

Daniele DI MITRI

# Multimodal Tutor Workshop

Delft, 8th April 2019

**Welten Institute**

Research Centre for Learning, Teaching and Technology

Open Universiteit

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# Who am I?



BSc in Computer Science



MSc in Artificial Intelligence



PhD in Learning Analytics



Start-up founder



IBM Extreme Blue

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# How people actually learn?



# What is Multimodality?

Humans interact with the world using multiple **MODALITIES**

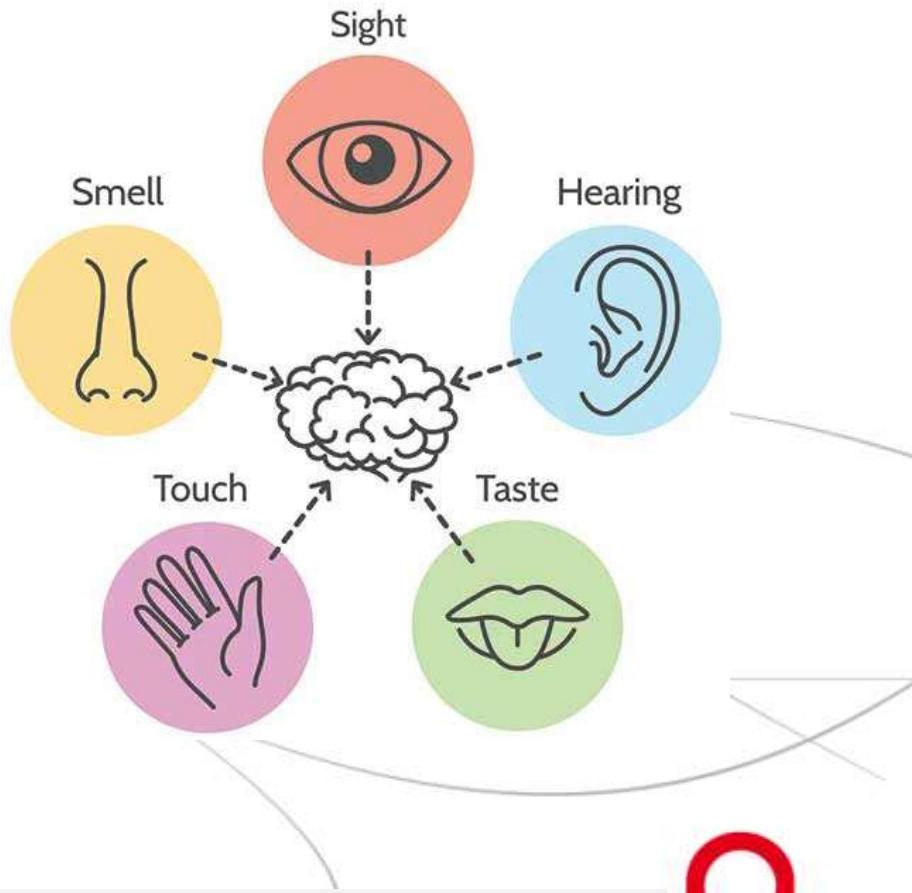
**Visual:** e.g. colors, perspective

**Aural:** sounds and effects

**Gestural:** body, gestures, emotions

**Spatial:** architectural, geographic

**Linguistic:** vocabulary, metaphors



Cope, Bill, and Mary Kalantzis, eds. *Multiliteracies: Literacy learning and the design of social futures*. Psychology Press, 2000.



# Multimodality in Human Interactions

Communication is a two-way process

- **Encoding** messages

using multiple modalities like textual,  
linguistic, spatial (Kress, 2003)

- **Decoding** messages

capturing through the senses and  
reasoning about them (Paivio, 1990).



Kress, G. (2003). Literacy in the new media age. Psychology Press.Chicago

Paivio, A. (1990). Mental representations: A dual coding approach. Oxford University Press.Chicago

