

Big Data Analytics and Artificial Intelligence

Prof. Dr Zhaohao Sun, PhD, Director & HoD
Centre of Big Data Analytics and Intelligent Systems
Department of Business Studies
PNG University of Technology
zhaohao.sun@pnguot.ac.pg; zhaohao.sun@gmail.com

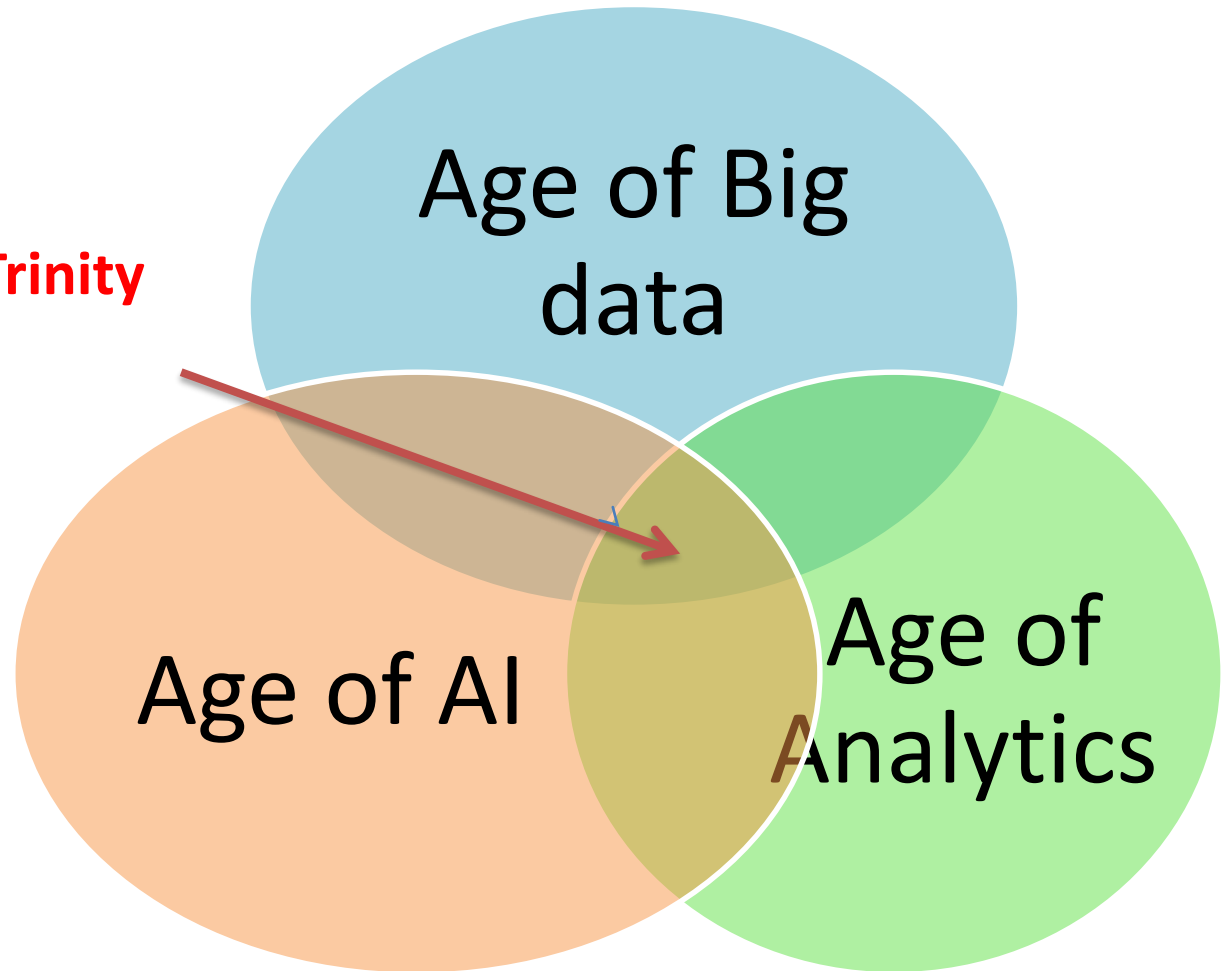
Outlines

- ❑ An age of trinity: big data, analytics and artificial intelligence (AI)
 - ❖ An age of big data
 - ❖ An age of analytics
 - ❖ An age of artificial intelligence
- ❑ Intelligent Big Data Analytics
- ❑ My research
- ❑ Conclusion

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An age of trinity: big data, analytics and artificial intelligence (AI)

