

# LOTUS Toolkit

Longitudinal Timeseries Unification & Signal Processing Toolkit

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# LOTUS Toolkit

The **LOTUS Toolkit** is a set of GUI's featuring a data reader and data analyser that were designed to facilitate organisation, management, processing, and analysis of data recorded using the EmbracePlus, or other devices that capture longitudinal recordings of continuous physiological signals.

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1. LOTUS *Reader*
2. LOTUS *Analyser*

# LOTUS READER

The **LOTUS Reader** is a GUI that enables the selective reconstitution of fragmented timeseries data by collating relevant ‘chunks’ of signal data into a continuous timeseries.

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This is critical for processing continuous raw data from the EmbracePlus and other devices that output data in arbitrary *chunks* (discrete files) to improve memory processing and efficiency of data management. That is, for most standard signal processing, users will first need to ensure that relevant periods of raw signal data are restored as a continuous timeseries (i.e., without discontinuities). Unfortunately, this process can be challenging, particularly when handling large and irregular datasets, which is often the case when dealing with wearable timeseries data across numerous individuals.

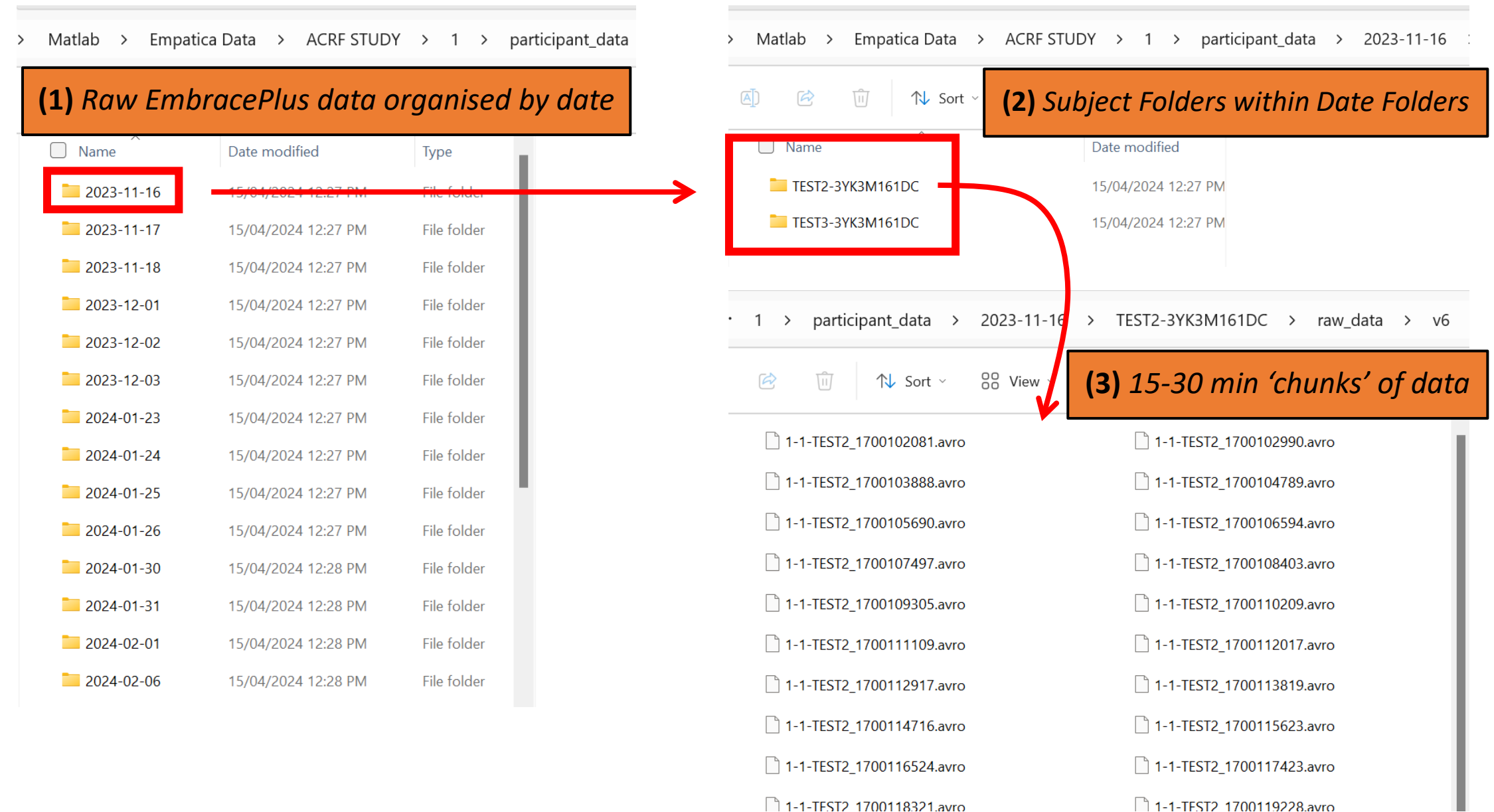
# Handling fragmented EmbracePlus data

The challenge is how to selectively and systematically extract and compile relevant periods of data from irregular and fragmented datasets - a programmatic solution is required that can allow users to have interactive control over this procedure to output relevant data efficiently.

EmbracePlus data is organised by Site, date, Participant, and device serial number...

