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The Pattern Atlas of System Vulnerabilities

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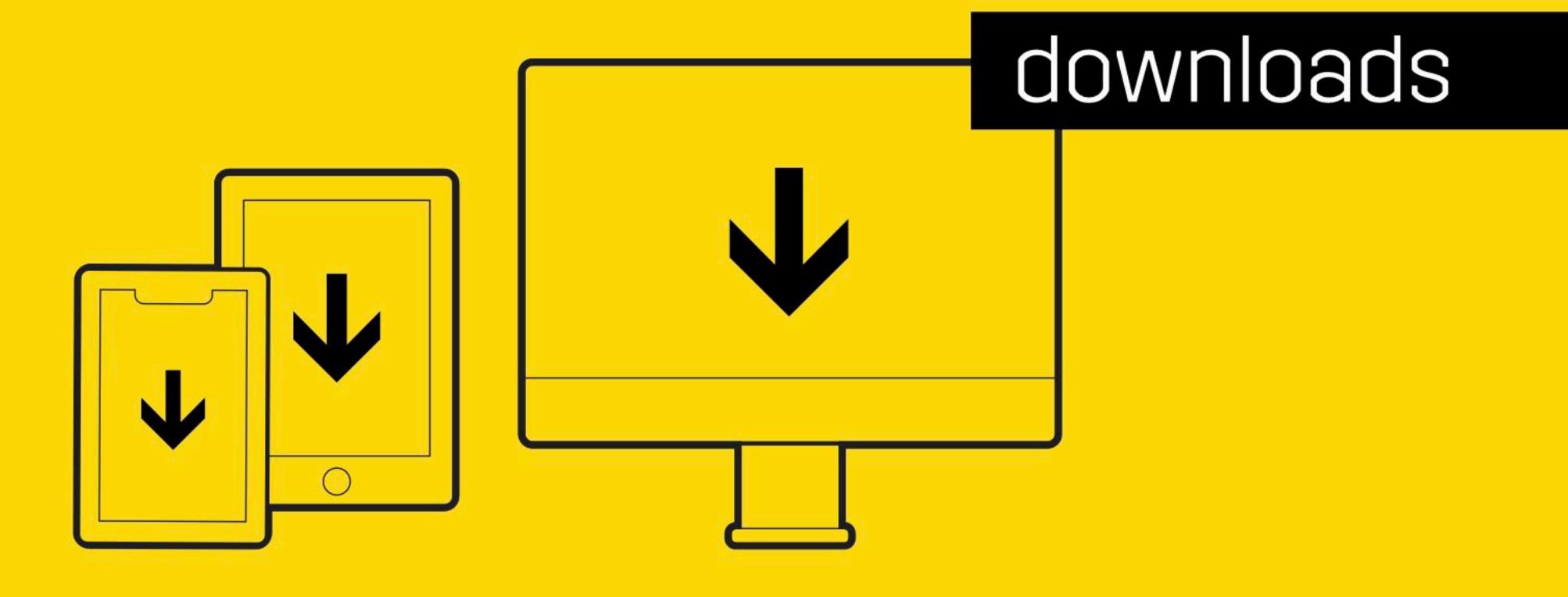
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the pattern atlas of system vulnerabilities

PETER STOYKO
RSD11 SYMPOSIUM
UNIVERSITY OF BRIGHTON
BRIGHTON, UK

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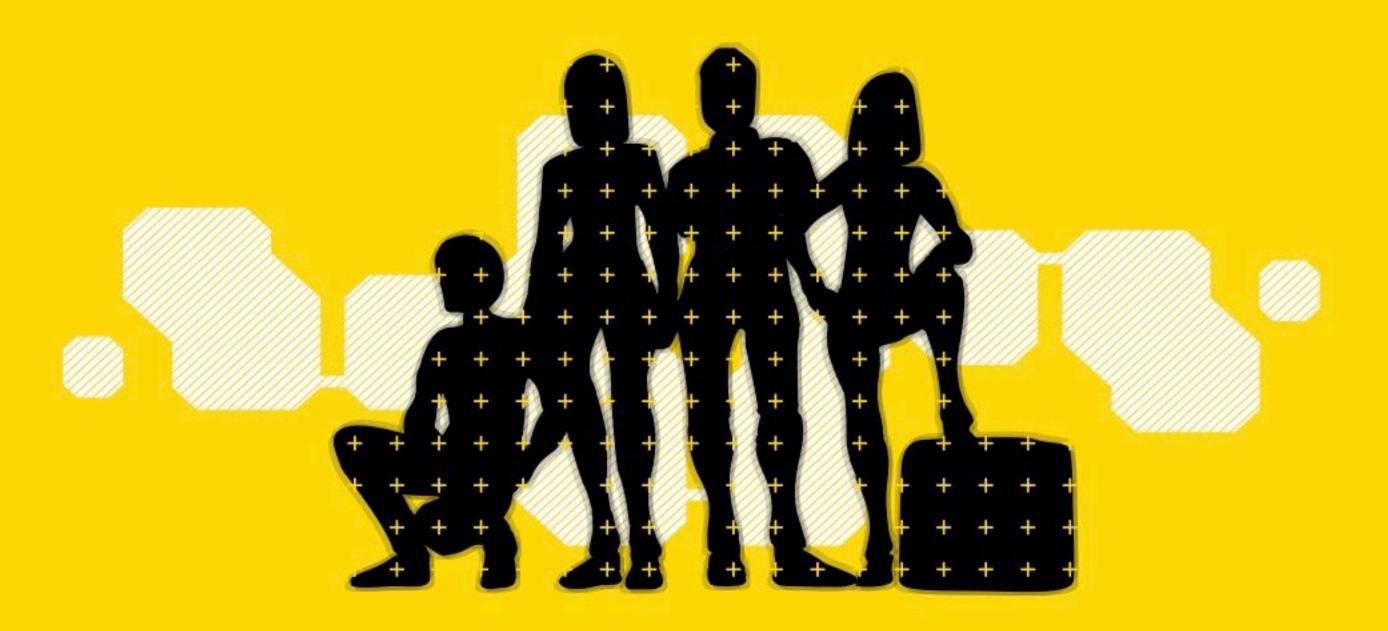


