Intelligence artificielle en anesthésie réanimation

M. Mouhaoui, Maroc

De quoi allons-nous parler ?

01 **Intelligence artificielle IA**

Principes et définitions

02 **IA en anesthésiologie**

Champs d'application de l'IA en anesthésiologie

03 **IA en réanimation**

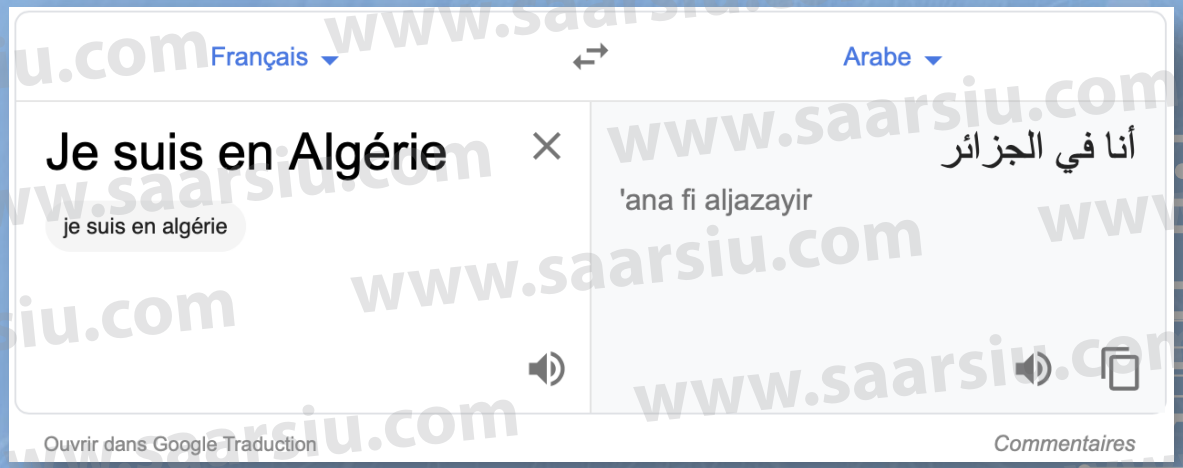
Champs d'application de l'IA en réanimation

04 **Mythe ou réalite ?**

Pertinence de l'IA dans notre contexte

C’est quoi une intelligence artificielle ?

C’est un domaine scientifique, qui cherche à résoudre des problèmes logiques ou algorithmiques, via des dispositifs imitant ou remplaçant l’être humain


Français
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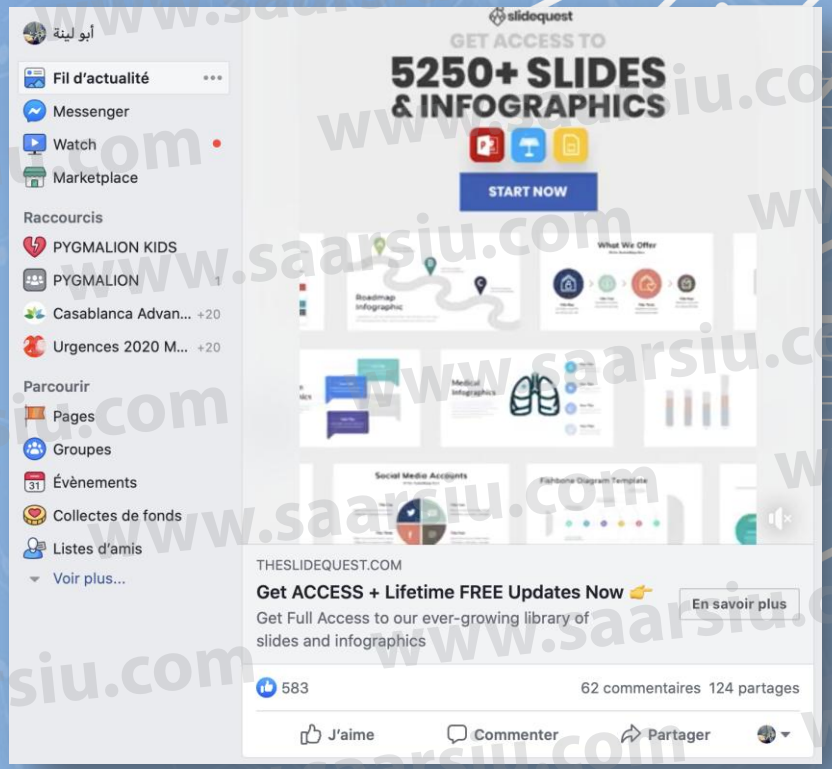
أبو لينة
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Marketplace
Raccourcis
PYGMALION KIDS
PYGMALION
Casablanca Advan... +20
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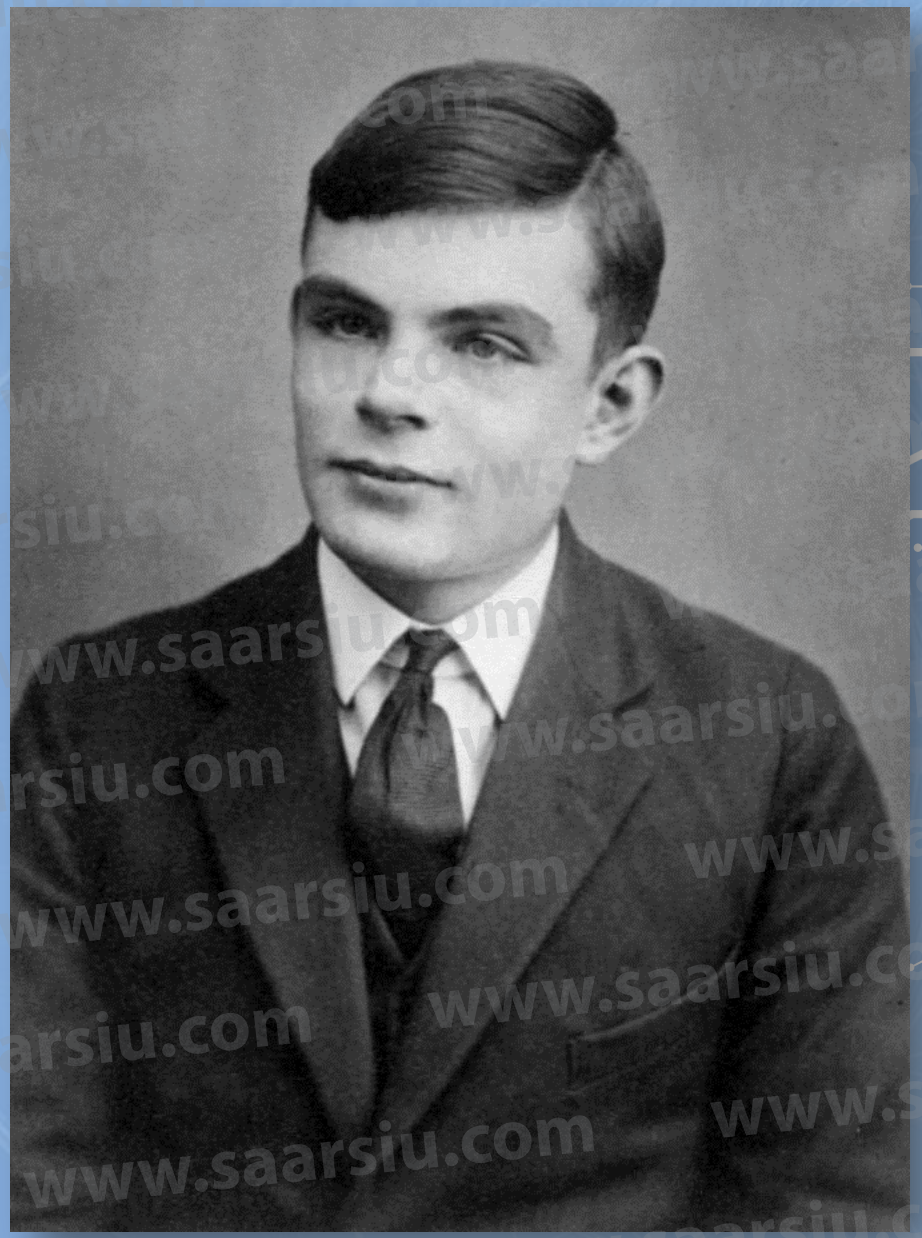