Note:

Avro files are a special type of text file containing raw signal data... these can be converted to CSV files for easier preprocessing or manual interaction (e.g. in excel)



# LOTUS READER (solution)

- The LOTUS Reader is a GUI built in Matlab 2023b with options to interactively filter, read, and compile data.
- For simplicity, the options for filtering, reading, and compiling data are all organised in a single window.
- **Output:** A mat file for each participant featuring two variables;
  1. **dat** - A mat structure containing reconstituted raw data and events (tags) over a selected period of time
  2. **cfg** - A mat structure containing file configurations (processing parameters and file history)

The screenshot shows the LOTUS Reader GUI. At the top, it says 'LOTUS Reader' and 'Jack Fogarty 2024'. Below this is a description: 'Browse, select, load, and compile EmbracePlus or other timeseries data for processing and analysis.' The 'Input' section has radio buttons for 'Avro' and 'CSV', with 'CSV' selected. There are checkboxes for 'EDA', 'BVP', 'SystP', 'Temp', 'ACC', 'GYR', 'Steps', 'Other', and 'Summary'. The 'Read Method' is set to 'Default' and the 'Time Zone of Data' is 'Asia/Singapore'. The 'Filter Date Range' section has 'Start Date' and 'End Date' dropdowns. The 'Time Window' section has 'Start Time' and 'End Time' dropdowns. The 'Timespan' section has 'Years', 'Months', and 'Days' dropdowns. There are checkboxes for 'Allow time windows to overlap', 'NaN pad discontinuities', and 'NaN pad to max window length'. A 'Select Subjects' list on the right shows 'Item 1' through 'Item 8'. At the bottom right are 'Browse', 'Read', 'Save', and 'Analyser' buttons.

Example of mat output structures

The screenshot shows the Matlab workspace and command window. The command window shows the command `>> load('04-3YK3M161DC-2024-02-09-Data.mat')` and the output `fx >>`. The workspace shows two variables: `cfg` (1x1 struct) and `dat` (1x1 struct). Below the workspace, the structure of the `dat` variable is shown, listing 11 fields: EDA, BVP, SystP, Temp, ACC, GYR, Steps, Other, Tags, Summary, and deleted\_Tags. The structure of the `cfg` variable is also shown, listing 17 fields: parent\_folder, InputType, DataType, ReadMethod, TimeZone, Sdate, Edate, Stime, Etime, Tspan, subjects, overlap, padding, padmax, day\_folders, selected\_subjects, and output\_folder.

Field	Value
EDA	1x1 cell
BVP	1x1 cell
SystP	[]
Temp	[]
ACC	[]
GYR	[]
Steps	[]
Other	[]
Tags	1x1 cell
Summary	[]
deleted_Tags	1x1 cell

Field	Value
parent_folder	'C:\Users\ ... \Desktop\Matlab\Empatica Data\1\1\rav'
InputType	'.csv'
DataType	1x1 struct
ReadMethod	'Default'
TimeZone	'Asia/Singapore'
Sdate	1x1 datetime
Edate	1x1 datetime
Stime	1x1 struct
Etime	1x1 struct
Tspan	1x1 struct
subjects	4x1 cell
overlap	1
padding	1
padmax	1
day_folders	6x1 struct
selected_subjects	1x1 cell
output_folder	'C:\Users\ ... \Desktop\Matlab\Empatica Data\output'

# LOTUS READER

## Core Procedure

1. Select input file type
2. Select required output
3. Choose read method
  - a) Default
  - b) Custom
  - c) Event-based
4. Time zone of data
5. Browse
6. Read
7. Select Subjects
8. Save

## Optional Filters

9. Filter dates
10. Set time window (Custom)
11. Set timespan (Custom)

LOTUSReader

**LOTUS Reader**

Jack Fogarty  
2024

Dark ☐

Cool ☐

Browse, select, load, and compile EmbracePlus or other timeseries data for processing and analysis.

**Select Data Type**

Input: ☐ Avro ☒ CSV

☒ EDA ☒ BVP ☐ SystP ☐ Temp ☐ ACC ☐ GYR ☐ Steps ☐ Other ☐ Summary

Read Method: Custom

Time Zone of Data: Asia/Singapore

**Filter Date Range**

Select date range (Start and End dates included)

Start Date: 02/Feb/2024

End Date: 02/May/2024

**Time Window**

Select epoch times in 24h format (e.g., 13:35:00)

Start Time: 8 : 0 : 0

End Time: 15 : 30 : 0

**Timespan**

Set the period between start and end timepoints (for day, 0 < 24h)

