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SYNTHESIS THEORY IN ACTION: DEDUCTIVE DERIVATION OF ALGORITHMS FOR APPLICATION SOFTWARE

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Abstract

The significance of the study is contingent upon two criteria. All objects in the actual world that can capture a researcher's attention are inherently complicated. Furthermore, every commodity that an individual manufactures and every work of art that an individual develops are intricate in nature. The entirety of the processes that an individual perceives and instigates are intricate. Although many professions have established techniques for constructing intricate entities, there currently exists no universally applicable concepts or methodologies for comprehensively studying, designing, producing, or generating complicated items.

The objective of this work is two-fold: firstly, to develop a comprehensive methodology for analysing complex synthetic processes, and secondly, to propose universal models or synthesis mechanisms that can be used to systematically derive specific process synthesis algorithms for various practical applications. The ability to utilize generalized models and synthesis techniques is highly advantageous when designing realistic computer programming.

The authors introduced a comprehensive process model and enumerated its characteristics. Using this concept, techniques for creating and suggesting processes have been formulated and put forward. The concept of a decomposition diagram enables the systematic design of intricate multi-level hierarchical processes. The multitude of processes and the intricacy of their combination give rise to the notion of formulating a synthesis theory. The acquired results can be regarded as the initial stage in the construction of such a theory. The authors' proposed methods of process synthesis enable the deductive derivation of useful algorithms for application software. Although the concept of the breakdown scheme and synthesis procedures is relatively straightforward, this advancement has been suggested for the first time.

In order to further this project, it is necessary to augment the generalized process model with supplementary traits and properties, as well as to further refine the synthesis procedures. A proposal is being made to initiate the development of a theory for synthesizing a comprehensive plan using the decomposition scheme and methods of synthesis and decomposition.

Keywords: theory of synthesis, method of synthesis, scheme for decomposition, algorithm, deductive reasoning, algorithm synthesis.

ТЕОРІЯ СИНТЕЗУ В ДІЇ: ДЕДУКТИВНИЙ ВИВІД АЛГОРИТМІВ ДЛЯ ПРИКЛАДНОГО ПРОГРАМНОГО ЗАБЕЗПЕЧЕННЯ

Анотація

Актуальність дослідження визначається двома факторами. По-перше, всі об'єкти реального світу, куди може бути спрямована увага дослідника, складні. По-друге, всі вироби, які виготовляє людина, всі предмети мистецтва, які творить людина, складні. Складними є всі процеси, які спостерігає або запускає людина. Незважаючи на те, що в конкретних сферах діяльності існують методи створення складних об'єктів, досі не запропоновано принципів або методів, сформульованих у загальному вигляді, які можна було б застосувати для дослідження складних об'єктів, для проєктування, для виробництва, або створення складних об'єктів.

***Мета роботи** – визначити та охарактеризувати загальний підхід до дослідження складних синтетичних процесів, а також запропонувати узагальнені моделі чи механізми синтезу, використовуючи які можна було б дедуктивно виводити конкретні прикладні алгоритми синтезу процесів для різних галузей застосування. Важливо отримати можливість застосовувати узагальнені моделі та механізми синтезу у проєктуванні реального практичного комп'ютерного програмування.*

Метод дослідження.

Авторами запропоновано узагальнену модель процесу та перераховано її атрибути. На основі цієї моделі розроблено та запропоновано способи синтезу процесів. Ідея схеми декомпозиції дозволяє методично проєктувати складні багаторівневі ієрархічні процеси.

Різноманітність процесів та складність їх синтезу підводить до ідеї створення теорії синтезу. Отримані результати можна розглядати як початок розробки подібної теорії. Запропоновані авторами способи синтезу процесів допускають можливість дедуктивного виведення практичних алгоритмів прикладного програмного забезпечення. Незважаючи на порівняльну простоту ідеї схеми декомпозиції та способів синтезу, подібна розробка запропонована вперше.

Напрямок досліджень.

Для розвитку цієї роботи слід наповнювати узагальнену модель процесу додатковими атрибутами і властивостями, а також має бути розвиток способів синтезу. Запропоновано на основі схеми декомпозиції, способів синтезу та схеми декомпозиції розпочати розробку теорії синтезу загального плану.

Ключові слова: теорія синтезу, спосіб синтезу, схема декомпозиції, алгоритм, дедуктивне виведення, синтез алгоритмів.

Problem formulation.

An individual is encompassed by intricate entities in their existence. Virtually everything in the physical world is inherently complicated, varying in degrees of complexity. All tangible entities in the physical realm are the outcome of either natural or artificial amalgamation. The human being, being an intricate and multifaceted entity, is encompassed by numerous systems of diverse nature and exists within multiple situations, thus highlighting their inherent complexity. In this work, the term «object» encompasses both a physical being and a series of actions or steps. An item, whether it be a creature, plant, or mechanism, remains constant over a specific length of time as perceived by humans. On the other hand, a process is something that undergoes change over a specified period as perceived by humans.

The constituents of the megaworld include celestial bodies such as stars, star systems, and galaxies. The state of these things is contingent upon the chosen observation time scale, notwithstanding their individual internal movement and ability to move as a collective entity. These artefacts exemplify complexity.

The constituents of the microcosm include atoms, neutrons, electrons, hadrons, and quarks. Every particle is a sophisticated artificial entity.

The entities comprising the macrocosm are the noosphere – encompassing all elements that surround an individual and are apprehended by their senses.

Complex phenomena in the universe include the motion of comets, asteroids, planets, stars, star systems, and galaxies, as well as the operation of black holes and white dwarfs.

The microcosm involves the intricate

presence and operation of an electron within what is known as an orbit. The presence of several forces operating on an electron highlights the intricate nature of this phenomenon.

The macrocosm encompasses intricate phenomena such as plant growth, cellular life in living organisms, social processes in society, and advanced technologies in mechanical engineering.

Processes can exhibit complexity and artificiality as a result of the resources employed and/or the tasks they execute. An instance that encompasses all of the aforementioned elements is exemplified by a tempestuous occurrence in the maritime domain. The resources utilized in this instance include the water element, the displacement of air masses, and the gravitational force exerted by the earth and celestial bodies. The tumultuous ocean encompasses marine flora, marine fauna, marine microorganisms, marine vessels, infrastructure, and all coastal entities, whether they are part of the mainland or an island inside the storm-prone area. The blood circulation of humans and higher animals, as well as the perception of the surrounding reality by human senses, are examples of very intricate systems that involve both complicated functions and extensive resources.

