

Breakout Session 4: Track A

Google Cloud Pipeline for Mouse Behavior and Frailty Assessment for the Aging Research Community

Dr. Vivek Kumar (Moderator)
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Google Cloud Pipeline for Mouse Behavior and Frailty Assessment for the Aging Research Community

Vivek Kumar, PhD
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[@vivekdna](https://twitter.com/vivekdna)

ODSS cloud program PI meeting
Jan 17-18, 2024



Kumar lab



Key Individuals: Brian Geuther, Leinani Hession, Gautam Sabnis, Keith Sheppard, Glen Beane



Develop better pre-clinical animal models

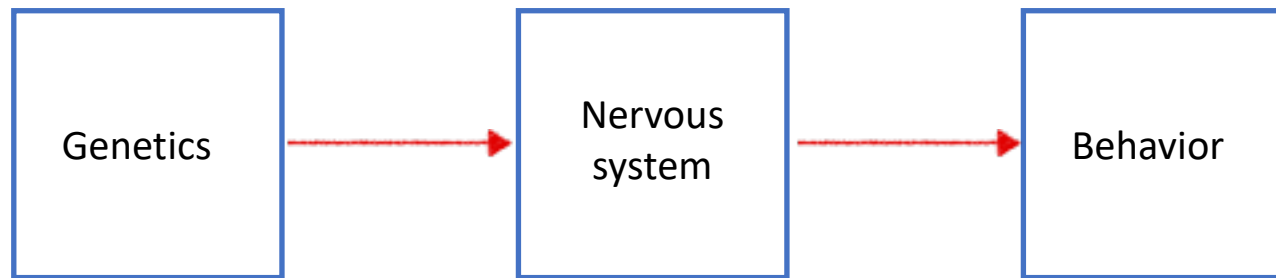
Aging

Neuropsychiatric

Neurodevelopmental

...

Simple Model



How do we study behaviors in mouse models?



Current methods

- Subjective
- Standardization
- Fragmented studies
- Lack proper validity

INCREASED VARIABILITY

POOR REPRODUCIBILITY AND REPLICABILITY

DECREASED TRANSLATABILITY



OPINION

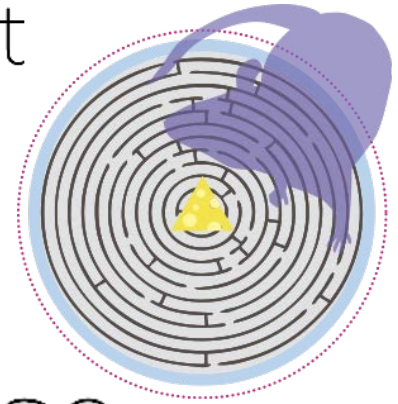
Misbehaving mice

BY VIRGINIA HUGHES / 19 AUGUST 2010

NEWS

Mutant mice show inconsistent behaviors in different labs

BY EMILY SINGER / 7 JANUARY 2013



OPINION / VIEWPOINT

Promises and limitations of mouse models of autism

BY JACQUELINE CRAWLEY / 10 MAY 2011



ILLUS

Why studying autism in mice may be doomed to fail

Why animal research needs to improve

29 SEPTEMBER 2011 | VOL 477 | NATURE | 511

Preclinical Success To Clinical Failure: Do We Have A Model Problem Or An Endpoint Problem?

nature International weekly journal of science

Published online 30 March 2010 | Nature | doi:10.1038/news.2010.158

News

Animal studies paint misleading picture

Toward a Science of Computational Ethology

David J. Anderson^{1,2,4,*} and Pietro Perona^{3,4,*}

¹Division of Biology and Biological Engineering

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Can we do better?

Use computer vision + machine learning

- Increased reproducibility and replicability
 - Standardized pipeline
 - Objective measurements
- Allow reuse of data
- Highly scalable
- Increased translatability

