Delegates' Summit:

– Best Practice and Definitions –

Algorithm and Algorithm Signification

September 11, 2023

The (12+1)th Symposium on
Advanced Computation and Information in Natural and Applied Sciences (SACINAS)
The International Conference on Numerical Analysis and Applied Mathematics (ICNAAM 2023)
September 11 – 17, 2023, Heraklion, Crete, Greece

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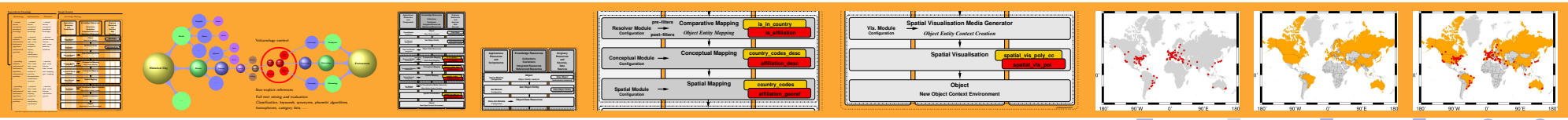

Abstract / Epitome

Abstract / Epitome

This comprehensive summary contains the committee of participants and contributors, the contributions, statements, summit results (p. 20), and references for the Delegates' Summit on Best Practice and Definitions: Algorithm and Algorithm Signification, part of the Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS).

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Post-Summit Results (Algorithm and Algorithm Signification)

Delegates' Summit: Best Practice & Definitions of . . .

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Program: `http://icnaam.org`

Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Knowledge and Computing (Delegates and other contributors)

- **"Knowledge is created from a subjective combination of different attainments as there are intuition, experience, information, education, decision, power of persuasion and so on, which are selected, compared and balanced against each other, which are transformed, interpreted, and used in reasoning, also to infer further knowledge. Therefore, not all the knowledge can be explicitly formalised. Knowledge and content are multi- and inter-disciplinary long-term targets and values. In practice, powerful and secure information technology can support knowledge-based works and values."**

- **"Computing means methodologies, technological means, and devices applicable for universal automatic manipulation and processing of data and information. Computing is a practical tool and has well defined purposes and goals."**

Citation: *Rückemann, C.-P., Skurowski, P., Staniszewski, M., Hülsmann, F., and Gersbeck-Schierholz, B. (2015): Post-Summit Results, Delegates' Summit: Best Practice and Definitions of Knowledge and Computing; Sept. 23, 2015, The Fifth Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 13th Internat. Conf. of Numerical Analysis and Applied Mathematics (ICNAAM), Sept. 23–29, 2015, Rhodes, Greece.*
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Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Data-centric and Big Data (Delegates and other contributors)

- **"The term data-centric refers to a focus, in which data is most relevant in context with a purpose. Data structuring, data shaping, and long-term aspects are important concerns. Data-centricity concentrates on data-based content and is beneficial for information and knowledge and for emphasizing their value. Technical implementations need to consider distributed data, non-distributed data, and data locality and enable advanced data handling and analysis. Implementations should support separating data from technical implementations as far as possible."**
- **"The term Big Data refers to data of size and/or complexity at the upper limit of what is currently feasible to be handled with storage and computing installations. Big Data can be structured and unstructured. Data use with associated application scenarios can be categorised by volume, velocity, variability, vitality, veracity, value, etc. Driving forces in context with Big Data are advanced data analysis and insight. Disciplines have to define their 'currency' when advancing from Big Data to Value Data."**

Citation: *Rückemann, C.-P., Kovacheva, Z., Schubert, L., Lishchuk, I., Gersbeck-Schierholz, B., and Hülsmann, F. (2016): Post-Summit Results, Delegates' Summit: Best Practice and Definitions of Data-centric and Big Data – Science, Society, Law, Industry, and Engineering; Sept. 19, 2016, The Sixth Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 14th Internat. Conf. of Numerical Analysis and Applied Mathematics (ICNAAM), Sept. 19–25, 2016, Rhodes, Greece. URL: https://scienceparagon.de/cpr/x/publ/2016/delegatessummit2016/rueckemann_icnaam2016_summit_summary.pdf*

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Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Data Science Definition (Delegates and other contributors)

- **"Qualified Data, especially for an enterprise, represents frozen knowledge or in other words frozen value.**
  The abilities to understand and manage these data is what we call data science.
  Data results from action, hence, data science can be defined secondary to data. The essence of Data Science is to give qualified access to relevant data to owners and users.
  Hardware and software and their implementation represent the tertiary level of qualified and high level data."

