Digital Transformation

Mário Caldeira

caldeira@iseg.ulisboa.pt

"The world is changing very fast.
Big will not beat small anymore.
It will be the fast beating the slow."
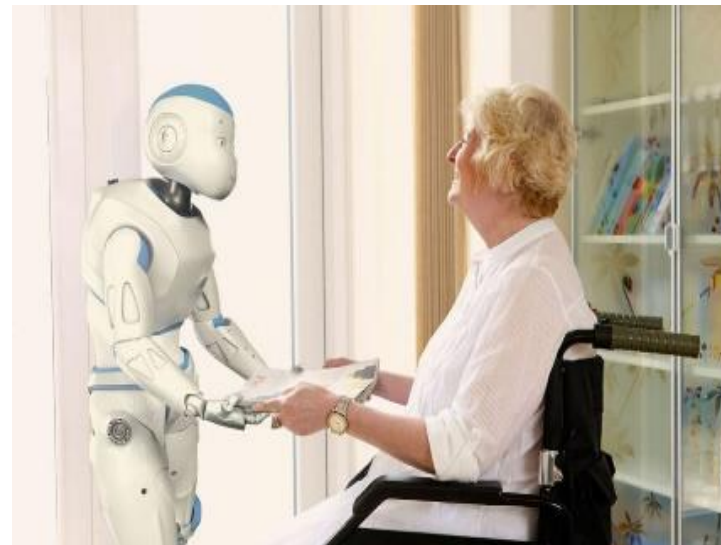
Rupert Murdoch, 21st Century Fox

Digital Transformation: If you don't change ?

Nowadays

Smart Devices

Watch all live Football Matches

2018 STATE OF SELF-DRIVING

SELF-DRIVING DELIVERY VEHICLE

Traditional Management Information Systems

- ERP systems (financial, accounting, HR, operations, marketing,…)

- CRM systems

- Supply-chain management systems

- Data Base Management Systems

- Office Automation …

Modern Information Technology

1. Big Data

2. NoSQL DBMS

3. Artificial Intelligence

4. Machine Learning

5. Supercomputation

6. Cognitive computing

7. Enterprise Systems (ERP, CRM, SCM)

8. Cloud Computing

9. Sentiment Analysis

10. Blockchain

11. Internet of Things

12. Vision and face recognition systems

13. RPA - Robotic Process Automation

14. Biotechnology

15. 3D Printing and 4D Products

16. Drones & other autonomous vehicles

Many clever people failed predicting the information technologies of the future!

Thomas Watson

Ken Olsen

Nathan Myhrvold

Bill Gates

*"**I think there is a world market for maybe five computers.**"
Thomas Watson, president of IBM, 1943*

*"**Remote shopping, while entirely feasible, will flop.**"
Time Magazine, 1966.*

*"**There is no reason anyone would want a computer in their home.**"
Ken Olsen, founder of Digital Equipment Corporation, 1977*

*"**I predict the Internet will … in 1996 catastrophically collapse.**"
Robert Metcalfe, founder of 3Com, 1995*

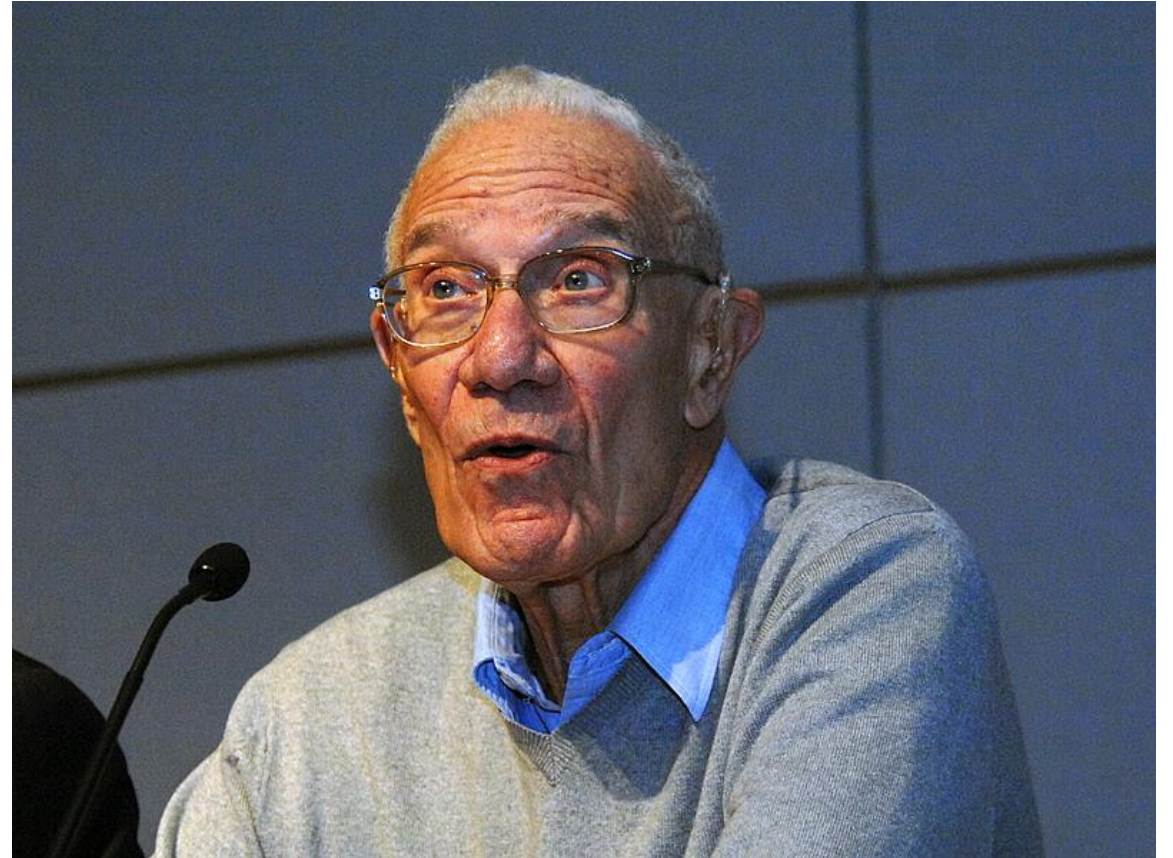*"**Apple is already dead.**"
Nathan Myhrvold, former CTO of Microsoft, 1997*

