SIT111 Computer Systems

The goal of this task was to design a register that could store 16-bits of data using basic logic gates. registers are fundamental memory elements used extensively in computer systems to temporarily store input values. They work by latching the current input onto the output lines when a control signal, such as a clock, is active. This allows the input at one time to be accessed as the output at the next.

I recognized that a register could be constructed from multiple 1-bit storage elements arranged in parallel. The basic building block for single-bit storage is the flip-flop, which uses feedback in a circuit of logic gates to retain its last input. By connecting 16 flip-flops together, each storing one bit, a 16-bit register architecture could be realized. With this understanding of registers and flip-flops, I began designing the HDL description. I defined the necessary inputs, outputs and control signals based on the required 16-bit interface. The body of the code instantiates 16 copies of a 1-bit storage chip wired to accept individual bits from the input and control lines. To test the design, I simulated it using sample input sequences and checked the output against expectations. Key tests included latching a sample data word on the first cycle when the load signal was active and preserving the latched value on subsequent cycles when load was inactive.

Comparing the simulated outputs to reference files confirmed the correct operation - that inputs were successfully captured and made available as outputs on the following cycle. This validated my design of the 16-bit register using basic sequential logic principles and an HDL description.