Big Data em Saúde: Desafios e Perspectivas

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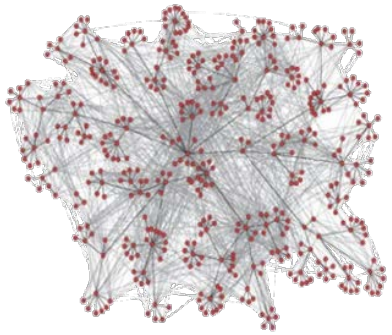
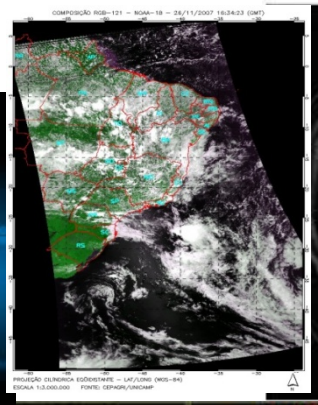
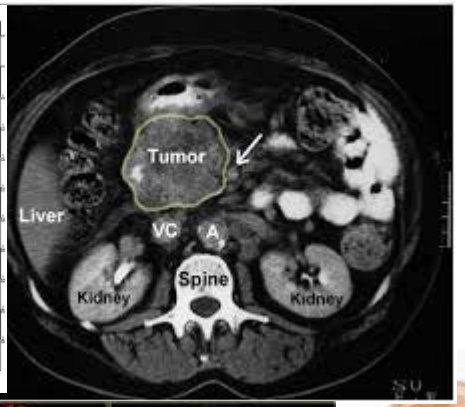
Introduction

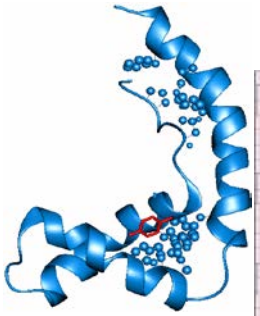
Current Scenario...