*"**Two years from now, spam will be solved.**"
Bill Gates, 2004*

"We see computers everywhere but not in productivity statistics".

Robert Solow
Economist, Nobel Prize Winner

"Computers are useless.
 They can only give you answers."

Pablo Picasso

Big Data

Massive sets of unstructured/semi-structured data from web traffic, social media, sensors, and so on. Petabytes, exabytes of data. Volumes too great for typical DBMS. Can reveal more patterns and anomalies.

- **Volume** - IDC estimates that, in 2020, the volume of digital data is 40 thousand exabytes (40.000.000.000.000 gigabytes / 40 trillion gigabytes). According to IDC, 35% of this data is useful for data analysis and more than 10% will be analysed to produce knowledge.

- **Variety** – structured and unstructured data. Besides the traditional formats (numeric, alfanumeric, dates, images), nowadays it is possible to use data collected from sensors, log files, unstrucxtured text, audio and video.

- **Velocity** – High speed processing, due to very powerful computers. For example, IBM Watson incorporates 750 servers, in cluster, using a an Ethernet (LAN) operating at 10 Gigabytes and can process more than 80 Teraflops (80 trilions / 80.000.000.000.000 operations per second).

Example: Impact of Big Data on Society

Everything we do leaves a digital track. Nowadays, there are more machines plug into the internet than people.

- Sensors in the car evaluate the way we drive;

- Smart TVs use facial recognition systems to control if children are watching TV;

- Personalized sales offers can be based on customers purchase history, customer location, social media data, and for example, weather information;

- Evaluate customers satisfaction;

- Sofware applications are use to predict the amount of time a collaborator stays in the firm;

- Near 130 million books were published until 2010. In 2015, the Google Books Project had digitalized near 25 million books.

Big Data use – examples

- **Sentiment Analysis** – Analytical tools and natural languages used to understand customers sentiments on a given product or service. Data collected from tweets, Facebook posts, TripAdviser reviews, ...

- **Customer Churn Analysis** – use of machine learning to reduce the probability of a customer leave.

- **Customer segmentation**, according to the type of products they buy.

- **Fraud detection** – Analysis of certain transactions that may indicate fraud. The cost for retailers of credit card fraud was 32 billion dollars in 2014.

- **Preventive maintenance** – incorporation of sensors in equipment to prevent faults.

- **Medical prevention** – Use of machine learning algoritms to detect unknown patterns and increase knowledge on medical information.

- **Risk analysis** – In products like insurance policies, price is base on risk. If more data is available it will be easier to evaluate risk.