# Multimodal interfaces



# Multimodality for computers

They **encode** messages

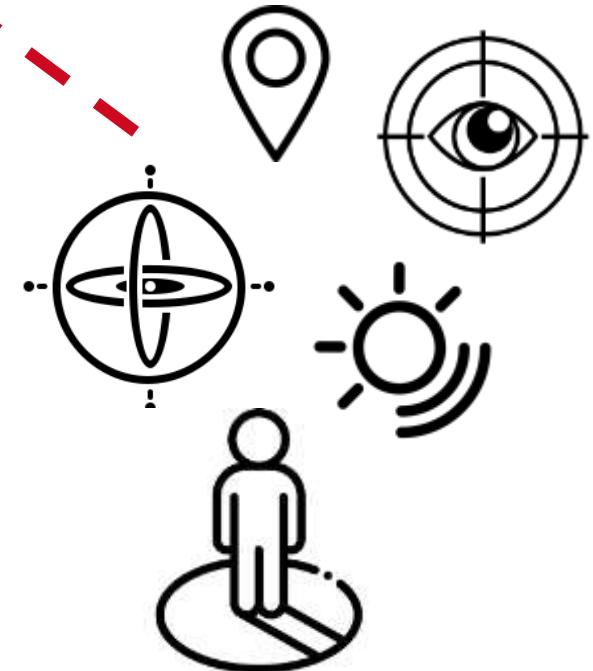


e.g. 3D visualisations in AR



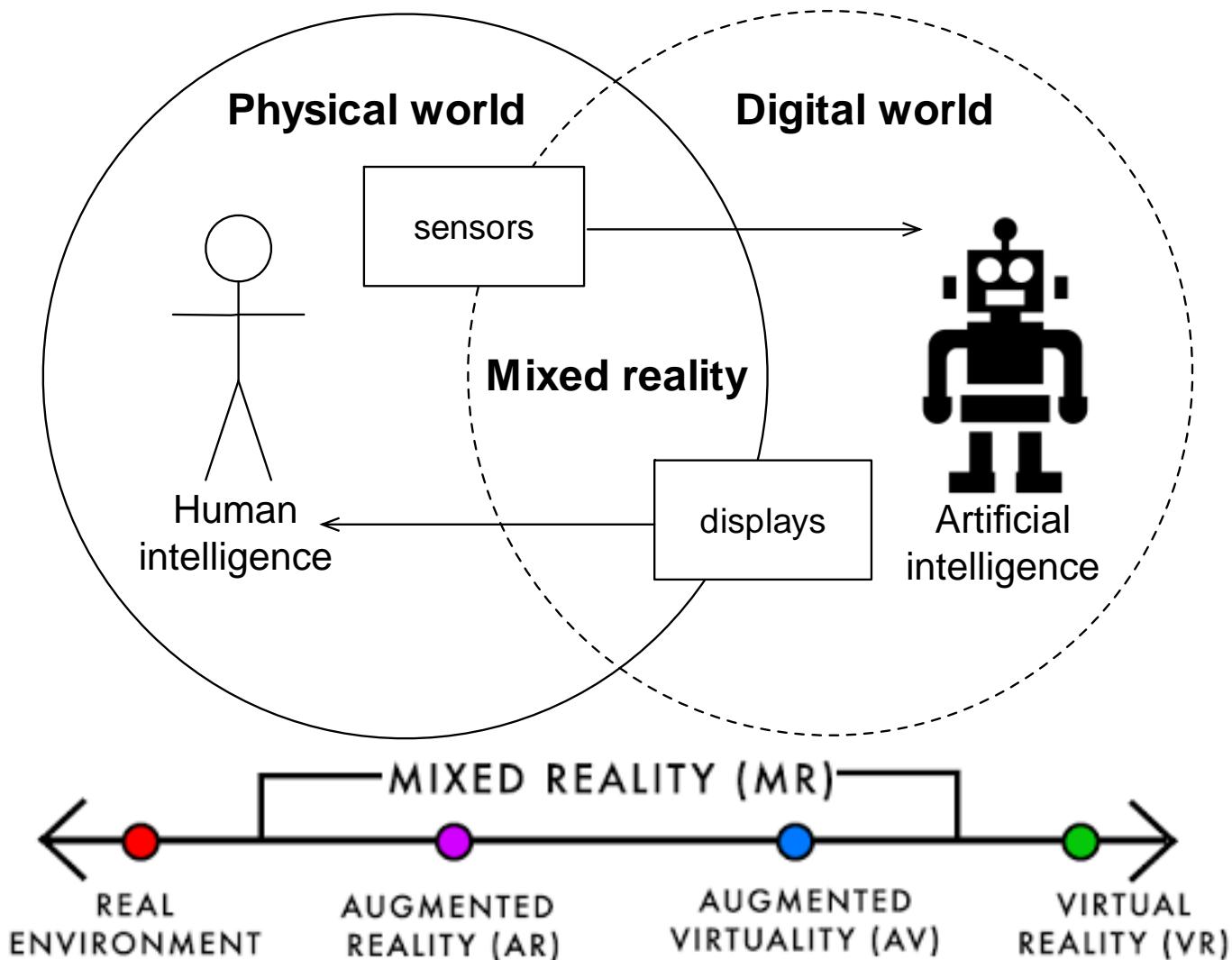
e.g modern AR headsets like Hololenses

They **decode** sensor inputs

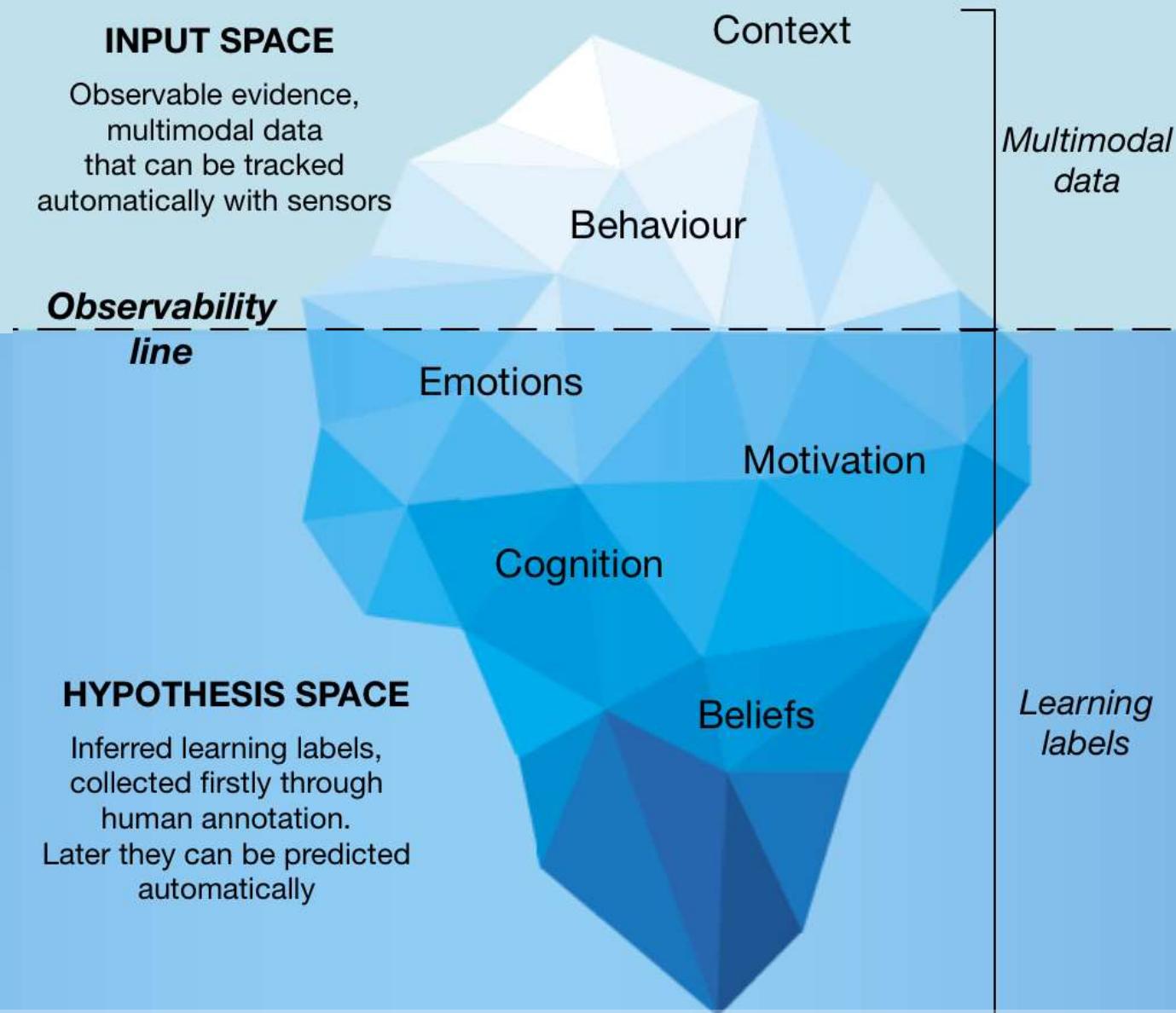


