Chapter 1 : Defining and Detecting Emergence in Complex Networks | Ian Macreadie - racedaydvl.com

Defining Emergence In the preface, I defined emergence as simply as possible: order arising out of chaos. A more nuanced definition is higher-order complexity arising out of chaos in which novel, coherent structures coalesce through interactions among the diverse entities of a system.

Acceptability A reflection of the willingness of surveillance staff to implement the system, and the end users of the data to accept and use the data generated by the system. Activities Actions performed to produce specific outputs using a given set of resources. A conceptual and strategic framework that spells out goals and objectives, priority themes and key strategies to be addressed by relevant operatives at all levels. It defines, for example, an agreed vision within the context of humanitarian coordination and traces a road map of actions to be undertaken to realize this vision. Support or argument for a cause, policy, etc Oxford Pocket Dictionary, 3. Affected people People who are adversely affected by a crisis or a disaster and who are in need of urgent humanitarian assistance. Age-adjusted mortality rate Mortality rate that takes into account the age structure of the population to which it refers. Age-sex pyramid Graph of the sex and age-group distribution of the population. Age-specific mortality rate Mortality rate in a specific age group. Alert threshold The critical number of cases or indicator, proportion, rate, etc. Assessment A systematic or non-systematic way of gathering relevant information, analysing and making judgment on the basis of the available information. Baseline assessment Is an assessment performed during the design phase of a surveillance plan of action. It provides information on the existing situation, forms the basis for the development of the plan of action, and provides baseline data against which prospective changes in the surveillance system are progressively assessed or measured. Baseline data Data or measurements collected at the outset of implementation of a surveillance system or of strengthening activities, or a set of indicators that have been identified to monitor and evaluate the performance of a surveillance and response system. Benchmark Reference point or standard against which performance or achievements can be assessed. A benchmark refers to the performance that has been achieved in the recent past by other comparable organizations, or what can be reasonably inferred to have been achieved in the circumstances OECD. Business Continuity Effective and useful survival. Business continuity is a biological and psychological imperative for individuals "instinct of survival" and an economic and cultural imperative for communities, at least at local level see also "social capital". The imperative can be less evident and weaker once one moves to the national level. It is by definition weak in "new" or "fragile states", and in short-lived institutions, especially in trans-cultural ones. It needs to be fostered by strong leadership, team building, clear mission statements, etc. Case definition Is a set of diagnostic criteria that must be fulfilled in order to identify a case of a particular disease. Case definitions can be based on clinical, laboratory, epidemiological, or combined clinical and laboratory criteria. When a set of criteria is standardized for purposes of identifying a particular disease, then it is referred to as "standard case definition". A surveillance case definition is one that is standardized and used to obtain an accurate detection of all cases of the targeted disease or condition in a given population, while excluding the detection of other similar conditions. Case-fatality ratio or rate CFR The proportion of cases of a given disease that result in death. It has a "narrative", descriptive value and, mostly, an advocacy purpose. Conceptually, it relates best to reconstruction activities. Cause-specific mortality rate The mortality rate due to a specific disease e. Civil defence organization Any organization that, under the control of a government, performs the functions enumerated in paragraph 61 of Additional Protocol I to the Geneva Conventions of Civil military cooperation CIMIC The coordination and cooperation, in support of the mission, between a military commander and civil actors, including the national population and local authorities, as well as international, national and non-governmental organizations and agencies. The purpose of the clusters is to foster timeliness, effectiveness and predictability while improving accountability and leadership. Cluster sampling A sampling design commonly used in retrospective mortality surveys when comprehensive lists of individual households cannot be obtained. Clusters are groups of households of which the first is chosen at random, and the remainder by a rule of proximity e. Completeness of reporting Proportion of surveillance reports or forms received irrespective of when the reports were submitted. Proportion of reports received based on expected reporting units if the system includes zero reporting. A situation with complex social, political and economic origins which involves the breakdown of state structures, the disputed legitimacy of host authorities, the abuse of human rights and possibly armed conflict, that creates humanitarian needs. The term is generally used to differentiate humanitarian needs arising from conflict and instability from those that arise from natural disasters ALNAP. Confidence interval A range that expresses the level of approximation, or imprecision, around the point estimate. Also known as a margin of error. Contingency planning The process of establishing programme objectives, approaches and procedures to respond to situations or events that are likely to occur, including identifying those events and developing likely scenarios and appropriate plans to prepare and respond to them in an effective manner Inter-Agency Contingency Planning Guidelines for Humanitarian Assistance The systematic utilisation of policy instruments to deliver humanitarian assistance in a cohesive and effective manner. Sensibly and sensitively employed, such instruments inject an element of discipline without unduly constraining action Larry Minear, Study on the First Gulf Crisis, Observed that money is important for coordination to be effective, and that in fact governments have the obligation to establish and maintain frameworks for coordination. Also observed that in practice, coordination is effective when structures are agreed first, reinforced by dynamic leadership Marc Somers; EFCT course material on the mechanics of coordination, Cost effectiveness analysis This form of analysis seeks to determine the costs and effectiveness of surveillance and response strategies and activities. It can be used to compare similar or alternative strategies and activities to determine the relative degree to which they will obtain the desired objectives or outcomes. The preferred strategy or action is one that has the least cost to produce a given level of effectiveness, or provides the greatest effectiveness for a given level of cost. Country Programme All types of aid project and non-project to one country. A situation that is perceived as difficult. A crisis may not be evident, and it demands analysis to be recognized. Conceptually, it can cover both preparedness and response "crisis management". Time of danger or greater difficulty, decisive turning point Oxford Pocket Dictionary, Crude mortality rate CMR Mortality rate among all age groups and due to all causes. Design effect Phenomenon caused by cluster sampling, and which increases the sampling error or imprecision. The DALY combines in one measure the time lived with disability and the time lost due to premature mortality. A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources ISDR. Situation or event, which overwhelms local capacity, necessitating a request to national or international level for external assistance CRED. A term describing an event that can be defined spatially and geographically, but that demands observation to produce evidence. It implies the interaction of an external stressor with a human community and it carries the implicit concept of non-manageability. The term is used in the entire range of risk-reduction activities, but it is possibly the least appropriate for response. Instead, it is widely recognized that such disasters are the result of the way individuals and societies relate to threats originating from natural hazards. The nature and scale of threats inherent in hazards vary. The risks and potential for disasters associated with natural hazards are largely shaped by prevailing levels of vulnerability and measures taken to prevent, mitigate and prepare for disasters. Thus, disasters are, to a great extent, determined by human action, or lack thereof. Driver A factor that directly influences or causes changes R. Early warning system A communicable disease surveillance and response system designed to detect as early as possible any departure from the usual or normally-observed frequency or phenomenon. The process through which activities are undertaken at the most appropriate level and with the most valuable ececution GIGNOS, 2. Emergency Emergency is a term describing a state. It is a managerial term, demanding decision and follow-up in terms of extra-ordinary measures Oxford Pocket Dictionary, A "state of emergency" demands to "be declared" or imposed by somebody in authority, who, at a certain moment, will also lift it. Thus, it is usually defined in time and space, it requires threshold values to be recognized, and it implies rules of engagement and an exit strategy. Conceptually, it relates best to Response. Emergency preparedness Actions taken in anticipation of an emergency to facilitate rapid, effective and appropriate response to the situation Inter-Agency Contingency Planning Guidelines for Humanitarian Assistance Emergency threshold Mortality rate above which an emergency is said to be occurring. Epidemic The occurrence in a community or region of cases of an illness, specific health-related behaviour, or other health-related events clearly in excess of normal expectancy. The community or region and the period in which the cases occur are specified precisely. The number of cases indicating the presence of an epidemic varies according to the agent, size, and type of population exposed, previous experience or lack of exposure to the disease, and time and place of occurrence. Epidemic threshold Is the critical number or density of susceptible hosts required for an epidemic to occur. The epidemic threshold is used to confirm the emergence of an epidemic so as to step-up appropriate control measures. Equity in health Equity in health implies that everyone should have a fair opportunity to attain his or her full health opportunity, and that no one should be disadvantaged from achieving this potential EURO European Centre for Health Policy, ECHP, Brussels, The systematic assessment of the relevance, adequacy, progress, efficiency or effectiveness of a policy, programme or project, in relation to its intended aims and objectives EURO European Centre for Health Policy, ECHP, Brussels, The process of determining the merit, worth or value of something or the product of that process Scriven, A systematic and impartial examination of humanitarian action intended to draw lessons to improve policy and practice and enhance accountability ALNAP. The systematic and objective assessment of an on-going or completed project, programme or policy, its design, implementation and results. The aim is to determine the relevance and fulfillment of objectives, development efficiency, effectiveness, impact and sustainability. Evaluation also refers to the process of determining the worth or significance of an activity, policy or programme. OECD Excess mortality, excess mortality rate Mortality above what would be expected based on the non-crisis mortality rate in the population of interest. Excess mortality is thus mortality that is attributable to the crisis conditions. In economic terms, a failing state is a low-income country in which economic policies, institutions and governance are so poor that growth is highly unlikely. The state is failing its citizens because even if there is peace they are stuck in poverty L. Flexibility Ability of the surveillance system to adapt to changing needs, incorporate new diseases, leave out less important diseases, change reporting frequency, change or modify data source. Hazard A possible threat of source of exposure to injury, harm or loss, e. Health is a state of complete physical, mental and social well being and not merely the absence of disease or infirmity WHO Constitution. The extent to which an individual or a group is able to realize aspirations and satisfy needs, and to change or cope with the environment. Health is a resource for everyday life, not the objective of living; it is a positive concept, emphasizing social and personal resources as well as physical capabilities Health Promotion: A Discussion Document, Copenhagen: A state characterized by anatomic, physiologic and psychological integrity; ability to perform personally valued family, work and community roles; ability to deal with physical, biologic, psychological and social stress a feeling of well-being; and freedom from the risk of disease and untimely death J. A state of equilibrium between humans and the physical, biologic and social environment, compatible with full functional activity JM.