Artificial Intelligence

Artificial Intelligence (AI) is the development of computer systems able to perform tasks that normally require human intelligence, such as image recognition, speech recognition, advanced decision-making or language translation
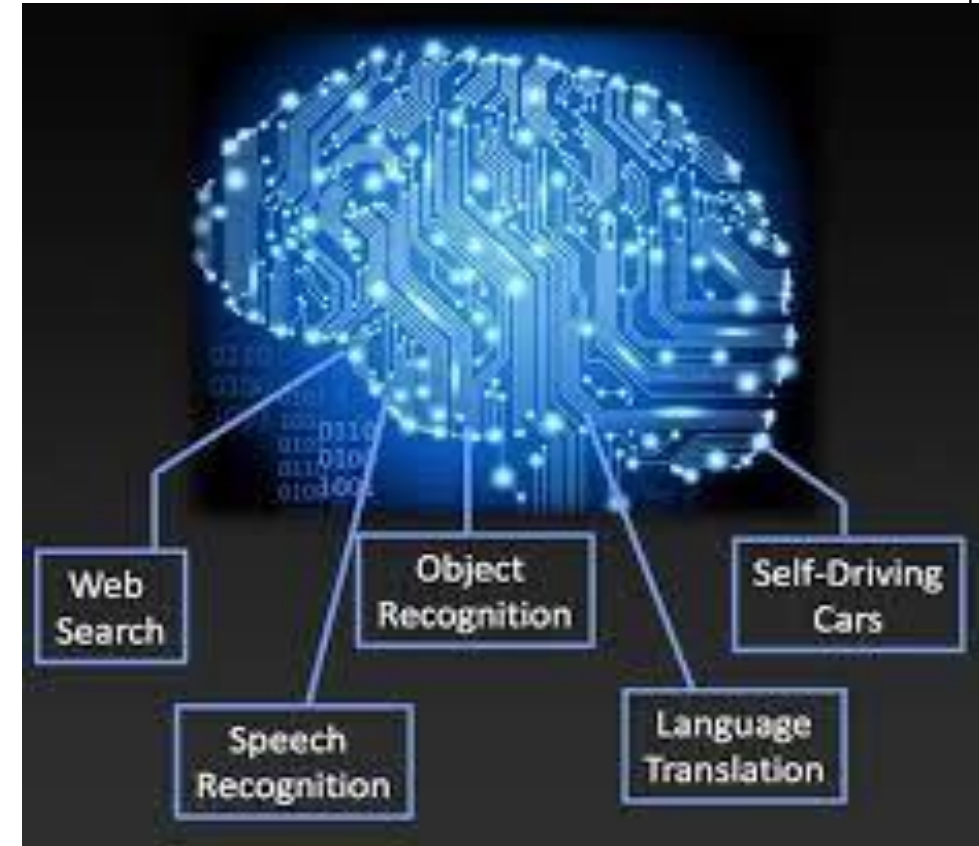
Cognitive Computing – Ex. IBM Watson

Supercomputation:

Massive (750) paralell power 7 3,5 Ghz processors (8 core each)

Processing speed: 500 GB/second = 1 million books/second

Steps:

1. Observation (Big Data: high volume, unstructured, fast processing)

2. Interpret and generate hypotheses (interpret content; learns natural languages and technical concepts; uses algoritms);

3. Evaluate hypotheses (uses neural networks, looks for patterns, scoring and ranking)
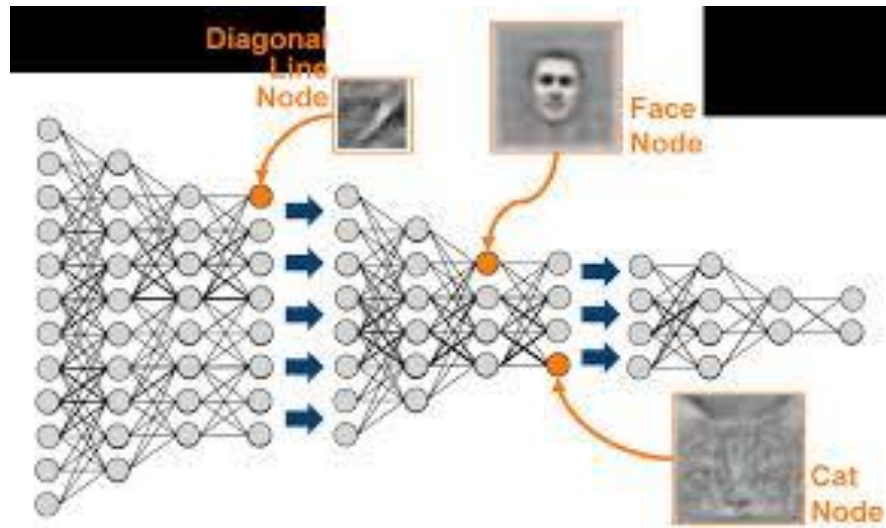
4. Decision.

QA pairs (Question, Answers), machine learning.

Example: IBM Watson can help recommend, in just a few minutes, personalized treatments for cancer patients by comparing the history of disease and treatment, scans and genetic data against almost the complete universe of up-to-date medical knowledge.

Neuronal Networks

Example

AlphaGo from Google DeepMind

The ancient game Go has as many possible moves as atoms in the whole universe.

It is not possible to test all alternatives (brute force).

The system has to simulate the way human brain works.

The programmers develop a general purpose algoritm, using neural science and machine learning.

The system learns from experience.

It started by analysing 100.000 human games available on the internet and, after that, was improved by playing 3 million times against itself. Then it beat the best human player.

Sentiment Analysis

Algoritms can be used to evaluate natural language and identify positive or negative feelings, or even ironic statements.

