Digital Storage Oscilloscope Project Checklist
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The commitment: display analog input signals on the screen.

1. ADC system, including ADC IP core and ADC controller module. These modules read analog signals from the Nexys 4 board headers. (DDR)
2. Buffer module. This module uses two BRAMs, one to store the actively updating signal and the other to store a frozen signal for use by the display system. It also stores the locations of samples that caused the trigger to fire. (DDR)
3. Trigger module. This module detects a rising edge crossing a particular threshold. (JAT)
4. XVGA module. Generates display signals for 1280 x 1024 video. (DDR)
5. Curve module. Reads buffer data and displays the curve on the screen. (JAT)

Testing: These modules are tested together by using a signal generator whose output is between 0 and 1 V (the range of the ADC) and feeding it into pins VAUXP/N 11 on the board. A signal will appear on the screen with the trigger sample at the right edge, demonstrating the XVGA, curve, and ADC modules. A steady (non-scrolling) signal indicates that the triggering and buffer modules are working correctly.

The goal: a usable, interactive oscilloscope.

6. ScopeSettings module enables user control via buttons/switches on the Nexys 4 board: (DDR)
   - Trigger level (displayed on screen via TriggerLevelSprite)
   - Horizontal scaling (we control this by changing the ADC sample rate)
   - Vertical scaling
7. Text module shows useful information on scope screen, including horizontal and vertical scaling settings. (JAT)
8. Grid module shows a background grid on the scope screen. (JAT)
9. Measurement module measures minimum and maximum signal values, and these are displayed on the screen. (DDR for measurements; JAT for display)

Testing: the grid appears on the screen. Changing scope settings changes the displayed signal correctly and the text updates to show new parameter choices.

Stretch goals: an oscilloscope you'd choose to use for more advanced tasks.

10. Multiple channels: two input signals can be simultaneously displayed on the scope screen. The two signals use a common trigger. (JAT)
11. Cursors: the scope can optionally display two horizontal or vertical cursors with controllable positions. For vertical cursors, the scope displays time and voltage measurements. For horizontal cursors, the scope displays voltage measurements. (JAT)
12. Fast Fourier Transform: the scope can display the discrete-time FFT of an input signal. (DDR)

13. Run/stop: pressing a button can pause data collection and freeze the signal displayed on the screen, while still allowing adjustments of cursors and scaling. (JAT)
14. X/Y display mode: if multiple channels are working, the scope can plot channel 2 as a function of channel 1 rather than both channels as a function of time. This feature is useful, for instance, in digital communications, when one signal is phase-shifted with respect to the other. (DDR)