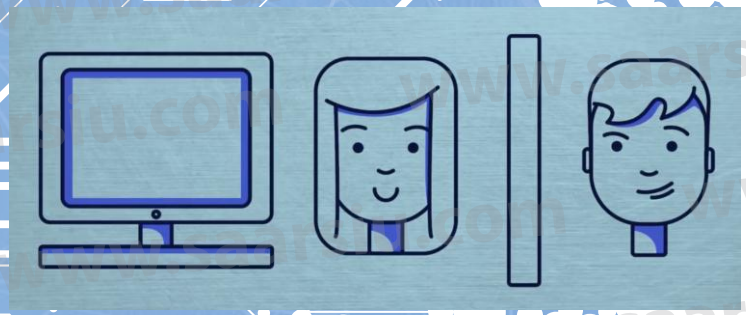

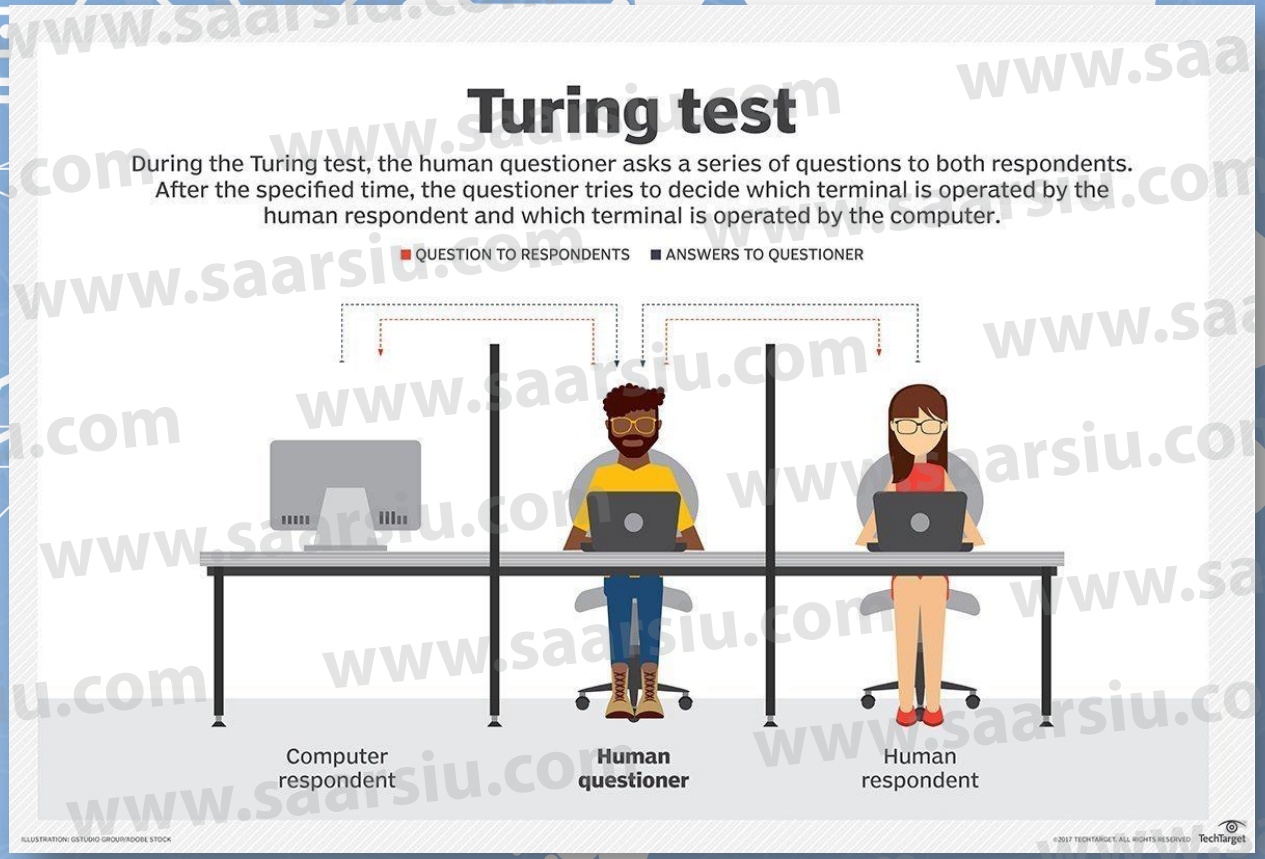
Turing test
During the Turing test, the human questioner asks a series of questions to both respondents. After the specified time, the questioner tries to decide which terminal is operated by the human respondent and which terminal is operated by the computer.
QUESTION TO RESPONDENTS
ANSWERS TO QUESTIONER
Computer respondent
Human questioner
Human respondent
ILLUSTRATION: GSTUDIO GROUP/ADOBE STOCK
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Une machine peut-elle penser ?

Historique

2016

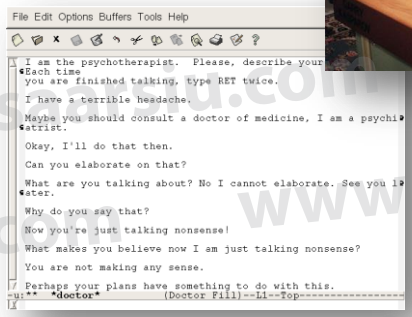
Alpha Go gagne contre Lee Sedol, N° 3 mondial, dans le jeu Go

1997

Deep blue Programme informatique ayant battu Kasparov sur une partie d'échecs

1964

ELISA Programme informatique simulant une psychothérapie



1956

Conférence de **Dartmouth**

Les machines

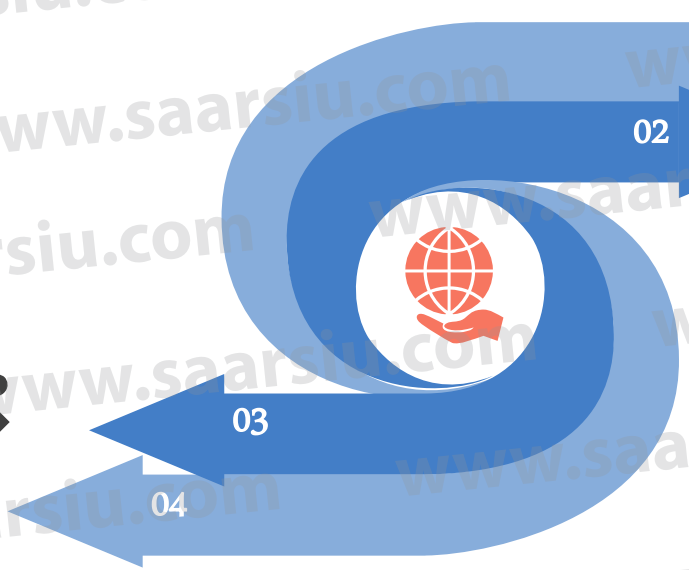
- Ne se déconcentrent pas
- Ont la même humeur
- Ne connaissent pas la pression

