From Pixels to Psychology: Decoding Behaviour Through Smartphone Sensing

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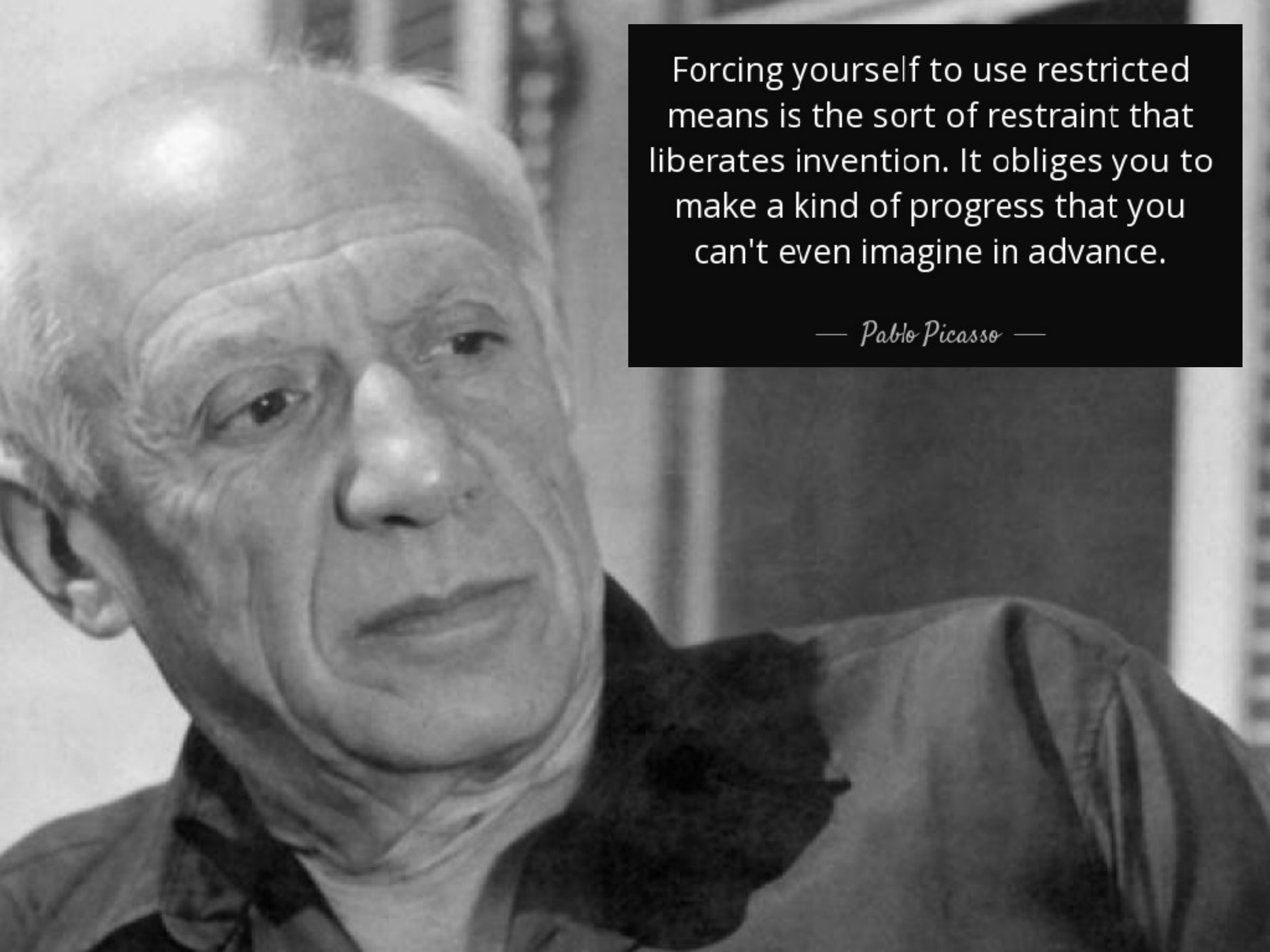
Oulu, Finland

Thank you to countless people


Forcing yourself to use restricted means is the sort of restraint that liberates invention. It obliges you to make a kind of progress that you can't even imagine in advance.
— Pablo Picasso —

