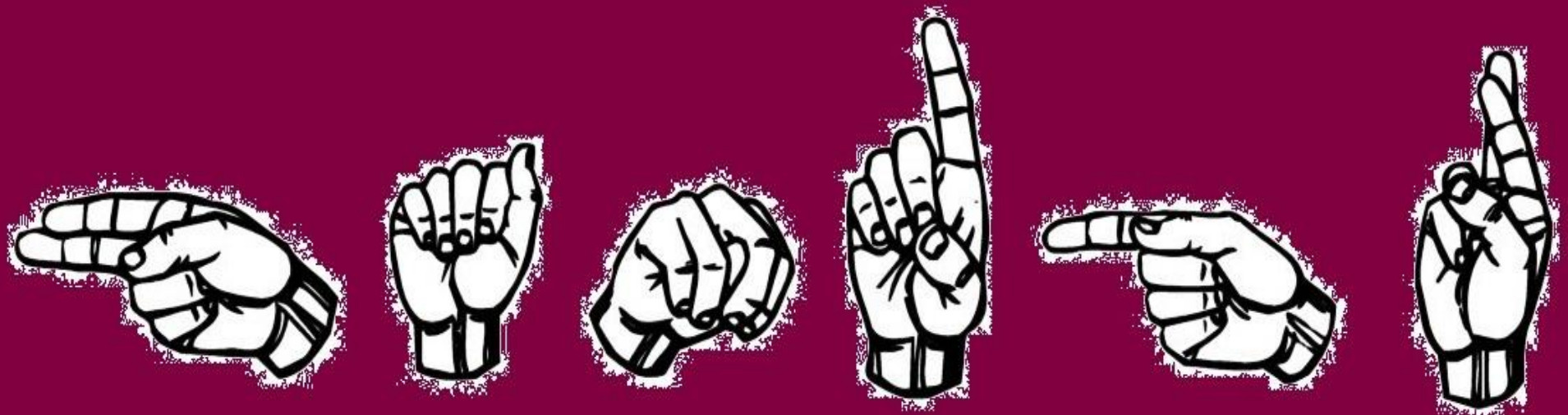


Anna Borysova Shaheel Kooverjee Erin Versfeld

Supervisors: Assoc. Profs. James Gain & Deshendran Moodley
Second Reader: Prof. Edwin Blake

Overview

The Road Ahead

- Problem description - Erin
- Problem statement
- Procedures and methods - Shaheel
  - Data gathering
  - Data processing
  - Features
  - Gesture classifiers
  - Evaluation
- Related work - Anna
- Anticipated outcomes and deliverables
- Ethical, professional and legal issues
- Project plan - Erin

Abbreviations

EMG - Electromyographic

SASL - South African Sign Language

ML - Machine learning

The essence of this project is machine learning.

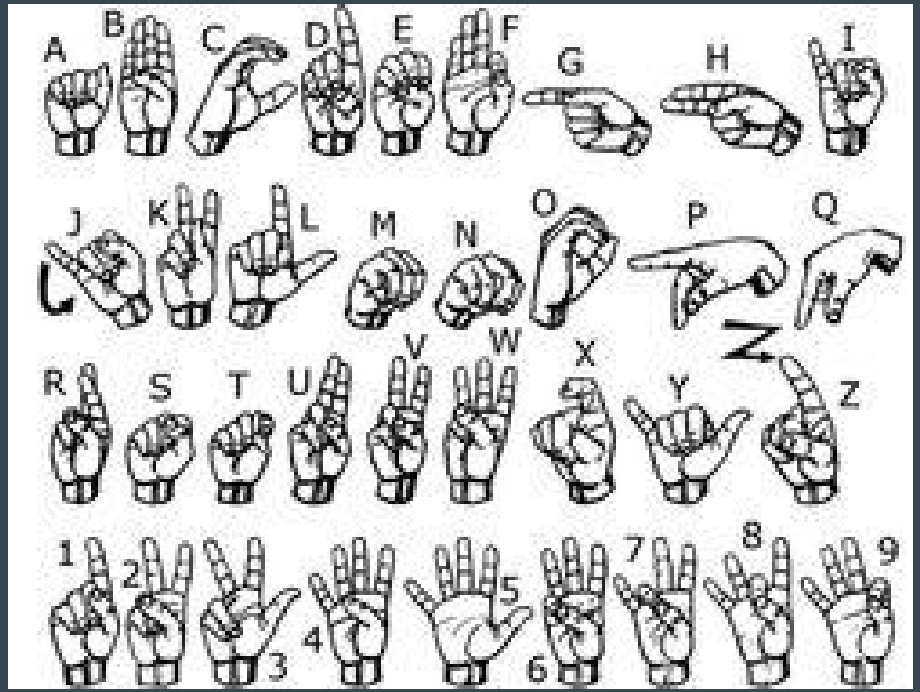
Problem description

Communication barrier

- Deaf/hearing communication divide
- Deaf vs deaf
- Total Communication
- Second language hearing