Kumar Lab Publications

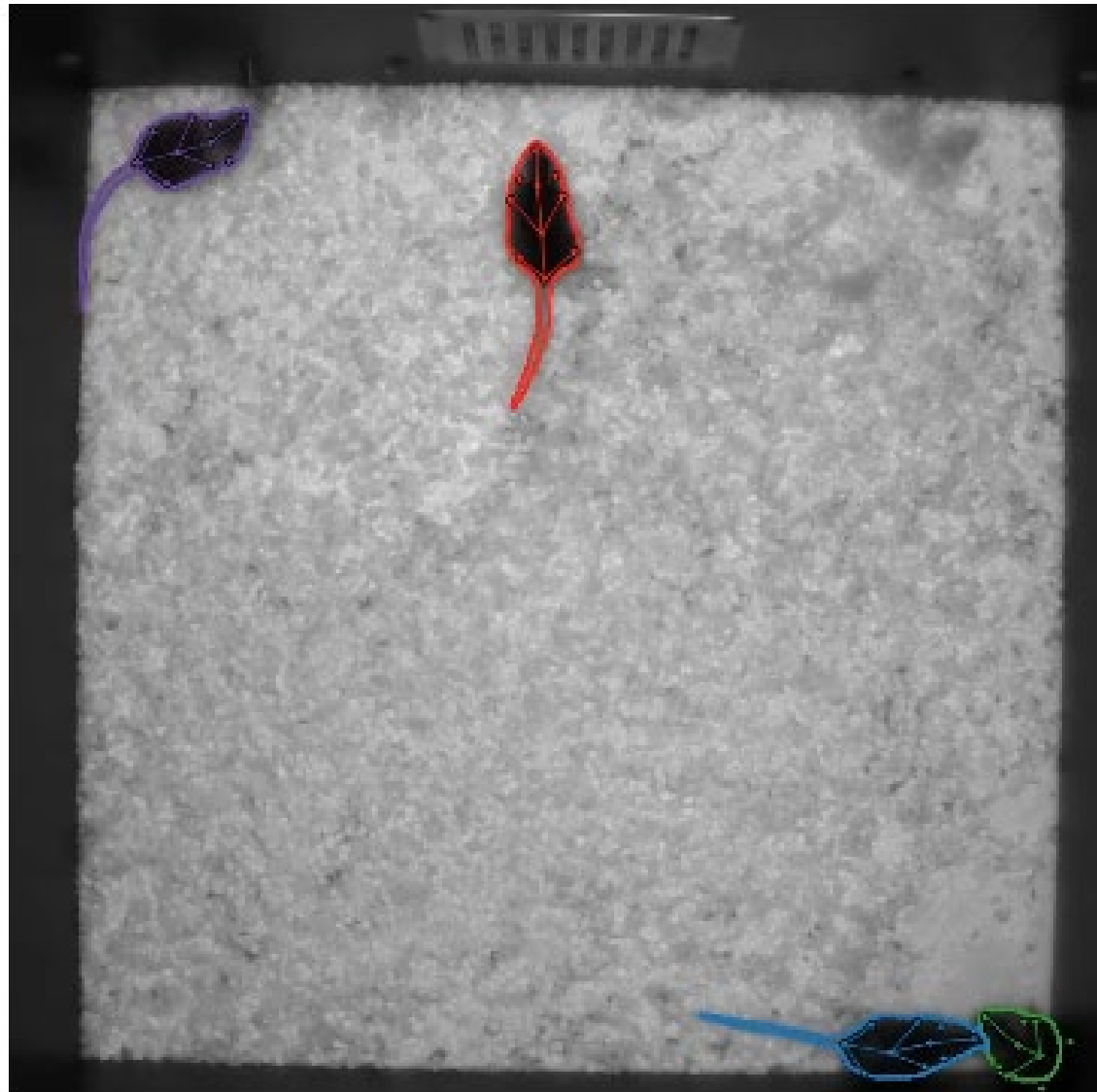
- Action detection (eLife, 2021)
- Mouse tracking (Nature Comm. Biol, 2019)
- Nociception assay (Mol. Pain 2020)
- **Gait and posture (Cell Reports, Jan 2022)**
- Sleep states (Sleep, 2021)
- **Frailty Index (Nature Aging, August 2022)**
- Social Interaction (unpublished)