Autres domaines

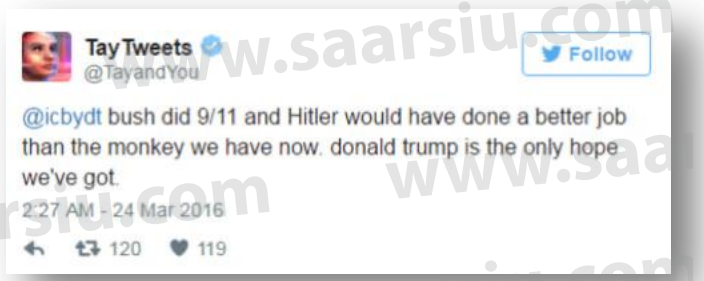
Robotique
Robot Asimo

Automobile
Voitures connectées

Santé
Diagnostic, imagerie



Microsoft
Application Tay IA sur réseau social



Terminologie

01 Intelligence artificielle

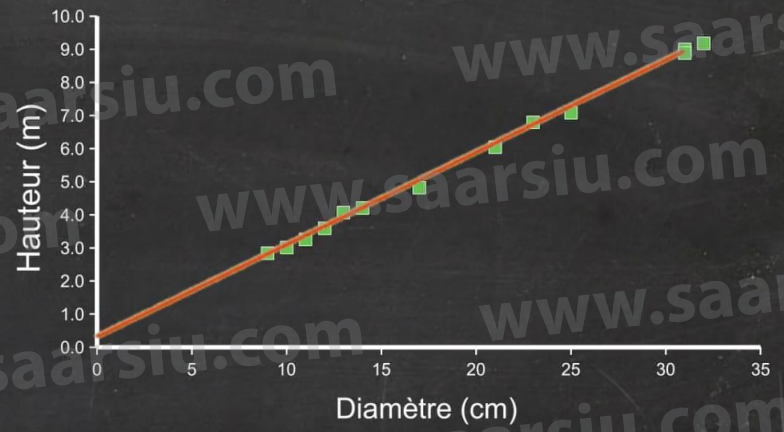
02 Machine learning

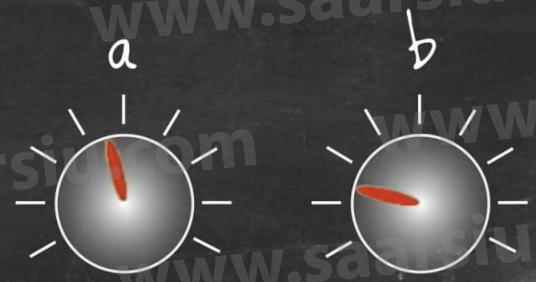
03 Neurones biologiques

04 Deep learning

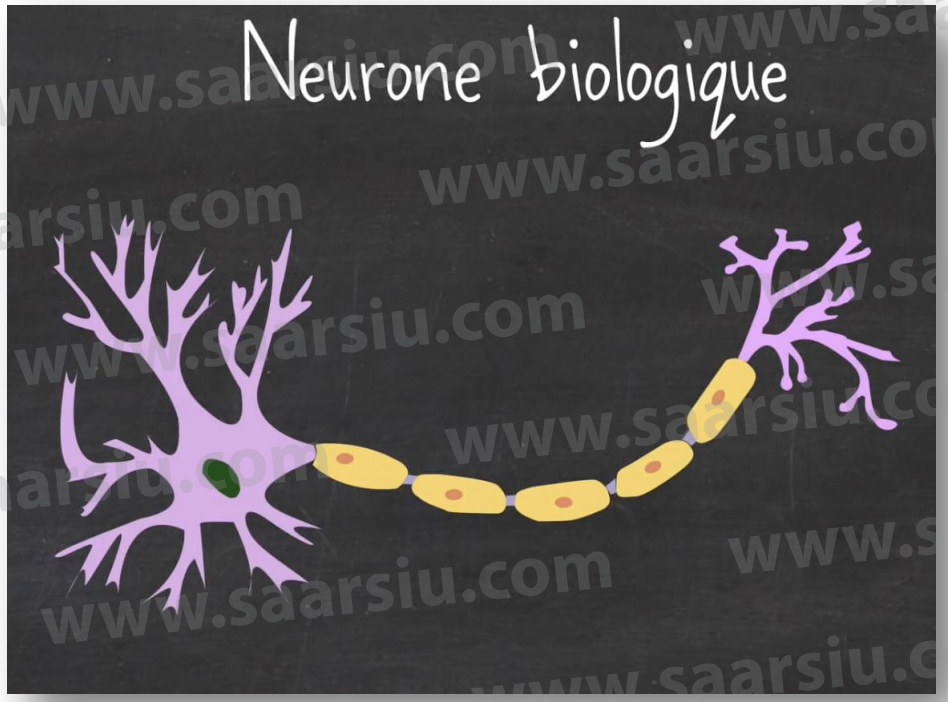
Machine learning

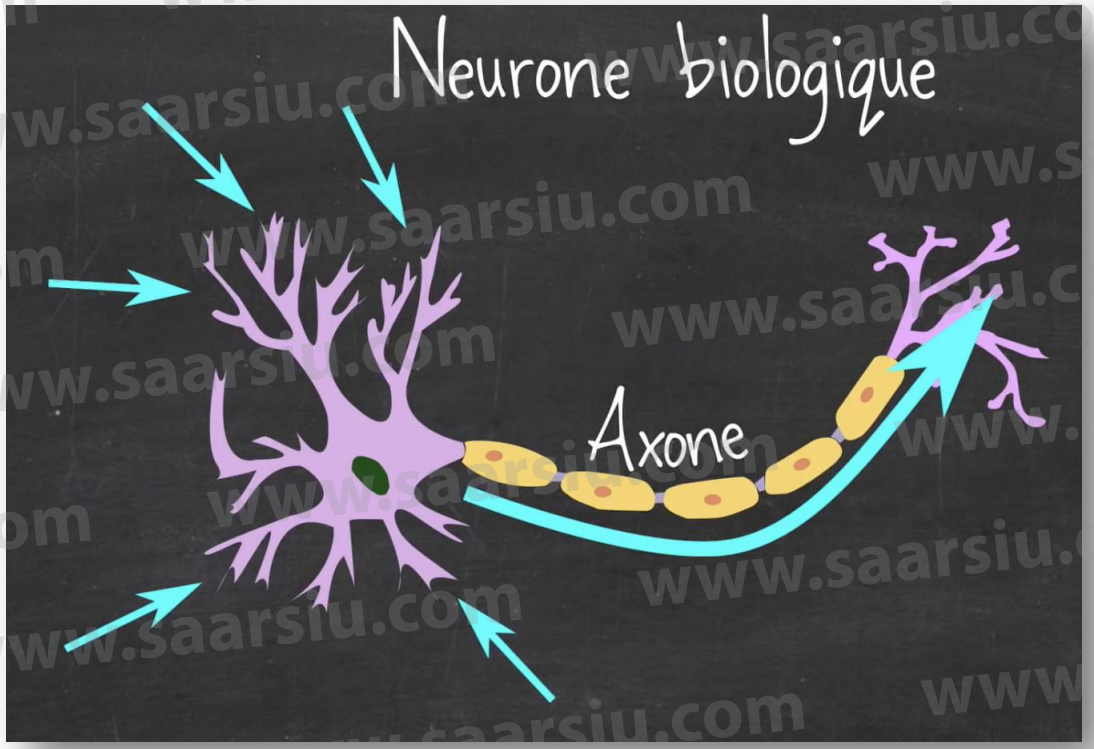
Diamètre (cm)	Hauteur (m)
10	2.8
17	4.6
14	4.0
9	2.6
21	5.8
25	6.9
31	8.8
12	3.4
23	6.6
32	9.0
31	8.7
11	3.0
13	3.8



