

What can simulations offer?

- Powerful reinforcements and supplements for theory

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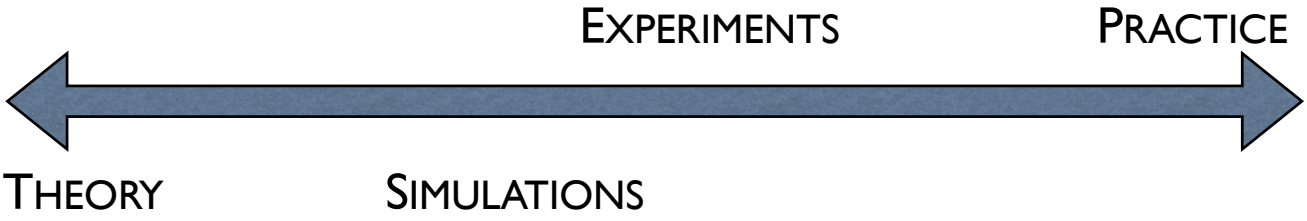

What can simulations offer?

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- Building highly effective motivational and practical case studies

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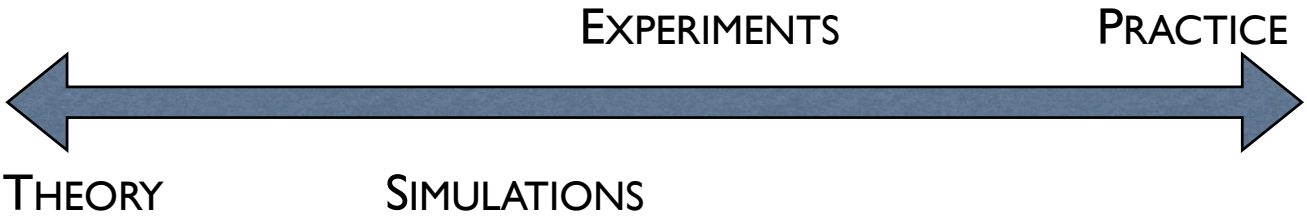

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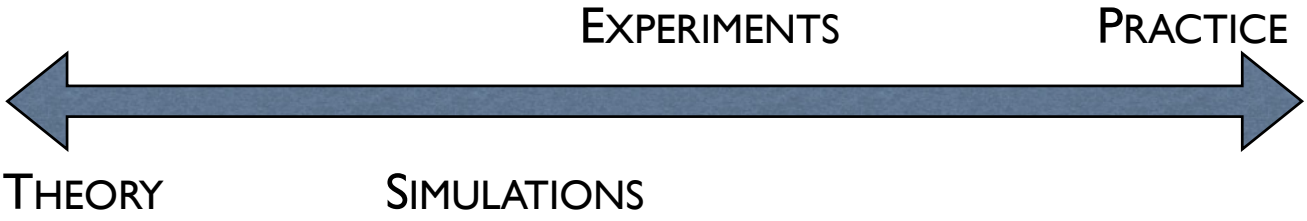

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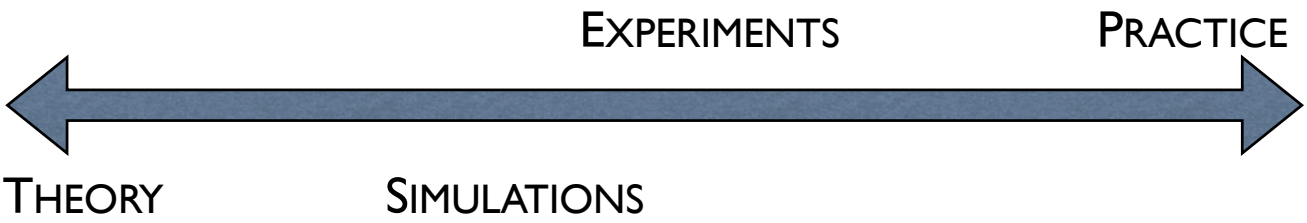

What can simulations offer?