Accuracy, scalability, replicability

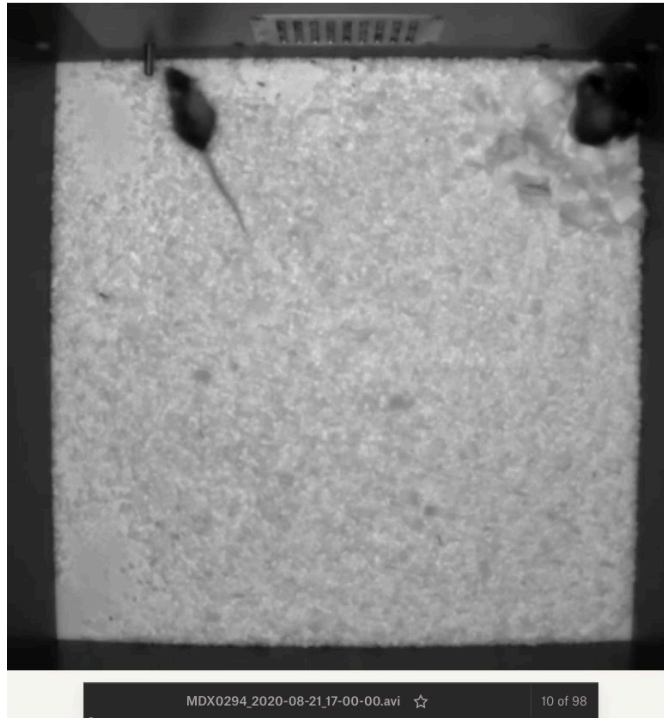


Video Processing for analysis

Custom NN with pose, identity tracking



Long Term Monitoring Dataset



800x800 px

30fps

8bit grey

1 hour video chunks

Total video count is 10944

Each video is 10-15Gb

Total dataset is ~150Tb

Located in Dropbox



Visual Frailty Index

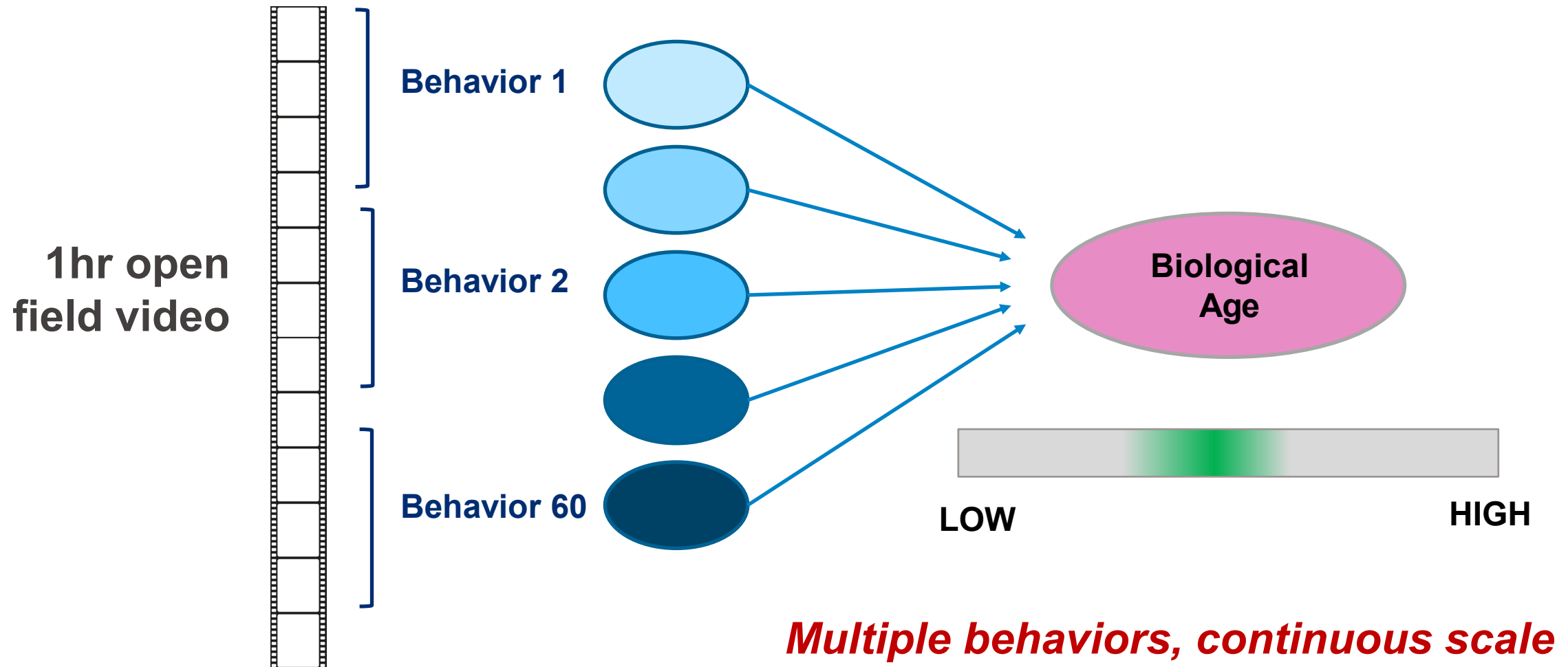


Biological age can be determined by frailty indexing in man and mouse.
Mouse assay is cumbersome and affected by tester.