Chapter 2 : History of Freemasonry - Wikipedia

Type (a) emergence clearly indicate, that the defining characteristic of an emergent property P-- that it belongs to Obs 2 (S 2) but not Obs 2 (S 1)-- does not entail that it could not be determined by Obs 1 (S 1) in an explanation using D.

Origin myths and theories[edit] Early Masonic sources[edit] The earliest masonic texts each contain some sort of a history of the craft, or mystery, of masonry. The oldest known work of this type, The Halliwell Manuscript, or Regius Poem , dates from between and This document has a brief history in its introduction, stating that the "craft of masonry" began with Euclid in Egypt, and came to England in the reign of King Athelstan born about , died 27 October The resulting constitutions are prefaced by a history more extensive than any before, again tracing the history of what was now freemasonry back to biblical roots, again forging Euclid into the chain. He maintained that Crusader Masons had revived the craft with secrets recovered in the Holy Land , under the patronage of the Knights Hospitaller. At this point, the "history" of the craft in Continental Freemasonry diverged from that in England. Mackey states that "The propositions of Larudan are distinguished for their absolute independence of all historical authority and for the bold assumptions which are presented to the reader in the place of facts. The list of his published works start in with "A Lexicon of Freemasonry", and extend to his monumental Encyclopedia of Freemasonry in Thus we have "sculptores lapidum liberorum" London , "magister lathomus liberarum petrarum" Oxford , and "mestre mason de franche peer" Statute of Labourers These all signify a worker in freestone, a grainless sandstone or limestone suitable for ornamental masonry. In the 17th century building accounts of Wadham College the terms freemason and freestone mason are used interchangeably. Freemason also contrasts with "Rough Mason" or "Layer", as a more skilled worker who worked or laid dressed stone. While this is difficult to reconcile with medieval English masons, it apparently became important to Scottish operative lodges. In England, he would leave home at nine or ten years of age already literate in English and French, educated at home or at the petty junior school. From then until the age of fourteen, he would attend monastery or grammar school to learn Latin, or as a page in a knightly household would learn deportment in addition to his studies. Between the ages of fourteen and seventeen he would learn the basic skills of choosing, shaping, and combining stone and then between the ages of 17 and 21, be required to learn by rote a large number of formal problems in geometry. Three years as a journeyman would often finish with the submission of a masterwork dealing with a set problem in construction or design. At this point, he was considered qualified, but still had a career ladder to climb before attaining the status of Master Mason on a large project. These would be realised on the ground by using a larger compass than the one used for drafting. Medieval architects are depicted with much larger compasses and squares where they are shown on a building site. Fine detail was transferred from the drawing board by means of wooden templates supplied to the masons. Visiting Master Masons and Master Carpenters sat at high table of monasteries, dining with the abbott. The original use of the word lodge indicates a workshop erected on the site of a major work, the first mention being Vale Royal Abbey in Later, it gained the secondary meaning of the community of masons in a particular place. The earliest surviving records of these are the laws and ordinances of the lodge at York Minster in It should be noted that these regulations were imposed by the Dean and Chapter of the Minster. The masons were late in forming such bodies. The major employer of masons in medieval England was the crown , and the crown frequently employed masons by impressment. In other words, they were forcibly recruited when the need arose. The Halliwell Manuscript, or Regius Poem is the oldest known document of masonic origin. It was published in by Shakespearean scholar and collector James Halliwell who dated it to Woodford , the pioneering Masonic scholar and a founder of Quatuor Coronati Lodge , agreed with this dating. Finally, in , four representatives of the "mystery" or trade are elected to the Common Council in London. This also seems to be the first use of the word "freemason" in English. It was immediately struck out, and replaced with the word "mason". The regulations or charges follow, usually with instructions as to the manner in which a new mason should swear to them. The Lansdowne , originally dated to this period, is now thought to date from the 17th century. It was at one time assumed that the church was the major employer of masons, and with the Dissolution of the Monasteries the lodges disappeared. In , "The bill of conspiracies of victuallers and craftsmen" was passed, revoking their monopolies. In it was repealed, presumably because they were too useful to the government. While this was not chartered until , the state used it in the sixteenth century to procure and indent masons for building projects. In addition, masons were increasingly employed by private individuals. Robert Cooper, the archivist of the Grand Lodge of Scotland, believes that the lost mystery play of the masons may survive in the ritual of contemporary masonic lodges. Towards the end of the century, William Schaw held both these posts. These state "They shall be true to one another and live charitably together as becometh sworn brethren and companions of the Craft. Edinburgh became the "first and principal" lodge and Kilwinning the "second and head" lodge of Scotland, attempting to appease all parties. Clair of Rosslyn the right to purchase patronage over the masons of Scotland. Kilwinning is noticeably absent from the list of lodges appending their endorsement. The charter seems to have lapsed when St. Clair fled following a scandal, [27] and a second charter was granted to his son, also William St. Clair, on the formation of the Grand Lodge of Scotland in , [43] in spite of the fact that it never won the royal approval that would have made it valid. The Scottish lodges began to keep minutes, and therefore the appearance of "accepted" or non-operative masons is better recorded than in England, where there are no known internal records of lodge proceedings. Clair charter, the lodges of Scotland being his own responsibility. The reasons that his brother and their friend were also admitted are unclear. As the responsibility for design shifted from the Master Mason to the architect in the sixteenth century, it is probable that architects started to join the lodges of the masons they worked with. The "old Brothers" were probably from the Cheshire Cheese and at least one other lodge. It is known that the four lodges mentioned above held an assembly at the Goose and Gridiron, in St. They agreed to restore their "Quarterly Communications", four meetings a year for the transaction of masonic business, and an annual assembly to elect the next Grand Master. At this meeting, they elected Anthony Sayer , Master of the lodge at the Apple Tree, of whom little else is known, and the Grand Lodge of London and Westminster was born. At this stage, it is unlikely that they saw themselves as anything more than an association of London lodges. This perception was to change very rapidly. He was a career civil servant with the commissioners of taxes. In , they elected John Theophilus Desaguliers , a clergyman, an eminent scientist, and a Fellow of the Royal Society. Thereafter, in what appears to be a deliberate attempt to raise the profile of the organisation, all the Grand Masters have been members of the nobility. Although he only served one term as Grand Master, he was twice Deputy Grand Master under figurehead Grand Masters, and at other times behaved as if he was Grand Master, forming irregular lodges to conduct initiations. It seems to have been Desaguliers who insisted that ritual be remembered rather than written down, leading to a dearth of material on the development of English ritual until after the formation of United Grand Lodge. Initiations began to be reported in newspapers. The noble grand masters were often fellows of the Royal Society, but the Duke of Wharton â€”23 had just had his Hell-fire club shut down by the government, and joined, or possibly formed, an anti-masonic group called the Gormagons almost as soon as he left office. From the installation of the new Grand Master was the occasion for a parade, originally on foot, later in carriages. This became the subject of some ridicule, until starting in there were also mock processions by anti-masonic groups, leading to the discontinuation of the practice in The rapid expansion of freemasonry also led to many new lodges failing after only a year or two. In addition to attacks from outside the craft, there were now disillusioned ex-masons willing to make money out of "exposures" of freemasonry. It was edited by the presbyterian clergyman, James Anderson , to the order of John Theophilus Desaguliers , and approved by a Grand Lodge committee under his control. This work was reprinted in Philadelphia in by Benjamin Franklin , who was that year elected Grand Master of Masons in Pennsylvania. It was also translated into Dutch , German , and French His reward for his labours was the copyright on the work. It was expanded, updated, and re-published in The ceremony for dedicating a new lodge was briefly outlined, and the work finished with a section of songs. Although the historical section was attacked at the time, and ever since, as being a work of obvious fiction, the work remains a milestone in masonic history. An apprentice who had learned his craft became a journeyman, qualified to do all manner of masonic work. The master was also qualified as a project manager, often functioning as architect as well. An apprentice, after serving his term of seven years, could elect to pay to join a lodge, becoming an "entered apprentice". Alternatively, he could elect to freelance on the lower grades of building work as a "Cowan". The members of the lodge were "Brithers" brothers , a Scottish legal term for those bound to each other by oath. The Master was simply the mason in charge of the lodge, or one who had held that distinction. From this, and from other documents of the same period, such as the Trinity College, Dublin manuscript of , we can form an idea of the ritual of an operative lodge at the end of the 17th century. This was accompanied by much horseplay, which was probably excised as the craft became more gentrified. The fellowcraft was made to take a further oath, and entrusted with two further words and the "five points of fellowship", which in were foot to foot, knee to knee, heart to heart, hand to hand, and ear to ear. The distinction between a fellowcraft and a master is unclear, and in many documents they appear to be synonymous. There still remains the rank of Installed Master, which comprises the Master in charge of the lodge and its past masters, and involves its own ritual, words and signs, but entails being elected to take charge of the lodge for a year. Other, "higher" degrees are optional and require a mason to join a side-order, except in lodges constituted under the Grand Lodge of Scotland , which are empowered to confer the Mark Master Mason degree on Master Masons, as an extension to the second or Fellowcraft degree. Hence the third degree emerged sometime between and , and took some time to spread within the craft. The fact that it did spread seems to many scholars to indicate that the tri-gradal system was not so much innovation, as the re-organisation of pre-existing material. The new Master Mason degree was centred on the myth of Hiram Abiff , which itself consists of three parts. The second is the story of his murder by subordinates, which is similar to one of the legends of the French Compagnonnage. Lastly, the story of the finding of his body, and the derivation therefrom of the five points of fellowship, which appears in the Graham Manuscript of , where the body being sought and exhumed is that of Noah. The earliest reference to the conferment of a third degree is from London, from the minutes of "Philo Musicae et Architecturae Societas Apollini", a short-lived musical society composed entirely of Freemasons. These minutes record the initiation and passing to the degree of Fellowcraft of Charles Cotton. This would nowadays be regarded as highly irregular.