Citation: *Rückemann, C.-P., Iakushkin, O. O., Gersbeck-Schierholz, B., Hülsmann, F., Schubert, L., and Lau, O. (2017): Post-Summit Results, Delegates' Summit: Best Practice and Definitions of Data Sciences – Beyond Statistics; Sept. 25, 2017, The Seventh Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 15th Internat. Conf. of Numerical Analysis and Applied Mathematics (ICNAAM), Sept. 25–30, 2017, Thessaloniki, Greece.*
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Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Data Value Definition (Delegates and other contributors)

"Data value is the primary ranked value in scenarios comprised of data and computing context. In general, processing of data, is the cause for computing. In consequence, data, including algorithms and other factual, procedural, and further knowledge, have to be ranked primary on the scale of values whereas machinery for processing data, including computing, are providing means of secondary ranked value. In addition, further values, including economic values, can be associated with consecutive deployment of data and machinery."

This is unaffected by varying views and attributions, including quality. Nevertheless, different views can scale values.

Citation: *Rückemann, Claus-Peter; Pavani, Raffaella; Schubert, Lutz; Gersbeck-Schierholz, Birgit; Hülsmann, Friedrich; Lau, Olaf; and Hofmeister, Martin (2018): Post-Summit Results, Delegates' Summit: Best Practice and Definitions of Data Value; Sept. 13, 2018, The Eighth Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 16th Internat. Conf. of Numerical Analysis and Applied Mathematics (ICNAAM), Sept. 13–18, 2018, Rhodos, Greece.*
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Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Formalisation Definition (Delegates and other contributors)

"Formalisation is the process of creating a defined set of rules, allowing a formal system to infer theorems from axioms. Formal systems may represent well-defined systems of abstract thought. Description and analysis of any detail of any more or less complex system and physical background essentially require a formalisation process. The process includes abstraction and reduction of knowledge, keeping the preconditioned importance of respective context. Consequently, formalisation should be created and context observed by educated experts within the respective discipline."

All mathematical-machine based systems, e.g., computers, are formal systems.
Ideologies should be kept outside of formalisation.

Citation: *Rückemann, Claus-Peter; Pavani, Raffaella; Gersbeck-Schierholz, Birgit; Tsitsipas, Athanasios; Schubert, Lutz; Hülsmann, Friedrich; Lau, Olaf; and Hofmeister, Martin (2019): Post-Summit Results, Delegates' Summit: Best Practice and Definitions of Formalisation and Formalism; Sept. 25, 2019, The Ninth Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 17th Internat. Conf. of Numerical Analysis and Appl. Math. (ICNAAM), Sept. 23–28, 2019, Rhodos, Greece.*
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Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Structure and Cognostic Addressing Definition (Delegates and other contributors)

"Structure is an organisation of interrelated entities in a material or non-material object or system, on homogeneous intrinsic levels. Structure should be addressed by super- and sub-levels. Cognostic addressing applies to the wish to gain essential properties in science and scholarship in general, such as correlation, interrelation, and coherence and leads to a fundamental understanding. Cognostic identification, addressing, and continuous refinement of structures are essential prerequisites of creating new insight. In future, we consequently propose the term '*nucleal cognstructure*' ".

Structure can mean features and facilities. Links between knowledge and cognostics are unpredictable, especially by artificial and automated means in general. Structure can be deployed by methods, e.g., matching predefinable models, patterns, and precision. In practical programming many practicists prefer to define structure and cognostic addressing by formal aspects only.