Leinani Hession, Gautam Sabnis, Gary Churchill
Nature Aging (2022)

Approaches to behavior annotation

3b. Indexing – Frailty/Pain

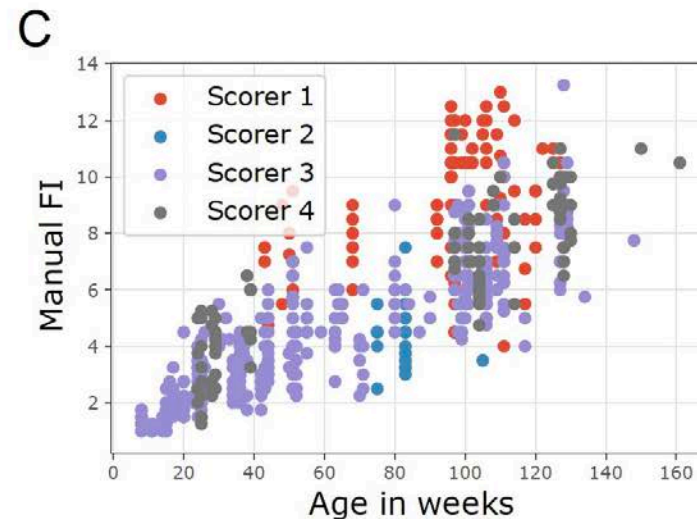
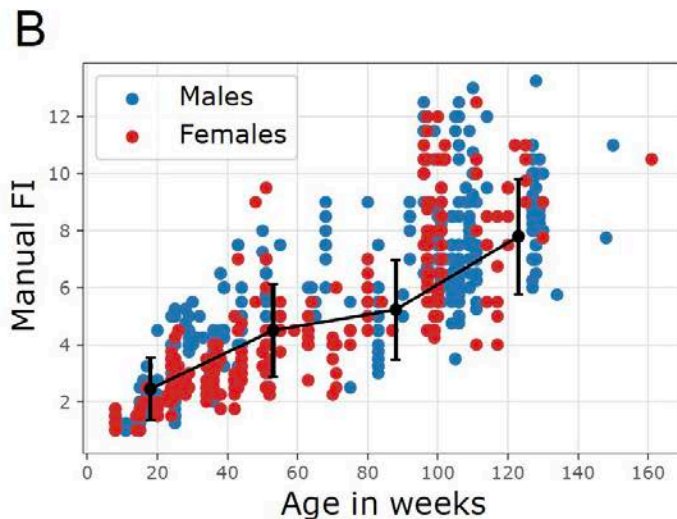
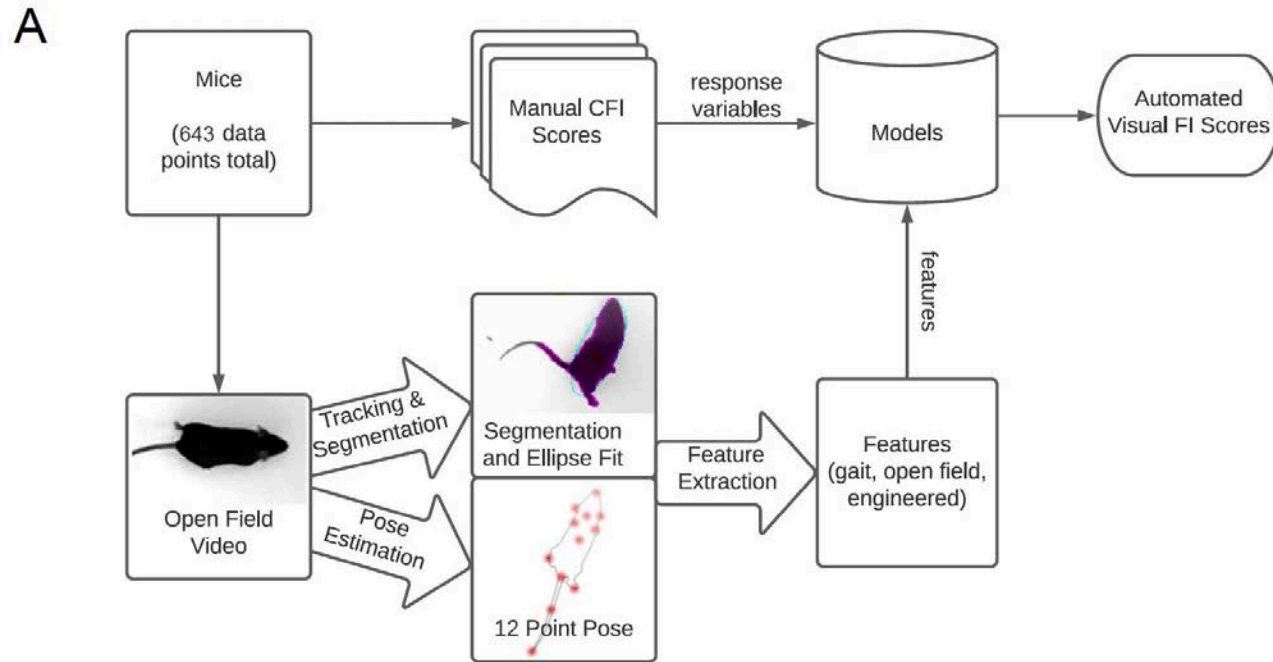