Chapter 3 : Emergent Strategy : Interaction Institute for Social Change

Summary and Next Steps In sum, the process of Generative Emergence leads to a range of outcomes, from failure, to first- degree order emergence, to second-degree systems emergence, to third-degree radical emergence.

Two years later, I published a post on my then-favourite definition of data science , as the intersection between software engineering and statistics. Unfortunately, that definition became somewhat irrelevant as more and more people jumped on the data science bandwagon â€" possibly to the point of making data scientist useless as a job title. However, I still call myself a data scientist. Even better â€" I still get paid for being a data scientist. But what does it mean? What do I actually do here? This article is a short summary of my understanding of the definition of data science in I knew I wanted to get back to working in the tech industry, ideally with a small startup. Around that time I heard about Kaggle and decided to try competing. This went pretty well , and exposed me to the data science community globally and in Melbourne, where I was living at the time. Upon graduating, I joined Giveable as a data scientist. Changing my LinkedIn title quickly led to many other offers, but I was happy to be working on Giveable â€" I felt fortunate to have found a startup job that was related to my PhD research on recommender systems. My understanding of data science at the time was heavily influenced by Kaggle and the tech industry. Kaggle was only about predictive modelling competitions back then, and so I believed that data science is about using machine learning to build models and deploy them as part of various applications. I was very comfortable with that definition, having spent my PhD years on several predictive modelling tasks, and having worked as a software engineer prior to that. Things have changed considerably since It is now much easier to deploy machine learning models, even without a deep understanding of how they work. Many more people call themselves data scientists, including some who are more focused on data analysis than on building data products. Even Kaggle â€" which is now owned by Google â€" has broadened its scope beyond modelling competitions to support other types of analysis. Numerous articles have been published on the meaning of data science in the past six years. We seem to be going towards a broad definition of the field, which includes any type of general data analysis. This trend of broadening the definition may make data scientist somewhat useless as a job title. However, I believe that data science tasks remain useful, as shown by the following definitions. Like other authors, they argue that causal inference has been neglected by traditional statistics and some scientific disciplines. Further, they emphasise the importance of domain expert knowledge, which is essential in causal inference. Defining data science in this broad manner seems to capture the essence of what the field is about these days. However, purely descriptive tasks are still often performed by data analysts rather than scientists. And the distinction between prediction and causal inference can be a bit fuzzy, especially as the tools for the latter are at a lower level of maturity. No one is born an expert â€" expertise is gained by learning from and interacting with the world. Further, there are numerous cases where experts were proven to be wrong. Despite the importance of domain knowledge, one can argue that scientists that specialise in a single domain are not data scientists. In fact, the ability to go beyond one domain and think of data in a more abstract manner is what makes a data scientist. Applying this abstract knowledge often requires some domain expertise or input from domain experts, but most data science techniques are not domain-specific â€" they can be applied to many different problems. John Hawkins explains this point well in an article titled why all scientists are not data scientists: Those scientists and statisticians who have focused themselves on understanding the limitations and possibilities of making inferences from experimental data are the ones who are the forerunners to data scientists. They have a skill which transcends the particulars of what it takes to do lab work on cell cultures, or field studies for ecology etc. Their core skill involves thinking about the data involved at an abstracted level. And more specifically, to make better decisions. That should be something no one can argue with. Everyone loves a good buzzword, and these days AI Artificial Intelligence is one of the hottest buzzwords. However, despite what some people may try to tell you , AI is unlikely to make data science obsolete any time soon. Following the above definition, as long as there is a need to make decisions based on data, there will be a need for data scientists. The resurgence of AI feels somewhat amusing given my personal experience. One of the reasons I decided to pursue a PhD in natural language processing and personalisation was my interest in what I considered to be AI back in There is plenty to learn and develop in this area, regardless of buzzwords and sexy titles.

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Chapter 4 : Emergence - Wikipedia

Emergence definition, the act or process of emerging. See more.

