DSP Final Project

- Your team has been hired to build a breathing rate detection system to detect potential acute respiratory infection (pneumonia) in children aged 11 months to 5 years

System Description

- Build a breathing rate monitor to warn of a potential acute respiratory problem (pneumonia) in a child age 11 months to 5 years of age
  - In children, a breathing rate of greater than 40 breaths per minute can indicate pneumonia
  - Fewer than 12 breaths per minute can also indicate an abnormal condition

System Requirements

- The monitor shall detect if the breathing rate is greater than 40 breaths per minute

- The monitor shall detect a breathing rate below 12 breaths per minute
  - This may indicate that the sensor is disconnected, <u>or</u> another abnormal condition is occurring
  - Either condition shall be detected and an alert sounded within 2 minutes of its occurrence

System Requirements

- A warning shall be sounded for a breathing rate greater than 40 breaths per minute
- A warning shall be sounded for a breathing rate less than 12 breaths per minute
- The warning for low breathing rate shall be different from that of the warning for high breathing rate

Final Project Approach

- You have 3 weeks to complete the project
  - TIMING and DELIVERABLES
    - Week 12 04/10 - Lab: Final Project Description, Filter Banks and Running Statistics
    - Week 13 04/17 - Lab: Tone generation, user logic for system implementation
    - Week 14 04/24 - Lab: System integration and test
    - Week 15 05/01 - Project video/demo and IEEE Journal Formatted Report DUE Monday, 05/01/23 at 11:59PM (myCourses)
    - -10 points/calendar day late
    - DDD: 05/05/23 Friday at 11:59PM (-40/100 points)
- Each week there are suggested activities to work on for your project
- You will have to invest significant time outside of lab to complete the final project
- Your group must work together to get a passing grade

Weekly Suggested Activities

- Week 01
  - Build and test filter banks
  - Build and test running statistics
- Week 02
  - Write detection logic
  - Write code to sound the warning
- Week 03
  - Complete the integration of all hardware and software
  - Test, create your video presentation/demo
  - Write your IEEE journal formatted report

Weekly Suggested Activities

- There are no reports due until the final project report
- Make sure that you have more than one person with a working set of hardware
- Start with the base code and build upon that each week

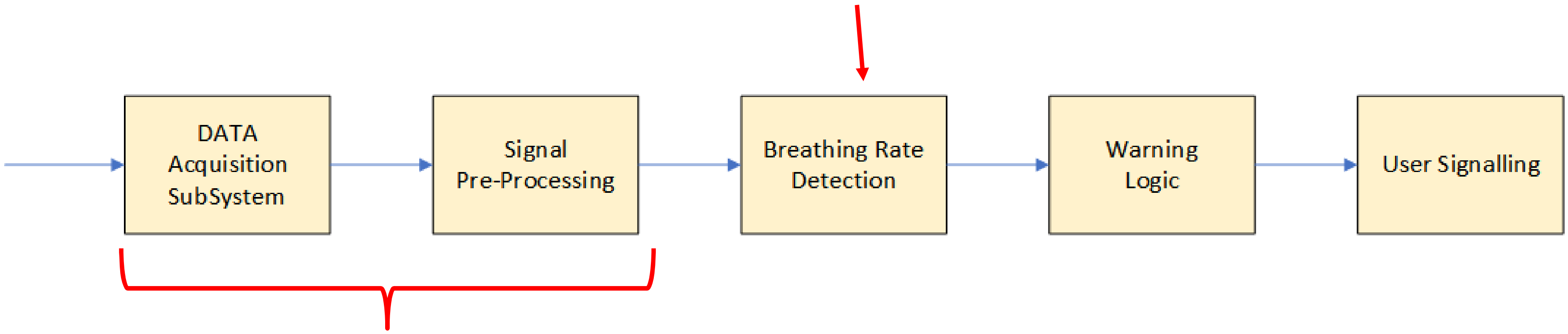
Project Suggestions

- This project will require a significant amount of work
  - Create a plan
- Each team member must participate
- Determine who is going to do what and when
  - Code sections
  - Test sections
  - Prepare the video
  - Work on the report
- Be accountable for your tasks
- Work together as a team!!!