The age of Trinity



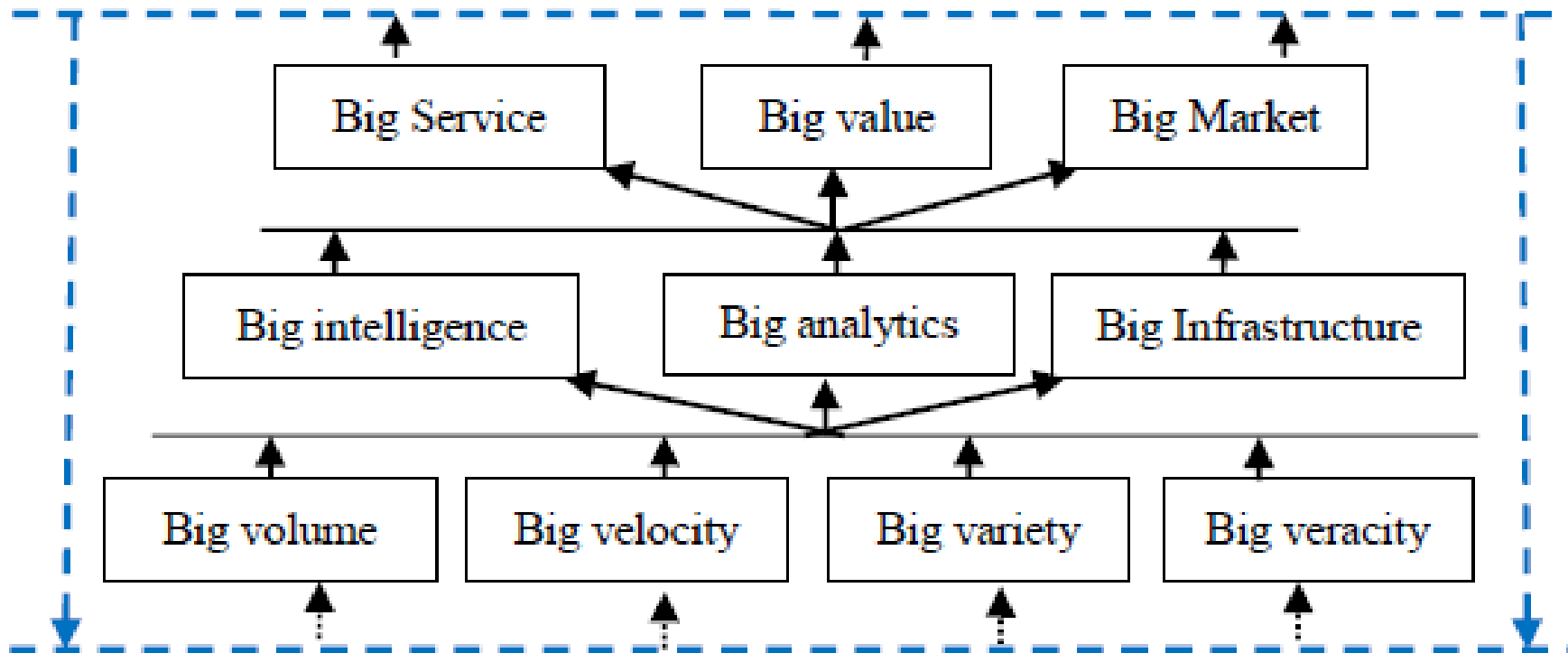
The Age of Big Data

- ❑ 2002 Gartner researcher described 3D->3V of big data in e-commerce
 - ❖ the 3V. Doug Laney (Laney, 2001) used 3V: volume, velocity and variety to represent the 3v characteristics of big data
- ❑ 2007 *Nature* published a special issue on big data
- ❑ 2011 McKinsey published big data as the next Frontier for innovation and productivity.
 - ❖ Big data in 2012 (March) as USA Gov Initiative
<http://www.cccb.org/2012/03/29/obama-administration-unveils-200m-big-data-rd-initiative>
- ❑ I circulated the news to my colleagues at UB the following day as an issue of ITIS series as the start of the age of big data
 - ❑ Ref: Manyika, James, et al. “Big data: The next Frontier for innovation and productivity”, McKinsey May 2011.

The Age of Big Data



Big data with 10 Big Characteristics



□ Sun et al (August 2016) Big data with 10 Big Characteristics.