Timespan: 0 Years 0 Months 0 Days

**Select Subjects**

Select All

0002-3YK3M161D

04-3YK3M161DC

05-3YK3M161DC

06-3YK3M161DC

07-3YK3M161DC

Browse

Read

Save

Analyser

☒ Allow time windows to overlap

☒ NaN pad discontinuities

☒ NaN pad to max window length

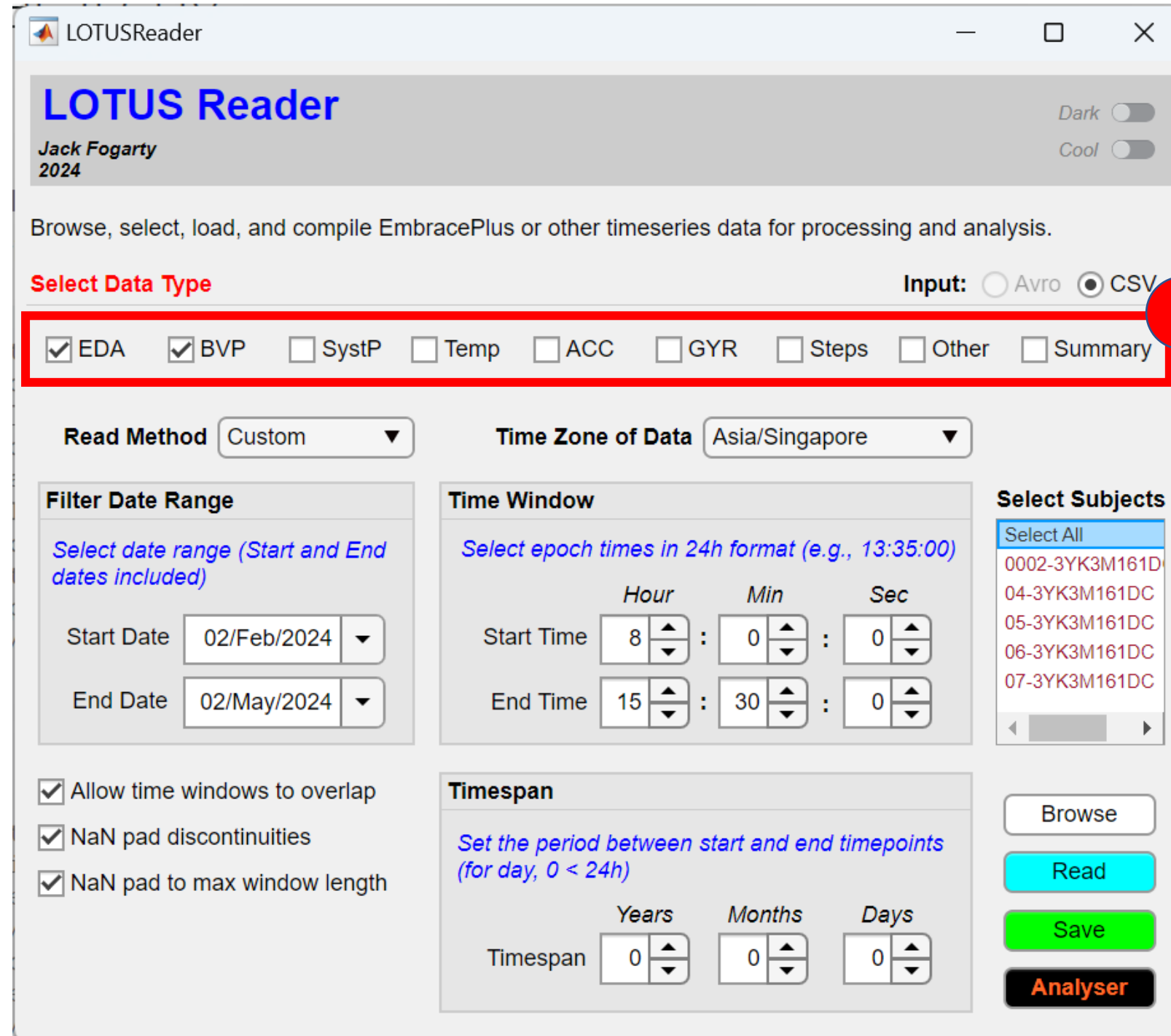
# LOTUS READER

## Core Procedure

1. Select input file type
2. Select required output
3. Choose read method
  - a) Default
  - b) Custom
  - c) Event-based
4. Time zone of data
5. Browse
6. Read
7. Select Subjects
8. Save

## Optional Filters

9. Filter dates
10. Set time window (Custom)
11. Set timespan (Custom)



LOTUSReader

**LOTUS Reader** Jack Fogarty 2024

Dark ☐ Cool ☐

Browse, select, load, and compile EmbracePlus or other timeseries data for processing and analysis.

Select Data Type Input: ☐ Avro ☒ CSV

☒ EDA ☒ BVP ☐ SystP ☐ Temp ☐ ACC ☐ GYR ☐ Steps ☐ Other ☐ Summary

Read Method: Custom Time Zone of Data: Asia/Singapore

Filter Date Range: Select date range (Start and End dates included)

Start Date: 02/Feb/2024 End Date: 02/May/2024

Time Window: Select epoch times in 24h format (e.g., 13:35:00)

Start Time: 8 : 0 : 0 End Time: 15 : 30 : 0

Timespan: Set the period between start and end timepoints (for day, 0 < 24h)

Years: 0 Months: 0 Days: 0

Select Subjects: Select All

0002-3YK3M161D  
04-3YK3M161DC  
05-3YK3M161DC  
06-3YK3M161DC  
07-3YK3M161DC

Browse Read Save Analyser



# LOTUS READER

## Core Procedure

1. Select input file type
2. Select required output
3. Choose read method
  - a) Default
  - b) Custom
  - c) *Event-based*
4. Time zone of data
5. Browse
6. Read
7. Select Subjects
8. Save

## Optional Filters

9. Filter dates
10. Set time window (Custom)
11. Set timespan (Custom)

LOTUSReader

**LOTUS Reader**  
Jack Fogarty  
2024

Dark ☐  
Cool ☐

Browse, select, load, and compile EmbracePlus or other timeseries data for processing and analysis.

Select Data Type Input: ☐ Avro ☒ CSV

☒ EDA ☒ BVP ☐ SystP ☐ Temp ☐ ACC ☐ GYR ☐ Steps ☐ Other ☐ Summary

**Read Method** Custom **Time Zone of Data** Asia/Singapore

**Filter Date Range**  
Select date range (Start and End dates included)  
Start Date 02/Feb/2024  
End Date 02/May/2024

**Time Window**  
Select epoch times in 24h format (e.g., 13:35:00)  
Start Time 8 : 0 : 0  
End Time 15 : 30 : 0

**Timespan**  
Set the period between start and end timepoints (for day, 0 < 24h)  
Timespan 0 0 0

**Select Subjects**  
Select All  
0002-3YK3M161D  
04-3YK3M161DC  
05-3YK3M161DC  
06-3YK3M161DC  
07-3YK3M161DC

Browse  
Read  
Save  
Analyser



# LOTUS READER

## Core Procedure

1. Select input file type
2. Select required output
3. Choose read method
  - a) Default
  - b) Custom
  - c) Event-based
4. Time zone of data
5. Browse
6. Read
7. Select Subjects
8. Save

## Optional Filters

9. Filter dates
10. Set time window (Custom)
11. Set timespan (Custom)

LOTUSReader

**LOTUS Reader** Jack Fogarty 2024

Dark ☐ Cool ☐

Browse, select, load, and compile EmbracePlus or other timeseries data for processing and analysis.