Citation: *Rückemann, Claus-Peter; Pavani, Raffaella; Kovacheva, Zlatinka; Gersbeck-Schierholz, Birgit; Hülsmann, Friedrich; and Naydenova, Ina (2021): Post-Summit Results, Delegates' Summit: Best Practice and Definitions – Concepts of Cognostic Addressing Structured and Non-structured Data; Sept. 20, 2021, The Eleventh Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 19th Internat. Conf. of Numerical Analysis and Appl. Math. (ICNAAM), Sept. 20–26, 2021, Rhodos, Greece. URL: https://scienceparagon.de/cpr/x/publ/2021/delegatessummit2021/rueckemann_icnaam2021_summit_summary.pdf, URL: https://doi.org/10.15488/11338 (DOI).*

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Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Quality of Knowledge and Quality of Data (Delegates and other contributors)

"Knowledge can be approached being a complex non-technical asset of complements (DOI:10.15488/3409). Data are "things given". 'Data' cannot be 'turned' into 'information' or 'knowledge'. Quality is a secondary virtue. Often, quality approaches and practice result from hermeticism. From the beginning on, quality of data requires well-defined methods and transparent, precise, consistent, holistic, sufficiently complete specifications and documentation of contexts and purposes to be reproducible and measured for a scenario. Quality of knowledge requires consideration of non-technical contexts accordingly.

Formalisation and abstraction need to be documented and referenced to knowledge complements and data. Discovery levels need to be documented and referenced to knowledge complements and data. Trying to 'turn' data into 'information' or 'knowledge' consequently leads to arbitrary results and arbitrary organisational states. Fundaments of 'quality' and its measures are arbitrary. High quality for a defined scenario can mean no quality or even wrong for other scenarios.The contextual nature of data quality requires scenario-dependent consideration of contexts, including measurability and re-interpretation, e.g., regarding criteria of ISO 8000-2:2020.

Citation: *Rückemann, Claus-Peter; Kaloyanova, Kalinka; Kovacheva, Zlatinka; Naydenova, Ina; Hülsmann, Friedrich; Gersbeck-Schierholz, Birgit (2022): Post-Summit Results, Delegates' Summit: Best Practice and Definitions – Quality of Knowledge and Quality of Data; Sept. 19, 2022, The Twelfth Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 20th Internat. Conf. of Numerical Analysis and Appl. Math. (ICNAAM), Sept. 19–25, 2022, Heraklion, Crete, Greece.*
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Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Complements of Knowledge and Corresponding Sample Implementations:

- **Factual Knowledge** $\Leftrightarrow$ Numerical data, data ...
- **Conceptual Knowledge** $\Leftrightarrow$ Classification ...
- **Procedural Knowledge** $\Leftrightarrow$ Computing ...
- **Metacognitive Knowledge** $\Leftrightarrow$ Experience ...
- **Structural Knowledge** $\Leftrightarrow$ Standard hybrid formats ...
- ...

(Sources/references: SACINAS Delegates' Summit, 2015–2022; Rückemann, Keynote on Structured Data Comprehension, MIM 2021 [1] [2]; Knowledge Mapping, 2018 [3]; Aristotle, 350 B.C.E. / Platon's Phaidon, [4] [5] [6]; Anderson & Krathwohl, 2001 [7]);
Rückemann, Coherent Knowledge Solutions From Prehistory to Future, Lawrence Livermore National Laboratories (LLNL), ML4I 2021 [8]

Best Practice and Definitions: . . . (1/4)

In 80 Words Around The World.

Case: Information science, natural sciences, prehistory, universal applications

Source: Claus-Peter Rückemann (KiM, DIMF)

- **Algorithm and Algorithm Signification:**

  An algorithm is a process or set of rules to be followed in problem-solving operations. Its specification may be associated with a number of priorities, conditions, and dependencies in certain contexts and use cases. Algorithms, contexts, and data inherently depend. Algorithm creation and employment should follow fundamental, clearly defined rules. An algorithm gets its signification by precise employment in a defined, formalised context. Algorithms can enable implementations and realisations with focus on procedural knowledge complements.

  Mostly every scientific discipline relies on creation and employment of algorithms. Some earliest known principles of algorithms are described in Aristotle's major works of the Organon, the instrument, and his Physics as well as works by Eratosthenes, and by Euclid. An algorithm is not defined by its realisation. Especially, it is not relevant for its essence by which implementation an algorithm is executed, e.g., by analog or digital means. An algorithm is per se not 'intelligent'. An algorithm, in its primordial signification can by definition not be controlled. Besides, from time to time and for various reasons, interest groups claim the intention to control algorithms.

Best Practice and Definitions: . . . (2/4)

In 80 Words Around The World.