Advanced Search Abstract Radiant frost is a significant production constraint to wheat Triticum aestivum and barley Hordeum vulgare , particularly in regions where spring-habit cereals are grown through winter, maturing in spring. However, damage to winter-habit cereals in reproductive stages is also reported. Crops are particularly susceptible to frost once awns or spikes emerge from the protection of the flag leaf sheath. Post-head-emergence frost PHEF is a problem distinct from other cold-mediated production constraints. To date, useful increased PHEF resistance in cereals has not been identified. Given the renewed interest in reproductive frost damage in cereals, it is timely to review the problem. Here we update the extent and impacts of PHEF and document current management options to combat this challenge. We clarify terminology useful for discussing PHEF in relation to chilling and other freezing stresses. We discuss problems characterizing radiant frost, the environmental conditions leading to PHEF damage, and the effects of frost at different growth stages. PHEF resistant cultivars would be highly desirable, to both reduce the incidence of direct frost damage and to allow the timing of crop maturity to be managed to maximize yield potential. A framework of potential adaptation mechanisms is outlined. Clarification of these critical issues will sharpen research focus, improving opportunities to identify genetic sources for improved PHEF resistance. Barley , frost , reproductive frost , spring radiant frost , wheat. Frost susceptibility generally increases with plant maturity. In particular, crop sensitivity to frost is increased after the awns or spikes start to emerge from the auricle of the flag leaf [Zadoks decimal growth stage 49, Zadoks et al. Radiant frost occurs when still cold air, clear skies and a dry atmosphere combine, allowing rapid radiation of heat to the night sky Foley, ; Hocevar and Martsolf, ; Willcocks and Stone, Such radiant frosts are a particular problem for autumn-sown spring-habit crops, grown through winter, that develop to susceptible post-heading stages in spring. PHEF damage to cereals during spring radiant frosts is a complex process and is distinct from a number of other cold-mediated production constraints. For example, although many elite winter habit cereals show significant freezing tolerance in vegetative stages Fowler and Carles, , both winter- and spring-habit types suffer severe damage at more moderate temperatures during the reproductive stages Livingston and Swinbank, ; Chatter and Schlehuber, ; Paulsen and Heyne, ; Fuller et al. In winter-habit wheat, the transition from the vegetative to reproductive growth stages is crucial to the regulation of low-temperature tolerance Mahfoozi et al. Vegetative freezing tolerance is well defined in the literature Fowler and Carles, ; Fowler, ; Galiba et al. As a result, PHEF is less widely understood and can potentially be confused with other cold-mediated production constraints. Research over several decades has not identified PHEF resistance in wheat or barley at levels useful for breeding Frederiks et al. Identifying PHEF resistance presents researchers with a number of significant challenges, which have limited the rate of progress. Developing methods for screening PHEF resistance has proved difficult, as outlined in a recent review Frederiks et al. Similarly, ice nucleation and propagation in plants is complex, particularly under radiant frost conditions. In Frederiks et al. With an increasing recent focus on reproductive frost resistance in cereals Reinheimer et al. In this review, we define the characteristics of spring radiant PHEF. We update the current understanding of the causes and impacts of spring radiant frost damage at different growth stages. Finally, strategies to manage PHEF risk and to identify sources of resistance are discussed. Many of the examples discussed here are from Australian cropping systems. However, the discussion is relevant to PHEF research internationally. Defining the problem PHEF crop losses typically arise in two ways: The relative importance of direct frost damage and lost yield potential varies with climate and cropping systems. Geographical extent and impact of PHEF damage Economically significant PHEF damage typically affects spring-habit cereals but damage to winter-habit cereals has been periodically reported Livingston and Swinbank, ; Chatter and Schlehuber, ; Paulsen and Heyne, , Fuller et al. PHEF crop damage is most important in regions with humid subtropical, Mediterranean, or maritime temperate climates. The problem is particularly common where, due to hot dry summers, spring habit cereals are grown through the winter and spring. Paradoxically, crops grown in warmer subtropical climates can be at greater risk of PHEF injury than those growing at higher latitudes, due to faster development from the relatively resistant vegetative stages to the more susceptible reproductive stages Single, , ; Frederiks et al. In subtropical regions, temperatures at night can fall to damaging levels despite mild daytime temperatures ideal for rapid plant growth Single, In Mediterranean regions, more frequent rainfall and cloud cover may lead to a lower frequency of damaging night time temperatures, while lower day time temperatures can slow crop progression to susceptible growth stages. However, damaging conditions still occur, particularly during drier seasons. Direct losses resulting from irregular frost damage of heading wheat and barley are significant internationally and have been widely described in Australia Farrer ; Single, , ; Woodruff, ; Frederiks, ; Frederiks et al. Even under optimal management where delayed sowing is used to postpone spike emergence past the main, mid-winter frost risk period, late spring frosts can result in significant crop losses. In affected areas, individual grain-growers risk crop failure. Winter-habit cereals grown in temperate cropping regions can also suffer PHEF damage when an unusually early break in spring results in crops heading early, leaving them vulnerable to late spring radiant frosts. Current management options and limitations Frost escape by manipulating heading time is the main method currently available to minimize PHEF risk. Wheat and barley are planted late to delay heading past the main frost risk period, often leading to grain filling when warmer temperatures and drought conditions prevail. Heat and drought during grain filling and ripening can dramatically reduce crop yield potential.

Chapter 5 : The Calculi of Emergence: Computation, Dynamics, and Induction

Discussion of emergence and reduction at the Moving Naturalism Forward workshop, October Participants include Sean Carroll, Jerry Coyne, Richard Dawkin.