Sentiment analysis has been incorporated, for example, in CRM systems.
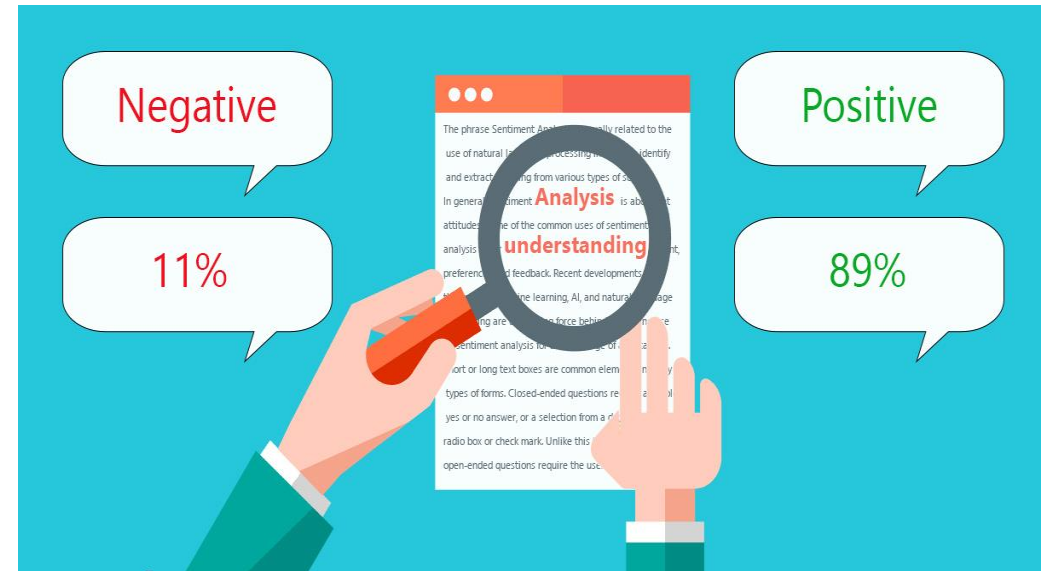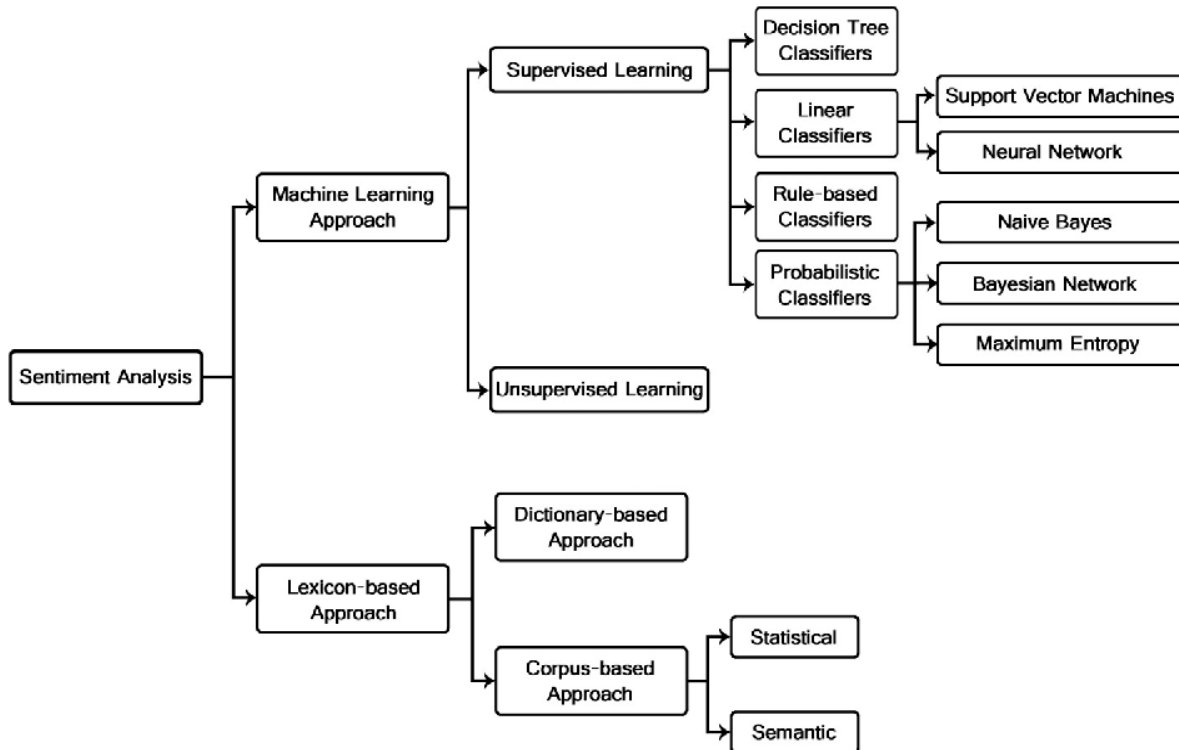
Robotic Process Automation (RPA)

RPA automate processes like data entry and user interface navigation, in order to cut costs, eliminate keying errors, speed up processes and link applications.

It reduces repetitive tasks.

Business Processes in which RPA can be used

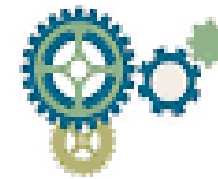Take over repetitive tasks that employees carry out 50-60 times a day
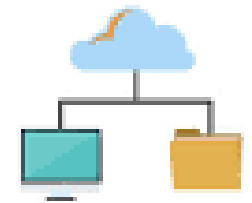
Periodic reporting, data entry and **data analysis**

Mass email generation, archiving, extracting

Conversion of data formats and graphics

ERP transactions

Process lists and **file storage**

Virtual Reality is an artificial, computer-generated simulation or recreation of a real life environment or situation. It immerses the user by making them feel like they are experiencing the simulated reality firsthand, primarily by stimulating their vision and hearing.

Augmented Reality

Is way of viewing the real world, either directly or via a device, such as a camera creating a visual of the real world, and "augmenting" that real-world visual with computer-generated input such as still graphics, audio, or videos.