Brief history of computing

1960’s

1980’s

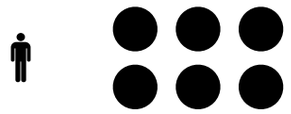
2000’s

3 “Waves” of computing

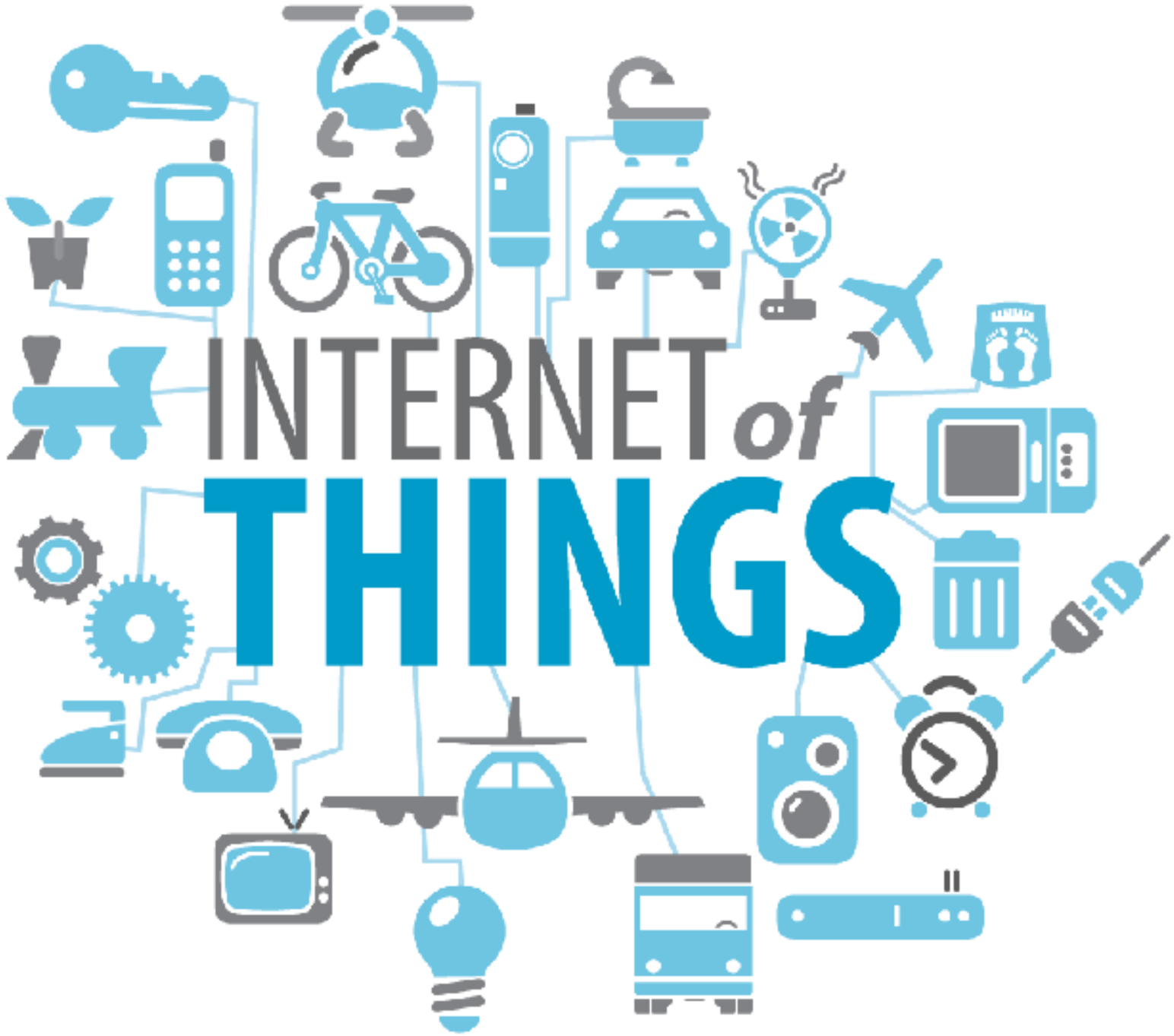
Capabilities

Size

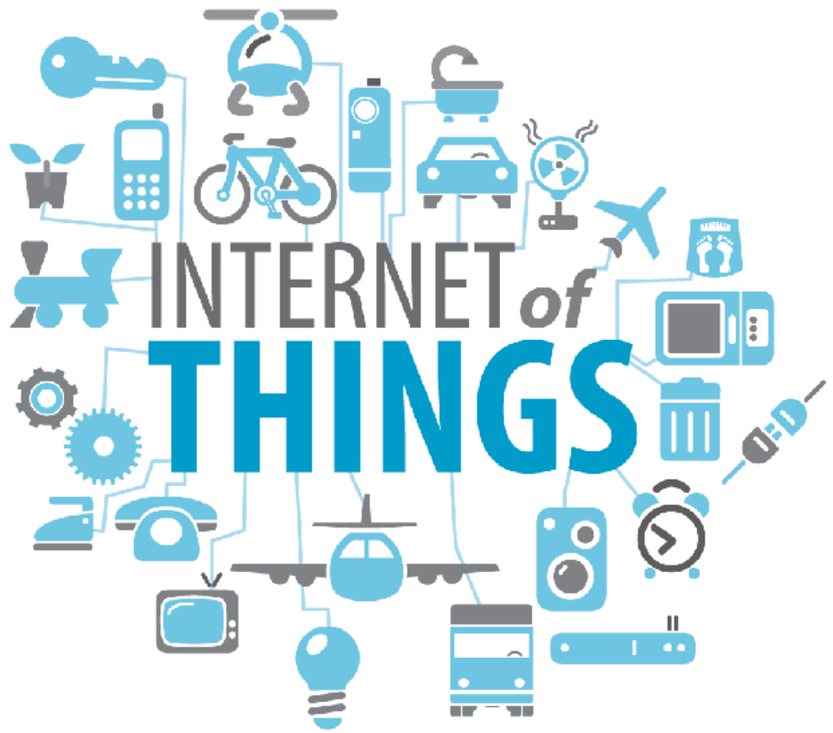
Usage



Research


INTERNET of
THINGS

Understand people -> build better technology

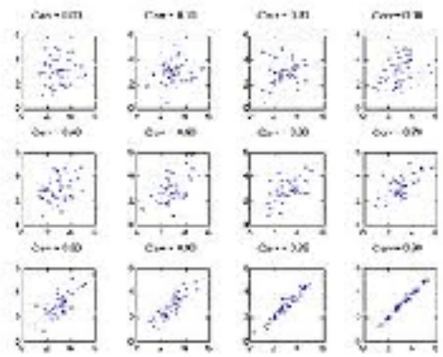


Study technology -> better understand people

Modus operandi

Smartphone data

Calculate metrics



Establish correlations
Describe behaviour

Behaviour, attitudes, questionnaires, etc.

