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A lecture for students at MSc in Persuasive Design

FROM CHESS…
…TO SOCIAL ROBOTICS

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Outline

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Part I: Introduction to Social Robotics

Part II: User Behavior Understanding

Part III: Selected research topics in Human – Robot Interaction (HRI)

- Public perception of android robots: An analysis of YouTube comments
- Evaluation of iSocioBot

Part I: Introduction to Social Robotics

From Chess…

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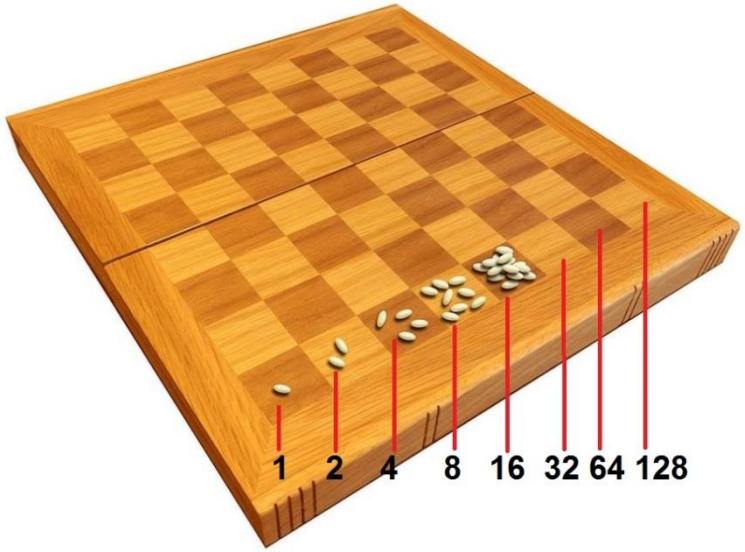
The ruler or India was so pleased with one of his palace wise men, who had invented the game of chess, that he offered this wise man a reward of his own choosing.

The wise man, who was also a wise mathematician, said that he would like just one grain of rice on the first square of the chess board, double that number of grains of rice on the second square, and so on.

From Chess…

A quantity of rice determined as follows:

- one grain of rice is placed on the first square of the chessboard,
- two grains on the second,
- four on the third, and so on
- each square receiving twice as many grains as the previous



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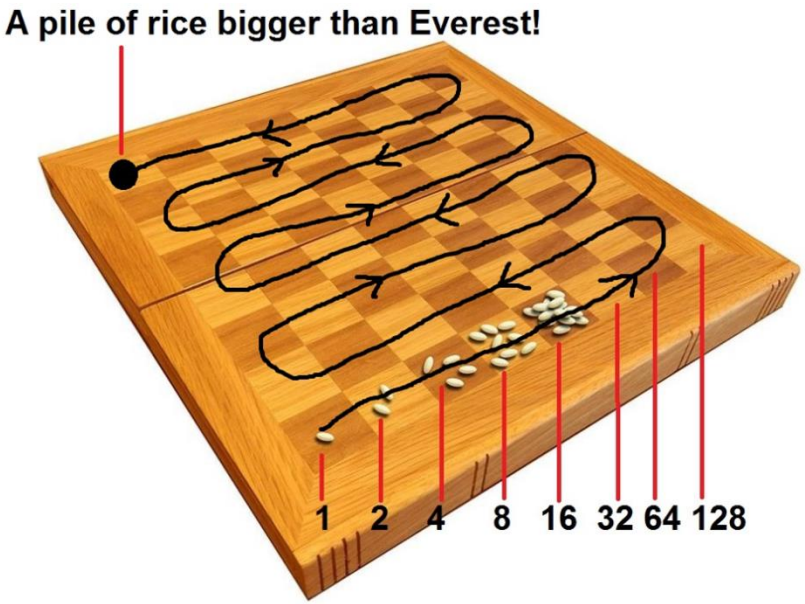
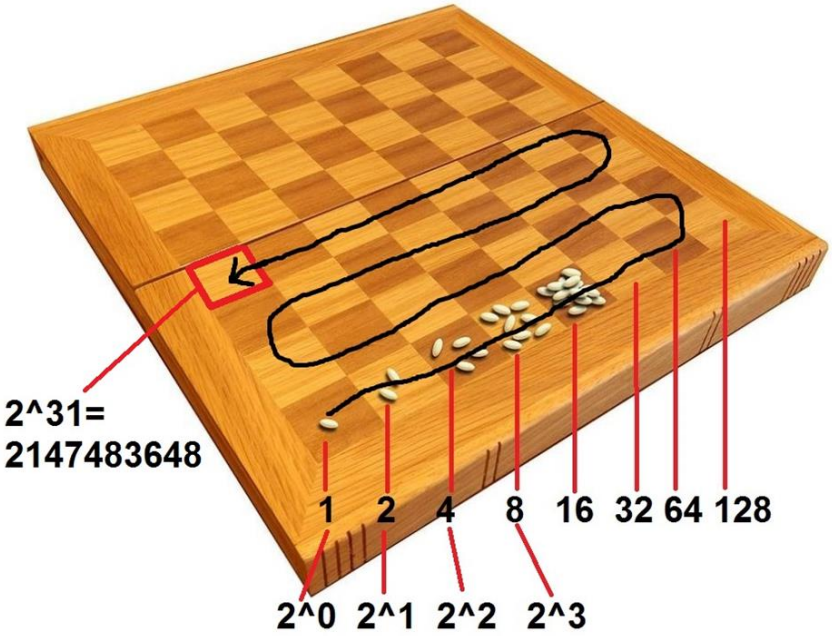


From Chess…

Constant doubling means exponential growth

more than
18,000,000,000,000,000,000
grains equal to about
210 billion tons



From Chess…

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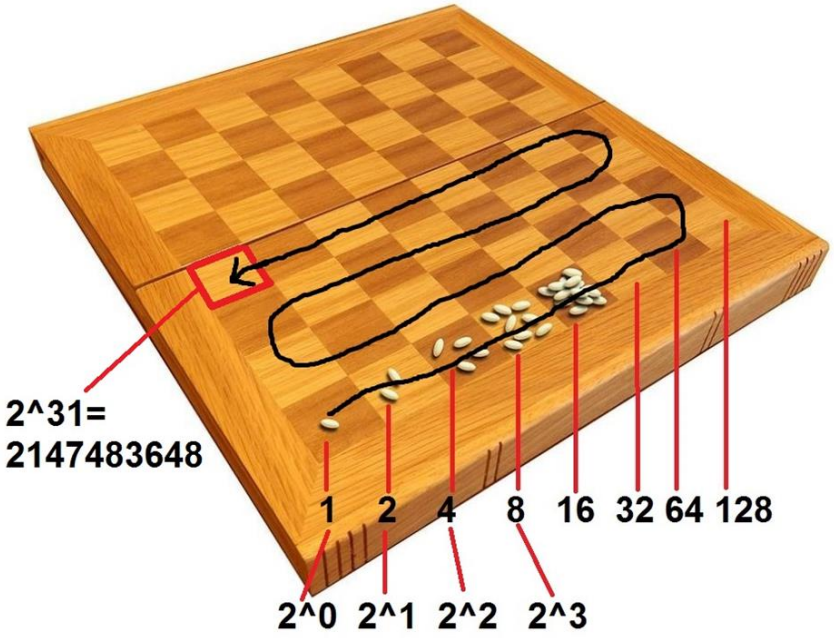

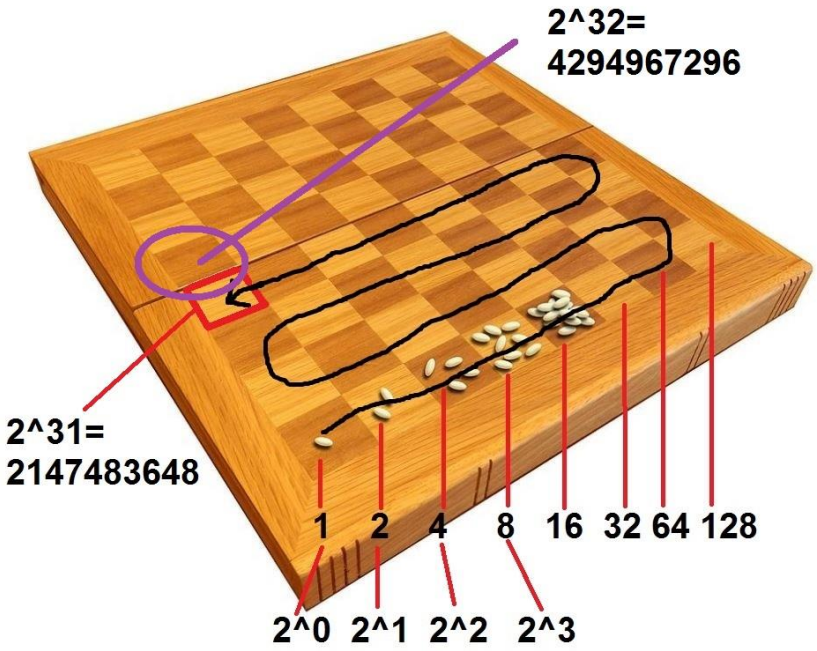

From Chess…

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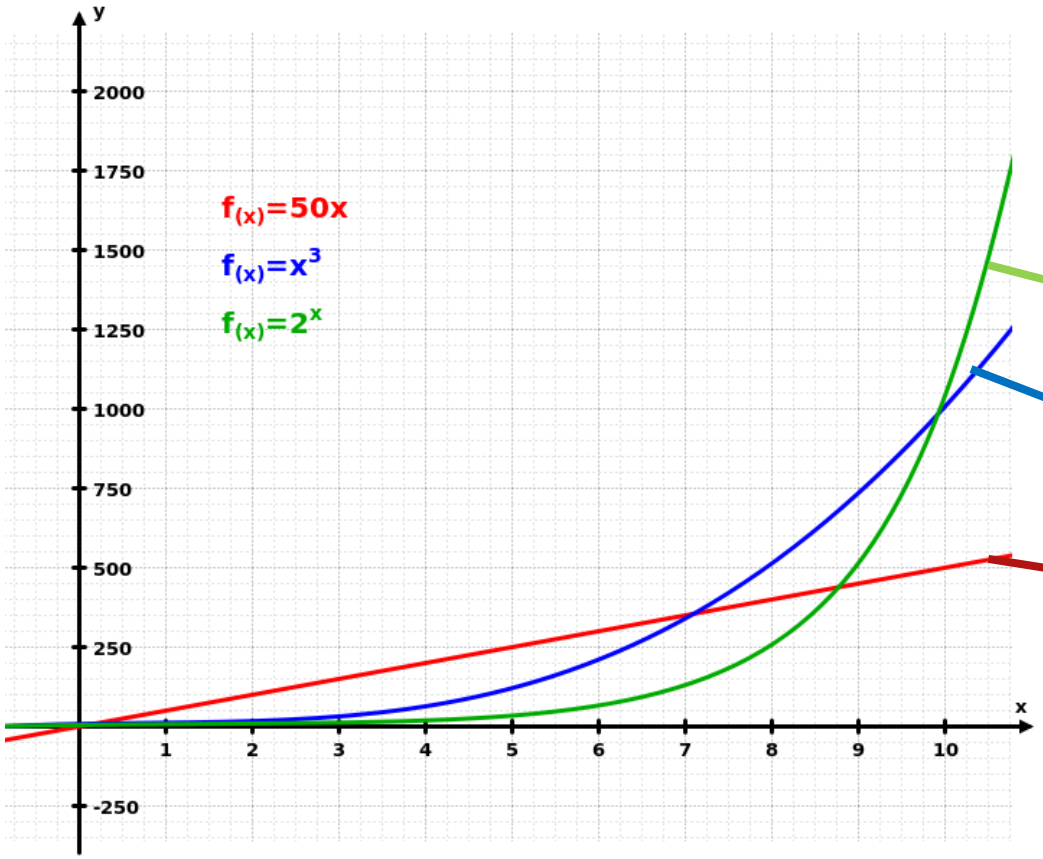
https://youtu.be/byk3pA1GPgU