10,000 Foot Level

- At the very highest level a block diagram for the system might look like this

Filter Banks
Energy Detection



DATA Acquisition SubSystem

Signal Pre-Processing

Breathing Rate Detection

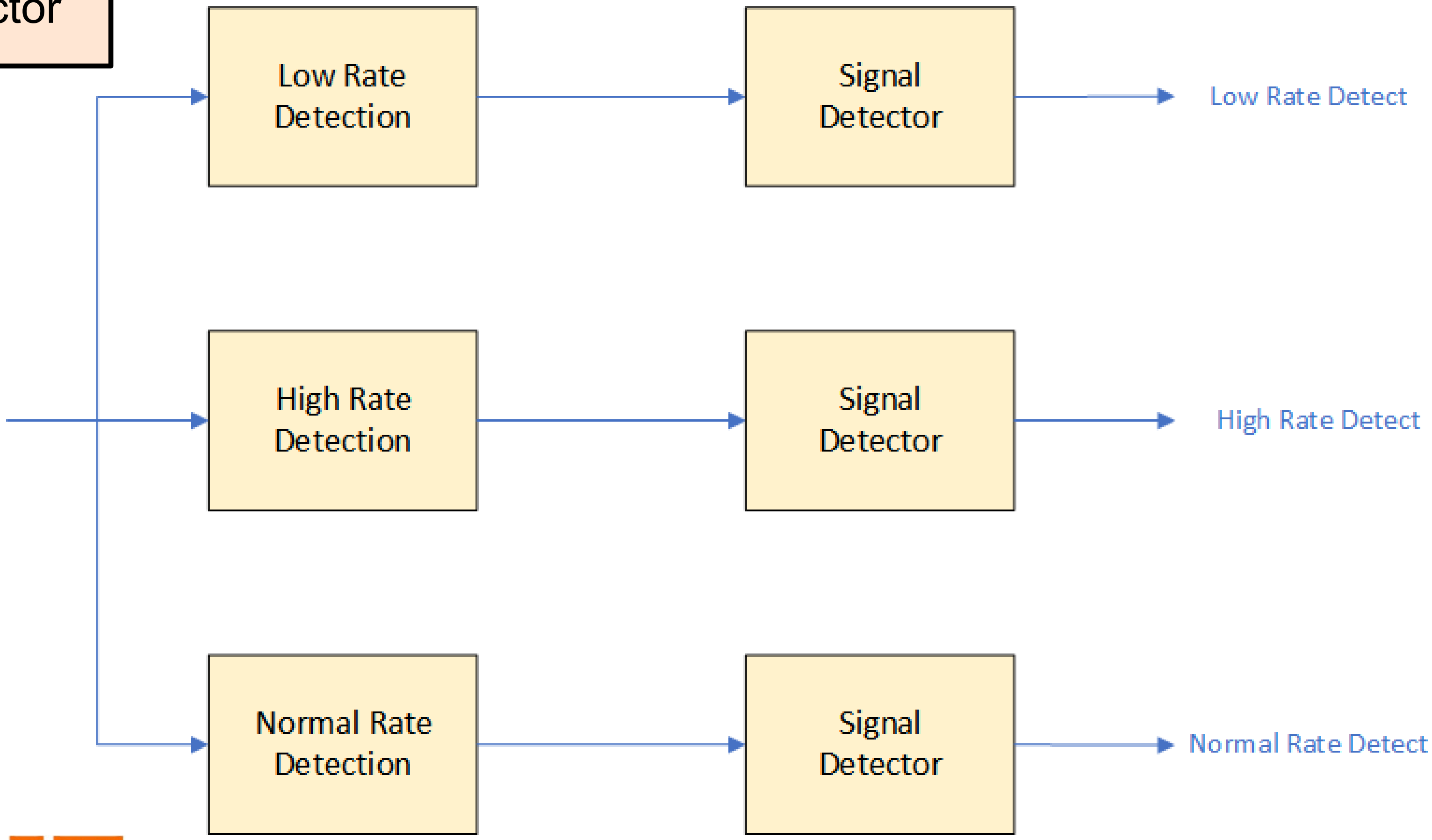
Warning Logic

User Signalling

Dither, ADC, Filter (optional), Equalizer

Filter Banks (General Approach)

Signal Detector



Digital Signal Processing

Final Project Week 01
Filter Bank Design

Week 01 Objectives

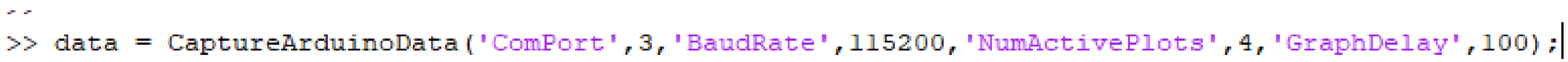
- Start to put together pieces for the final project
- Implement a bank of filters to provide frequency separation
- Run these filters in parallel