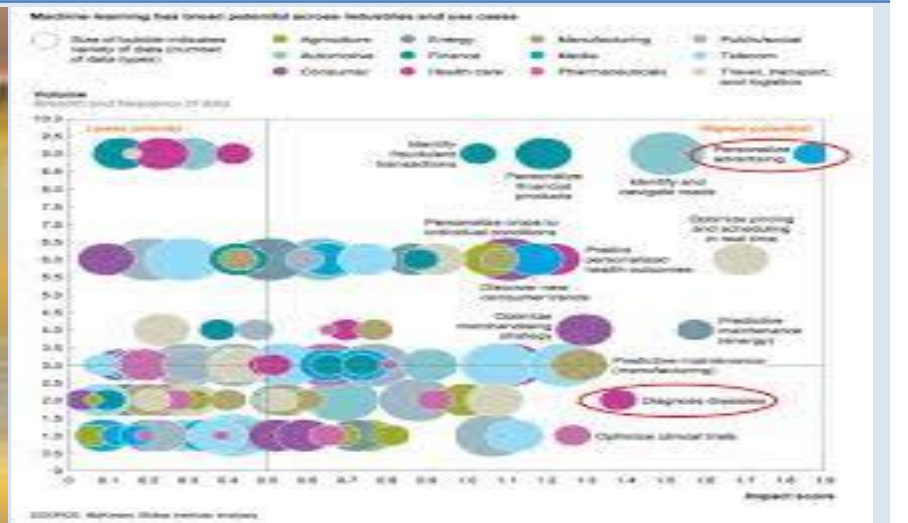
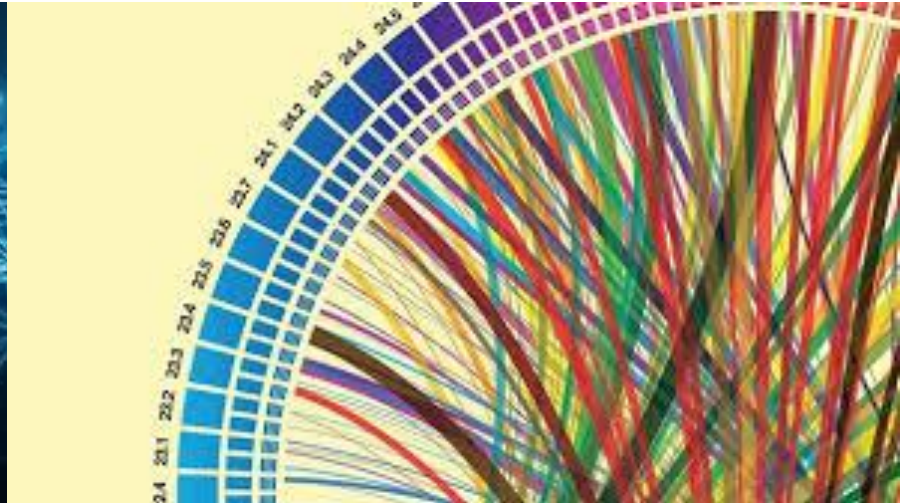
The Age of Big Data-II

- ❑ Cameron Chell (2015), The Age of Big Data, Youtube Oct 28
 - ❖ <https://www.youtube.com/watch?v=nGcxmxzeEe0>
- ❑ Big data is equivalent to the oil of 20th century
- ❑ Big data is the goldmine of the 21st century
- ❑ Big data is a strategic asset of an organisation, a government, and individual.
- ❑ Everyone is proactive contributor to big data
 - ❖ Are you a beneficiary from big data?
 - ❖ Yes, You have used smart, the Internet phone,...
 - ❖ No, because you are neither a millionaire nor a billionaire from big data, like Zuckerberg of Facebook, Jeff Bezos of Amazon
 - ❖ ?

The age of Analytics

- ❑ Sun (2012-2013)
 - ❖ Big data like oil has not very big value, However, the commercial value of big data becomes bigger and bigger with its processing, deep processing, smart processing, intelligent processing
- ❑ What is behind processing, deep processing, second time processing, multi-processing Of big data
- ❑ This is big data analysis, more important than big data
- ❑ This is the reason why I have been undertaking research on it since 2013.
- ❑ McKinsey Global Institute (December 2016), The age of analytics: Competing in a data-driven world
 - ❖ <http://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/the-age-of-analytics-competing-in-a-data-driven-world>