e.g. accelerometer, gaze direction position in the room, light sensor

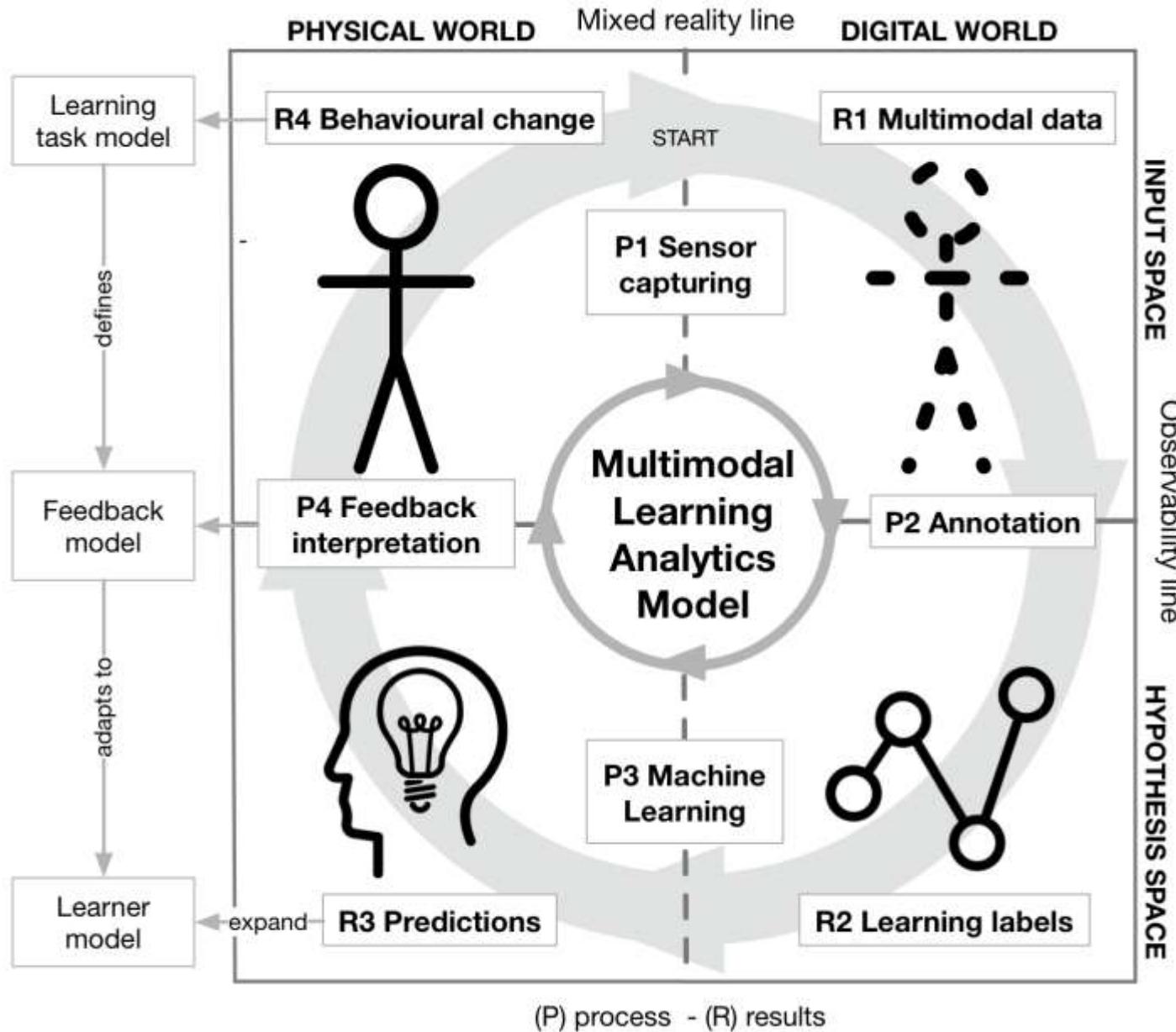
# Physical vs Digital World



Milgram, P., & Kishino, F. (1994). A taxonomy of mixed reality visual displays. IEICE TRANSACTIONS on Information and Systems, 77(12), 1321-1329. Chicago