SYSTEMUZ

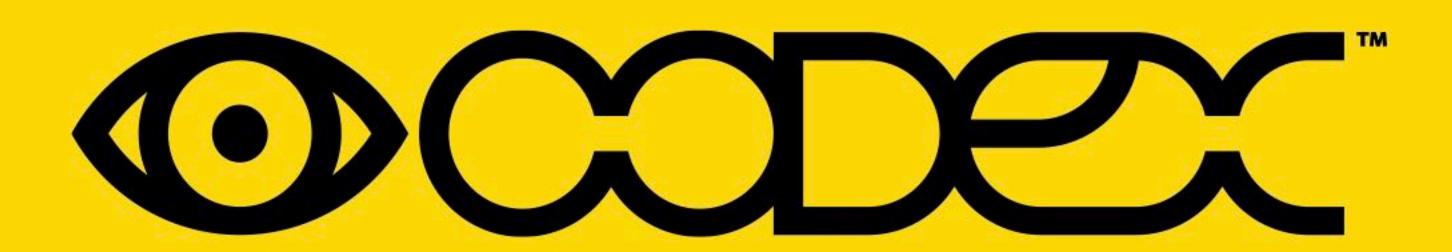
www.systemviz.com







concept-driven inquiry



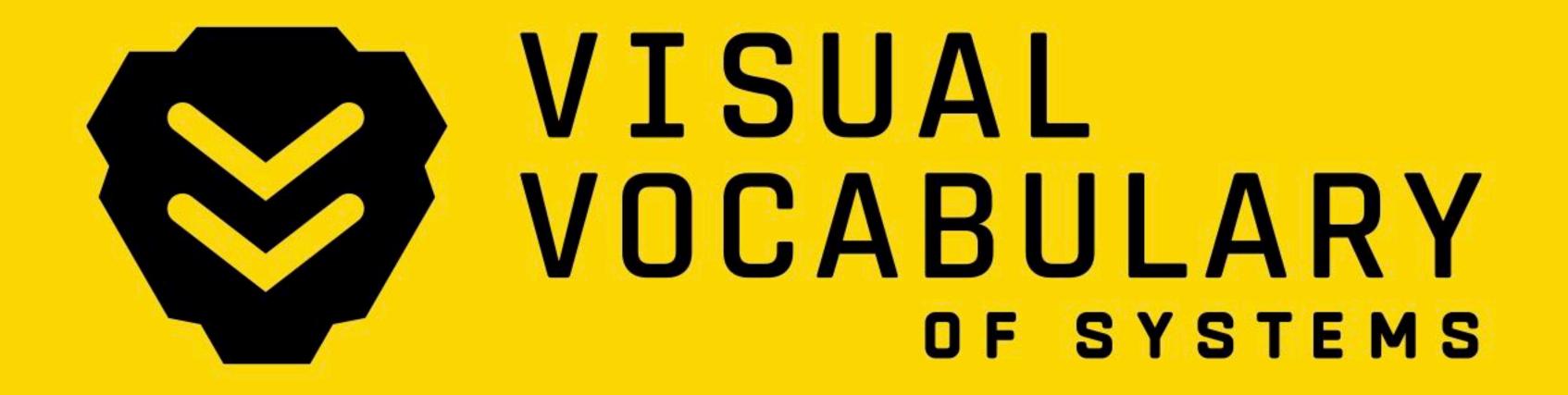
ILLUSTRATIVE VISUAL ANCHOR

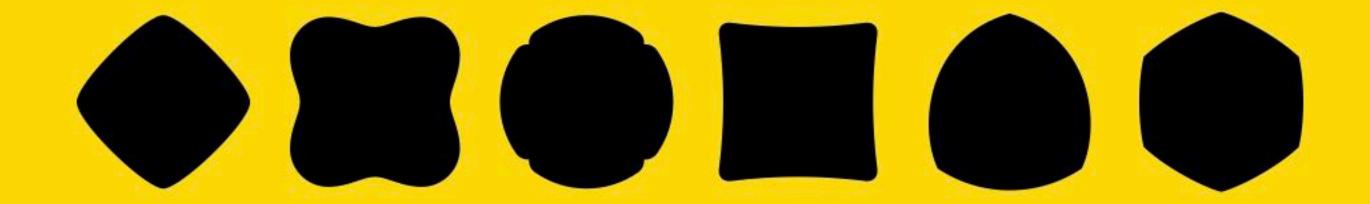
+ SENSITIZING CONCEPTS

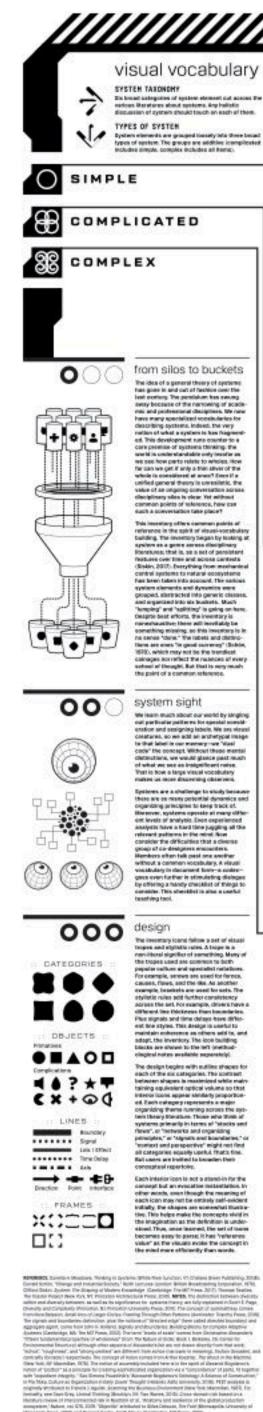
= ATTENTIONAL SENSITIZATION