Complex synthetic processes are intricate occurrences within human society, encompassing the establishment of a nation or state, conflicts such as wars, familial connections, and power dynamics.

Synthetic phenomena refer to the collective instincts observed in animals, such as the coordinated hunting behaviour of lions, wolves, and dolphins, as well as their collaborative efforts to protect buffalo herds from predators. Synthetic phenomena encompass several instances of symbiosis between animal and plant species, as well as the coexistence of primitive life forms with more advanced animal species.

Synthesis is a cognitive process by which individuals gain new knowledge. The human consciousness combines concepts, information, technologies, and experience to generate new knowledge. Furthermore, synthesis is one of the methods through which an individual generates and fabricates an artefact. An individual combines materials, technologies, structures, and machines, applies effort, and creates a product or initiates specific processes.

The principles of synthesis are examined in distinct theoretical and applied fields. The imperative to investigate synthesis in its most comprehensive manifestation is pressing. To clarify, the objective is to define, delineate, and explicate synthesis as a phenomenon. This entails portraying synthesis as a widespread and universal occurrence, rather than an infrequent, specific, or extraordinary occurrence. Additionally, the aim is to offer a structured and methodical account of synthesis as a mechanism or approach for generating novel knowledge or creating an artefact. This will entail the exploration of overarching principles and universal mechanisms of synthesis. The objective is to consolidate all the enumerated subtasks into a unified endeavor, namely the development of a synthesis theory. In addition, the author emphasizes the necessity of developing a comprehensive theory of synthesis [Epshtein 2020: 74-100]. Recognizing the extensive universality of the notion, he dubs it the philosophy of synthesis. The authors [Poli 2013: 142-147; Ritchey 1996: 21-41] provide a general discussion on many facets of the concept of analysis and synthesis. In order to examine the phenomenon of synthesis, it is necessary to have a formal explanation of the process and decomposition scheme, as outlined by Kolisnyk [2020: 26-43], is necessary.

This study considers three constraints that restrict the scope of comprehending synthesis and handling complexity. Only several processes are considered, not all possible objects. Secondly, we analyse processes that are either seen, initiated, or controlled by humans. Thirdly, significant emphasis is placed on computer-controlled procedures.

The **objective of this work** is two-fold: firstly, to develop a comprehensive methodology for studying complex synthetic processes, and secondly, to propose generalized models or synthesis mechanisms. These models will enable the deductive derivation of specific applied algorithms for various fields of application, particularly in the realm of practical computer programming design.

Introduction of the primary research material.

Elucidation of principles. The term «synthesis» and its adjective form «synthetic» are employed in a broad, interdisciplinary sense within this study by combining two or more components, an object can be created that possesses features that the individual components did not possess [Merriam-Webster Dictionary 2023].

Synthesis can be comprehended as both a strategic approach and a procedural action. As a method, synthesis refers to the assembly of a specific thing from its individual components. The object consists of two levels: one level represents the thing itself, while the other level includes components that are one level higher in number. Within the context of the proposed work, synthesis is specifically defined as a one-step technique.

From a material perspective, the synthesis process is believed to involve the combination of two or more substances, such as products or mechanisms. It does not involve the physical alteration of a single substance, nor does it involve chemical modifications. It may even entail several transformations of the reagent. Furthermore, the act of isolating a constituent from an intricate system or a compound substance, such as the extraction of different carbon and hydrogen compositions from oil, is not regarded as synthesis.

Certain occurrences can only be regarded as synthetic within a specific context. From the perspective of a visitor, a running stream may seem simple, but from the standpoint of a hydrogeologist or physicist, it is a highly intricate phenomenon.

Mentally, syllogisms are regarded as a form of synthesis, where new assertions or ideas are derived from two or more premises, rather than being a mere inductive or deductive conclusion. Furthermore, it is presumed that synthesis does not involve the conversion of a single thought or idea. According to Merriam-Webster Dictionary [2023], a synthesis occurs when a statement incorporates a previously unattainable meaning for a specific term, so unveiling a novel and previously undiscovered idea.

Furthermore, the book disregards the concept of synthesis, which is employed in the thesis-antithesis-synthesis triad [Law 2021], deeming it excessively broad and instead perceiving it as a literary device.

The concept of «integration» is recognized in academic literature. It might serve as a synonym for the notion of «synthesis».

An object is classified as synthetic if it is possible to mentally or physically separate many components from its composition.

Description of processes. The motivations behind human synthesis are two-fold: to fulfil functional requirements that cater to human needs, and to conserve essential resources during the course of life.

Processes that are initiated or produced can be found in various areas of human activity, such as:

- Production processes in industries like instrument making, aircraft manufacturing, mechanical engineering, and other types of industry.
- Processes involved in the production of chemical and petrochemical products.
- Processes in agro-industry and food production.
- Processes in the transport sector.
- Processes in mining.
- Processes related to organized recreation.
- Processes in the healthcare field.
- Processes in military operations.
- Processes in ballet, opera, and dramatic performances.
- Processes in show business and the film industry.
- Processes in diplomatic procedures.
- Processes in political processes.
- Processes in scientific research.

Scientific research processes, similar to processes in the aforementioned disciplines, typically involve multiple components (such as people and mechanisms), multiple stages, and require coordinated interaction while being intellectually stimulating.

Significant emphasis is placed on processes involving the utilization of computer technology (such as computers, computer networks, microprocessors, and microchips) by individuals, as these processes accurately mirror the real world. To be more specific, the computer serves as a mirror for the real world, allowing information from the computer to manifest in the physical realm.

While the physical world remains relatively steady in terms of its scale and size, the amount of information about it continues to multiply. Furthermore, the amount of information is increasing rapidly. The distinguishing characteristic of a computer is its sequential processing of information, which hinders its ability to cope with increasing volumes.

The act of processing information is linked to either a lengthy time commitment or a lack of adequate processing quality. The information itself hinders its own processing. The concept of compressing information can be effectively addressed through the application of synthesis theory.