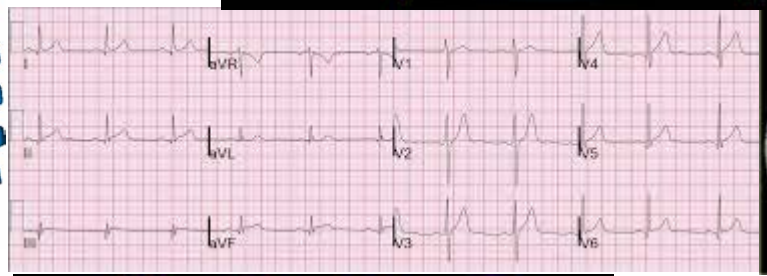
Complex big data everywhere

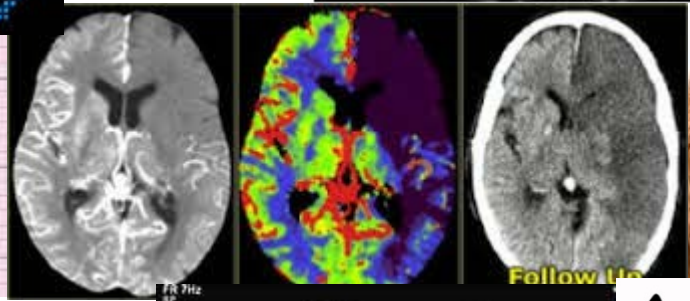


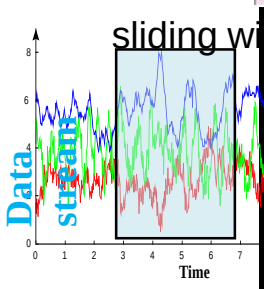


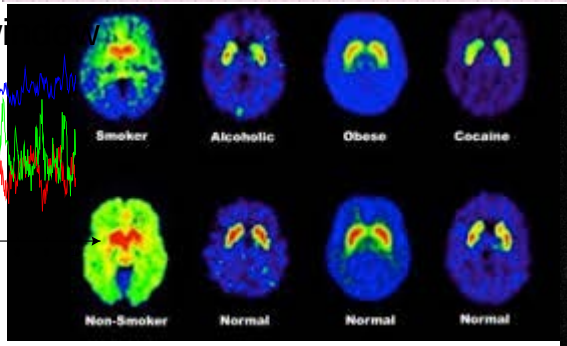


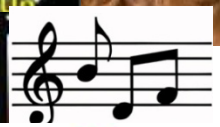






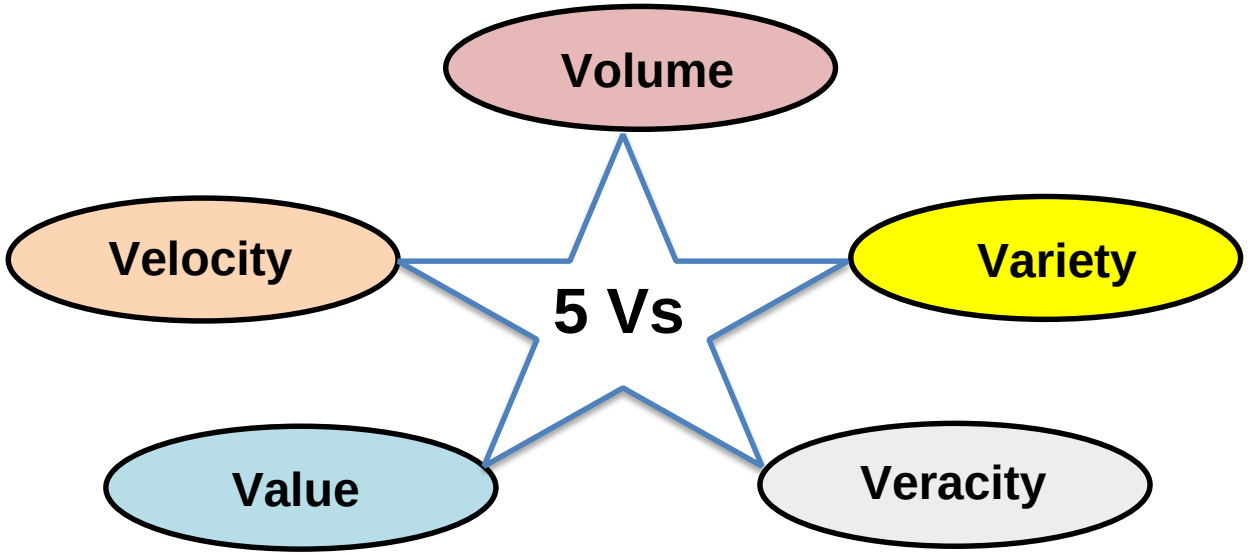






Current Scenario... Big Data

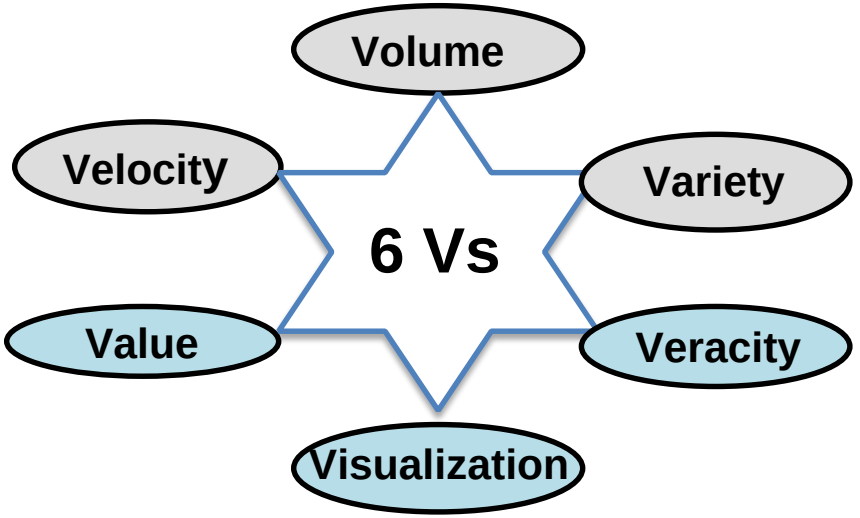
150 exabytes or 10^{18} bytes of new healthcare data generated yearly in USA, growing 48% annually [1]



[1] Nature Medicine | VOL 25 | Jan 2019 | 24–29 | www.nature.com/naturemedicine
Stanford Health. Harnessing the power of data in health. *Stanford Medicine 2017 Health Trends Report* (2017).