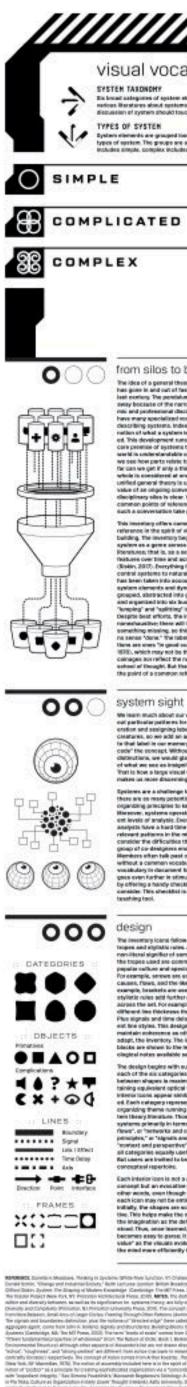


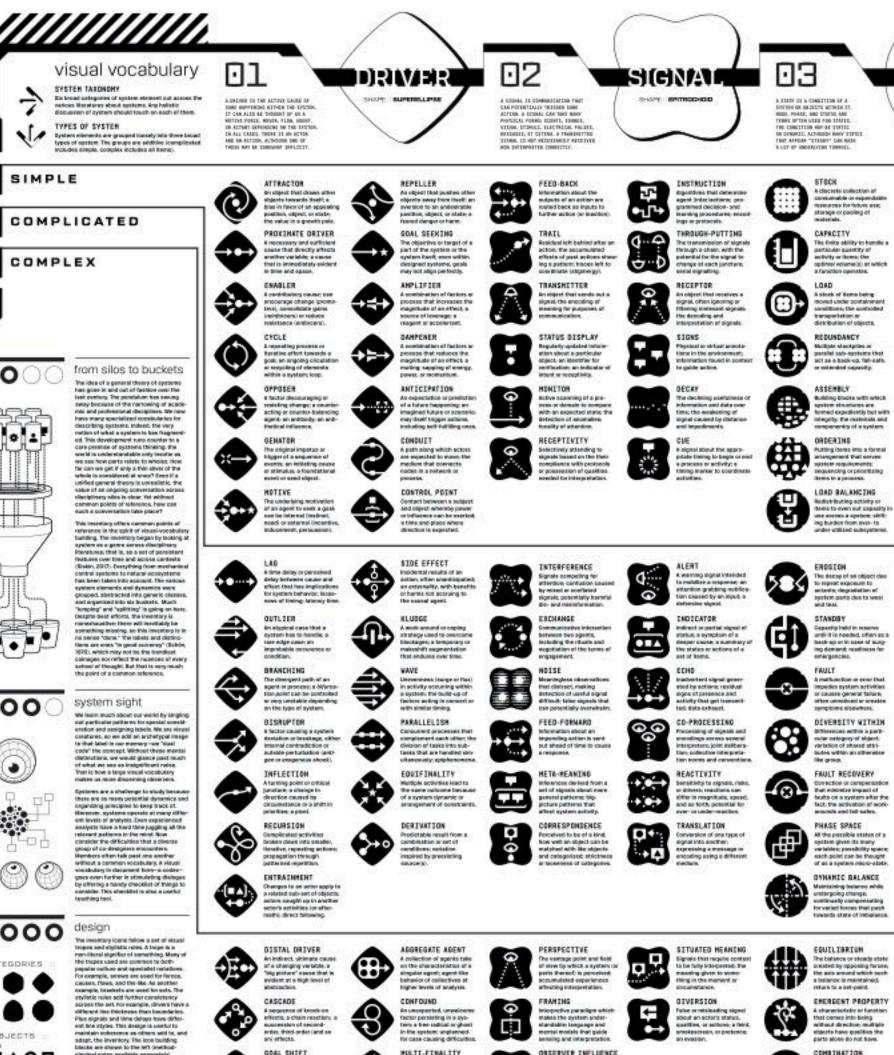


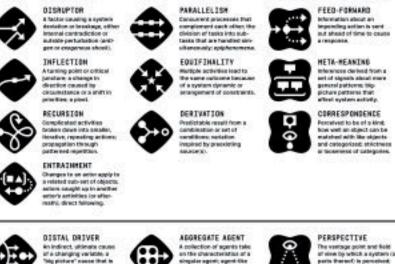














TERSION

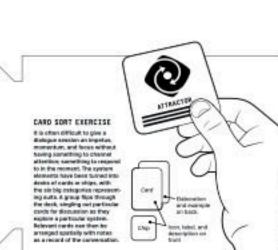
An opposing sendency or leader will be feature for each policy file or goods from it is received, bidenood, or ignored streets against

