

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/iphs/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.

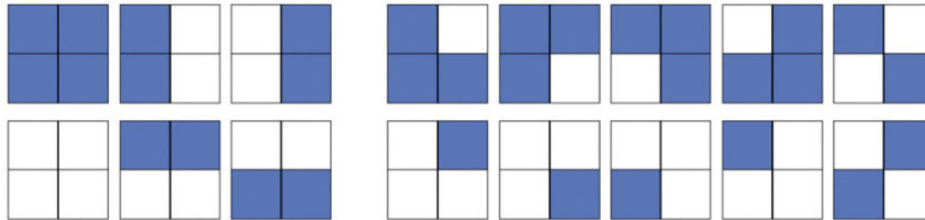


FIG. 1. **Bars and stripes data set.** Suppose each image here corresponds to a different state of a system.