…to Technology…



Exponential growth

Cubic growth

Linear growth

…to Technology…

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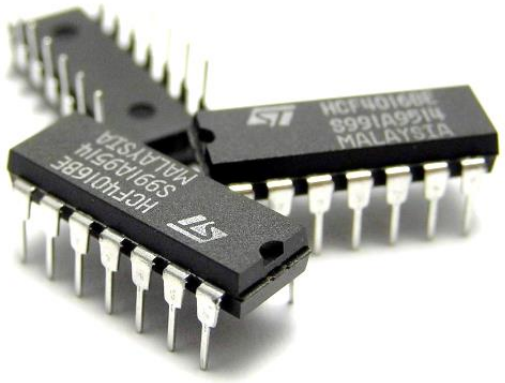
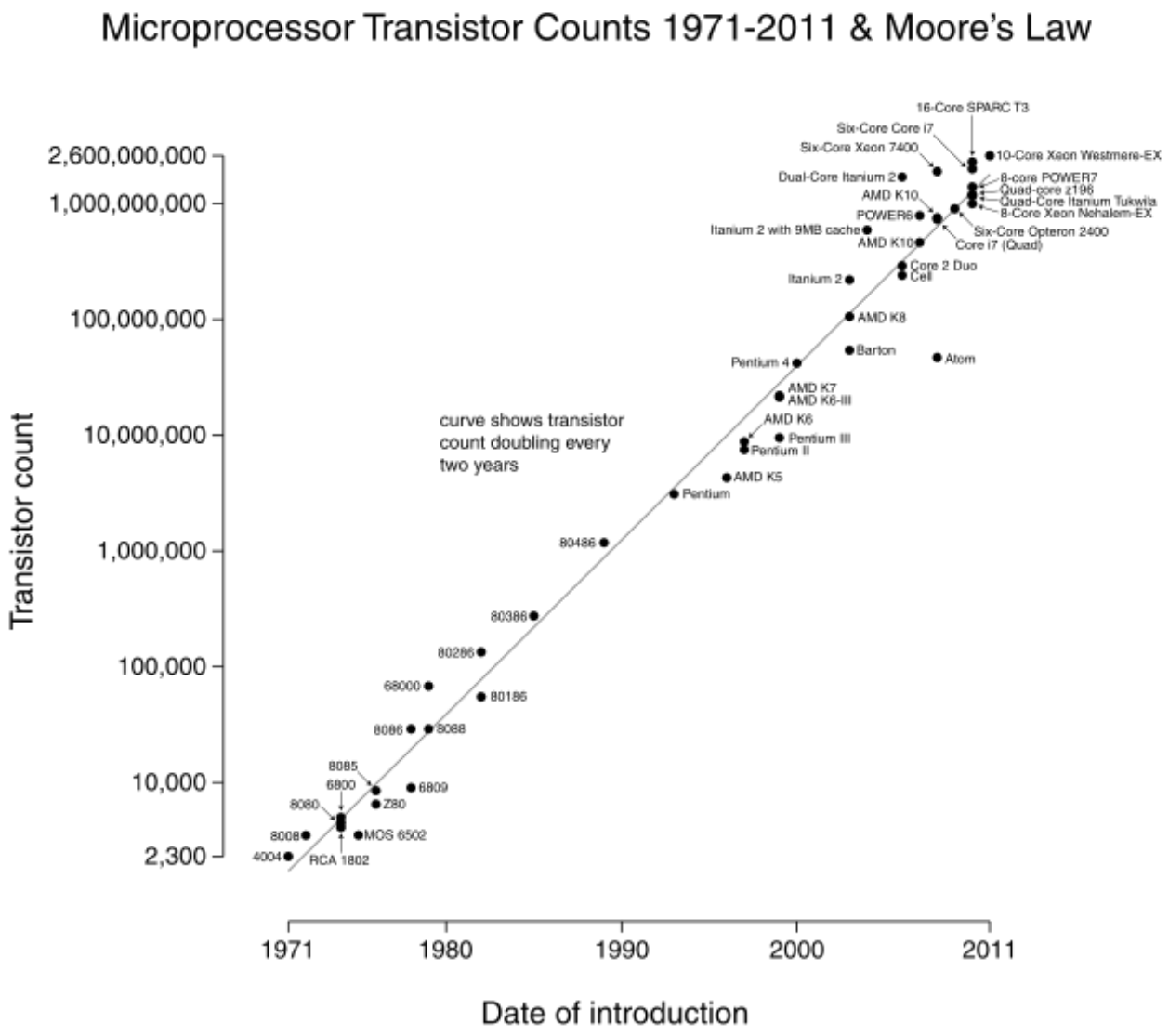
- The Moore's Law:
  Processing power for computers will double in power, and half in price roughly every 18 months.

- Gordon Moore – cofounder of INTEL

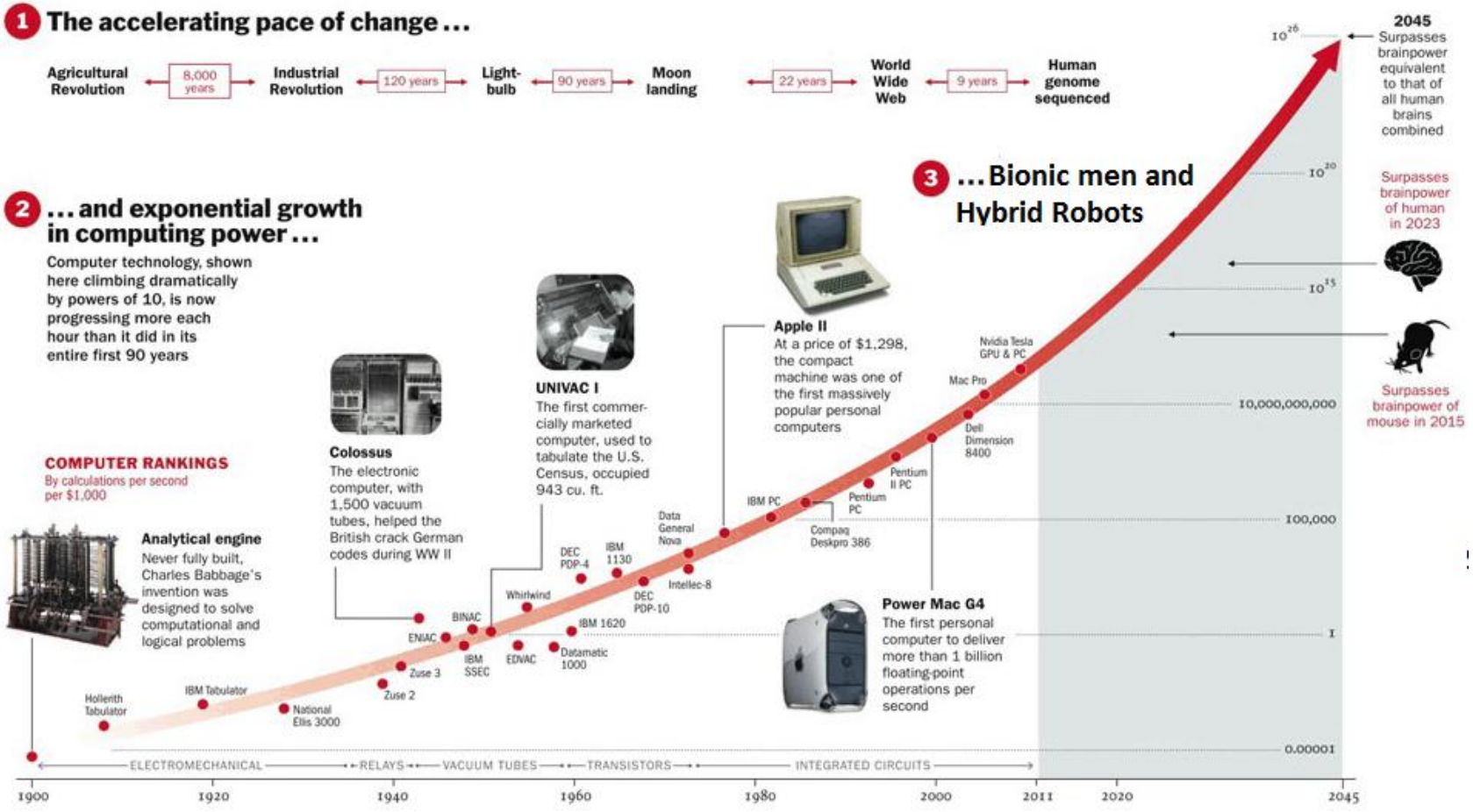
- 1965 - the number of transistors per square inch on integrated circuits double every 18 months.



…to Technology…



…to Society…


1 The accelerating pace of change…
Agricultural Revolution
8,000 years
Industrial Revolution
120 years
Light-bulb
90 years
Moon landing
22 years
World Wide Web
9 years
Human genome sequenced
2 …and exponential growth in computing power…
Computer technology, shown here climbing dramatically by powers of 10, is now progressing more each hour than it did in its entire first 90 years
3 …Bionic men and Hybrid Robots
2045
Surpasses brainpower equivalent to that of all human brains combined
Surpasses brainpower of human in 2023
Surpasses brainpower of mouse in 2015
COMPUTER RANKINGS
By calculations per second per $1,000
Analytical engine
Never fully built, Charles Babbage's invention was designed to solve computational and logical problems
Colossus
The electronic computer, with 1,500 vacuum tubes, helped the British crack German codes during WW II
UNIVAC I
The first commercially marketed computer, used to tabulate the U.S. Census, occupied 943 cu. ft.
Apple II
At a price of $1,298, the compact machine was one of the first massively popular personal computers
Power Mac G4
The first personal computer to deliver more than 1 billion floating-point operations per second
Hollerith Tabulator
IBM Tabulator
National Ellis 3000
Zuse 2
Zuse 3
ENIAC
BINAC
IBM SSEC
EDVAC
Whirlwind
IBM 1620
Datamatic 1000
DEC PDP-10
DEC PDP-4
IBM 1130
Data General Nova
Intellec-8
IBM PC
Compaq Deskpro 386
Pentium PC
Pentium II PC
Dell Dimension 8400
Mac Pro
Nvidia Tesla GPU & PC
ELECTROMECHANICAL
RELAYS
VACUUM TUBES
TRANSISTORS
INTEGRATED CIRCUITS
1900
1920
1940
1960
1980
2000
2011
2020
2045

…to Robotics…

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- Robot comes from the Czech word ROBOTA meaning “forced labor” , “to serve”.
- First appeared in 1921 in the play Rossum’s Universal Robots by Karel Capek.
- Develop robots according to the job/task we want them to perform.
- We have to define the task.
- What do we want ? What do we lack of?
- *According to ISO 8373:2012,*
  Robot is an actuated mechanism programmable in two or more axes with a degree of autonomy, moving within its environment, to perform intended tasks.

  Note 1: A robot includes the control system and interface of the control system.
  Note 2: The classification of robot into industrial robot or service robot is done according to its intended application.

…to Robotics…

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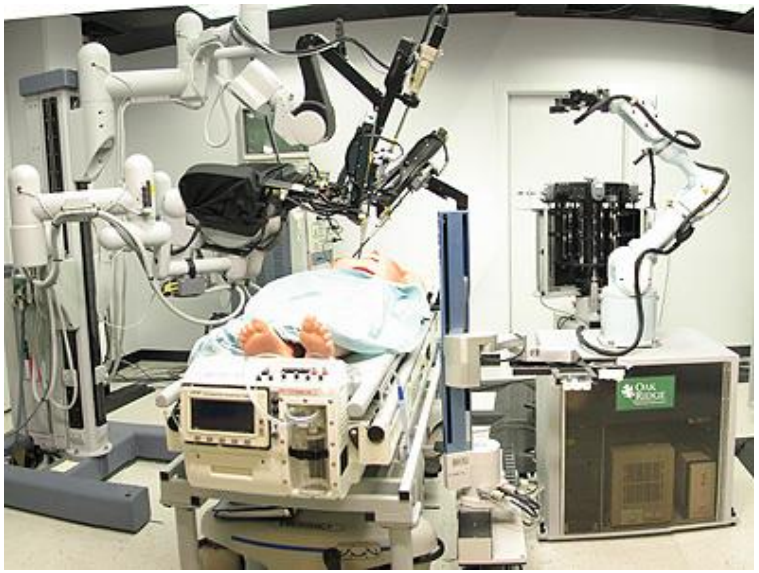
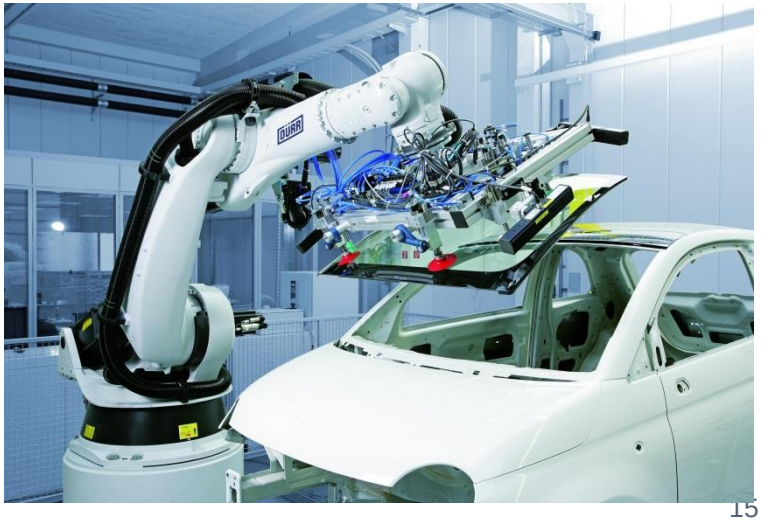
Industrial Robots

- Accuracy
- Acceleration
- Carrying capacity
- Durability
- Repeatability
- Speed





…to Robotics…

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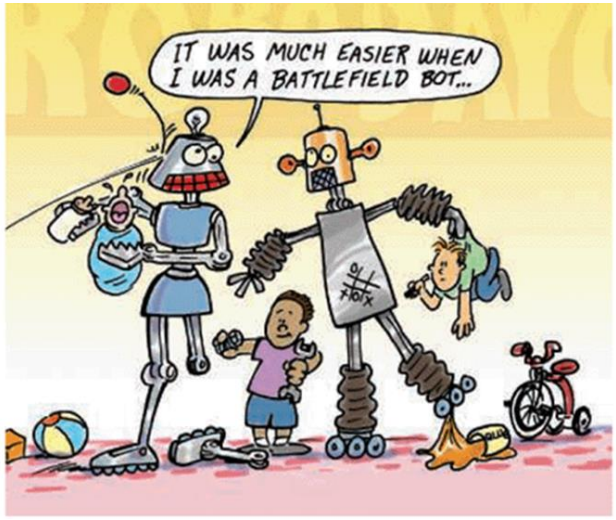
Service Robots

- A robot that performs useful tasks for humans or equipment excluding industrial automation application.

- A personal service robot is a service robot used for a non-commercial task, usually by lay persons.

  Examples are domestic servant robot, automated wheelchair, personal mobility assist robot, and pet exercising robot.



…to Social Robotics

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- *Robots that are able to interact and communicate among themselves, with humans, and with their environment, within the social and cultural structure attached to their role.*

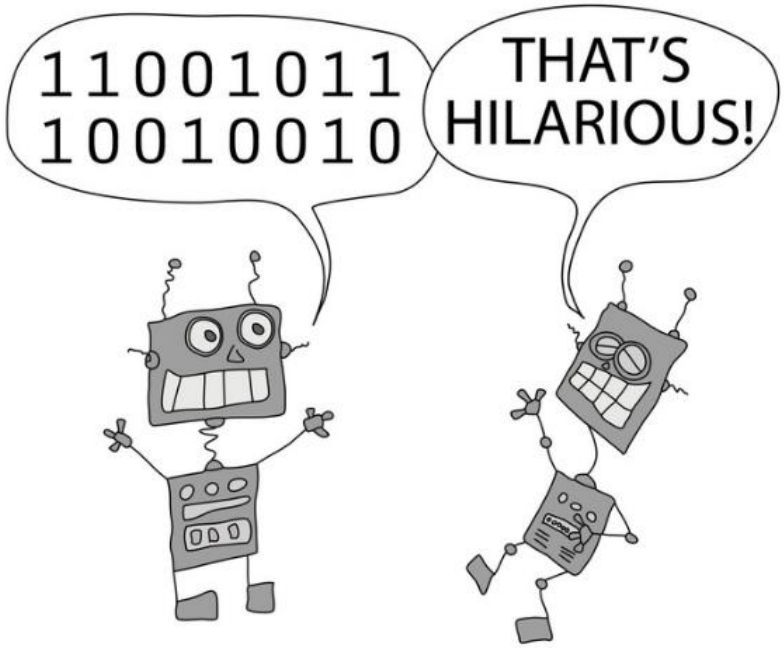
- We expect that social robots will have the ability to understand all socially accepted norms, as well as the capability to respect them.

