MAT327: Introduction to Topology. Solutions to the Big List Problems

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Thank you to my instructor Ivan Khatchatourian for providing these wonderful problems.

Contents

Preface

I attempt to answer and LaTeXall of the solutions to the big list of problems posted by my instructor Ivan Khatchatourian for MAT327: Introduction to Topology. The problems are separated into difficulties which are labelled via asterisks. One asterisk being the lowest difficulty and 3 being the highest. Especially hard problems are marked via a cross. This is the format my instructor uses and I'm merely copying it for consistency's sake.

Topologies

Ex. 1 — * Fix $a < b \in \mathbb{R}$. Show explicitly that the open interval (a, b) is open in $\mathbb{R}_{\text{usual}}$. Show explicitly that the interval $[a, b)$ is not open in $\mathbb{R}_{\text{usual}}$.

Answer (Ex. 1) — First, we show that (a, b) is open in $\mathbb{R}_{\text{usual}}$.

Ex. 2 — * Let X be a set and $\mathcal{B} = \{\{x\} : x \in X\}$. Show that the only topology on X that contains $\mathcal{B}$ as a subset is the discrete topology.