Introduction: Big Data challenges

- Development of **new**, **scalable** and **expandable** big data infrastructure (*volume*, *velocity*, *variety*),
- **analytical methods** (*veracity* and *value* and
- **visualization** techniques to support understanding data/information/knowledge gathered yielding better decisions and outcomes.

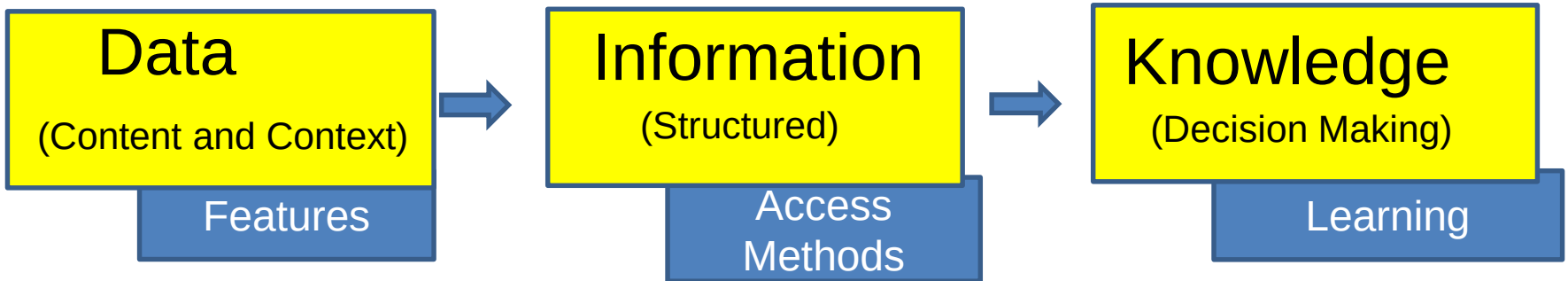


Current Scenario... Big Data

A great need for developing **automated systems** that could help users to **retrieve complex data** from the databases, employing their inherent **content** supported by their **context**

Thus, for each type of data it is important:

- Extract the relevant **features** that **best describe** them
- Get **dependable** data
- **Index** the data for **fast retrieval/processing** (**scalability**)
- Process queries on their content (**Similarity queries**)



DIKW Pyramid

garbage in ► garbage out

DIKW Pyramid

Considering the *DIKW* Pyramid:

- **How** are my data?
- **What** the data can **provide**?
- **When** the data is useful?
- **Who** owns the data? Who benefits from the data?

Ethical issues

Ethical issues: some studies

- **United Kingdom** survey (April 2018): 65% have reservations on allowing personal data to improve healthcare and is unfavorable to AI replacing doctors and nurses [1]
- **Germany**: 83% medical students are motivated with AI, but skeptical regarding diagnosing ... [2]
- **USA:** ~50% healthcare organizations decision-makers are not confident that AI will improve medicine, but ~ 50% of them have reservations [3]:
  - produce fatal errors,
  - not work properly,
  - not meet currently hyped expectations

1. Fenech M, Strukelj N, Buston O. *Ethical, social and polictical challenges of artificial intelligence in health.* 2018 April. http://futureadvocacy.com/wp-content/uploads/2018/04/1804_26_FA_ETHICS_08-DIGITAL.pdf.
2. Pinto dos Santos D, Giese D, Brodehl S, Chon SH, StaabWet al. *Medical students' attitude towards artificial intelligence: a multicentre survey*. Eur Radiol 2018 Jul 6. https://doi.org/10.1007/s00330-018-5601-1 PMID: 29980928
3. Intel Corporation. *Overcoming barriers in AI adoption in healthcare*. 2018 April https://newsroom.intel.com/wp-content/uploads/sites/11/2018/07/healthcare-iot-infographic.pdf.