Definition and attributes of processes. Processes can be defined as a series of actions or steps that are taken to achieve a particular outcome or goal. They typically involve the use of resources, such as time, money, and materials, and are characterized by their sequential nature. Processes can vary in complexity and can be found in several domains, such as business considering the aforementioned limitations, the category «process» is seen as a distinct instance or a specific form of the category «artefact», representing a unique occurrence of what an individual can create or witness. The category «process» is seen as a specific instance of the category «object». The process attributes include the following:

- Driving organ (DO) (one or more).

- Participant (component) (one or more). The entities involved in the process can be classified as animate (living), inanimate (non-living), or environmental.

- Process function. One characterizes the process or more functions performed by the object(s) involved, as perceived by the object(s) themselves.

- Duration of the process. It is determined by the time it takes to complete.

- Process parameters (one or more). The process is influenced by one or more parameters that affect its outcome.

- Interaction of participants (component). The participants in the process interact with each other.

- Dynamics (algorithm) of the process. The process follows a specific algorithm or set of rules.

- Flow conditions; signs or conditions for the beginning and completion of a process. The conditions under which the process occurs are defined by its flow.

- There are specific signs or conditions that indicate the beginning and completion of the process.

- Utilized resources (one or more);

- Hierarchical intricacy of the process, including a list of subprocesses in the event of significant complexity of the original process.

The procedure may possess the following supplementary attributes.

- Factors related to discreteness. Algorithm for determining the duration and magnitude of intervals. Cause of disruption.
- Relevant considerations. The occurrence and extent of influence.
- Manipulate variables or conditions. Effects or influences. They possess the ability to exert influence over the process and will be required to do so. The duration in which the influencing elements are in operation.
- The operational context of the process refers to the various aspects that impact the process, regardless of whether they are directly related to the system.

A process is a series of uncomplicated acts that commence and/or conclude with events. A simple action is defined as an action that cannot be divided or broken down from the perspective of observation, investigation, or production. Specifically, this particular aspect of the process does not necessarily need to be considered as essential or indispensable. An action can be categorized as either executed or not executed. A process can be composed of subprocesses. In other words, basic activities might form either an entire process or a sub-process.

Activities and subprocesses might vary in terms of their types. The diversity of types is produced by the characteristics of the process.

During a process, two or more discrete actions may occur concurrently or overlap temporally. Under specific circumstances, the process may involve a prolonged period of inaction. Participants in the process have the option to collaborate or contend with one another.

Occurrences inside a process might initiate further events or actions in reaction to them. In other words, the process can involve a sequence of acts that alternate between taking action and receiving a reaction. A response can occur as a result of a collection of events, whether they are of the same or distinct types, or due to a change in the process circumstances. Monitoring changes in the parameters of another process is the sole function of a process. The process has the ability to autonomously manage itself. In other words, the process parameters are evaluated within the process itself. If needed, specific control signals are generated and sent to the DO in order to modify the process parameters. This allows for the control of the process.

Describing and categorizing processes is essential for identifying the key factors that influence their occurrence and for developing systematic approaches (principles, mechanisms) to synthesize these processes. The investigations conducted involve the categorization of actions, events, sub-processes, processes, and their properties based on their kind or class. Types (classes) are recognized. The items and phenomena under study are assigned numerical values within the class.

Process categories. The processes can be provisionally classified into three categories:

1. An inherent phenomenon that takes place in the physical realm. An individual does not impede its advancement, but rather observes the procedure.
2. An inherent phenomenon that takes place in the physical realm. An someone intentionally or unintentionally disrupts the process.
3. An individual commences a procedure and subsequently manages or fails to manage it. The process might occur either in the physical realm or inside the realm of human cognition.

Another subdivision within the domain of process is linked to the utilization of a computer. In other words, the process occurs in the physical world, utilizing a computer and involving human participation. In the interaction between a human and a computer, there are two conceivable scenarios: either the person takes control of the process and uses the computer as a tool, or the computer takes control of the process and the person becomes involved.

In order to recognize the real-time flow of processes in a real location, it is necessary to identify processes from all three categories. The following knowledge is required:

- Criteria and prerequisites for initiating and concluding the process.
- Prerequisites and specific parameters of the process.
- Definitive list of participants and the methods by which they interact.
- Potential subprocesses that serve as integral components of the process.

To effectively analyse the second and third categories, assuming they exist in reality, it is essential to understand the specific conditions and the extent of human involvement. Supplementary attributes of the process may encompass the subsequent data:

- The quantity of individuals involved and their level of engagement (support or opposition).
- The quantity of factors that impact the process.
- The quantity of control loops, if applicable.
- The quantity and nature of functions inherent in the process.
- Potential limitations on resources.
- The hierarchical multi-level complexity of the process.

From a synthesis perspective, processes can be categorized based on two factors – the quantity of functions performed and the variety of resources utilized:

- A functionally simple process (FSP) is a process that produces or provides only one function or property.
- A functionally complex process (FCP) is a process that produces or provides more than one function or property.
- A resource-simple process (RSP) is a process that consumes only one resource.
- A resource-complex process (RCP) is a process that consumes more than one resource.

It is postulated that every process yields a minimum of one function. The purpose(s) of the procedure may or may not be known, but there is at least one. A procedure has the flexibility to utilize multiple types of resources or none at all. A procedure is deemed simple if it possesses a sole function and abstains from utilizing any resources. Any additional amalgamation of functions and resources in the process will be deemed intricate.

Computer-based processes provide substantial quantities of data, encompassing corporate, applied, scientific, industrial, and freely accessible information. These data are found in both public and restricted portions of the Internet. According to Kolisnyk (2020), the information presented here is derived from the analysis of various items in the physical world. The outcome of implementing different decomposition schemes. The same information can be utilized to acquire further knowledge by methods such as further decomposition, the inclusion method [Kolisnyk 2020: 26-43], generalizations, or inductive and deductive inference.

To synthesize this information, it is necessary to specify or qualify it as attributes of objects or their components. The processes of breaking down and combining, as well as the specific systems by which information is interconnected, need to be identified. The creation of requirements for the synthesis of information can only be achieved in this manner.