- User-friendly appearance.

- Communication functions.

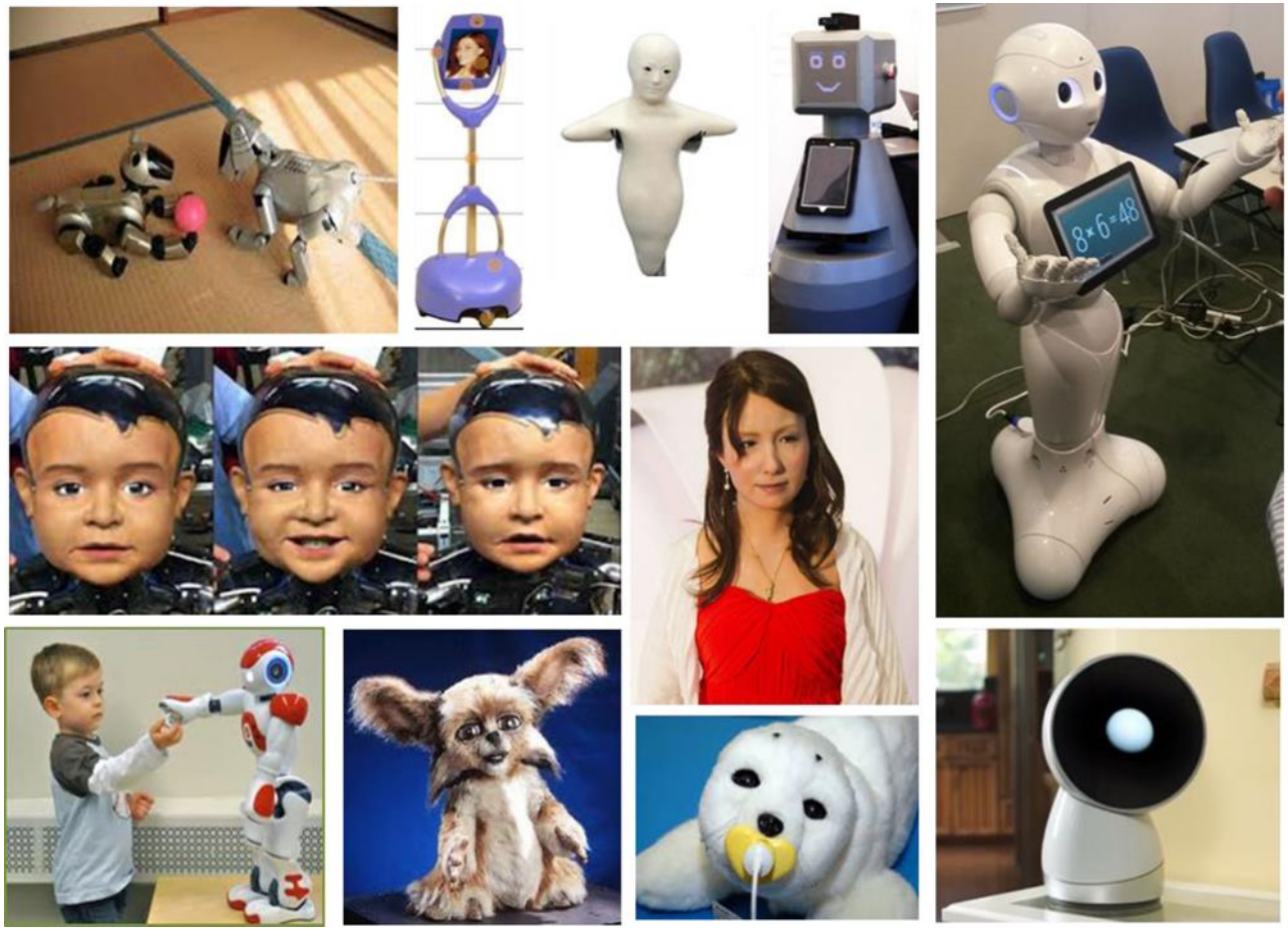
- Cognitive skills .

- Situations related to:
  - Companionship
  - Communication
  - Healthcare
  - Affect
  - Education
  - Play



…to Social Robotics

…to Social Robotics



Responsible Robotics

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- Responsible design, development, implementation, and policy of robots embedded in our society.
- Robot revolution raises urgent societal issues not addressed by policy makers.
- Robots are moving out of the factories to automate many aspects of our daily lives.
- Robots are only as responsible as the humans who build them and use them.
- Topics:
  - What responsibilities and decisions should or should not be delegated to a robot?
  - Who is responsible when something goes wrong?
  - What is a responsible roboticist?
  - Can there be such a thing as a responsible robot?
- Ethics and Information Technology (Springer) journal.

Part II:
User Behavior Understanding

User Model and the Process of User Modeling

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- A user model consists mainly of knowledge about the individual preferences which determine the user's behavior.

- Information Systems are becoming more complex and, therefore, intelligent user interfaces are needed to improve user interaction with these systems.

- User Modeling (UM) aims to make information systems user-friendly, by adapting the behavior of the system to the needs of the individual.

- User model acquisition
  - Explicit methods (provided by the user)
  - Implicit methods (provided from observation)

User Model and the Process of User Modeling

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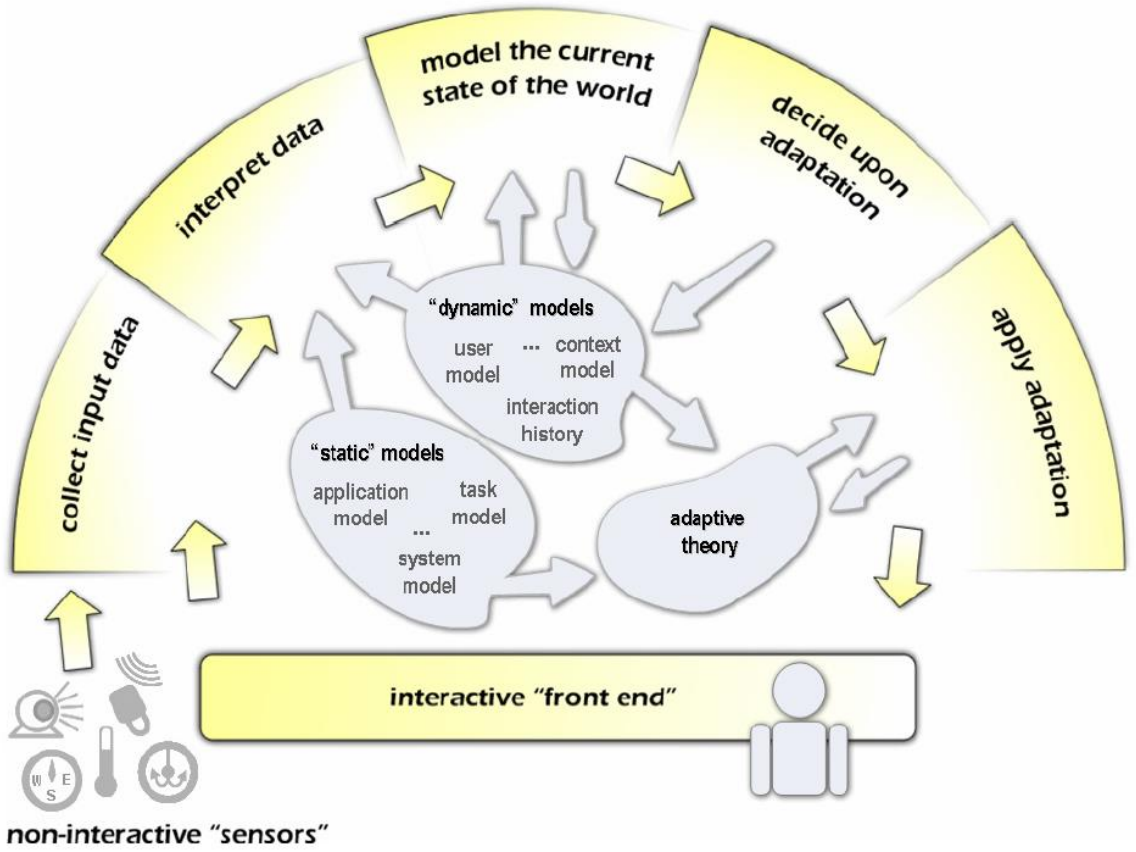
The goal of user modeling may be to:

- predict user behavior
- to gain knowledge of a particular user in order to tailor interactions to that user
- to create a database of users that can be accessed by others
- the create the model itself, when that model is used to create an autonomous agent to fill a role within a system

The adaptation process: a process-oriented view



Paramythis, A., Weibelzahl, S., & Masthoff, J. (2010). Layered evaluation of interactive adaptive systems: framework and formative methods. User Modeling and User-Adapted Interaction, 20(5), 383-453.

How to get the user model?

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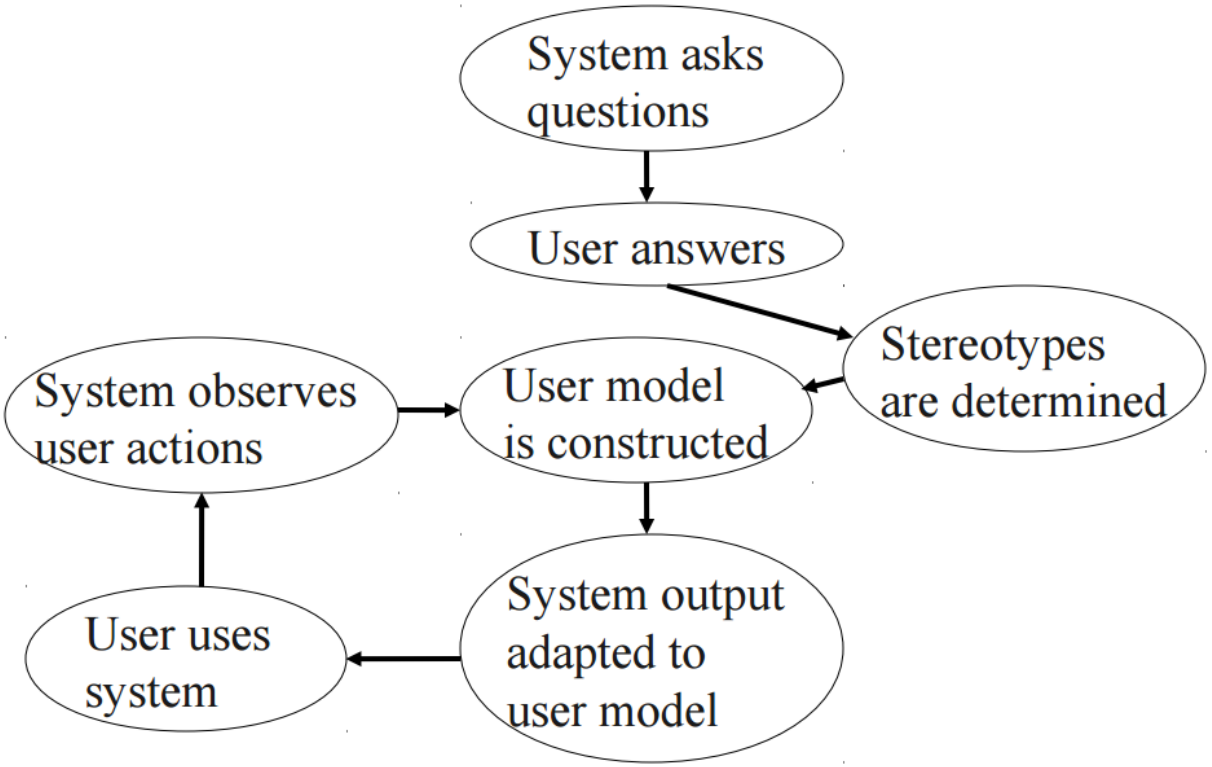
- Ask the user questions
- Observe the user's actions
- User model is constructed
- A combination



Behavioral and Attitudinal data

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- Behavioral data provides:
  - Insight into what a user is doing.
  - Insight into actions.
  - Insight into the motivations, decisions, emotions.
  - Often unobtrusive (subjects are not aware of being studied), non-reactive, low-constraint data.

- Attitudinal data provides:
  - Insight why a user is doing something.
  - Insight into what is important for the user.
  - Insight into contextual, situational, cognitive, and affective data.
  - Obtrusive (subjects are aware that they are being studied), reactive data.

Behavioral and Attitudinal data

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Behavioral Data

Example:

- The Amazon online store recommends items of interest based on (among others):
  - items that you bought, searched or browsed in the past
  - items that you recently visited
  - items that similar users bought, searched or browsed (similar means there is an overlap between items visited by you and them)

Attitudinal Data

- But Amazon does not know:
  - whether you look for items for yourself or for your girlfriend/boyfriend
  - whether you are window shopping, or shopping for work
  - whether you already have these items

Information represented in a user model

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- *Demographic information:* simple demographics can be used for a rough initial fine-tuning of the interface (e.g. localization)
- *Personal data:* Name, address, age, birthday, email address, education, profession
- *Contacts and friends*: Friends' personal data, groups and group membership, chatlogs, . . .
- *Social Media*: User IDs or User Names for social media (e.g. Skype, Twitter,Facebook, LinkedIn…)
- *Login data* (direct or via a token) for accessing the contents of the social media profiles
- *Privacy controls* (which data may be retrieved and used)

Information represented in a user model

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- *User goals and user tasks:* used to satisfy user needs as effectively, and efficiently as possible
- *User background knowledge:* which concepts a user is already familiar with, and which need additional explanation.
- *User interests:* used for determining the information, services or products that users are most likely to appreciate.
- *User skills and capabilities:* the user's familiarity with the system and practical knowledge on how to interact with the system.
- *User traits:* personality factors, cognitive factors, and learning styles.
- *User mood:* happy, stressed, relaxed, tense, afraid, motivated, bored, engaged, frustrated, . . .