Solution: Develop an automated visual frailty index



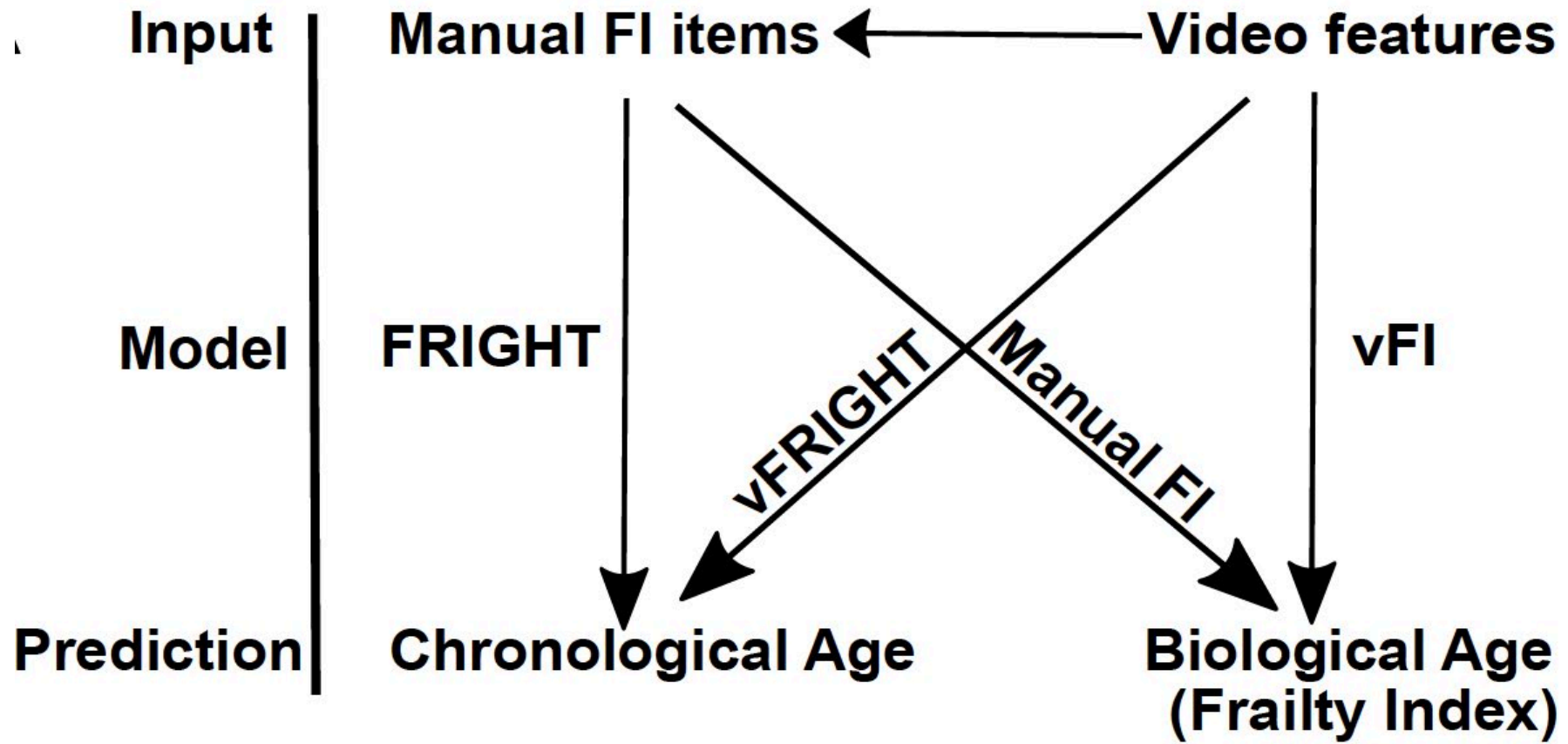
We are very accurately able to predict frailty score from the video

