

L'intelligence artificielle

Rodolphe Thiébaut, Bordeaux



Cambo-les-Bains

14e colloque

**La transformation du système
de santé : l'hôpital de demain**

Vendredi 27 septembre 2019

Gartner Hype Cycle for Emerging Technologies, 2019



gartner.com/SmarterWithGartner

Source: Gartner
 © 2019 Gartner, Inc. and/or its affiliates. All rights reserved.

Gartner®



CÉDRIC VILLANI

Mathématicien et député de l'Essonne

**DONNER UN SENS
À L'INTELLIGENCE
ARTIFICIELLE**

POUR UNE STRATÉGIE
NATIONALE ET EUROPÉENNE

03/2018

**MÉDECINS
ET PATIENTS DANS
LE MONDE DES DATA,
DES ALGORITHMES
ET DE L'INTELLIGENCE
ARTIFICIELLE**

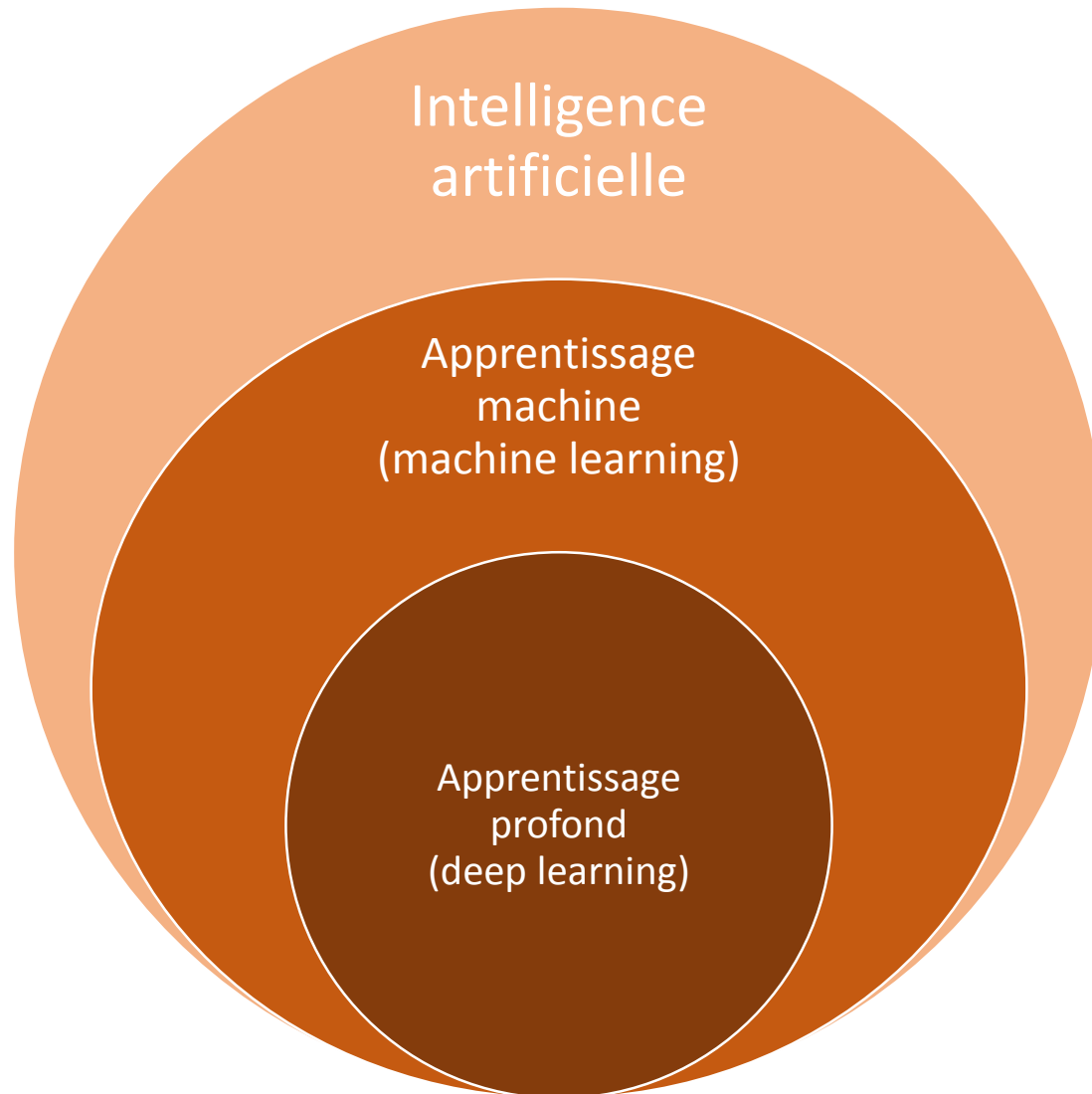
Analyses et recommandations
du Cnom



ORDRE NATIONAL DES MÉDECINS
Conseil National de l'Ordre

01/2018

De quoi parle-t-on?



De quoi parle-t-on?

IA faible
&
IA générale, ou forte

Apprentissage profond
(Deep learning)



Test de Alan Turing

e.g. traducteur:
www.deepl.com

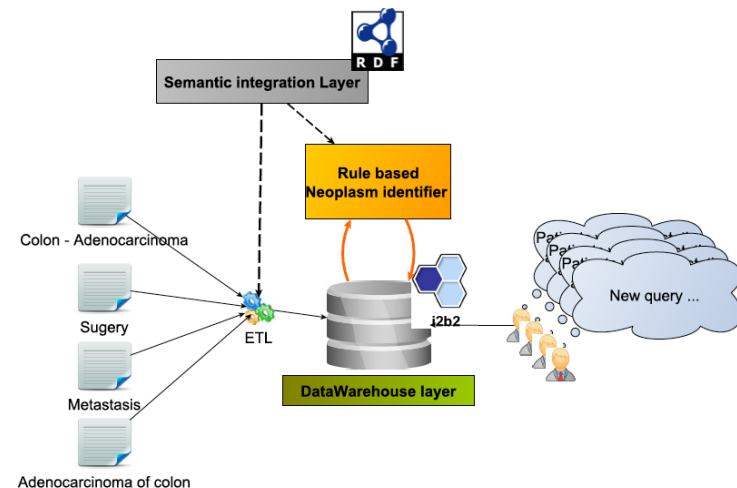
De quoi parle-t-on?