Calculate metrics

Sources

Social Media

Smartphone use

Smart city

Interaction

Insights

Happiness

Personality

Habits

Exposure

Methods

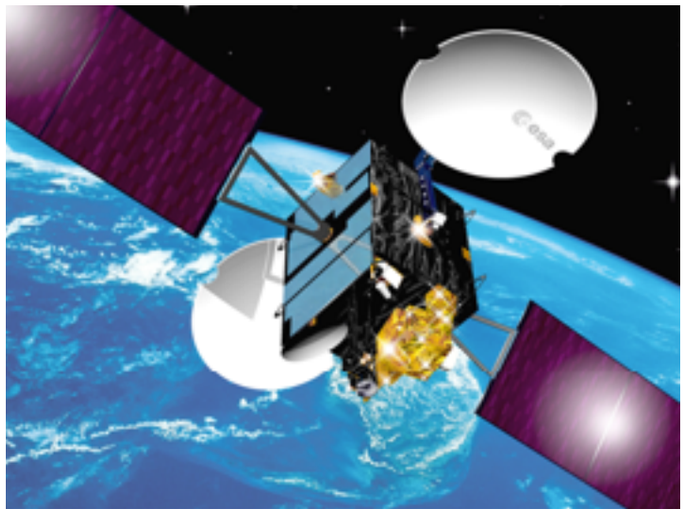
Smartphone instrumentation

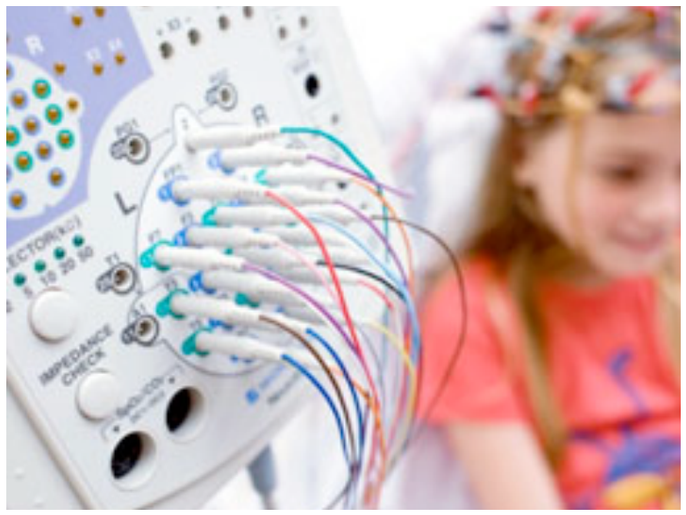
Crowdsourcing

In-the-wild methods

Smartphones for science

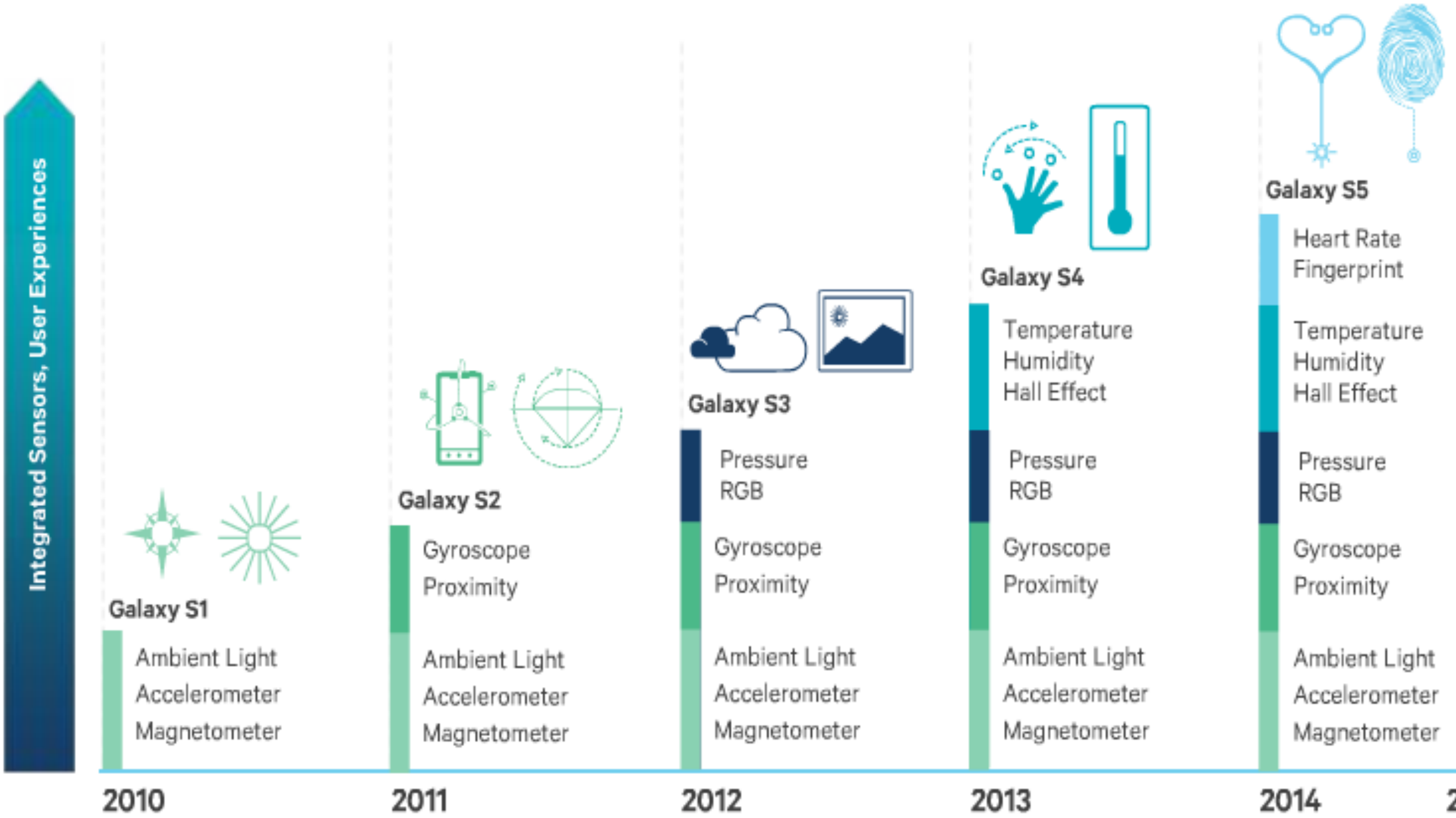
Scientific instruments



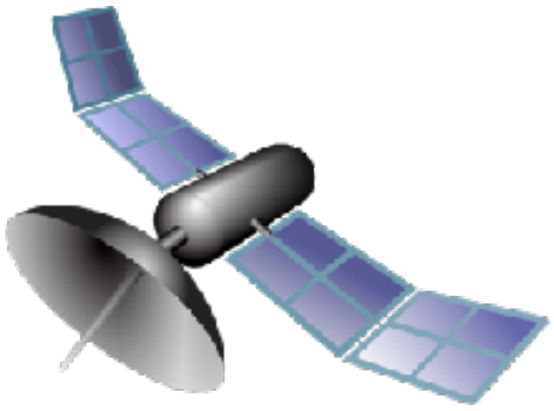


Non-invasive sensing

Sensor growth in smartphones



Over the next year



2 500

90 000 000

280 000 000

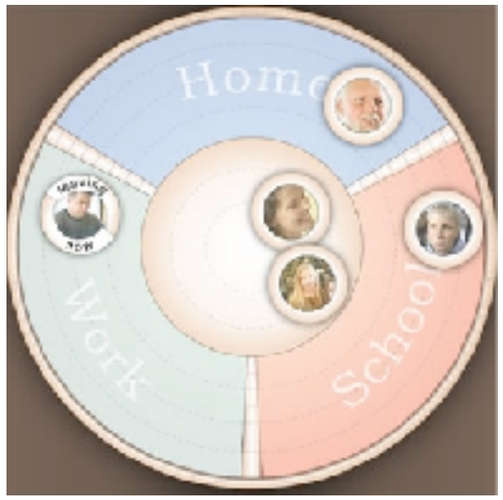
1 500 000 000

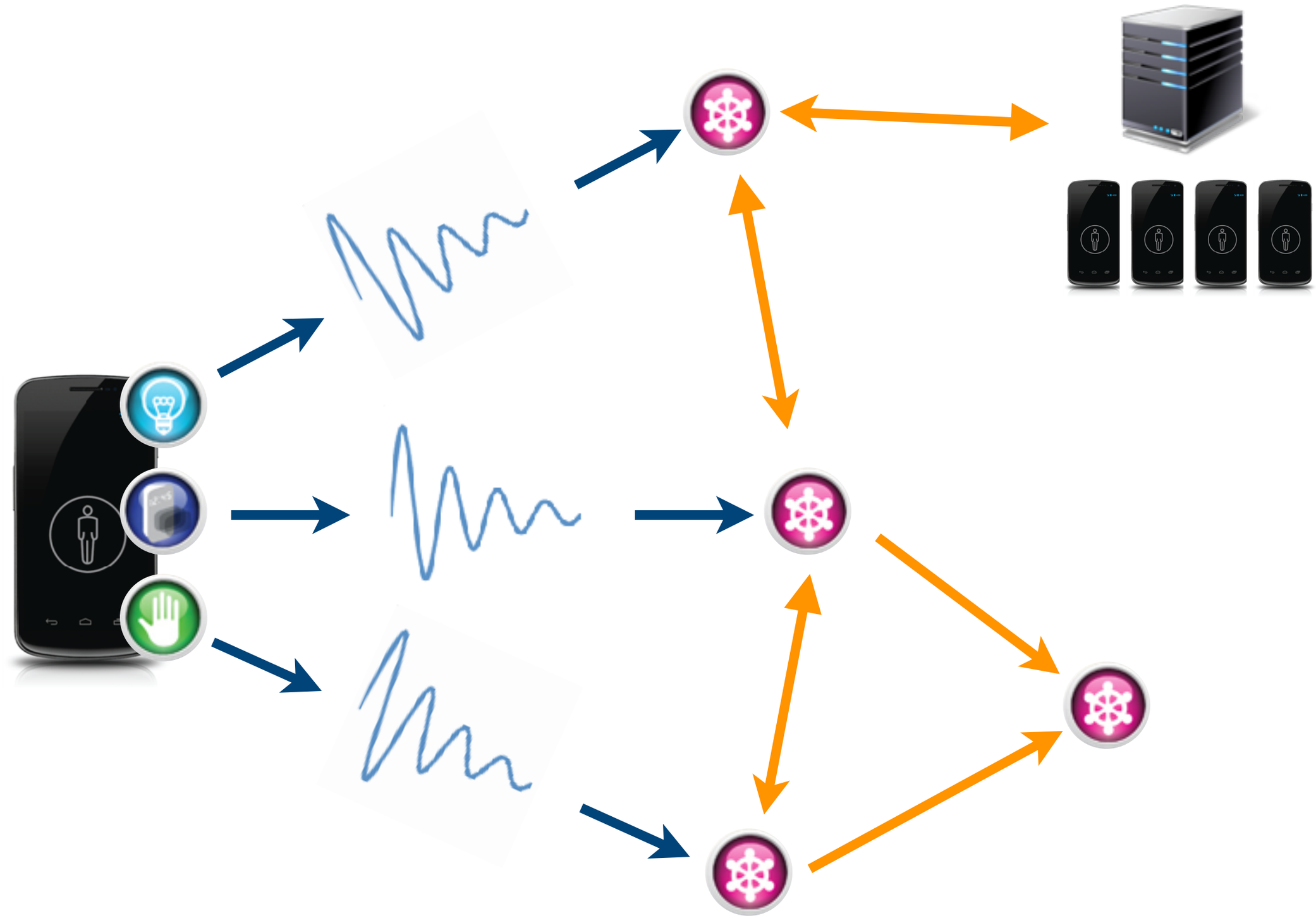
5 x

What to analyse?

How to analyse?