Nevertheless, no standard definition of emergence is cur- rently available in the literature. This lack of a shared view affects the development of tools to detect and model emergence for both scientific and engineering applications. Here we review some definitions of emergence with the aim to describe how they can be implemented in algorithms to detect and model emergence in sensor and communication networks. However, definitions of emer- gence available in the literature differ considerably in both their philosophical approach and formal rigour. This lack of shared understanding makes communication between scientists and practitioners in Complex System Science difficult, and, worse still, represents an obvi- ous challenge in the development of analytical tools for the formal and experimental study of emergent properties. There are many reasons why the study of emergence is important. The most obvious is that emergent behaviour seems to be ubiquitous in Nature. And emergence does not seem to arise solely from natural systems: This led some authors to claim that the understanding of emergence is a crucial missing component in our understanding of the world [14]. Confident that the study of emergence is a worthwhile endeavour, in this review, we cover some definitions of emergence available in the literature. Our aim is not philosophical, but practical. Our aim is ultimately towards the many engineering appli- cations which nowadays depend on development of intelligent self-organizing networks in order to tackle problems of increasing complexity and size. In these systems, the desired responses emerge by self-organization: In the rest of this paper we ask the following questions: Kubik [11], Shalizi [25] and Crutchfield [3] criticise this definition, mostly on the basis that such definition simply implies that we are currently unable to explain its relation to lower level entities. One day, with better scientific knowledge, we may be able to do so. Consequently such a statement is based on a temporary state of lack of knowledge of the observer rather than on an intrinsic property of a system see the discussion of causation and control in Pattee, [17]. A potential problem with this definition is that basically everything can be seen as emergent according to it. For example, all macroscopic matter is made of atoms, and no individual atoms display the features of the macroscopic ma- terial [1]. Arguably, this definition has more appeal than the previous one since it offers itself to numerical analysis. A considerable body of work explores this view of emergence, in partic- ular in the Cellular Automata CA literature. For example, the way intrinsic computation may emerge spontaneously and come to dominate the dynamics of physical systems when those systems are in the vicinity of a second-order phase transition has been studied by Langton [13], Mitchell et al. More recently, Wiedermann and van Leeuwen [28] have explored the emergent computation capabilities of large number of interacting agents. They formally prove that their emergent computational power goes beyond traditional systems and results in super Turing computational capabilities. Importantly, Shalizi [25] and Crutchfield [3] give a formal, information-theoretic definition of the above concept as well as numerical tools to implement it. In fact, this choice often depends on the emergent phenomena. So the pro- cess can be best characterised in terms of tangled hierarchies exhibiting Strange Loops: As an example, we can imagine individuals organising into a community. Their actions affect how the community develops upward causality and the development of the community itself affects the behaviour and in- teraction of the individuals downward causality. A critique of the concept of downward cau- sation can be found in [17]. This definition has an obvious appeal since it clearly goes beyond the reductionist approach to the analysis of complex system. An application example of this approach is presented by Prokopenko and Wang [20], who demonstrated that self-inspection and self-repair of a sensor and communication network can be described in self-referential terms. It is our opinion that the last three definitions are particularly suited to study multi-agent engineering systems: The Computational Mechanics view of emergence as increased predictability on system behavior allows us to focus on a subset of features which carry maximum information about the system. Model reduction and predictability are the sought outcomes. In the remainder of the paper we discuss potential tools implementing these ideas in multi- agent systems studies. The purpose of these tools is to identify low er dimensional manifolds in higher dimensional data sets. They are used in visualisation, data compression but also data mining with, potentially, useful application in the study of emer- gence. Under the assumption that the coordination between lower entities should constrain their behaviour, we may expect emergent features to occupy a lower dimensional state space compared to the uncoordinated dynamics. Thus, one obvious approach to detect emergence is based on the idea that the complex behaviour of interacting components results in some form of coordination: In other words, a departure from randomness, and correlations between components, may be seen as a very first step in the detection of emergent properties. It is thus natural to look at various information- theoretic measures as a basis for the approach. It was observed that the average mutual information has a distinct peak at the transition point. Wuensche [30] has convincingly demon- strated that only complex dynamics exhibits high variance of input-entropy, leading to auto- matic classification of the rule-space. Importantly, the peak of input-entropy variance points to a phase transition as well, indicating the edge of chaos complexity. An information-theoretic approach to quantifying information flows in agent-environment interactions was also con- structively used in recent studies of perception-action loops and sensor evolution [10]. It is also well-known that graph connectivity can be analysed in terms of the size of the largest connected subgraph LCS and its standard deviation obtained across an ensemble of graphs, as suggested by the random graphs theory [5]. In particular, critical changes occur in connectivity of a directed graph as the number of edges increases: Thus, a graph-theoretic metric based on LCS variance may capture spatial aspects of desired emergent patterns connectivity , while a metric based on entropy of local agent variables rules, coordinates, velocities, etc. In the context of multi-agent networks it may be possible to unify the information-theoretic and graph-theoretic representations of the metrics. It could be argued that only complex dynamics exhibits high variance, and the peak of this variance would point to a phase transition in connectivity. The distinction between information-theoretic and graph-theoretic metrics is identified and put to use by Prokopenko et al. These metrics contributed to a specification of various evolvable aspects: Minati [15] proposes a measure of ergodicity to detect emergence. A system is commonly defined as ergodic when the average, at a single instant of time, on all microscopic behaviors present within the system, is equal to the time average on the behaviour of a single compo- nent. This property best describes systems at some form of stable equilibrium which offer themselves naturally to be studied via statistical mechanics tools. Since the property of ergod- icity is completely lost during a phase transition, or via structural changes Minati proposes to detect increase of ergodicity as a signature of the evolution towards a new state which may be considered as emergent. Intrinsic emergence refers to the emergent features which are impor- tant within the system because they confer additional functionality to the system itself, like supporting global coordination-computation-behaviour e. The algorithmic approach behind the concept of Computational Mechanics [24] is pro- posed as the main tool in the study of intrinsic emergence, which aims to model the way information is processed within a system. Shalizi [25] formalises this approach by proposing the following definition: This definition is interesting since it defines emergence as a property of the system, not of the observer. Also, if offers some specific information-theoretic measures which can be implemented via the machinery of the Computational Mechanics ap- proach. The approach is based on the Causal-State Splitting Reconstruction CSSR algorithm [24], which aims to reconstruct the dynamical states of a system and their transition proba- bilities. Via the use of the algorithm, not only the statistical complexity of the process can be measured, but emergent features i. The ideas can be applied to both temporal and spatial patters. Of particular interest is the application of the above concept to the study of the evolutionary emergence of complexity in small population of simple agents and the analysis of the structural hierarchies which allow for self-organisation [4]. One convincing example is described by Parunak and Brueckner [18] in the context of pheromone-based coordination. Similarly, it can be shown that the emergence of multi-agent networks, indicated by the minimal variance of their fragments an approximation of the network heterogeneity , is ex- plained by increased entropy on a micro-level. This micro-level is the communication space where the inter-agent messages are exchanged [21]. With the view of studying large systems of self-organising agents, we have reviewed some definitions of emergence and described how they could lead to useful tools for the detection of emergence, for the identification of features which are maximally informative about the system dynamics which could lead to model com- plexity reduction and to the better understanding of multi-scale and multi-level information processing in complex systems. University of Aarhus Press. To be published Sept. Computation, Dynamics, and Induction, Physica D 75 Acta Mathemat- ica Scientia, Hungary, 12, An Eternal Golden Braid. Simple Cases of Stigmergy. Downward Causation, in press. On evolution and archi- tectural constraints. Collected Papers, Reading, MA: Finding gliders, filtering, and relating space-time patterns, attractor basins, and the Z parameter.

Chapter 6 : WHO | Definitions: emergencies

So, more agency, more differentiation, more orderly relationship, more synergy - all of that comes together and the net defining thing is emergence. How much fundamental new advantage arises, and that's what evolution selects for.