- Powerful reinforcements and supplements for theory
- Building highly effective motivational and practical case studies
- Excellent tools for zones where theory fears to tread
- Safe and effective substitute for experiments
- Opportunities for innovation and testing

Teaching Paradigms

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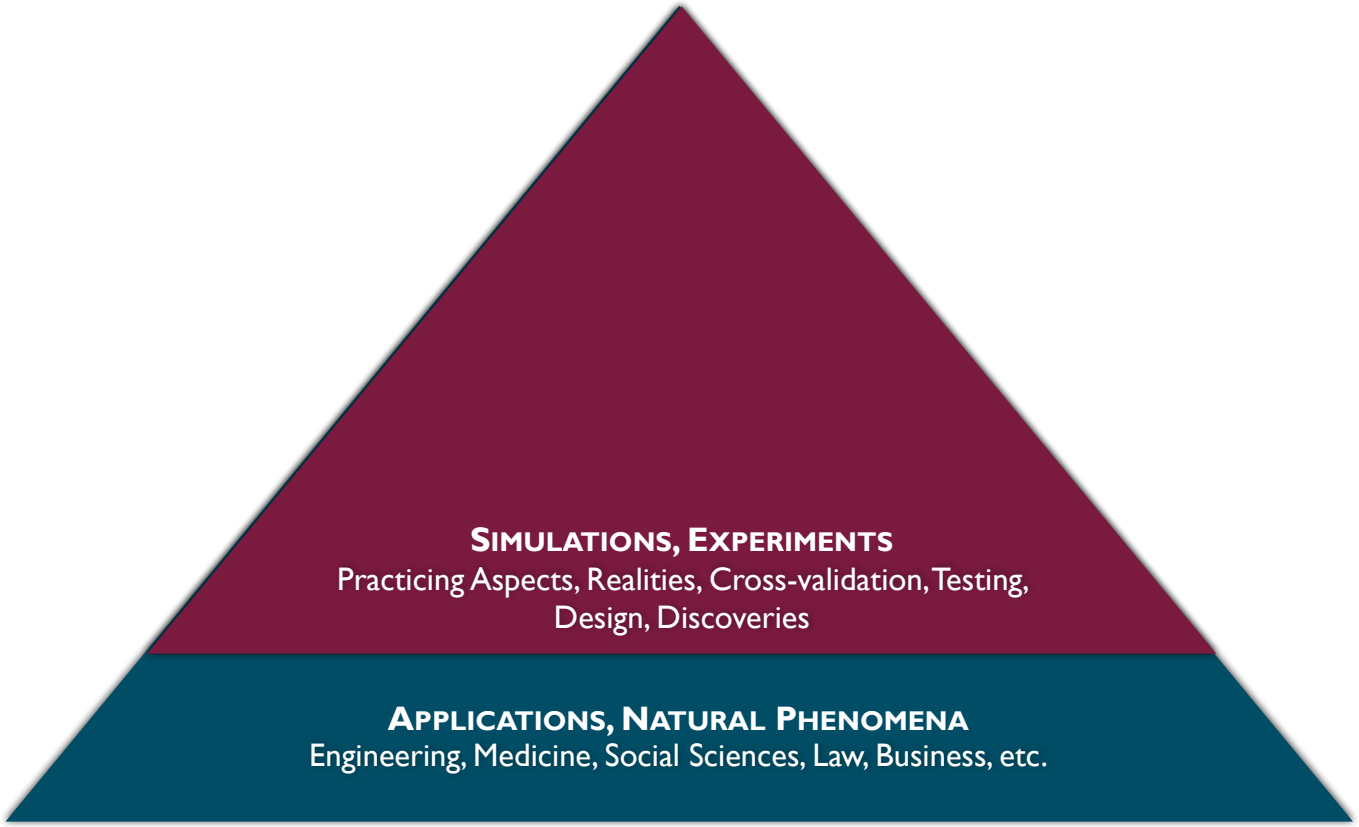