Information represented in a user model

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- *Device Information:* System specs, display resolution, network speed and bandwidth, software and tools
- *Location:* Position, direction, speed, vehicle
- *Browsing-History & Bookmarks*
- *Learning actions*: *Visited pages, Test scores, Number of test attempts, Time spent learning*

Explicit /Implicit user models

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Explicit

- ask the user directly
- fit the user into a predefined profile (gender, marital status…)
- the user model explicitly represents the relevant aspects of the user as closely as possible
- the model is built from human-like inferences
- intuitive process, interpretable and reproductible models
- limitations in scalability and extendability

Implicit

- observing user actions / tracking user
- making inferences based on stored knowledge
- Statistical models and machine learning techniques
  - implicit, statistical approaches are more flexible and better suitable for dealing with huge quantities of data
  - implicit user models are built from raw user data, which is the input for the adaptation mechanisms

User behavior understanding

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Implicit

Observing Users:

- *User testing /Usability tests*

tests whether the developed product is usable by the intended user population

- *Log Files*

with log file analysis tools one retrieves information about where visitors are coming from, how often they return, how they navigate through a site, other statistics

- *Participant observation*
- *Diaries*
- *Web Tracker Application*

installed to each participants computer recording Web browser actions

Explicit

Asking Users (Controlled environment):

- *Personal Interviews*

  at the participants workplace/environment

- *Questionnaire Survey*

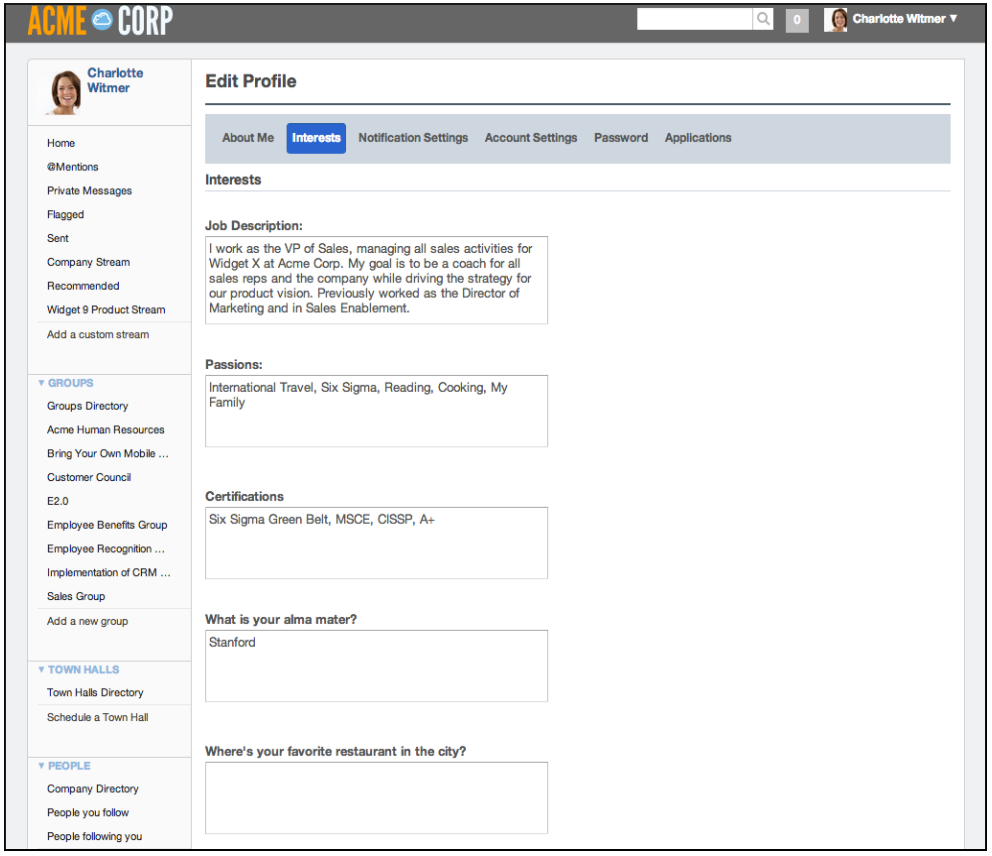
  asking respondents about some aspects of themselves, others, objects, or their environment

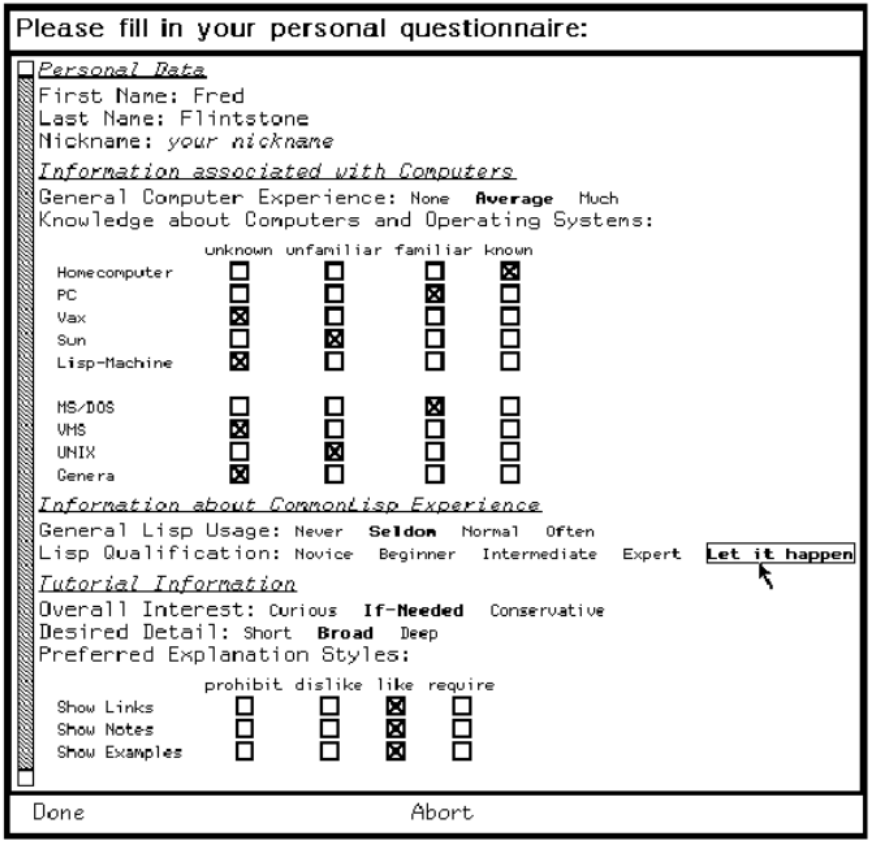
- *Experiments / Workshops*

  invite participants to a controlled and predictable environment to study interactions (that are unpredictable and complex)

Direct input from the user 1

forms / questionnaires





Direct input from the user 2

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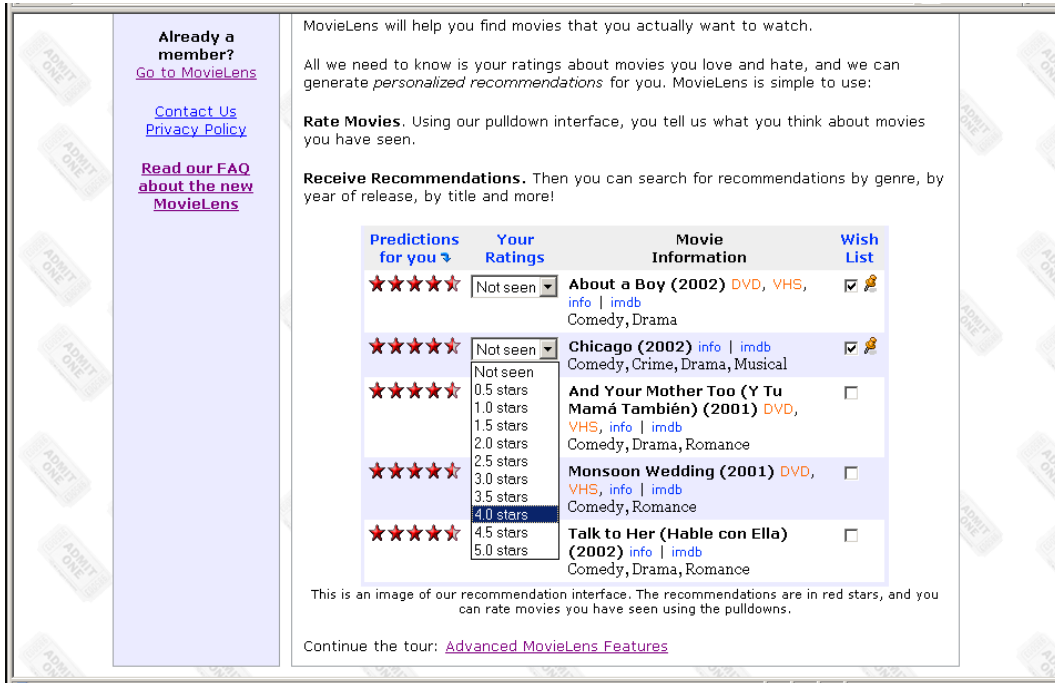
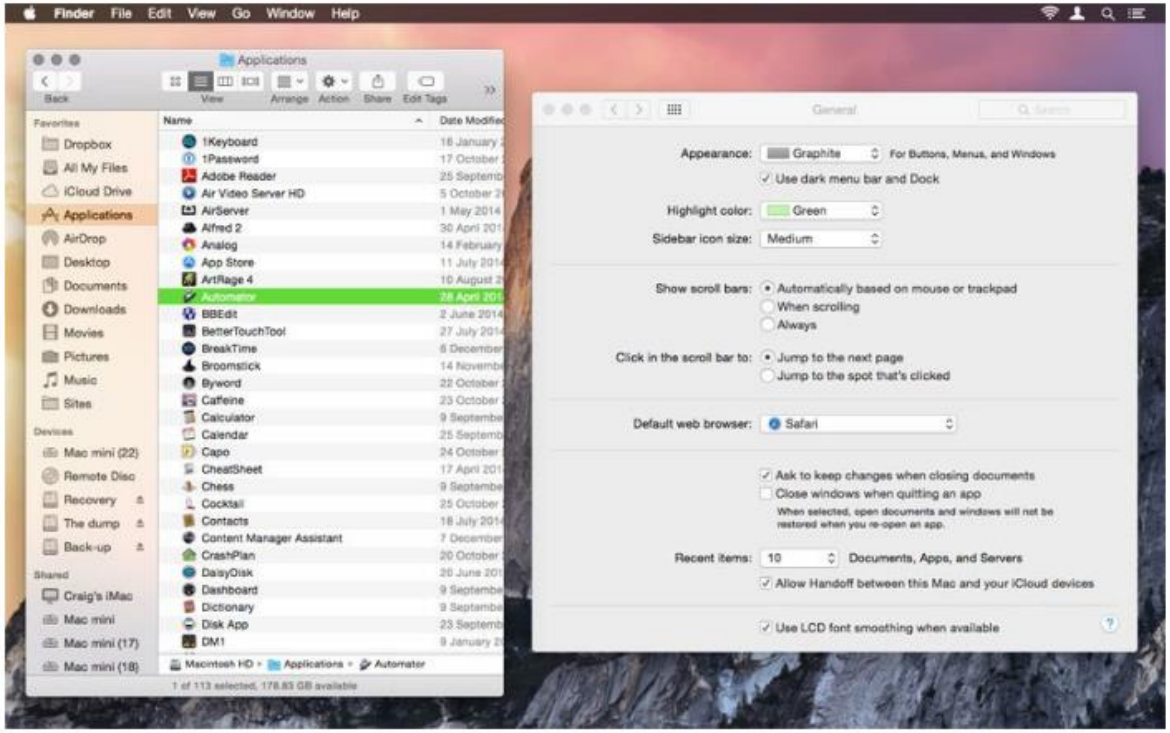
User gives *relevance feedback*

In recommendation systems feedback is an essential part of the system, as the recommendation process mainly relies on user ratings and reviews



Direct input from the user 3

ordering lists, enabling or disabling options, dragging interface elements or by any other specific interaction with the system



Observing the user 1

In many cases users just want to start working on their tasks without first reading manuals, following an introductory tour or filling out forms.

Many adaptive systems attempt to infer knowledge directly by unobtrusively monitoring the user interactions with the system.

Observing the user 2

Log File Analysis- Tools such as Google Analytics show general trends:

- number of visits and users
- where do users come from
- which systems do they use
- popular pages and keywords
- user journeys
- time spend on page
- clicks

Part III:
Selected research topics in Human – Robot Interaction (HRI)

Public perception of android robots: An analysis of YouTube comments

Article submitted at Computers in Human Behavior, 2017
(Authors Evgenios Vlachos, Henrik Scharfe, Zheng-Hua Tan)

Public perception of android robots: An analysis of YouTube comments

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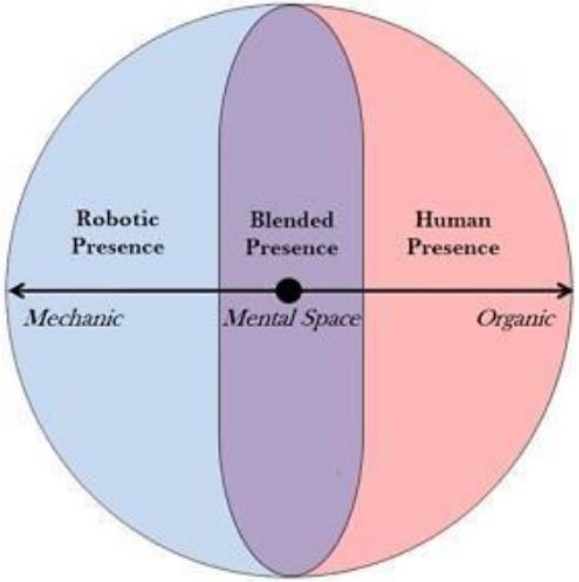
- Uncertainty and insecurity connected with meetings of the unfamiliar (an android) might not be settled at an instant.

