Datasets 1001 and 1002 were recorded from two individuals at the university in a small office room. Datasets 1003-1010 have been recorded using various rooms in a domestic residence. Datasets 1003, 1004, 1005, 1006 were all recorded within the same room. Datasets 1001 and 1002 are constructed for it to be highly evident from the data which activity a user was engaged in (e.g. physical artefacts related to other tasks were removed from camera view of the autographer so as not to confuse activities). Datasets 1003 to 1010 more closely simulate real-world environments where a person might engage in an activity where artefacts of the previous activity are still in the environment. For example, a person wouldn't put away all the documents they were just sorting because they needed to make a telephone call. Artefacts like documents may remain in the autographer camera's view, however, we could use a sensor value like from a wrist-worn accelerometer (left or right) to understand that the orientation of a subject's hand for that time period indicated they were holding a phone to their ear. **Task participants will need to decide how best to use all (or only some of) the sensor sources in combination to disentangle and understand the context in which the activity occurs.**

# Data format

Download and unzip MART_2020_MERGED.7z to find the MART dataset.

The MART data directory is structured as follows:

- Each of these folders contain the following 4 folders:
    - AUTOGRAPHER: autographer (lifelog) images for the test, trainA, and trainB
    - PANDAS: csv files that are easily loaded e.g. into pandas, etc
    - RAW: raw data in text file format
    - SCREENSHOTS: loggerman screenshots

Data is made available in a number of formats including both raw and preprocessed data (to extract aggregate statistics). It's expected in most instances task participants will use pre-calculated features (via the csv files in the PANDAS folder), however, preprocessed time-series data is made available for those who wish to implement their own preprocessing approaches (in RAW).

**note:**

**1) Task participants are free to use either the RAW or PANDAS data (or both) when building their system.**

**2) A list of activities completed by participants is provided in the Appendix with corresponding activity IDs e.g. act08.**

## AUTOGRAPHER / SCREENSHOTS:

File format for training files:
SID_ACT_IND.jpg (e.g. 1001_act01_1.jpg ) where:
SID = participant data_id

ACT = activity id
IND = incrementing index of images captured during this time period.

File format for testing files:
SID_PRED_IND e.g. (1001_pred0_1.jpg) where:
SID = participant data_id
PRED = unique (randomised) id *
IND = incrementing index of images captured during this time period

# RAW:

* The preprocessing and extraction of raw data is shown in the jupyter notebook. Please pay particular attention to which files contain time-series samples versus those that contain aggregate statistics.

File format in the raw directory (for training data):
training_SID_DATASOURCELABEL_ACT_TSET.txt (e.g. train_1001_data_RIGHT_ACC_Z_act00_A.txt) where:
SID = participant data_id
DATASOURCELABEL = data source (*see list in appendix: Labels of data sources)
TSET = whether it belongs to training set A or B

File format in the raw directory (for test data):
test_SID_DATASOURCELABEL_PRED.txt (e.g. test_1001_data_LEFT_ACC_X_pred9) where:
SID = participant data_id
DATASOURCELABEL = data source (*see list in appendix: Labels of data sources)
PRED = unique (randomised) id

# PANDAS:

In order to speed up development, further precomputed features are provided in csv format in the PANDAS directory. These features are computed on the same data that is in RAW.

For each time-series signal source (e.g. accelerometer magnitudes) a range of descriptive statistics are computed over the activity time window.

For example, data_LEFT_ACC_MAG_min describes in a single value the minimum magnitude value for the 90s time window for that activity. **Each of these different data source labels are described in the Appendix in Labels of data sources.** The following descriptive statistics are computed: min, max, average, median and std.

Included in the csv files are ResNet-101 features. Descriptive statistics are calculated on the softmax outputs (per category) across all the autographer images captured as part of an

activity. e.g. one might use data_AUTOGRAPHER_RESNET_max_tennis ball to detect if any of the images contained a tennis ball in an activity for example.

# Appendix

## Unique Randomised ID:

IDs of events/activities in the test set (e.g. pred0) are randomized and unique per participant dataset. For example, you might discern that pred0 for participant 1002 is act09, pred1 for participant 1002 is act02, etc

## Training/test split:

Each of the 20 activities are repeated 3 times per participant. For each activity for each experimental participant, two training datasets (with ground truth) are provided (i.e. trainA and trainB). Test data is labelled test.

## Labels of data sources (within RAW and PANDAS):

**data_EOG_UD_by_activity** = EOG up/down activity. This is calculated by re-referencing the channel for an electrode placed below the eye to one placed directly above it. This contains notable eye-related artefacts such as blinks and up/down eye movements. Units are in microVolts with a sampling rate of 100 Hz for the 90 seconds of the activity.

**data_EOG_LR_by_activity** = EOG left/right activity. This is calculated by re-referencing channels for electrodes placed (horizontally) on the temple for either side of the eye (i.e. right-left). Units are in microVolts with a sampling rate of 100 Hz for the 90 seconds of the activity.

**data_LEFT_ACC_MAG** / **data_RIGHT_ACC_MAG** = time-series magnitude data calculated from the accelerometer placed on the left hand. Units are in g's of g-force with a sampling rate of 85 Hz for the 90 seconds of the activity. 1 g has been subtracted from each magnitude signal to remove the effect of gravity.

**data_LEFT_ACC_X** / **data_LEFT_ACC_Y** / **data_LEFT_ACC_Z** = time-series data from the accelerometer placed on the left hand. These values indicate movement and the resting orientation of a hand (e.g. it's held up or resting on a table). Units are in g's of g-force with a sampling rate of 85 Hz for the 90 seconds of the activity. These values are as they are captured from the accelerometer(s).