In Augmented Reality the computer-generated content is an overlay on top of the real-world content.

Scanning frequently allows teams to verify that the work in place matches the original design.

PHOTO

SCAN + BIM MODEL
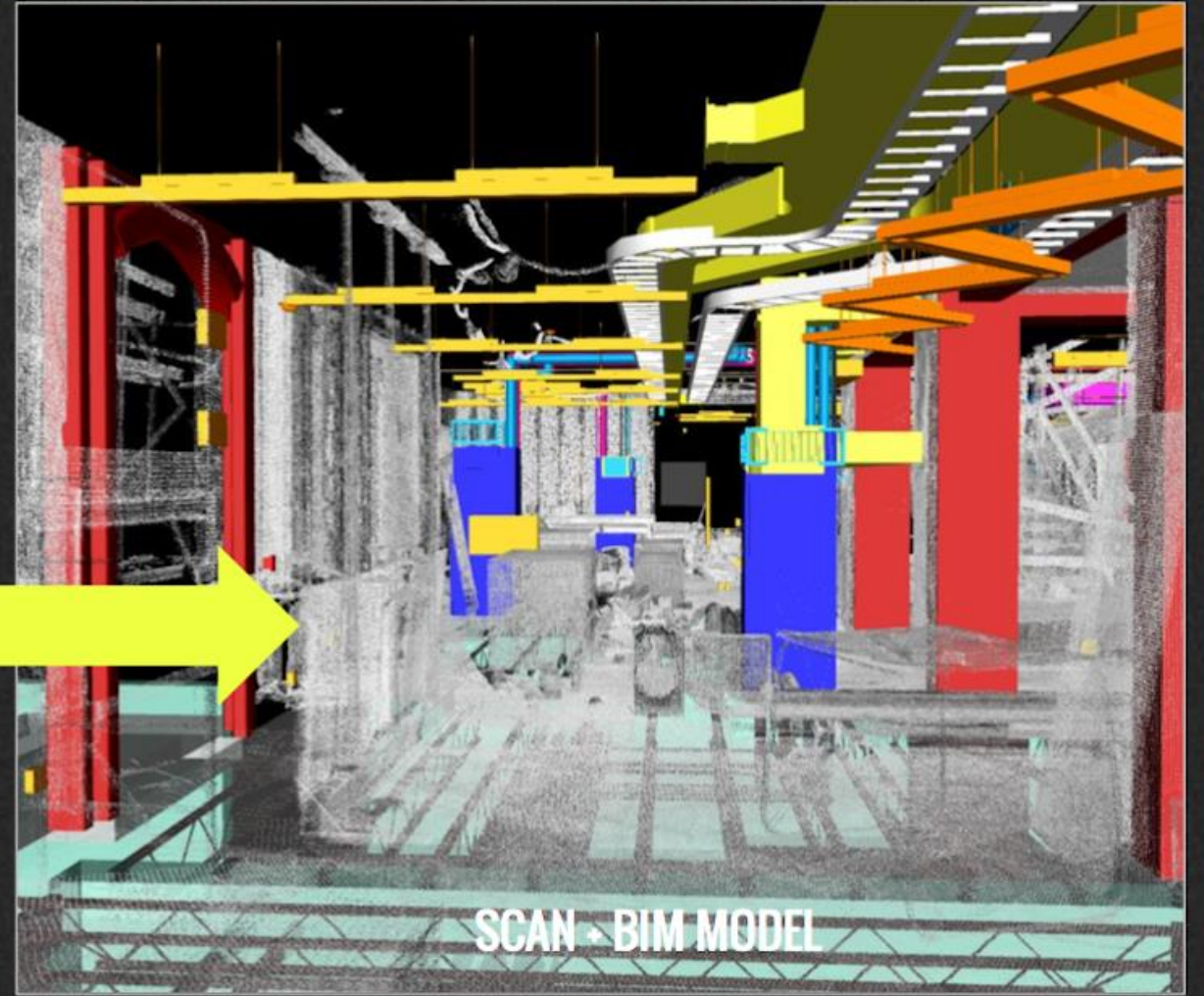
Cloud Computing

"Cloud Computing is on-demand access to virtualized IT resources that are housed outside of your own data center, shared by others, simple to use, paid for via subscription, and accessed over the Web."

<p align="center">Foley, "A Definition of Cloud Computing", Information Week, Sept. 26, 2008</p>

"Cloud Computing is a model for enabling convinient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly providing and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five essencial characteristics, three delivery models and four deployment models".

<p align="right">National Institute for Standards and Technology</p>

Cloud Computing

Cloud computing

*Delivery Models***:**

Iaas - Infrastructure as a Service – It is the simples of cloud services.
It is possible to use hardware and other physical resources without capita
l investment.

