Introduction to Modular Forms and Analytic Techniques used in the Field

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The great German number theorist Martin Eichler claims there are five fundamental operations of mathematics: addition, subtraction, multiplication, division, and modular forms. This bold statement conveys the importance Eichler, and incidentally many other mathematicians, place on the topic. Modular forms appear in many areas of mathematics including number theory, algebraic topology, and outside of pure mathematics with a few applications to physics. Modular forms are most closely associated with number theory because many arithmetic and number theoretic facts have been derived from them. The most notable contribution coming from Andrew Wiles, who proved Fermat's Last Theorem via a connection to the theory. I will introduce the basic theory of modular forms, with an aim to derive infinitely many arithmetic facts. Furthermore, I will demonstrate relevant analytic techniques that are essential to my own research.

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