These exercises are for you to think about now, and prepare to continue working on in groups during the tutorial. Before tutorial you must at least know enough of the course material to understand what these questions are asking.

For this tutorial: attendance and good-faith participation are worth the entire 1.5% grade.

When you have an answer to one of the questions, or if you are stuck, then write down your work up to that point very carefully (either before or during the tutorial), and show your TAs in tutorial.

You do not need to work on the questions in any particular order.

The TAs will check that you have applied the course processes to understand the problem. They will read your proofs line by line to check that you have proper claims with annotations, until they get to the first line that has a problem (is not readable as an English sentence, or is not a boolean claim when it should be, or is not clear whether it’s an assumption versus a deduction when it should be, or tracing with specific numbers would catch an error, etc) and discuss that. You can then fix that first problem, think about the effect on the rest of your answer, fix that if necessary, and then ask about your fixed version. This is essentially the process that will be used when marking your answers later in the course, and we want to give you the chance to get used to this before it is worth marks.

We will not be posting solutions to these problems: so the more you think about them, and work on them during tutorial, and write up your work clearly and carefully with a group, then the more you will get out of these exercises and the tutorial.

1. The Exercises from the Lecture Summaries posted on the course web page.

2. The Exercises from the Week 2 Tutorial posted on the course web page.

3. For each of the Universally Quantified Implications in (a)–(e), do the following:
   - Express it in the form “∀x, y ∈ R : if _ then _."
   - Use our standard processes to illustrate and explore it.
   - Prove or disprove it, and write that up in our corresponding standard form.
   - Repeat all that with its converse.
   (a) x < 1 and 3 > y only if x < y.
   (b) 2x + y < 20 when x < 5 and y < 8.
   (c) x − y < 4 implies that x < 7 and y < 3.
   (d) x < 3 and y < 1 if 2x + 3y < 9.
   (e) For each x < 4 and y < 3 we have that x + y < 11.

4. For each of the Universally Quantified Implications in (a)–(d), do the following:
   - Express it in the form “∀x ∈ R : if _ then _."
   - Use our standard processes to illustrate and explore it.
   - Prove or disprove it, and write that up in our corresponding standard form.
   - Repeat all that with its converse.
   (a) If x > 100 then \( \frac{100}{3 - 2x} < \frac{1}{2} \).
   (b) \( \frac{3}{x^2 - 1} < \frac{1}{100} \) only if x ≥ 20.
   (c) x > 10 whenever \( \frac{x^3 - 2}{3x + 7} < 100 \).
   (d) \( \frac{x^4 + x^3 + x + 1}{x^2} > 200000 \) implies that x > 100.