SaaS – Software as a Service - Software services in cloud computing: CRM (salesforce.com, sugar CRM,
Microsoft Dynamics); HR aplications (Workday, Taleo); financial aplications (workday, netsuite), collaboration tools
(Google Apps: Gmail, Google Calendar, Talk, Docs, Sites), health (Pharmacy), logistica (data management, order
management, procurement, manufacturing, etc) p

PaaS – Platform as a Service. Software development platform in the cloud. May include programming languages,
reusable components, interfaces, etc.
Exemples: Google App Engine, Microsoft Windows Azure.
Microsoft Azure includes Visual Studio Cloud Services, .NET services (service bus, workflow, net control); SQL
services (database, analytics, reporting), Line Services (identity, contacts, devices).
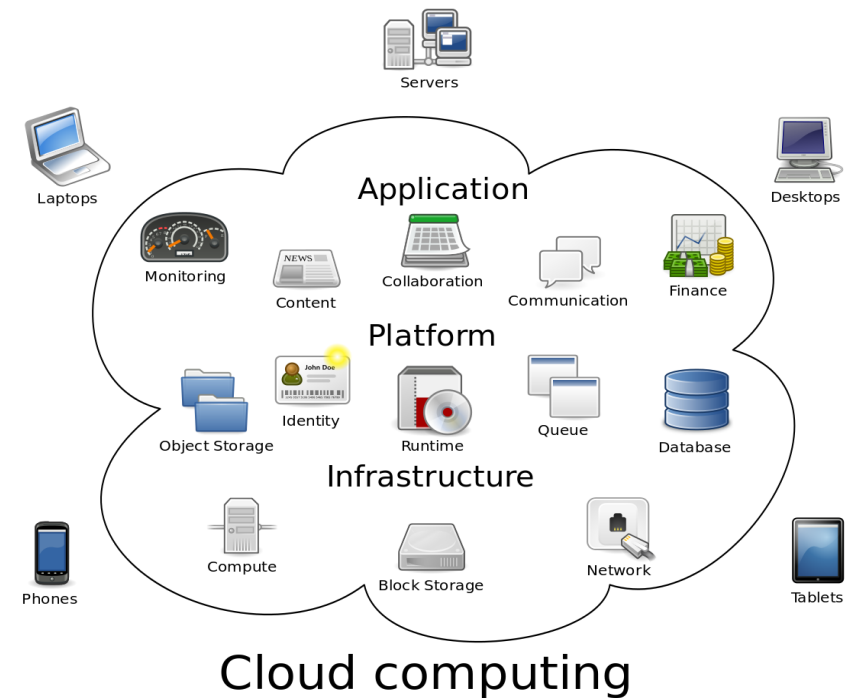
Social Impact

Will it have social implications ?   Yes !

Mankind will be able to adapt, as it happened before , but most likely in a reactive way.
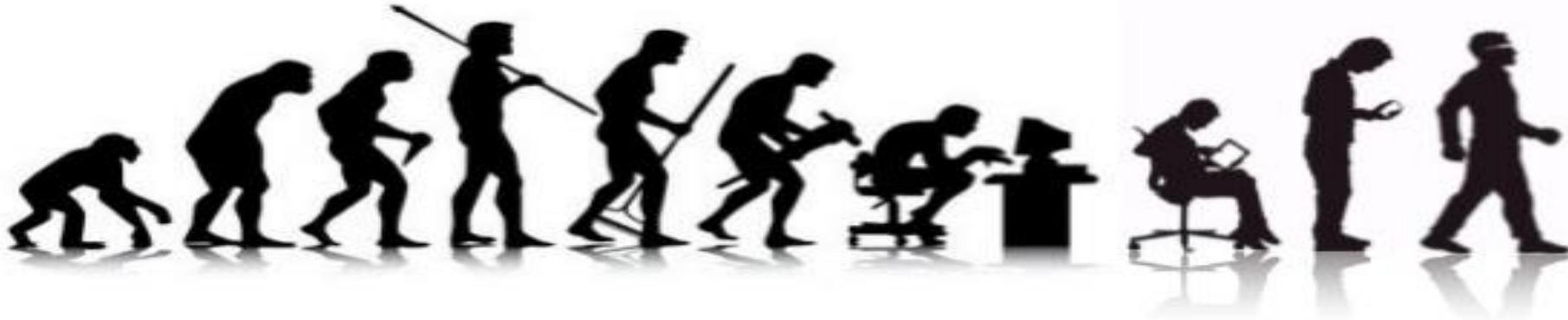
Evolution of Mankind

The seven stages of robot replacement

A robot/computer cannot possibly do the tasks I do;

2. *(later)* OK, it can do a lot of those tasks, but it can't do everything I do;

3. *(later)* OK, it can do everything I do, except it needs me when it breaks down, which is often;

4. *(later)* OK, it operates flawlessly on routine staff, but I need to train it for new tasks;

5. *(later)* OK, OK, it can have my old boring job, because it's obvious that was not a job that humans were meant to do;