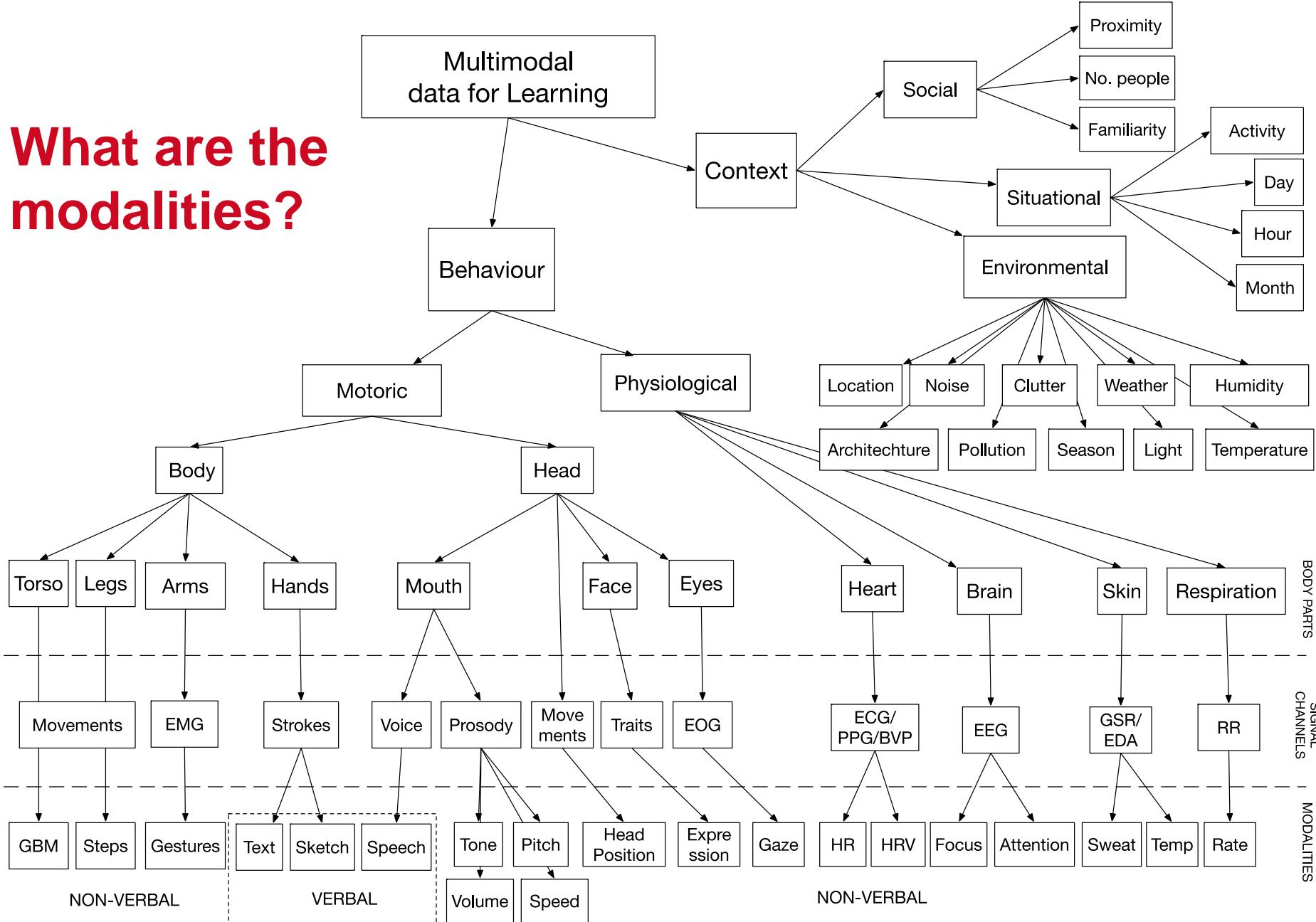


# Multimodal Learning Analytics Model



(P) process - (R) results

# What are the modalities?



# Final objective: Multimodal Tutors

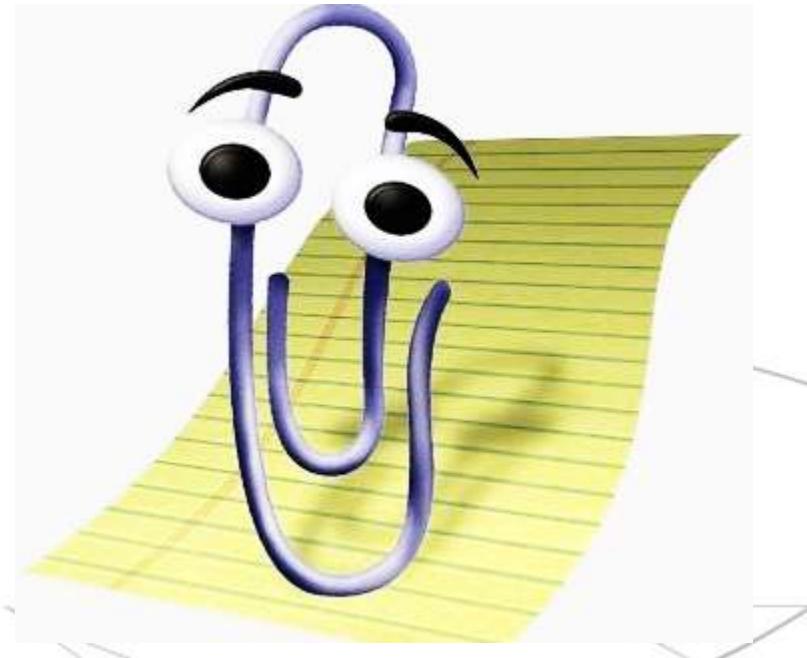
The vision is to create

## intelligent tutoring systems

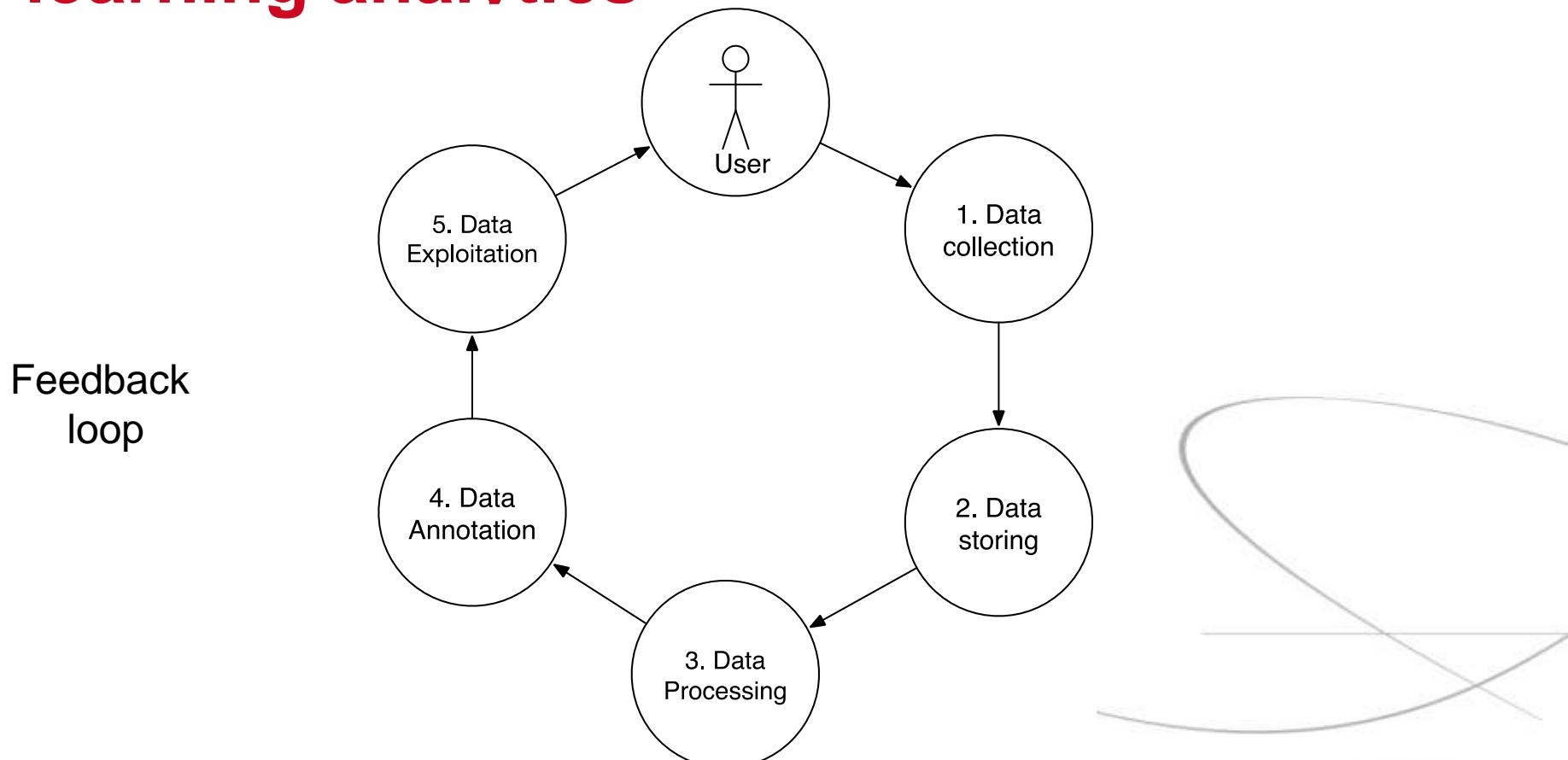
which fully understand the user ...

... and can maximise objectives such as:

- learning gains
- collaboration
- skill mastery
- knowledge acquisition
- behavioral change ....