**Select Data Type** Input: ☐ Avro ☒ CSV

☒ EDA ☒ BVP ☐ SystP ☐ Temp ☐ ACC ☐ GYR ☐ Steps ☐ Other ☐ Summary

Read Method: Custom

**Time Zone of Data**: Asia/Singapore

**Filter Date Range**  
Select date range (Start and End dates included)  
Start Date: 02/Feb/2024  
End Date: 02/May/2024

**Time Window**  
Select epoch times in 24h format (e.g., 13:35:00)  
Start Time: 8 : 0 : 0  
End Time: 15 : 30 : 0

**Timespan**  
Set the period between start and end timepoints (for day, 0 < 24h)  
Timespan: 0 Years 0 Months 0 Days

**Select Subjects**  
Select All  
0002-3YK3M161D  
04-3YK3M161DC  
05-3YK3M161DC  
06-3YK3M161DC  
07-3YK3M161DC

Browse Read Save Analyser

# LOTUS READER

## Core Procedure

1. Select input file type
2. Select required output
3. Choose read method
  - a) Default
  - b) Custom
  - c) Event-based
4. Time zone of data
5. Browse
6. Read
7. Select Subjects
8. Save

## Optional Filters

9. Filter dates
10. Set time window (Custom)
11. Set timespan (Custom)

# LOTUS READER

## Core Procedure

1. Select input file type
2. Select required output
3. Choose read method
  - a) Default
  - b) Custom
  - c) Event-based
4. Time zone of data
5. Browse
6. **Read**
7. Select Subjects
8. Save

## Optional Filters

9. Filter dates
10. Set time window (Custom)
11. Set timespan (Custom)

The screenshot shows the LOTUS Reader application window. The title bar says 'LOTUSReader'. The main header area has 'LOTUS Reader' in blue, 'Jack Fogarty 2024' in grey, and a 'Dark' theme toggle. Below the header, a description reads: 'Browse, select, load, and compile EmbracePlus or other timeseries data for processing and analysis.' The 'Select Data Type' section has radio buttons for 'Input: Avro' and 'CSV' (selected). Below this are checkboxes for data types: EDA (checked), BVP (checked), SystP, Temp, ACC, GYR, Steps, Other, and Summary. The 'Read Method' is set to 'Custom' and the 'Time Zone of Data' is 'Asia/Singapore'. There are three main panels: 'Filter Date Range' with 'Start Date' (02/Feb/2024) and 'End Date' (02/May/2024); 'Time Window' with 'Start Time' (8:00) and 'End Time' (15:30); and 'Timespan' with 'Years' (0), 'Months' (0), and 'Days' (0). On the right, the 'Select Subjects' panel shows a list of subjects: '0002-3YK3M161D', '04-3YK3M161DC', '05-3YK3M161DC', '06-3YK3M161DC', and '07-3YK3M161DC'. At the bottom right, there are buttons for 'Browse', 'Read' (highlighted with a red box and a red circle with the number 6), 'Save', and 'Analyser'.

## NOTE

**'Read'** identifies potential subjects and updates the GUI configuration. Press this before selecting subjects and clicking **'Save'** to ensure settings are up-to-date.

If GUI settings are altered on the fly, press **'Read'** again to ensure GUI is up-to-date.

# LOTUS READER

## Core Procedure

1. Select input file type
2. Select required output
3. Choose read method
  - a) Default
  - b) Custom
  - c) Event-based
4. Time zone of data
5. Browse
6. Read
7. **Select Subjects**
8. Save

## Optional Filters

9. Filter dates
10. Set time window (Custom)
11. Set timespan (Custom)

LOTUSReader

**LOTUS Reader**  
Jack Fogarty  
2024

Dark ☐  
Cool ☐

Browse, select, load, and compile EmbracePlus or other timeseries data for processing and analysis.

**Select Data Type** Input: ☐ Avro ☒ CSV

☒ EDA ☒ BVP ☐ SystP ☐ Temp ☐ ACC ☐ GYR ☐ Steps ☐ Other ☐ Summary

Read Method: Custom Time Zone of Data: Asia/Singapore

**Filter Date Range**  
*Select date range (Start and End dates included)*  
Start Date: 02/Feb/2024  
End Date: 02/May/2024

**Time Window**  
*Select epoch times in 24h format (e.g., 13:35:00)*  
Start Time: 8 : 0 : 0  
End Time: 15 : 30 : 0

**Timespan**  
*Set the period between start and end timepoints (for day, 0 < 24h)*  
Timespan: 0 Years 0 Months 0 Days

**Select Subjects**  
Select All  
0002-3YK3M161D  
04-3YK3M161DC  
05-3YK3M161DC  
06-3YK3M161DC  
07-3YK3M161DC

Browse  
Read  
Save  
Analyser

# LOTUS READER

## Core Procedure

1. Select input file type
2. Select required output
3. Choose read method
  - a) Default
  - b) Custom
  - c) Event-based
4. Time zone of data
5. Browse
6. Read
7. Select Subjects
8. **Save**

## Optional Filters

9. Filter dates
10. Set time window (Custom)
11. Set timespan (Custom)

The screenshot shows the LOTUS Reader application window. The title bar reads 'LOTUSReader'. The main header area contains the 'LOTUS Reader' logo, the name 'Jack Fogarty 2024', and a 'Dark' theme toggle. Below the header, a description states: 'Browse, select, load, and compile EmbracePlus or other timeseries data for processing and analysis.' The 'Select Data Type' section has an 'Input' dropdown set to 'CSV'. A row of checkboxes includes 'EDA' (checked), 'BVP' (checked), 'SystP', 'Temp', 'ACC', 'GYR', 'Steps', 'Other', and 'Summary'. The 'Read Method' is set to 'Custom' and the 'Time Zone of Data' is 'Asia/Singapore'. The 'Filter Date Range' section has 'Start Date' as '02/Feb/2024' and 'End Date' as '02/May/2024'. The 'Time Window' section shows 'Start Time' as 8:00 and 'End Time' as 15:30. The 'Timespan' section shows 'Years', 'Months', and 'Days' all set to 0. The 'Select Subjects' list on the right contains several IDs, with '0002-3YK3M161D' selected. At the bottom right, there are buttons for 'Browse', 'Read', 'Save' (highlighted with a red box and a red circle with the number 8), and 'Analyser'.