Imiter l'Homme

Fouiller les données



Poppy de l'équipe Inria Flowers



Entrepôt de données hospitalier

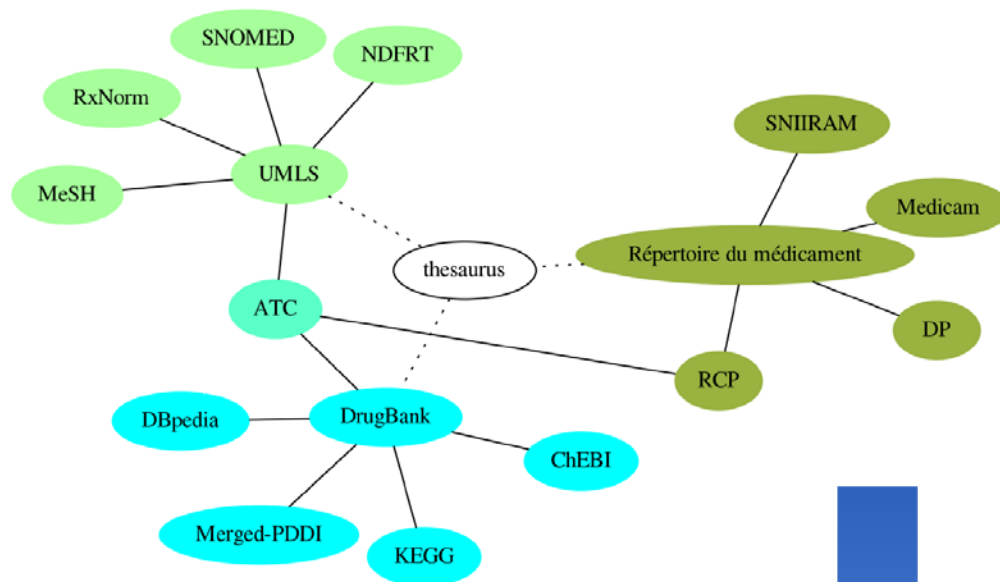
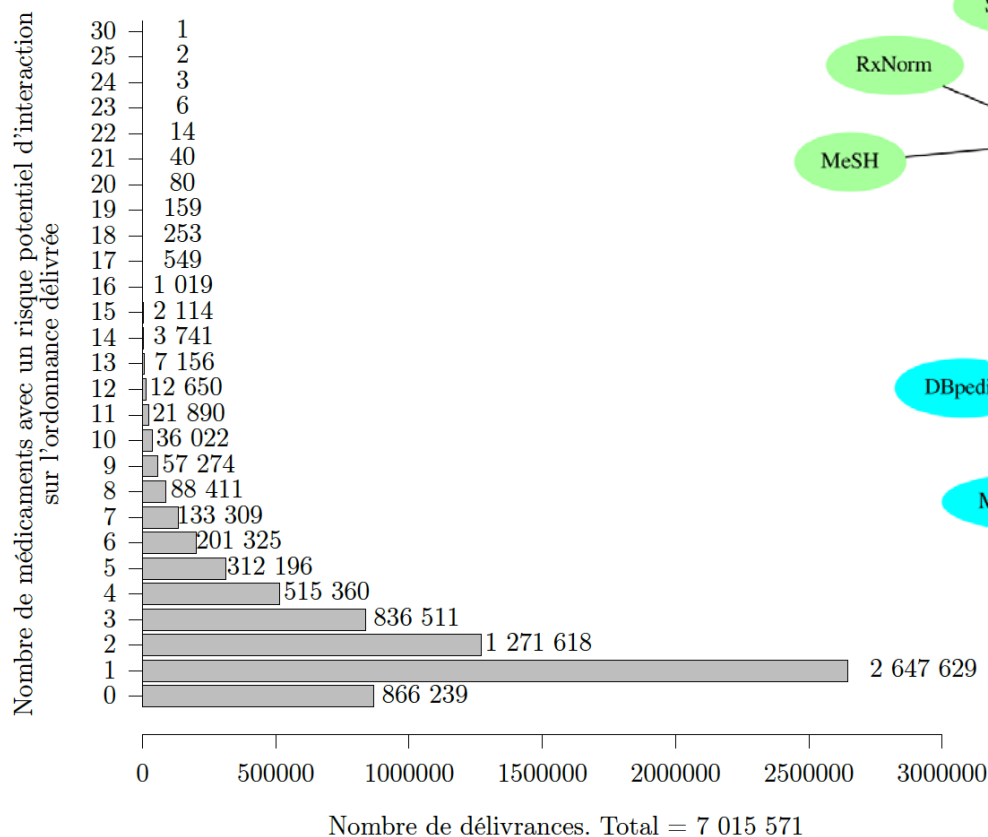