# Lifecycle: the 5 steps for multimodal learning analytics

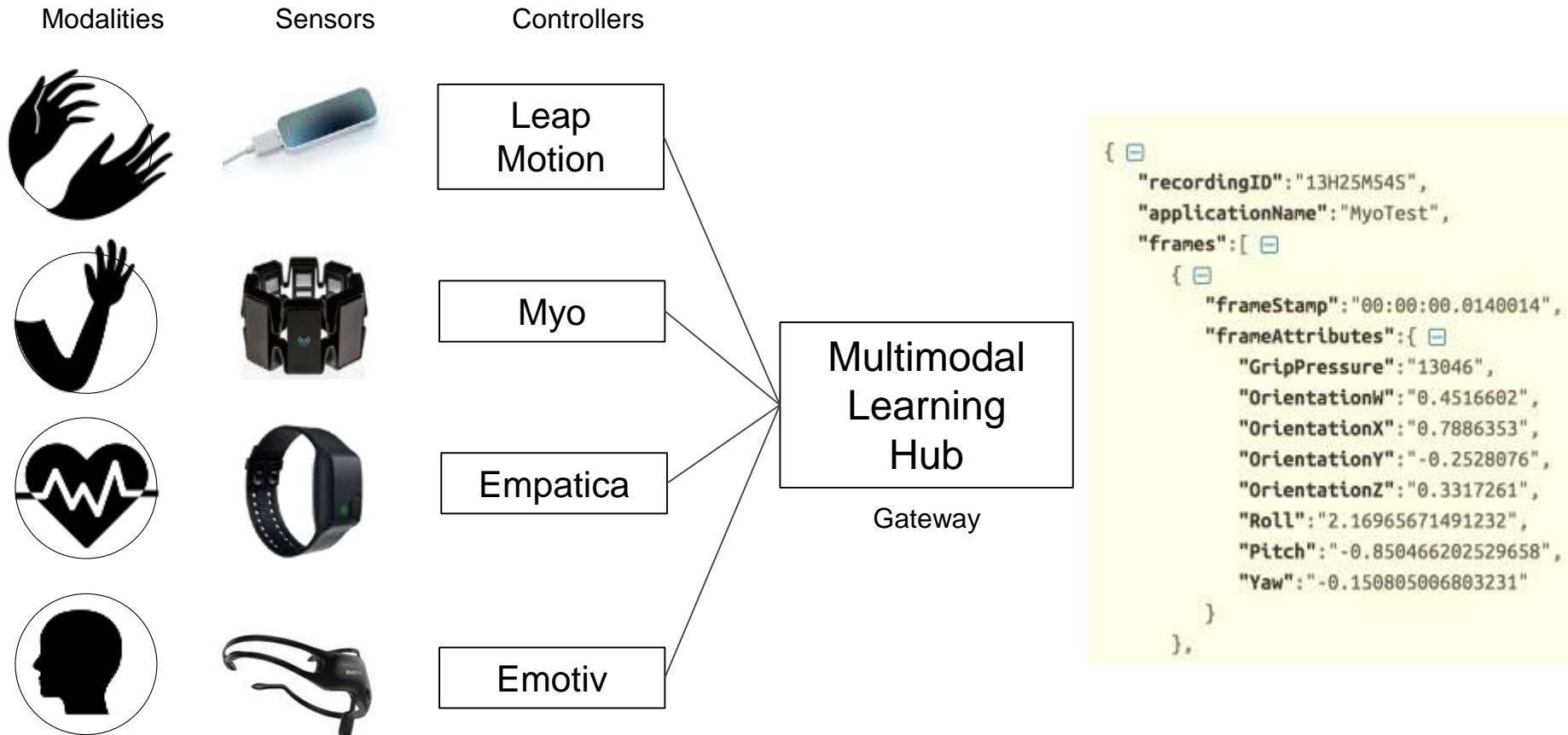


D Di Mitri, J Schneider, M Specht, H Drachsler - 2018

The Big Five: Addressing Recurrent Multimodal Learning Data Challenges



# Multimodal Learning Hub



Schneider, J., Di Mitri, D., Limbu, B., & Drachsler, H. (2018). **Multimodal Learning Hub**: A Tool for Capturing Customizable Multimodal Learning Experiences, 1, 45–58. [http://doi.org/10.1007/978-3-319-98572-5\\_4](http://doi.org/10.1007/978-3-319-98572-5_4)

# Visual Inspection Tool

## Purpose:

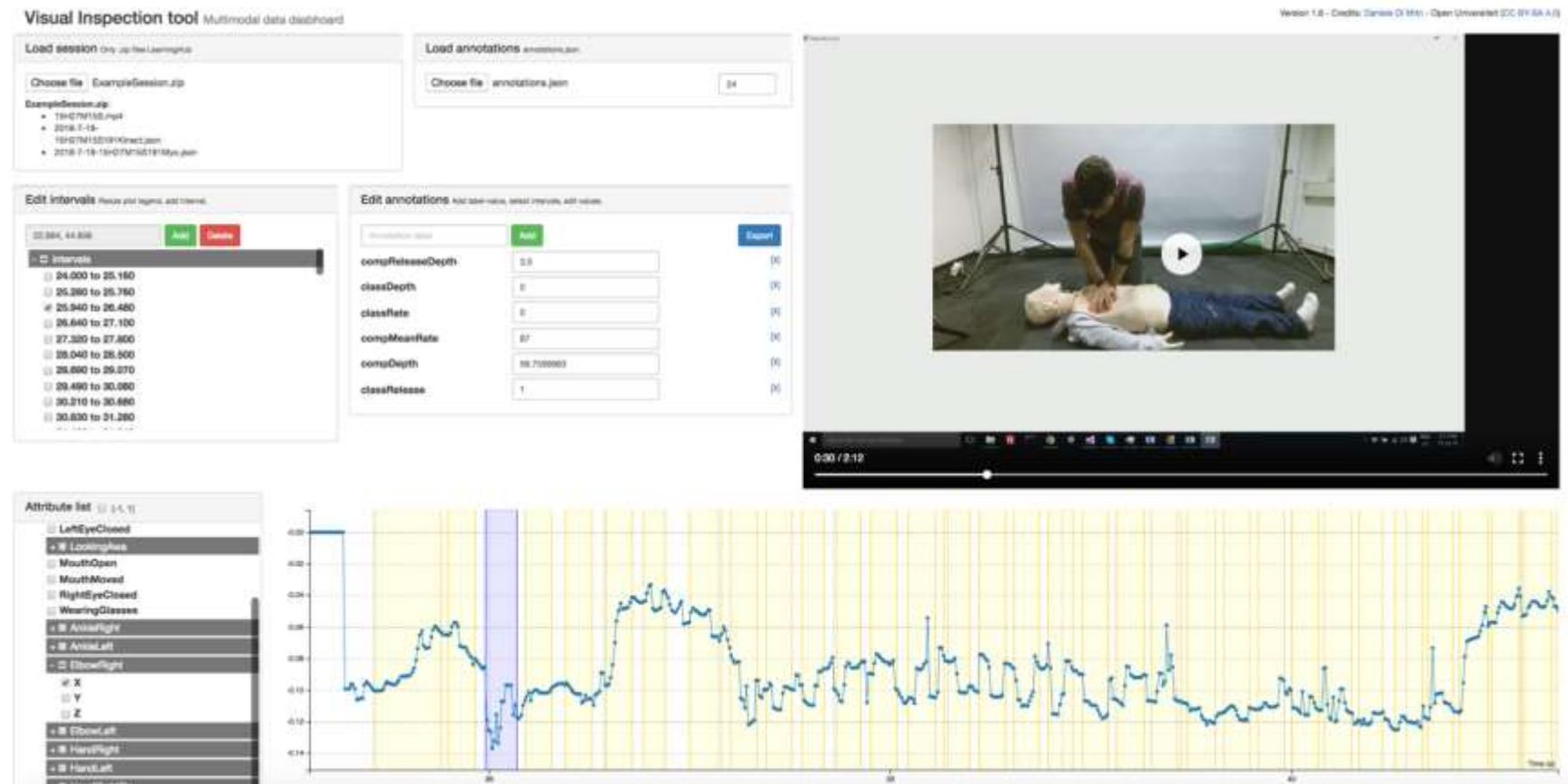
Annotate (collect labels) of the activities

