EE 233 Experiment 2

- Digital controller implementation.
  - similar to digital filters.
  - control G(z) $\Rightarrow$ difference equation.
  - boils down to implementing a sequential solution to a difference equation.

- Fixed-point or floating-point?
  - for most control applications, fixed-point is sufficient.
  - difference equation solution basically multiply and add operations.
  - need to implement floating-point operations on fixed-point processors.

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- A/D operation converts voltage to n-bit value (integer).

  D/A operation converts n-bit value (integer) to voltage.

- Project details.
  - $e(k)$ is the input voltage.
  - $y(k)$ is the output voltage.
  - assume input and output voltage range is -1.65 V to +1.65 V.
  - the voltages are quantized into unsigned 10-bit values.

$$-1.65V \leftrightarrow \text{0x0000}$$
$$+1.65V \leftrightarrow \text{0x03FF}$$

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- Create a C program that will implement the sequential solution to the difference equation.
  - write the progam assuming no internal floating-point number representation and no internal floating-point operations.
  - only unsigned int variables are allowed.
  - only exception are input $e(k)$ and output $y(k)$ variables.

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- General program flow.
  - declarations. choose sampling interval and represent controller coefficients as unsigned int.
  - initialize : set initial conditions.
  - A/D operation : convert floating-point input to unsigned int filter input.
  - filter operation : multiply and add operations.
  - D/A operation : convert unsigned int filter result to floating-point output.
  - repeat : loopback to A/D operation.

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- **Write the program in C (ANSI C). Put in appropriate comments.**

- **Run the program with zero initial conditions and using the following inputs.**
  - **unit step.**
  - **$\sin(\omega t)$ with $f = 100Hz$**

- **Store / plot the input and output samples.**

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- **Verify. Compare the outputs of the C programs for this experiment and experiment 1.**