Interactions médicamenteuses



Synapse Medicine

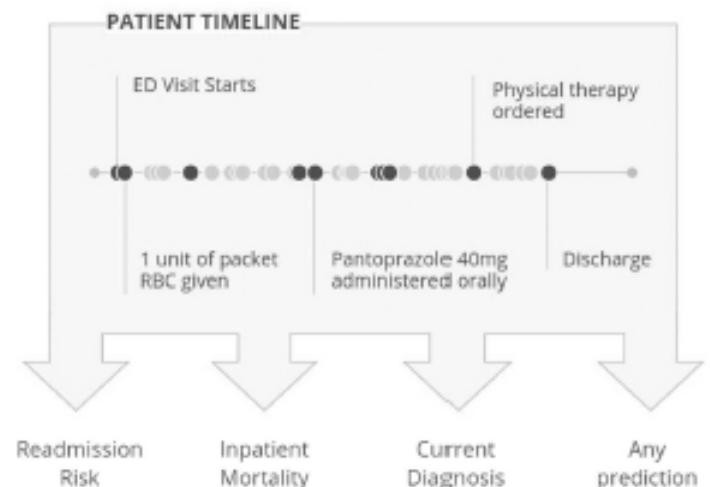
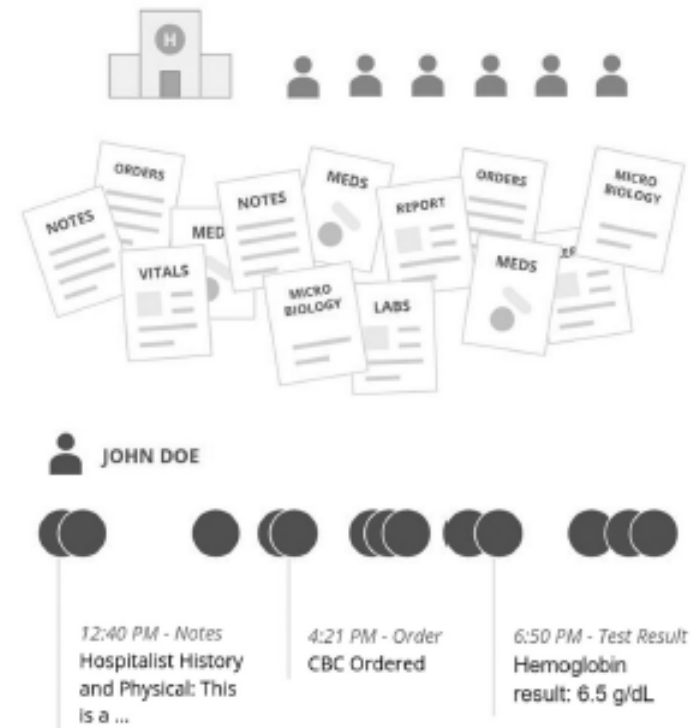
ERIAS – Inserm BPH U1219



11% dossier pharmaceutique (2013)

Prédire le devenir

- 216 221 adultes
- 46 milliards d'enregistrements
- Prédiction de :
 - Mortalité (AUC 0.93-0.94)
 - Réadmission
 - Durée d'hospitalisation

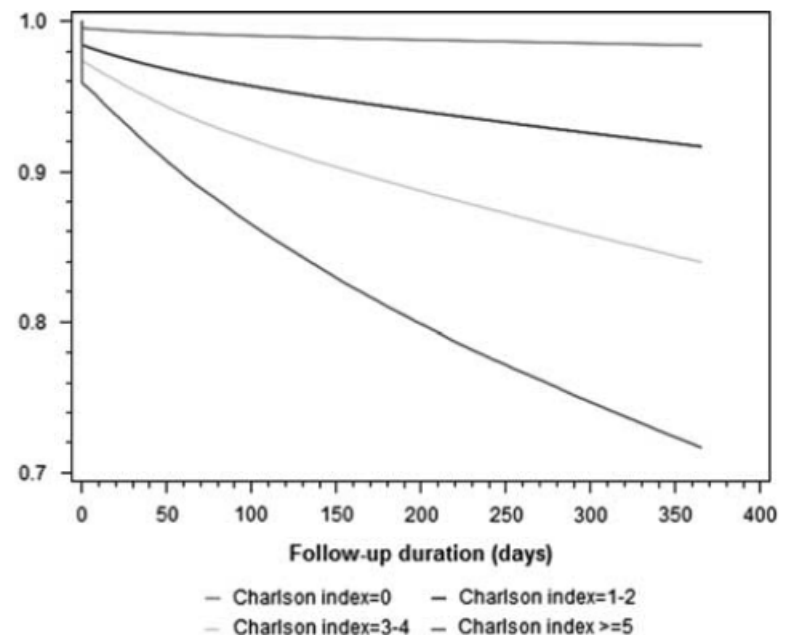


Mais: des analyses intelligentes peuvent aussi être pertinentes

The Best Use of the Charlson Comorbidity Index With Electronic Health Care Database to Predict Mortality

Aurélie Bannay, MD, Christophe Chaignot, MSc,† Pierre-Olivier Blotière, MSc,†
Mickaël Basson, MD, MSc,† Alain Weill, MD,† Philippe Ricordeau, MD,†
and François Alla, MD, PhD†*

- Données SNIIRAM
- 6 millions d'individus



Mais: différence entre analyse rétrospective et intervention en temps réel

Journal of the American Medical Informatics Association, 0(0), 2017, 1–7

doi: 10.1093/jamia/ocx072

Research and Applications



OXFORD

Research and Applications

Impact of an emergency department electronic sepsis surveillance system on patient mortality and length of stay

Jonathan S Austrian,^{1,2} Catherine T Jamin,³ Glenn R Doty,² and Saul Blecker^{1,4}

Best Practice Advisory - Radiant, Testing

▼ SIRS Criteria (Advisory: 1)

↑ ERS SIRS Advisory

ERS SIRS (Systemic Inflammatory Response Syndrome)

This patient presents signs consistent with an inflammatory response. For patients 18 and above, two or more signs of inflammation at triage or in an ERS Case Area:

- Temperature $\geq 38^{\circ}\text{C}$ (100.4°F) OR $\leq 36^{\circ}\text{C}$ (96.8°F)
- Heart rate ≥ 90 beats per minute (sinus rhythm)
- Respiratory rate ≥ 20 breaths per minute or $\text{PaCO}_2 \geq 32\text{mmHg}$
- White Count $\leq 4 \times 10^9/\text{L}$, $\geq 12 \times 10^9/\text{L}$ OR $> 10\%$ bands

Consider one of the following:

- If you suspect infection or progression of an existing infection, click "Call Sepsis or other Critical Alert" and initiate orders based on the ERS Sepsis Labs/Diagnostic tests triage protocol. The orders will be sent to the provider for co-signature.
- If treatment to address an infection or sepsis is ongoing, click "Already on Sepsis protocol" then ACCEPT.
- If you do NOT suspect an infection, click "No suspected or new signs of infection" then ACCEPT.