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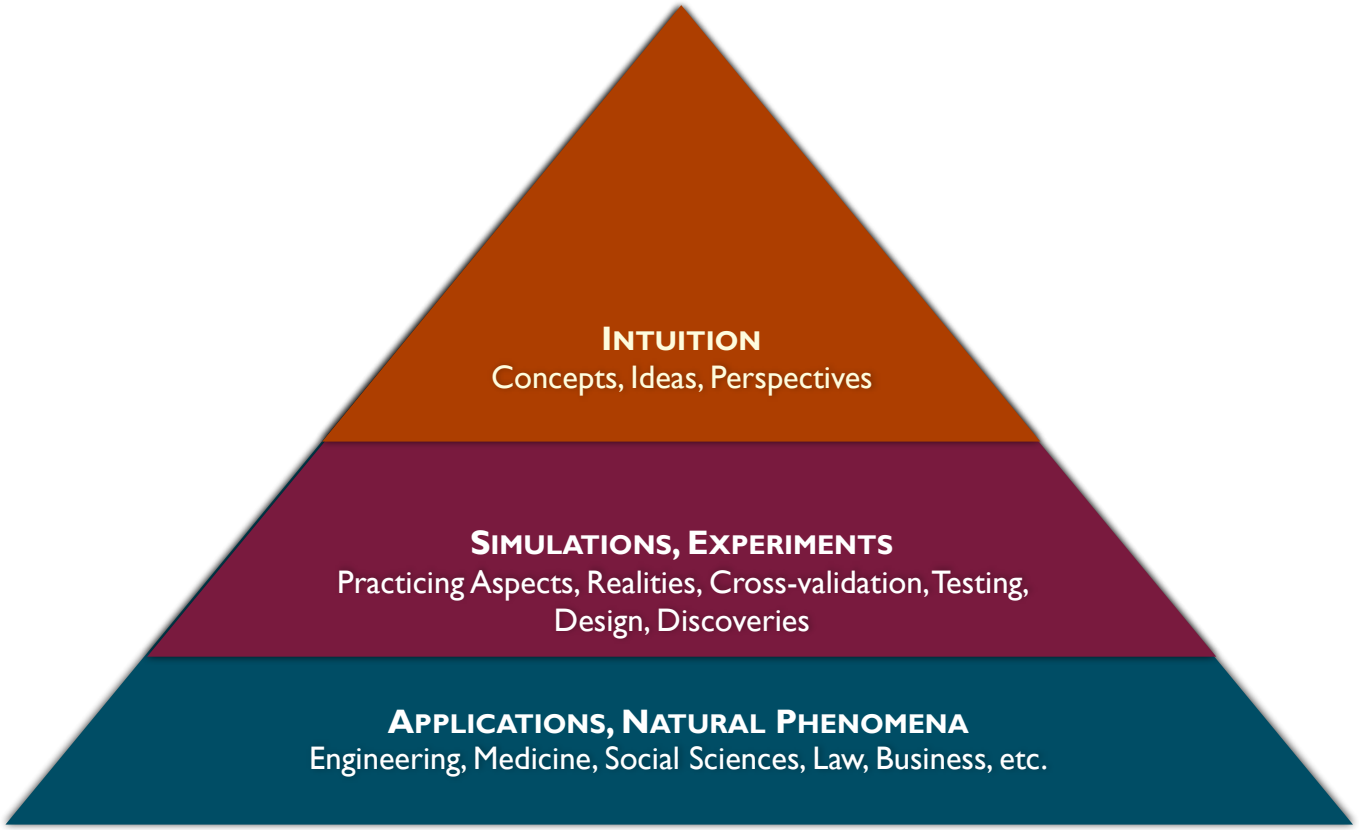

