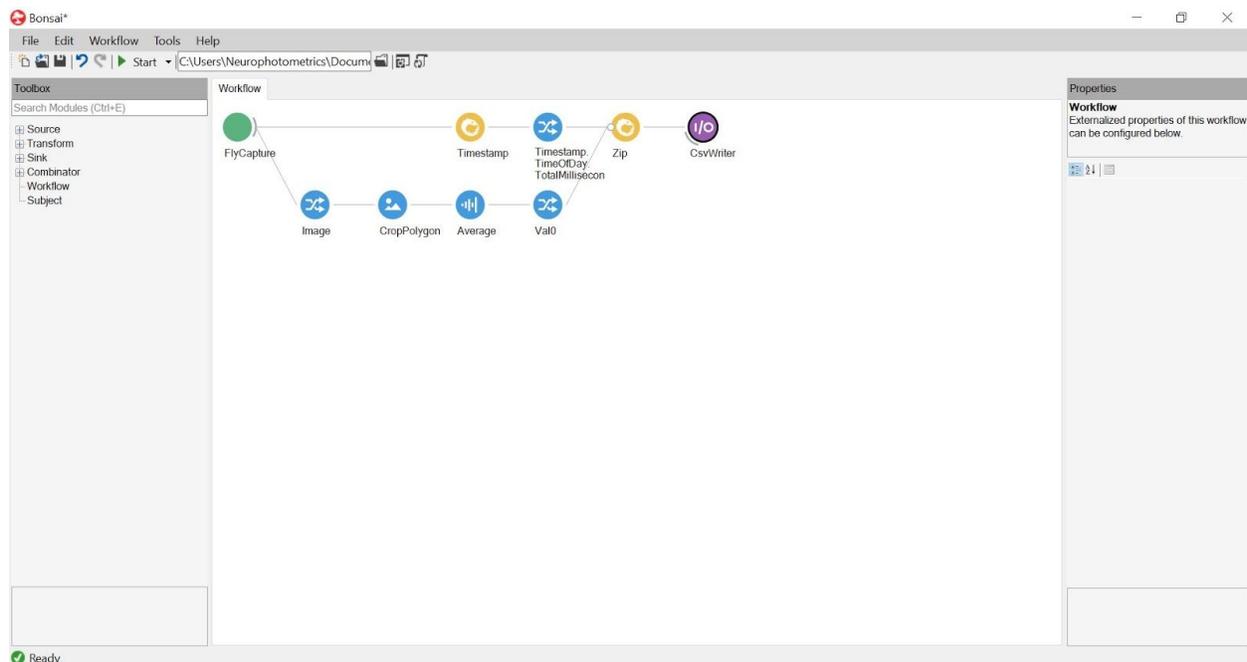


# FP ACADEMY

## Sample Bonsai Workflows



## Fiber Photometry Workflow



**FlyCapture:** Source node. Communicates with the CMOS camera in your system to collect all and any data captured by your camera. Obtained from toolbox.

ColourProcessing: Default

Index: 0 (you can use multiple CMOS cameras in Bonsai at once) type a number to choose a specific camera. If you have two cameras, one node will have index 0, the other node will have index 1.

**Source.Image:** Transform node. Specifies what data format you want to transform. Obtained by right clicking on FlyCapture, click on Image.

**Timestamp:** Combinator node. Collects the timestamp for each data point (= 1 frame) in your workflow. Obtained from toolbox.

**Source.Timestamp.TimeOfDay.TotMill:** Transform node. Specifies what type of time you want to collect. We prefer time of day TOTAL milliseconds simply because the time doesn't loop back to 0 milliseconds. Easier for post hoc analysis. Obtained from right clicking timestamp.

**CropPolygon:** Transform node. Allows you to draw your Region of Interest (ROI) around each end of your patch cord; specifying an area within the camera's visual field to analyze. Obtained from toolbox.