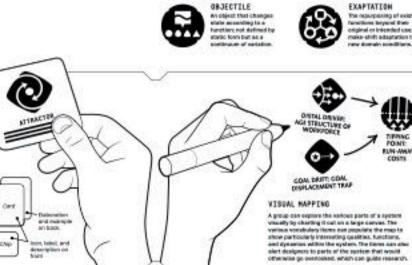


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usage scenarios

The viscal vocabulary has several applications for diverse trains of designative for the several applications for diverse trains of designative trains to provide the control of the contr





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Capacity hald in reserve until it is needed, often as a basis-up or in sase of surg-ing demand; restliness for

DIVERSITY WITHIN

differences within a part exiler netegory of slopest, variation of shared attri-

PHASE SPACE

All the persible states of a system given its many variables; possibility square; each point; can be thought

Meinteining between while undergoing change, continually congeniating for varied torses that peak towards state of initialises.

A characteristic or function that comes into being without direction, multiple

COMBINATION

CRITICALITY

The threshold beyond which a dynamic becomes self-sustaining critical reses necessary for an authory to

EQUILIBRIUM
The besisece or electry states
consisted by opposing famore,
the axis amund which such
a famore is maintained,
return to a extract.

A TIME OF A CAMBITIME OF A DISTURS ON HEIGHT METHER IT. MINDS, FARE, AND COMMENT AND TIMES OF THE OLDS THE TIMES. THE CHIEFLE WHE A TIMES! THE CHIEFLE WHEN ANY TIMES THE CAMPILL THE APPEAR TITIABLE DOES MIND A LOT OF MEDICAL THE TIMESOL.

The finite oblity to handle a particular quantity of activity or items; the optimal returns to at which

SIGNAL

INSTRUCTION

Experiment interview open prammed decision- and learning procedure; relacions on a manufacture of the control of

9.

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CORRESPONDENCE

Interpretive paracipes which makes the system under-standable language and membel models that guide securion and interpretation

OBSERVER INFLUENCE

D-PROCESSING

TRANSLATION

STITUTED HEART NO.
Signals that require contact
to be fully independed. The
makening given to some
thing in the manners or

GIVERSION
Palse or missiending signal spout an actors status, qualifies, or authoris, a fried, another status, or professor.

HROUGH-PUTTING

The transmission of signals through a chain, with the potential for the signal to

A EXCHAI IL COMMUNICATION PAUT CAM POTRYTIALLY TRIBLES EINE ACTION & ETHAIL CON THE BROW POWERLA PARKS EXCHAIN FROM VIEWS LOWERT EINE FROM PAUT STEERS LOWERT EINE CONTRACT FOR ENGLANCE TO LOTTE AND PROPERTY ENGLAND TO ENGLANCE TO LINE OF THE PAUT AND THE PAUT THE PAUT STEERS AND THE TRIBLE THE PAUT THE PAUT

intervention about the industrial and the industrial are entire are toursed back as inputs to turble action (or teaching).

В

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Residual left behind after on action, the accumulated effects of past actions show

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A boundary that groups and maintee objects; the nestriction of movement to a confined space or damain.

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BUFFER
Aboundary or gone that
denarrative, delays, or other
wise afters a driver or its
impact while passing
meaning

A boundary that responds to forces and acts as se actant to its own right; a

regulation of a flord boundary the expended parameters of an edge.

PERMISSIONS

CONTAMINATION

in unintended mixture of tems, the tolet of an urbane adject or agent errors a containment

The postsol of sething with-in a bounded area, the for-real and informal conditions of access to a damain.

Þ

MUTATION
A reconsignation of an object caused by an error or assessment and the account of the a

曲

SENT-PERHIABLE

A controlled opening in a borrier, a borrier opening that allows passage of

A barder preventing damage to an object by blocking or reflecting unwanted forces.

SHUAHUR

TRANSITION
Changing from are state to
applying the depotated as
phoses or stages of change;
the process of developing a
new statistics.

(RE)DISTRIBUTION

The transition have passive object to settles artifle; or witz versus, emerging from or dissounding into, a

LOAD BALANCING
Bedishbilding sociality or
thoreis to viven out capacity in
other to viven out capacity in
other socials a speciment whiteting but don from over- to
under will also subsystemed.

The control of the purpose

FAULT DETECTION

DIVERSITY BETWEEN

SCALABILITY

HOLTAJUHUSCA

TOLE PANCE
Permissible variation in precision or sociarity siloning
antinued specialize siliny
to case with anomalius or
faults without introuption.

The build-up of items or experiences over time, can affect sprinn gradually or once the build-up reaches s

When an aligest is capted, reproduced, or divided into two or share assingable

TIPPING POINT

The threshold beyond which rapid, large seeks change happens the dynamic unleashed by a subten

MALTI-FUNCTION
The ability to perform more
than one type of task and
make judgements about
task autability contrast
with undisabling benefits.

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THOMODARY 05

benter that limits the flow trajectory of agents, the estateed charactery of

Exemperated boundary or delineation, can be tangible in its effects, includes seeful distinctions and

 \boxtimes

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Domento defined as a group by virtue of prostrelly and receivement, a neighborstoned or constanting.