The age of Analytics



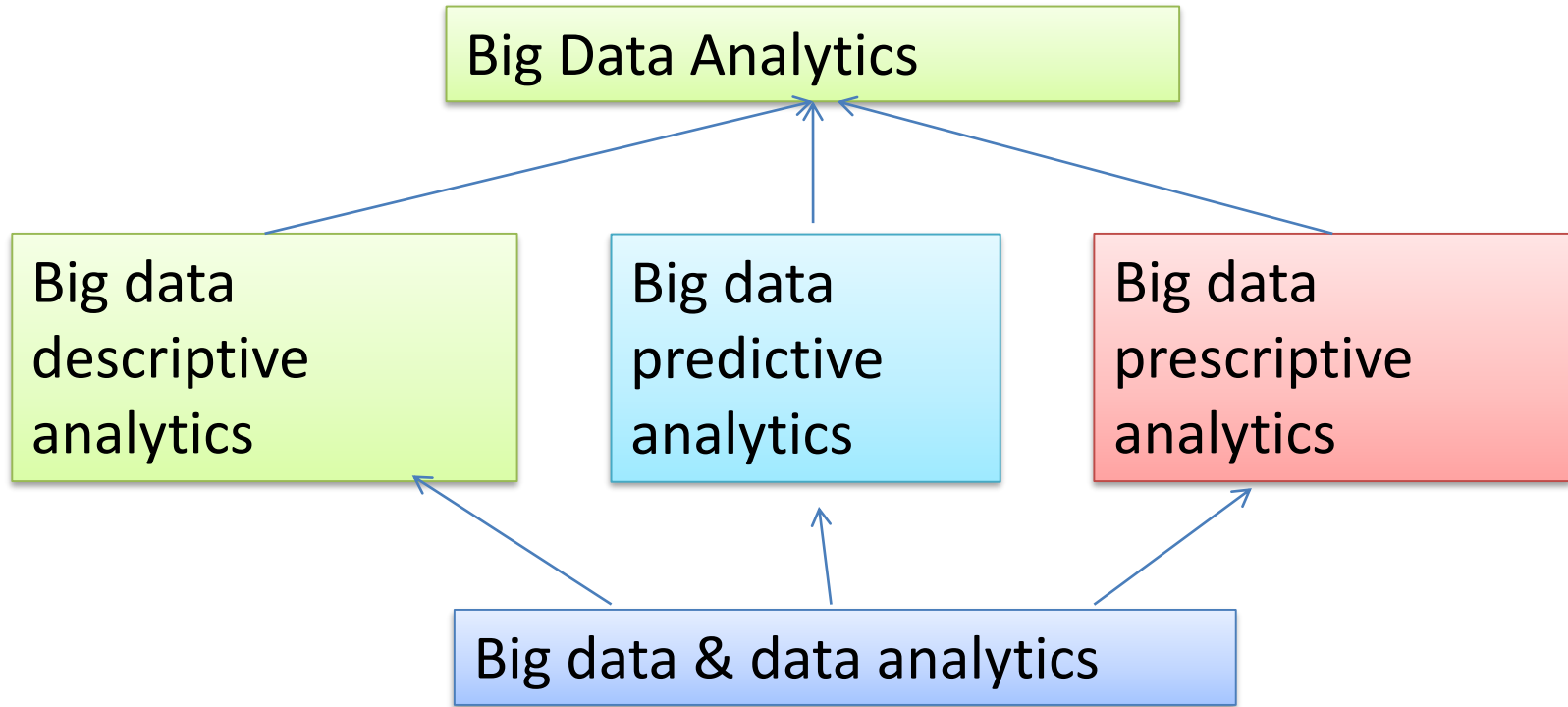
The age of Analytics

- ❑ [McKinsey & Company](#) The age of analytics: Youtube, Dec 8, 2016
 - ❖ <https://www.youtube.com/watch?v=gO8-5v2zjf0>
- ❑ Data analytics might be the oldest among all types of analytics (since 1936). So is business analytics
- ❑ Data analytics is a method or technique that uses data, information, and knowledge to learn, describe and predict something.
- ❑ Data analytics is the science and technology about examining, summarizing, and drawing conclusions from data to learn, describe and predict something.
 - ❑ Ref: Sun, Z; Sun, L; Strang, K (2016) Big Data Analytics Services for Enhancing Business Intelligence, Journal of Computer Information Systems (JCIS), DOI:10.1080/08874417.2016.1220239

Big Data Analytics

- ❑ Big data analytics (BA) is science and technology about to collect, organize and analyse big data to discover patterns, knowledge, and intelligence as well as other information within the big data [7]*.
- ❑ BA is an emerging science and technology involving the multidisciplinary state-of-art ICT, mathematics, operations research (OR), machine learning, and decision science for big data [1, 2]
- ❑ BA = big data descriptive analytics + big data predictive analytics + big data prescriptive analytics [11]
 - ❖ Ref: Sun Z, Zou, H, & Strang K (2015) Big data analytics as a service for business intelligence, LNCS9373, pp. 200-211, 2015, Springer.

An Ontology of Big Data Analytics



- ❖ Ref: Sun Z, Zou, H, & Strang K (2015) Big data analytics as a service for business intelligence, LNCS9373, pp. 200-211, 2015, Springer

Technical Fundamentals of Big Data Analytics

❑ Big data analytics = Big data + Data analysis + DW + DM + SM + ML
+ Visualization + optimization

- ❖ DW = data warehouse, DM = Data mining, SM = statistical modelling
- ❖ ML = machine learning
- ❖ Aims to enhance decision making

❑ Examples:

- ❖ Google analytics, Amazon analytics, Baidu analytics
- ❖ Health Analytics: Please see your smart phone.
- ❖ Research Analytics 2.0 (many staff and students of Unitech there)
- ❖ Ref: Sun Z, Zou, H, & Strang K (2015) Big data analytics as a service for business intelligence, LNCS9373, pp. 200-211, 2015, Springer
- ❖ Sun, Z; Sun, L; Strang, K (2016) Big Data Analytics Services for Enhancing Business Intelligence, Journal of Computer Information Systems (JCIS), DOI:10.1080/08874417.2016.1220239