Week 01 Objectives

- Implement a resettable statistics function
    - Run the statistics function in parallel

Preventing Serial Port Overload

- The “CaptureArduinoData.m” routine includes a parameter “GraphDelay”
  - Prevents serial port overload from occurring
  - Add “GraphDelay”, N to the function call



```
>> data = CaptureArduinoData('ComPort',3,'BaudRate',115200,'NumActivePlots',4,'GraphDelay',100);
```

  - <u>N=100</u> samples works well

A More General Way to Write to the Serial Port

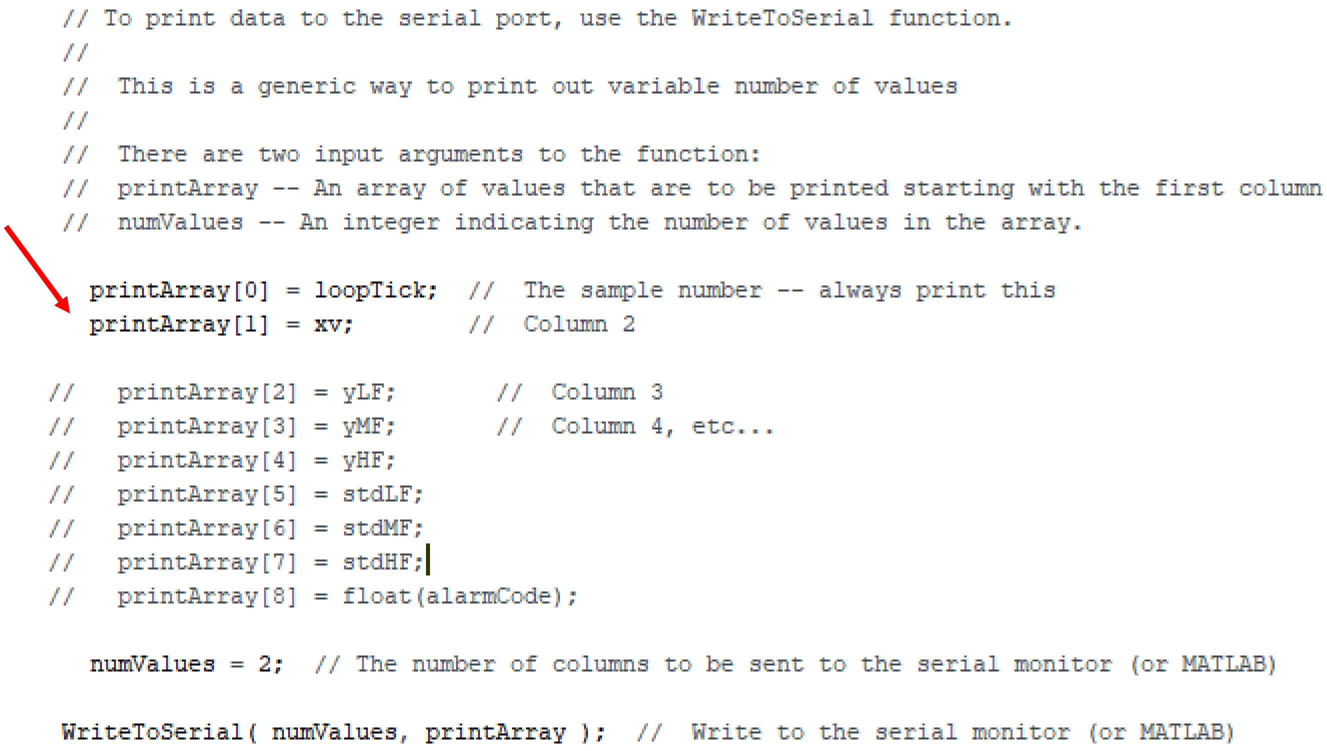
- In many of the earlier labs, the function 'displayData' was called to write to the serial port
    - It is specific to the data that is to be written
- In the project you may want to write many different types of data to the serial port
    - We need a more general way to write the data
        - That avoids re-writing 'displayData' for each change
    - 'WriteToSerial' is the new function

A More General Way to Write to the Serial Port

- Instead of changing the ‘displayData’ function, just write different values to the variable ‘printArray’