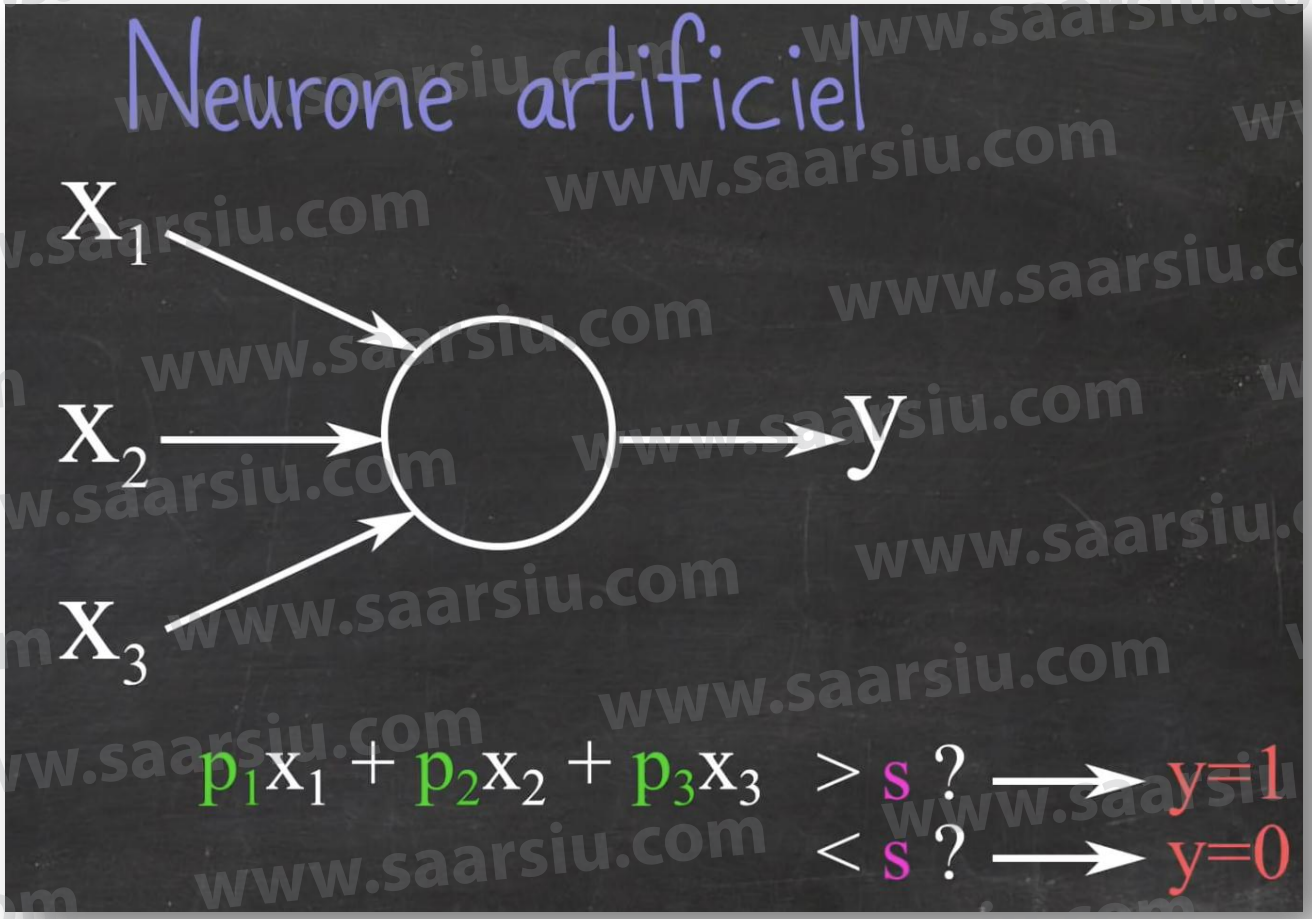


Neurones biologiques

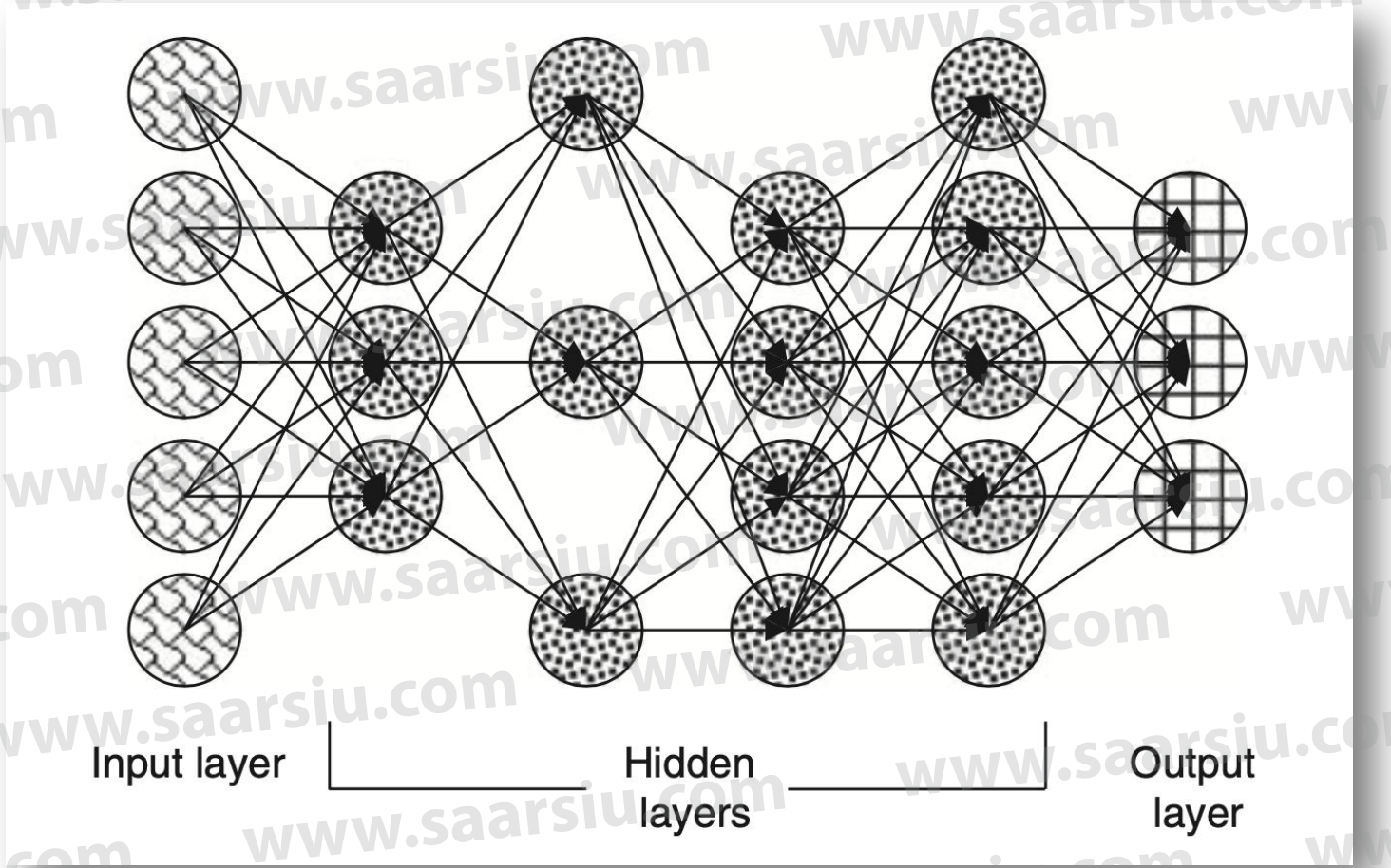




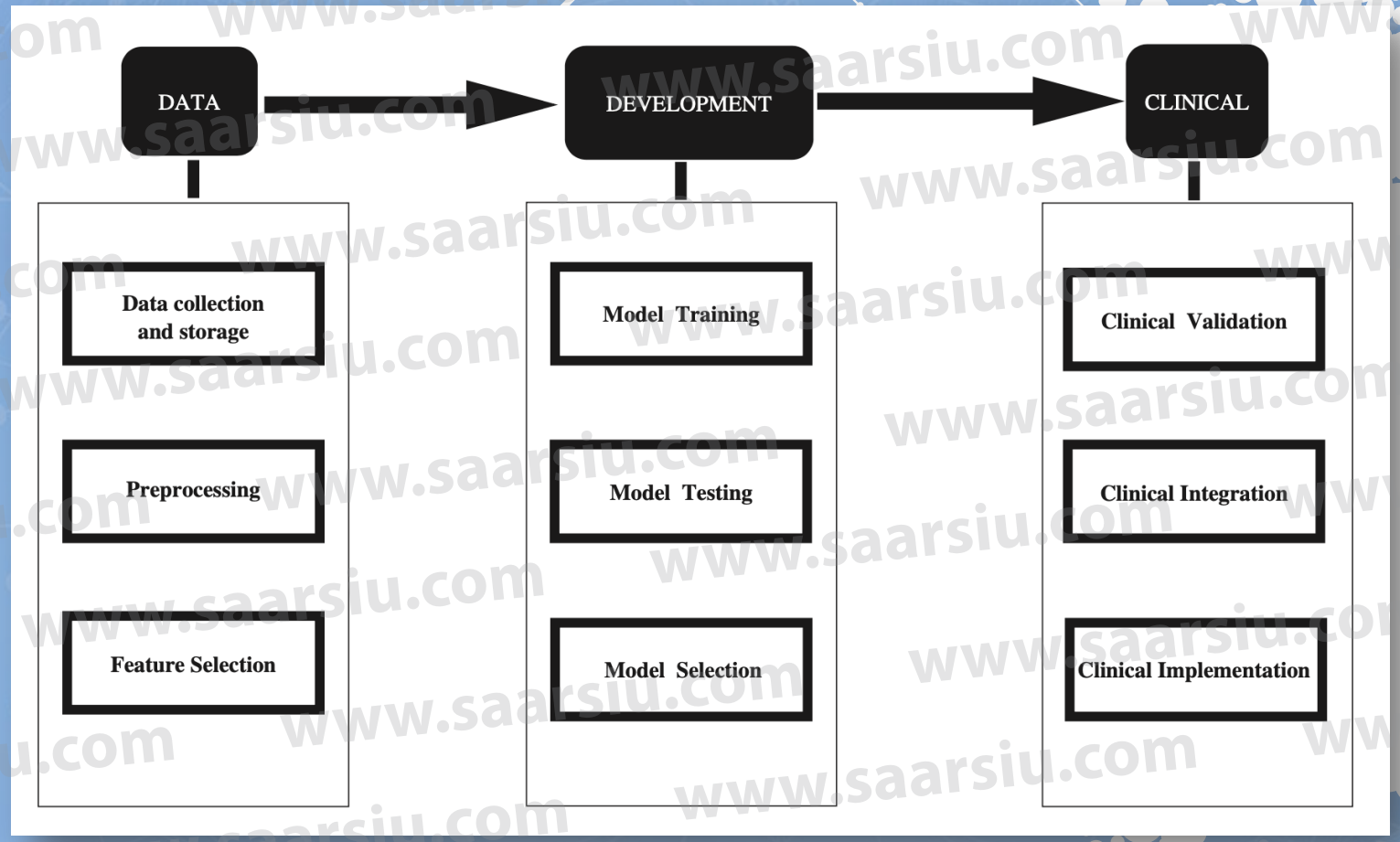
Neurones biologiques



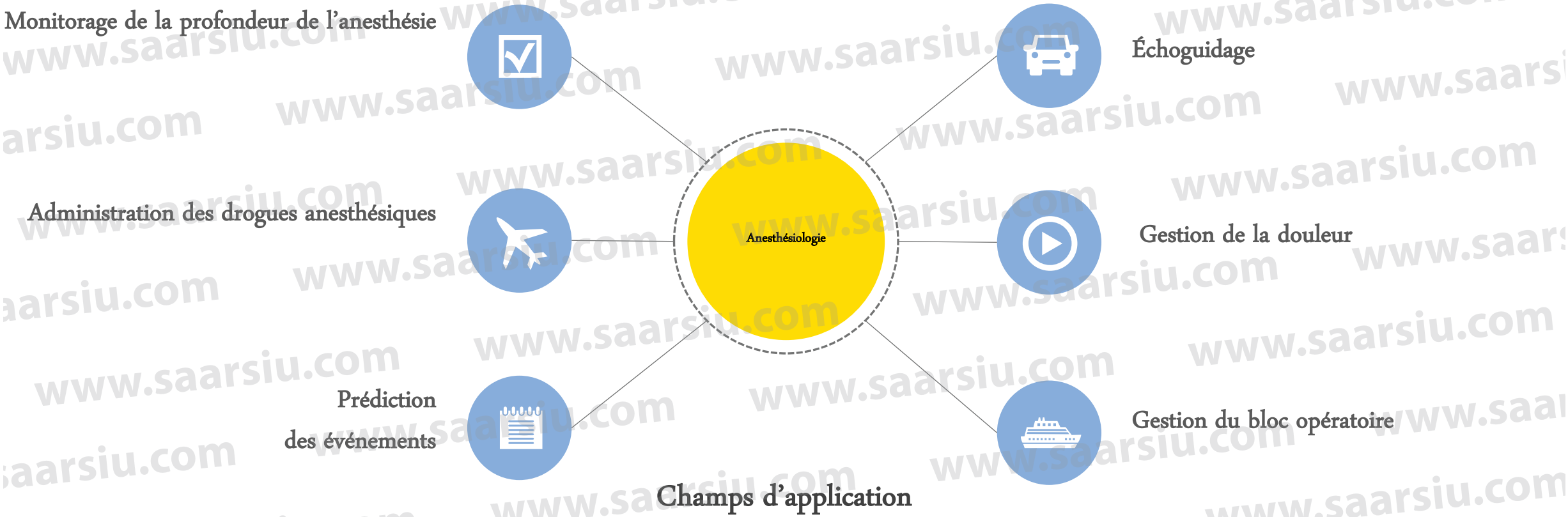
Deep learning



Intelligence artificielle en santé



Anesthésiologie



Champs d'application

Profondeur de l'anesthésie

Br J Anaesth. 2002 May;88(5):644-8.

EEG signal processing in anaesthesia. Use of a neural network technique for monitoring depth of anaesthesia.

Ortolani O[1], Conti A, Di Filippo A, Adembri C, Moraldi E, Evangelisti A, Maggini M, Roberts SJ.

Author information

Abstract

BACKGROUND: The Bispectral Index (BIS) is a proprietary index of anaesthesia depth, which is correlated with the level of consciousness and probability of intraoperative recall. The present study investigates the use of a neural network technique to obtain a non-proprietary index of the depth of anaesthesia from the processed EEG data.

METHODS: Two hundred patients, who underwent general abdominal surgery, were recruited for our trial. For anaesthesia we used a total i.v. technique, tracheal intubation, and artificial ventilation. Fourteen EEG variables, including the BIS, were extracted from the EEG, monitored with an EEG computerized monitor, and then stored on a computer. Data from 150 patients were used to train the neural network. All the variables, excluding the BIS, were used as input data in the neural network. The output targets of the network were provided by anaesthesia scores ranging from 10 to 100 assigned by the anaesthesiologist according to the observer's assessment of alertness and sedation (OAA/S) and other clinical means of assessing depth of anaesthesia. Data from the other 50 patients were used to test the model and for statistical analysis.

RESULTS: The artificial neural network was successfully trained to predict an anaesthesia depth index, the NED (neural network evaluated depth), ranging from 0 to 100. The correlation coefficient between the NED and the BIS over the test set was 0.94 ($P<0.0001$).

CONCLUSION: We have developed a neural network model, which evaluates 13 processed EEG parameters to produce an index of anaesthesia depth, which correlates very well with the BIS during total i.v. anaesthesia with propofol.

Administration des drogues anesthésiques

Eur J Clin Pharmacol. 2012 Jul;68(7):1025-31. doi: 10.1007/s00228-012-1236-3. Epub 2012 Feb 19.

Influence of real-time Bayesian forecasting of pharmacokinetic parameters on the precision of a rocuronium target-controlled infusion.

Motamed C[1], Devys JM, Debaene B, Billard V.

Author information

Abstract

INTRODUCTION: Bayesian forecasting has been shown to improve the accuracy of pharmacokinetic/pharmacodynamic (PK/PD) models by adding measured values to a population model. It could be done in real time for neuromuscular blockers (NMB) using measured values of effect. This study was designed to assess feasibility and benefit of Bayesian forecasting during a rocuronium target-controlled infusion (TCI).

METHODS: After internal review board (IRB) approval and informed consent, 21 women scheduled for breast plastic surgery were included. Anesthesia was maintained with propofol, alfentanil, and controlled ventilation through a laryngeal mask. Rocuronium was delivered in TCI with Stanpump software and the Plaud population model. The target effect was 50% blockade until insertion of breast prosthesis; thereafter it was set to 0%. Response to train of four (TOF) at adductor pollicis was recorded using a force transducer. In ten patients, drug delivery was based on the population model. In the others, repeated measures values were entered in the software, and the PK model was adjusted to minimize the error in predicted effect. Model precision was compared between groups using mean prediction error and mean absolute prediction error.

RESULTS: At target 50%, model accuracy was not improved with Bayesian adjustments; conversely, post-infusion errors were significantly decreased. The first two measures had the most influence on the model changes.

DISCUSSION: Below clinical utility, such adjustments may be used to explore cofactors influencing interindividual and intraindividual variability in NMB dose-response relationship. Similar tools may also be developed for drugs in which a quantitative effect is available, such as electroencephalography (EEG) for hypnotics.

IMPLICATION: Real-time Bayesian forecasting combining measured values of effect with a population model is suitable to guide NMB-agent delivery using Stanpump software.

Administration des drogues anesthésiques

J Clin Monit Comput. 2014 Oct;28(5):487-98. doi: 10.1007/s10877-013-9489-7. Epub 2013 Jul 28.

A knowledge- and model-based system for automated weaning from mechanical ventilation: technical description and first clinical application.

Schädler D[1], Mersmann S, Frerichs I, Elke G, Semmel-Griebeler T, Noll O, Pulletz S, Zick G, David M, Heinrichs W, Scholz J, Weiler N.

Author information

Abstract

To describe the principles and the first clinical application of a novel prototype automated weaning system called Evita Weaning System (EWS). EWS allows an automated control of all ventilator settings in pressure controlled and pressure support mode with the aim of decreasing the respiratory load of mechanical ventilation. Respiratory load takes inspired fraction of oxygen, positive end-expiratory pressure, pressure amplitude and spontaneous breathing activity into account. Spontaneous breathing activity is assessed by the number of controlled breaths needed to maintain a predefined respiratory rate. EWS was implemented as a knowledge- and model-based system that autonomously and remotely controlled a mechanical ventilator (Evita 4, Dräger Medical, Lübeck, Germany). In a selected case study (n = 19 patients), ventilator settings chosen by the responsible physician were compared with the settings 10 min after the start of EWS and at the end of the study session. Neither unsafe ventilator settings nor failure of the system occurred. All patients were successfully transferred from controlled ventilation to assisted spontaneous breathing in a mean time of 37 ± 17 min (± SD). Early settings applied by the EWS did not significantly differ from the initial settings, except for the fraction of oxygen in inspired gas. During the later course, EWS significantly modified most of the ventilator settings and reduced the imposed respiratory load. A novel prototype automated weaning system was successfully developed. The first clinical application of EWS revealed that its operation was stable, safe ventilator settings were defined and the respiratory load of mechanical ventilation was decreased.