Characteristics of the process. The process characteristics are succinctly outlined in the next section. Processes can encompass a variety of activities or operations.

- Covers multiple subjects. Multiple DOs and participants exist, engaging in interactions or resistance. There exist multiple forms of mutual interdependence among the players, as indicated by the facts pertaining to management.
- Involving multiple factors. A process often consists of multiple control loops. The approach necessitates considering multiple factors inside a single circuit.
- Versatile. A process has the capability to execute or generate several functions.
- Hierarchical. A process can comprise an indefinite number of various subprocesses.
- Structurally intricate. Both sequential and parallel execution are feasible.
- Utilizing several resources. The process entails the utilization of resources of diverse kinds in varying quantities.
- Characterized by a high level of resource intensity. The procedure may be constrained by restricted resources.

Procedures for synthesizing processes. Process synthesis is necessary either to integrate functions that can be achieved through a single process or to optimize resource use by combining many processes. There are two primary methods of synthesis: breakdown synthesis and synthesis by inclusion in the surrounding system.

In Levin's [2021: 185-204] study, the author explored the idea of diachronic synthesis and its potential application in understanding the synthesis of processes.

Decomposition-based synthesis. The sequence of actions is as follows.

1. Carry out a mechanical union of DO_1 (one or more) and DO_2 (one or more) to ensure the execution of the respective functions of the first and second processes. Subsequently, it is vital to verify if the synthesized process attains the necessary functionality. Once the desired functionality is attained, the synthesis process is considered finished. However, if the desired functionality is not reached, there is a possibility to modify DO_1 and/or DO_2, and then repeat the first steps. If the procedures outlined in step 1 fail to enable you to attain the necessary functionality, it is advisable to proceed to step two.

The acts described in step 1 are considered zero-level actions, meaning that they involve complete processes rather than individual components.

2. At this stage, the process is divided into smaller components by decomposition. Prior to performing division, it is necessary to establish division schemes for both the initial and future stages. The division scheme in the initial step may vary, but it is not necessarily the same as the division scheme in future steps:

a) Partition the initial procedure into distinct components. If the components of the procedure are controlled by the identical DO_1, attempt to establish a connection between the DO_1 component of the initial procedure and the DO_2 of the subsequent procedure. If the components of DO_1 do not align, proceed to *scenario b*.

If certain components of the initial procedure are propelled by different entities, attempt to establish a connection between them and DO_2. It is possible that certain portions, or potentially all, will need to be merged. If the desired functionality is not attained, then it is advisable to go to *scenario b*.

b) In this scenario, the identical operations are executed as in *scenario a*, but certain components of the second process are divided. If the desired functionality is not attained at this level, it is advisable to proceed to the next phase (*scenario c*), which is the prototype validation.

c) In this scenario, the identical operations are executed as in *scenario a*, but both procedures are subdivided into segments. In this scenario, the DO components of both the initial and subsequent processes are linked.

The synthesis of processes is considered complete if the desired enhanced functionality is attained after completing any of the scenarios – a, b, or c. If the desired functionality is not attained, it is necessary to revert back to step 2 and proceed with the subdivision of the previously obtained components into smaller segments. The division schemes in the current stage may either remain unchanged from the previous stage or vary.

The subdivision of processes into components can be further extended without limitations. However, there may arise a scenario where it becomes evident that any further endeavours to combine elements are pointless and should be ceased.

Depending on the specific characteristics or nature of the process, it will be necessary to employ diverse techniques for merging sediments or resources, such as mechanical, chemical, biological, or physical ways.

The proposed initial methodology, by virtue of its comprehensiveness, is applicable for the creation of any entities. They can encompass processes, procedures, chemicals, household things, or any other type of spectacle – essentially, any artefacts. It is important to consider the nature of the desired outcome, the means of connection, and the available resources.

The integration of DO and synthetic components may necessitate a modification in the attributes of the components, such as their shape or structure. Modifying attributes may be necessary for either one or both of the components. Supplementary tools or supplies may be necessary. The process of synthesis can include multiple iterations.

The amalgamation of writings, ideas, works of art, and theories is executed in accordance with an identical framework.

Synthesis by inclusion. The sequence of actions is as follows:

1. Connect two processes by physically amalgamating DO and/or participants and/or resources. Once the new functionality is attained, the synthesis will be considered finished. Alternatively, modify either the initial process (N1), the subsequent process (N2), or both. The form or structure of the process can be altered. Subsequently, it is advisable to replicate *step 1*. Altering the connection method might suffice. In the event of unsuccessful attempts, it is advisable to proceed to *step 2*.

The acts described in *step 1* are considered zero-level actions, meaning they are whole processes rather than individual components of a process.

2. a) In essence, we are referring to the process of identifying a system that contains an object as an element, observing the productive characteristics of the system, and using deductive reasoning to acknowledge the existence of these characteristics in the object under consideration. Next, the researcher or designer will focus on an object that possesses supplementary productive features. In procedural words, this implies that one must identify a procedure in which the procedure N1 in issue is a constituent. Identify productive features in the inclusive process at level 1 and, using deductive reasoning, acknowledge the existence of these properties in the original process at N1. Subsequently, it is advisable to endeavour to establish a connection between processes N1 and N2. In the event of an unsuccessful connection, move directly to *step 2b*.

b) Execute identical procedures as outlined in step 2a, but for process N2. Upon successful connection, the synthesis process is considered finished; otherwise, it is necessary to proceed to *step 2c*.

c) Execute identical procedures as outlined in *step 2a*, but for process N1 and process N2.

Steps 2a, 2b, and 2c of the discussed inclusive processes may have many instances.

The synthesis is considered complete if the connection of processes in any of steps 2a, 2b, or 2c was effective and resulted in the implementation of new extra functionality. Alternatively, proceed to *step 3*.

3. The system includes a higher level that is situated above the first level.

a) Execute steps analogous to those described in *step 2a*. The system at level 1, which was previously deployed during the search process, is referred to as process N1. An inquiry is conducted for a level 2 system that encompasses a level 1 system. Process N1 possesses an intrinsic quality that is deductively proven and is part of the level 2 system. Furthermore, processes N1 and N2 are interconnected. This link would likely be enabled by the presence of an extra property. In the event that the actions in *step 3a* do not yield the desired outcome, it is advisable to proceed to *step 3b*. Alternatively, the synthesis is finished.

b) The level 2 system and its supplementary attributes for process N2 are sought, and efforts to establish a connection between processes N1 and N2 persist. In the event that the actions in *step 3b* do not yield the desired outcome, it is advisable to proceed to *step 3c*.