Some background about SASL

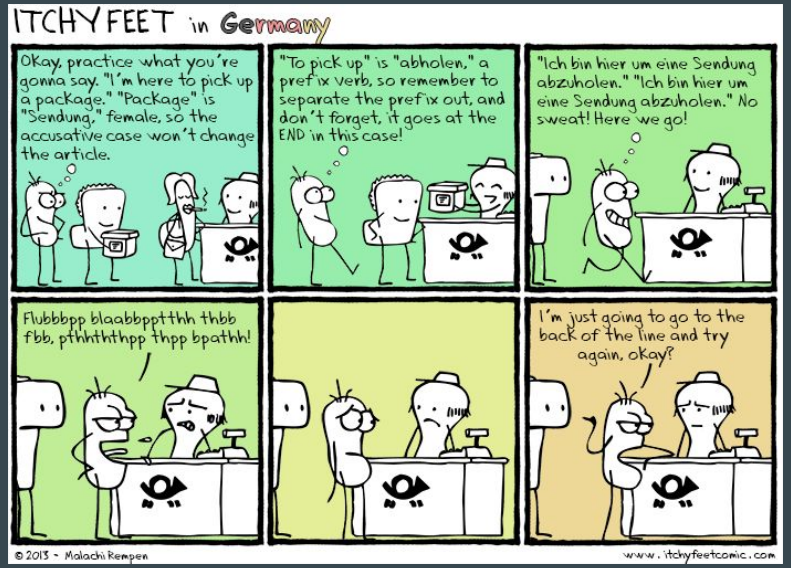
- Require full body
- Facial expression very important
- SASL alphabet



Learning SASL

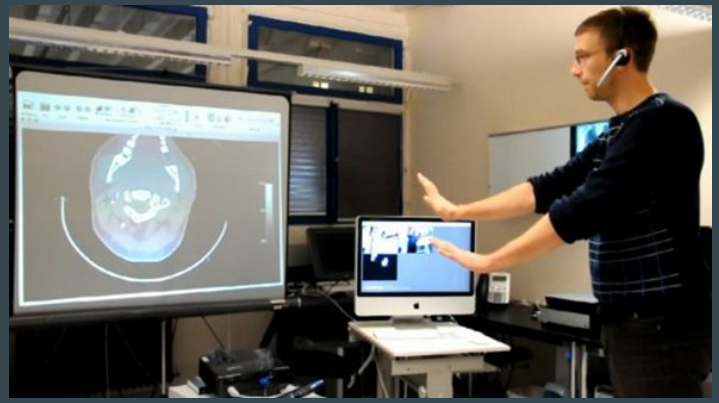
- Lack of materials
- Require feedback

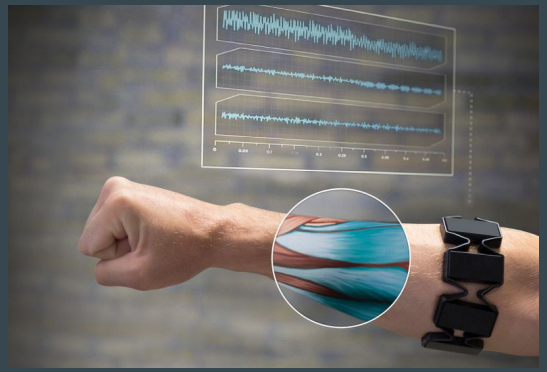
- Personal experience



Gesture recognition and machine learning

- Depth sensors
- EMG sensors, accelerometers and gyroscopes
- Commercial availability
- Sound ML libraries
- Limitations
    - Only the alphabet





Problem statement

Research question

Phase 1

For a given commercially available gesture recognition device, which of the explored machine learning techniques is best for implementing a SASL alphabet learning tool?