Prédiction des événements

Med Decis Making. 2011 Mar-Apr;31(2):308-14. doi: 10.1177/0272989X10379648. Epub 2010 Sep 27.

Application of an artificial neural network to predict postinduction hypotension during general anesthesia.

Lin CS[1,2], Chang CC[2], Chiu JS[3], Lee YW[2,4,5], Lin JA[2], Mok MS[2], Chiu HW[4,6], Li YC[4,5].

Author information

Abstract

BACKGROUND: Perioperative hypotension is associated with adverse outcomes in patients undergoing surgery. A computer-based model that integrates related factors and predicts the risk of hypotension would be helpful in clinical anesthesia. The purpose of this study was to develop artificial neural network (ANN) models to identify patients at high risk for postinduction hypotension during general anesthesia.

METHODS: Anesthesia records for March through November 2007 were reviewed, and 1017 records were analyzed. Eleven patient-related, 2 surgical, and 5 anesthetic variables were used to develop the ANN and logistic regression (LR) models. The quality of the models was evaluated by an external validation data set. Three clinicians were asked to make predictions of the same validation data set on a case-by-case basis.

RESULTS: The ANN model had an accuracy of 82.3%, sensitivity of 76.4%, and specificity of 85.6%. The accuracy of the LR model was 76.5%, the sensitivity was 74.5%, and specificity was 77.7%. The area under the receiver operating characteristic curve for the ANN and LR models was 0.893 and 0.840. The clinicians had the lowest predictive accuracy and sensitivity compared with the ANN and LR models.

CONCLUSIONS: The ANN model developed in this study had good discrimination and calibration and would provide decision support to clinicians and increase vigilance for patients at high risk of postinduction hypotension during general anesthesia.

Échoguidage

International Workshop on Deep Learning in Medical Image Analysis
International Workshop on Large-Scale Annotation of Biomedical Data and Expert Label Synthesis
DLMIA 2016, LABELS 2016: Deep Learning and Data Labeling for Medical Applications pp 30-38 | Cite as

Vessel Detection in Ultrasound Images Using Deep Convolutional Neural Networks

Authors | Authors and affiliations

Erik Smistad, Lasse Løvstakken

Conference paper
First Online: 27 September 2016

7 Citations | 5.4k Downloads

Part of the Lecture Notes in Computer Science book series (LNCS, volume 10008)

Abstract

Deep convolutional neural networks have achieved great results on image classification problems. In this paper, a new method using a deep convolutional neural network for detecting blood vessels in B-mode ultrasound images is presented. Automatic blood vessel detection may be useful in medical applications such as deep venous thrombosis detection, anesthesia guidance and catheter placement. The proposed method is able to determine the position and size of the vessels in images in real-time. 12,804 subimages of the femoral region from 15 subjects were manually labeled. Leave-one-subject-out cross validation was used giving an average accuracy of 94.5 %, a major improvement from previous methods which had an accuracy of 84 % on the same dataset. The method was also validated on a dataset of the carotid artery to show that the method can generalize to blood vessels on other regions of the body. The accuracy on this dataset was 96 %.

Échoguidage

Automatic Localization of the Needle Target for Ultrasound-Guided Epidural Injections

Publisher: IEEE

4 Author(s) Mehran Pesteie ; Victoria Lessoway ; Purang Abolmaesumi ; Robert N. Rohling View All Authors

Abstract:
Accurate identification of the needle target is crucial for effective epidural anesthesia. Currently, epidural needle placement is administered by a manual technique, relying on the sense of feel, which has a significant failure rate. Moreover, misleading the needle may lead to inadequate anesthesia, post dural puncture headaches, and other potential complications. Ultrasound offers guidance to the physician for identification of the needle target, but accurate interpretation and localization remain challenges. A hybrid machine learning system is proposed to automatically localize the needle target for epidural needle placement in ultrasound images of the spine. In particular, a deep network architecture along with a feature augmentation technique is proposed for automatic identification of the anatomical landmarks of the epidural space in ultrasound images. Experimental results of the target localization on planes of 3-D as well as 2-D images have been compared against an expert sonographer. When compared with the expert annotations, the average lateral and vertical errors on the planes of 3-D test data were 1 and 0.4 mm, respectively. On 2-D test data set, an average lateral error of 1.7 mm and vertical error of 0.8 mm were acquired.

Published in: IEEE Transactions on Medical Imaging (Volume: 37 , Issue: 1 , Jan. 2018)

Page(s): 81 - 92

Date of Publication: 11 August 2017

ISSN Information:

INSPEC Accession Number: 17436243

DOI: 10.1109/TMI.2017.2739110

Publisher: IEEE

Funding Agency:

Gestion de la douleur

International Workshop on Soft Computing Models in Industrial and Environmental Applications
International Conference on EUropean Transnational Education
Computational Intelligence in Security for Information Systems Conference
SOCO 2017, ICEUTE 2017, CISIS 2017: International Joint Conference SOCO'17-CISIS'17-ICEUTE'17 León, Spain, September 6–8, 2017, Proceeding pp 461-470 | Cite as

A Machine Learning Based System for Analgesic Drug Delivery

Authors | Authors and affiliations

Jose M. Gonzalez-Cava, Rafael Arnay, Juan Albino Méndez Pérez, Ana León, María Martín, Esteban Jove-Perez, José Luis Calvo-Rolle, Jose Luis Casteleiro-Roca, Francisco Javier de Cos Juez

Conference paper
First Online: 23 August 2017

Part of the Advances in Intelligent Systems and Computing book series (AISC, volume 649)

Abstract

Monitoring pain and finding more efficient methods for analgesic administration during anaesthesia is a challenge that attracts the attention of both clinicians and engineers. This work focuses on the application of Machine Learning techniques to assist the clinicians in the administration of analgesic drug. The problem will consider patients undergoing general anaesthesia with intravenous drug infusion. The paper presents a preliminary study based on

Gestion de la douleur

J Clin Monit Comput. 2013 Dec;27(6):659-68. doi: 10.1007/s10877-013-9487-9. Epub 2013 Jul 9.

Monitoring the nociception level: a multi-parameter approach.

Ben-Israel N[1], Kliger M, Zuckerman G, Katz Y, Edry R.

Author information

Abstract

The aim of the present study was to develop and validate an objective index for nociception level (NoL) of patients under general anesthesia, based on a combination of multiple physiological parameters. Twenty-five patients scheduled for elective surgery were enrolled. For clinical reference of NoL, the combined index of stimulus and analgesia was defined as a composite of the surgical stimulus level and a scaled effect-site concentration of opioid. The physiological parameters heart rate, heart rate variability (0.15-0.4 Hz band power), plethysmograph wave amplitude, skin conductance level, number of skin conductance fluctuations, and their time derivatives, were extracted. Two techniques to incorporate these parameters into a single index representing the NoL have been proposed: NoLlinear, based on an ordinary linear regression, and NoLnon-linear, based on a non-linear Random Forest regression. NoLlinear and NoLnon-linear significantly increased after moderate to severe noxious stimuli (Wilcoxon rank test, $p < 0.01$), while the individual parameters only partially responded. Receiver operating curve analysis showed that NoL index based on both techniques better discriminated noxious and non-noxious surgical events [area under curve (AUC) = 0.97] compared with individual parameters (AUC = 0.56-0.74). NoLnon-linear better ranked the level of nociception compared with NoLlinear ($R = 0.88$ vs. 0.77, $p < 0.01$). These results demonstrate the superiority of multi-parametric approach over any individual parameter in the evaluation of nociceptive response. In addition, advanced non-linear technique may have an advantage over ordinary linear regression for computing NoL index. Further research will define the usability of the NoL index as a clinical tool to assess the level of nociception during general anesthesia.

PMID: 23835792 DOI: 10.1007/s10877-013-9487-9

[Indexed for MEDLINE]

Gestion du bloc opératoire

Original Paper | Published: 14 April 2010

Prediction of Surgery Times and Scheduling of Operation Theaters in Optholmology Department

S. Prasanna Devi ✉, K. Suryaprakasa Rao & S. Sai Sangeetha

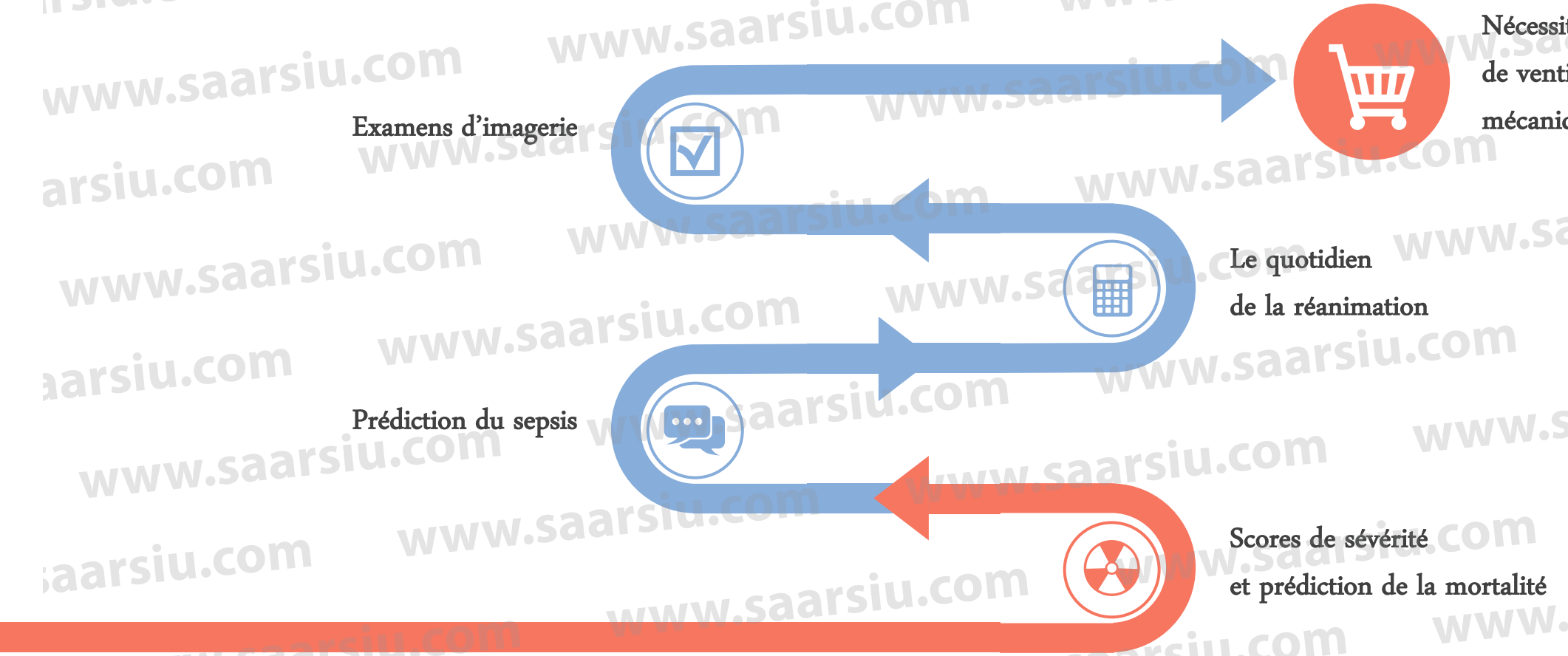
Journal of Medical Systems **36**, 415–430(2012) | Cite this article