Visual Frailty Index

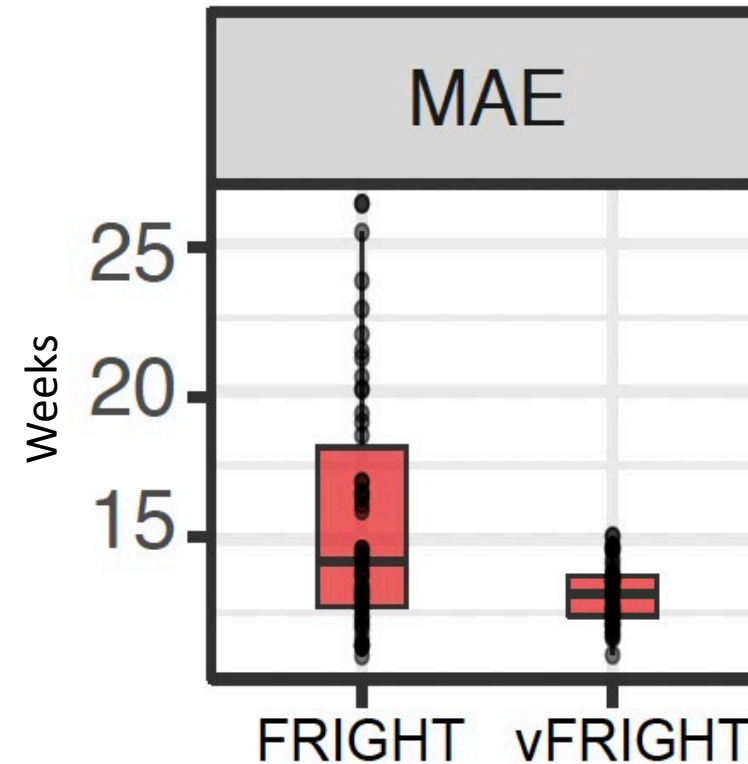
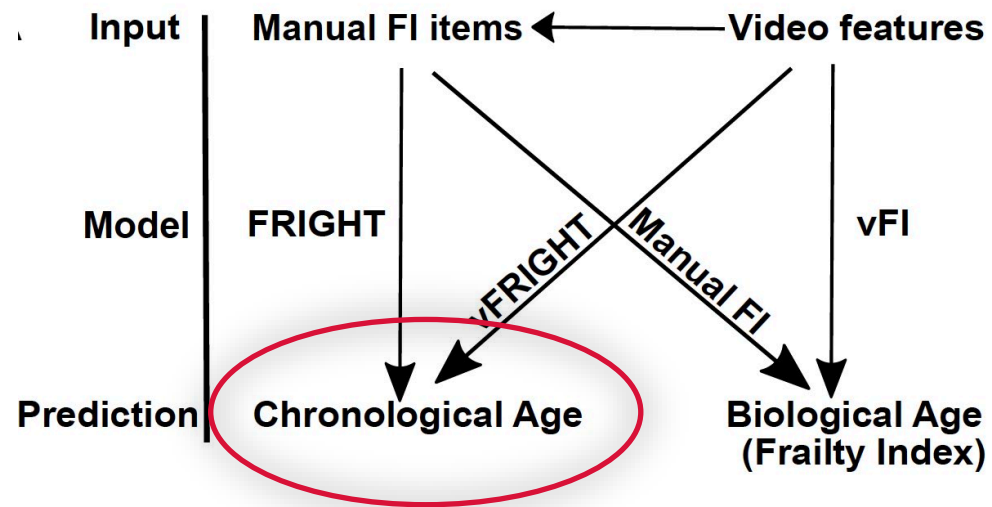