Vitals:

12/05/16 11:49	12/15/16 10:07
Pulse: (1) 125	(1) 122
Resp: 20	
Temp: 37.9 °C (100.3 °F)	(1) 38.9 °C (102 °F)
SpO2: 100%	

No results found for this or any previous visit (from the past 24 hour(s)).

Recommended But Cannot Be Performed Now

Open Order Set: ERS R/O SEPSIS Nursing Panel

```
view
```

Acknowledge Reason

☐ Call Sepsis or other Critical Alert ☐ Already on sepsis protocol ☐ No suspected or new signs of infection

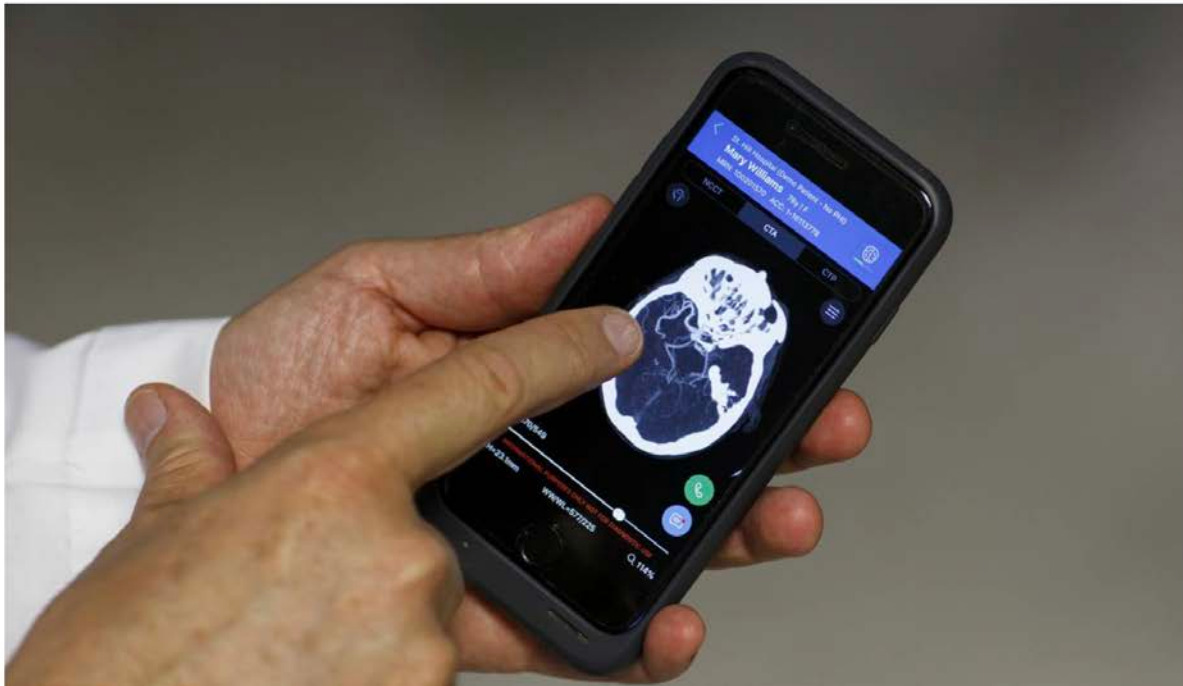
© 2017 Epic Systems Corporation. Used with permission.

Outcome	Prior to sepsis alert N = 838	After sepsis alert N = 1306	P-value
Length of stay, days (SD)	10.1 (10.1)	8.6 (7.9)	<0.001
Mortality	8.5	7.0	0.22

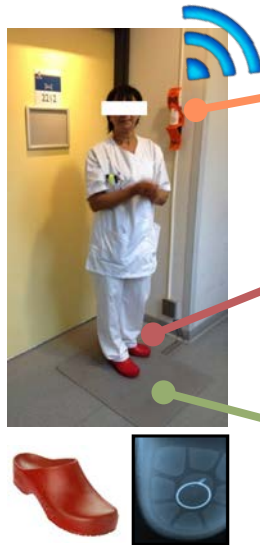
Et toutes les autres données dont l'imagerie

New Technology Promises to Speed Critical Treatment for Strokes

Several young companies are introducing methods to quickly and precisely address severe blockages in major arteries caused by blood clots



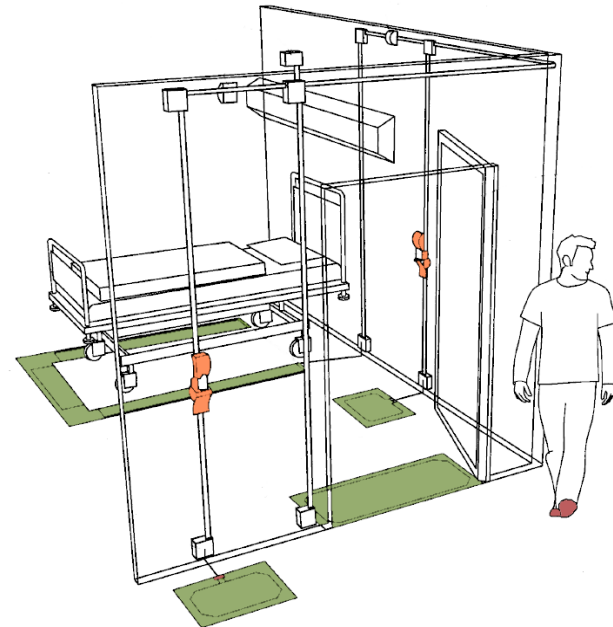
Avec les nouvelles données, exemple de l'hygiène des mains