FillValue: 0,0,0,0 (0-255) if your ROI is not a square, will fill in the borders with a specific colour.

MaskType: ToZero

Regions: or Point[][] Array; click on cell, then ellipsis on the right to define your ROI.

Left click and drag to define a rectangle. Double left click to add a point, double right click to delete a point. Right click and drag to move a point. Note: Click inside of your ROI, the cursor will snap to the nearest point. Clicking outside may create a tiny ROI and create an error.

**Average (Dsp):** Transform node. Calculates the average pixel intensity within your ROI. Obtained from toolbox.

**Source.Val0:** Transform node. Specifies that you want to look at greyscale data opposed to selectively R(red),B(blue),G(green). Obtained from right clicking Average.

**Zip:** Combinator node. Combines different streams of data. Matches items as they arrive. (Timestamps each time the camera captures a frame.) Limited by your slowest acquiring object. Obtained from toolbox.

**CsvWriter:** Sink node. Exports all your data into a csv file. Obtained from toolbox.

Append: False. True or False

FileName: or "animal###\_VTA" Name your file. Click on cell, click on ellipsis on the right. This opens the file directory, select where you want to save your file and type in the file name.

IncludeHeader: False. True or False

Overwrite: False. True or False. If true overwrites file with the same name.

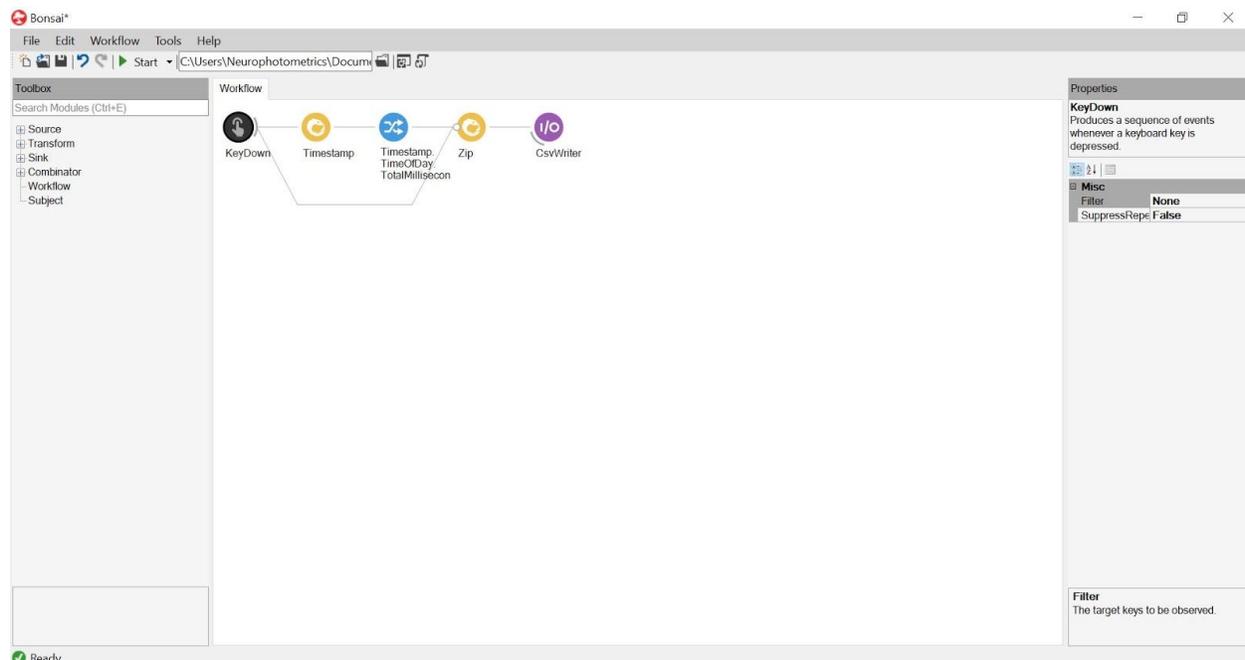
Selector:

Suffix: Timestamp. Adds a suffix to the end of your file name. Drop-down arrow allows you to choose from None: No suffix, FileCount: If the same file name, adds a number to the end, or Timestamp: Regardless if the file name is the same, adds the time and date to the end of the file name.