Case: Informatical point of view of practical implementation

Source: Zlatinka Kovacheva, Oksana Kharchenko (BAS Bulgaria)

- **Algorithm and Algorithm Signification:**

  The term algorithm is derived from the name of Muhammad ibn Musa al-Khwarizmi, Muslim mathematician and astronomer from Central Asia. In terms of mathematics, it is defined as a finite sequence of instructions for solving problems, that are executed in a certain order and can be partially repeated. They can be linear, branched and cyclic. The main properties of the algorithm are: definiteness, effectiveness, discreteness, massiveness and finiteness. Algorithms are widely used in all areas of practice for automating computer decisions.

Best Practice and Definitions: . . . (3/4)

In 80 Words Around The World.

Case: Biology

Source: Birgit Gersbeck-Schierholz (KiM, DIMF)

- **Algorithm and Algorithm Signification:**

  In natural sciences, e.g. biology, we have to create fact-based, precise, formalised, reproducible, logically correct, and consistent solutions and approaches, considering the overall contexts. Algorithms are processes created to provide solutions to defined problems, following methodological and systematical principles. Algorithms are valuable tools to be deployed in all fields of scientific research, from investigation of new phenomena to analysis and description of results during continuous development of scientific insights.

Best Practice and Definitions: . . . (4/4)

In 80 Words Around The World.

Case: General application, humanities
Source: Friedrich Hülsmann (KiM, DIMF)

- **Algorithm and Algorithm Signification:**

  Algorithms constitute the only non-intuitive way of solving programming tasks. They represent the necessary logical framework for identifying the real problem/s in question and for developing adequate solutions for problems. Thus they are the best way to avoid tinkering around with obscure apps never reaching a final status of programming.

Best Practice and Definitions

In 80 Words Around The World.

Statements on Algorithm and Algorithm Signification

(Delegates and other contributors)

- **How can a widely general definition of algorithm be achieved?**
- **What is an algorithm an what are inherent characteristics?**
- **Which signification can and should be assigned to an algorithm?**
- **Which Best Practice for algorithm creation and employment can be summarised?**
- **Next Delegates' Summit Contexts:**

  Best Practice and Definitions of multi-disciplinary knowledge integration.

  Best Practice and Definitions [topics]
  aware of "Science Under Direction".

Best Practice Bibliography

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Networking and Outlook

Thank you for your attention!

Wish you an inspiring conference and a pleasant stay on Crete!

Looking forward to seeing you again next year for the Symposium on Advanced Computation and Information!

Post-Summit Results

In 80 Words Around The World.

Algorithm and Algorithm Signification (Delegates and other contributors)

"An algorithm is a process or set of rules to be followed in problem-solving operations. Its specification may be associated with a number of priorities, conditions, and dependencies in contexts and use cases. Algorithms, formalisation, contexts, and data inherently depend. Algorithm creation and employment should follow fundamental, clearly defined rules. An algorithm gets signification by precise employment in a defined, formalised context. Algorithms can enable implementations and realisations with focus on procedural knowledge complements, e.g., in scientific research and analysis.

Algorithm processes, e.g., linear, branched, and cyclic, can be defined as finite sequences of instructions, which can be repeated and employed for scientific research, from investigation of new phenomena, analysis and description of results during continuous development of scientific insights to automation. Targets of implementation can be definiteness, effectiveness, discreteness, massiveness, and finiteness. Scientific algorithm creation and employment should follow methodological and systematical principles and be based on fact-based, precise, formalised, reproducible, consistent, logically and context-correct fundaments. A respective problem should be identified and understood before creating an algorithm-based feasible solution. Mostly every scientific discipline relies on creation and employment of algorithms. Some earliest known principles of algorithms are described in Aristotle's major works of the Organon, the instrument, and his Physics as well as works by Eratosthenes, and by Euclid. An algorithm is not defined by its realisation, e.g., not by informatics or programming. Especially, it is not relevant for its essence by which implementation an algorithm is executed, e.g., by analog or digital means. An algorithm is per se not 'intelligent'. An algorithm, in its primordial signification can by definition not be controlled. Besides, we have to be beware of the fact that from time to time and for various reasons, interest groups claim the intention to control algorithms.

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