**ECE 6740 Advanced Embedded Systems \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Prof. D. Hanna Name**

**Winter 2024**

**Lab # 3: Hybridization for Speeding Up an Algorithm: Fast Fourier Transform**

**Teams of up to 2**

Part I. PS Only:

Using existing resources, implement a Fast Fourier Transform algorithm in C on the Microblaze or Zynq processing system (ARM core). I recommend that you use the resources at

<http://paulbourke.net/miscellaneous/dft/>

Use as input sampled data preloaded into memory or sampled from the ADC audio input on the board. If you use data preloaded into memory, create the data using MATLAB in the audio range of frequencies. Output the bin with the maximum value on the terminal using *printf*. Or, alternatively, compute the inverse FFT at a single audible frequency and output it to a pin connected to a speaker to hear the tone.

Before working in the embedded system, start by porting the algorithm that you intend to use in C to MATLAB to test it and gain an understanding of how it works with your input data.

Turn in on Moodle a zip file containing:

1. Your MATLAB .m file
2. all .c and .h files that you modified
3. a screenshot of the output

Part II. Estimation:

Profile the algorithm in Part I using the instructions for the Xilinx Vivado code profiler.

Discuss the results.

Turn in:

1. results and discussion (Word docx) with screenshots of the profile results

Part III. PS-PL:

Identify at least one bottleneck from Part II where you believe that creating a hybrid system would increase the execution speed. Implement the necessary hardware component linked to the processor using shared memory with a CDMA controller. Fixed point libraries for VHDL are available on Moodle.

Rerun your samples from Part I using your new, hybrid system and conduct an analysis showing the improvement or decline in performance. Use the Vivado Profiler and clock counters to measure the performance.

Turn in:

1. results and discussion (Word docx) with screenshots of the profile results
2. .vhd files for components that you created
3. all .c and .h files that you modified