598 Accesses | **15** Citations

Abstract

This paper presents the framework for forecasting the surgery time by taking into account the surgical environment in an ophthalmology department (experience of surgeon in years, experience of anesthetist in years, staff experience in years, type of anesthesia etc.). The estimation of surgery times is done using three techniques, such as the Adaptive Neuro Fuzzy Inference Systems (ANFIS), Artificial Neural Networks (ANN) and Multiple Linear Regression Analysis (MLRA) and the results of estimation accuracy were compared. Though the developed framework is general, it is illustrated for three ophthalmologic surgeries such as the cataract surgery, corneal transplant surgery and Oculoplastic surgery.

Réanimation



Activité du triage

Ann Emerg Med. 2018 May;71(5):565-574.e2. doi: 10.1016/j.annemergmed.2017.08.005. Epub 2017 Sep 6.

Machine-Learning-Based Electronic Triage More Accurately Differentiates Patients With Respect to Clinical Outcomes Compared With the Emergency Severity Index.

Levin S[1], Toerper M[2], Hamrock E[3], Hinson JS[4], Barnes S[5], Gardner H[4], Dugas A[4], Linton B[4], Kirsch T[6], Kelen G[4].

Author information

Abstract

STUDY OBJECTIVE: Standards for emergency department (ED) triage in the United States rely heavily on subjective assessment and are limited in their ability to risk-stratify patients. This study seeks to evaluate an electronic triage system (e-triage) based on machine learning that predicts likelihood of acute outcomes enabling improved patient differentiation.

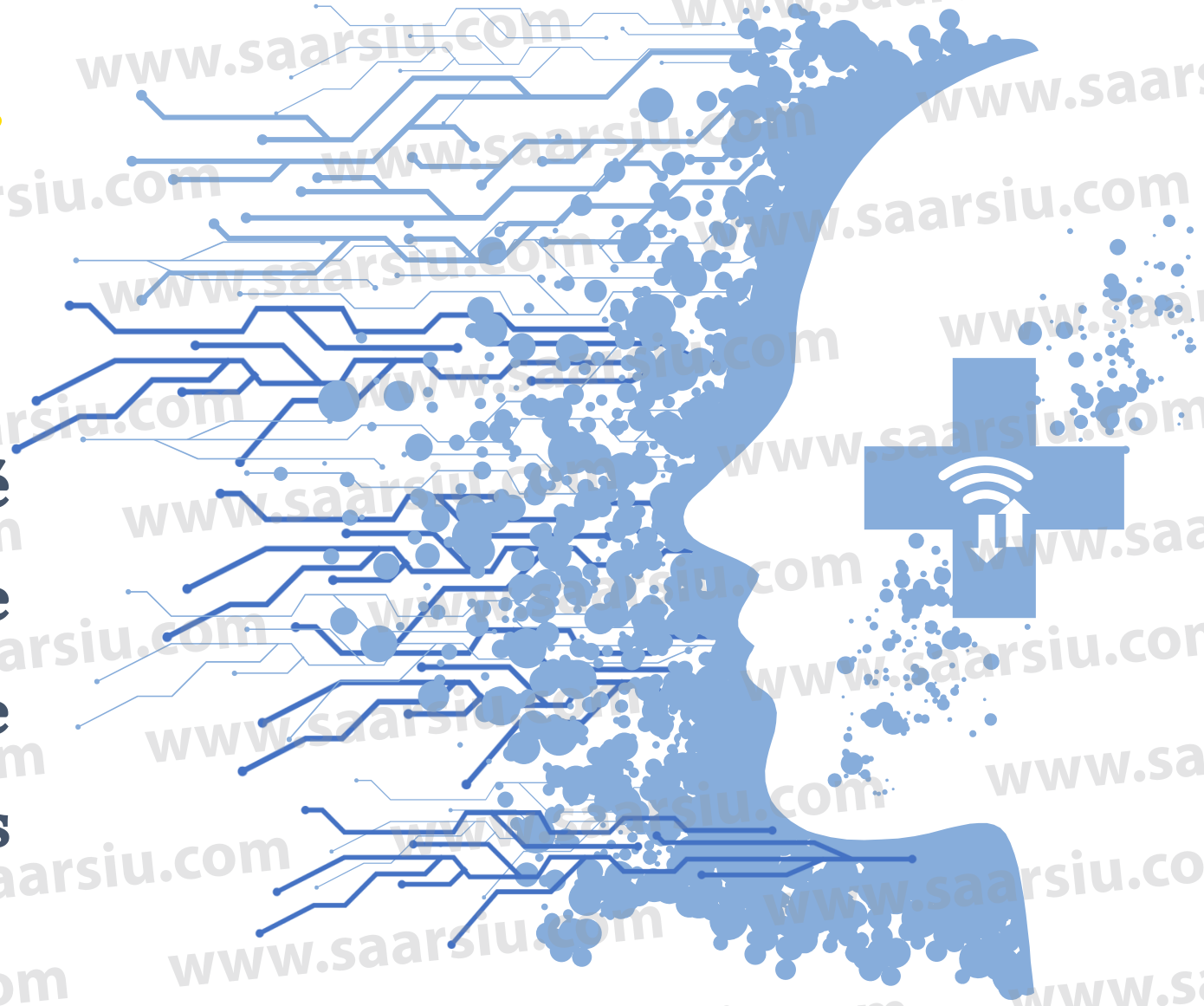
METHODS: A multisite, retrospective, cross-sectional study of 172,726 ED visits from urban and community EDs was conducted. E-triage is composed of a random forest model applied to triage data (vital signs, chief complaint, and active medical history) that predicts the need for critical care, an emergency procedure, and inpatient hospitalization in parallel and translates risk to triage level designations. Predicted outcomes and secondary outcomes of elevated troponin and lactate levels were evaluated and compared with the Emergency Severity Index (ESI).

RESULTS: E-triage predictions had an area under the curve ranging from 0.73 to 0.92 and demonstrated equivalent or improved identification of clinical patient outcomes compared with ESI at both EDs. E-triage provided rationale for risk-based differentiation of the more than 65% of ED visits triaged to ESI level 3. Matching the ESI patient distribution for comparisons, e-triage identified more than 10% (14,326 patients) of ESI level 3 patients requiring up triage who had substantially increased risk of critical care or emergency procedure (1.7% ESI level 3 versus 6.2% up triaged) and hospitalization (18.9% versus 45.4%) across EDs.

CONCLUSION: E-triage more accurately classifies ESI level 3 patients and highlights opportunities to use predictive analytics to support triage decisionmaking. Further prospective validation is needed.

Objectif

Faisabilité et fiabilité de l'intelligence artificielle quant à l'activité de triage aux urgences



Malades et méthodes

Étude observationnelle prospective

Multicentrique (SAU, SAUP, 20 août)

4 mois

Admission primaire, Medvire

Medvire Urgences

Malades et méthodes

Accueil du patient

1ère étape

Critères d'inclusion ?

