



Leidos Cognitive Load Tool (CoLT)

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COGNITIVE WORKLOAD

- Cognitive Workload (CW) is defined as:
 - *"the degree of mental effort required to complete a task"*.
- CW can be measured as:
 - **Underload**—low mental effort is required to complete a task.
 - **Overload**—high mental effort is needed to complete a task.
- Ideally, users should experience a middling level of CW where they are engaged, but not overwhelmed.
- Example:
 - Fighter pilots handling various sensors while flying modern combat aircrafts were found to fall in an overload state
 - State of high physiological arousal
 - Dynamically measure a pilot's Cognitive Workload



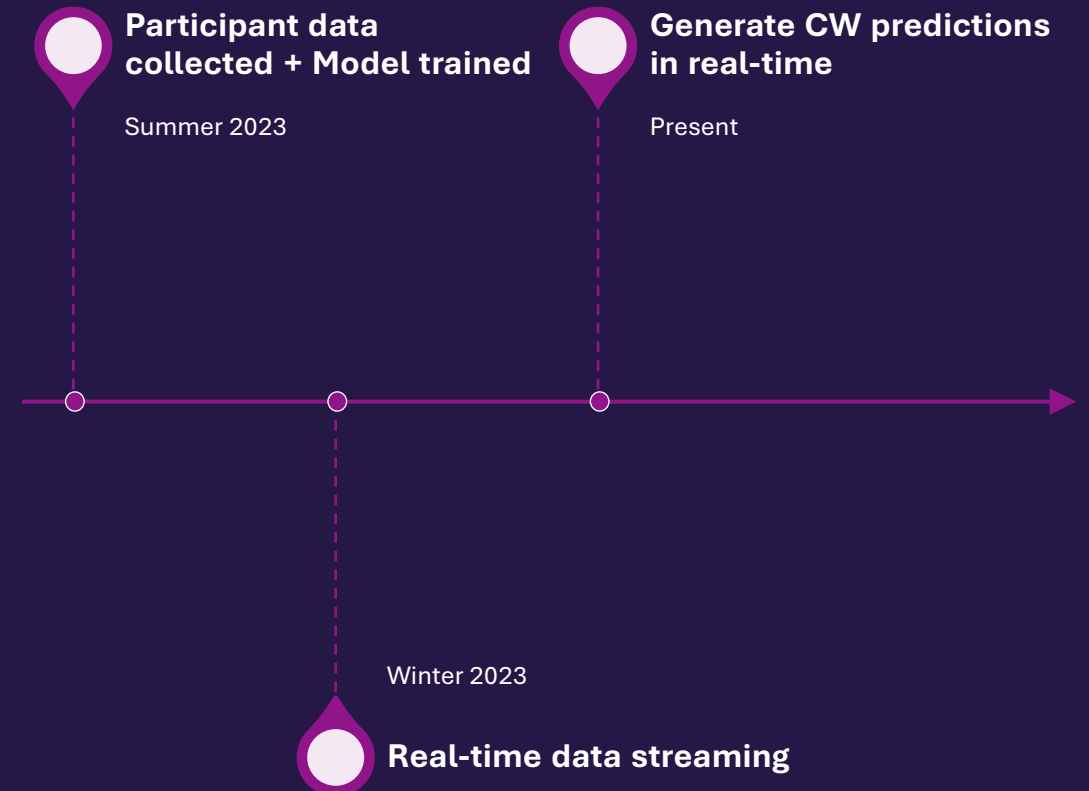
MEASURING AND IMPROVING CW

- Automation is an increasing feature of emergent National Defense technologies
 - Calibrated CW is critical for operators supervising technologies
- Over-reliance on automation, and automation compliance have been found to hamper task performance
- To ensure operators are functioning at an optimal CW; we need:
 - A reliable real-time classification system,
 - A capability for a precise measurement of CW, and
 - A way to alter the HMI to facilitate optimal operator CW.
- We found that CW can be measured via physiological sensors

RESEARCH ACCOMPLISHMENTS

GOAL: Development of a real-time Cognitive Load Classifier

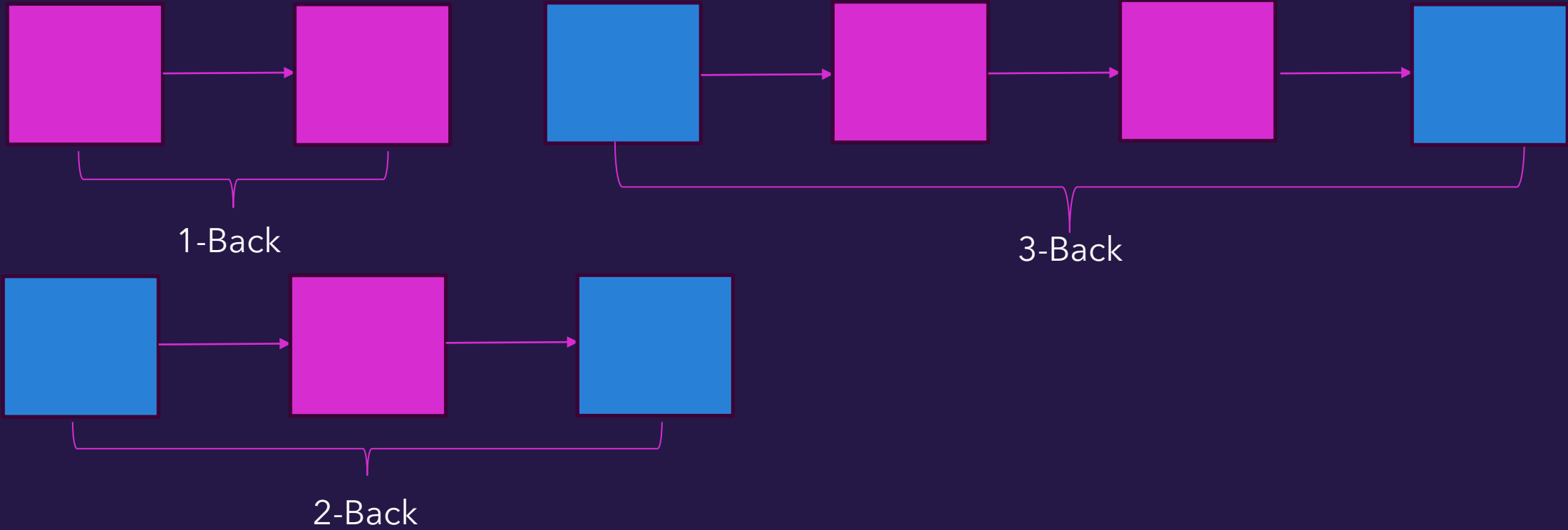
- Leidos Cognitive Load Tool (CoLT)
- "Phase 1" (Summer 2023)
 - Collect data in various CW states and create a post-hoc classifier
- "Phase 2" (Winter 2023)
 - Amend the classifier to collect physiological data in real-time
- "Phase 3" (Present)
 - Generate CW predictions in real-time in a dynamic task