6. *(later)* Wow, now the robots are doing my old job, my new job is much more interesting and pays more!
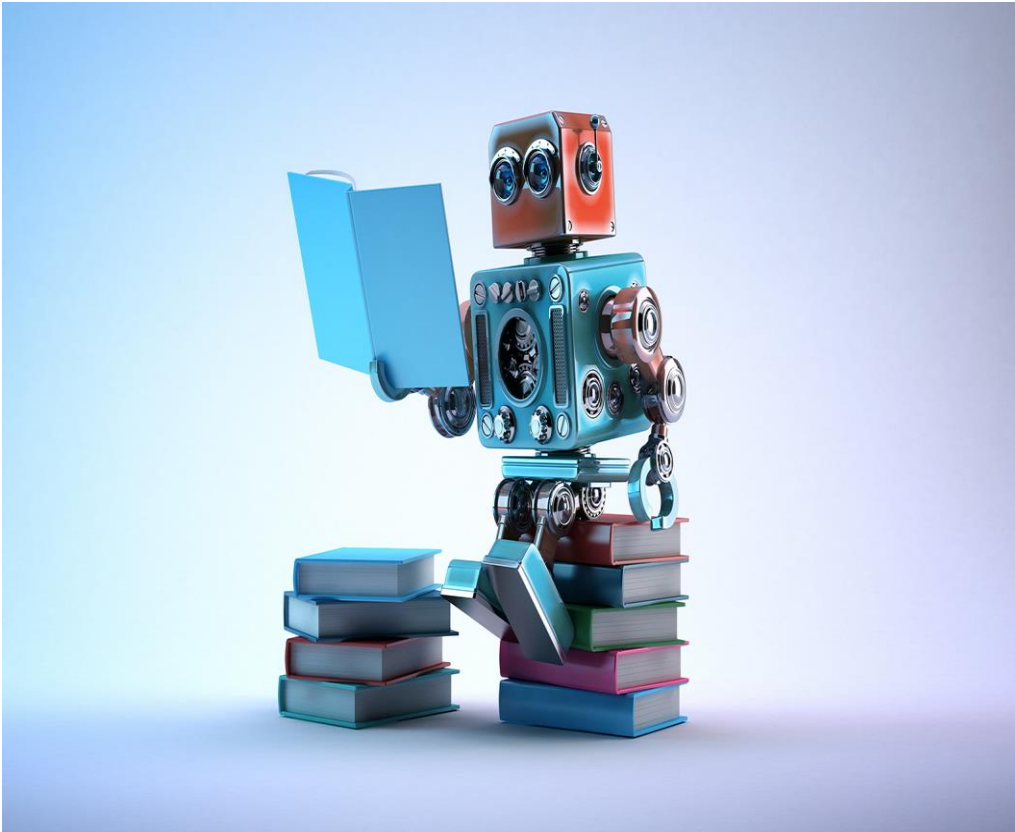
7. *(later)* I am so glad a robot/computer cannot possibly do what I do now.

(repeat from the beginning)

in Kevin Kelly, The Inevitable, 2016.

Robotics

Professions that are at risk of automation (according to Frey & Osborne, 2013)

Low risk :

- Medical ...ctor (0,4%)
- Dentist (...
- Teacher (0,4...
- Medical cientis...
- Nurse (0,9%)
- Business Executive (1...
- Architect (1,8%)
- Civil Engineer...
- Lawyer (3,5...
- Musician...
- Politician (9,3%)

High risk :

- Tele...ing operator (99%)
- Re...nt Cook (96%)
- ...t Office man (95%)
- Waiter (94%)
- Accountant (94%)
- Butcher (93%)
- ...xi driver (89%)
- ...tate Broker (86%)
- Carpe... (72%)
- Cleaning lady (69%)
- Bus driver (67%)

Some activities **won't be automated**, only because we will prefer them to be performed by humans (sports, arts, etc.), and new activities will emerge

Examples in Retail

1. **Auto Checkout** – "*Just walkout technology",* used in new shops of Amazon Go (based on vision systems and big data). Enables customers to buy supermarket products and walkout, with no need to check the products or pay at the end.

2. **Self-driving vehicles for goods transportation**.

3. **Robot assistant technology** – Robots using image recognition patterns that facilitate customer interaction.

4. **Facial recognition systems** – these systems can analyze around 16.000 face references, that may be used to know the type of products someone buys or read his/her emotions when facing a product.

5. **Virtual Reality & Artificial Intelligence** – test an object that the customer wants to purchase. Example: test driving a car or purchasing a new home without ever even stepping inside.

6. **Smart Mirrows**: use of artificial intelligence, virtual reality and gesture recognition technology to test outfits without having undressed. Using mobile phones and social media, friends can be contacted and give advice on dresses and other clothes.

7. **Internet of Things** – Retailers will be able to use data to personalize shopping experiences, put the right products in front of the right people at the right time, and deal with auto-shopping requirements (ex. auto-refill refrigerators). More than 50 billion IoT devices are expected by 2020. The data produced from these "Things" will have a high impact on consumption.

8. **New cognitive products**: for example, toys that perform like pets, dolls that can converse and are lovable (dolls may be the first really popular robots).

9. **Smart Wi-fi Beacons** – Small wireless devices, detected by smartphones to promote products and sales.

Examples in Banking

1. Application Programming Interfaces (APIs)

Middleman software that connect applications, like mobile apps, to back-end office IT systems. New banking regulations (like PSD2) involve sharing customer data, facilitating collaboration, especially by APIs.

2. Artificial Intelligence

Artificial Intelligence will enable customer experience (on-line systems, chatboats, etc) and process simplification through intelligent automation. It can also enable the detection of criminal activities buy analyzing patterns. Artificial intelligence may also have a strong impact in traditional ERP systems.

3. Biometrics security

Biometrics can improve authentication methods and control money laundering, terrorist funding, and other financial crimes.