Alcohol Dispenser
Microswitch

Shoes-embedded
RFID Tags

Floor rugs
antenna

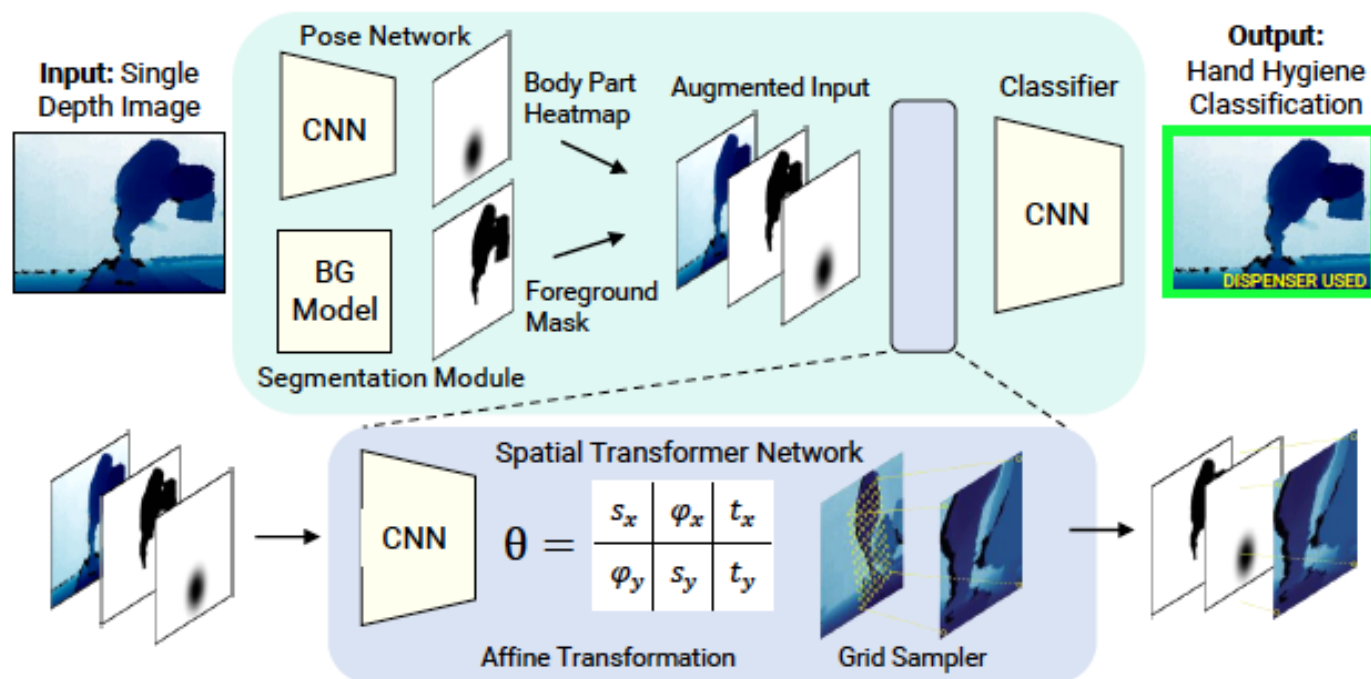


JC Dufour, Journal of Hospital Infection 2017

Avec les nouvelles données, exemple de l'hygiène des mains

Bedside Computer Vision — Moving Artificial Intelligence from Driver Assistance to Patient Safety

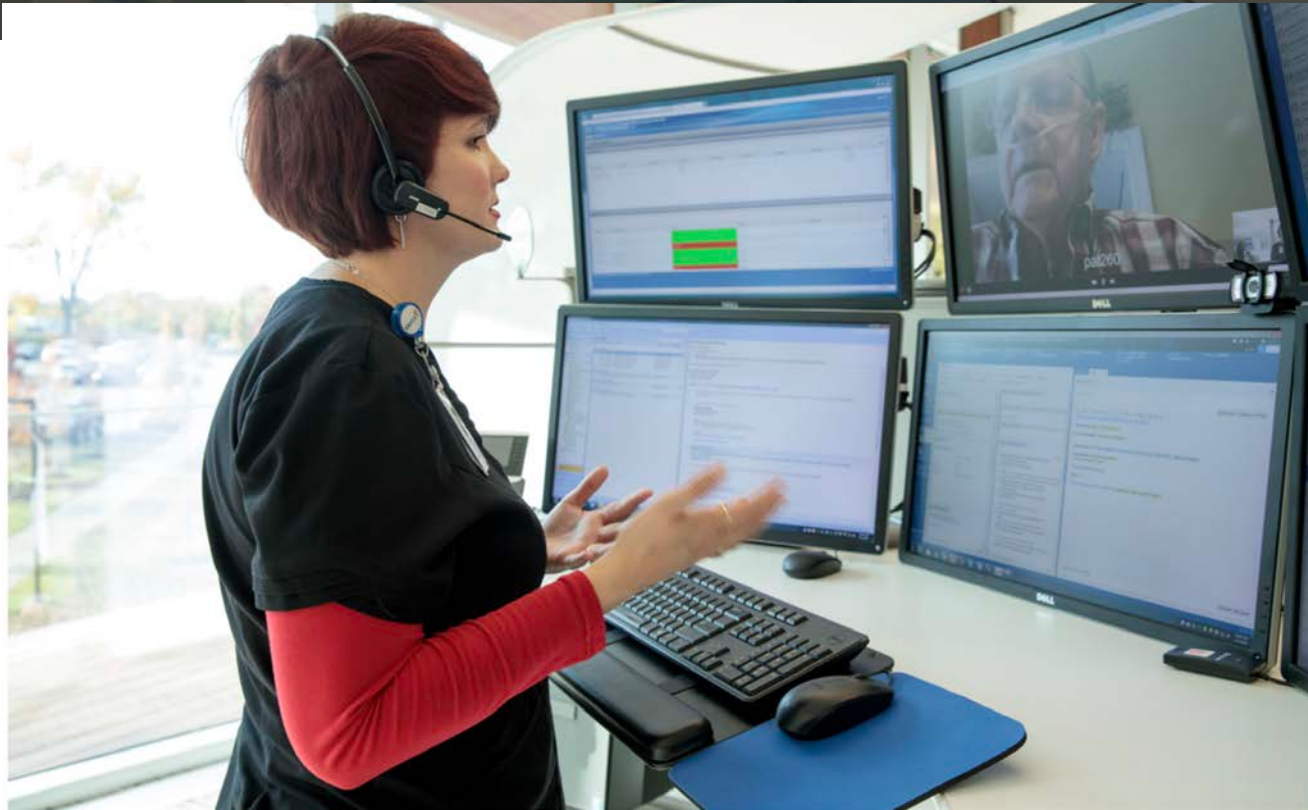
Serena Yeung, M.S., N. Lance Downing, M.D., Li Fei-Fei, Ph.D., and Arnold Milstein, M.D., M.P.H.