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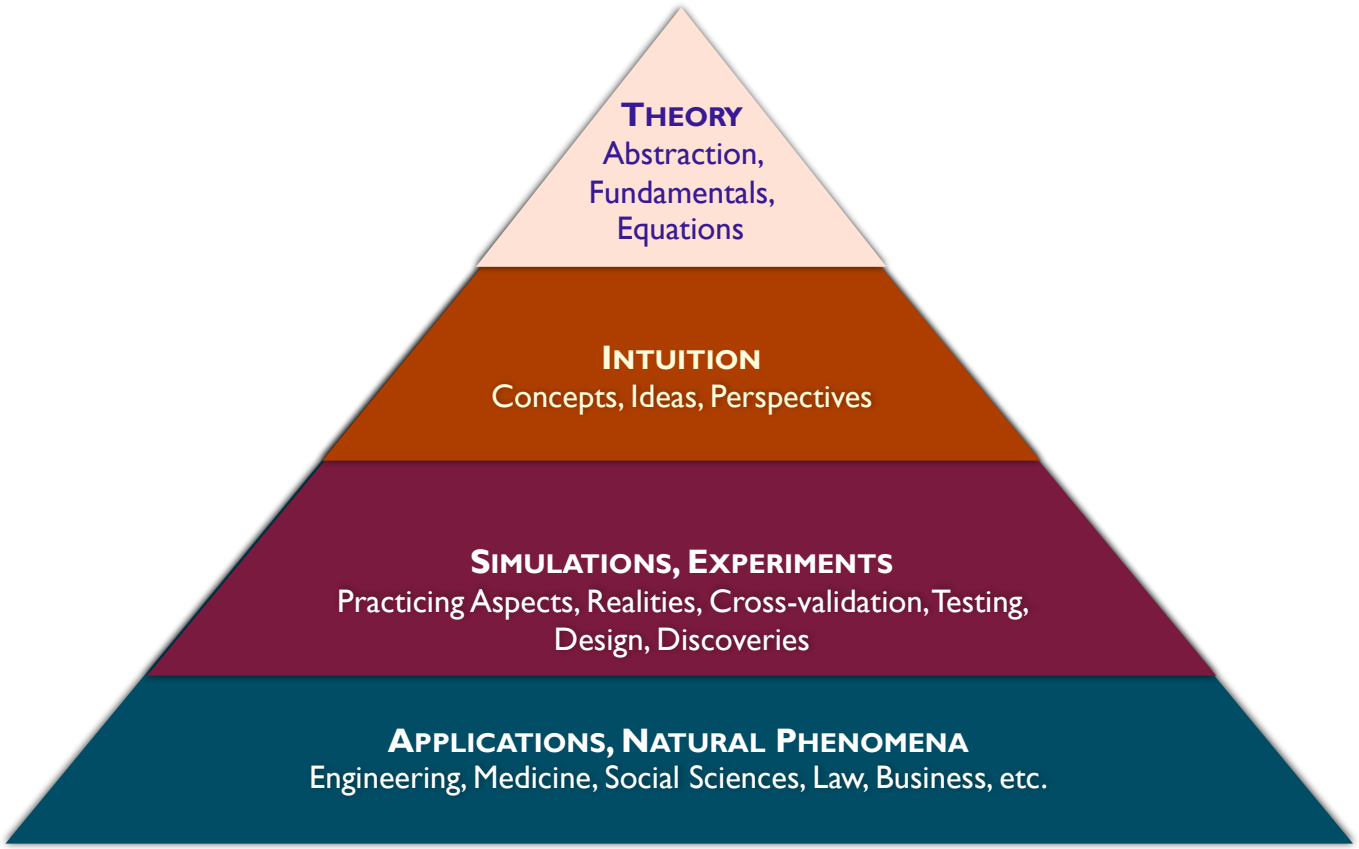