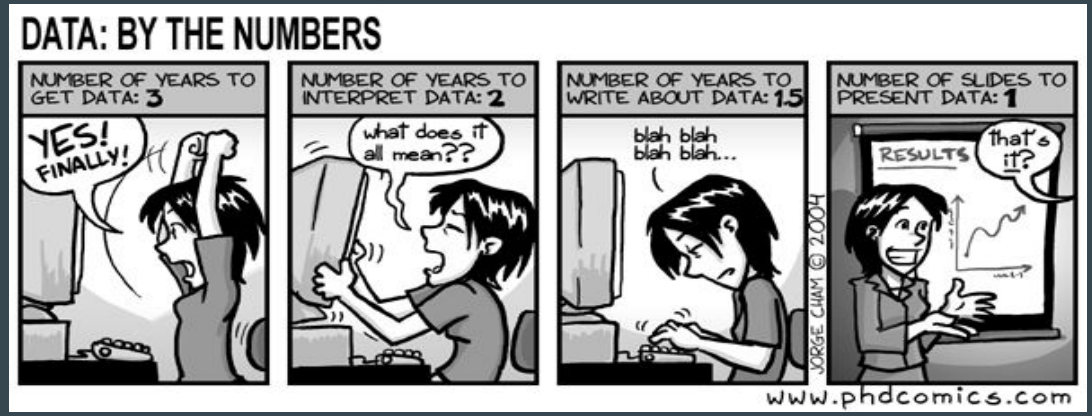
Phase 2

For a given combination of commercially available gesture recognition devices, which of the explored machine learning techniques is best for implementing a SASL alphabet learning tool?

Procedures and Methods

Data gathering

- No available dataset for SASL alphabet gestures
- Pilot data gathering stage
  - Ensure devices record required information
  - Clarify experimental setup
- Main data gathering stage
  - Recruit participants of reasonable familiarity with SASL alphabet
  - Record individual letters, in randomised orders

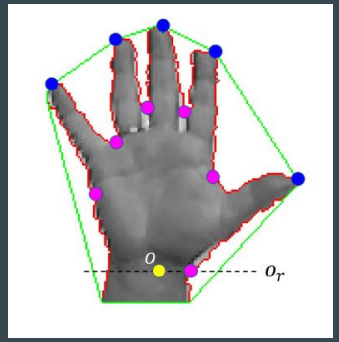


Data gathering setup

- Gestures recorded using *all devices simultaneously*
- Allows for data to be used across both phases

Features

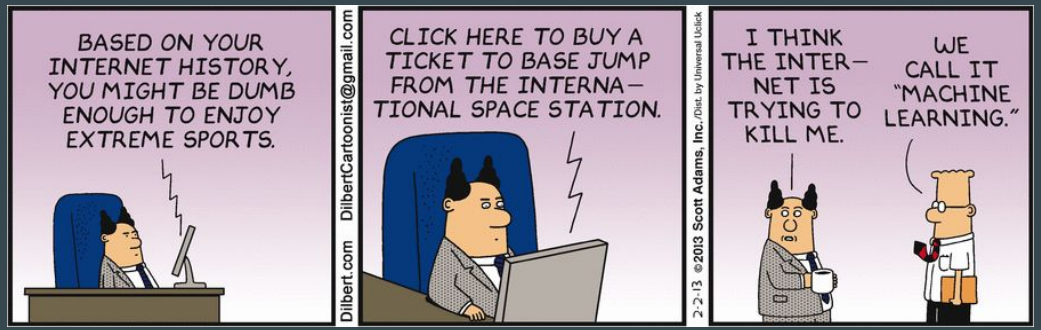
- Classifiers require effective input!
- Kinect: Hand extraction from images required
  - Features can then be used from this