The Agenda
AGENDA 2020

A hospital without patients

The cutting edge of health care is tucked off a St. Louis highway exit. And it's eerily quiet.



Conclusion sur l'IA

- Un véritable progrès dont beaucoup d'aspects sont liés aux données
- Un impact potentiel fort



Mais prudence sur...

- Les attendus (e.g. Watson) !!! Cf Hivers de l'IA

IBM pitched its Watson supercomputer as a revolution in cancer care. It's nowhere close

By CASEY ROSS @caseymross and IKE SWETLITZ @ikeswetlitz / SEPTEMBER 5, 2017



Mais prudence sur...

- Les attendus (e.g. Watson) !!! Aux hivers de l'IA
- Les méthodes (e.g. biais de l'IA)

BUSINESS NEWS OCTOBER 10, 2018 / 5:12 AM / A YEAR AGO

Amazon scraps secret AI recruiting tool that showed bias against women

Jeffrey Dastin

8 MIN READ



SAN FRANCISCO (Reuters) - Amazon.com Inc's ([AMZN.O](#)) machine-learning specialists uncovered a big problem: their new recruiting engine did not like women.

Mais prudence sur...

- Les attendus (e.g. Watson) !!! Aux hivers de l'IA
- La démarche scientifique (e.g. biais de l'IA)
- l'éthique

DRAFT ETHICS GUIDELINES

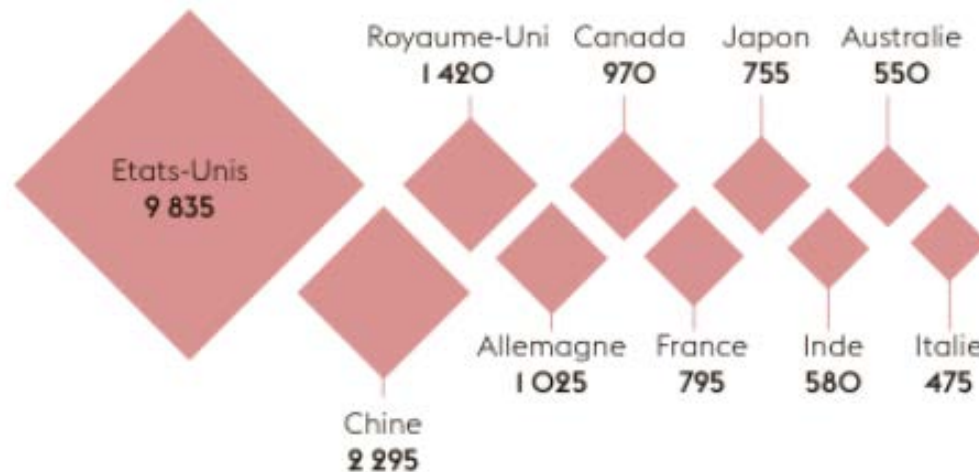
FOR TRUSTWORTHY AI



Conclusion

- Nécessité d'un positionnement de la France... pour la France

Principaux pays d'origine des chercheurs en intelligence artificielle (IA)
(en nombre de chercheurs)



Merci!