Human  
annotations



Video  
recordings

Sensor  
data



# 5. Data exploitation strategies

## 1. Corrective feedback: hardcoded rules

e.g. “if sensor value is  $x$  then  $y$ ”; (non-adaptive)

## 2. Predictions: estimation of the learning labels (adaptive)

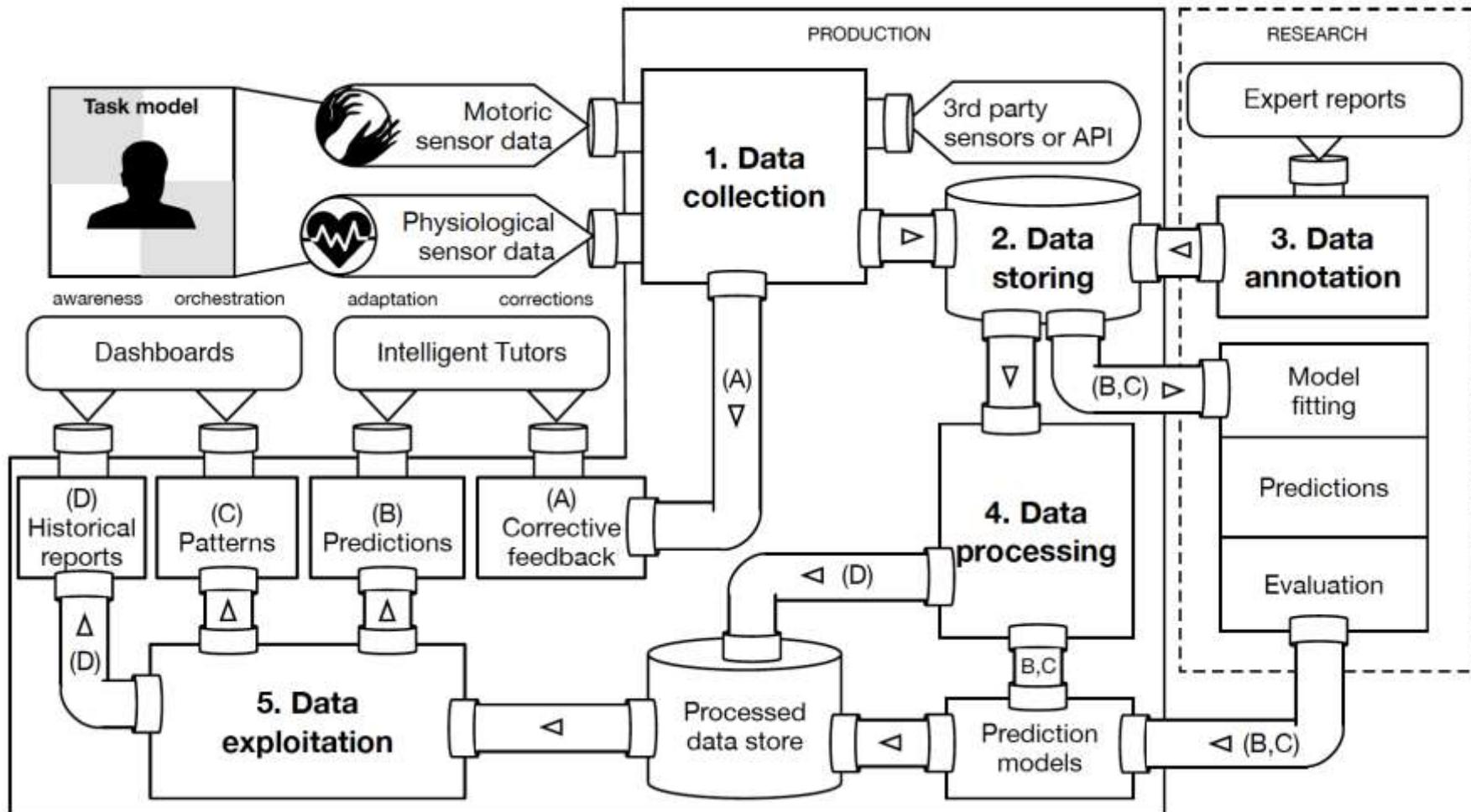
## 3. Pattern identification mining of recurrent sensor values