Start from scratch



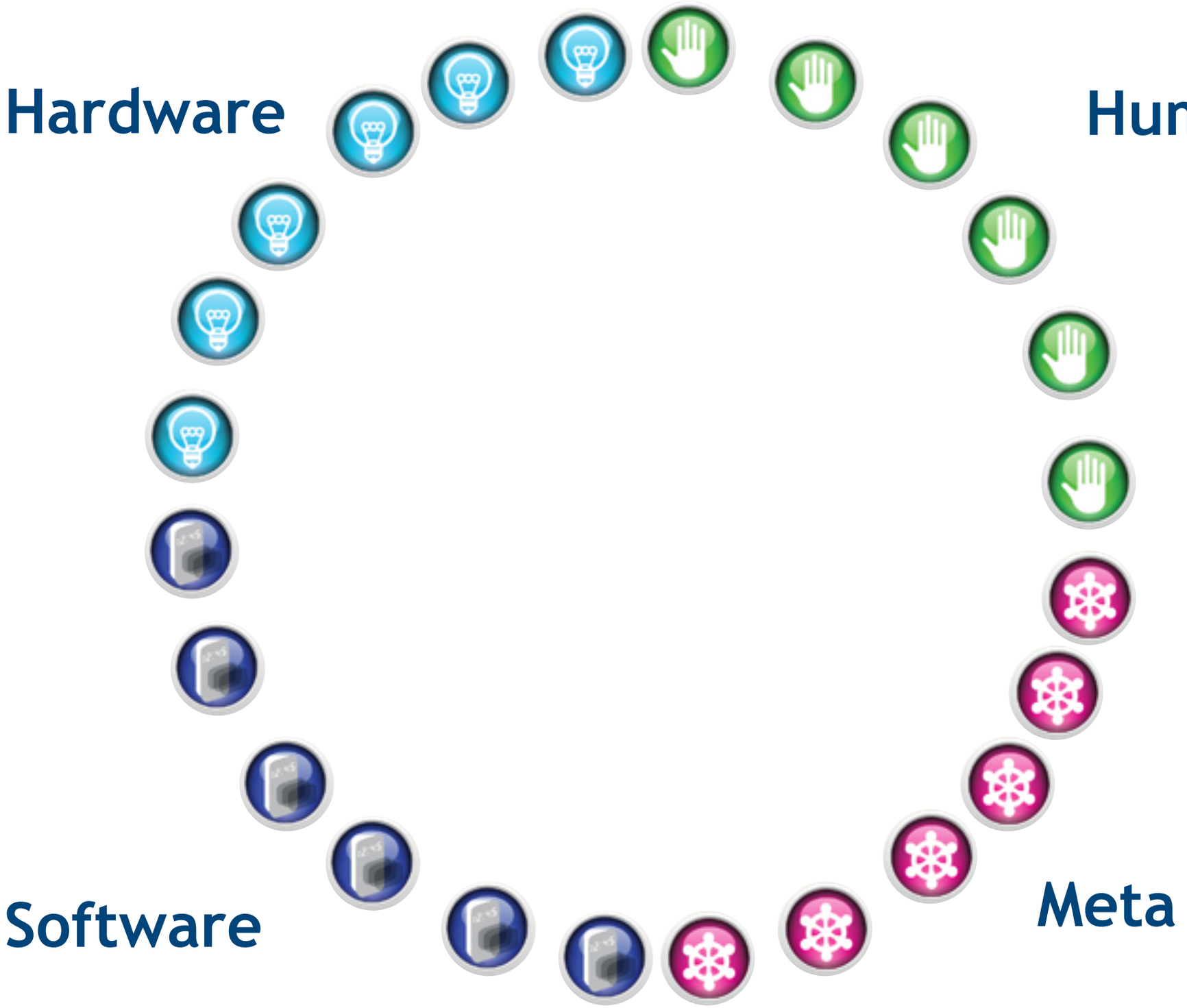


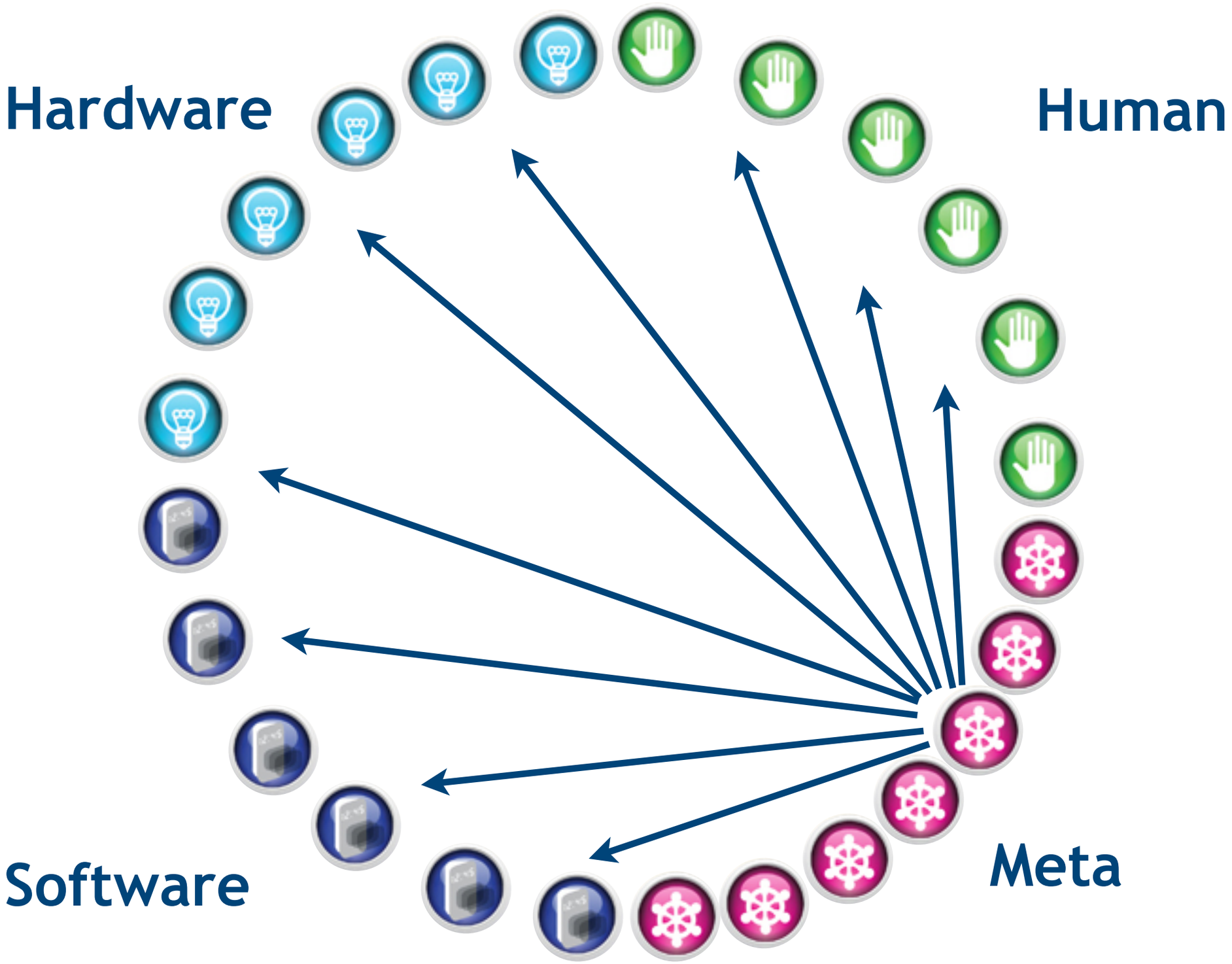
Hardware

Software

Human

Meta

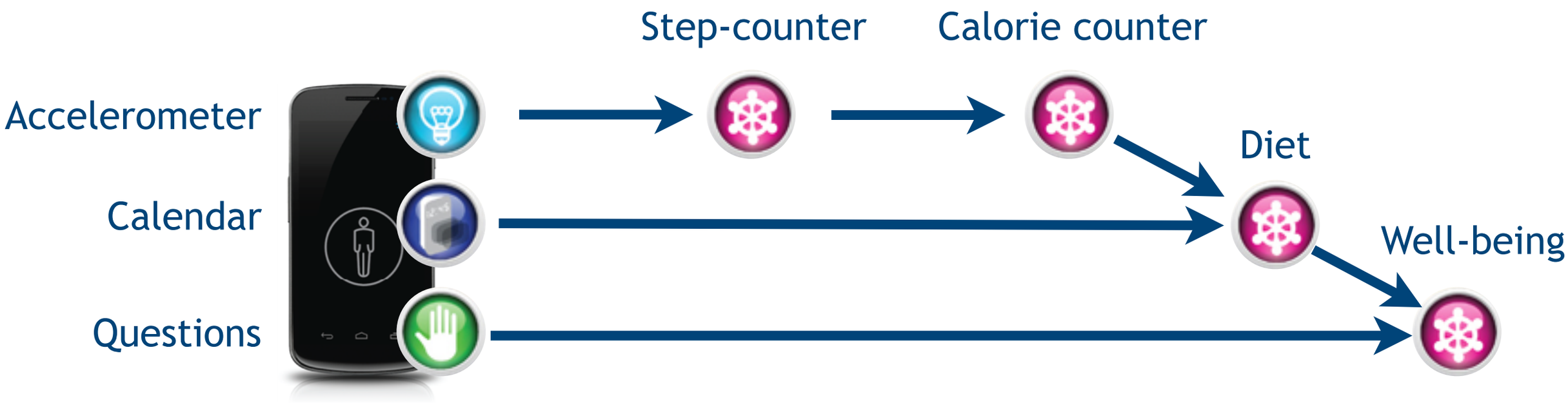

Hardware
Human
Software
Meta

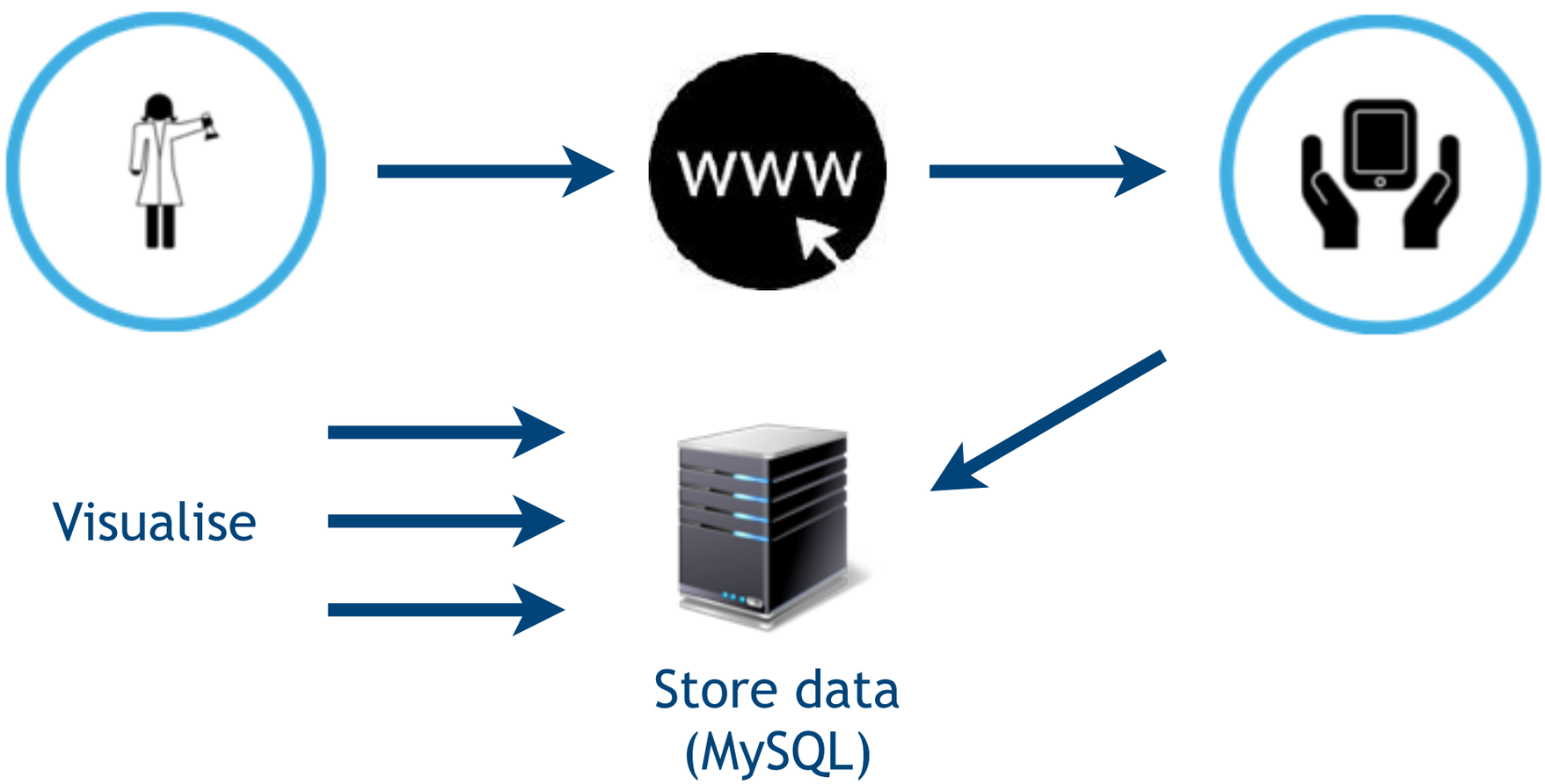

Hardware
Human
Software
Meta

AWARE framework

- https://www.awareframework.com

“LEGO” - context

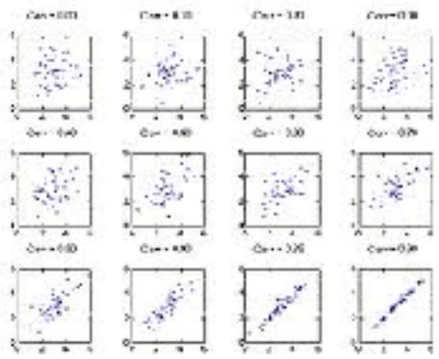



Scientist
Define study
Deploy to participants
www
Visualise
Store data
(MySQL)