Perform analogous steps to those described in *step 3b* for processes N1 and N2. The synthesis is accomplished when the enabling systems of level 2 are identified, new productive features are discovered for processes N1 and N2, and the connection between these processes is established.

If the desired increased functionality is not attained, then steps akin to those described in *step 3* are undertaken to seek a more advanced enabling system, and so on.

Eventually, either the synthesis will be effectively finished, or it will become evident that further attempts at synthesis are pointless, and the synthesis process was unsuccessful.

Resource-driven process synthesis. There exist resources that are consumed gradually over a period, such as the utilization of power, water, or compressed air for a specific duration. Resource utilization might exhibit either homogeneity or heterogeneity. In other words, utilizing a resource also involves a process, which can be referred to as a process-resource (PR). Among the various human activities, numerous procedures make use of PR. These processes can also be combined or synthesized, with PR being the subject of this combination or synthesis. This necessity arises from the demands of cost-effectiveness and optimal utilization of public relations. Here we examine the integration of processes in which PRs are merged.

PR may exhibit fragmentation. For instance, the equipment can be utilized for a duration of five hours, after which it necessitates a transition to an alternative mode or a temporary cessation before resuming function. Public relations can be dissected into smaller components at a more profound level. Specifically, the parts of the initial level are subsequently subdivided. It is possible for there to exist a greater number of divisions beyond two.

Process design encompasses the identification of the following characteristics: participants, DO (one or more), process functions, interplay between components, flow conditions, resource utilization, and flow duration. The duration of the process will be decided, or if the procedure is time-specific, a start time and end time will be established. If the resource is unlimited and the duration of the process is not stated, then the description of the designed process becomes an accurate description of the actual one. The following are many scenarios in which the most basic methods for creating and combining processes are outlined.

Initial scenario. The utilization of a resource can be defined by regular intervals of time (duration K units) and regular intervals of inactivity (duration L units), during which the resource remains unused. This condition refers to the resource decomposition strategy.

Figure 1 displays the chronological sequence.

The slender line denotes the temporal periods during which the resource is accessible. The bold line denotes intervals during which the resource is inaccessible.

At this location the values of H_1, Z_1, H_2, Z_2, ..., H_N, and Z_N can be calculated using the following formulas: $H_1 = 0$, $Z_1 = K$, $H_2 = K + L$, $Z_2 = 2K + L$, ..., $H_N = (K + L) * (N - 1)$, $Z_N = (K + L) * (N - 1) + K$.

N represents the quantity of intervals in which the essential resource is utilized to carry out the process. *K* refers to the duration during which a resource is accessible and can be utilized. L refers to the duration in which the resource is unavailable for utilization.

The decomposition diagram of this scale is displayed as a tree structure in *Figure 2a* or alternatively, in a more condensed format, in *Figure 2b*. In *Figure 2b*, the variable j undergoes a transition from *1* to *N*.

The process is capable of being finished at any given moment. However, if the procedure is required to be finished at a specific time (M), then the values of H_j and Z_j need to be incremented by this quantity (M).

Subsequent scenario. Two resources are utilized. The duration for utilizing the initial resource is indicated in the form of equally spaced intervals. Additionally, the durations in which the initial resource is unavailable are of equal duration. The durations of usage for the second resource are consistent; however, they vary from the durations of usage for the first resource. The gaps maintain equal lengths in the absence of the second resource, but they deviate from the lengths of the corresponding gaps of the first resource. By determining the duration of the process, it is possible to create a schedule of specific time intervals when the process will be finished. *Figure 2b* will depict the process diagram as a series of gaps.

In this context, the variable j ranges from *1* to *M*, where *M* is the total number of intervals in which the process will take place and be finished.

Similarly to the preceding scenario, the process can be executed at an indeterminate, unpredictable time. However, if the process is scheduled to occur at a specific time (S), then H_j and Z_j need to be incremented by this value – *S*.

The third scenario. *Figure 3* displays the temporal durations. Scale 1 depicts the utilization of resource 1. Scale 2 demonstrates the utilization of resource 2. Scale 3 indicates the advancement of the procedure.

The resource availability intervals on the first scale are same. The periods of time during which the resource is not accessible are also of equal duration. The situation remains unchanged on the second scale. The durations of resource availability intervals on the first scale are not equivalent to the corresponding intervals on the second scale. Similarly, the durations of the intervals when the resource is not accessible vary across different magnitudes.

If the initiation of resource use and the initiation of the process are not predetermined, then you have the flexibility to schedule its commencement at any given moment, provided that both resources are concurrently accessible. If there is any interruption in the utilization of any resources, that interruption will mark the conclusion of the initial phase of the operation.

The first and second scales use thin lines to represent the availability of the resource and thick lines to indicate its unavailability. At the third level, Narrow lines represent the time intervals in which the process takes place, whereas wide lines represent the periods in which the process is halted.

Subsequently, a search is conducted to identify the closest time window during which another resource will become available. The time point H_2 marks the commencement of the subsequent period in which the procedure will occur. The termination point of this gap will occur when any of the resources (Z_2) becomes inaccessible. The figure shows that the start and end points of the working time are vertically aligned with the accessibility points that utilize resources.

This examination of resource availability will persist until the process execution intervals are established and the task is fully performed.

Put simply, the duration of the process is determined by the overlapping periods when both resources are accessible (akin to the intersection of sets in set theory).

Potential complications arising from synthesis methods. Processes that need to be combined into a single process, regardless of whether it is to add more functionality or to use resources efficiently, shall be referred to as operand processes (OP) in the following discussion.

OP is capable of accommodating periods of varying durations, both inside and across different time scales. The amalgamation of two such OP is identical to that in subsequent scenario. Specifically, the objective is to locate two corresponding segments within a given timeframe and incorporate them as sequential intervals of the overall procedure.