## Caption

A workflow ideal for collecting relative fluorescence from a Neurophotometrics fiber photometry system or if you are using a BFLY camera for video analysis. The example code above collects relative fluorescence (A.U.) and timestamps in milliseconds at the same rate your camera is collecting data, typically 40 Hz.

## Key Down Work Flow



**KeyDown:** Source node. Bonsai recognizes when ever a key on your keyboard is pressed. (Numbers are recorded as D#. Ex. pressing 1 records D1). Obtained from toolbox.

Filter: None. Drop down arrow allows you to filter which keys can be pressed.

**Timestamp:** Combinator node. Collects the timestamp for each data point (= 1 frame) in your workflow. Obtained from toolbox.

**Source.Timestamp.TimeOfDay.TotMill:** Transform node. Specifies what type of time you want to collect. We prefer time of day TOTAL milliseconds simply because the time doesn't loop back to 0 milliseconds. Easier for post hoc analysis. Obtained from right clicking timestamp.

**Zip:** Combinator node. Combines different streams of data. Matches items as they arrive. (Timestamps each time the camera captures a frame.) Limited by your slowest acquiring object. Obtained from toolbox.

**CsvWriter:** Sink node. Exports all your data into a csv file. Obtained from toolbox.

Append: False. True or False

FileName: or "animal###\_VTA" Name your file. Click on cell, click on ellipsis on the right. This opens the file directory, select where you want to save your file and type in the file name.

IncludeHeader: False. True or False

Overwrite: False. True or False. If true overwrites file with the same name.

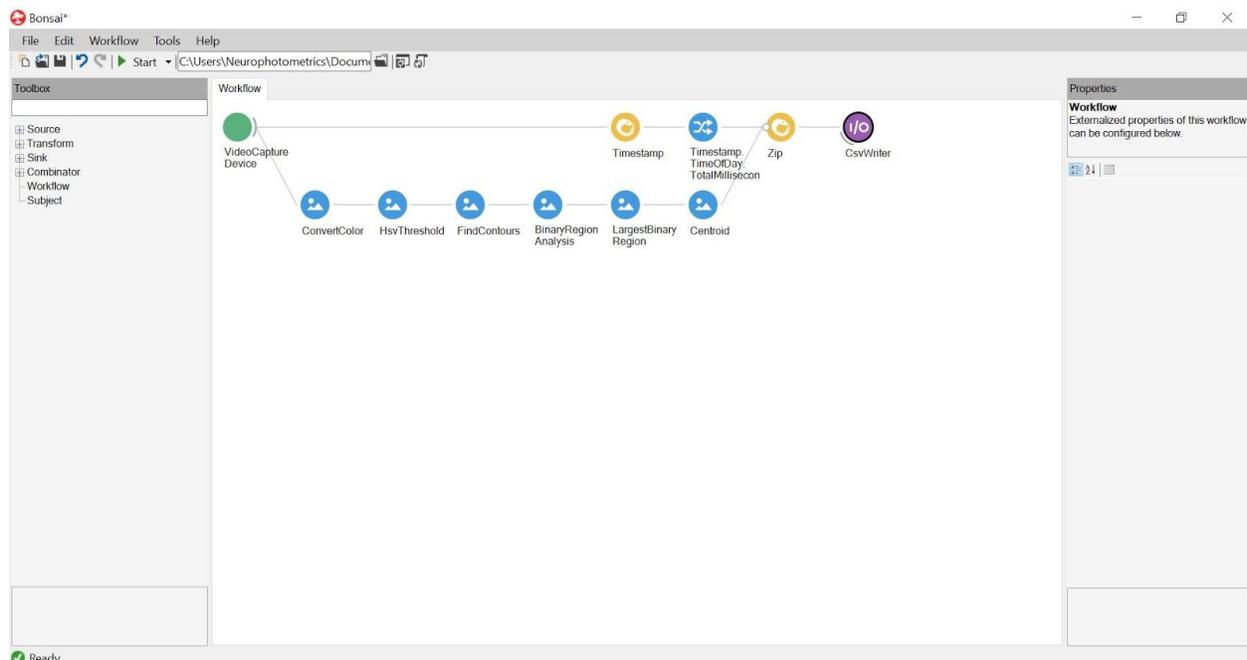
Selector:

Suffix: Timestamp. Adds a suffix to the end of your file name. Drop-down arrow allows you to choose from None: No suffix, FileCount: If the same file name, adds a number to the end, or Timestamp: Regardless if the file name is the same, adds the time and date to the end of the file name.

### Caption

A workflow ideal for signal checks or making notes during an experiment such as an unexpected door slam. The example code above records a timestamp when any key is pressed. You can use the filter property to only timestamp when select keys are pressed. Outputs time and key pressed.

## Motion Tracking Workflow



**VideoCaptureDevice:** Source node. Allows Bonsai to acquire video data from a connected video camera. **Note: does not work with Logitech cameras.** Obtained from toolbox.

Format: . Drop down arrow allows you to choose a specific resolution.

Index: 0 (Integrated Camera). Drop down arrow allows you to choose a specific camera connected to your computer.

\*\*\***FileCapture:** Source node. Allows Bonsai to acquire data from a file on your computer (we have only worked with videos) Obtained from toolbox.

FileName: or "animal####\_VTA" Open a file. Click on cell, click on ellipsis on The right. This opens the file directory, select where what file you want to open.

Loop: False. True or False.

PlaybackRate: 0. Speed at which your file is playing at.

Playing: True. True or False.

Position Units: Frames. In what steps/units is your file characterized.

Milliseconds: Goes through your file 1 millisecond at a time. Frames: Goes through your file 1 frame at a time. AviRatio: Unknown, considers when audio is also stepped?

**ConvertColour:** Transform node. Bgr2Hsv. Convert the colour format to whichever format under the drop-down arrow. (Bgr2Hsv takes BlueGreenRed images and converts it to HueSaturationValue) Obtained from toolbox.

**HsvThreshold:** Transform node. Set numbers in HSV standards (0-255) to capture only a certain area. Numbers may change based upon what you want to select. Obtained from toolbox.

Lower: (53,33,15,0) Lightest colour bound

Upper: (13,177,153,255) Darkest colour bound

**FindContours:** Transform node. Detects the edges of a continuous object within the threshold. Obtained from toolbox.

MaxArea: . Number will represent the maximum area to be selected

Method: ChainApproxNone

Min Area: . Number will represent the minimum area to be selected.

Mode: External. How you want the contours to be retrieved.

Offset: 0,0. Change if you want certain contour points offset.

**BinaryRegionAnalysis:** Transform node. Simply looks for regions within the threshold and defined contours for the whole file. Obtained from toolbox.

**LargestBinaryRegion:** Transform node. Keeps only the biggest regions. Obtained from toolbox.

**Source.Centroid:** Transform node. Tracks x-y coordinates of the center of the largest binary region. Obtained from right clicking LargestBinaryRegion.

Selector: Source.Centroid

**Timestamp:** Combinator node. Collects the timestamp for each data point (= 1 frame) in your workflow. Obtained from toolbox.

**Source.Timestamp.TimeOfDay.TotMill:** Transform node. Specifies what type of time you want to collect. We prefer time of day TOTAL milliseconds simply because the time doesn't loop back to 0 milliseconds. Easier for post hoc analysis. Obtained from right clicking timestamp.