4. Sophisticated CRM systems with machine learning and sentiment analysis

The development of close relationships with customers can be enabled by the use of more sophisticated CRM systems, incorporating sensitive analysis and machine learning.

5. Blockchain technology

Blockchain technology supports cryptocurrencies, enables record keeping and tracking (for example

transparency in mortgage), document management authentication (such us dLoc).

Blockchain

Blockchain is a secure protocol, developed by Satoshi Nakamoto (nickname) that works as a "distributed ledger", where a network of computers collectively verifies a transaction before it can be recorded and approved.

It creates trust by enabling people, who do not know each other, to collaborate without having to go to neutral central authority.
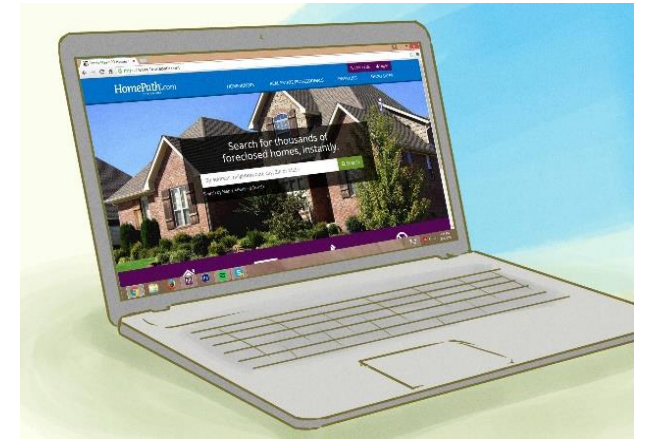
The most well-known application is the **bitcoin**, but can be used to register other transactions and occurrences, like:
- birth and dead certificates,
- education degrees,
- marriage licenses,
- medical procedures,
- votes.

Ex: The government of Honduras is using *blockchain* to handle land titles.

Examples in **Real Estate & Construction**

1.Bio materials – The subject is growing in relevance. Tendency to reduce CO2 footprint;

2.Building Information Modeling (BIM)- Digitalization of the construction process, by the use of digital models, which include the geometric features of the construction and the nature of objects used (composition, physical properties, mechanical behavior, etc). Management of the off-site construction revolution: building elements are built in a factory and transported to a construction site (for example, bathrooms). The integration of water, electricity, gas and data networks within the walls is a real problem;

3.Cognitive construction – Project management software that is smart enough to take into account weather forecast, port traffic delays, currency exchange rates, accidents, in addition to design changes;

4.3D printers to produce (small) building materials;

5.Robots able to lay 1.000 bricks/hour;

Examples in **Real Estate & Construction** (cont.)

6.Use of **drones** to reduce the cost of project progress analysis (for example, detect cracks in bulding façades) and remotely pilote bulldozers;

7.**Big data** models for property valuation, for example, to avoid displaying too high a rent, which would not attract new tenents;

8.Use of **CRM systems** to manage (hundreds or thousands) residential units;

9.**On-line rental platforms** (like Airbnb; Oyo, in India; or Tujia, in China);

10.**Sensors**, for example, for preventive maintenance of elevators;

11.**Artificial Intelligence** to optimize real estate decision making, matching buyers and sellers. Example: "renters who liked this apartment also liked these …".

12.**Virtual Reality** that enables someone to purchase a new home or flat without stepping inside.

Examples in Healthcare
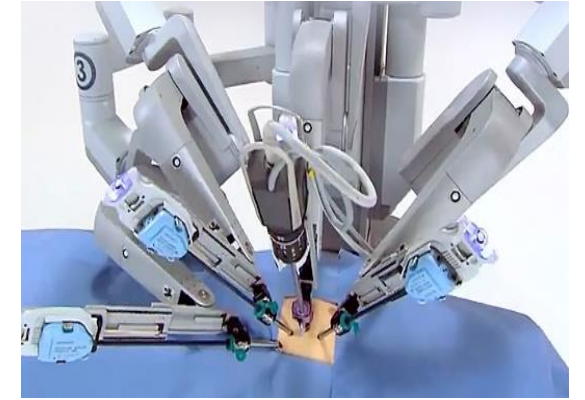
1. Electronic Health Records (EHRs) – Electronic Health Records help maintaining the track record of a patient medical history which improves diagnosis and treatment of diseases.

2. Remote healthcare services - Increases the coverage of healthcare in remote areas and ensures that patients get quality treatment at reasonable cost.

3. Big Data and analytics – Since medicine is a probabilistic science, diagnostic tools based on artificial intelligence and using big data, are a significant improvement in healtcare. It took more than 10 years and a cost of 2,7 billion USD to complete the human genome project. Nowadays, a genome can be sequenced in a few hours and for less than 1.000 USD.

4. Brain Computer Interfaces - Help paraplegics and to control computer cursors only with their brains.

5. Robotics - Robots can bring a significant contribution to perform surgical operations, with a very high precision or assisting elderly people.

6. 3-D Printing - 3D printing can help the medical device world to produce hearing aids, teeth-straightening braces or prosthetics. 3D Printing enables product customization. 3D bio-printing combined with gene editing to produce living tissues, for repairing a regeneration.