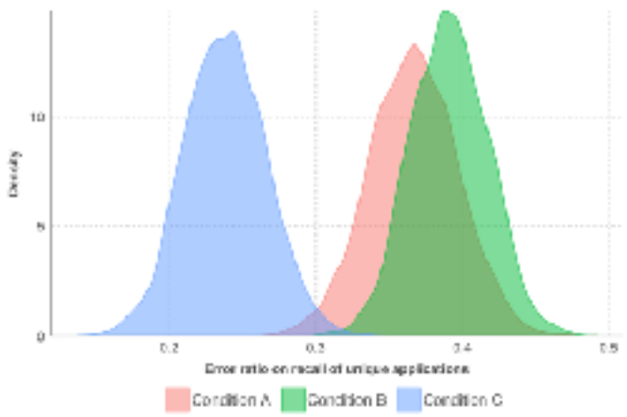
Measurement

Phenomena

Sample data



Analysis/Statistics



Measurement instrument

- Bias
- Reliability
- Transparency
- Repeatability

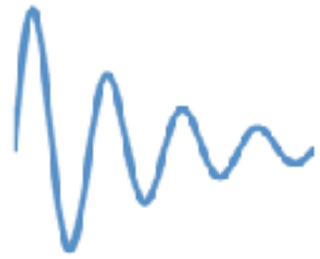
- Privacy
- Battery life
- Convenience

Looking forward

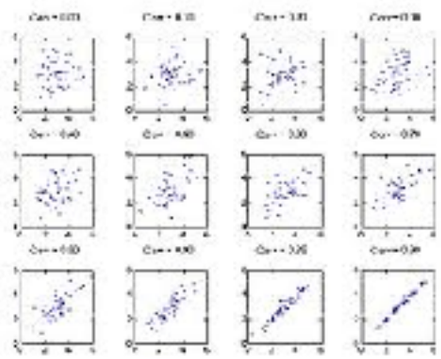
Lifestyle sensing

Modus operandi

Digital phenotype



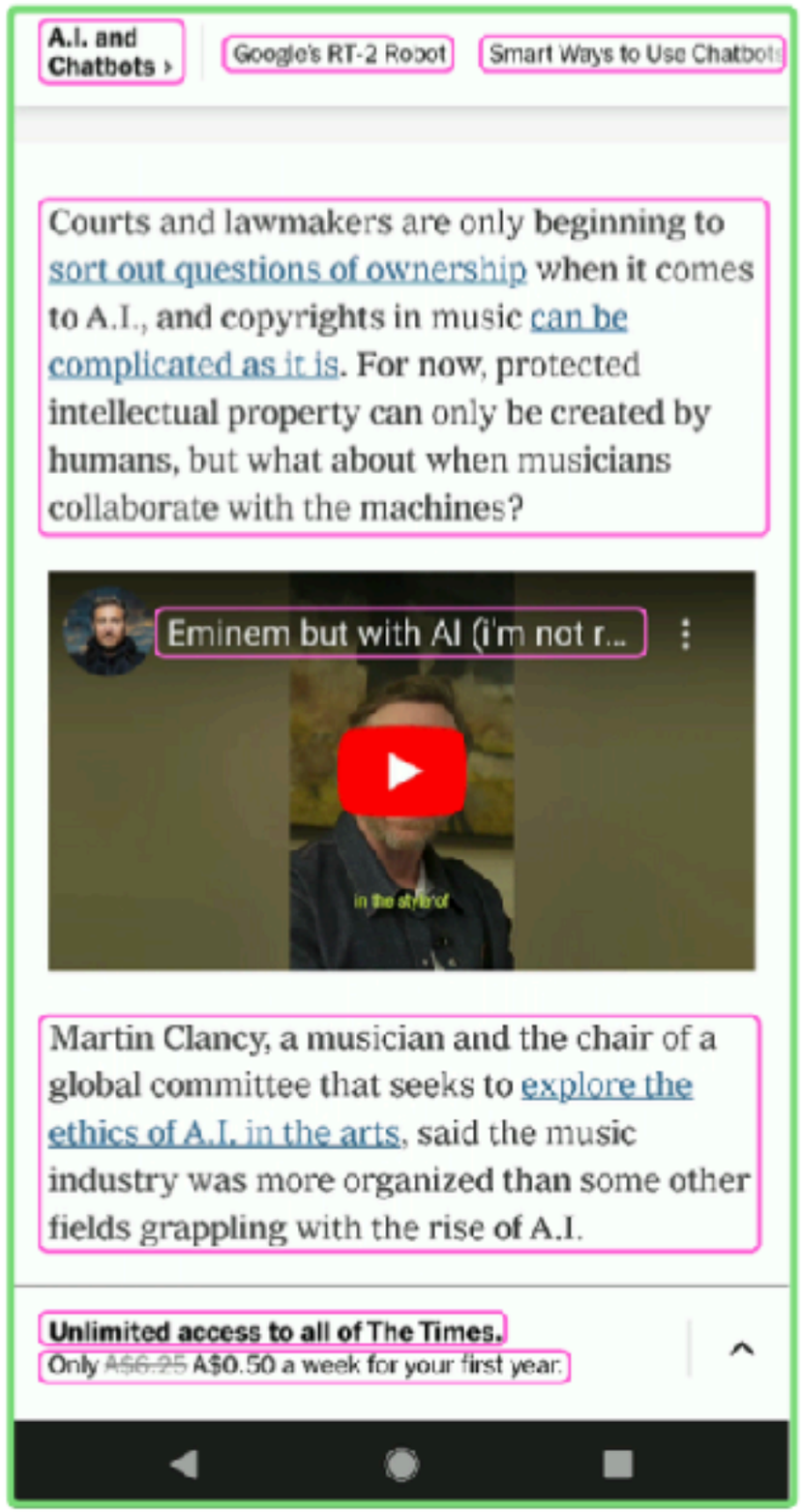
Calculate metrics

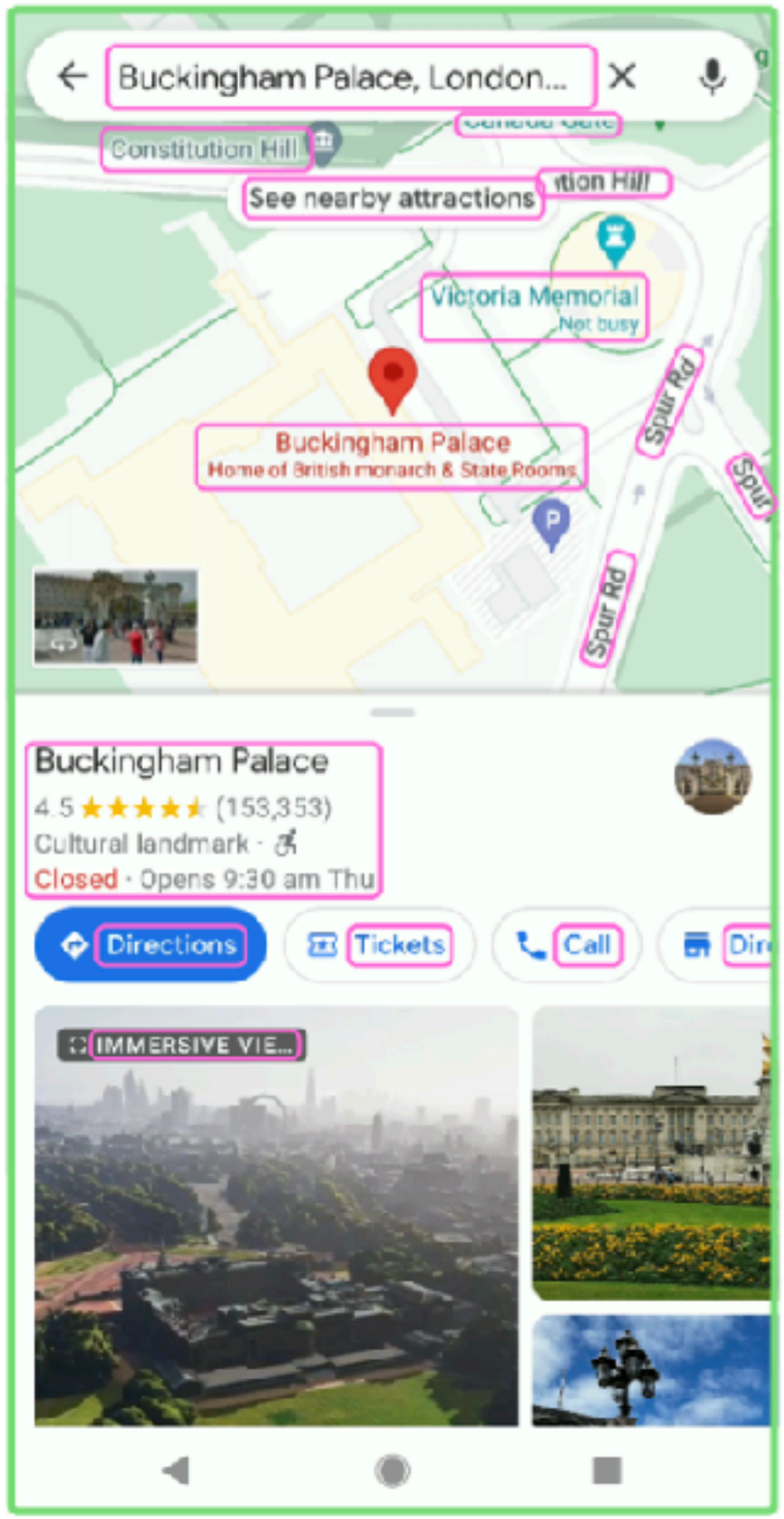


Establish correlations
Prescribe treatment

Treatments

Calculate metrics


A.I. and Chatbots ›
Google's RT-2 Robot
Smart Ways to Use Chatbots
Courts and lawmakers are only beginning to sort out questions of ownership when it comes to A.I., and copyrights in music can be complicated as it is. For now, protected intellectual property can only be created by humans, but what about when musicians collaborate with the machines?
Eminem but with AI (i'm not r...
Martin Clancy, a musician and the chair of a global committee that seeks to explore the ethics of A.I. in the arts, said the music industry was more organized than some other fields grappling with the rise of A.I.
Unlimited access to all of The Times.
Only A$6.25 A$0.50 a week for your first year.


Buckingham Palace, London...
Constitution Hill
See nearby attractions
Victoria Memorial
Not busy
Buckingham Palace
Home of British monarch & State Rooms
Spur Rd
Buckingham Palace
4.5 (153,353)
Cultural landmark
Closed · Opens 9:30 am Thu
Directions
Tickets
Call
IMMERSIVE VIE...

Word	Count
relevant	1070
unit	856
teaching	758
lecturer	689
information	642
accounting	535
professional	535
academic	535
cyber	535
security	535

App: SEEK (Job-Finding) (All Participants)

Word	Count
cal	11348
km	7875
distance	5473
set	5057
heart	4995
sleep	4949
hr	4811
fitbit	4793
rate	4162
2023	4100