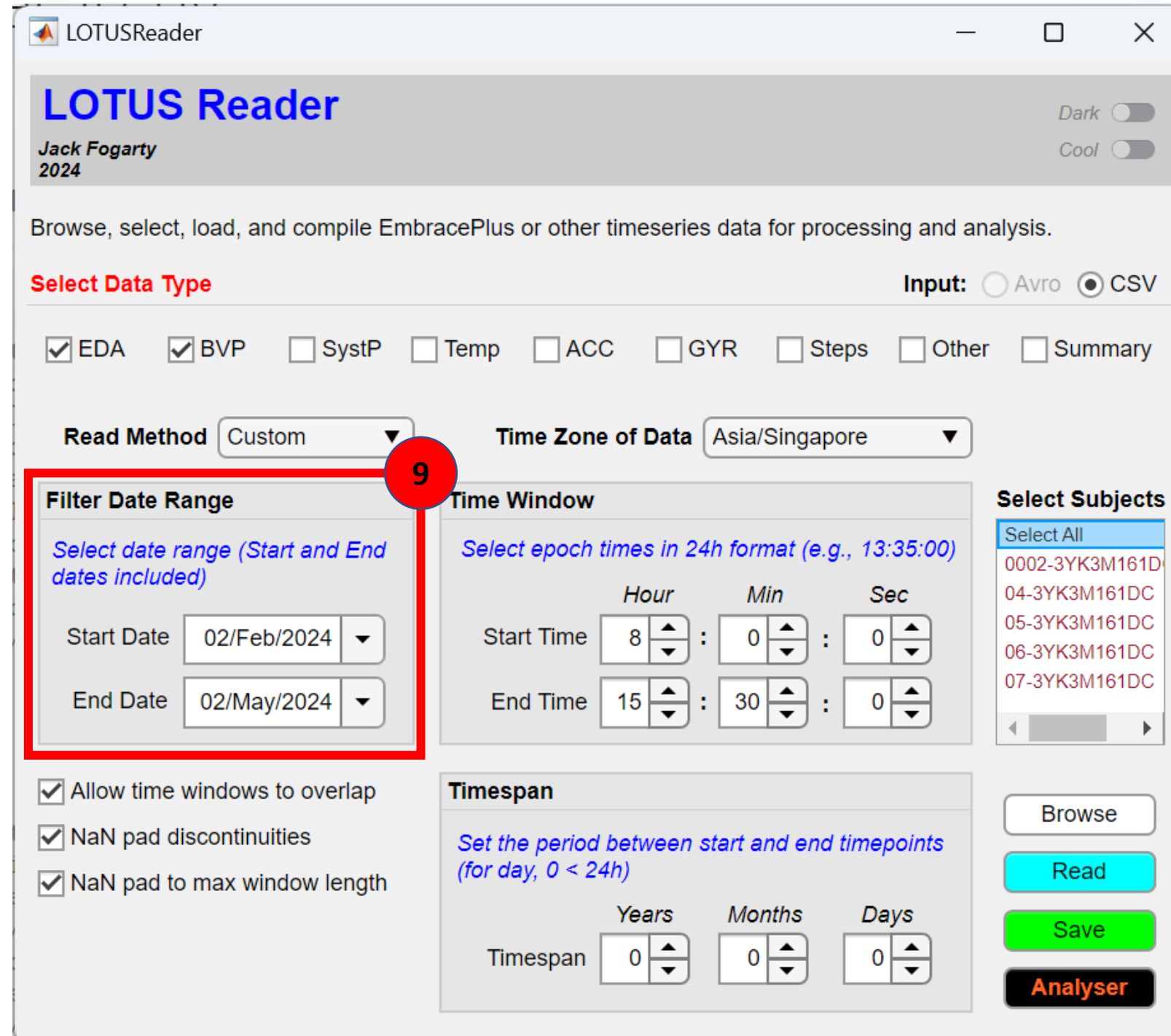
# LOTUS READER

## Core Procedure

1. Select input file type
2. Select required output
3. Choose read method
  - a) Default
  - b) Custom
  - c) Event-based
4. Time zone of data
5. Browse
6. Read
7. Select Subjects
8. Save

## Optional Filters

9. Filter dates
10. Set time window (Custom)
11. Set timespan (Custom)



LOTUSReader

### LOTUS Reader

Jack Fogarty  
2024

Browse, select, load, and compile EmbracePlus or other timeseries data for processing and analysis.

