MODELLING OF PHYSICAL SYSTEMS

Thursday 2-5 pm, weeks
1-11
10 credits

LAYOUT

- 33 hours in 11 supervised sessions
- 33 hours in 11 unsupervised sessions
- 34 hours report preparation

ASSESSMENT

- Project 1: week 1-4 Write up week 5
  (due in by on Feb. 29th) 1/3

- Project 2: week 5-10 Write up week 11
  (due in by on May 9th) 1/2
  Presentation 1/6
  (to be given on the 09/05)

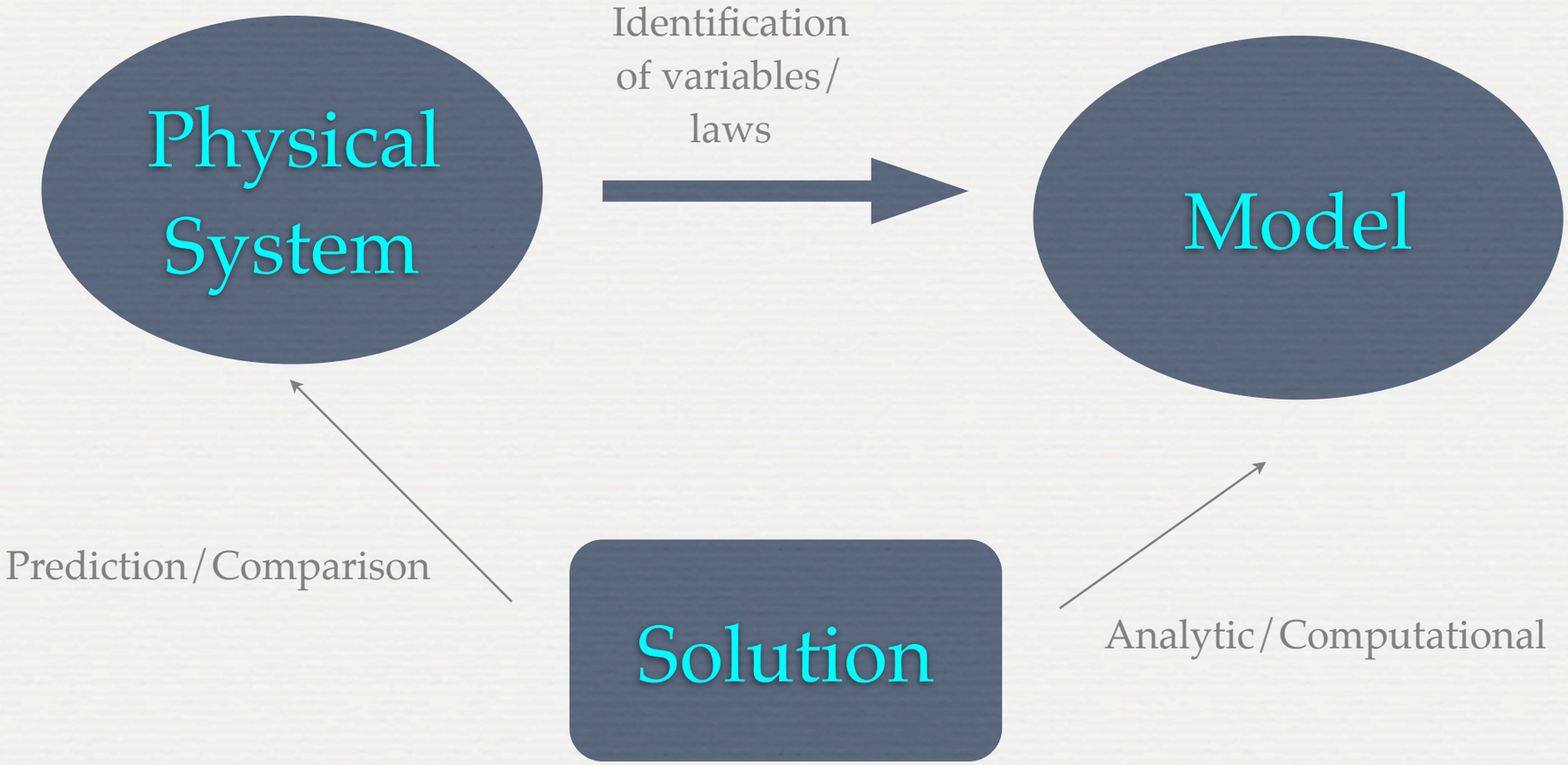
MODELLING AIMS

1. Understanding of how / why a system works
2. Predictions of future experiments / observations

MATHEMATICAL MODELS

Mathematical models need

1. Variables
2. Equations they satisfy
3. Constraints


Physical System
Identification of variables/ laws
Model
Prediction/Comparison
Solution
Analytic/Computational

A good model

1. Encompasses the key physics of the problem
2. Is as simple as possible
3. Is tractable

VARIABLES

- Variables are parameters (numbers with dimension) that describe the system
- Often they are obvious, like e.g. the position of a particle
- Sometimes they are collective, e.g. the centre of mass of a rigid body or the pressure of a thermodynamic system

CONSTRAINTS

- Many mathematical equations have a large class of solutions (e.g. heat or wave equations)
- Constraints allow us to choose the physical solutions
- Constraints might be the initial conditions, finiteness, boundary values, single valued, causality....

COMPUTATIONAL METHODS

- Contrary to common believe, this is the easiest part if the analysis of the problem has been done carefully
- We should allow for flexibility: changing slightly the problem should not imply a complete rewriting of the code
- Programming language: through BlackBoard you have access to last year's VisualBasic routines. You can choose another language, but be aware of consequences!

WORKFLOW

- Project 1: weeks 1-4
- Project 2: weeks 5-11
- Don’t dwell on Project 1, otherwise you will have not enough time to complete Project 2
- Each project will have 2-3 preliminary tasks, these must be completed before moving to the next step