An affiliated collective of actors that share patterns of behavior or firthing a collective acting seconding to a shared look thank.

HOLTANIHOO

the paint of poetact

Staying in soil interested pursuit of a goal shared by risale, alternats to head others by sequinous, status, or measures.

INTEGRATION

COMPLEMENTARITY.

INTER-MEDIATION

A go-between two or more actors of processes that serves a function a machanism of translation.

Aspects of two or more aspects are combined to meate a hybrid, the purposeful breeding of a new type of entity.

ADJACENCY

PARASITISH

A relationship to which one party is harmed or destroy-ed white the harming party benefits, or is unaffected.

(RE)APPROPRIATION

Bi-products of activity in g. makin, debition, residual, used by others; repurposing of outputs by ecoverging or lag-sing agents; selecte.

AGGREGATE

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DIRECTED BOUNDARY

A boundary that functions differently depending on what side is facing. boundary sides with

BOUND POSSIBILITY

COMPARTMENT

Moving into the space between dostale bound-aries, the raw land allow that comes from travelling across domains.

FLEXIBLE BOUNDARY

The father of a boundary to function so designed: The damaging of a boundary by a ferrer, the dissolution of a

THE BROWN HERE

estowed on an object or ster; verifical entiredien aged on criterien decreed

COMPATIBILITY

apable of esertal someotien or transfer staveen two parts of a

components for a functional assembly, a group of objects recessary for an

In an angement in which one party is dependent upon another but that dependence is neither barrelel nor helpful.

The self-serting of actors two homogeneous groups; the tandency of like-actors to affiliate with like-actors

Imbalance of power, risk, resources, access, or opportunity; uneversees can come realignment

An energement of letter connected parts that triberact cheetly through common linkages; the con-

MIMICAY

A situation wheneby one
actor sogies or simulates
the behaviour of anviller;
using one type of system as

COUPLING

MEDIATION

ALTONNENT

SYNCHRONY

PREDATION

SYMMATHESY

Affaciling or plundering of one entity by asother or by a process; the use of ameticar sotter as consumable

8

DOMATH SPACE

0

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(1)

MESTING

AUTO-ENVIRONMENT

The variable contains of an environment or space; an x-once, with "x" being a physical-spatial or symbolic-spatial variable.

Receivering from use by setting unde or outbing use for an interval resources; ston of depleted resources.

TOPOLOGY

FALLOW

UNCERTAINTY

STRATA

SOMAIN SPACE
The objusted or virtual axes to which a system to parts thereof exist, the parts of the aparts of the aparts of the aparts.

PERIPHERY

FRICTION

PERIPHERY
Exhibiting on on mean the solder
edges or a space, boundary,
group, or final of authority,
the binderated of a chemic
an assa of relative neglect.

A source of passine repish-ance that hindess activity within a density, a write train of energy fecusive of effort resided to supercone

REFERENCE POINTS

Professes in the contest that can act as ofenting devices, including markers (features singled out for special most destina).

The availability and access to the factor inputs weeded for a process, sustainable and predictable supply of

SYMBOLIC MILIEU

3

0

(3)

DENSITY

The relative proximity of system elements to each other; the size of other

DOMAIN OVERLAP

The existence of more than one domain or partial domain within the same physical or sintual space;

the mechanisms by shock a system is able to expend or proliferate, the extension of system edges.

AMBIENT CONDITIONS

The continually changing physical evolvement or cultural militar with the potential to affect system.

CROWDENG BUT
When the provisions of an item or authority drives out when it a group enterpation of rimbs space that file spaces that file spaces that file

CROWDING OUT

CIRCUNSTANCE

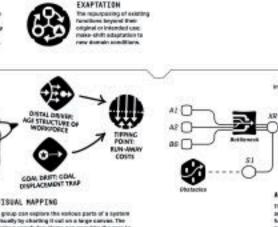
THE ROPY
The entirement of disorder or chants in a system, souncest of disarray article a system and the extent to which they had away.

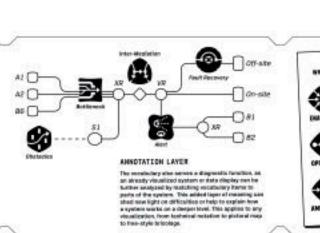
CROSS-DSHAIN RISK
A diliver to one donaté has a
broke an effect resulting in
a subcatelliny in prother
demain due to complete
infar or owner scheme.

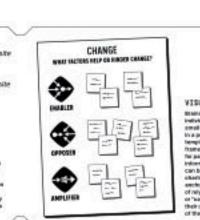
CROSS-DOMAIN RISK

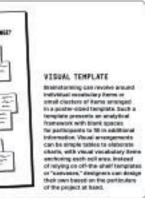
ENTROPY

tridely shared and observed symbolis meanings required for interpretation; premailing linguistic conventions for

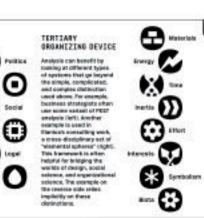














V. 1.5.1 BY PETER STOYKO

systems thinking

Try all very simple," were after tald — come to the avong place. The man about our messy world just before a conclusion I chan from the Marature put claim to offered. Or a chronic pro- on systems—in the natural sciences. blem is 'boiled down' and ussigned a the social sciences, the managerial free-step 'solution' by a well-mean-ing 'Rices." Or a pundit offers a 'hot that there are a great many common take" that stridently turns initial impressions into a confident read of keep track of it is worth iterating the situation. All that to say we what these commonalties are and become familiar with their qualities habitually turn to reasouring simplifications to golde us in uncertain That is how we turn our page iffs a dearting task, to be sure. It's easy to get last in the details. The hape is that this codes makes that learning a little ease. times, even when that habit has a diamal track record of success.