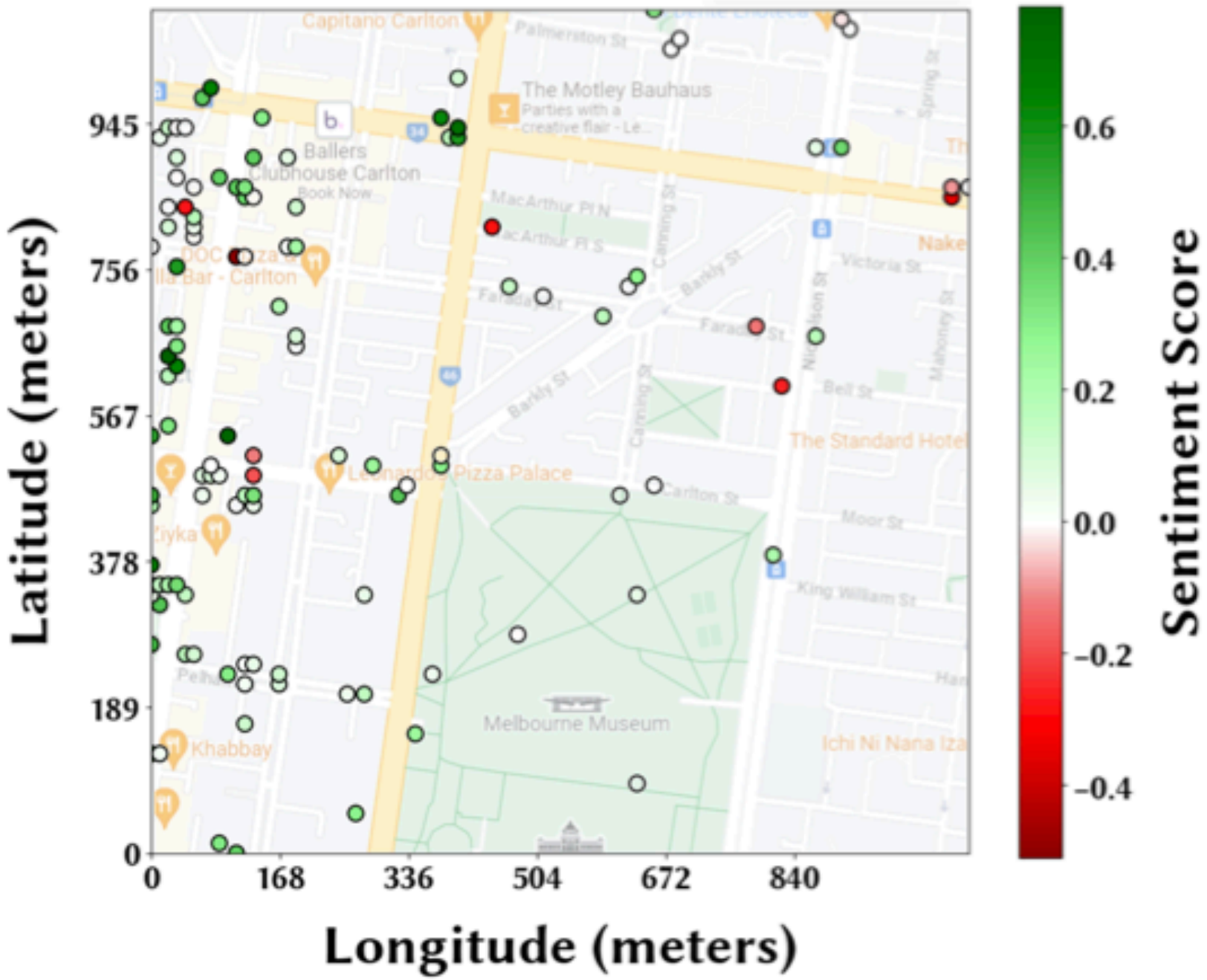
Category: Health (All Participants)

Word	Count
taylor	3964
swift	3248
version	1832
playlist	1749
red	1628
loving	1174
english	980
never	927
chou	879
g.e.m	860

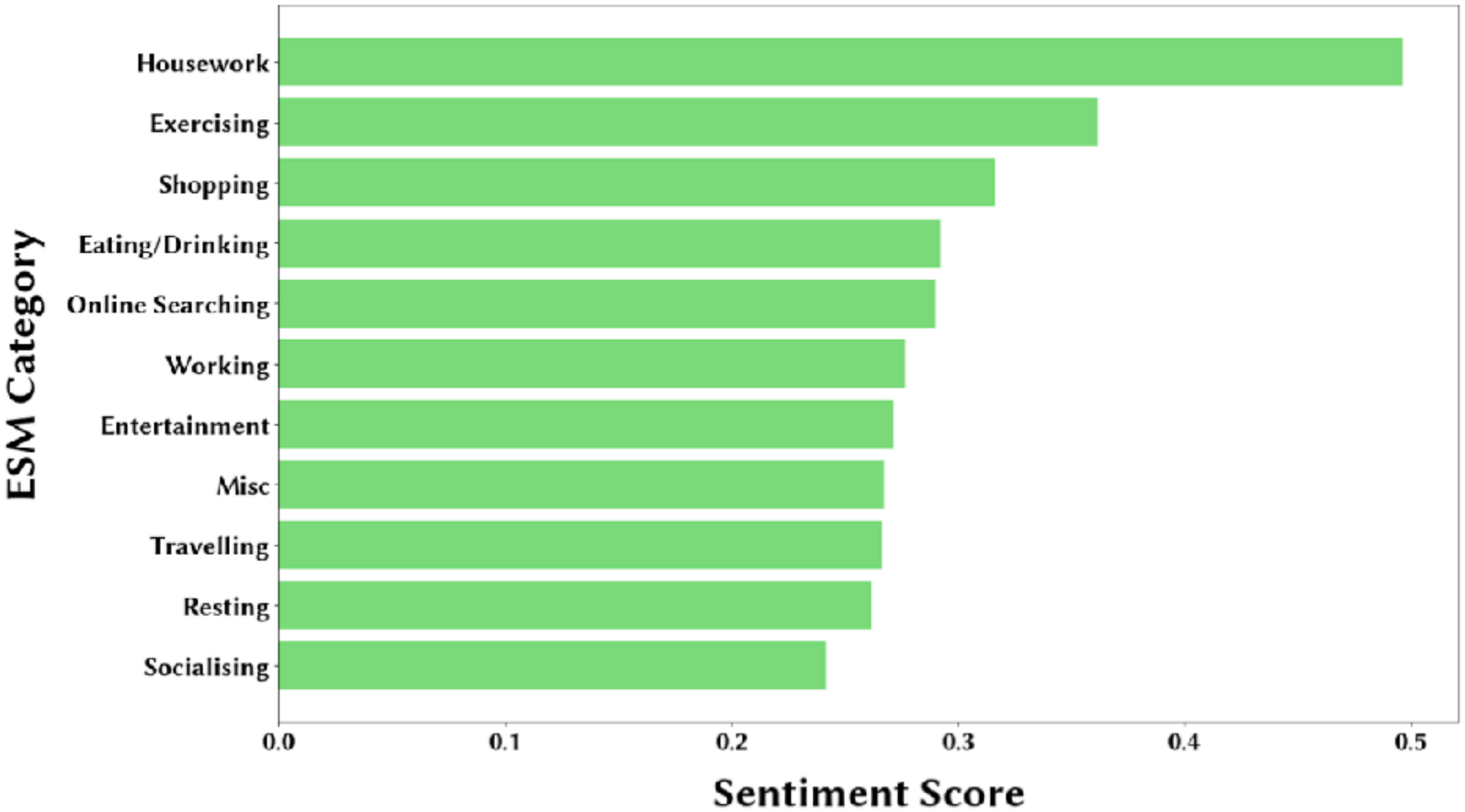
App: Spotify (Music) (P8)

Word	Count
foo	3197
fighters	3197
bon	3031
jovi	3016
led	2490
zeppelin	2490
remaster	1747
jukebox	1594
postmodern	1592
rock	1346

App: Spotify (Music) (P11)



(a) Average sentiment.