**Select Data Type** Input: ☐ Avro ☒ CSV

☒ EDA ☒ BVP ☐ SystP ☐ Temp ☐ ACC ☐ GYR ☐ Steps ☐ Other ☐ Summary

Read Method: Custom Time Zone of Data: Asia/Singapore

**Filter Date Range**

Select date range (Start and End dates included)

Start Date: 02/Feb/2024

End Date: 02/May/2024

**Time Window**

Select epoch times in 24h format (e.g., 13:35:00)

Start Time: 8 : 0 : 0

End Time: 15 : 30 : 0

**Timespan**

Set the period between start and end timepoints (for day, 0 < 24h)

Timespan: 0 : 0 : 0

**Select Subjects**

Select All

0002-3YK3M161D

04-3YK3M161DC

05-3YK3M161DC

06-3YK3M161DC

07-3YK3M161DC

Browse

Read

Save

Analyser



# LOTUS READER

## Core Procedure

1. Select input file type
2. Select required output
3. Choose read method
  - a) Default
  - b) Custom
  - c) Event-based
4. Time zone of data
5. Browse
6. Read
7. Select Subjects
8. Save

## Optional Filters

9. Filter dates
10. Set time window (Custom)
11. Set timespan (Custom)

LOTUS Reader

Jack Fogarty 2024

Dark ☐ Cool ☐

Browse, select, load, and compile EmbracePlus or other timeseries data for processing and analysis.

Select Data Type Input: ☐ Avro ☒ CSV

☒ EDA ☒ BVP ☐ SystP ☐ Temp ☐ ACC ☐ GYR ☐ Steps ☐ Other ☐ Summary

Read Method Custom Time Zone of Data Asia/Singapore

Filter Date Range

Select date range (Start and End dates included)

Start Date 02/Feb/2024 End Date 02/May/2024

Time Window

Select epoch times in 24h format (e.g., 13:35:00)

Start Time 8 : 0 : 0 End Time 15 : 30 : 0

Timespan

Set the period between start and end timepoints (for day, 0 < 24h)

Timespan 0 : 0 : 0

Select Subjects

Select All

0002-3YK3M161D  
04-3YK3M161DC  
05-3YK3M161DC  
06-3YK3M161DC  
07-3YK3M161DC

Browse Read Save Analyser

# LOTUS READER

## Core Procedure

1. Select input file type
2. Select required output
3. Choose read method
  - a) Default
  - b) Custom
  - c) Event-based
4. Time zone of data
5. Browse
6. Read
7. Select Subjects
8. Save

## Optional Filters

9. Filter dates
10. Set time window (Custom)
11. Set timespan (Custom)

LOTUSReader

**LOTUS Reader**  
Jack Fogarty  
2024

Dark ☐  
Cool ☐

Browse, select, load, and compile EmbracePlus or other timeseries data for processing and analysis.

Select Data Type Input: ☐ Avro ☒ CSV

☒ EDA ☒ BVP ☐ SystP ☐ Temp ☐ ACC ☐ GYR ☐ Steps ☐ Other ☐ Summary

Read Method Custom Time Zone of Data Asia/Singapore

Filter Date Range  
Select date range (Start and End dates included)  
Start Date 02/Feb/2024  
End Date 02/May/2024

Time Window  
Select epoch times in 24h format (e.g., 13:35:00)  
Start Time 8 : 0 : 0  
End Time 15 : 30 : 0

Select Subjects  
Select All  
0002-3YK3M161D  
04-3YK3M161DC  
05-3YK3M161DC  
06-3YK3M161DC  
07-3YK3M161DC

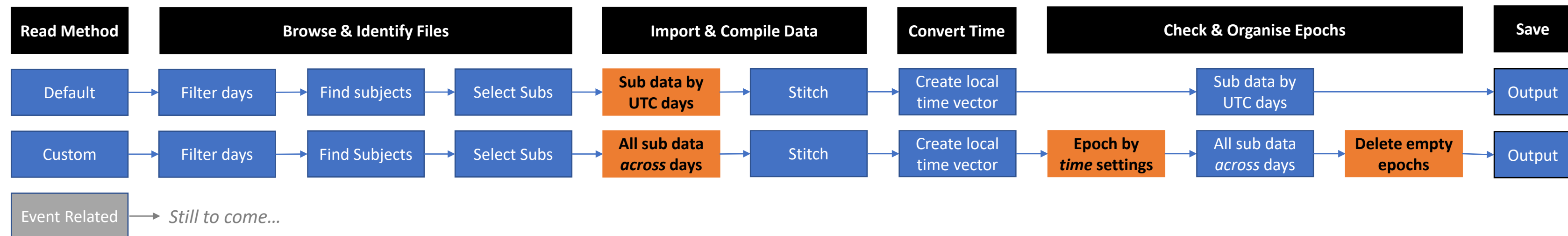
Timespan  
Set the period between start and end timepoints (for day, 0 < 24h)  
Timespan 0 0 0

Browse  
Read  
Save  
Analyser

# Basic Pipeline and Backend Code

The backend code (Matlab functions) behind the GUI are in early stages of development and this pipeline and underlying code will likely be subject to change as improvements are made.

*This basic pipeline below is implemented after selecting the type of input (i.e., CSV) and desired output options...*



Parameters are set interactively via GUI **Browse** **Read** **Save** 'Save' initiates actual compilation and output →

*ep\_read\_data.m*

*ep\_import\_data.m*

- *ep\_import\_tag.m*
- *ep\_import\_eda.m*
- *ep\_import\_bvp.m*
- ...
- ...
- *ep\_import\_sum.m*