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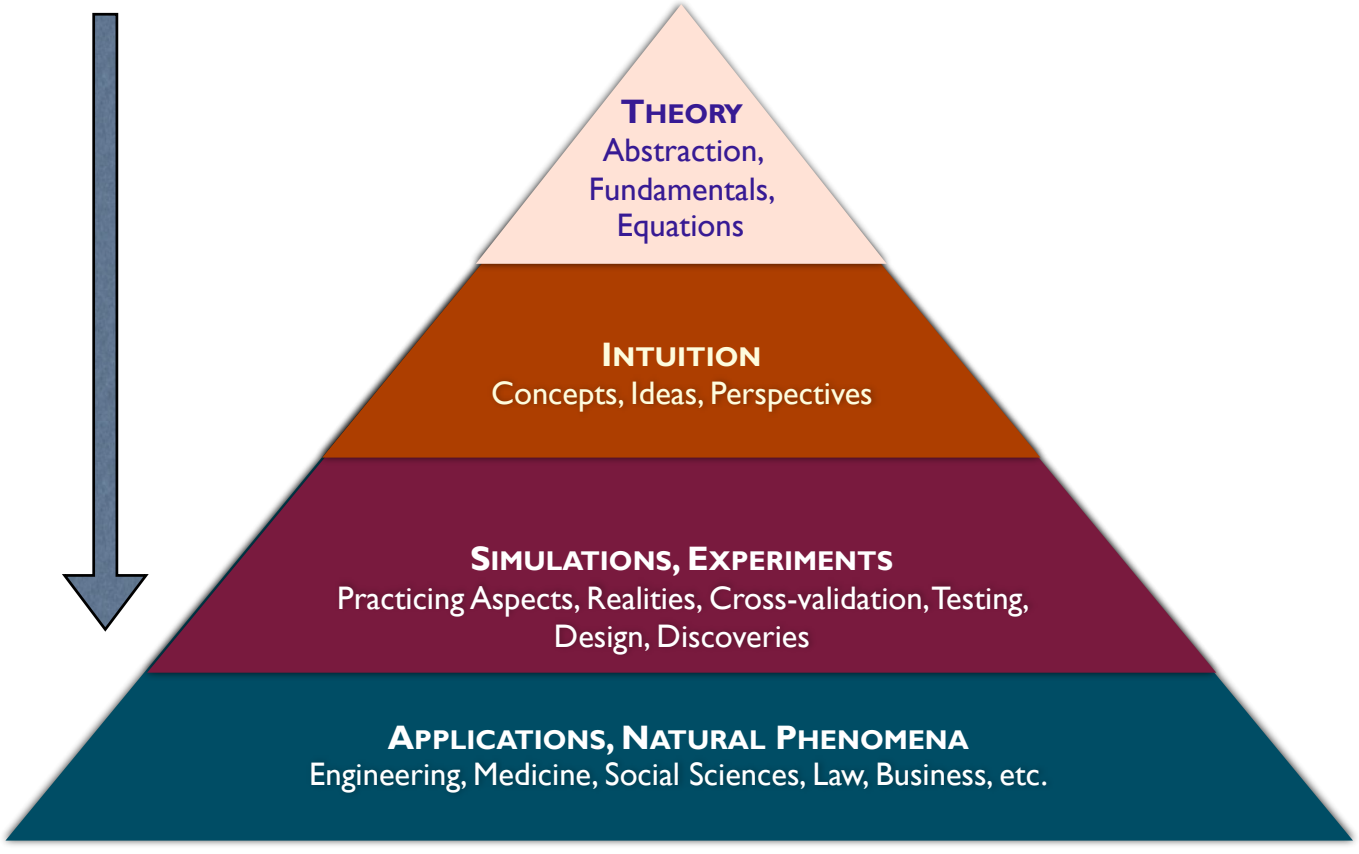