The duration of resource availability can be precalculated, but can also be dynamically determined during runtime. If the precalculation of the interval's length is conducted, an algorithm or pattern can be employed based on the length of the preceding interval (in accordance with the context), or it can be determined through random sampling within a specified range of values. The duration of the subsequent period can be decided in real-time as the procedure unfolds. Hence, the process synthesis will be strategically scheduled in real-time.

The resulting process can be generated using OP, of which there is an indefinite quantity. The synthesis procedure might incorporate a limitless number of steps that guarantee the proper operation of OP.

The initiation of any intricate synthetic processes can be ascertained by time. Specifically, the process can only be initiated at a predetermined time, regardless of an individual's influence, such as when witnessing a solar or lunar eclipse. Such processes are present in both the *megaworld* and the *macroworld*. The synthesis of such processes is identical to that of subsequent scenario.

Until now, the presentation has assumed that the period for resource utilization is separated into indivisible parts. A two-level tree (see Figure 4a) depicts the graphical representation of the decomposition scheme for this division. However, the duration of resource utilization within a single interval might be further subdivided based on an alternative decomposition scheme. In other words, time intervals at the first level are partitioned based on one decomposition scheme, while time intervals at the second level are partitioned based on a different scheme. A three-level tree, as shown in Figure 4b, visually depicts the decomposition strategy in this situation. It is possible to have more than three tiers of time division for resource utilization.

Thus far in the presentation, the synthesis of processes has been dictated by the expansion of functions and/or the utilization of resources. However, the synthesis of processes may arise from the necessity to combine decomposition mechanisms. By combining decomposition processes, a more intricate decomposition mechanism can be derived. The synthesis mechanism can be further developed into a more intricate process composition mechanism. The arrangement and engagement of individuals can be influenced by synthesis. Furthermore, resources can be artificially created.

Metamorphosis. There is an additional procedure in the series of synthesis procedures. An entity (whether it be a process, topic, mental concept, or material item) is fragmented into distinct components. Division can take place at multiple levels. Consequently, certain components were acquired. These components are regarded as autonomous entities. The recently acquired items are combined to form a complete entity. The sequence of assembly and grouping varies from the sequence of decomposition of the initial entity. Multiple layout levels can exist. By combining the individual components, it is possible to create larger assemblies, which may subsequently be used to construct a new object. The ultimately constructed novel entity may exhibit a dissimilar configuration compared to the initial entity. Significantly, this recently formed entity may possess distinct functioning, or at the very least, distinct qualities that were not discernible within this assemblage of components as a constituent of the first entity. For instance, a set of statistical data was gathered. The data either were collected in a systematic manner, in geographical, chronological, or in other predetermined sequence. The data is arranged in a distinct sequence, specifically in descending order based on a certain parameter. Moreover, this novel arrangement enables the observation of previously imperceptible attributes of the item under investigation. Essentially, an inductive inference occurred.

Strictly speaking, this approach does not qualify as a synthesis as it does not include the linking of objects, processes, or ideas. However, it is frequently used in conjunction with the synthesis procedures outlined earlier.

Focus on research. A process can be defined as a single action. Executing this operation guarantees the result of the entire process. For instance, one individual satisfied his thirst by taking a single sip – a singular act. However, this work addresses intricate processes. The degree of intricacy of the processes being considered may vary. Furthermore, the concept of process can be observed in many circumstances or viewed from diverse perspectives:

Firstly, a natural process that can be observed possesses its own inherent organization. Additionally, it is imperative to ensure that the processes established are well-structured. In this study, the notions of «process» and «organization» are inherently interconnected. These notions are employed in their most comprehensive meaning in this paper.

Understanding the organization of a natural process entails knowledge of the following characteristics:

- The key components of the process include:
  - the movement of organs,
  - the participants involved,
  - algorithms for interaction between participants and subsidiaries,
  - the specific time and location of the process,
  - the resources utilized, the process functions or the outcomes achieved during its execution or completion,
  - the intervals of downtime and action if the process is discrete or observed discretely,
  - the algorithms for interaction between the process and monitoring tools.
- Organizing a process involves determining the following characteristics:
  - the movement of organs;
  - the individuals involved;
  - the algorithms that govern the interaction between participants and subsidiaries;
  - the specific time and location of the process;
  - the resources utilized;
  - the functions performed inside the process;
  - periods of inactivity and activity occur if the process is distinct or if discrete observations are made.

When designing a process, it is possible that the specific start and end times are unknown, but only the sequence of events or subprocesses is determined. Among the characteristics of the process, only the sequence of interaction between the DO, participants, and resource utilization is known. The whole order of action execution or subprocesses will only be completely understood at the process's conclusion. An instance of such a procedure can be observed in the exchange between commuters and a transportation service. The true culmination of the subprocess will only be known once a shift or a day of work has passed. In contemporary times, the utilization of Global Positioning System (GPS) and servers that monitor traffic is particularly prevalent.

Secondly, if a process, whether observed or planned, is composed of components such as subprocesses or actions, and if all the properties mentioned earlier are known for each subprocess, then we can confidently state that the algorithm for the process is known. The algorithm can be documented as a sequential list of executed actions or subprocesses. The list can be extensive, which is crucial for the medium that contains it. A succinct and condensed format is necessary to describe, analyse, or create processes. This represents an alternative perspective on the procedure.

Thirdly, we are discussing a visual depiction of procedures. The process image represents the decomposition diagram. Similar to decomposition strategies, processes can exhibit both simplicity and complexity. The intricate nature of this complexity necessitates the use of simplified and hence imprecise process descriptions. The third perspective that must be considered is the capacity to choose a visual representation for illustrating processes.

Generic ideas and illustrations. A decomposition diagram may only be able to illustrate a portion of the process flow when explaining intricate procedures. A process's description, or decomposition scheme, will grow more intricate and detailed as it is studied or designed in a dynamic manner. Writing down processes that include a lot of distinct subprocesses and action types – either in text or graphic form – will be challenging or nearly impossible (see Figure 5).