*ep\_check\_signal.m*

- *ep\_pad\_discontinuities.m*
- *ep\_pad\_to\_epoch.m*

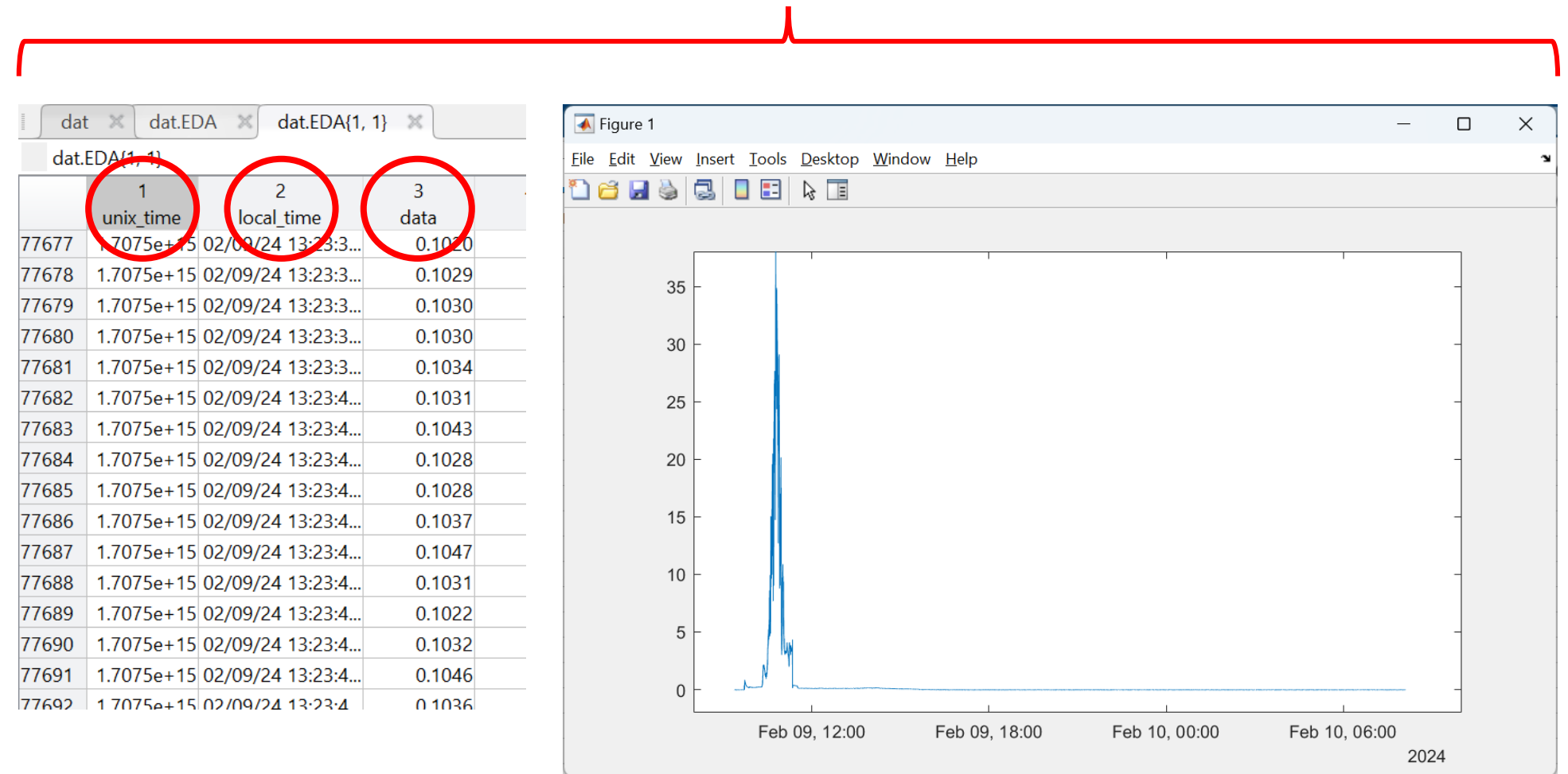
*ep\_export\_data.m*

# LOTUS READER: Data Output

Data structure (dat)

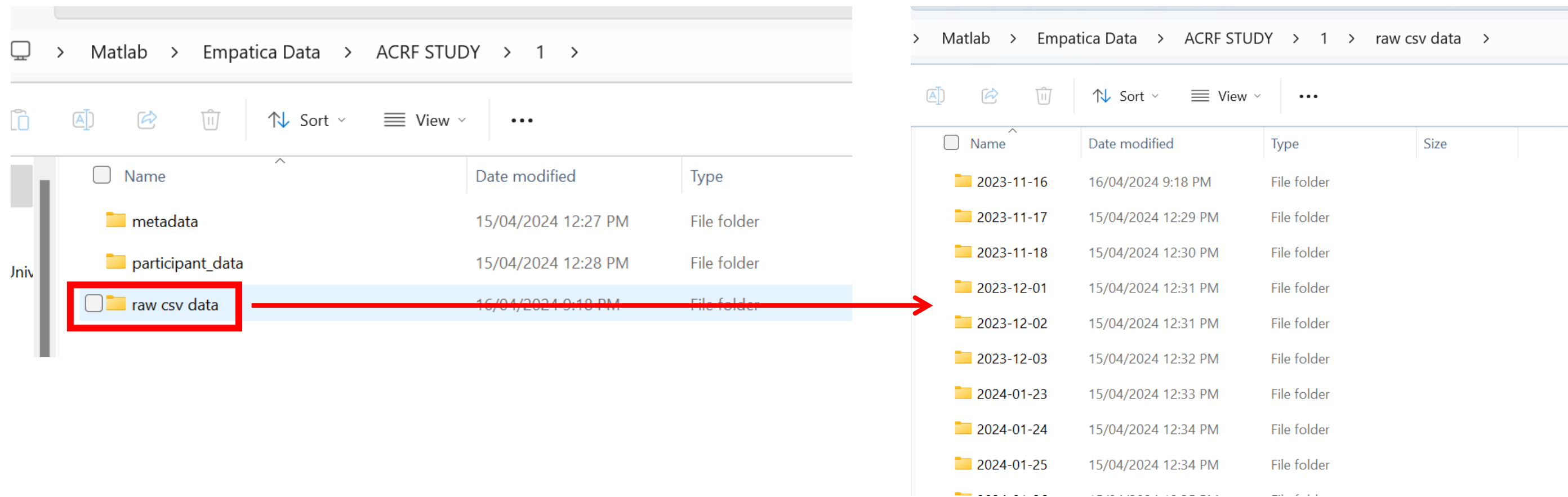
VARIABLE		SELECTION
dat		
1x1 struct with 11 fields		
Field	Value	
EDA	1x1 cell	
BVP	1x1 cell	
SystP	[]	
Temp	[]	
ACC	[]	
GYR	[]	
Steps	[]	
Other	[]	
Tags	1x1 cell	
Summary	[]	
deleted_Tags	1x1 cell	