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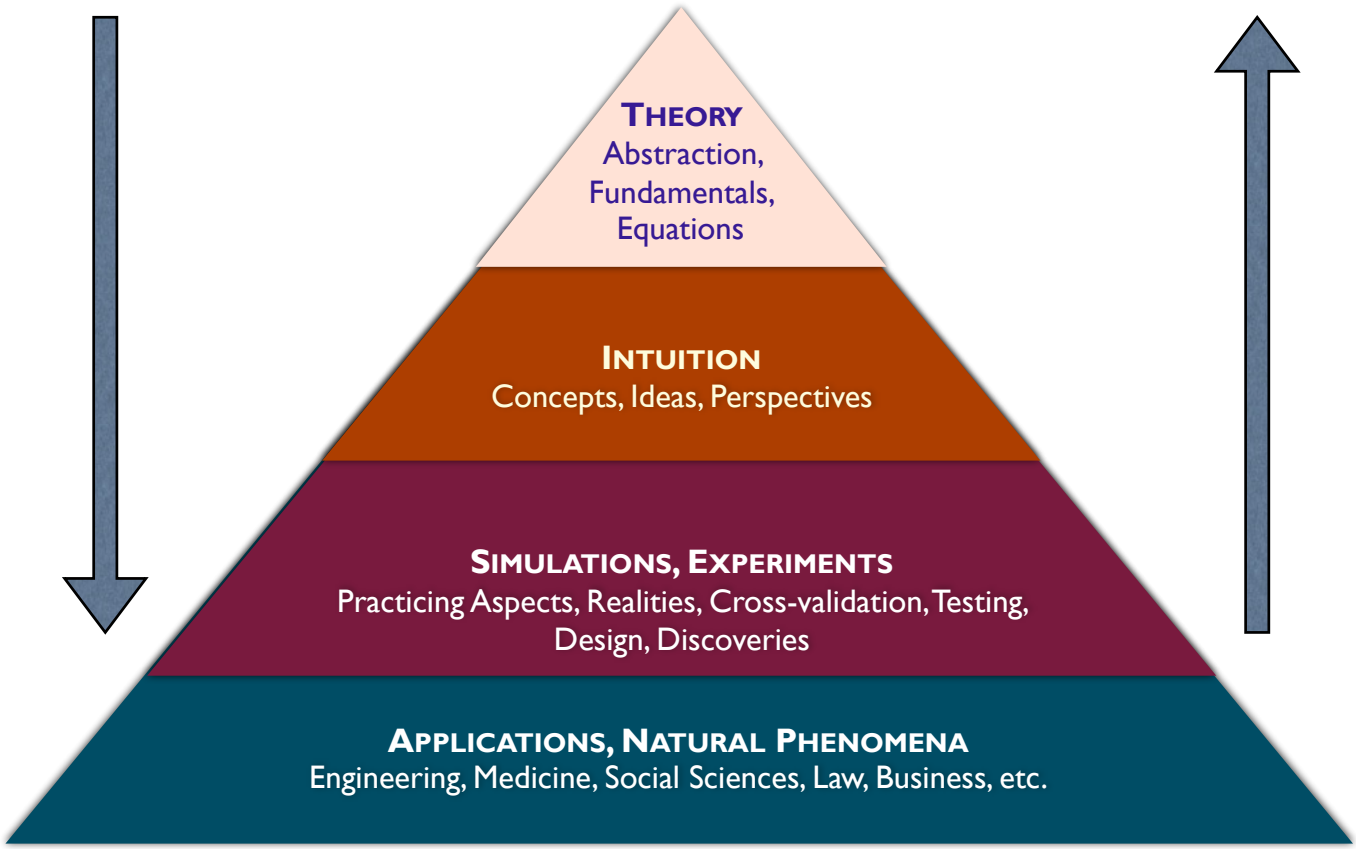

Case Studies

- Elementary computing
  - *MATLAB*
- Understanding and simulating dynamical systems
  - *MATLAB and SIMULINK*
- Approximating non-linear systems through linearisation
  - *MATLAB and SIMULINK*
- Signal estimation and Fourier transform
  - *MATLAB*
- Simulating uncertainties and parameter uncertainties