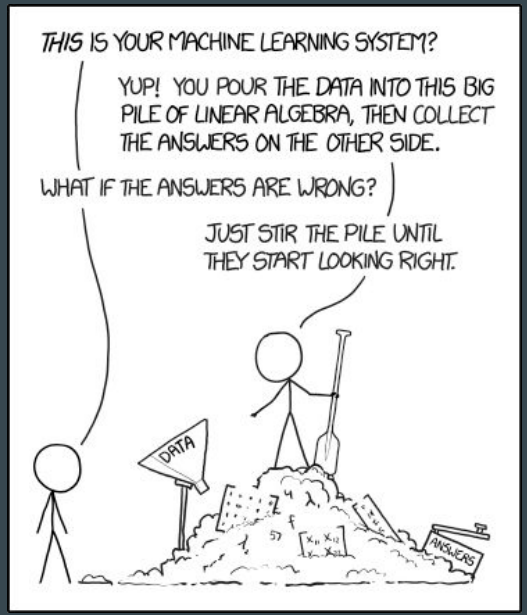


- Myo and Leap: No feature extraction, only selection

Gesture classifiers

- Gesture classifiers
  - Support vector machines
  - Artificial Neural Networks
  - Hidden Markov Models
  - K-nearest neighbour
  - Naïve Bayes Classifier
- Bayesian Inference methods to combine outputs taken from different classifiers

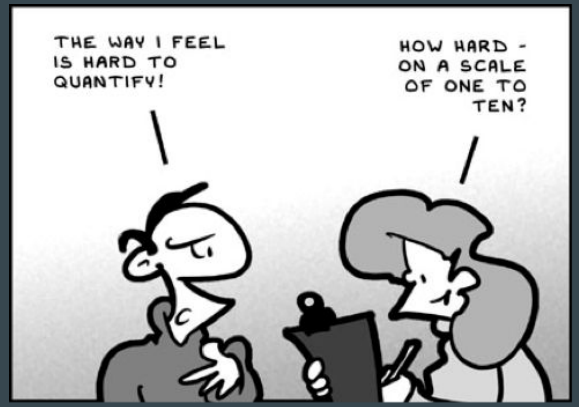




Evaluation

- Multiple quantitative measures
  - Accuracy/recognition rate
  - Type I and Type II errors
    - Confusion matrix
  - Other measures including true or false positives or negatives
  - Be more concerned about reducing number of false positives than false negatives

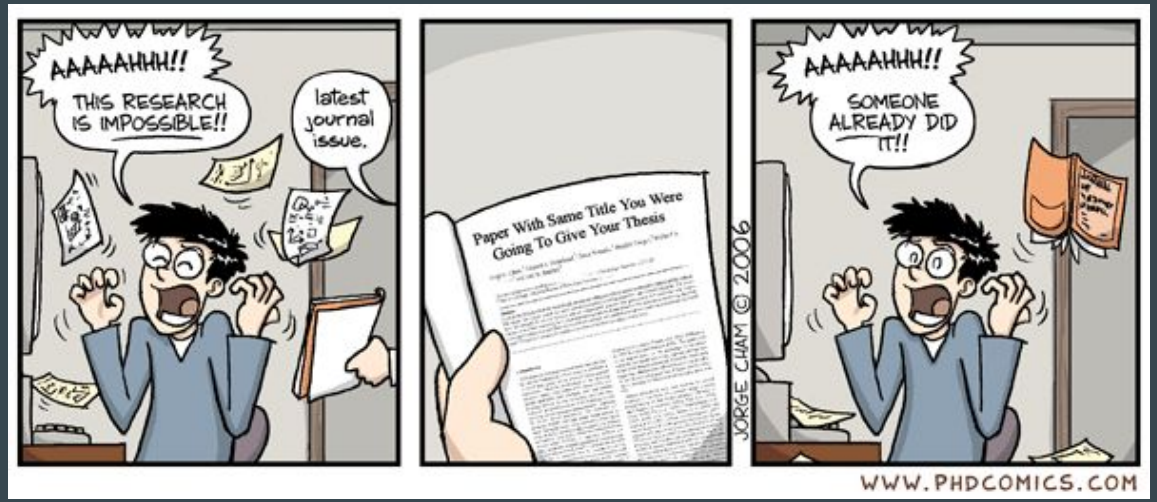
	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10
G1	**0.99**		0.01							
G2		**0.96**	0.03		0.01	0.01				
G3		0.02	**0.96**		0.01		0.01			
G4		0.01	0.01	**0.91**	0.01		0.01	0.03		0.01
G5		0.03		0.01	**0.94**	0.01		0.01		
G6		0.01	0.01		0.02	**0.86**			0.04	0.07
G7			0.01	0.02	0.01	0.01	**0.90**	0.05		
G8				0.03			0.07	**0.86**		0.04
G9						0.01		0.01	**0.97**	0.01
G10					0.01	0.19		0.03		**0.78**