L'intelligence artificielle

Rodolphe Thiébaut, Bordeaux



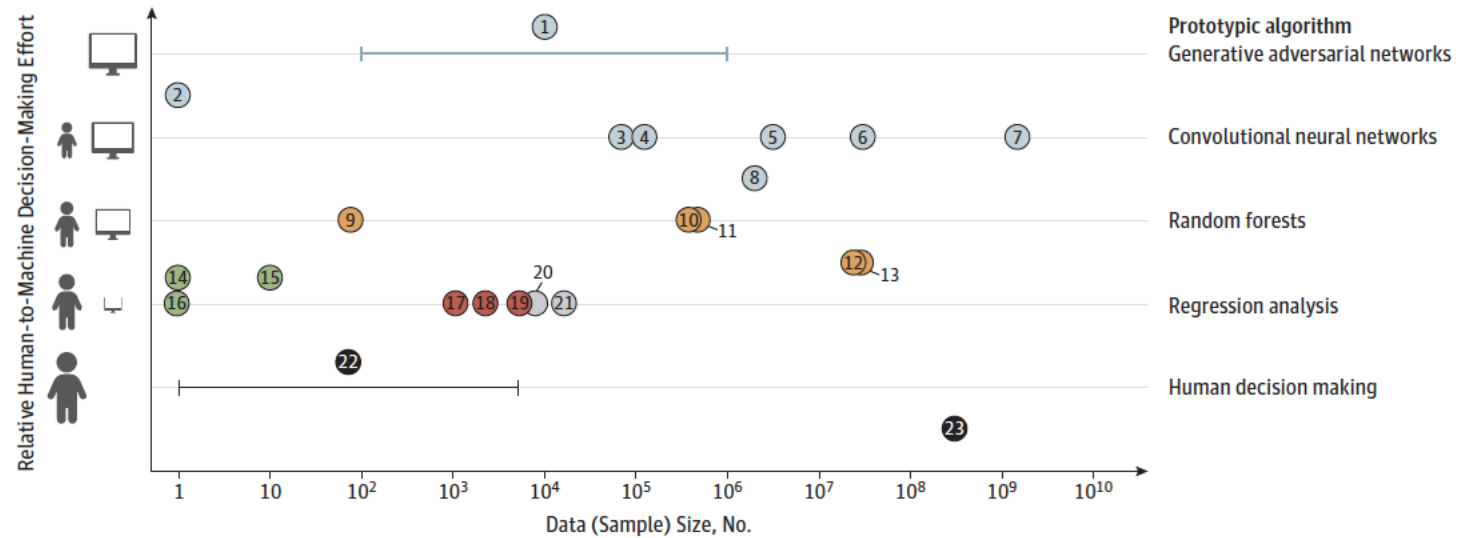
Cambo-les-Bains

14e colloque

**La transformation du système
de santé : l'hôpital de demain**

Vendredi 27 septembre 2019

Figure. The Axes of Machine Learning and Big Data



Andrew L. Beam, PhD
Department of
Biomedical Informatics,
Harvard Medical
School, Boston,
Massachusetts.

**Isaac S. Kohane, MD,
PhD**
Department of
Biomedical Informatics,
Harvard Medical
School, Boston,
Massachusetts.

Deep learning

- ① Generative adversarial networks (2014)
- ② Google AlphaGo Zero (2017)
- ③ ATM check readers (1998)
- ④ Google diabetic retinopathy (2016)
- ⑤ ImageNet computer vision models (2012-2017)
- ⑥ Google AlphaGo (2015)
- ⑦ Facebook Photo Tagger (2015)
- ⑧ Prediction of 1-y all-cause mortality (2017)

Classic machine learning

- ⑨ Diffuse large B-cell lymphoma outcome prediction by gene-expression profiling (2002)
- ⑩ EHR-based CV risk prediction (2017)
- ⑪ Netflix Prize winner (2006)
- ⑫ Google Search (1998)
- ⑬ Amazon product recommendation (2003)

Expert AI systems

- ⑭ MYCIN (1975)
- ⑮ CASNET (1982)
- ⑯ DXplain (1986)

Risk calculators

- ⑰ CHA₂DS₂-VASc Score for atrial fibrillation stroke risk (2017)
- ⑱ MELD end-stage liver disease risk score (2001)
- ⑲ Framingham CV risk score (1998)

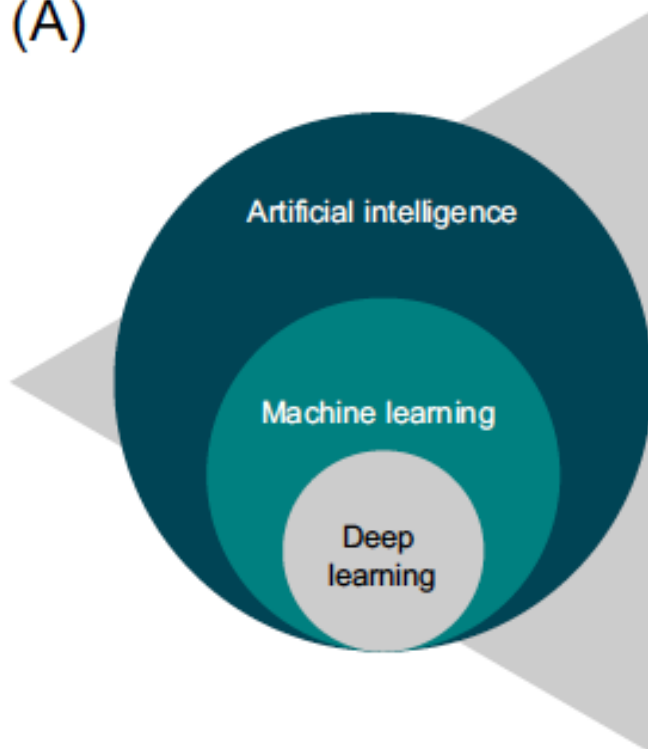
Randomized Clinical Trials

- ⑳ Celecoxib vs nonsteroidal anti-inflammatory drugs for osteoarthritis and rheumatoid arthritis (2002)
- ㉑ Use of estrogen plus progestin in healthy postmenopausal women (2002)

Other

- ㉒ Clinical wisdom
- ㉓ Mortality rate estimates from US Census (2010)

(A)



Artificial intelligence

Artificial Intelligence is the science of making machines do things requiring human intelligence. It is human intelligence in machine format where computer programs develop data-based decisions and perform tasks normally performed by humans.

Artificial intelligence is any computer program that does something smart.

Machine learning

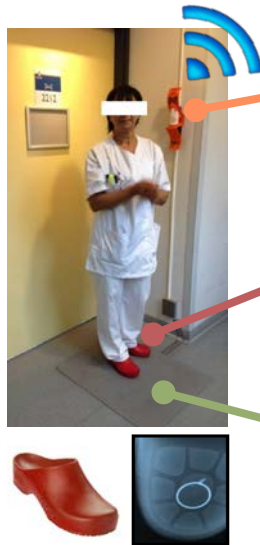
Machine learning takes artificial intelligence a step further in the way that algorithms are programmed to learn and improve without the need for human data input and reprogramming.

Deep learning

Deep learning is the next generation of machine learning that introduces multiple layers of learning from massive datasets. Deep learning decisions and data classifications are refined at each layer to produce accurate insights.