Different parts were published in a modified form as 1 Emmeche The present web version below contains the complete argument of both articles. The strong version of Artificial Life claim that emergent computational patterns may not simply simulate life but realize the very phenomenon. This is one of several reasons why a definition of life is of interest. In this paper, it is argued that the received view of definitions of life in biology and philosophy is misleading. Generality cannot in general be dispensed with. Though criteria for adequacy of definitions are highly context-dependent, definitions of life are of a special nature, belonging to what is here called ontodefinitions. Separate definitions of life fulfilling a set of relevant criteria exist and belong to distinct paradigms of theoretical biology. Emergence is implicit in these. Explaining things - introductory remarks Modern biology explains life, living beings, as a highly organized material entities composed of cells composed of molecules and as results of a long process of evolution by ripe with emergent structure. Today we hear the claims of new artificial life, that it is possible to mimick evolution not only by gene manipulation and other biotechniques, but by computer and robot techonology as means to create similar or even identical instances of living organization realized in other media. In what sense will these other patterns, processes, entities be alive? Will it effect the way we conceive and explains the living organisms we already know? By explaining things, we change them. They do not remain the same in our conceptions. Explanations should satisfy our quest for understanding. There are, of course, forms of understanding that do better without explanation. Jokes should not be explained unless somebody makes a request, and explaining the point and even why it was funny can be a demolishing undertaking. Being a good thing to pursue in science, called upon in the court-room, often required in the upbringing of children and in everyday life, we should, however, be careful about the use of explanations. In science, there is a certain flavour of reduction to the very notion of explanation that underlies the dualism between explanation of mechanisms in the natural sciences and understanding of meaning in the humanities. For the moment, these can be thought of as certain very broad categories -- such as matter, life, mind, or society -- which are not simply denoting huge phenomenologies in a very vague manner, but also refer to some categories of the so-called modern scientific and evolutionary world picture, whose symbolic and cognitive content science has contributed to deepen. The ontodefinitions in science, of which I shall only consider the concept of life, are very basic for the paradigmatic character of scientific activity. They are almost mixed explanations and definitions. They define what scientists are looking for thus constitute what is relevant and what entities experiments should deal with , and at the same time, the provide some basic understanding of the very nature of these objects, a narrative, an explanatory story of some kind. This is all implicit in a given paradigm. The ontodefinitions are not considered by the scientists to be important or to have anything to do with the usual everyday experimental activity. We shall see that biologists are typically reluctant to define life in explicit terms; nonetheless, such definitions exists within distinct paradigms of contemporary biology. This investigation is in part motivated by some general assumptions about scientific activity as explanatory. Similarly, within the social sciences, functional explanations may play a role, but more important are intentional explanations, also known in cognitive science as the intentional stance i. Views may differ about the derived or non-fundamental status of some of these forms, and about whether only one form, typically the causal one, should be preferred also in biology and sociology, or whether, e. That such borders are crossed is at least a tempting interpretation of one of the new dimensions of philosophical importance of this research, and is consistent with its own emphasis of emergent phenomena. By constructing quite new instances of life, alife research promise add to our primitive Zoo of archetypes of lifeforms and thus be able to explain or understand what is universally true about life and what is simply contingent upon the particular way life evolved on Earth e. We can imagine an isomorphy between constructing and explaining, for instance, a detailed procedure for assembling a machine may give us enough information to construct an explanation of its workings in the form of an algorithmic description of the rules for its change of state. This is probably a very common sentiment in physical science. Even though these explanations are still reductive in the methodological sense that one can in principle show exactly what is going on from step to step in a simulation of, e. The explanation, comprising both explanans and explanandum, should in a narrative form of which deductive logic is considered here as a highly specific kind lead a listener to a particular kind of understanding of the phenomenon. Explanations are a certain kind of narrative rules of a science-specific game of language, that is, the game of generating a representation of a phenomenon by logical mechanisms such as deduction, induction, abduction, or by more elaborated computational and hermeneutic procedures such as construction and interpretation of computer models of emergent phenomena. In explanations, we reproduce a system by producing another one. Is Artificial Life redefining the notion of living systems in biology, or does it for the first time give a universally valid definition of life? In the year , the term biology will celebrate its second centennial, and the modern idea of a unified science of living systems is at about the same age. Biology before Artificial Life was and still is considered as an autonomous science with its own standard methods, theories, and basic assumptions about its subject matter -- living systems, life, organisms. How can one be sure that life simply can be defined as "the emergence in any kind of medium of complex structures with certain life-like properties"? What makes this notion counterintuitive to some biologists? Do organisms have to be material? We may even ask: What may be the meaning of the fact that all attempts to formulate a satisfactory definition of life have failed? As I hope to show, the very presupposition that it has failed, seemingly accepted by a majority of biologists, is misleading, based on wrong premises. Such a conception of a definition of life the standard view leads to problems, and these problems vagueness, special exceptions, etc. This intuition is historically and empirically well grounded. I shall argue that the problem is not just to define life -- as this has already been done implicitly by 20th century biology in two important ways. In order to evaluate the alife claim one must grasp the nature of the definition and its cognitive role, and its relation to the notion of emergence, a term often used quite informally. The strategy here is to show that the standard view of the definition of life is flawed; that two effective implicit definitions of life are in use in contemporary biology and a further one is possible ; and that these definitions constitute life as an emergent phenomenon, but only implicitly. General attitudes and the standard view The view that defining life is a futile endeavour is very common among biologists, even though this complete and unreflective refusal of the very question does not constitute what we below shall call the standard view. Though possibly interesting, it is hardly necessary to do a systematic survey with questionnaires to practising researchers within biochemistry, molecular, cellular and evolutionary biology, in order to observe that most scientists are extremely sceptical toward attempts to make clear definitions of living beings - their objects of study. They simply assert with some justification that a definition is of no use in solving the various experimental puzzles of normal research. Go into a DNA lab or a molecular biology department, attend a research seminar, and ask about what definition of life the researcher takes as his or her point of departure, and you will be met with an indulgent smile. On the one hand, this sceptical refusal of the very question may surprise the outsider of science, given the common idea that science must afford clear and logically consistent definitions of all concepts employed. This is the pragmatic answer as to why biologists usually do not consider the definition question as an important one: Who cares, so long as we can distinguish dead from living fruit flies? A remark made by Ernst Mayr is representative for this attitude: These endeavours are rather futile since it is now quite clear that there is no special substance, object, or force that can be identified with life. Thus from the citation just given he immediately proceeds by acknowledging a kind of definition of life: There is no doubt that living organisms possess certain attributes that are not in the same manner found in inanimate objects. Different authors have stressed different characteristics, but I have been unable to find in the literature an adequate listing of such features. The list, which I will not discuss in depth here, has as its key words: Complexity and Organization; 2. Chemical Uniqueness referring to the high specificity of biochemical macromolecules ; 3. Quality whereby Mayr makes a contrast between physics as a quantitative science and the biological world as a world of qualities, individual differences, communications systems, interactions in ecosystems, etc. Uniqueness and Variability; 5. Possession of a Genetic Program with the notable remark that "Nothing comparable to it exists in the inanimate world, except for manmade computers. Historical Nature of the taxonomic categories, e. Indeterminacy under this tag Mayr includes unpredictability because of randomness, stochastic perturbations, complexity and "emergence of new and unpredictable qualities at hierarchical levels". Therefore, one may conclude that on the one hand, Mayr thinks that definitions have to be essentialistic ones and that attempts to define life by one single "essence" or crucial characteristic are futile, but on the other hand, it is indeed possible to define life as a process by a very qualitative and possibly redundant list of eight properties or nine, if we include emergence and irreducibility [18]. Particular living beings may not hold all properties given, so the list may not be a list of necessary and sufficient properties; it may be more vague or redundant. Should we list the crucial properties of living processes, then complexity, organization, and genuine biological ones such as self-reproduction and metabolism cf. The central claims are i and ii , and most biologists will usually not feel committed to make further elaborations of the consequences of this stance. Biologists of today are emphatically non-essentialist and non-vitalist. They shy general claims of the nature of life that have to them the slightest stain of vitalistic ideas or connotations. This attitude may be decent if one faces attempts to substitute quasi-scientific, pseudo-holistic, or intuitive notions of life for the normal scientific view of life as highly complex and specific physical systems open for biological, chemical and physical inquiry. However, it is only a sad consequence of the defeat of vitalism that some biologists still conceive the foundation of modern biology to be mechanistic, i. Gould and other contemporary evolutionary biologists. One can also say that the attitude of subscribers to the SVDL is this: This, the distinguishing feature of organisms, is best thought of as involving some kind of complex organization, giving an ability to use energy sources for self-maintenance and reproduction. Efforts to find some distinctive substance characterizing life have proven as futile as they have been heroic. The one thing which is clear is that any analysis of life must accept and appreciate that there will be many borderline instances, like viruses. Inconvenient as this may be for the lexicographer, this is precisely what evolutionary theory would lead us to expect. In a sense, the very idea of studying life-as-it-could-be enforces an interest in more general definitions of life. Within the neodarwinian tradition, we find John Maynard Smith also interested in alife [25] as a exemption to the unreflected view that it is not interesting to define life. He surpasses the SVDL in his attempt to give a general definition. Maynard Smith , pp. Maynard Smith goes on to discuss their interdependence and relation to biological evolution. Maynard Smith does not simply give a list -- he relates the listed features internally within the theoretical framework of evolutionary biology. Both must be seen as integrated within the modern version of darwinism so that life can be defined, according to Maynard Smith, by the possession of those properties that are needed to ensure evolution by natural selection, i. Requirements for a definition We have noticed that many biologists are sceptical about the use of definitions of life and do not appreciate previous attempts which they think have failed; and that several biologists do not think it is possible in principle to define life in a precise, mathematical or exact way. Definitions are usually considered as speculative and of no use in guiding practical experimental studies. What requirements should a definition of life meet? Are such requirements specific to biology or general for any scientific term? Should a definition of life reveal the deepest nature of biological life? These questions can be answered in two steps.

Chapter 7 : Emergence | Define Emergence at racedaydvl.com

The idea of emergence originates from the fact that global effects emerge from local interactions producing a collective coherent behavior. A particular instance of emergence is illustrated by a.