The Age of Artificial Intelligence

- ❑ Autonomous vehicles, advanced vision systems, virtual customer assistants, smart personal agents and natural language processing are all the advanced technology of market-driven AI (Laney & Jain, 2017).
 - ❖ Google, Baidu Driverless car
- ❑ Mobile devices (e.g. Smart phone): provide health analytics, weather, shopping and travel services to you wherever you are, whenever you are
 - ❖ Your position can be tracked,
 - ❖ You are selfless contributor to big data
- ❑ Whenever you click, you can be instructed to click next.
 - ❖ Your click has been tracked
 - ❖ You are selfless contributor to big data.
- ❑ Robots, bots around you, help you more and more, track you more and more.

The Age of Artificial Intelligence



The Age of Artificial Intelligence

- ❑ George John, 2013, The Age of Artificial Intelligence, at TEDxLondonBusinessSchool.
 - ❖ <https://www.youtube.com/watch?v=0qOf7SX2CS4>
- ❑ The Age of Artificial Intelligence - The Rise of the Thinking Machines, 2016
 - ❖ <https://www.youtube.com/watch?v=Wjk06IPJQOc>
- ❑ John McCarthy, Kevin Minsky, Claude Shannon. 1956
- ❑ I taught AI since 1990, also knowledge engineering, expert systems
- ❑ Annual worldwide revenue from AI is projected to hit \$37 billion by 2025 (Ong 2017)
- ❑ Facebook, Amazon, Microsoft and Google formed a group called Partnership on AI, a not-for-profit that plans to formulate best practices in AI technology, in 2016 [Ong 2017]

Artificial Intelligence in Australia

- ❑ There is a huge boom in China and in the US towards AI and that's why things are moving very fast in those countries, where Australia is far behind
 - ❑ Australian universities have introduced courses on data sciences around data scientists, and not offered courses on AI, They believe that AI is more of [just] theory [Ong 2017].
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- ❖ (Ong 2017) Thuy Ong, Artificial intelligence coming sooner than you think, experts say, <http://www.abc.net.au/news/2017-04-13/artificial-intelligence-coming-sooner-than-you-think-experts-say/8440358> (retrieved on 130417)

Intelligence 2.0

□ What is intelligence (1.0)

- ❖ Basic: ability of learning + thinking + understanding=AI

□ Intelligence 2.0

- ❖ Advanced intelligence: BI + EI

- ❖ why I is advanced here

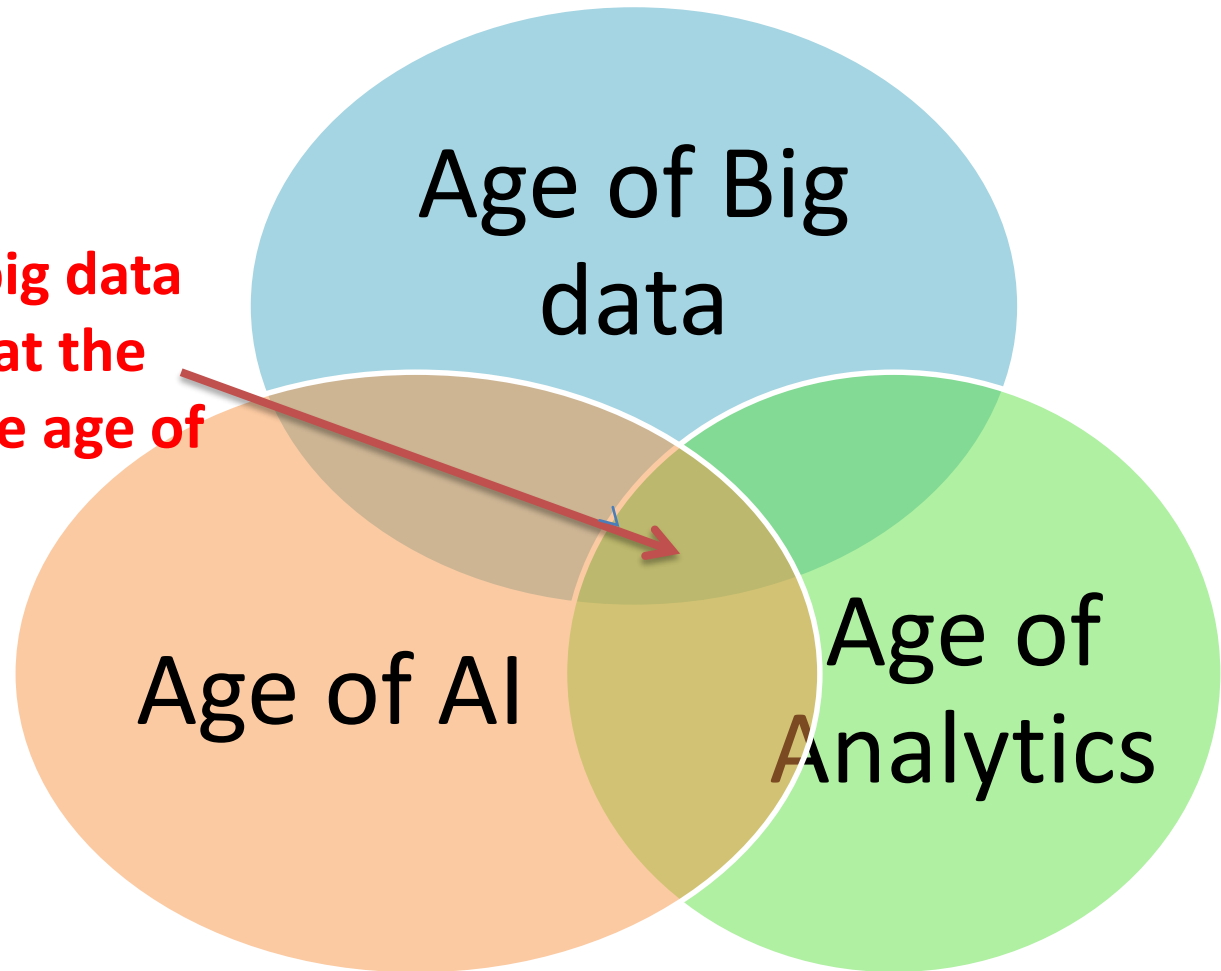
- Temporality
- Expectability ([Expectable](#))
- Relativity of intelligence