## 4. Historical reports: visualizations and analytics dashboard

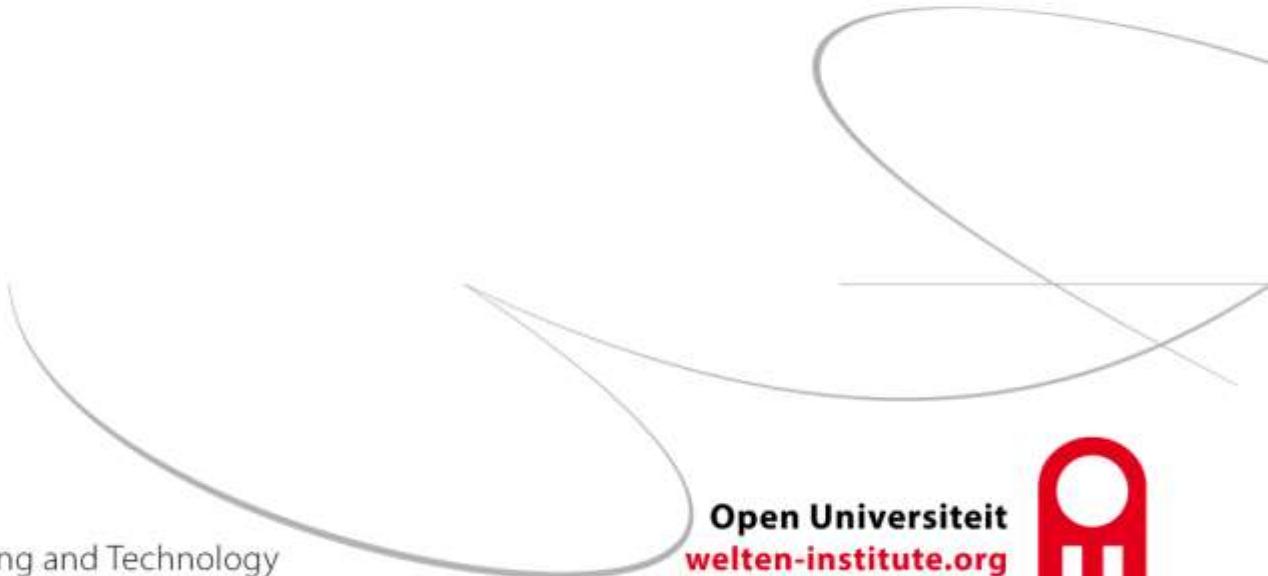
## 5. Diagnostic analysis of factors

## 6. Comparison (e.g. Expert vs Learner)

# A Pipeline for MMLA



# Examples of Multimodal Tutors



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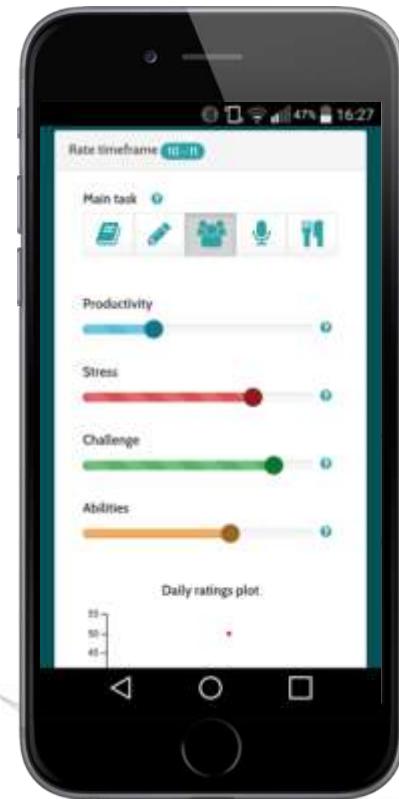
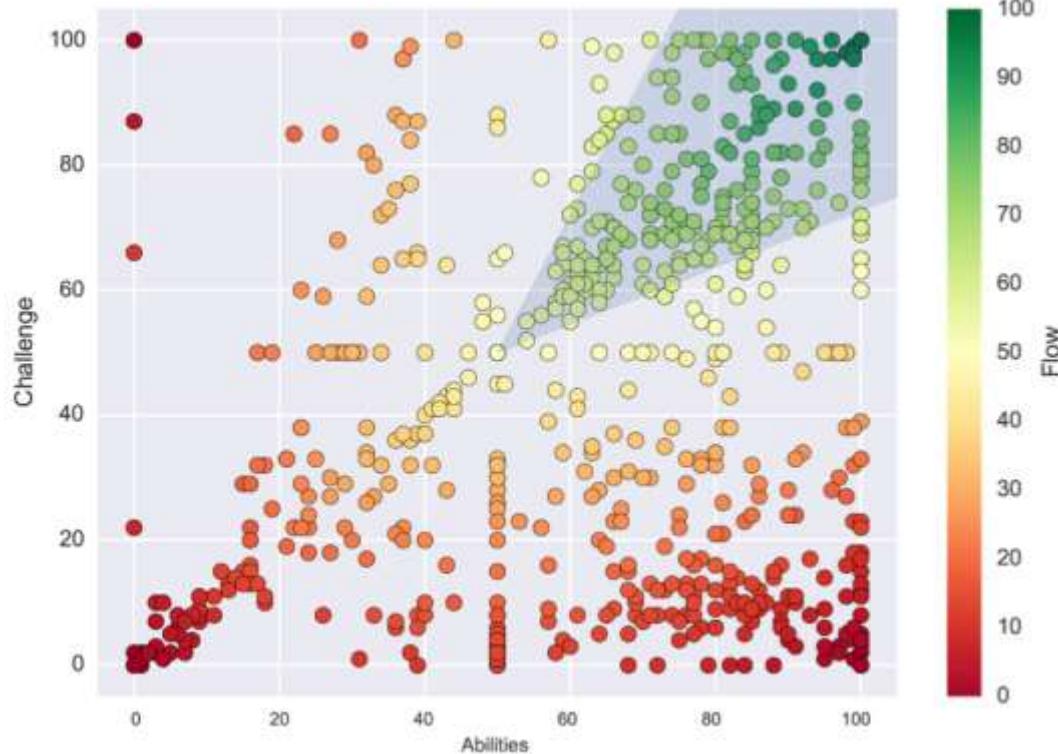
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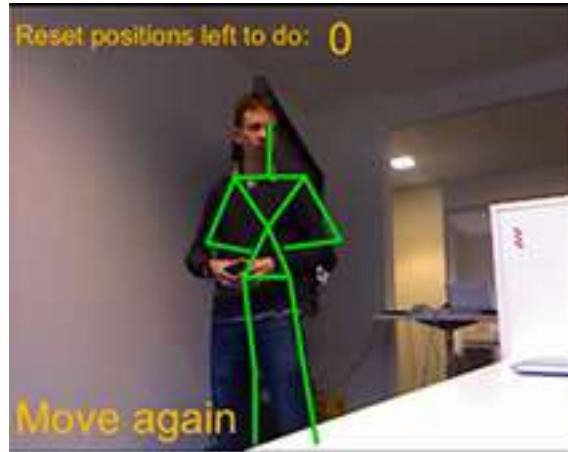
# Learning Pulse – are you in the Flow?



Di Mitri, D., Scheffel, M., Drachsler, H., Börner, D., Ternier, S., & Specht, M. (2017). **Learning Pulse**: a machine learning approach for predicting performance in self-regulated learning using multimodal data.