- It is negotiated over time, while the mind tries to come to terms with the fact that the presence before them cannot be solely accounted for neither as a robot, nor as a human being.

“How can we understand and describe what happens when humans are engaged in meeting an android?”

Blended Presence

- Conceptual Blending is a general theory about cognition , Fauconnier and Turner (2008).
- Human thought operates on basis of small pieces of conceptualizations oriented towards actions, and thoughts.
- Two or more mental spaces can be combined into a blended space where new structures emerge.



Vlachos, E., & Schärfe, H. (2013, July). The geminoid reality. In International Conference on Human-Computer Interaction (pp. 621-625). Springer Berlin Heidelberg.

Blended Presence

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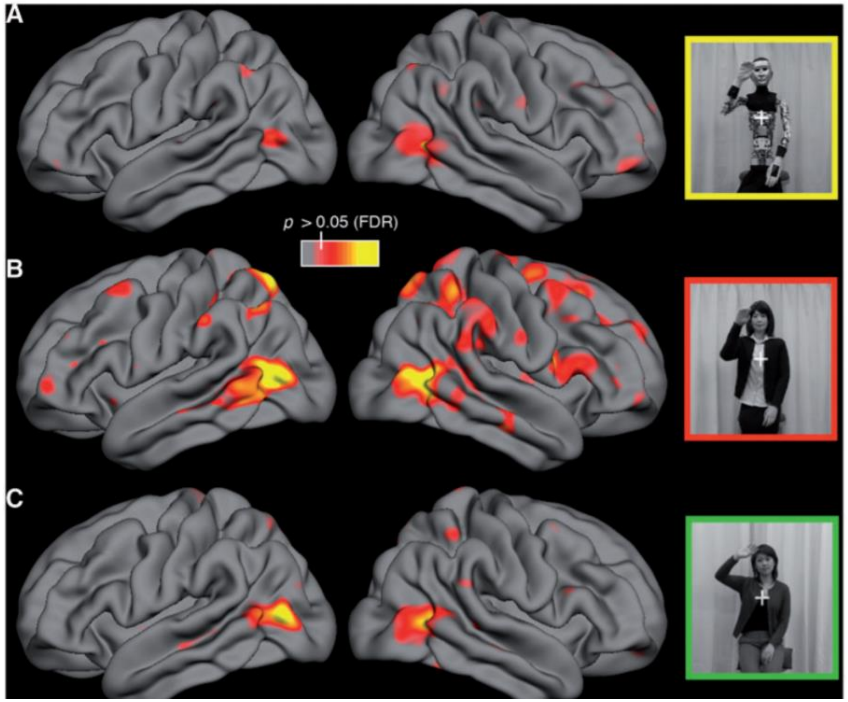
- Functional magnetic resonance imaging (fMRI) to explore the selectivity of the human action perception system when encountering an android.



[*Saygin, A. P., Chaminade, T., Ishiguro, H., Driver, J., & Frith, C. (2012). The thing that should not be: predictive coding and the uncanny valley in perceiving human and humanoid robot actions. Social cognitive and affective neuroscience, 7(4), 413-422*]

About YouTube

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- YouTube is the second most visited site on the web (after Google.com).
- More than 1.000.000.000 users.
- YouTube is the largest platform for disseminating content to a very broad audience comprised of both amateur creators and professionals.
- YouTube comments are more spontaneous and less regulated compared to Facebook discussions.
- YouTube comments are more rewarding compared to standard questionnaires where subjects are usually college students paid to participate.
- The motives for participation on YouTube in descending order according to importance are:
  - relaxing/entertainment,
  - social interaction,
  - information seeking
  - giving information.

About YouTube

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- YouTube visitors seeking information about androids, want to

“increase awareness and knowledge of one’s self, others, and the world”

- The activity patterns and behavior of humans seem to remain unchanged across online and offline communication channels.
- The visitors desire to increase their awareness on androids is sincere and honest.

Method

- *Stimulus*

https://youtu.be/eZlLNVmaPbM

Robot	Published	Comments	Views	Likes/ Dislikes	Time (sec)
Geminoid-F	2012	1338	1235345	2267/136	164
Sophia	2016	6534	5203009	15459/2992	157
Geminoid-DK	2011	754	2401413	2340/74	54
Jules	2006	1675	889273	2437/104	309

Method

- *Procedure*

Apply **text mining** and **machine learning** techniques with the use of **R** free software environment for statistical computing. https://www.r-project.org/

Prepare the corpus for analysis:

- removing all punctuation and special characters (e.g., “@”, “/”, “_” etc.)
- removing numbers
- removing words that have no analytic value (e.g., “a”, “and”, “also”, “but”, “I”, “or”, “she”, “the”, etc.) which appear frequently and perplex the analysis
- removing particular words that YouTube is using as terminology and are frequent in the files like “comment”, “day”, “days”, “month”, “months”, “year”, “years”, “ago”, “edit”, “hide”, “reply”, “replies”, “just”, “now”, etc.
- removing unnecessary white space
- stemming the files by removing common word endings such as “-ing”, “-es”,”-s” , so that a word can be recognizable to the software despite the possible endings it might have in the text
- converting all text to lowercase characters for uniformity

Method

- *Text corpus analysis*

After processing our data, we explored them by:

- Finding the significant words that appear on all four files.
- Removing the words that are present due to coincidence and have very low frequency.
- Finding the most frequent occurring significant words.
- Clustering words that appear together in comments across all four files into groups.
- Identifying the topics that emerge from the clusters of the comments.

Method

- *Text corpus analysis*

  - Text files are unstructured data.

  - They enclose information in a not organized and predefined manner.

  - Exploration and analysis is only possible when the text is transformed into structured data (i.e., a matrix).

  - We use the method of **Principal Component Analysis (PCA)** to provide visualizations of our corpus by means of dimensionality reduction.

  - The goal of PCA is to identify the most meaningful way to extract the important information from a corpus.

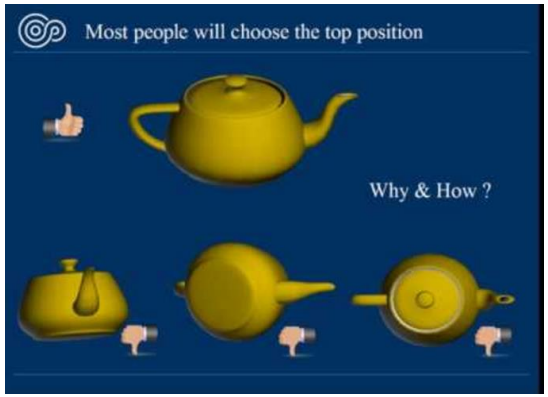
  - Several dependent inter-correlated variables are re-expressed by filtering out the noise and revealing hidden structures- as a set of two new orthogonal variables called principal components.

Method

- *Text corpus analysis*

  - **Principal Component Analysis (PCA)**

    How to take a picture that captures the most information about the teapot?

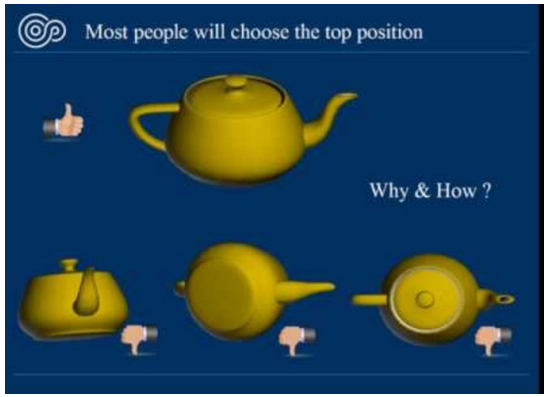


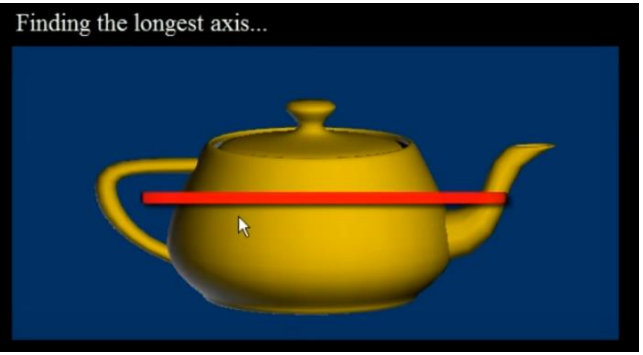
Method

- *Text corpus analysis*

  - **Principal Component Analysis (PCA)**

    How to take a picture that captures the most information about the teapot?



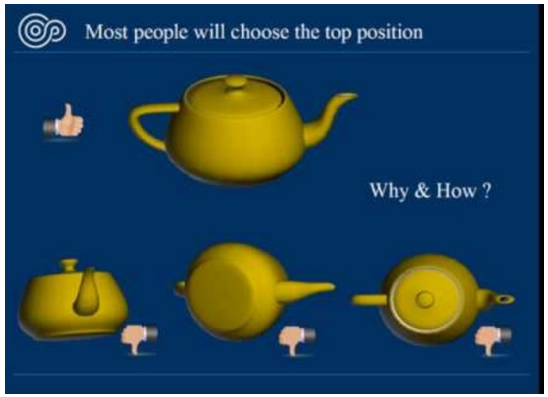


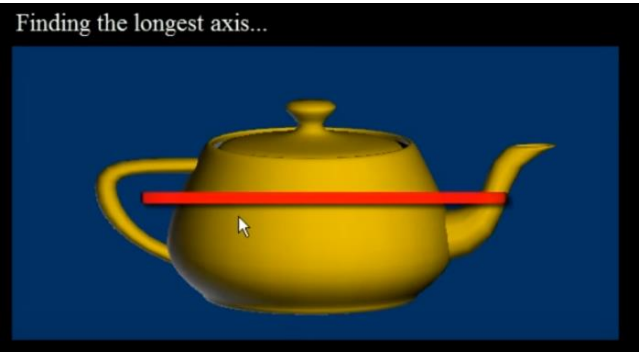
Method

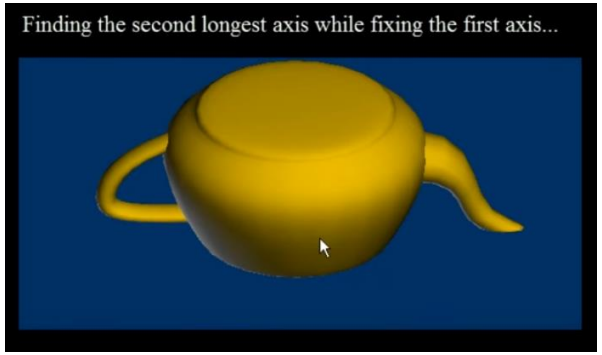
- *Text corpus analysis*

  - **Principal Component Analysis (PCA)**

    How to take a picture that captures the most information about the teapot?





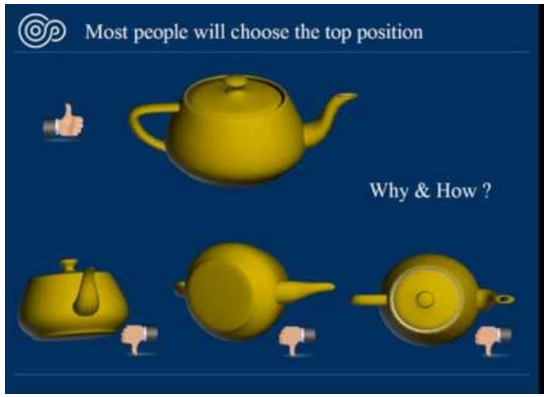


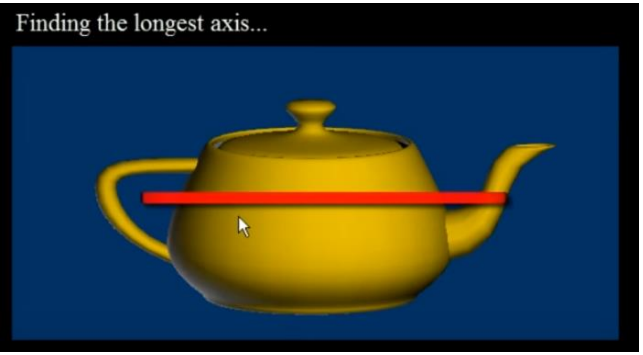
Method

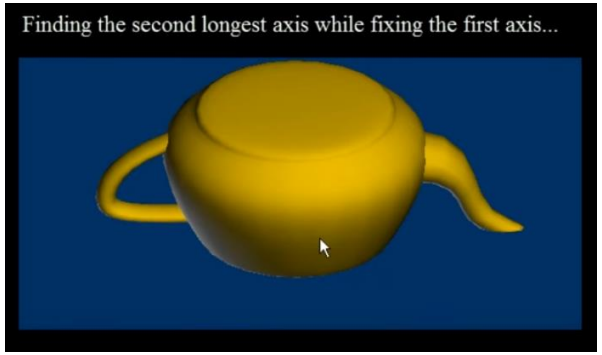
- *Text corpus analysis*

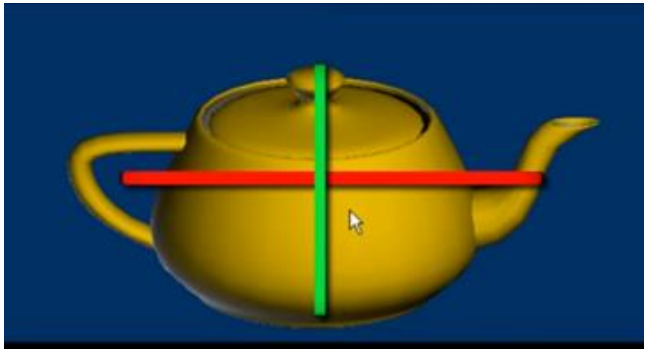
  - **Principal Component Analysis (PCA)**

How to take a picture that captures the most information about the teapot?