ESM Category
Housework
Exercising
Shopping
Eating/Drinking
Online Searching
Working
Entertainment
Misc
Travelling
Resting
Socialising
0.0
0.1
0.2
0.3
0.4
0.5
Sentiment Score

Here are the sentiments of text that a university student has viewed on their smartphone for each day over a week. The sentiments range from -1 to 1, with -1 being most Negative and 1 being most Positive.
Your task is to rate how the student felt for each of the following feelings based on the sentiments of the text they have viewed:

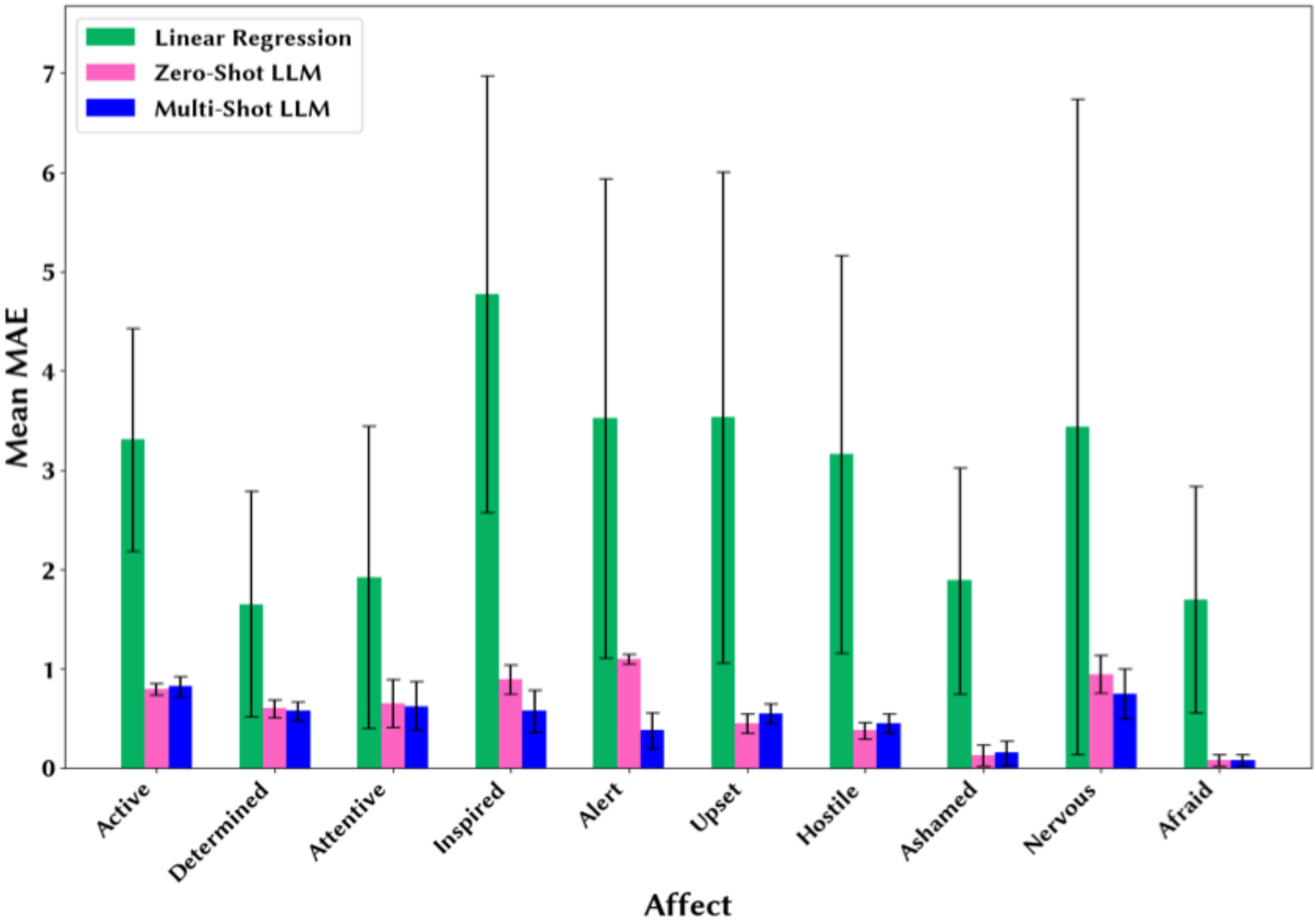
Active
Determined
Attentive
Inspired
Alert
Upset
Hostile
Ashamed
Nervous
Afraid

For each feeling, choose a Likert score ranging from 1 to 5 that best represents how the student generally felt during the week, where 1 represents Never and 5 represents Always.

Sentiments of text the student has viewed on their smartphone over a week:

Day 1: {sentiment of text viewed on the first day of the week}
Day 2: {sentiment of text viewed on the second day of the week}
Day 3: {sentiment of text viewed on the third day of the week}
Day 4: {sentiment of text viewed on the fourth day of the week}
Day 5: {sentiment of text viewed on the fifth day of the week}
Day 6: {sentiment of text viewed on the sixth day of the week}
Day 7: {sentiment of text viewed on the seventh day of the week}

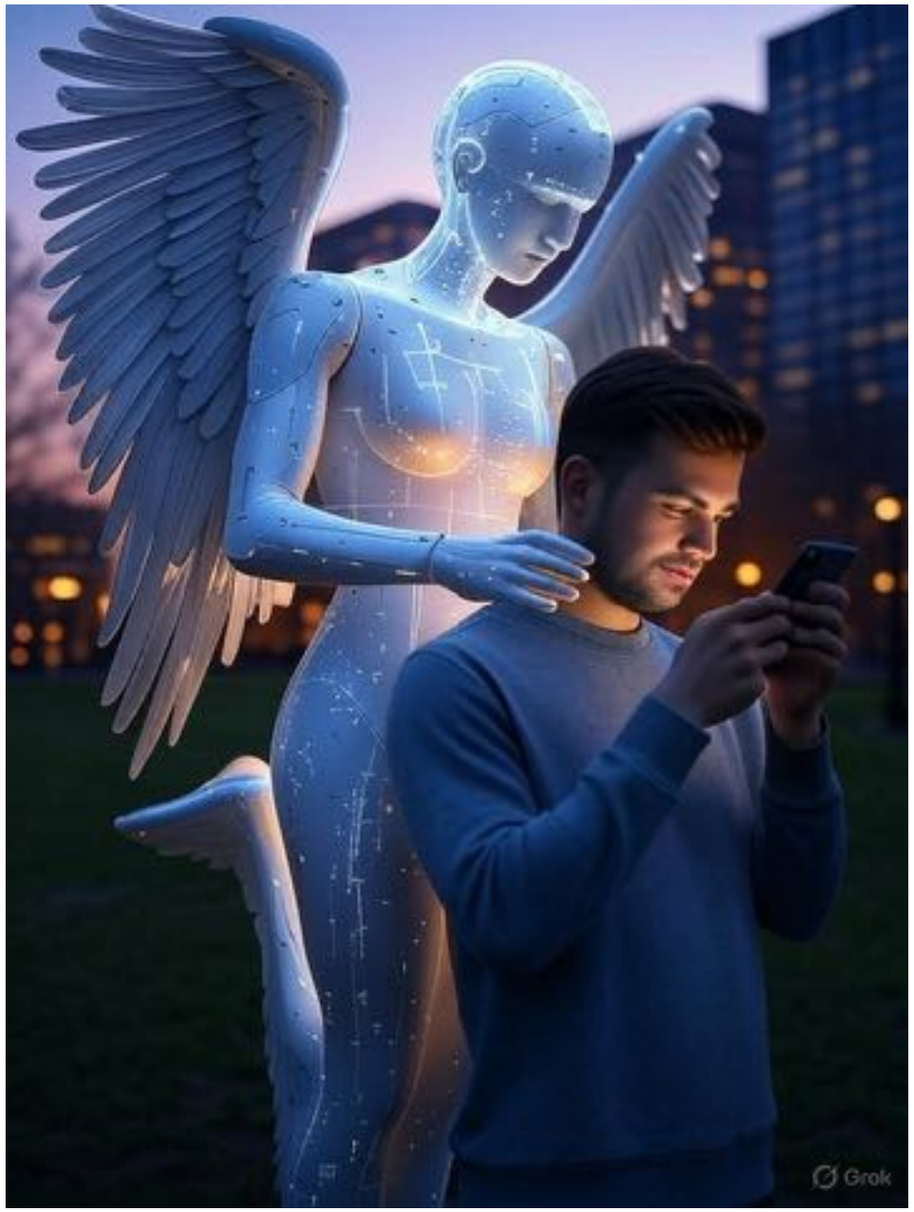
When predicting information for a single week, only consider data from that


Linear Regression
Zero-Shot LLM
Multi-Shot LLM
Mean MAE
0
1
2
3
4
5
6
7
Active
Determined
Attentive
Inspired
Alert
Upset
Hostile
Ashamed
Nervous
Afraid
Affect

StudentSense - 150 students

- Deployment to 150 students
- Observe for a whole semester
- Most AWARE sensors
- A wide range of questionnaires

Ongoing work: Guardian Angel



User: “I want to loose weight”

…

Guardian Angel: “You should not add sausages to your shopping cart”

Ongoing work: Digital self

Observe user behavior

Answer question on the user's behalf

"If a user took a mental health questionnaire now, what would they answer?"

"What was the most stressful part of the user's day today?"

The end!

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