42% variability is due to Scorer

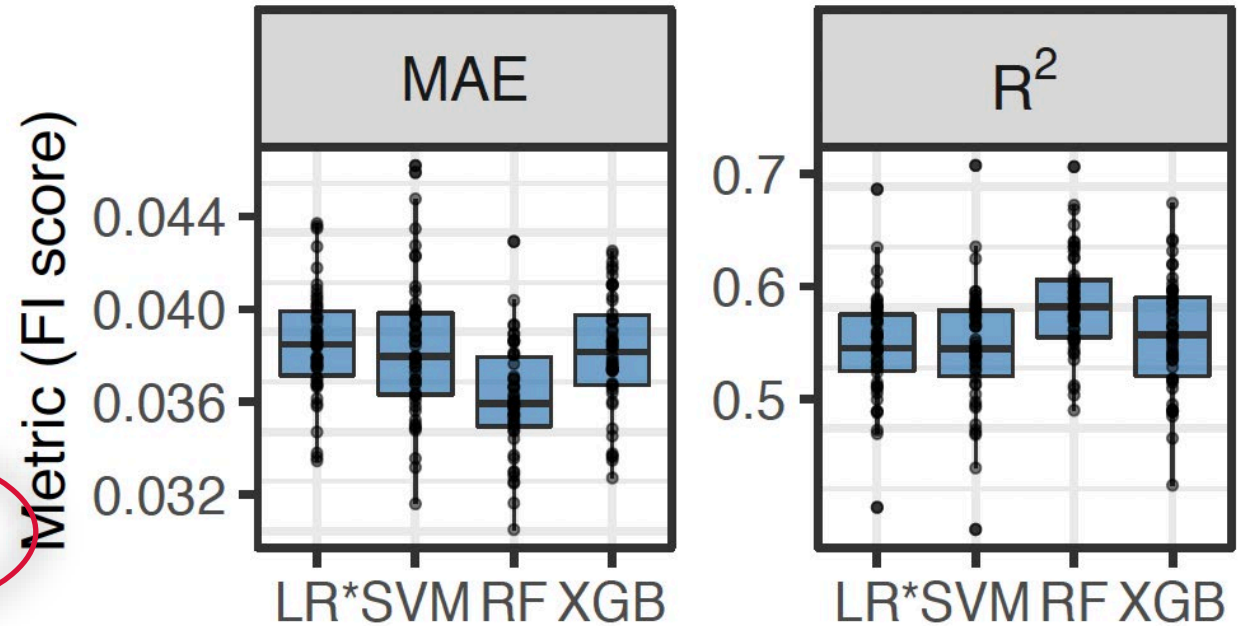
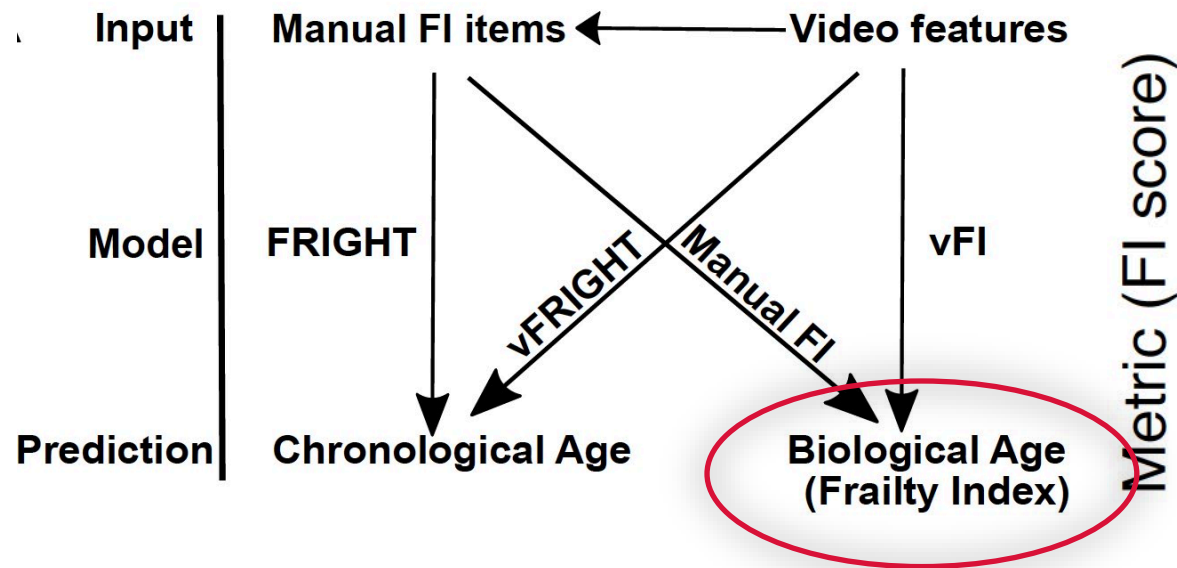
Models