□ 2D analysis of 1st D and 2nd D and then one can get a spectrum of advanced intelligence: Intelligence 2.0

- Ref: Sun, Z; Sun, L; Strang, K (2016) Big Data Analytics Services for Enhancing Business Intelligence, Journal of Computer Information Systems (JCIS), DOI:10.1080/08874417.2016.1220239

Intelligent big data analytics is at the centre of the age of trinity

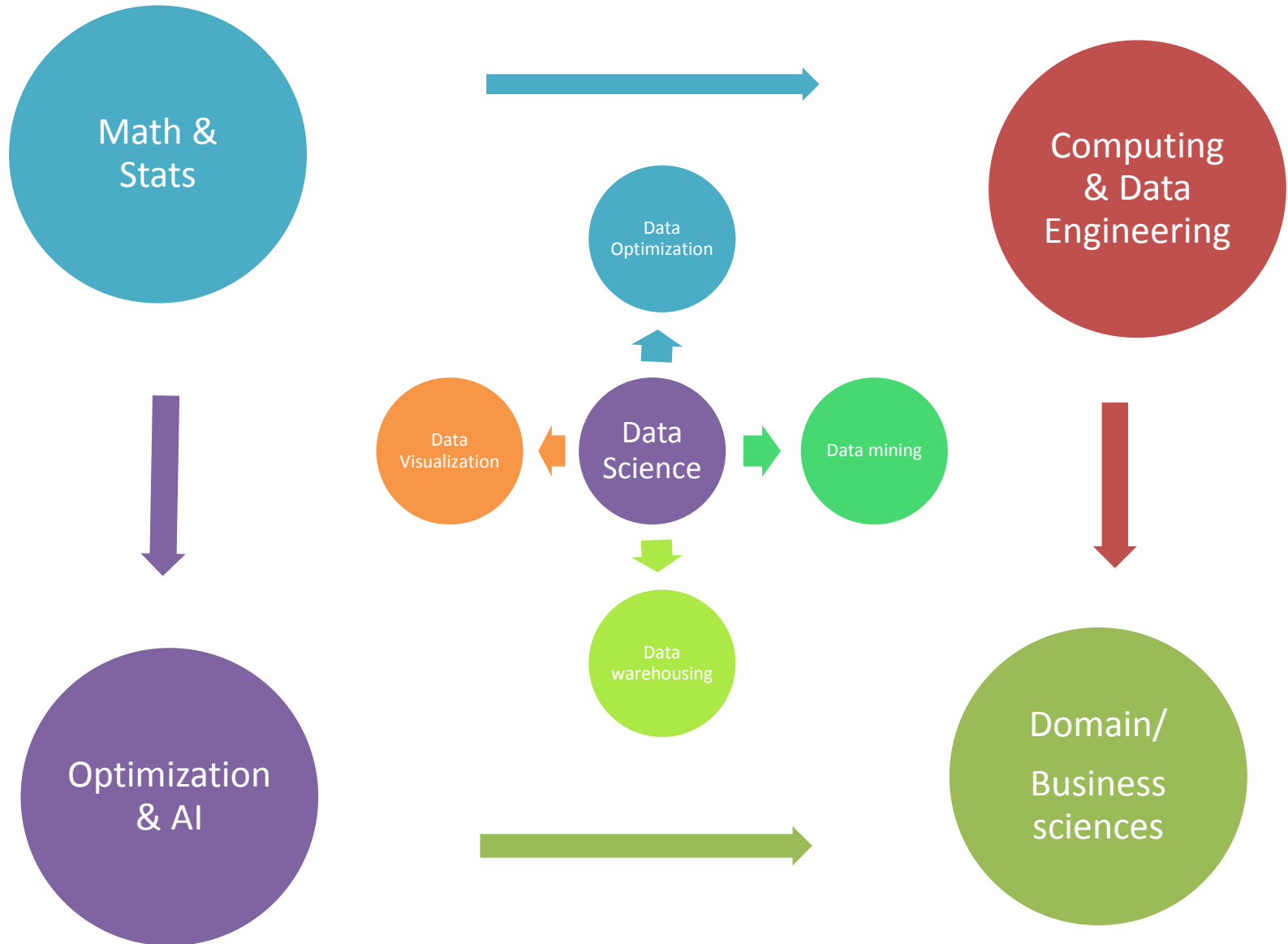
Intelligent big data analytics is at the centre of the age of trinity