It is required to employ generic or generalised notions rather than listing acts by themselves (see Figure 5a). In *Figure 5b*, the phrases *«Process»* and *«Action»* refer to general notions, in contrast to *Figure 5a* where they describe a specific process and an activity. *«Process»* refers to a class, kind, or genera of processes, even in cases when the class only has one instance of itself. In addition, *«action»* is a class, type, or sort of action that has an infinite number of instances. However, the graphs of decomposition techniques can still be complicated, with nearly infinite numbers of branches, nodes, and edges, even when generalisations are used.

The primary graphical tool for representing processes is a tree (tree graph), in which the nodes represent process attributes as generic (generalised) notions through words or sentences. Furthermore, notations can be loaded into both edges and branches. Text descriptions, mathematical symbols, any type of image, and tables (such as solution tables) can all be added to the decomposition scheme. Process comprehension deepens as a result of the organization's saturation with specifics throughout process study or design. As a result, the process breakdown scheme grows increasingly intricate. Furthermore, multiple decomposition schemes may exist. A process's organisational structure is depicted in a breakdown diagram.

Circuit synthesis is another factor contributing to the complexity of decomposition circuits. Generally speaking, the aforementioned functionally complex process (FCP) and resource-complex process (RCP) are the end products of process synthesis. The decomposition schemes of the processes under study or design get more complex due to process synthesis.

The synthesis process can be used to two or more operand processes (OP), each of which is already the outcome of the synthesis of an OP. Additionally, as OP, etc., this previously synthesised process can take part in the synthesis process. In other words, there is an arbitrary nesting depth superposition of decomposition algorithms.

Transforming an algorithm from a decomposition scheme. A particular format for capturing a process description is needed if a computer is a participant or DO in the intended process. We are discussing a conventional algorithm that is written in a programming language and is intuitively understood by programmers. In contrast to such an algorithm, a decomposition scheme is a tree-like graph packed with general notions that explain the process. The programmer needs to be aware of the location and format of process data, as well as how to input the data into the computer and output it after processing. They also need to understand how to tell the computer about the nature of data processing. The algorithm must be used to represent all methods of specifying process attributes that support the decomposition scheme tree.

It is not necessary to use a tree to represent a decomposition scheme; alternative graphical methods can be employed instead. However, the tree is the best method if the decomposition strategy is described as a hierarchical structure.

When it comes to the decomposition scheme, there is a chance that a tree node will be connected to multiple specific schemes, which might be applied for a deeper decomposition. In this instance, the sequence and prerequisites for implementing these specific schemes need to be established when turning a decomposition scheme into an algorithm. Multiple decomposition strategies can be used with a private schema [Kolisnyk 2020: 26-43]. It is necessary to establish the application technique and conditions in respect to decomposition mechanisms. If analytical dependencies are independent of one another, they must be calculated in a certain order. It is also necessary to define the sequence in which independent synthetic dependencies are computed.

Conclusions.

The paper provides a broad explanation of the procedure as one of the real-world object types. The first step in process research can be established as a process description is thought of as a collection of process attributes. There is a description of the processes' kinds and internal organisation.

The article also provides a general description of the phenomena of synthesis. The synthesis of diverse processes is the centre of attention. The notion of developing a theory of synthesis arises from the diversity of processes and the intricacy of their synthesis. The following are the characteristics of this theory:

- Research areas include real and imagined, observable and controllable processes, as well as artificial and natural phenomena.
- The process and its elements are the subject of the study.
- Research topic: characteristics of the pro-

cess, including flow, component kinds, internal organisation and structure, driving force, component properties, sequence of operation, and component interaction.

- Research goals include creating synthetic elements of natural processes, developing mechanisms for creating artificial processes, and devising techniques for translating decomposition schemes into computer programme algorithms.
- Research methodology: employing and developing graphical schemes to represent processes, as well as characterising, categorising, typifying, and generalising processes and their properties.
- A generalised theoretical model that includes operations using schemes and a decomposition scheme.

The study of the synthesis of processes and the processes themselves that result in a synergistic effect is a unique field of research.

The creation or synthesis of artificial processes is the third area of study. Procedures for creating complex processes from two or more simple ones are suggested in this work. The directions of increasing complexity of various synthesis techniques are discussed, starting with the simplest. The idea of a breakdown scheme is utilised to explain the steps involved in their synthesis. Furthermore discussed is the subject of designing computer-controlled or computing tool-using processes. It is examined if it is possible to deduce conventionally accepted algorithms from the structure of processes, which is essentially an algorithmic synthesis in and of itself. For programming technology, the work of synthesising algorithms for application software is crucial.

Figure 1. Fragmentary use of the resource in time

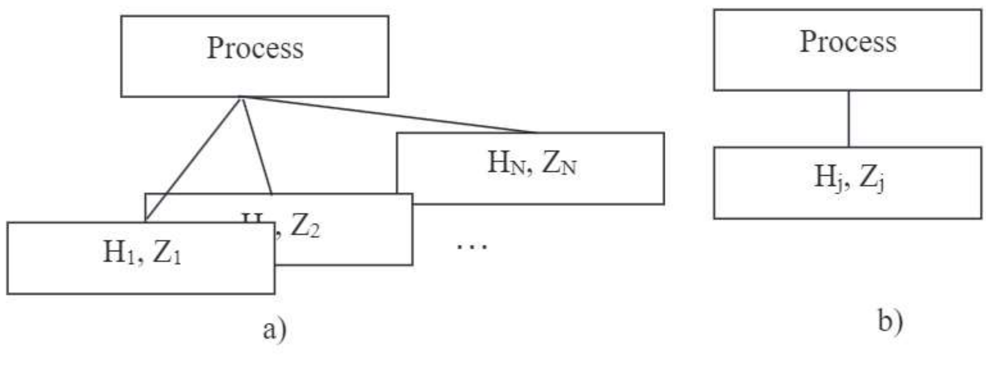

Figure 2. Process represented by decomposition diagram

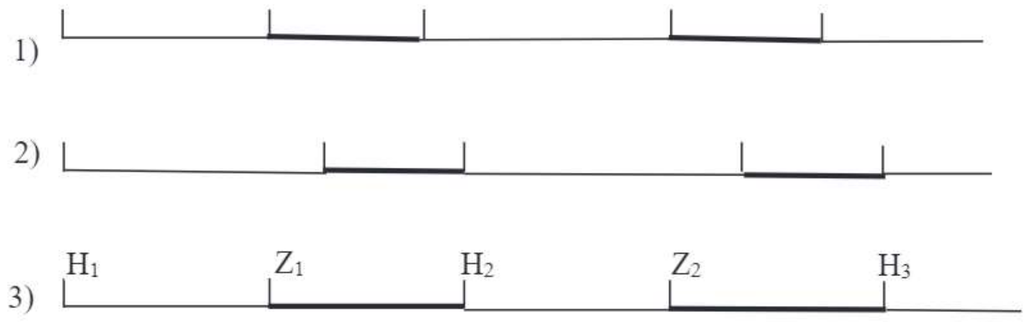

Figure 3. Synthesis of two resources for the process
Here, scale 1 is the schedule for using resource 1,
scale 2 – schedule of resource use 2,
scale 3 – graph of the process.