thinking in terms of systems can ourb that impulse, Indeed, seeing our Before proceeding, it helps to stops late what to meant by "system." As Gonella Masdow's puts it, "A system is a set of things—people, cells, restectives, or whatever—interco-cessed, as whatever—intercoworld as a tangle of cresshatching systems is quite humbling. Even the simple objects that surround us are the product of various systems sed subsystems operating behind the scenes. Ty tracing the development nested in such a way that they of that paper-clip on your desk. Each produce they swn patters of behavior you even fathers the systems that processors fathern the systems that prelief the rectal alloy the city is made off And the larger impact of the mining and armsting to the surrounding consistency and communitient. Thomas Theades (2016) famously built a touster completely from sociation victious the benefit of standard manufacturing systems. If took wire months, And that was with high time counties of the systems that enabled him to operate in modern society.

It started by poetr pechang the crude size displacement with the subject of standard points. It is started by poetr pechang the crude size displacement with the subject on which should systems. over time." (Meadows, 2008) She adds that there is a coherent organi-

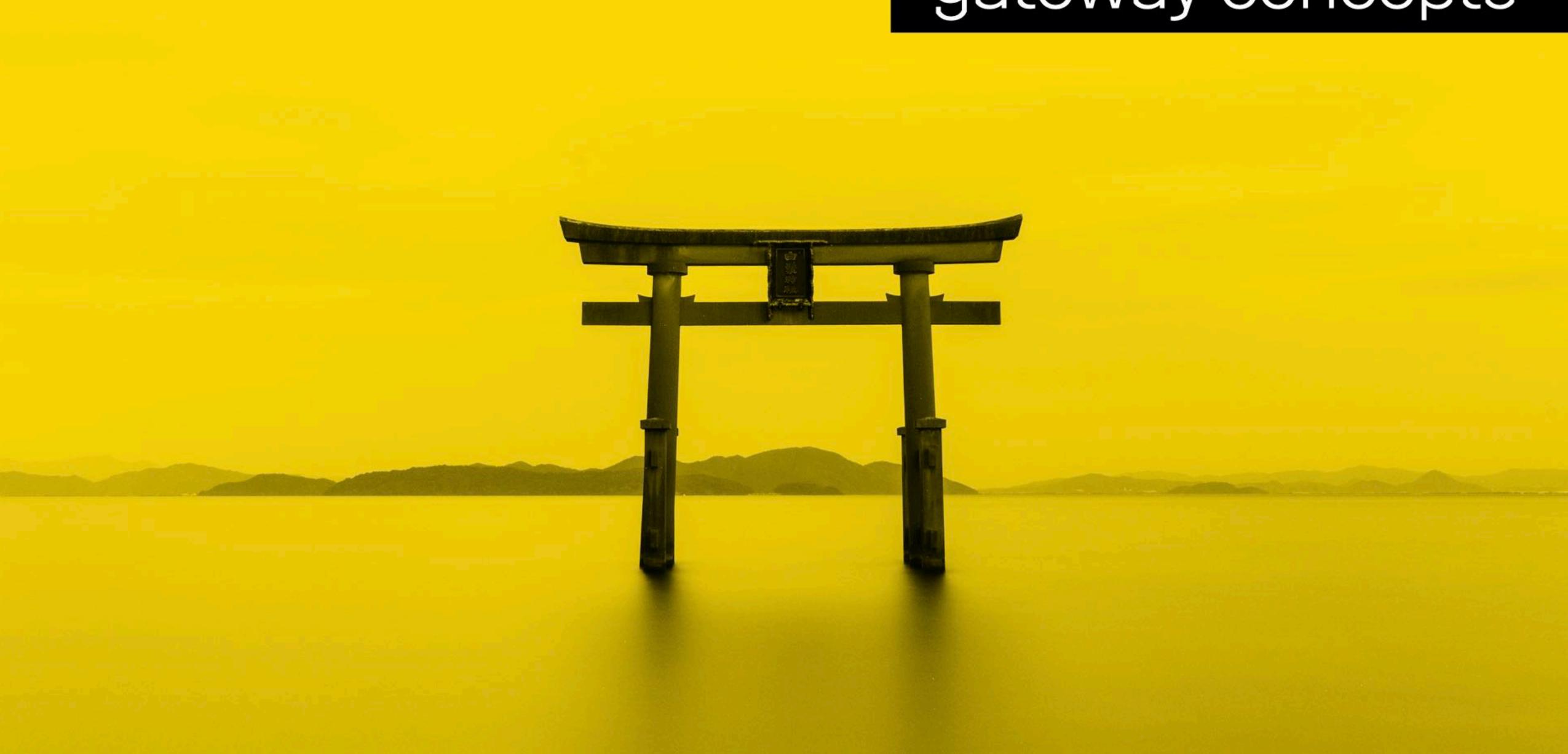
I started by positive profiling the crude streptifications we habit safty reach for to explain our wents, I should clarify one the analytical printites of this codes, I do not have anything against, reductionians, per us lindeed, building bridges across the various disclip-tines is unavaidably an exercise in destillation to some extent, Yet, Tool destillation to some extent, Yet, Tool Paper-clos and lossters are the product of clearly denoscated and lightly controlled systems. Many of society's difficulties are entangled in receivity's difficulties are entanglied in the less predictable systems that interact in ways we exceed by understand. The dynamics seem buts, paradoxical and instactable, perhaps even reystlerious. These "velicled problems" are enough to make us threat up our frends in reaspossition and settle for short-eighhed coping strategies. Not so feat. These are still early days in our attempts to properly have surveyed of seeing to adequately grasp have opsteems affect our lives. This codes starts from the grembe lot about the trees does not neces-