Ethical issues: Principles

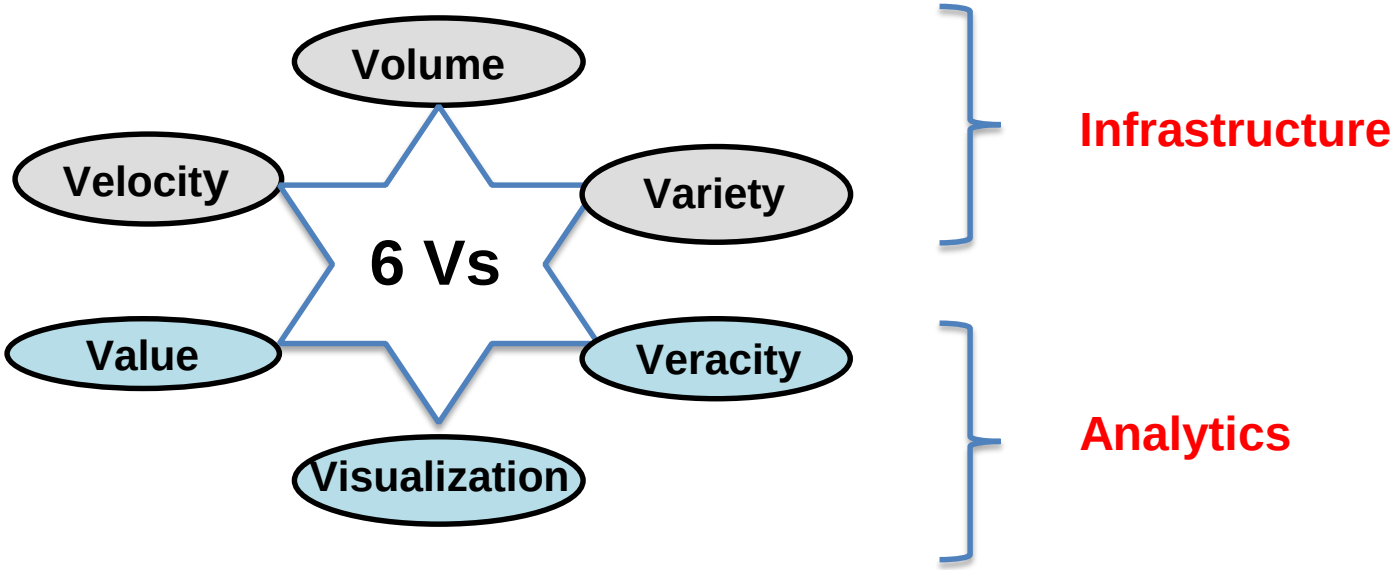
- transparency
- fairness
- non-maleficence
- liability
- privacy

❑ European General Data Protection Regulation (GDPR): Europe
❑ Health Insurance Portability and Accountability Act (HIPAA): USA
...

Explainable AI (XAI) vs. Black Box

Big Data still has meaningfull challenges !

- Development of **new**, **scalable** and **expandable** big data infrastructure (*volume*, *velocity*, *variety*),
- **analytical methods** (*veracity*, *value* *and* *visualization*)



Complex data with Missing values

- Big data applications must deal with:
  - Large number of data elements (i.e., cardinality)
  - High dimensionality (i.e., number of attributes)
  - Complexity of the features that describe the attributes
  - Non-dimensional data (e.g. DNA sequences)

Missing data can occur due to:

- **Preventable errors** or **mistakes** (e.g. failing to appear for a medical exam,…etc).
- Problems **outside of control** (e.g. failure of the equipment, low battery,…etc).
- Privacy or security reason.
- **Legitimate** (e.g. a survey question that does not apply to the respondent).

	A_1	A2	A3	A4	A5
Obj_1					
Obj_2					
Obj_3					
Obj_4					
Obj_5					

	A_1	A2	A3	A4	A5
Obj_1		?		?	
Obj_2	?	?			
Obj_3	?	?	?	?	?
Obj_4		?			
Obj_5		?			?

Safia Brinis, Caetano Traina Jr., Agma Traina - *Hollow-tree: a Metric Access Method for Data with Missing Values*, Journal of Intelligent Information Systems, pp. 1-26. DOI: 10.1007/s10844-019-00567-8

Conclusions

Complex big data bring new interesting challenges:

- regarding BD infrastructure and analytics as well

- Access methods to query processing (**high-dimensional** and **adimensional data)**,

- **Scalable approaches** to deal with **missing data,**

- New mechanisms for **organizing the data,**

- To ease the problem of **“garbage in garbage out”**

- A **closer relationship with related fields** to gather/convey to the users the knowledge & wisdom needed and desired.

Many opportunities to work/research!

Thanks!

- To all the members of the **Databases and Images Group (GBdI)** ICMC-USP/São Carlos and **MiVisBD** research

- To the Ciência e Inovação Digital em Saúde FAPESP organizers

- To **you all** for attending to this panel

ACKNOWLEDGMENT