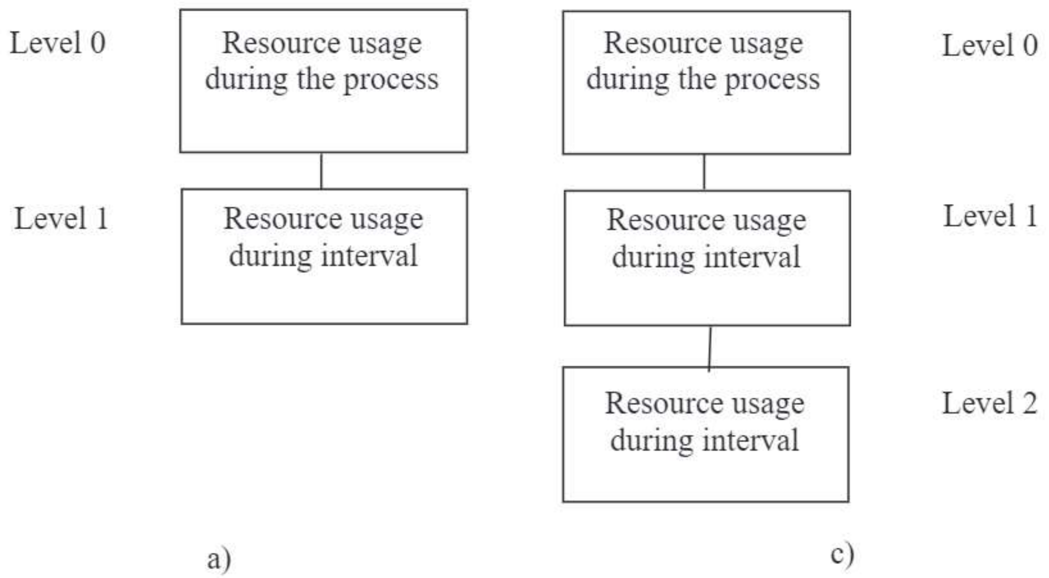

Figure 4. Options for using resources over time

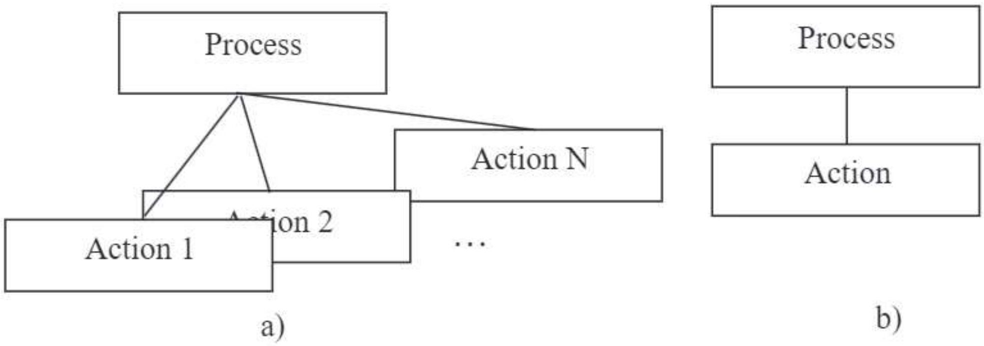

Figure 5. Methods for depicting process fragments
a) a literal listing of actions (subprocesses)
b) use of a generic concept

Бібліографічні посилання / References

Epstein, M. (2020). *From Analysis to Synthesis: Conceiving a Transformative Metaphysics for the Twenty-First Century*, in: *M.Sergeev, A. Chumakov & M. Theis (Eds), Russian Philosophy in the Twenty-First Century. An Anthology*, 74-100. Leiden, Boston: Brill, Rodopi. Retrieved from PhilArchive.

Law, R. (2021, April 14). Persuasive Writing in Three Steps: Thesis, Antithesis, Synthesis [ANIMALZ]. Retrieved October 1, 2023 from https://www.animalz.co/blog/thesis-antithesis-synthesis/

Levin, G. (2021). Realistic Theory of Classical Analysis and Synthesis. *Filosofskaya antropologiya*, 7(1), 185-204. https://doi.org/10.21146/2414-3715-2021-7-1-185-204

Poli, R. (2013). A Note on the Difference between Complicated and Complex Social Systems. *Cadmus*, *2*(1), 142-147.

Ritchey, T. (1996). Analysis and Synthesis: On Scientific Method – Based on a Study by Bernhard Riemann. *Systems Research*, *8*(4), 21-41. http://dx.doi.org/10.1002/sres.3850080402.

Synthesis. Merriam-Webster Dictionary. Retrieved November 24, 2023 from https://www.merriam-webster.com/dictionary/synthesis

Колісник, В. (2020). Формалізація процесу декомпозиції: декомпозиція, схема декомпозиції, процедура, об'єкт, властивість об'єкта, алгоритмічна залежність, механізм декомпозиції. *Epistemological Studies in Philosophy, Social and Political Sciences*, 3(2), 26-43. / Kolisnyk, V. (2020). Formalizatsiia protsesu dekompozytsii: dekompozytsiia, skhema dekompozytsii, protsedura, obiekt, vlastyvist obiekta, alhorytmichna zalezhnist, mekhanizm dekompozytsii [Formalization of the Decomposition Process]. *Epistemological Studies in Philosophy, Social and Political Sciences*, 3(2), 26-43. https://doi.org/10.15421/342030 (in Ukrainian)