Intelligent Big Data Analytics

- ❑ Intelligent Big data analytics = Big data analytics + AI
- ❑ Intelligent Big data analytics = Intelligent Big data + Intelligent Data analysis + Intelligent DW + Intelligent DM + Intelligent SM + Intelligent ML+ Intelligent Visualization + Intelligent optimization
- ❑ "Intelligent Big Data Analytics" has only 66 indices in Google Scholar, (retrieved on 06 Aug 2018)
 - ❖ It is at its infancy stage for development
- ❑ It is at the centre of the age of trinity: big data, analytics and AI
- ❑ It is the core of data science.

Data Science



My Research on Big Data 2010-2014

- ❑ I started to do research on big data in 2010.
 - ❖ I did some research on big statistics with applications in 2010
- ❑ After 2012's first announcement of big data in USA's government, I expedite my transfer to big data
- ❑ 2014 published a book on demand-driven web services (including the research on big data, analytics, analytics services, IoT)
 - ❖ Sun, Z et al (2014) demand-driven web services. IGI-Global, USA
- ❑ 2014 CP in ACM
 - ❖ Sun Z, et al (2014) Analytics service oriented architecture for enterprise information systems, CONFENIS 2014, 4 - 6 Dec 14, Hanoi. ACM Press, pp. 506-18.

My research on Big Data 2015

- ❑ 2015 published three conference proceeding papers (2 LNCS, 1 IEEE).
 - ❖ Sun Z, Zou, H, & Strang K (2015) Big data analytics as a service for business intelligence, The 14th IFIP Conf on e-Business, e-Services and e-Society (I3E 2015), 13-15 Oct, Delft, The Netherlands. M.Janssen et al. (Eds), Open and Big Data Management and Innovation. I3E 2015, LNCS9373, pp. 200-211, 2015, Springer.
 - ❖ Vajjhala N, Strang K, & Sun Z (2015) Statistical modeling and visualizing of open big data using a terrorism case study. The International Conference on Open and Big Data (OBD 2015), 24-26 Aug, Rome, IEEE Press. pp. 489-496.
 - ❖ Sun Z, Pambel F, Wang F (2015) Incorporating Big Data Analytics into Enterprise Information Systems. In I. Khalil et al. (Eds.): LNCS 9357, CONFENIS 2015, Daejeon, Korea, October 4–7, 2015, pp. 300-309.

My Research on Big Data 2016 (Cont)

- ❖ Sun, Z; Sun, L; Strang, K (2016) Big Data Analytics Services for Enhancing Business Intelligence, Journal of Computer Information Systems (JCIS), DOI:10.1080/08874417.2016.1220239
- ❖ Sun Z (2016) A Framework for Developing Management Intelligent Systems. International Journal of Systems and Service Oriented Engineering (IJSSOE). 6(1) 37-53.
- ❖ Sun, Z (2016) A logical approach to experience-based reasoning, Journal of New Mathematics and Natural Computation, Vol. 12, No. 4 (2016) 1–21
- ❖ Strang K & Sun Z (2016) Meta-Analysis of Big Data Security and Privacy: Scholarly Literature Gaps. IEEE Big Data 2016, Washington DC, USA. IEEE Press., pp.7-9
- ❖ Ref: www.researchgate.net

My Research on Big Data 2017

- 2017 Two journal papers (ERA A, SCI) (offline 2017) and one SCOPUS-indexed, one INSPEC and DBLIP indexed
 - ❖ Sun Z, Wang PP (2017) A Mathematical Foundation of Big Data. Journal of New Mathematics and Natural Computation. In Press (to be published in July).
 - ❖ Strang KD & Sun Z (2017) Big Data Paradigm: What is the Status of Privacy and Security? Annals of Data Science (Springer). 4(1): 1–17.
 - ❖ Sun Z, Strang D. K, & Firmin S (2017) Business Analytics-Based Enterprise Information Systems, Journal of Computer Information Systems (JCIS), 57(2): 169-178.
 - ❖ Strang D. K, & Sun Z (2017) Analyzing relationships in terrorism big data using Hadoop and statistics. Journal of Computer Information Systems, 57(1): 67-75 .