Related Work

Related work

- Leap and Kinect used successfully for SL alphabet recognition
- EMG not as widely used: Myo even less so
- The classifiers previously mentioned have all been successful in these studies
- Combinations of devices and classifiers less common
  - Most common for Leap and Kinect
  - Successful



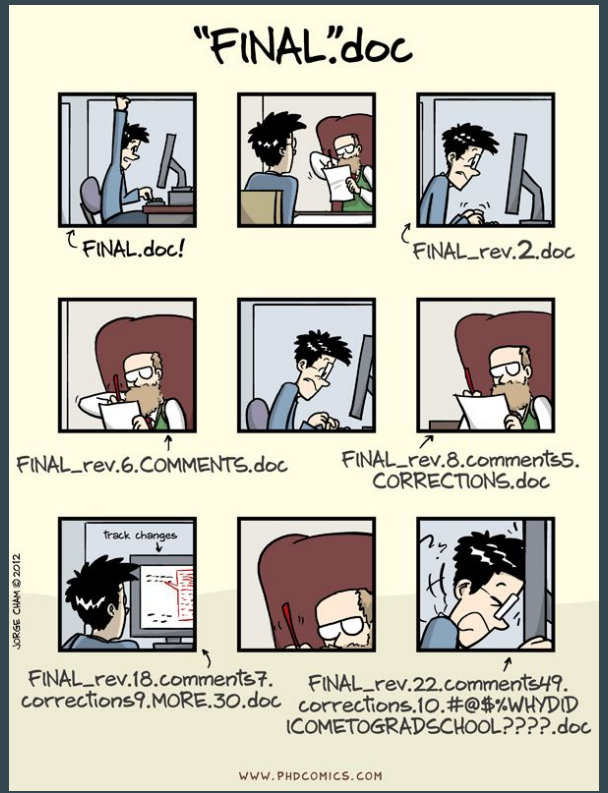
Gaps to fill

- Comparing the most successful classifiers
- Combining classifiers using Bayes
- Investigating the new device Myo
- ⟵ Gap to fill...
- Investigating combinations of classifiers and devices (NB Myo and depth)
- SASL alphabet recognition

Anticipated Outcomes and Deliverables

Anticipated outcomes and deliverables

- Not a software engineering project
  - Not creating/designing the actual learning tool
- Rudimentary system to answer research questions
  - Technical components of learning tool
  - Code used will be publicly available
- Data set
  - Individual letters
  - Variety of performers
  - Publicly available
- Research papers
- Reproducible
- Contribute to scientific knowledge



Ethical, professional and legal issues

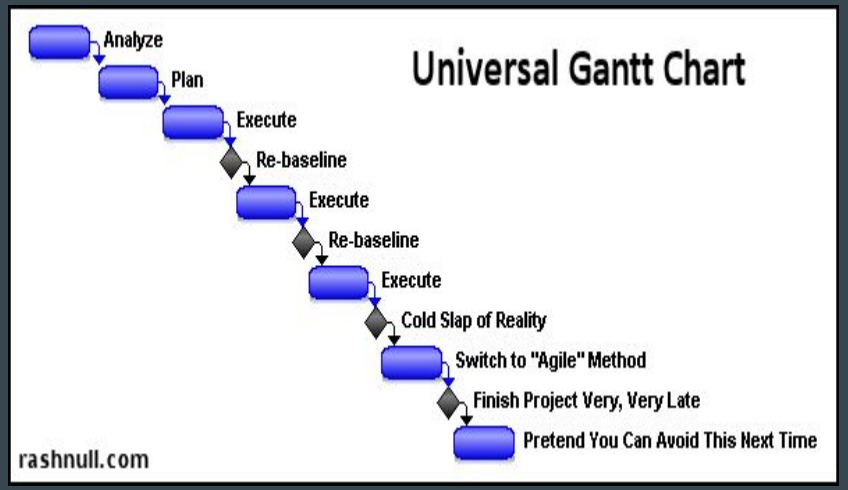
Ethical considerations

- General considerations for human participants in data gathering
  - Informed consent
  - Drop out at any time
- Developing a tool for the socially dominant group
  - Put burden of bridging gap on hearing
- Applying for ethical clearance