If you wish to make an apple pie from scratch, you must first invent the universe. When something new arises, we have no simple, shorthand language for it. The words we try seem like jargon. So we stumble with words, images, and analogies to communicate this whiff in the air that we can barely smell. We know it exists because something does not fit easily into what we already know. Emergence disrupts, creates dissonance. We make sense of the disturbances that emergence creates partially through developing language that helps us to tease out useful distinctions. As the vocabulary to describe what is emerging becomes more familiar, our understanding increases. For example, disturbance, disruption, and dissonance are part of the language of engaging emergence. These terms are cousins, and I often use them interchangeably. Disruption is the most general of the three words. If something involves an emotional nuance, chances are that I call the disruption a disturbance. When conflict is involved or the disruption is particularly grating, with a lack of agreement or harmony, I will likely refer to its dissonance. This chapter helps build a vocabulary we can all use by defining emergence. The chapter also provides a brief history of how our understanding of emergence has evolved. It offers some distinctions between strong and weak emergence and describes essential characteristics of emergenceâ€”what it looks like and how it behaves. The chapter ends by reflecting on the challenge of learning how to engage emergence. Defining Emergence In the preface, I defined emergence as simply as possible: A more nuanced definition is higher-order complexity arising out of chaos in which novel, coherent structures coalesce through interactions among the diverse entities of a system. Emergence occurs when these interactions disrupt, causing the system to differentiate and ultimately coalesce into something novel. Key elements of this definition are chaos and novelty. Chaos is random interactions among different entities in a given context. Think of people at a cocktail party. Chaos contains no clear patterns or rules of interaction. Make that a cocktail party in which no single culture prevails, so that no one is sure how close to stand to others, whether to make eye contact, or whether to use first or last names. Emergent order arises when a novel, more complex system forms. It often happens in an unexpected, almost magical leap. In his bestseller Emergence, science writer Steven Johnson puts it this way: A Short History of Emergence If we want to engage emergence, understanding its origins helps. Scientist Peter Corning offers a brilliant essay on emergence. I have paraphrased some highlights: Emergence has gone in and out of favor since According to philosopher David Blitz, the term was coined by the pioneer psychologist G. The emergent is unlike its components. Analysis was seen as the best means to make sense of our world. In recent years, nonlinear mathematical tools have provided the means to model complex, dynamic interactions. This modeling capability has revived interest in emergenceâ€”how whole systems evolve. Emergence is intimately tied to studies of evolution. Although evolutionary scientists have done much of the work, people from a variety of disciplines have also struggled to explain this common and mysterious experience. What enables an unexpected leap of understanding in a field of study or practice? In , Thomas Kuhn contributed to our understanding by coining the term paradigm shift to describe a tradition-shattering change in the guiding assumptions of a scientific discipline. Engagingly told by Mitchell Waldrop in his book Complexity, the story of how the Santa Fe Institute was born reads like a great adventure. They were no longer alone with their questions. Others were exploring the same edges. They gave this experience a name: It is something moreâ€”and different. It is whole systems evolving over time. Single-cell organisms interact, and multicellular creatures emerge. Humans become self-conscious and track their own evolution. In Emergence, Steven Johnson speaks of how our understanding of emergence has evolved. As language emergedâ€”complexity, self-organization, complex adaptive systemsâ€”a second phase began. These terms focused our attention in new directions. People started coming together across disciplines to understand the nature of these patterns. The Santa Fe Institute was central to this phase. And we started working with itâ€—for example, developing software that recognizes music or helps us find mates. This book is about creating conditions for applied emergence in our social systems. It aims to help us work with the dynamics of emergent complexity so that our intentions are realized as life-serving outcomes. Understanding this distinction clears up some confusion. Predictable patterns of emergent phenomena, such as traffic flows and anthills, are examples of weak emergence. In contrast, strong emergence is experienced as upheaval. Weak emergence describes new properties arising in a system. A baby is wholly unique from its parents, yet is basically predictable in form. In weak emergence, rules or principles act as the authority, providing context for the system to function. In effect, they eliminate the need for someone in charge. Road systems are a simple example. Strong emergence occurs when a novel form arises that was completely unpredictable. We could not have guessed its properties by understanding what came before. Nor can we trace its roots from its components or their interactions. We see stories on television. Yet we could not have predicted this form of storytelling from books. As strong emergence occurs, the rules or assumptions that shape a system cease to be reliable. The system becomes chaotic. In our social systems, perhaps the situation is too complex for a traditional hierarchy to address it. Self-organizing responses to emergencies are an example. Such circumstances give emergence its reputation for unnerving leaps of faith. Yet emergent systems increase order even in the absence of command and central control: Open systems extract information and order out of their environment. They bring coherence to increasingly complex forms. In emergent change processes, setting clear intentions, creating hospitable conditions, and inviting diverse people to connect does the work. Think of it as an extended cocktail party with a purpose. Characteristics of Emergence Although the conversation continues, scientists generally agree on these qualities of emergence: Radical noveltyâ€”At each level of complexity, entirely new properties appear for example, from autocracyâ€”rule by one person with unlimited powerâ€”to democracy, where people are the ultimate source of political power Coherenceâ€”A stable system of interactions an elephant, a biosphere, an agreement Wholenessâ€—Not just the sum of its parts, but also different and irreducible from its parts humans are more than the composition of lots of cells Dynamicâ€”Always in process, continuing to evolve changes in transportation: Birds flock, sand forms dunes, and individuals create societies. Each of these phrases names a related but distinct system. Each system is composed of, influenced by, but different from its mate: As with all change, emergence occurs when disruptions shape the interactions. In emergence, coherence breaks apart; differences surface and re-form in a novel system. The two most frequently cited dynamics: No one is in chargeâ€”No conductor is orchestrating orderly activity ecosystems, economic systems, activity in a city. Simple rules engender complex behaviorâ€—Randomness becomes coherent as individuals, each following a few basic principles or assumptions, interact with their neighbors birds flock; traffic flows. Twelve-step programs characterize these ideas at work. Most participants are fiercely independent people who are not there to follow someone in authority. Yet with the guidance offered through 12 statements, these programs are highly complex, worldwide organizations that have influenced the lives of millions. No doubt the simplicity of these two dynamics may leave many senior executives and government agency heads skeptical. No one is in charge? What happens when orders come from the top? If they disrupt existing functions of the organization, sometimes it moves in novel and useful directions. And sometimes the orders produce entirely unexpectedâ€—emergentâ€—outcomes that arise from within the system, bearing little resemblance to the orders given. We often make things more complicated than necessary.

Chapter 8 : Moving Naturalism Forward - Sean Carroll

Defining emergence as "a property which is not displayed by the lower level entities" provides us with a set of information-theoretic tools for "quick and dirty" detection of emergence. 2. The Computational Mechanics view of emergence as increased predictability on system behavior allows us to focus on a subset of features which carry.