My current research on Big Data 2018

- ❑ Special Issues on
 - ❖ Big Data, Services and Intelligence in IJSSOE (IGI)
 - ❖ Big Data driven Risk and Contingency Management in IJRCM (IGI)
 - ❖ Health Analytics and Systems
- ❑ Three articles of peer-reviewed articles on Big Data, Analytics and Intelligence will be completed and published.
 - ❑ Book: Managerial Perspectives on Intelligent Big Data Analytics, IGI-Global, to be released 2019
 - ❑ A Mathematical Theory of Big Data

My Research profiles

❑ Research transparency and accountability

❑ Research analytics 1.0

❖ Google Scholar

❖ <https://scholar.google.com.au/citations?user=xaZMiV0AAAAJ&hl=en&oi=ao>

❑ Research analytics 2.0

❖ https://www.researchgate.net/profile/Zhaohao_Sun

❖ <https://www.semanticscholar.org/search?author%5B%5D=Zhaohao%20Sun&q=Zhaohao%20Sun&sort=relevance&ae=false>

❖ <https://www.academia.edu>.

❑ SCOPUS (63), DBLP (35), SCI (ISI) 35+, Harvard (120+)

Discussion and Implications

- ❑ We live in an interconnected world.
- ❑ The basic elements of the interconnected world are big data, analytics and intelligence
 - ❖ You cannot weigh big data, but you cannot leave it
 - ❖ You cannot understand big data analytics, although you use it daily
 - ❖ You cannot be a scholar of AI, but you always think about intelligence, can I become more intelligent? You do not reject smart phone, smart washing machine, smart TV, and smart laptop. ...

Conclusion

- ❑ Looks at the age of trinity: big data, analytics and AI.
- ❑ Explores intelligent big data analytics
- ❑ Proposes ten big characteristics of big data
- ❑ Introduces the presenter's research in big data analytics, business analytics, intelligent systems, and business intelligence.
- ❑ Future work: Analytics of Business Intelligence: a 3D method.
 - ❖ Business intelligence: A Modern Approach
 - ❖ Intelligent big data analytics : Foundations and Applications

References (see the references of the paper)

- ❑ Sun Z, Zou, H, & Strang K (2015) Big data analytics as a service for business intelligence, The I3E 2015, 13-15 Oct, Delft, Netherlands. LNCS 9373, Springer, DOI:10.1007/978-3-319-25013-7_16.
- ❑ C. P. Chen & C.-Y. Zhang, Data-intensive applications, challenges, techniques and technologies: A survey on Big Data, Information Sciences, (275): 314–347, 2014.
- ❑ E. Lim, H. Chen & G. Chen, Business Intelligence and Analytics: Research Directions," ACM Trans. on Management Inform Syst, 3(4):1-10, 2013.
- ❑ C. Holsapple, A. Lee-Postb & R. Pakath, A unified foundation for business analytics, Decision Support Systems, 64:130–141, 2014.
- ❑ R. van der Meulen & J. Rivera, Gartner Says Worldwide Business Intelligence and Analytics Software Market Grew 8 Percent in 2013, 2014. Available: <http://www.gartner.com/newsroom/id/2723717>. [Accessed 28 6 2014].

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- ❑ M. Minelli, M. Chambers & A. Dhiraj, Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Wiley & Sons, 2013.
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- ❑ Sun, Z; Sun, L; Strang, K (2016) Big Data Analytics Services for Enhancing Business Intelligence, Journal of Computer Information Systems (JCIS), DOI:10.1080/08874417.2016.1220239
- ❑ Sun Z, Strang D. K, & Firmin S (2016) Business Analytics-Based Enterprise Information Systems, Journal of Computer Information Systems (JCIS), DOI: 10.1080/08874417.2016.1183977.
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- ❑ Z. Sun & G. Finnie, Intelligent Techniques in E-Commerce: A Case-based Reasoning Perspective, Heidelberg Berlin: Springer-Verlag, 2004; 2010.

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- ❑ Laney, D., & Jain, A. (2017, June 20). *100 Data and Analytics Predictions Through*. Retrieved August 04, 2018, from Gartner: <https://www.gartner.com/events-na/data-analytics/wp-content/uploads/sites/5/2017/10/Data-and-Analytics-Predictions.pdf>