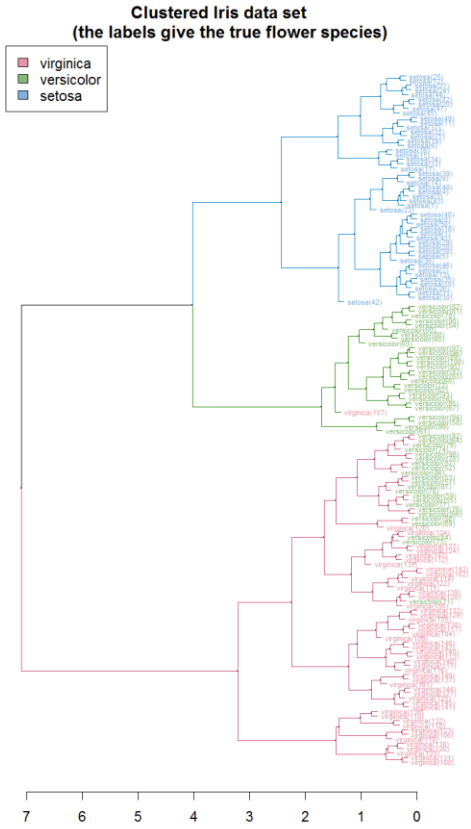
Method

- *Text corpus analysis*

  - **Clustering**

    Two main techniques:

    1. Hierarchical type that creates a dendogram tree structure.



Method

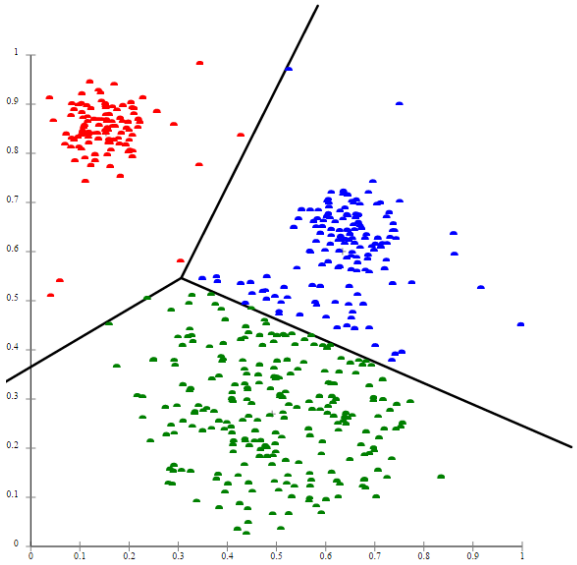
- *Text corpus analysis*

  - **Clustering**

    Two main techniques:

    2. Partitioning type - which we will apply - that divides the data into homogeneous clusters.

    A cluster would consist of words that would be “similar” in terms of relevance – meaning that they appear together in comments- and dissimilar to the words belonging to other clusters



Method

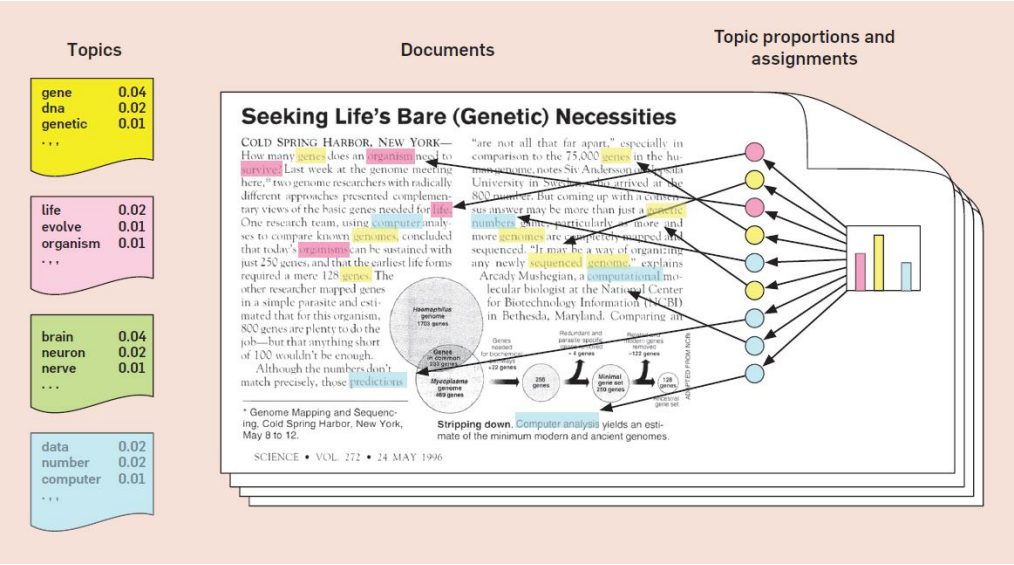
- *Text corpus analysis*

  - **Topic Modeling**

To determine the number of topics that can be identified while “reading” through the comments .

Latent Dirichlet Allocation unsupervised learning probabilistic model for modeling text corpora to represent our corpus as a mixture of topics comprised of words with certain probabilities.

A topic is a distribution over a fixed vocabulary containing words with high probability.



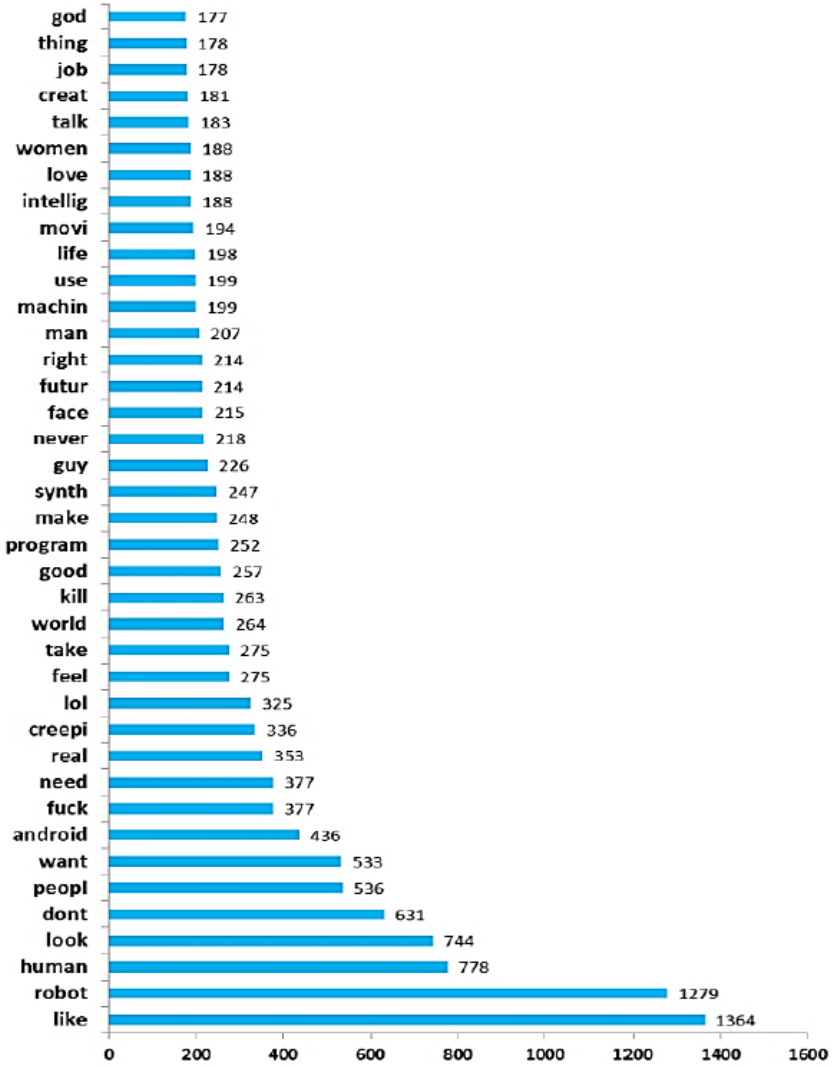
Results

- Found 16857 words appearing 22880 times.

- 66% sparsity in the four files. Sparse words are words that only occur very few times in few of the documents

- Removing sparse words: 694 unique words that appeared many times in all of the documents.

- *Frequency Plot* for words that apper more than 170 times.

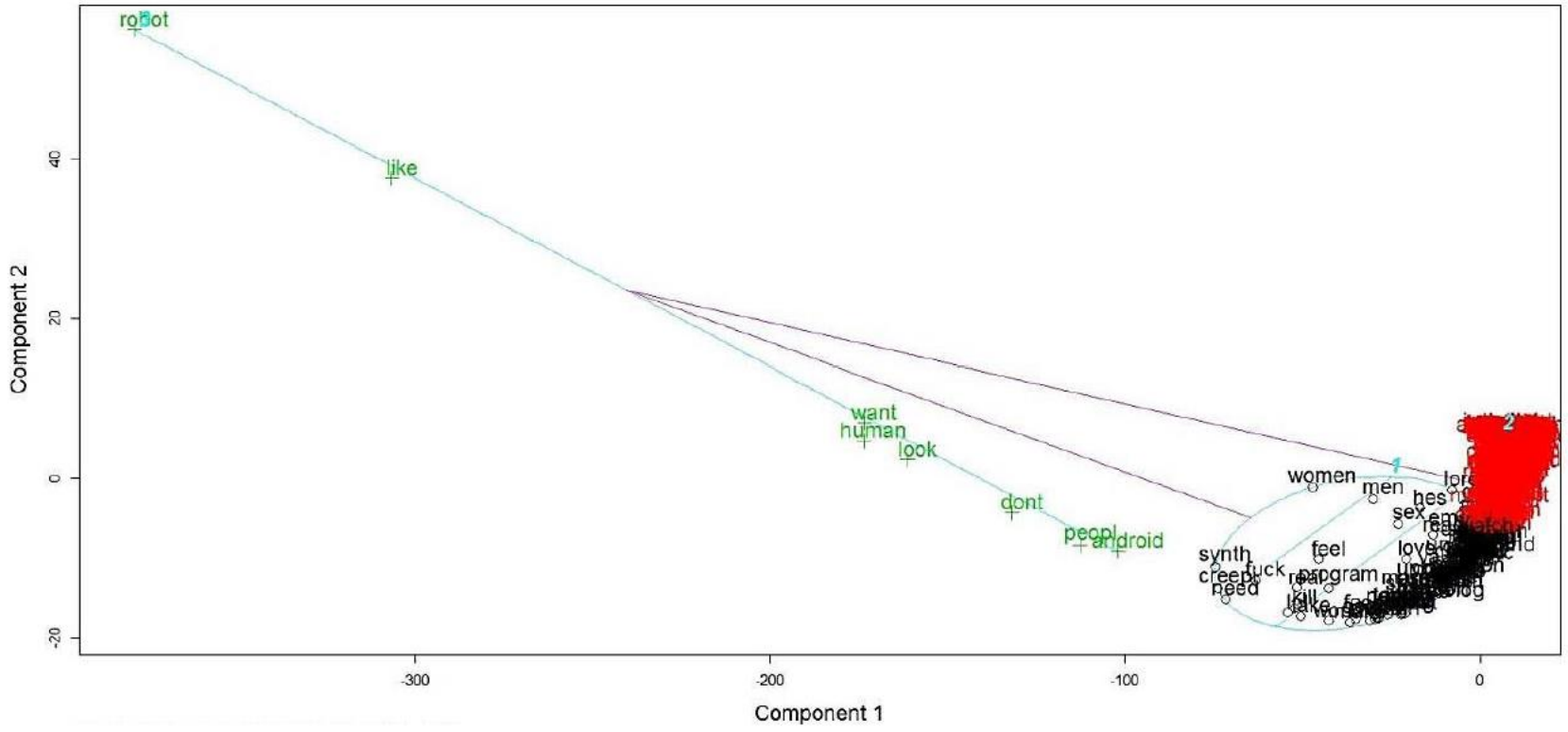


Results

- *Cluster plot.*

- Principal component analysis: 2 components can explain 98.97% of total word variability of the corpus.

- 3 thematic clusters:



Results

- *Topic Modeling.*
- Identified topics in the corpus by a Latent Dirichlet Allocation probabilistic model.
- 30 most frequent words in ascending order of specificity.

Topic 1	Topic 2	Topic 3
"like"	"robot"	"like"
"dont"	"want"	"human"
"fuck"	"like"	"robot"
"women"	"look"	"program"
"look"	"human"	"feel"
"human"	"android"	"look"
"real"	"synth"	"dont"
"men"	"dont"	"peopl"
"android"	"creepi"	"real"
"peopl"	"peopl"	"lol"
"sex"	"need"	"world"
"man"	"kill"	"hes"
"love"	"take"	"good"
"robot"	"job"	"talk"
"need"	"face"	"doesnt"
"read"	"futur"	"emot"
"use"	"skynet"	"life"
"your"	"right"	"movi"
"never"	"uncanni"	"make"
"lord"	"lol"	"need"
"first"	"termin"	"hope"
"lol"	"end"	"fuck"
"guy"	"fuck"	"kill"
"girl"	"machin"	"face"
"good"	"make"	"never"
"world"	"guy"	"sound"
"futur"	"help"	"comput"
"take"	"valley"	"express"
"life"	"god"	"question"
"give"	"thing"	"head"

Results

- *Topic Modeling.*
- Identified topics in the corpus by a Latent Dirichlet Allocation probabilistic model.
- 30 most frequent words in ascending order of specificity.
- The word “real”, for example, in the first topic is more specific than the word “like”.

Topic 1	Topic 2	Topic 3
"like"	"robot"	"like"
"dont"	"want"	"human"
"fuck"	"like"	"robot"
"women"	"look"	"program"
"look"	"human"	"feel"
"human"	"android"	"look"
"real"	"synth"	"dont"
"men"	"dont"	"peopl"
"android"	"creepi"	"real"
"peopl"	"peopl"	"lol"
"sex"	"need"	"world"
"man"	"kill"	"hes"
"love"	"take"	"good"
"robot"	"job"	"talk"
"need"	"face"	"doesnt"
"read"	"futur"	"emot"
"use"	"skynet"	"life"
"your"	"right"	"movi"
"never"	"uncanni"	"make"
"lord"	"lol"	"need"
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"lol"	"end"	"fuck"
"guy"	"fuck"	"kill"
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"take"	"valley"	"express"
"life"	"god"	"question"
"give"	"thing"	"head"

Discussion

- *Topic 1:*
  Human presence – Intimate relations between humans and androids

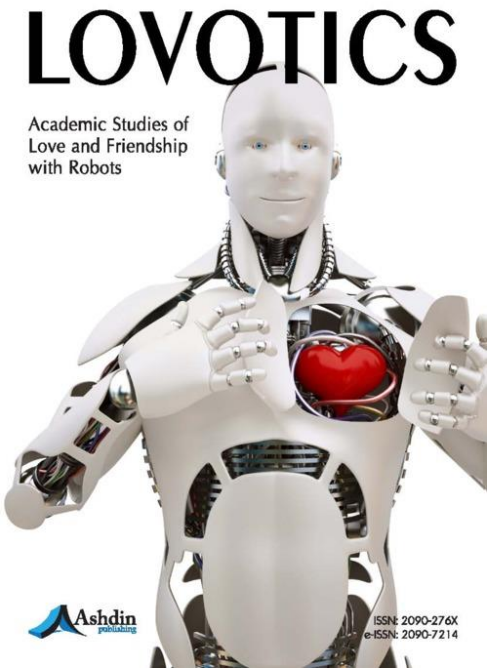
  - Independent of the gender of the robot, there are individuals who would enjoy the company of androids.