2ème étape

Analyse Medvire Diagnostics

3ème étape

Analyse Medvire Orientation

4ème étape

Triage Internes

5ème étape

Analyse Internes Diagnostics

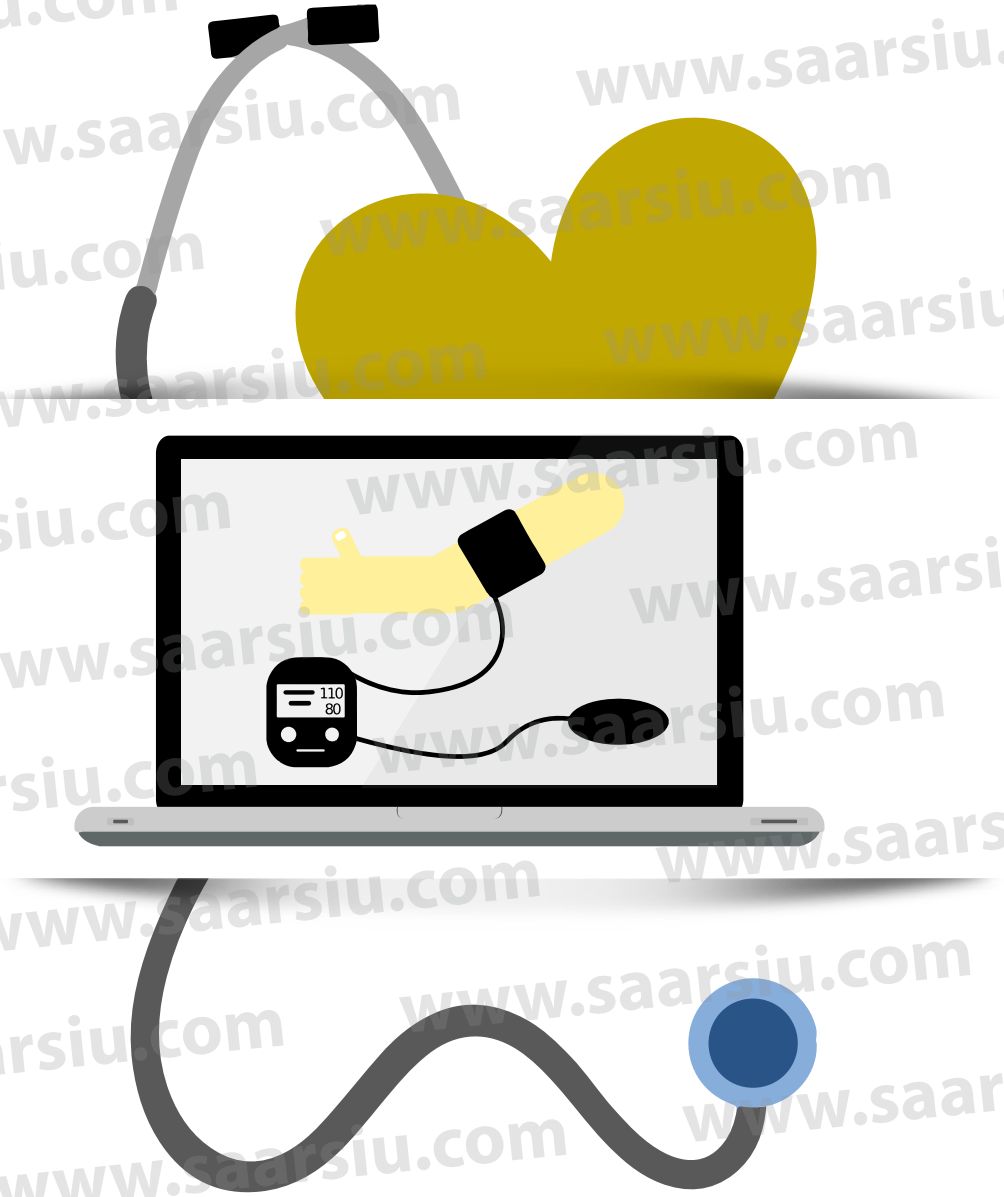
6ème étape

Analyse Internes Orientation

7ème étape

Analyse Concordances

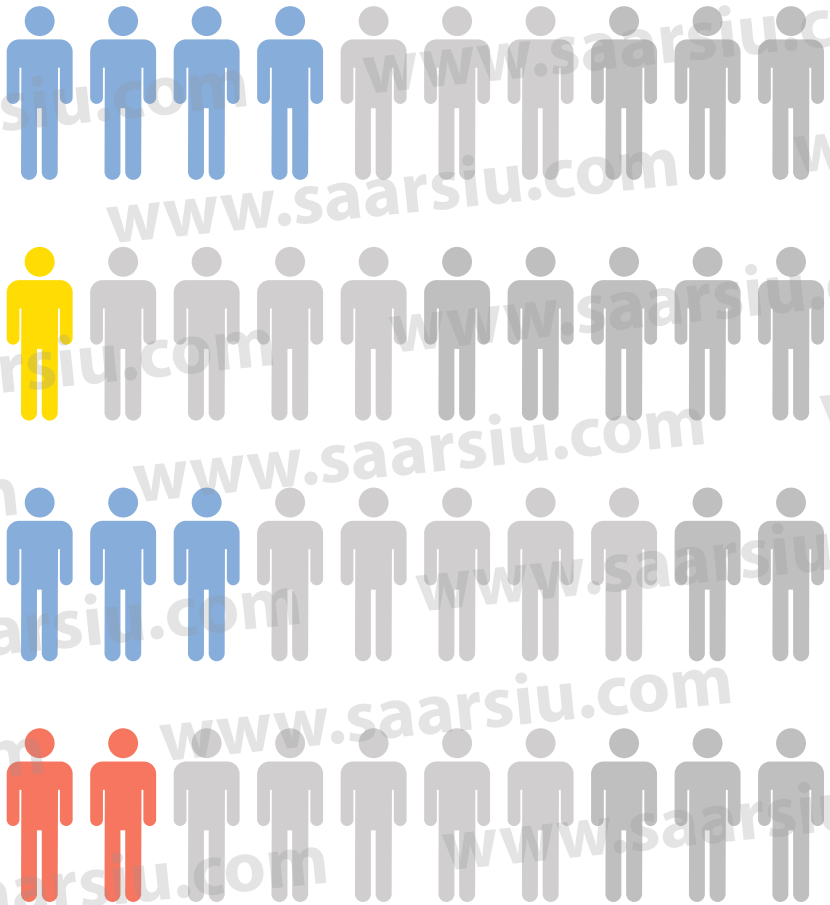
8ème étape



Résultats

Nombre de patients inclus	**300**
Âge moyen	**42 ans**
Sex-ratio	**0,96**
ATCD médical	**54%**
ATCD chirurgical	**33%**

Diagnostics Internes *vs* Medvire



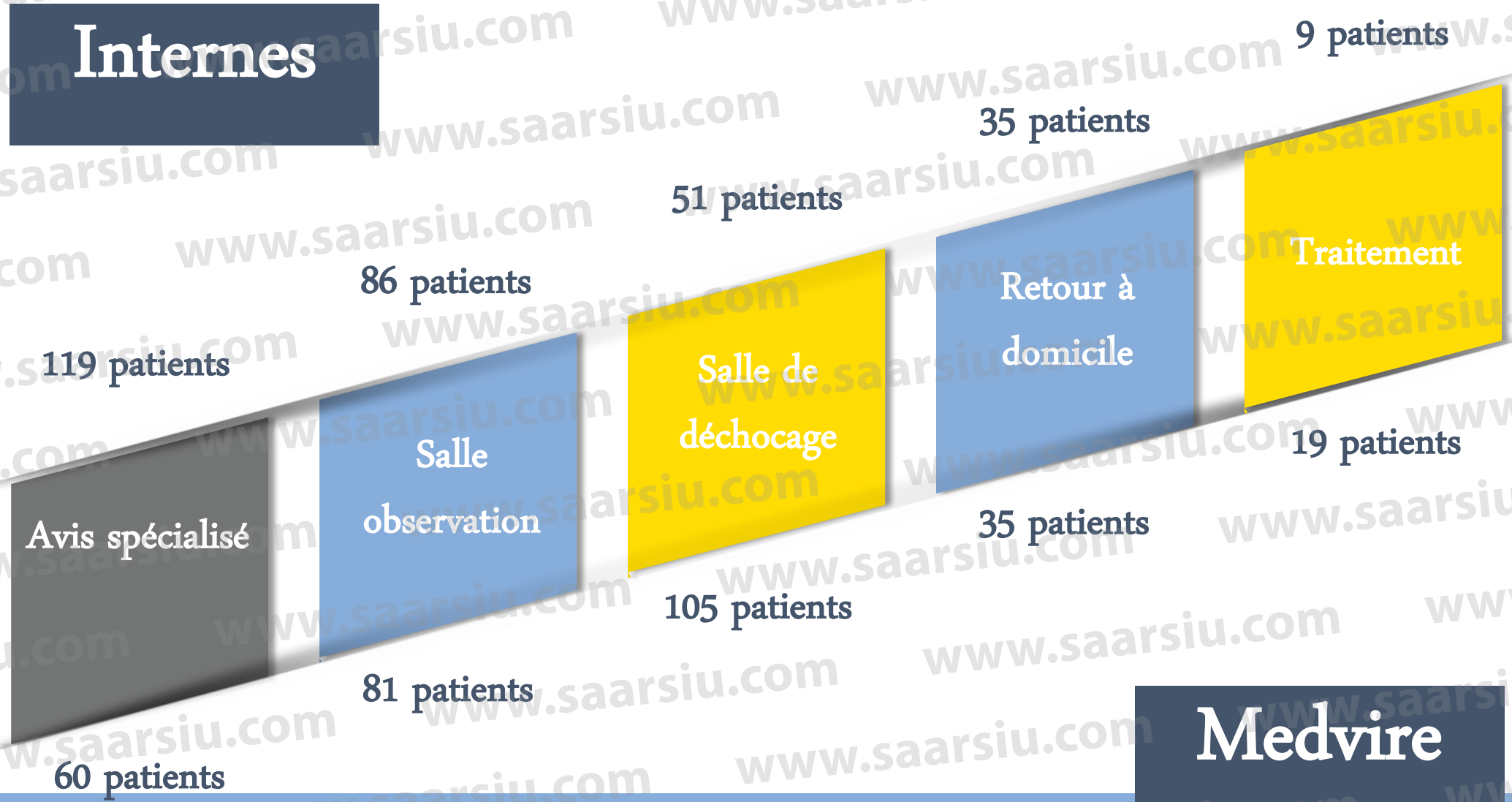
37% ≥ 3 diagnostics en commun

5% 2 diagnostics en commun

34% 1 seul diagnostic en commun

24% Divergence diagnostique

Orientation Internes *vs* Medvire



Commentaires

Faisabilité de l'IA aux urgences

Concordance diagnostique satisfaisante

Chronophagie

Moins bonne concordance sur l'orientation

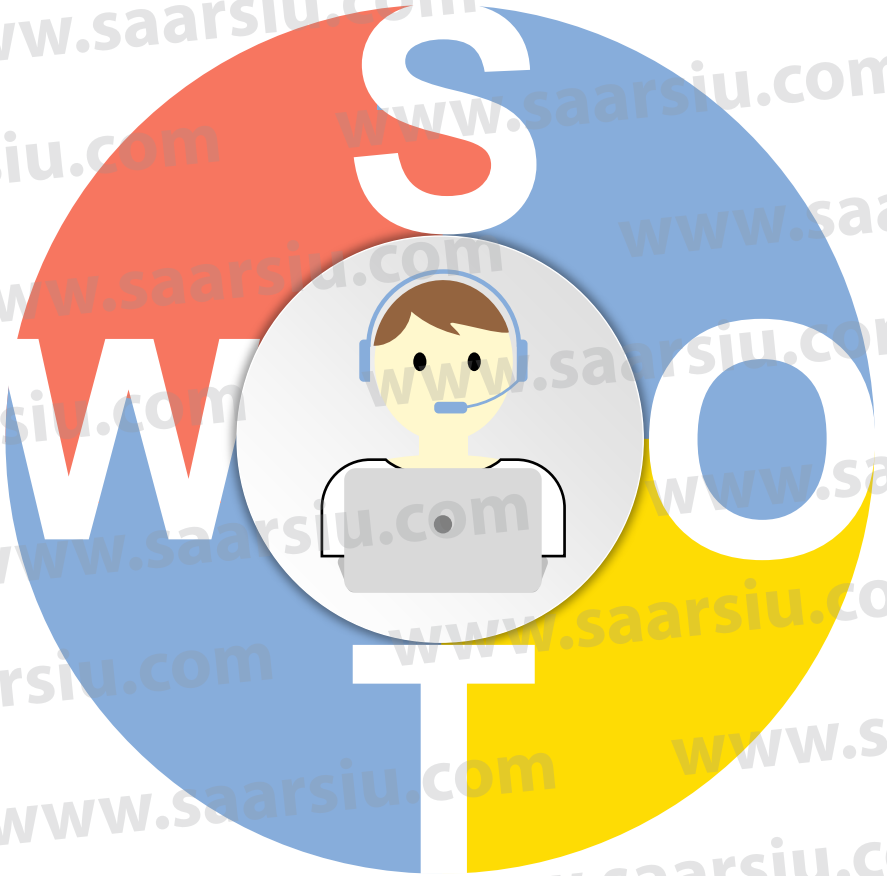
Commentaires

Forces

Reproductibilité

Opportunités

Digitalisation



Faiblesses

Fiabilité et EBM

Menaces

Impact social

Conclusion

Intelligence artificielle et triage

Solution possible pour le diagnostic et l'orientation

Fiabilité et robustesse à prouver

Création d'une fonction triage dédiée (IOA voire MOA)