**Zip:** Combinator node. Combines different streams of data. Matches items as they arrive. (Timestamps each time the camera captures a frame.) Limited by your slowest acquiring object. Obtained from toolbox.

**CsvWriter:** Sink node. Exports all your data into a csv file. Obtained from toolbox.

Append: False. True or False

FileName: or "animal###\_VTA" Name your file. Click on cell, click on ellipsis on the right. This opens the file directory, select where you want to save your file and type in the file name.

IncludeHeader: False. True or False

Overwrite: False. True or False. If true overwrites file with the same name.

Selector:

Suffix: Timestamp. Adds a suffix to the end of your file name. Drop-down arrow allows you to choose from None: No suffix, FileCount: If the same file name,

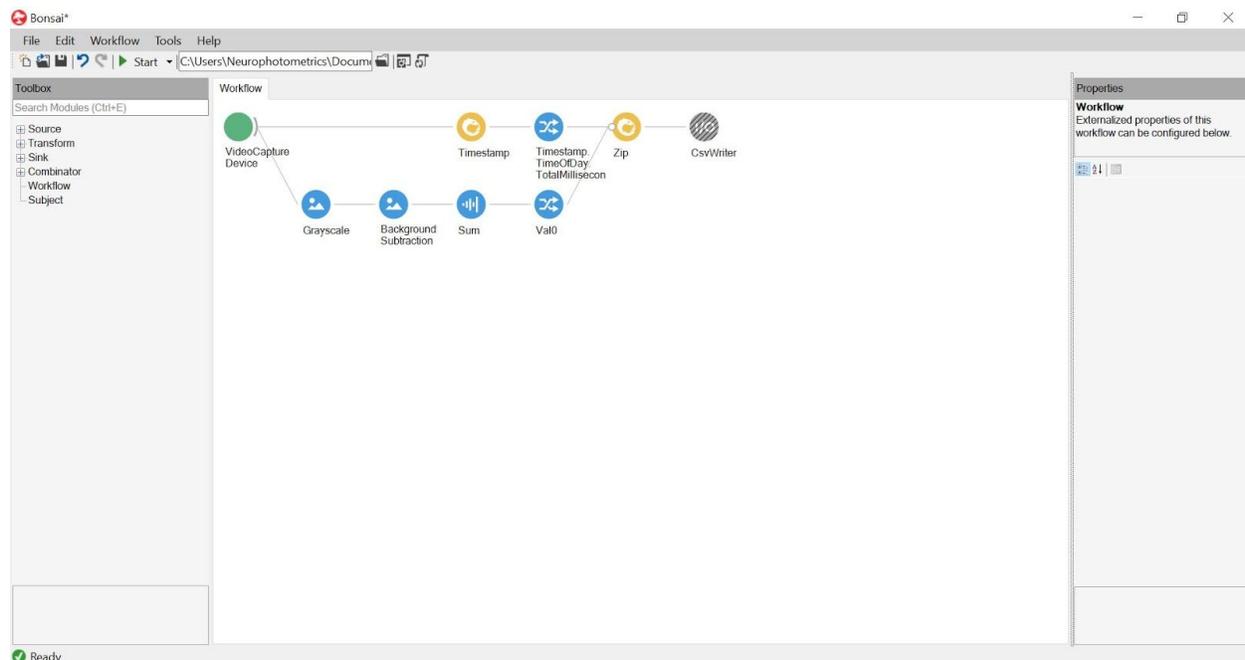
adds a number to the end, or Timestamp: Regardless if the file name is the same, adds the time and date to the end of the file name.

\*\*\* Use FileCapture instead of VideoCaptureDevice is scoring offline.

### Caption

A workflow ideal for collecting x and y coordinates of an animal. Thresholds your video stream such that only the animal, contrasted against a negative background (ie. if an animal is black, the background is white or vice versa). Defines the area of your animal and places a centroid in the middle. Output is time in milliseconds along with the x and y coordinates of the centroid.