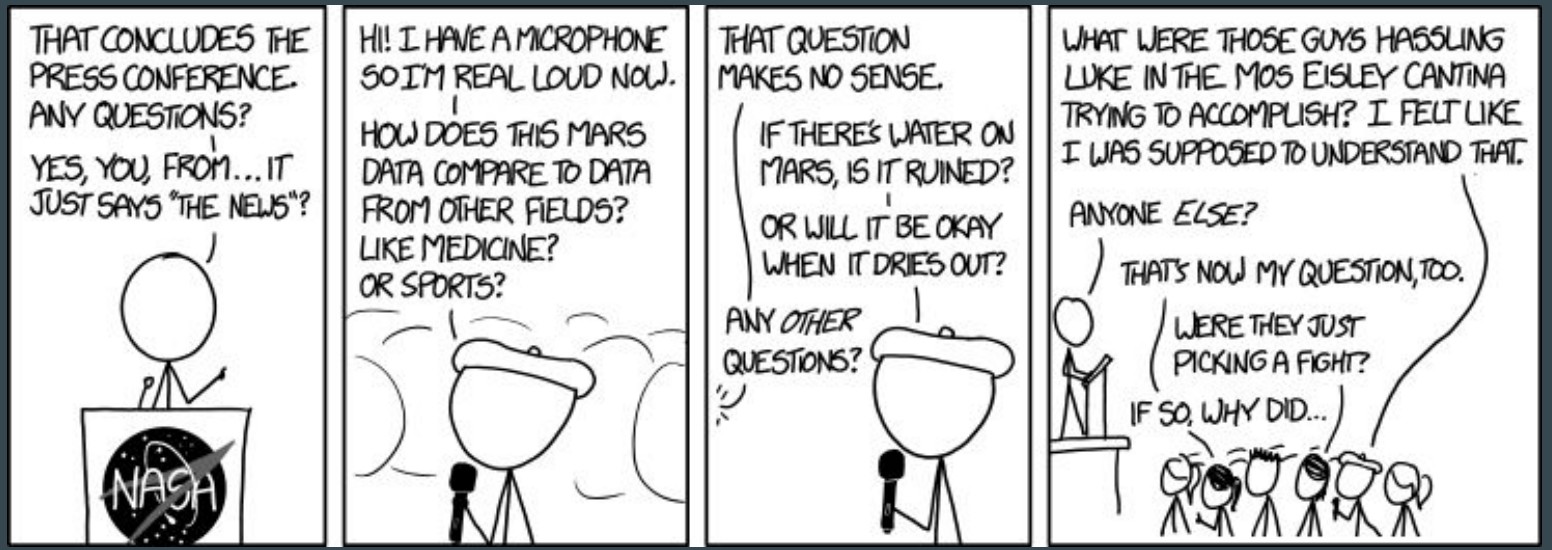
Project Plan

Project Plan

- Risks
- Timeline
  - Phase 1: In progress - 4 August
  - Phase 2: 7 August - 5 September
  - Draft of final paper by 7 September
  - Final paper by 22 September
- Resources
- Work allocation



Questions


THAT CONCLUDES THE PRESS CONFERENCE. ANY QUESTIONS?
YES, YOU, FROM... IT JUST SAYS "THE NEWS"?
NASA
HI! I HAVE A MICROPHONE SO I'M REAL LOUD NOW.
HOW DOES THIS MARS DATA COMPARE TO DATA FROM OTHER FIELDS? LIKE MEDICINE? OR SPORTS?
THAT QUESTION MAKES NO SENSE.
IF THERE'S WATER ON MARS, IS IT RUINED?
OR WILL IT BE OKAY WHEN IT DRIES OUT?
ANY OTHER QUESTIONS?
WHAT WERE THOSE GUYS HASSLING LUKE IN THE MOS EISLEY CANTINA TRYING TO ACCOMPLISH? I FELT LIKE I WAS SUPPOSED TO UNDERSTAND THAT.
ANYONE ELSE?
THAT'S NOW MY QUESTION, TOO.
WERE THEY JUST PICKING A FIGHT?
IF SO, WHY DID...

Questions

1. Why a tool for the hearing?
    - Place burden on dominant group
2. Why the alphabet?
    - Basis of most languages
    - Gesture recognition devices can recognise
    - Other SASL gestures too complex
    - A familiar bridge to SASL from a spoken language
3. Where will we find people?
    - Audiology students - have to learn
4. Why the focus on hearing signers?
    - Important that the data be appropriate for classifiers to work properly
5. Individual devices are expensive already, is using two devices for a learning tool viable?
6. Why Machine Learning?

References