Limites

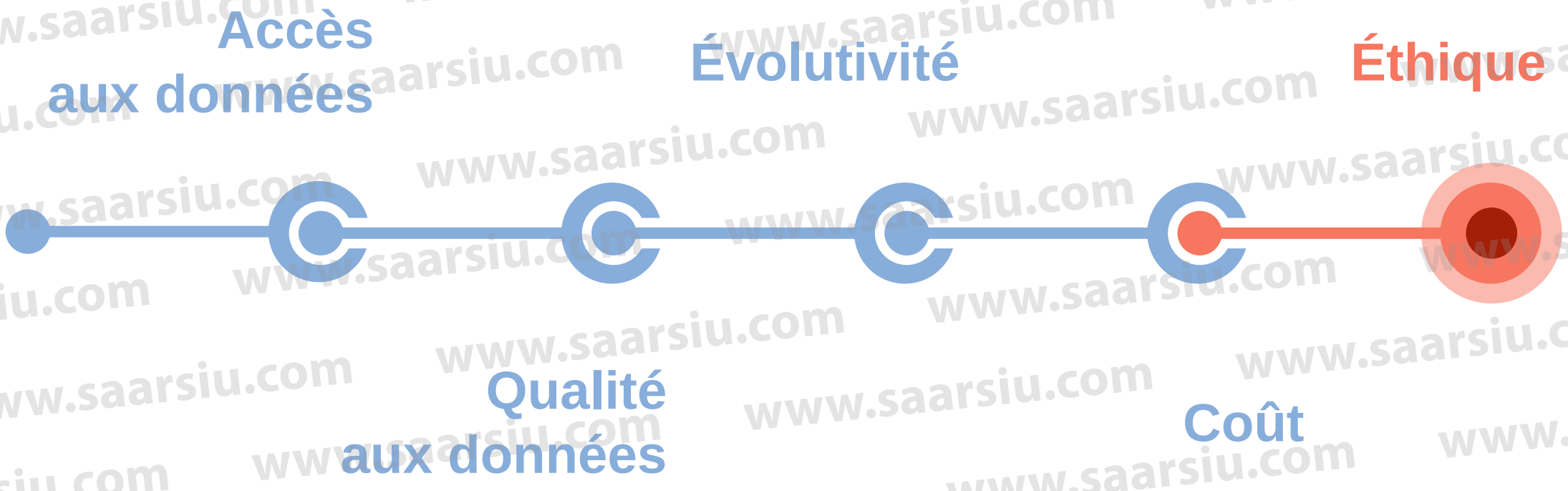
Attentes exagérées

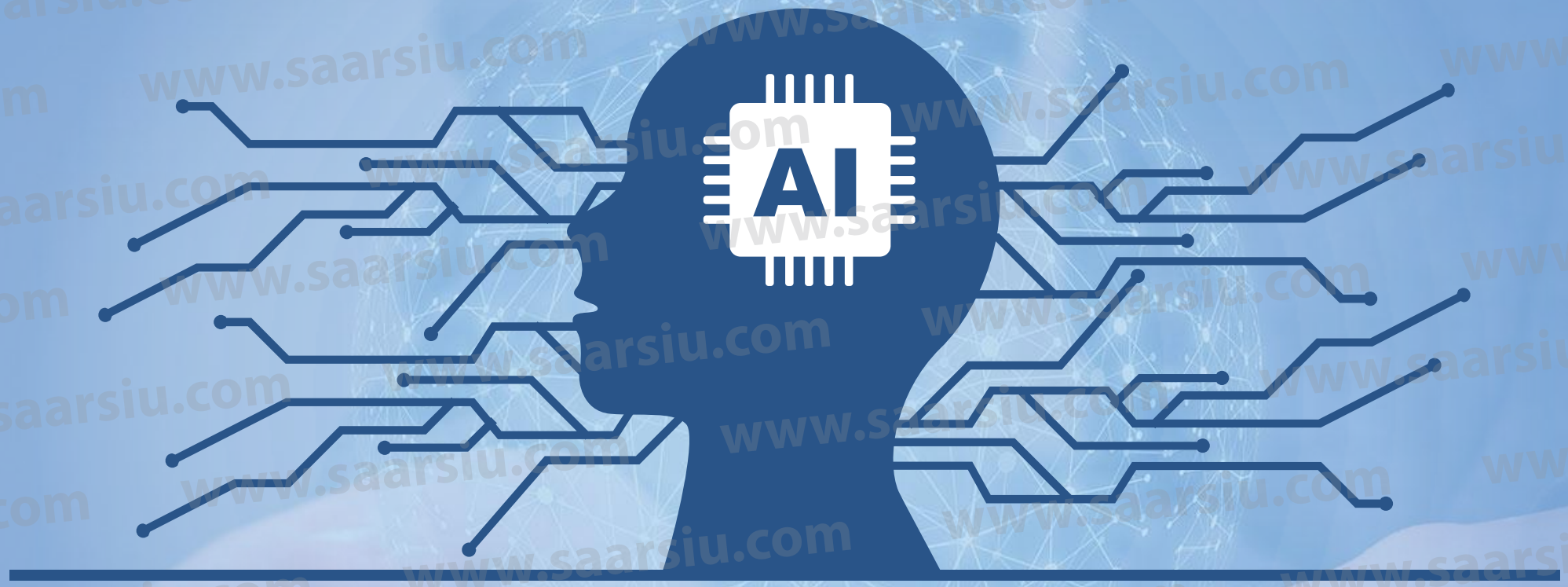
Box noirs

Biais de sélection

Effet nouvelle mode

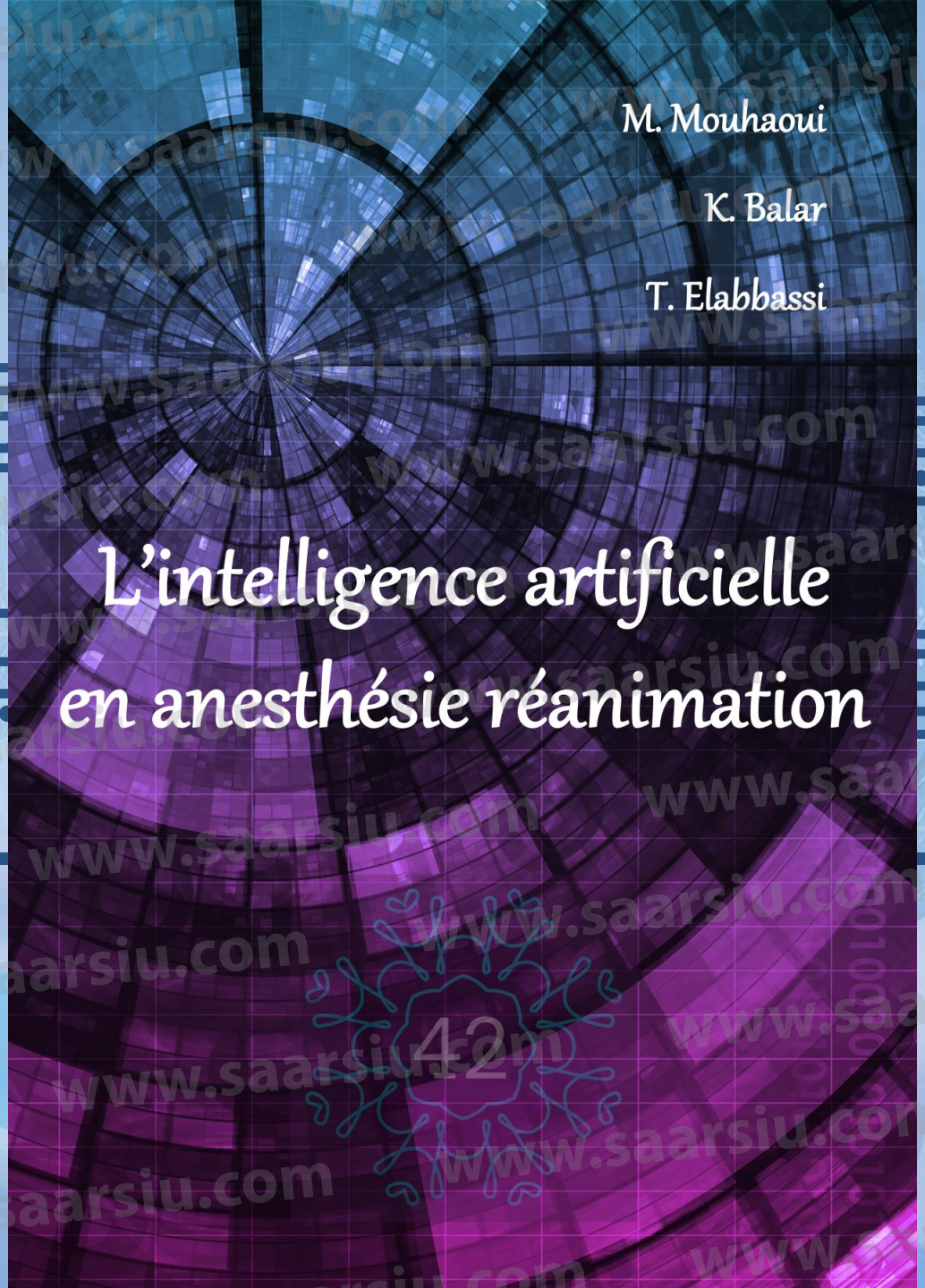
Challenges





Trop d'intelligence artificielle

tue l'intelligence !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