Set values in ‘printArray’ to the value to send to the port

‘printArray[0] is always loopTick (sample Number). Don’t’ change!



```
// To print data to the serial port, use the WriteToSerial function.
//
//  This is a generic way to print out variable number of values
//
//  There are two input arguments to the function:
//  printArray -- An array of values that are to be printed starting with the first column
//  numValues -- An integer indicating the number of values in the array.

  printArray[0] = loopTick;  //  The sample number -- always print this
  printArray[1] = xv;        //  Column 2

//   printArray[2] = yLF;       //  Column 3
//   printArray[3] = yMF;       //  Column 4, etc...
//   printArray[4] = yHF;
//   printArray[5] = stdLF;
//   printArray[6] = stdMF;
//   printArray[7] = stdHF;
//   printArray[8] = float(alarmCode);

  numValues = 2;  // The number of columns to be sent to the serial monitor (or MATLAB)

 WriteToSerial( numValues, printArray );  //  Write to the serial monitor (or MATLAB)
```

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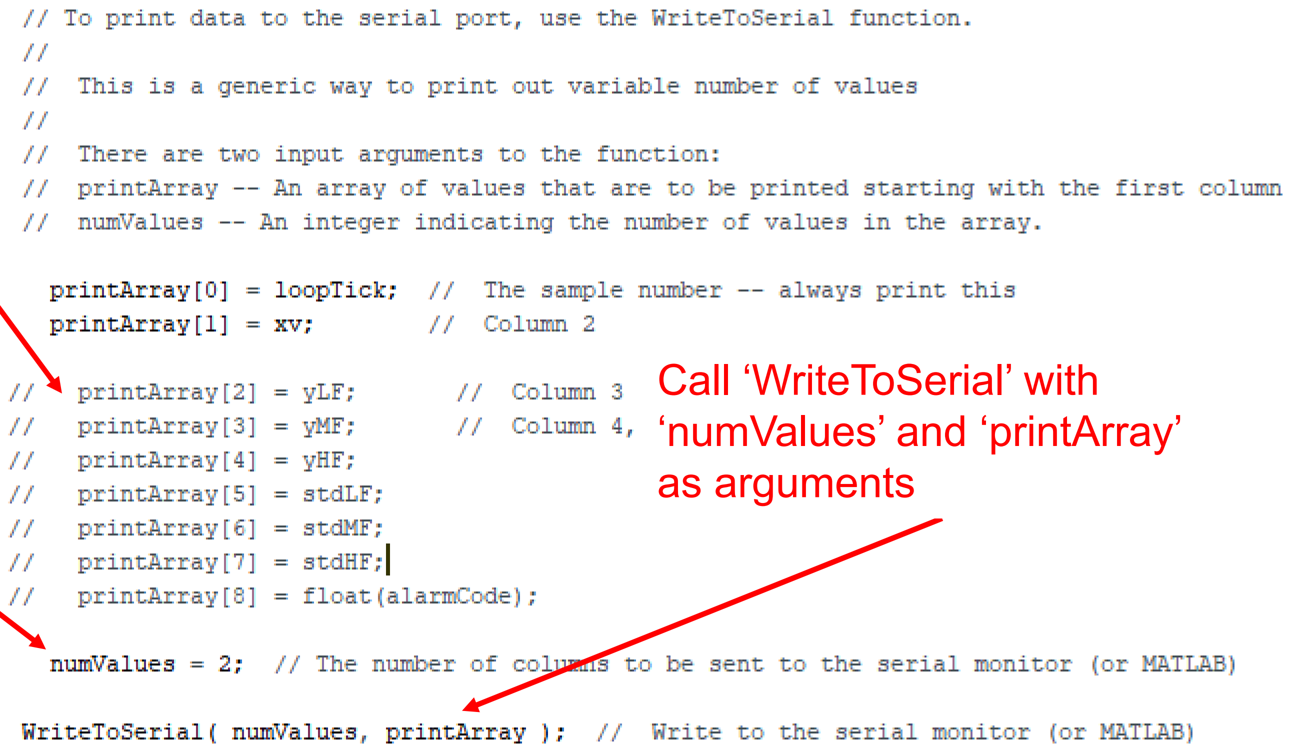

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Uncomment other array values as needed

Set ‘numValue’ to the number of variables passed

(Always include printArray[0])

Call ‘WriteToSerial’ with ‘numValues’ and ‘printArray’ as arguments

Week 01 Steps

- Design and implement
  - Low frequency filter
  - Mid range filter
  - High range filter
  - Run them in parallel
  - Add running statistics, running in parallel
  - Measure execution time