Topology in condensed matter physics
exercise sheet 1

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1.1 Inspirations from topology

* This exercise is optional and for inspirational purpose.

1. (1* points) Watch Wind and Mr.Ug: https://youtu.be/4mdEsouIXGM.
2. (2* points) Answer the question(s) that are posed at the end of the video.
3. (1* points) Extra question: If Wind finds her dog again after the earth quake, is the dog the same as before? If not, could there be serious problems?

1.2 The Möbius strip

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1. (2* points) Hypothesize what happens if you cut the Möbius strip parallel to its boundary, where the cut has a constant distance of $1/3$ of the width of the strip. Consequently, answer the question experimentally.
2. (2* points) What happens if you cut the Möbius strip in an arbitrary (but constant) distance to its boundary?

1.3 Foundations of topology

1. (2 points) Which of the following families are topologies of $X = \{1, 2, 3\}$?
   (a) $\mathcal{T} = \{\{\}, \{1, 2, 3\}\}$
   (b) $\mathcal{T} = \{\{\{\}\}, 1, 2, 3\}$
   (c) $\mathcal{T} = \{\{\}, 1, 2, 3, \{1, 2\}, \{1, 2\}, \{1, 3\}, \{2, 3\}, \{1, 2, 3\}\}$
   (d) $\mathcal{T} = \{\{2\}, \{1, 3\}, \{1, 2, 3\}, \{\}\}$
2. (3 points) What are the remaining possible topologies of $X = \{1, 2, 3\}$?
   Hint: Hard exercise. Listing this systematically requires some thinking.

End