Output EDA signal



# Notes on Input Data

- LOTUS Reader can read in avro or CSV data converted from avro files.
  - Conversion from avro to csv is can be done using python code provided in Empatica manuals (see their documentation)
  - Python code has also been customized to directly read avro into matlab (more memory efficient but potentially slower for LOTUS)
- Users should *browse* to the parent folder containing the raw CSV data grouped by date.
  - This raw csv folder structure is a product of a [custom version](#) of the Empatica python script for converting avro to csv
  - To read avro directly, browse to the 'participant\_data' folder instead



# Data Output

## Data structure (dat)

The screenshot shows the Tableau interface with the 'dat' variable selected. The variable has 11 fields. The 'Tags' field is circled in orange, and its value '1x1 cell' is also circled in orange.

Field	Value
EDA	1x1 cell
BVP	1x1 cell
SystP	[]
Temp	[]
ACC	[]
GYR	[]
Steps	[]
Other	[]
Tags	1x1 cell
Summary	[]
deleted_Tags	1x1 cell

## Output events (tags)

dat x dat.Tags x dat.Tags{1, 1} x


dat.Tags{1, 1}

	1 Tag	2 UTC_FileTime	3 TZ_FileTime	4 TZ_TagTime	5 Annotation
1	1	'1707442807'	02/09/24	09:44:57.876	"
2	2	'1707443710'	02/09/24	09:59:08.055	"
3	3	'1707443710'	02/09/24	10:09:42.733	"
4	4	'1707444607'	02/09/24	10:12:06.119	"
5	5	'1707444607'	02/09/24	10:18:30.321	"
6	6	'1707444607'	02/09/24	10:24:53.189	"
7	7	'1707446412'	02/09/24	10:50:52.988	"
8	8	'1707447319'	02/09/24	10:57:05.333	"
9	9	'1707447319'	02/09/24	10:57:37.392	"
10	10	'1707447319'	02/09/24	11:03:15.614	"
11	11	'1707448221'	02/09/24	11:13:41.233	"
12	12	'1707448221'	02/09/24	11:14:26.468	"
13	13	'1707448221'	02/09/24	11:20:44.445	"



# Cfg Output

## Configuration structure (cfg)



VARIABLE	SELECTION	EDIT
cfg		
1x1 struct with 17 fields		
Field	Value	
parent_folder	'C:\Users\jfogarty\Desktop\Matlab\Empatica Data\1\1\rav'	
InputType	'.csv'	
DataType	1x1 struct	
ReadMethod	'Default'	
TimeZone	'Asia/Singapore'	
Sdate	1x1 datetime	
Edate	1x1 datetime	
Stime	1x1 struct	
Etime	1x1 struct	
Tspan	1x1 struct	
subjects	4x1 cell	
overlap	1	
padding	1	
padmax	1	
day_folders	6x1 struct	
selected_subjects	1x1 cell	
output_folder	'C:\Users\jfogarty\Desktop\Matlab\Empatica Data\output'	

Contains details regarding the file/dataset that will be kept for posterity or used in subsequent analysis steps within the LOTUS *analyzer*

# Use Requirements

LOTUS Reader was built in Matlab 2023b and utilises python code via Matlab, using python version 3.11

Users without Matlab can install LOTUS Reader via a compiled version but will still need a [compatible version](#) of python (i.e. 3.9, 3.10, or 3.11) installed to read avro data directly into organised mat structures.

Dependencies to read avro via python also need to be installed for:

- Avro (run: `pip install avro` in a command prompt or other terminal)

# Reading in Avro Data

## Option 1

- Run the adjusted Empatica Python script provided to transform to Avro to CSV
- Import CSV data via LOTUS

## Requirements

- Python installed
- Use 'external' python script [extractavro\_matlab.py]
  - Dependencies (libraries) to install:
    - Avro (run: **pip install avro** in a command prompt or other terminal)
    - json (comes with python)
    - csv (comes with python)
    - os (comes with python)
- Ability to run python script in external environment (e.g., via Jupyter Notebook)

## Notes

- Reading in CSV is currently a lot faster than reading in Avro directly to LOTUS via Option 2 (next slide)

# Reading in Avro Data

## Option 2

- Call avro data into Matlab directly via LOTUS Reader

## Requirements

- Python version 3.11 installed
- Be using Matlab 2023 or later (as this can utilise Python version 3.11)
  - Dependencies (libraries) to install:
    - Avro (run: **pip install avro** in a command prompt or other terminal)
    - json (comes with python)
    - csv (comes with python)
    - os (comes with python)

## Notes

- Reading in Avro files is slower (but more memory efficient) as Matlab is calling python [ep\_read\_avro.py] to read avro data directly into mat files (i.e., no CSV files necessary)
- Need to ensure [compatible versions](#) of Matlab and python are installed
- LOTUS was built with Matlab 2023 [which is 'installed' in the LOTUS\_reader.exe] and this is compatible with python versions 3.9, 3.10, and 3.11
- Python 3.11 was installed during the development of LOTUS

# On the Horizon for Future Releases...

- LOTUS Analyzer is currently in development and to be released soon to enable signal preprocessing

## *LOTUS Reader*

- Backwards compatibility with E4 data to come
- Modular output formats (i.e., mat or CSV)
- Refined 'summary' of input datasets
- Read functions for GYR, steps, and other signals from alternate devices may be built in
- Update for status and warning messages