Hygiène des mains à l'hôpital

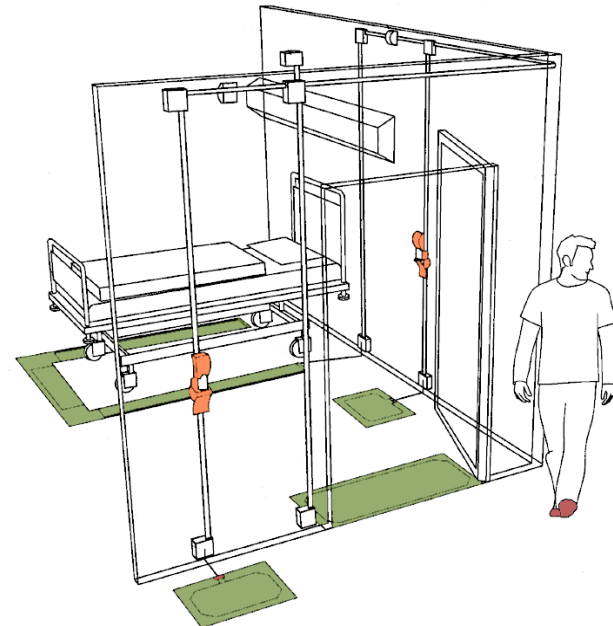
- 7 chambres x 40 soignants x 24/24 x 3 ans



Alcohol Dispenser
Microswitch

Shoes-embedded
RFID Tags

Floor rugs
antenna



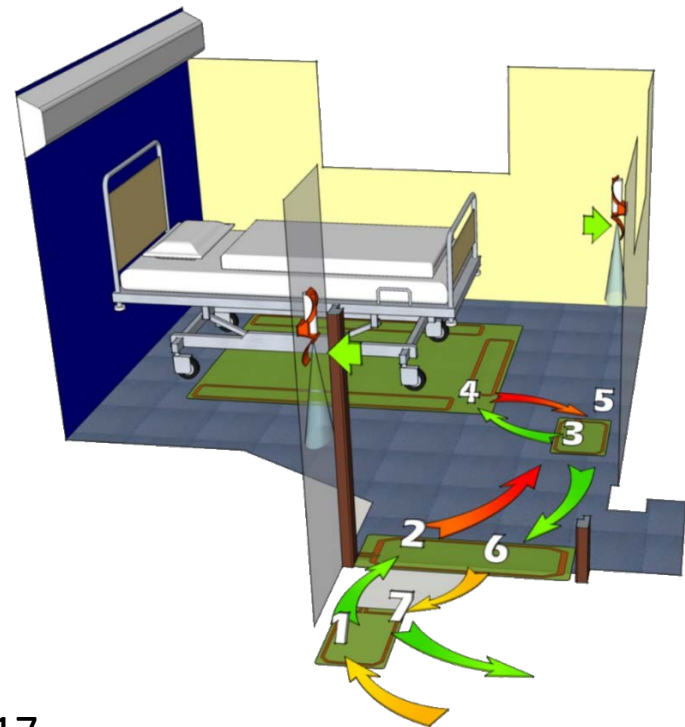
JC Dufour, Journal of Hospital Infection 2017

Hygiène des mains à l'hôpital

Hand hygiene compliance of healthcare workers (HCWs)

Hand hygiene compliance	No. of HCWs	No. of paths (%)
Hand hygiene before entering the patient care zone using inside/bedside AHR dispenser	35	285 (6.1)
Hand hygiene before entering the patient's bedroom using outside AHR dispenser	40	763 (16.5)
No AHR use	41	3581 (77.4)
Total	42	4629 (100)

AHR, alcohol-based hand rub.



JC Dufour, Journal of Hospital Infection 2017

Les données de santé

International ✓

If your business operates internationally it is important to identify which data protection supervisory authority you come under.

Data Protection Officers ✓

Designate a Data Protection Officer to be accountable for data protection compliance. Consider the position of this role within your business structure and governance measures.

Data Protection Impact ✓

Ensure you conduct an impact assessment within your business, it will ensure you can deliver the required changes in time for GDPR.

Data breaches ✓

Make certain you have the necessary measures in place to detect, report and investigate a personal data breach.

Children ✓

Consider implementing a system to verify individuals' ages and to gather parental or guardian consent for the data processing activity.

Consent ✓

Carry out an audit into how you are seeking, obtaining and recording consent? It is important you understand it in order to make any changes to this process.

Awareness ✓

Ensure that all decision makers and key people in your business are aware that the law is changing to the GDPR. It's important you make them aware of the impact this may have.

Information ✓

It is important to document any personal data you hold, including where it came from and who you share it with. Consider organising an information audit.

Communicating privacy information ✓

Review your current privacy notices and implement a plan for making any necessary changes to it in time for GDPR implementation.

Individuals' rights ✓

Evaluate your procedures to confirm they cover all the rights individuals have, including how you would delete personal data or provide data electronically and in a commonly used format.

Subject access requests ✓

Update your procedures and implement a plan for how you will handle requests within the new timescales and provide any additional information.

Legal basis for processing personal data ✓

Analyse the various types of data processing you carry out as a business and identify your legal basis for carrying it out and document it.

Are you prepared for the
General Data Protection
Regulation (GDPR)?

Here are 12 steps to help
you take action now

“Le respect des secrets des personnes est la base même de la confiance qu’elles portent aux médecins. Il faut donc mettre cette exigence éthique dans le traitement massif des data lors de la construction des algorithmes.”



ORDRE NATIONAL DES MEDECINS
Conseil National de l'Ordre

La protection des données

14 septembre 2017

Elle tape son nom sur Internet et découvre le dossier médical de son enfant



César Rincón Flickr

Le 11 février 2013, Madame W. fait des recherches sur Internet, et, par curiosité, tape ses nom et prénom sur le moteur de recherche Google. Elle voit s'afficher l'inscription « *dossier enfant* » avec son numéro de sécurité sociale. En cliquant sur ce résultat, elle arrive sur le site « <http://www.dbsi.eu> », qui comporte d'autres noms et prénoms précédés d'un numéro de sécurité sociale. .

Elle clique sur le sien, et

découvre le dossier médical de son fils, Jean-François, prématuré né à l'hôpital Nord de Marseille, le 22 juin 2008. Elle constate qu'elle peut aussi accéder aux autres, et même les modifier ou les supprimer.

Et les robots!



Kaspar