# Presentation Trainer

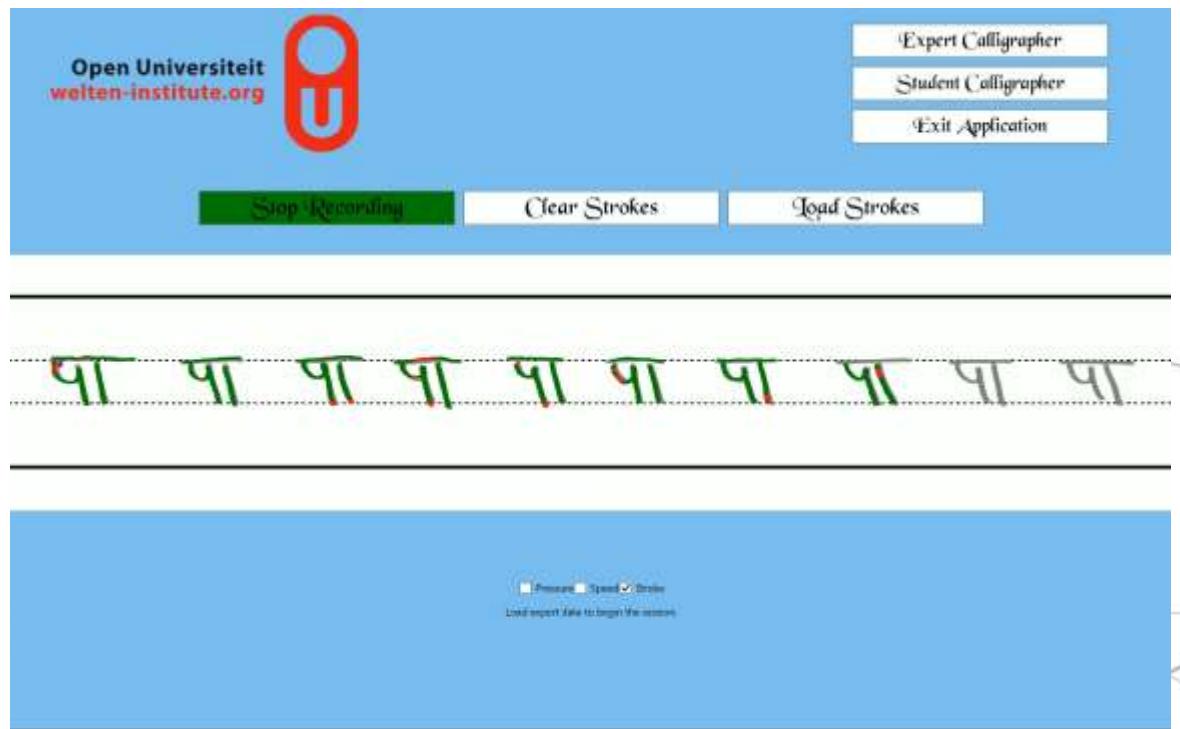
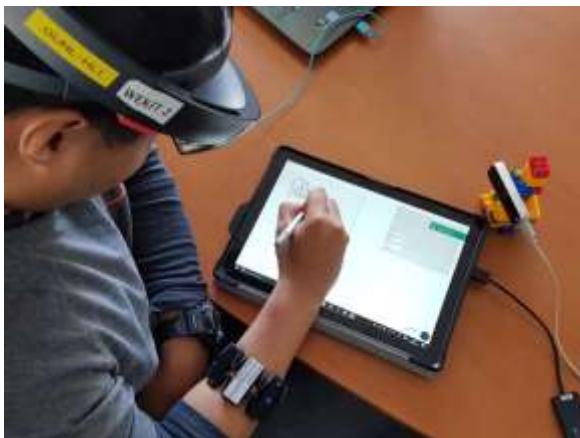


Schneider, J., Börner, D., Van Rosmalen, P., & Specht, M. (2015, November). Presentation trainer, your public speaking multimodal coach. In Proceedings of the 2015 ACM on International Conference on Multimodal Interaction (pp. 539-546). acm.ISO 690

<https://www.youtube.com/watch?v=EIB6OvbL8fA>



# Calligraphy Learning



B. Limbu, J. Schneider, R. Klemke, and M. Specht: Augmentation of practice with expert performance data:  
Presenting a calligraphy use case.





# WEKIT project

Wearable Experience for  
Knowledge Intensive Training

<http://www.wekit.eu/>



Wearable Experience for Knowledge Intensive Training connects researchers, developers and industry advancing workplace training mediated by AR / wearables.

Medical use case



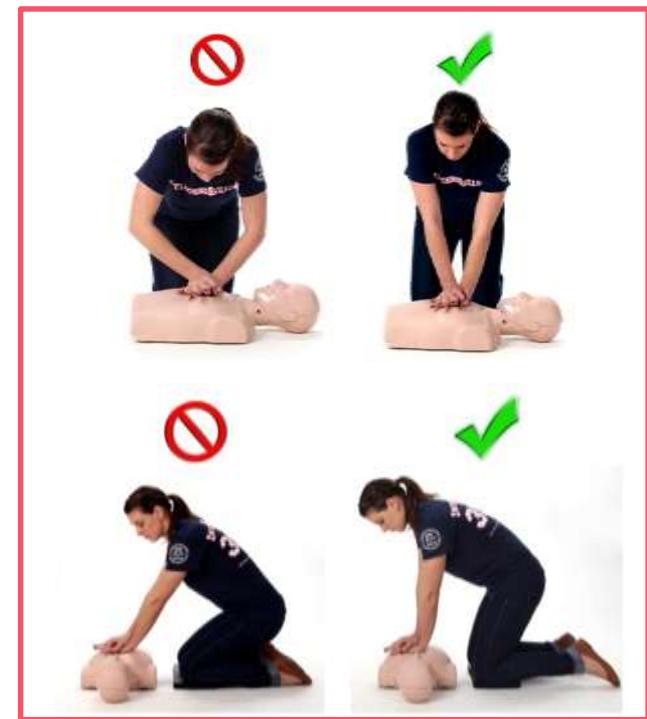
Astronaut training



Aircraft maintenance



# Multimodal Tutor for CPR



# Q&A

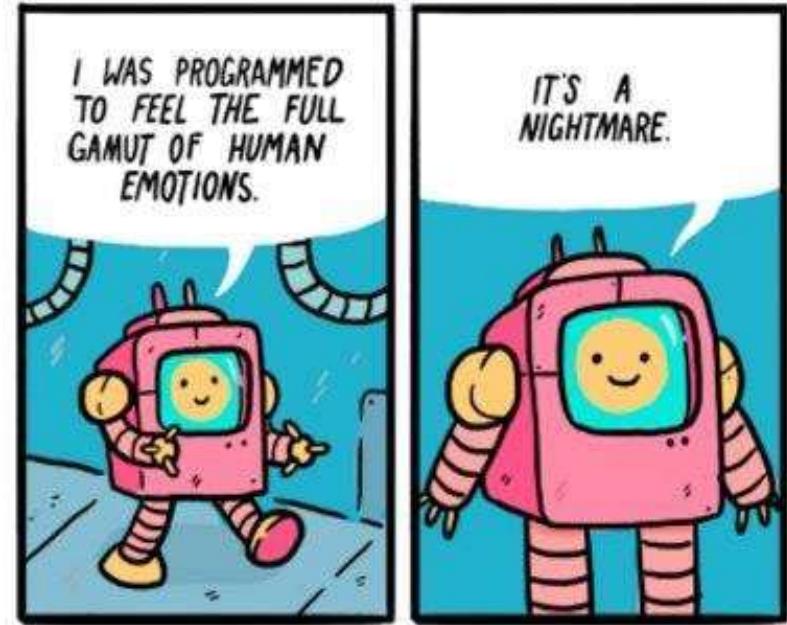
Thanks for listening!

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