## Freezing Detection Workflow



**VideoCaptureDevice**: Source node. Allows Bonsai to acquire video data from a connected video camera. **Note: does not work with Logitech cameras.** Obtained from toolbox.

Format: . Drop down arrow allows you to choose a specific resolution.

Index: 0 (Integrated Camera). Drop down arrow allows you to choose a specific camera connected to your computer.

**GreyScale**: Converts image to GreyScale. Obtained from toolbox.

**BackgroundSubtraction**: Determines the amount of change within an image by adapting to any change within your image by subtracting the previous image from the incoming image.

AdaptationRate: 0-1. Set to 1 for motion detection

BackgroundFrames: 1.

SubtractionMethod: Bright.

ThresholdType: Binary.

Threshold: 0.

**Source.Val0**: Transform node. Specifies that you want to look at greyscale data opposed to selectively R(red),B(blue),G(green). Obtained from right clicking Average.

**Sum**: Transform node. Can arithmetically add values from an incoming data stream/elements. Obtained from toolbox.

**Timestamp**: Combinator node. Collects the timestamp for each data point (= 1 frame) in your workflow. Obtained from toolbox.

**Source.Timestamp.TimeOfDay.TotMill:** Transform node. Specifies what type of time you want to collect. We prefer time of day TOTAL milliseconds simply because the time doesn't loop back to 0 milliseconds. Easier for post hoc analysis. Obtained from right clicking timestamp.

**Zip:** Combinator node. Combines different streams of data. Matches items as they arrive. (Timestamps each time the camera captures a frame.) Limited by your slowest acquiring object. Obtained from toolbox.

**CsvWriter:** Sink node. Exports all your data into a csv file. Obtained from toolbox.

Append: False. True or False

FileName: or "animal###\_VTA" Name your file. Click on cell, click on ellipsis on the right. This opens the file directory, select where you want to save your file and type in the file name.

IncludeHeader: False. True or False

Overwrite: False. True or False. If true overwrites file with the same name.

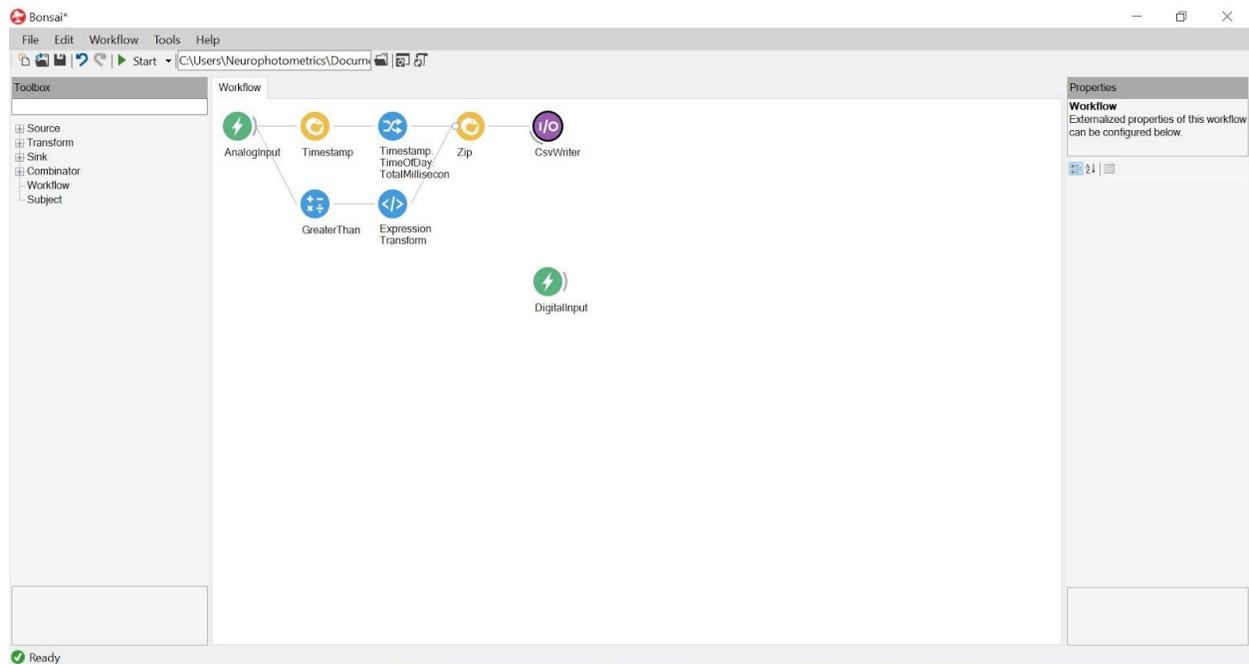
Selector:

Suffix: Timestamp. Adds a suffix to the end of your file name. Drop-down arrow allows you to choose from None: No suffix, FileCount: If the same file name, adds a number to the end, or Timestamp: Regardless if the file name.

## Caption

A workflow ideal for quantifying the amount of movement within your videofeed, applicable to forced swim test analysis or freezing detection. The example workflow above subtracts the previous frame from the incoming frame and sums the pixel value of the difference. The higher the pixel value, the more movement in that given point of time. Outputs time in milliseconds and pixel value.

## TTL Detection with an Arduino DAQ



**AnalogInput:** Source node. Allows Bonsai to work with analog inputs from a specific Arduino pin. Obtained from toolbox.

Pin: . Corresponds to which pin Bonsai is receiving data from.

PortName: COM#. Corresponds to which serial port your Arduino is connected to. Drop down arrow shows all ports. (Can be determined in the Arduino software.)

**DigitalInput:** Source node. Allows Bonsai to work with digital inputs from a specific Arduino pin. Obtained from toolbox.

Pin: . Corresponds to which pin Bonsai is receiving data from.

PortName: COM#. Corresponds to which serial port your Arduino is connected to. Drop down arrow shows all ports. (Can be determined in the Arduino software.)

**GreaterThan:** Transform node. Applies a greater than numeric comparison on incoming data streams/elements. Output = True or False. Obtained from toolbox.

**ExpressionTransform:** Transformation node. Can complete Math functions. "it" stands for the input variable. Obtained from toolbox.

Description: Note what the expression intends to do.

Name: Change the name of the node on your workflow.

Expression: Input any expression you wish to add, "it ? 1:0" converts a boolean to binary integers

**Timestamp:** Combinator node. Collects the timestamp for each data point (= 1 frame) in your workflow. Obtained from toolbox.

**Source.Timestamp.TimeOfDay.TotMill:** Transform node. Specifies what type of time you want to collect. We prefer time of day TOTAL milliseconds simply because the time doesn't loop back to 0 milliseconds. Easier for post hoc analysis. Obtained from right clicking timestamp.

**Zip:** Combinator node. Combines different streams of data. Matches items as they arrive. (Timestamps each time the camera captures a frame.) Limited by your slowest acquiring object. Obtained from toolbox.

**CsvWriter:** Sink node. Exports all your data into a csv file. Obtained from toolbox.

Append: False. True or False

FileName:     or "animal###\_VTA" Name your file. Click on cell, click on ellipsis on the right. This opens the file directory, select where you want to save your file and type in the file name.

IncludeHeader: False. True or False

Overwrite: False. True or False. If true overwrites file with the same name.

Selector:

Suffix: Timestamp. Adds a suffix to the end of your file name. Drop-down arrow allows you to choose from None: No suffix, FileCount: If the same file name, adds a number to the end, or Timestamp: Regardless if the file name is the same, adds the time and date to the end of the file name.

The code above represents how I would detect TTLs from an Arduino DAQ. Depending on my experimental setup, I would use an analog or digital input along with a timestamp to timelock my data. In the above figure I have used a GreaterThan condition and expression transformation to digitize my analog signal.