  - *Turkle* (2011) argues, such individuals can be seen as early adapters who provide a future view of the human-robot intimate relations.

  - Academic journal on Lovotics:
    Explores the bidirectional human-robot love.

  - *Yeoman, I., & Mars, M. (2012). Robots, men and sex tourism. Futures, 44(4), 365-371*.

    By 2050 robot sex would have solved problems associated with the sex trade, including human trafficking and sexually transmitted diseases.



Discussion

- *Topic 1:*
  Human presence – Intimate relations between humans and androids

  - "There should be "ethical limits on the manipulation of human psychology when it comes to building sex robots and in the simulation of love in such machines".

    Sullins, J. P. (2012). Robots, love, and sex: The ethics of building a love machine. IEEE transactions on affective computing, 3(4), 398-409.

  - *https://campaignagainstsexrobots.org/*

Discussion

- *Topic 2:*
  Blended presence – The science fiction valley

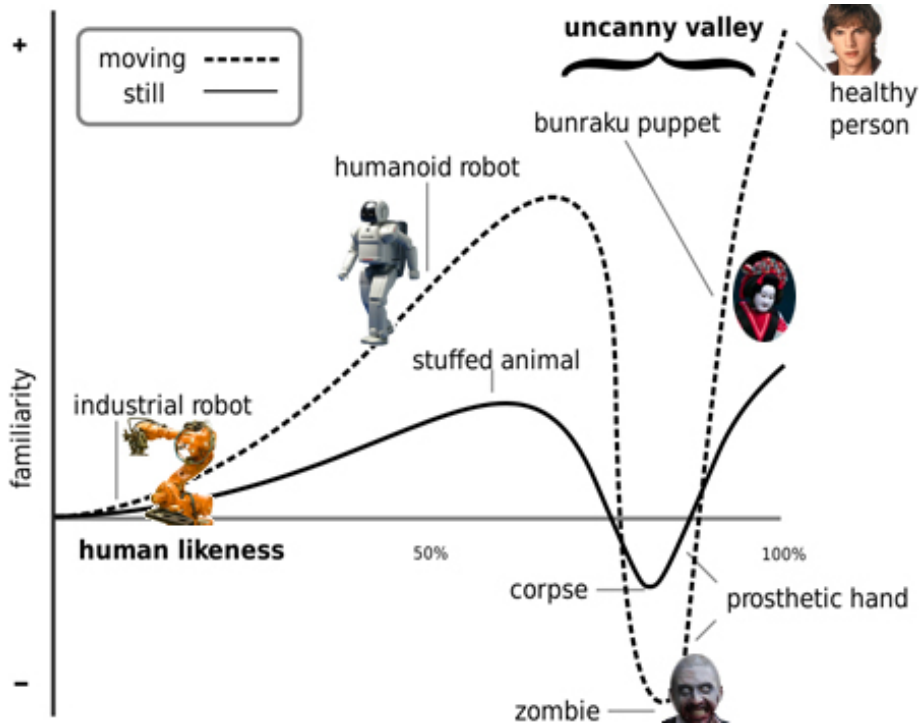
  - **Uncanny Valley (Mori, 1970)**

  - Hiroshi Ishiguro, creator of Geminoids:

  "*Cannot confirm Mori's hypothesis of the Uncanny Valley. The robots' movements and their level of anthropomorphism may be complex phenomena that cannot be reduced to two factors*"

  - Cynthia Breazeal, director of the Personal Robots Group at MIT:

  "*not a fact, it's a conjecture… no detailed scientific evidence*"



Discussion

- *Topic 2:*
  Blended presence – The science fiction valley

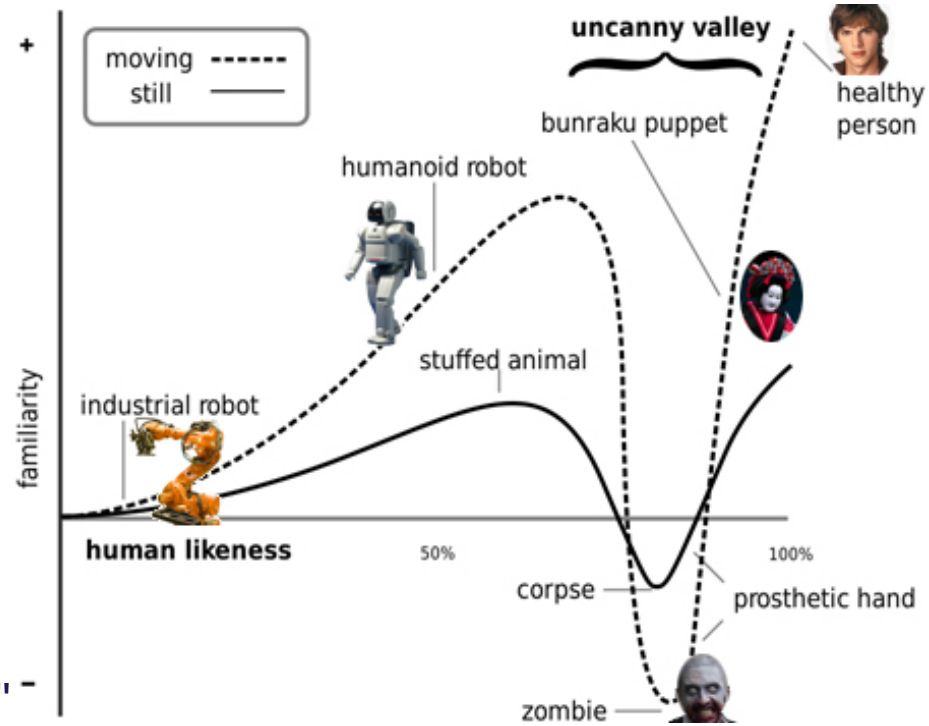
  - **Uncanny Valley (Mori, 1970)**

  - Karl MacDorman, director of the Android Science Center at Indiana University:

    “there's something to the idea, but it's clearly not capturing all the complexity and nuances of HRI”

  - David Hanson, founder of Hanson Robotics:

    "people get used to the robots very quickly...as in, within minutes"



Discussion

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- *Topic 2:*
  Blended presence – The science fiction valley

  - **Creepiness** (appeared in 336 times)

  - Reactions of revulsion were combined with scenarios influenced from science fiction novels, films and games.

  - Classic stock phrase "**god help us all**" when horrific events happen ("god" appeared in 177 comments).

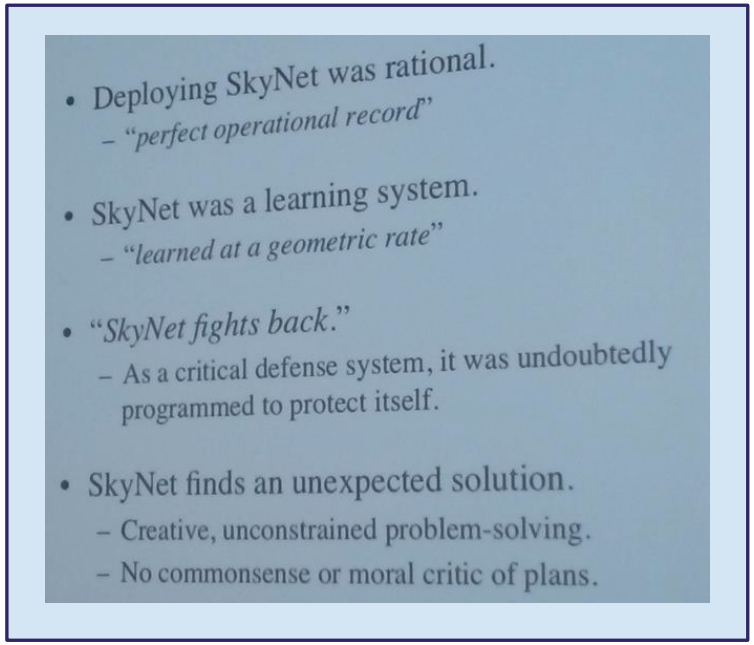
  - The word "synth" appeared 247 times. Term taken from the post nuclear role playing video game "**Fallout**" and is diminutive for synthetic humanoid.

Discussion

- *Topic 2:*
  Blended presence – The science fiction valley

  - Robots killing humans ("**kill**" appeared in 263 comments), the end of the world narrative.

  - The word **"skynet"** that appears in topic 2 list of specificity. Terminator movie.
    https://www.youtube.com/watch?v=4DQsG3TKQ0I



Discussion

- *Topic 2:*
  Blended presence – The science fiction valley

  - The combination of words “**take**” and “**job**” (“job” appeared in 178 comments).

  - Physist Stephen Hawking, multi-billionaire Bill Gates, and entrepreneur Elon Musk, advise careful management of super intelligent artificial agents.

https://youtu.be/nccryZOcrUg

Discussion

- *Topic 3:*
  Robotic presence – Positive and negative markers on technical specifications

- Direct references to terminology used in robotics/programming:

  → current state-of-the-art

  → advice on how to improve the androids

  → technical questions on the functionalities of the robots

  → hopes for future improvements

  → opinions on making a point whether they are pro/con on such technological advancements.

Evaluation of iSocioBot

Part of the article "On building multimodal interactive Social Robots"
submitted at International Journal of Social Robotics, 2016

Evaluation of iSocioBot

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Face detection/recognition: Logitech HD Pro Webcam C920

Facial Expressions: Color LED array with acoustic cloth

Server: Dell Latitude E6540 laptop

ROS: Ubuntu 14.04

Additional input/output: iPad

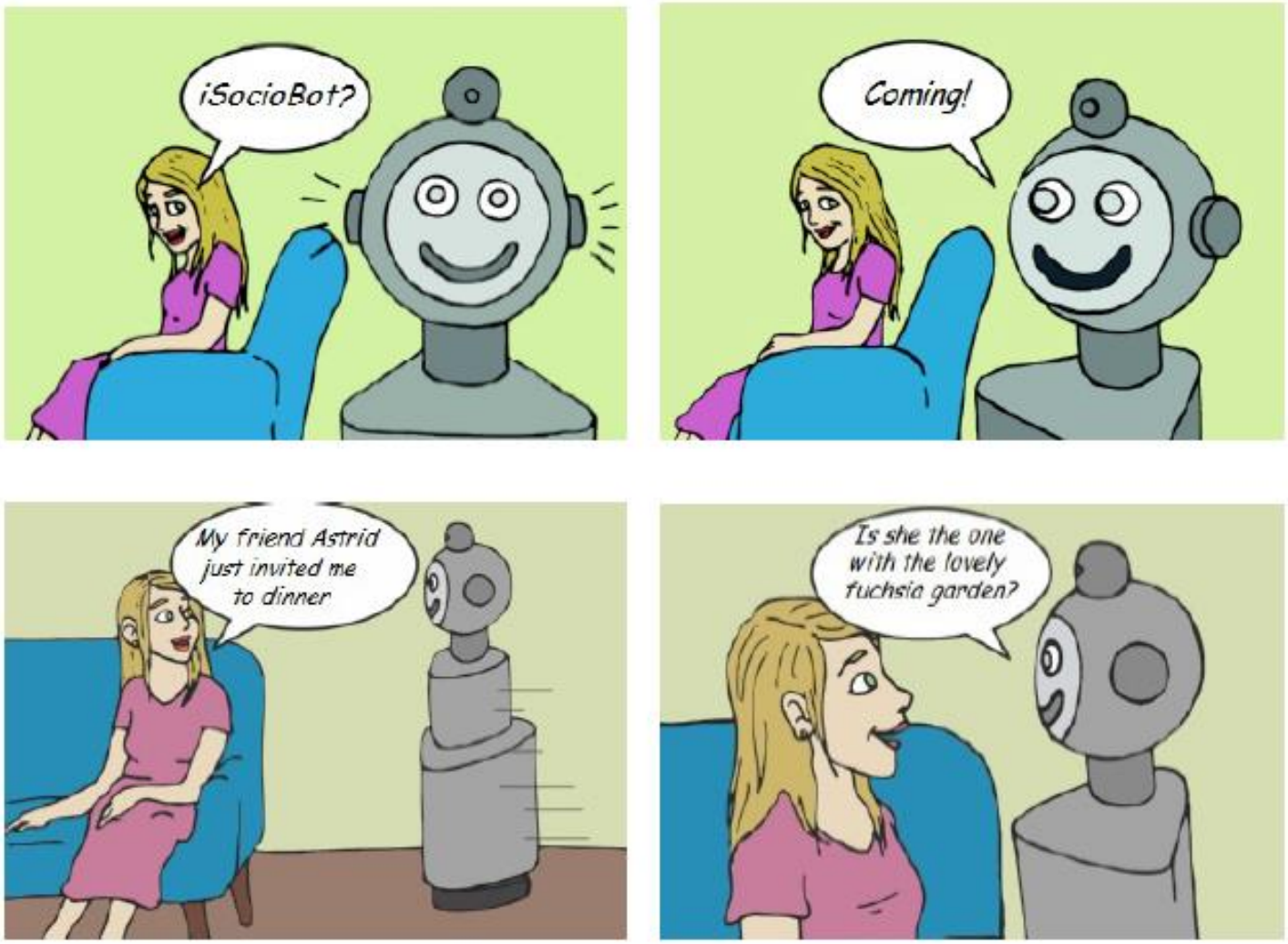
Reverberation and noise: Wireless handed microphone