Prediction of Chronological Age from clinical items or from video

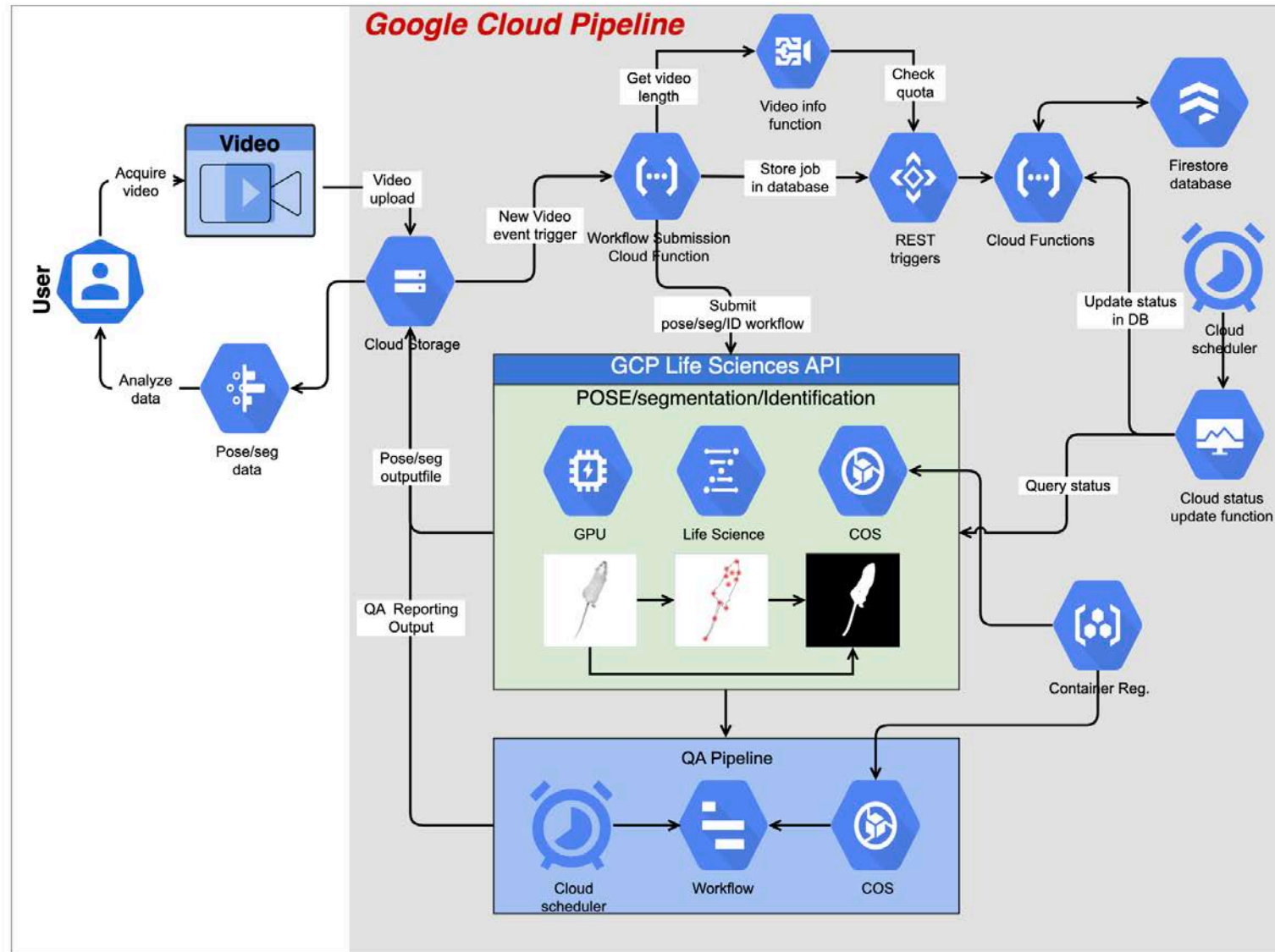


Prediction of Frailty from video



Error is
1 item out of 27 or
2 - 0.5 items out of 27

Cloud pipeline to process video data



Thank you.

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Vihaan Akshay
Rohith Dhinakar
Shreyas Kulkarni



JAX
Director's
Innovation Fund

DA041668
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MH129298