**data_HEAD_MAG_by_activity** = time-series magnitude data calculated from the accelerometer placed on the left hand. Units are in g's of g-force with a sampling rate of 100

Hz for the 90 seconds of the activity. 1 g has been subtracted from each magnitude signal to remove the effect of gravity.

**data_HEAD_X_by_activity** / **data_HEAD_Y_by_activity** / **data_HEAD_Z_by_activity** = time-series data from an accelerometer on the head. These values indicate head movement. The raw values from the accelerometer have been calibrated. X = perpendicular to the frontal plane (front-to-back), Y = perpendicular to the transverse plane (top-to-bottom) and Z = perpendicular to the sagittal plane (ear-to-ear). Units are in g's of g-force with a sampling rate of 100 Hz for the 90 seconds of the activity.

**data_HR_activity** = time-series heart rate data extracted from a (led) pulse sensor placed on the left ear. Raw time-series data is processed using an algorithm (see jupyter notebook) based on autocorrelation and a sliding window of 4 seconds to obtain instantaneous heart rate values (e.g. 80 beats per minute). Data is sampled at 1 Hz i.e. one reading per second

**data_MOUSE_PIX_DISTS** = euclidean distance travelled between successive mouse movements (in units of pixels) in order of temporal occurrence. One could sum these to get an idea of how much mouse movement occurred during the activity. If this file is empty, it indicates no mouse movements occurred. *note: len(data_MOUSE_TIMEDIFFS) == len(data_MOUSE_PIX_DISTS).*

**data_MOUSE_TIMEDIFFS** = time differences between mouse movements (in seconds) in order of temporal occurrence. *note: len(data_MOUSE_TIMEDIFFS) == len(data_MOUSE_PIX_DISTS).*

**data_MOUSE_VELOCITY** = velocity of mouse movements (in pixels per second). Calculated from data_MOUSE_PIX_DISTS/data_MOUSE_TIMEDIFFS.

**data_AUTOGRAPHER_RESNET_mean/max/min** = A resnet101 pre trained model is used to extract concepts from the autographer images, where softmax is computed for each of the labels (for an image) to get a probability. In this case, min = the lowest softmax values for each label category across all autographer images captured during the activity. Max = the highest softmax values for each label category across all autographer images captured during the activity. Mean = the average softmax values for each label category across all autographer images captured during the activity. In each file there are 1000 rows, where each row corresponds to a category/label. This list can be found in imagenet_classes.txt as part of the mart_data.

## Activities completed by experimental participants

- Act01: Writing/replying to an email
- Act02: Reading text on screen. For this, news websites and articles were not used.
- Act03: Editing a presentation on the computer.
- Act04: Zoning out while staring at a point in the room
- Act05: Finance management (specifically using a calculator to total numbers present on paper or screen)

- Act06: Physical precision task that requires both hands e.g. manipulating a circuit board, sowing clothing, ...
- Act07: Document organisation where the subject needed to organise A4 sheets into a particular order.
- Act08: Reading text on paper. This can be written or printed.
- Act09: Counting/arranging physical currency (money).
- Act10: Writing with pen on paper. For example, this could be writing on a blank sheet of paper or writing notes with a pen on printed text.
- Act11: Watching a youtube video.
- Act12: Browsing (any) news website.
- Act13: Having a conversation with another person in the room. The subject can be directly facing this person or they might be out of view in the room.
- Act14: Making a telephone call. This involved holding a cellular phone (either hand) to their ear. The telephone call from the experimenter with the subject discussed how the experiment was progressing.
- Act15: Drinking/eating. The subject can be eating or drinking anything.
- Act16: While seated, the subject closed their eyes and refrained from any movement for 90 seconds.
- Act17: Cleaning e.g. with a broom/hoover/cloth
- Act18: Physical exercise. In this task the subject was instructed to repeatedly sit up-and-down from their chair.
- Act19: Hand-eye coordination activity. In this task the subject was instructed to use both hands to 'play' with a tennis ball e.g. passing/throwing it between their hands.
- Act20: Walking/pacing around. In this task, the subject was instructed to pace the room continuously.

## Submission System

Submissions for the NTCIR-MART task are made by submitting a formatted text file to the following web url: http://neuroslap.com:10111

Final queries will be of the form:
"Find all instances (activities) where people were writing an email" i.e. act01
"Find all instances (activities) where people were browsing a news website" i.e. act12

This can be easily accomplished using the curl command for instance.
curl http://neuroslap.com:10111 --upload-file /home/me/my_predictions.txt

Submissions for each query should be submitted in the following format:
group_id: abc123 PassWord
act01 1001_pred0
act01 1003_pred19
act01 1005_pred9
act01 1004_pred12
…
act02 1009_pred3
act02 1008_pred13
…

As there are 200 items/documents/activities in the test set (across all experimental participants), each query result should provide a ranked list of 200 ids for that query. Since there are 20 queries in total, this submission should have 4001 rows (first row is for group_id and submission password). AP (average precision) will be computed on the ranked list given for each query, and the mean of the APs will be calculated across all queries. If a group makes a submission with a ranked list for a query less than 200 (say only the top 20), the ranked list will be extended to pad the difference (using the remaining activity-pred labels in a randomized order).

Once predictions are deposited they will be visible at
http://ntcir-mart.computing.dcu.ie/mart_report/YOUR_GROUP_ID/metrics.txt

i.e. http://ntcir-mart.computing.dcu.ie/mart_report/group99/metrics.txt

Further details regarding the submission format for labels for the test set will be released shortly.

Graham Healy (2020)