An emergent property of a system, in this context, is one that is not a property of any component of that system, but is still a feature of the system as a whole. Nicolai Hartmann , one of the first modern philosophers to write on emergence, termed this categorial novum new category. Definitions[edit] This idea of emergence has been around since at least the time of Aristotle. The term "emergent" was coined by philosopher G. Lewes , who wrote: Every resultant is either a sum or a difference of the co-operant forces; their sum, when their directions are the same â€" their difference, when their directions are contrary. Further, every resultant is clearly traceable in its components, because these are homogeneous and commensurable. It is otherwise with emergents, when, instead of adding measurable motion to measurable motion, or things of one kind to other individuals of their kind, there is a co-operation of things of unlike kinds. The emergent is unlike its components insofar as these are incommensurable, and it cannot be reduced to their sum or their difference. The common characteristics are: He also says that living systems like the game of chess , while emergent, cannot be reduced to underlying laws of emergence: They serve merely to describe regularities and consistent relationships in nature. These patterns may be very illuminating and important, but the underlying causal agencies must be separately specified though often they are not. But that aside, the game of chess illustrates Indeed, you cannot even reliably predict the next move in a chess game. It also includes the players and their unfolding, moment-by-moment decisions among a very large number of available options at each choice point. The game of chess is inescapably historical, even though it is also constrained and shaped by a set of rules, not to mention the laws of physics. Moreover, and this is a key point, the game of chess is also shaped by teleonomic , cybernetic , feedback-driven influences. In terms of physical systems, weak emergence is a type of emergence in which the emergent property is amenable to computer simulation. This is opposed to the older notion of strong emergence, in which the emergent property cannot be simulated by a computer. Some common points between the two notions are that emergence concerns new properties produced as the system grows, which is to say ones which are not shared with its components or prior states. Also, it is assumed that the properties are supervenient rather than metaphysically primitive Bedau Weak emergence describes new properties arising in systems as a result of the interactions at an elemental level. However, it is stipulated that the properties can be determined only by observing or simulating the system, and not by any process of analysis. Bedau notes that weak emergence is not a universal metaphysical solvent, as the hypothesis that consciousness is weakly emergent would not resolve the traditional philosophical questions about the physicality of consciousness. However, Bedau concludes that adopting this view would provide a precise notion that emergence is involved in consciousness, and second, the notion of weak emergence is metaphysically benign. The whole is other than the sum of its parts. An example from physics of such emergence is water, being seemingly unpredictable even after an exhaustive study of the properties of its constituent atoms of hydrogen and oxygen. Bedau Rejecting the distinction[edit] However, "the debate about whether or not the whole can be predicted from the properties of the parts misses the point. Wholes produce unique combined effects, but many of these effects may be co-determined by the context and the interactions between the whole and its environment s " Corning In accordance with his Synergism Hypothesis, Corning Corning also stated, "It is the synergistic effects produced by wholes that are the very cause of the evolution of complexity in nature. Koestler Further, The ability to reduce everything to simple fundamental laws does not imply the ability to start from those laws and reconstruct the universe. The constructionist hypothesis breaks down when confronted with the twin difficulties of scale and complexity. At each level of complexity entirely new properties appear. Psychology is not applied biology, nor is biology applied chemistry. We can now see that the whole becomes not merely more, but very different from the sum of its parts. Anderson Viability of strong emergence[edit] The plausibility of strong emergence is questioned by some as contravening our usual understanding of physics. Although strong emergence is logically possible, it is uncomfortably like magic. How does an irreducible but supervenient downward causal power arise, since by definition it cannot be due to the aggregation of the micro-level potentialities? Such causal powers would be quite unlike anything within our scientific ken. This not only indicates how they will discomfort reasonable forms of materialism. Their mysteriousness will only heighten the traditional worry that emergence entails illegitimately getting something from nothing. Now, M, as an emergent, must itself have an emergence base property, say P. Now we face a critical question: Why cannot P do all the work in explaining why any alleged effect of M occurred? Moreover, this goes against the spirit of emergentism in any case: One escape route that a strong emergentist could take would be to deny downward causation. However, this would remove the proposed reason that emergent mental states must supervene on physical states, which in turn would call physicalism into question, and thus be unpalatable for some philosophers and physicists. Meanwhile, others have worked towards developing analytical evidence of strong emergence. In , Gu et al. The view that this is the goal of science rests in part on the rationale that such a theory would allow us to derive the behavior of all macroscopic concepts, at least in principle. The evidence we have presented suggests that this view may be overly optimistic. The development of macroscopic laws from first principles may involve more than just systematic logic, and could require conjectures suggested by experiments, simulations or insight. To explain such patterns, one might conclude, per Aristotle , [2] that emergent structures are other than the sum of their parts on the assumption that the emergent order will not arise if the various parts simply interact independently of one another. However, there are those who disagree. In fact, some systems in nature are observed to exhibit emergence based upon the interactions of autonomous parts, and some others exhibit emergence that at least at present cannot be reduced in this way. In particular renormalization are methods in theoretical physics which enables scientists to study systems that are not tractable as the combination of their parts. Defining structure and detecting the emergence of complexity in nature are inherently subjective, though essential, scientific activities. Despite the difficulties, these problems can be analysed in terms of how model-building observers infer from measurements the computational capabilities embedded in non-linear processes. The discovery of structure in an environment depends more critically and subtly, though, on how those resources are organized. The synergies associated with emergence are real and measurable, even if nobody is there to observe them. They contend that artistic selfhood and meaning are emergent, relatively objective phenomena. Pearce has used emergence to describe the experience of works of art in relation to contemporary neuroscience. In international development, concepts of emergence have been used within a theory of social change termed SEED-SCALE to show how standard principles interact to bring forward socio-economic development fitted to cultural values, community economics, and natural environment local solutions emerging from the larger socio-econo-biosphere. These principles can be implemented utilizing a sequence of standardized tasks that self-assemble in individually specific ways utilizing recursive evaluative criteria. Emerging Literatures, Bern, Berlin, etc. By opposition, "emergent literature" is rather a concept used in the theory of literature. Emergent properties and processes[edit] An emergent behavior or emergent property can appear when a number of simple entities agents operate in an environment, forming more complex behaviors as a collective. If emergence happens over disparate size scales, then the reason is usually a causal relation across different scales. In other words, there is often a form of top-down feedback in systems with emergent properties. Emergent behaviours can occur because of intricate causal relations across different scales and feedback, known as interconnectivity. The complex behaviour or properties are not a property of any single such entity, nor can they easily be predicted or deduced from behaviour in the lower-level entities, and might in fact be irreducible to such behavior. The shape and behaviour of a flock of birds [1] or school of fish are good examples of emergent properties. One reason emergent behaviour is hard to predict is that the number of interactions between a system components increases exponentially with the number of components, thus allowing for many new and subtle types of behaviour to emerge. Emergence is often a product of particular patterns of interaction. Negative feedback introduces constraints that serve to fix structures or behaviours. In contrast, positive feedback promotes change, allowing local variations to grow into global patterns. Another way in which interactions leads to emergent properties is dual-phase evolution. This occurs where interactions are applied intermittently, leading to two phases: On the other hand, merely having a large number of interactions is not enough by itself to guarantee emergent behaviour; many of the interactions may be negligible or irrelevant, or may cancel each other out. In some cases, a large number of interactions can in fact hinder the emergence of interesting behaviour, by creating a lot of "noise" to drown out any emerging "signal"; the emergent behaviour may need to be temporarily isolated from other interactions before it reaches enough critical mass to self-support. Thus it is not just the sheer number of connections between components which encourages emergence; it is also how these connections are organised. A hierarchical organisation is one example that can generate emergent behaviour a bureaucracy may behave in a way quite different from that of the individual humans in that bureaucracy ; but emergent behaviour can also arise from more decentralized organisational structures, such as a marketplace. In some cases, the system has to reach a combined threshold of diversity, organisation, and connectivity before emergent behaviour appears. Unintended consequences and side effects are closely related to emergent properties. Instead a component implements a behaviour whose side effect contributes to the global functionality [Steels In other words, the global or macroscopic functionality of a system with "emergent functionality" is the sum of all "side effects", of all emergent properties and functionalities. Systems with emergent properties or emergent structures may appear to defy entropic principles and the second law of thermodynamics , because they form and increase order despite the lack of command and central control. This is possible because open systems can extract information and order out of the environment. Emergence helps to explain why the fallacy of division is a fallacy. Emergent structures in nature[edit] This section needs additional citations for verification. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed. November Ripple patterns in a sand dune created by wind or water is an example of an emergent structure in nature. Emergent structures can be found in many natural phenomena, from the physical to the biological domain. For example, the shape of weather phenomena such as hurricanes are emergent structures. The development and growth of complex, orderly crystals , as driven by the random motion of water molecules within a conducive natural environment, is another example of an emergent process, where randomness can give rise to complex and deeply attractive, orderly structures. Water crystals forming on glass demonstrate an emergent, fractal process occurring under appropriate conditions of temperature and humidity. However, crystalline structure and hurricanes are said to have a self-organizing phase.

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In philosophy, systems theory, science, and art, emergence is the condition of an entity having properties its parts do not have, due to interactions among the parts.