Microphone array: Microsoft Kinect

Movebase: Pioneer P3-DX 5 from Adept mobilerobots

Height: 149cm

Evaluation of iSocioBot



Godspeed Questionnaire

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Measurement Instruments for the Anthropomorphism, Animacy, Likeability, Perceived Intelligence, and Perceived Safety of Robots

GODSPEED I: ANTHROPOMORPHISM

Please rate your impression of the robot on these scales:
以下のスケールに基づいてこのロボットの印象を評価してください。

Fake 偽物のような	1	2	3	4	5	Natural 自然な
Machinelike 機械的	1	2	3	4	5	Humanlike 人間的
Unconscious 意識を持たない	1	2	3	4	5	Conscious 意識を持っている
Artificial 人工的	1	2	3	4	5	Lifelike 生物的
Moving rigidly ぎこちない動き	1	2	3	4	5	Moving elegantly洗練された動き

GODSPEED II: ANIMACY

Please rate your impression of the robot on these scales:
以下のスケールに基づいてこのロボットの印象を評価してください。

Dead 死んでいる	1	2	3	4	5	Alive 生きている
Stagnant 活気のない	1	2	3	4	5	Lively 生き生きとした
Mechanical 機械的な	1	2	3	4	5	Organic 有機的な
Artificial 人工的な	1	2	3	4	5	Lifelike 生物的な
Inert 不活発な	1	2	3	4	5	Interactive 対話的な
Apathetic 無関心な	1	2	3	4	5	Responsive 反応のある

GODSPEED III: LIKEABILITY

Please rate your impression of the robot on these scales:
以下のスケールに基づいてこのロボットの印象を評価してください。

Dislike 嫌い	1	2	3	4	5	Like 好き
Unfriendly 親しみにくい	1	2	3	4	5	Friendly 親しみやすい
Unkind 不親切な	1	2	3	4	5	Kind 親切な
Unpleasant 不愉快な	1	2	3	4	5	Pleasant 愉快な
Awful ひどい	1	2	3	4	5	Nice 良い

GODSPEED IV: PERCEIVED INTELLIGENCE

Please rate your impression of the robot on these scales:
以下のスケールに基づいてこのロボットの印象を評価してください。

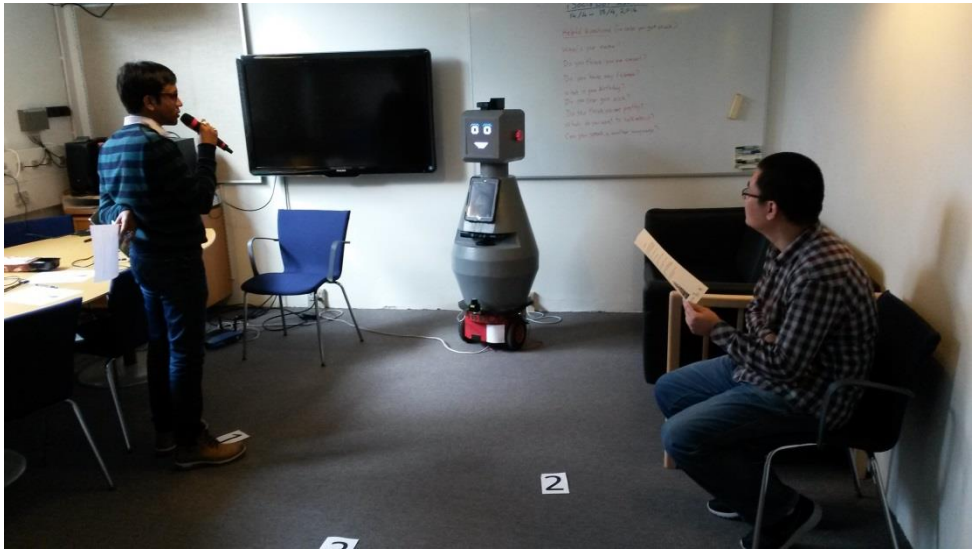
Incompetent 無能な	1	2	3	4	5	Competent 有能な
Ignorant 無知な	1	2	3	4	5	Knowledgeable 物知りな
Irresponsible 無責任な	1	2	3	4	5	Responsible 責任のある
Unintelligent 知的でない,	1	2	3	4	5	Intelligent 知的な
Foolish 愚かな	1	2	3	4	5	Sensible 賢明な

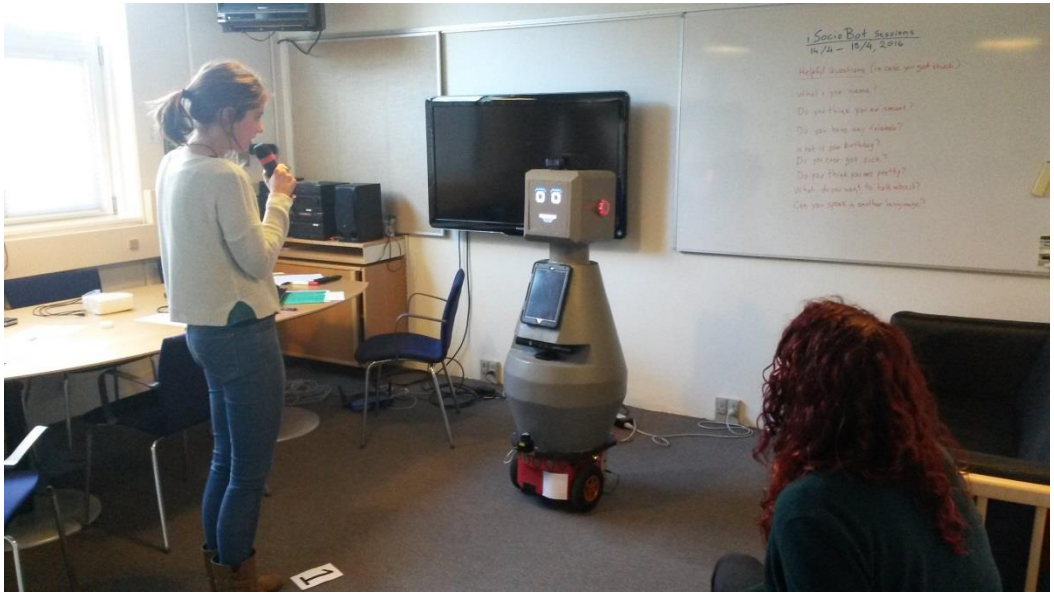
GODSPEED V: PERCEIVED SAFETY

Please rate your emotional state on these scales:
以下のスケールに基づいてあなたの心の状態を評価してください。

Anxious 不安な	1	2	3	4	5	Relaxed 落ち着いた
Agitated 動揺している	1	2	3	4	5	Calm 冷静な
Quiescent 平穏な	1	2	3	4	5	Surprised 驚いた

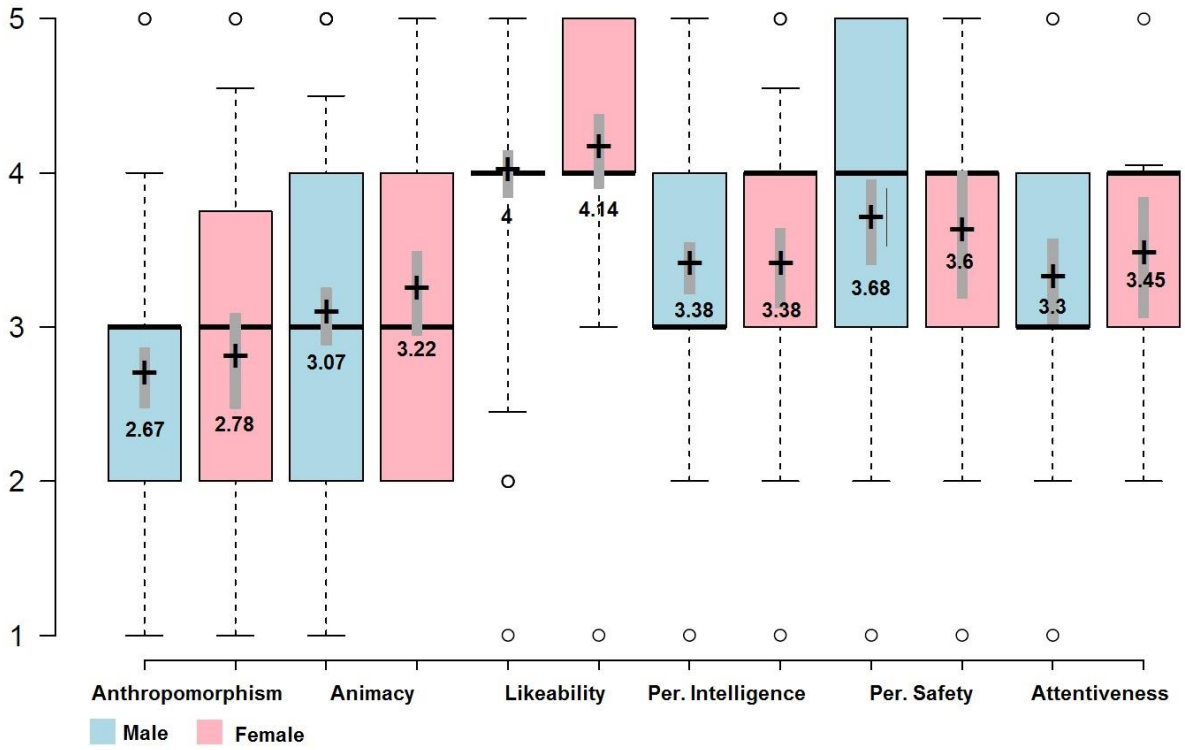
Bartneck, C., Kulić, D., Croft, E., & Zoghbi, S. (2009). Measurement instruments for the anthropomorphism, animacy, likeability, perceived intelligence, and perceived safety of robots. International journal of social robotics, 1(1), 71-81.

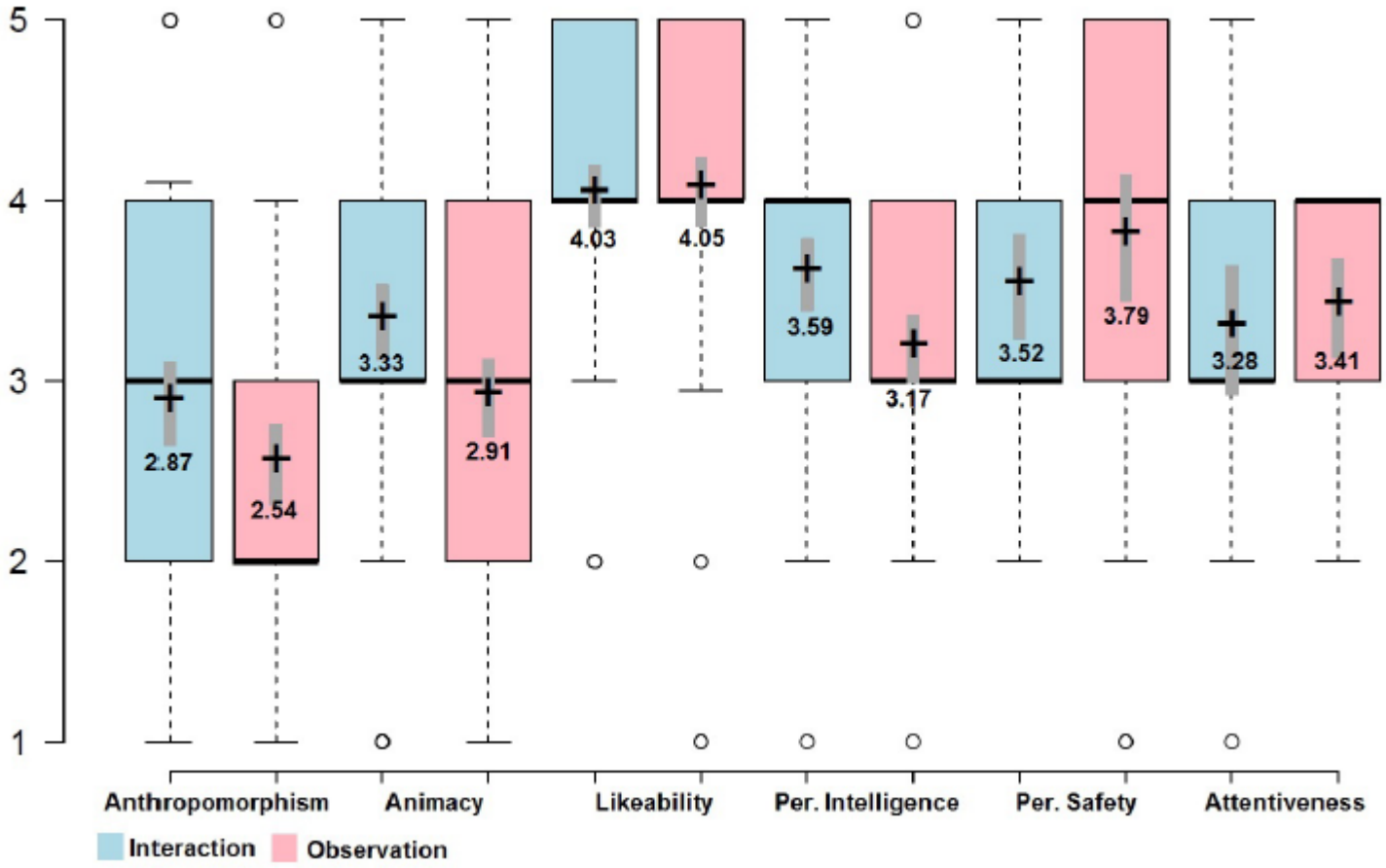




- Interacts in friendly and competent manner
- Has pleasant appearance
- Makes users feel calm and safe around it
- Attentive
- Has proper height to sense users while they stand or sit
- Expressive both verbally and non-verbally
- General comments:

"A good overall experience!"
"Interacting well with the environment!"
"Needs to learn better jokes"
"Would almost always turn to the direction where the speaker was standing"
"A friendly and calm discussion between the robot and the interlocutor"




5
4
3
2
1
2.87
2.54
3.33
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4.03
4.05
3.59
3.17
3.52
3.79
3.28
3.41
Anthropomorphism
Animacy
Likeability
Per. Intelligence
Per. Safety
Attentiveness
Interaction
Observation

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THANK YOU