

# Problem Sheet 1: Classical Theory

In this problem sheet, and all others, I highly recommend using Mathematica to deal with any messy algebra.

Install and get a license for mathematica from <https://www.epfl.ch/schools/sb/research/iphys/our-services/computer/software/software-faq/mathematica-license/> and familiarise yourself with how to do basic linear algebra on mathematica (e.g. <https://reference.wolfram.com/language/tutorial/LinearAlgebraIntroduction.html>).

1. Let  $S$  be a single DNA base, which can be in one of four sharp states  $A, T, G, C$ .
  - a) Define an appropriate set of basis states for this system.
  - b) What is the state of the system if you know that the DNA strand is not  $C$  but otherwise are completely uncertain?
  - c) Define a measurement to ask: "Is the base 'A or T'?"
  
2. Consider the bars and stripes data set (shown below) as corresponding to different possible states of a classical system.
  - a) Define an appropriate set of basis states for this system.
  - b) Write down the classical states corresponding to the first three in the first line.
  - c) What is the state space for this system?
  - d) Define a measurement to determine whether the system is fully shaded.
  - e) Define a measurement to determine whether the system contains blue or white stripes or bars, i.e. the first six patterns on the left.

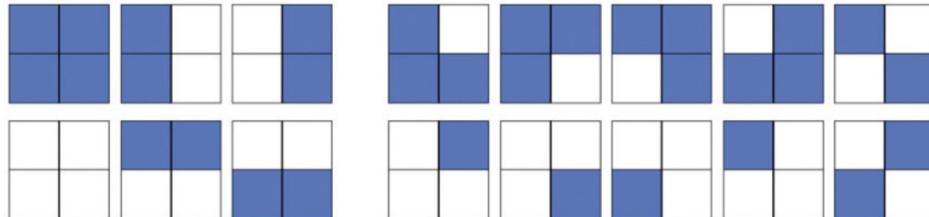


FIG. 1. **Bars and stripes data set.** Suppose each image here corresponds to a different state of a system.