METHOD

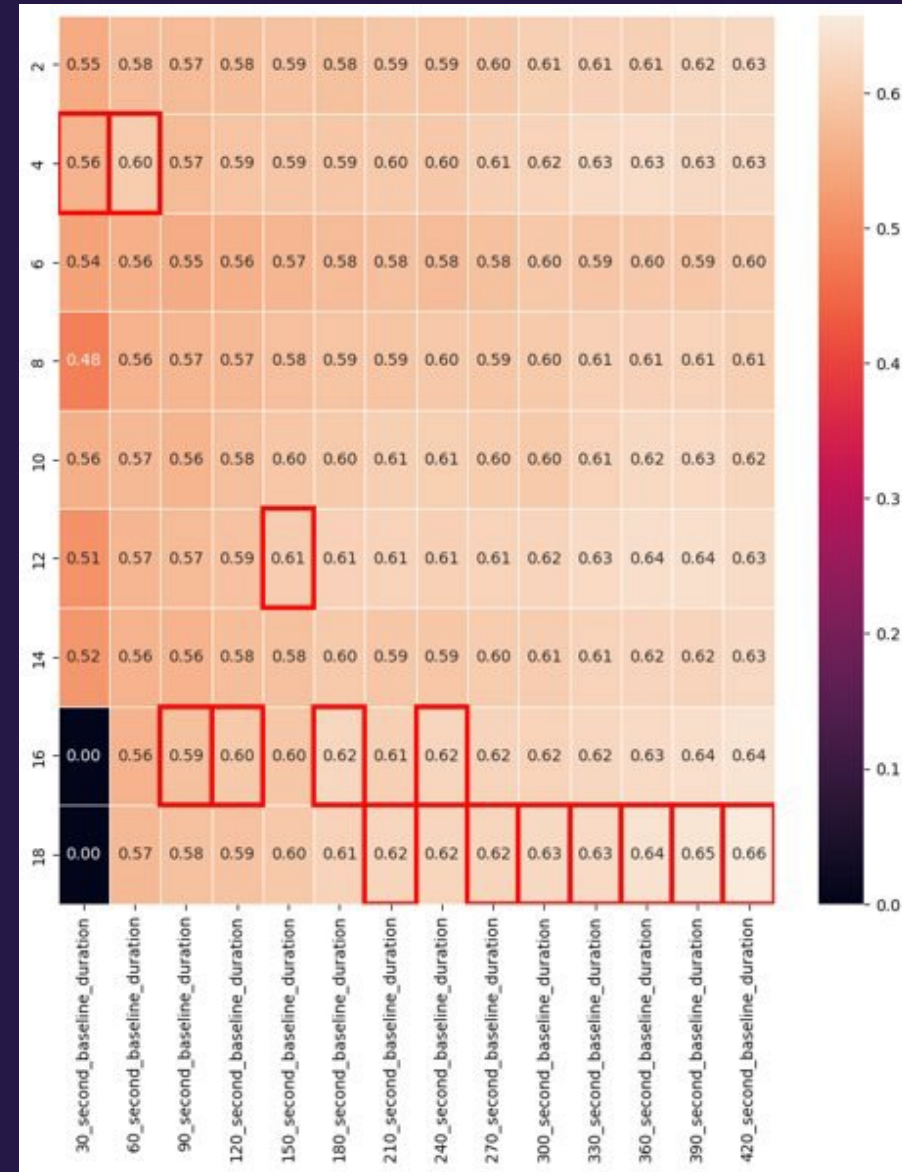
- Physiological data was collected from 34 participants
 - Physiological data included:
 - Heart Rate,
 - Electrodermal Activity (EDA), and
 - Eye-tracking (i.e., point-of-gaze, pupil dilation and fixations)
- Participants completed a series of n-backs (1-back, 2-back, 3-back)
 - The N-Back test: a cognitive task in which users must match a currently presented stimuli (a colored square) with a previously presented stimuli (n presentations back)
 - For 1-back, participants needed to match the current color of the square with the color 1 trial back.
 - For 2-back and 3-back, the compared color was 2 and 3 trials back respectively
- The classifier predicted which N-Back condition the participant was in based on the physiological data.

N-BACK



RESULTS

- Model test accuracy of 66%
- Best combination
- Segment length: 18 seconds
- Baseline duration: 7 minutes



DEMO