that such understandings are saidly mean losing sight of the forest; possible. However, if you are looking schoolly, it's quite essential to figuring for quick and easy guide, you've out flow the forest works. visualizing sw

professional without There are too ma mentally keep interact in a system in lincolar CONDITION SHOCK The ballet up of salablems, parches, and work seconds, parches, and work seconds, with the salable up of salable u ELEMENTS/

DYNAMICS @**①**

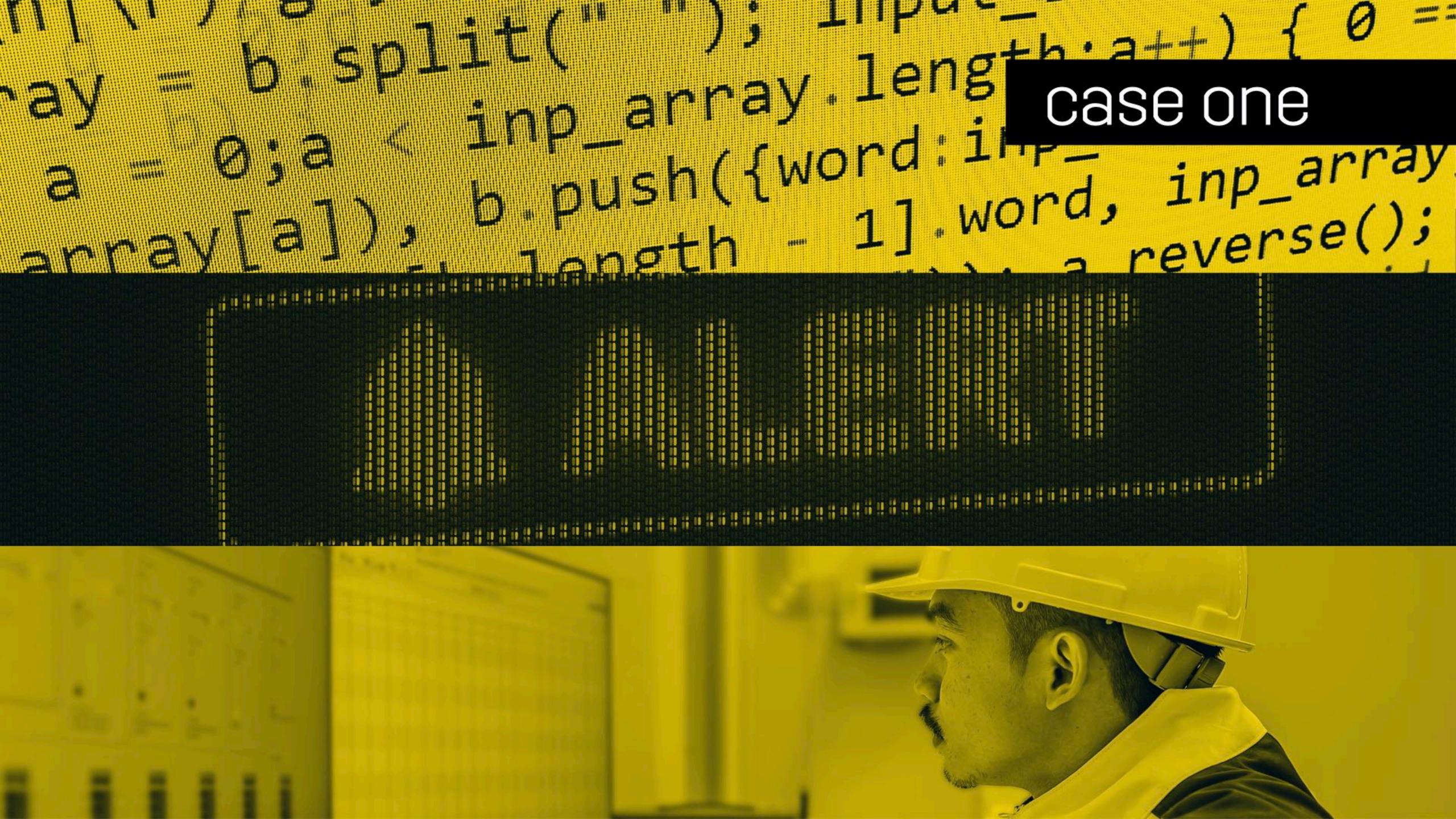


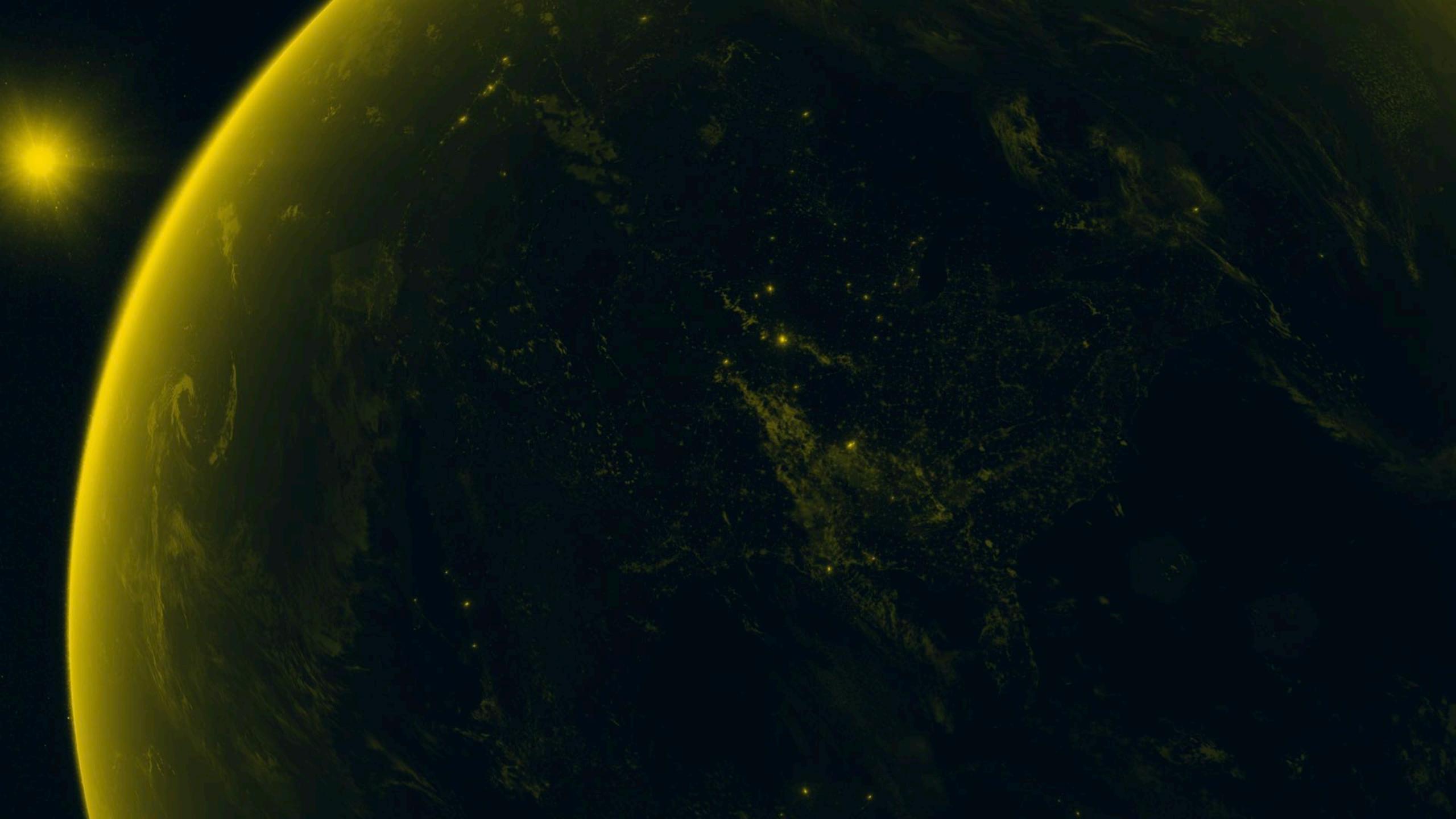


















099ed:# #4:80a?: al.config m4:h61l0

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"problems"

REGULAR DISRUPTIONS











IRREGULAR DISRUPTIONS () () () ()











NEGATIVE EXTERNALITIES



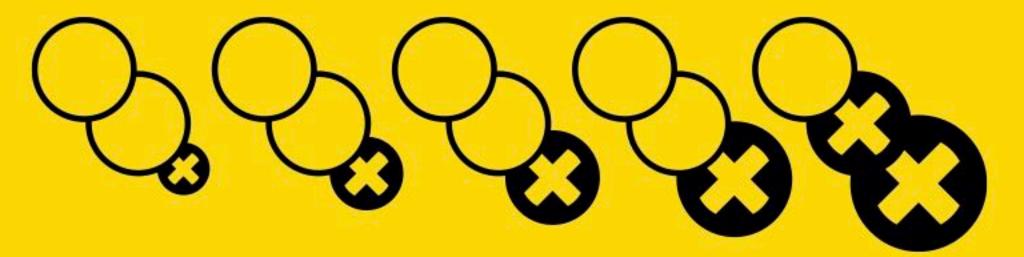






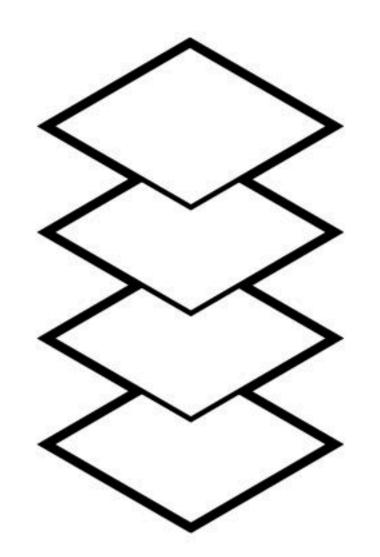


CHRONIC DIFFICULTIES

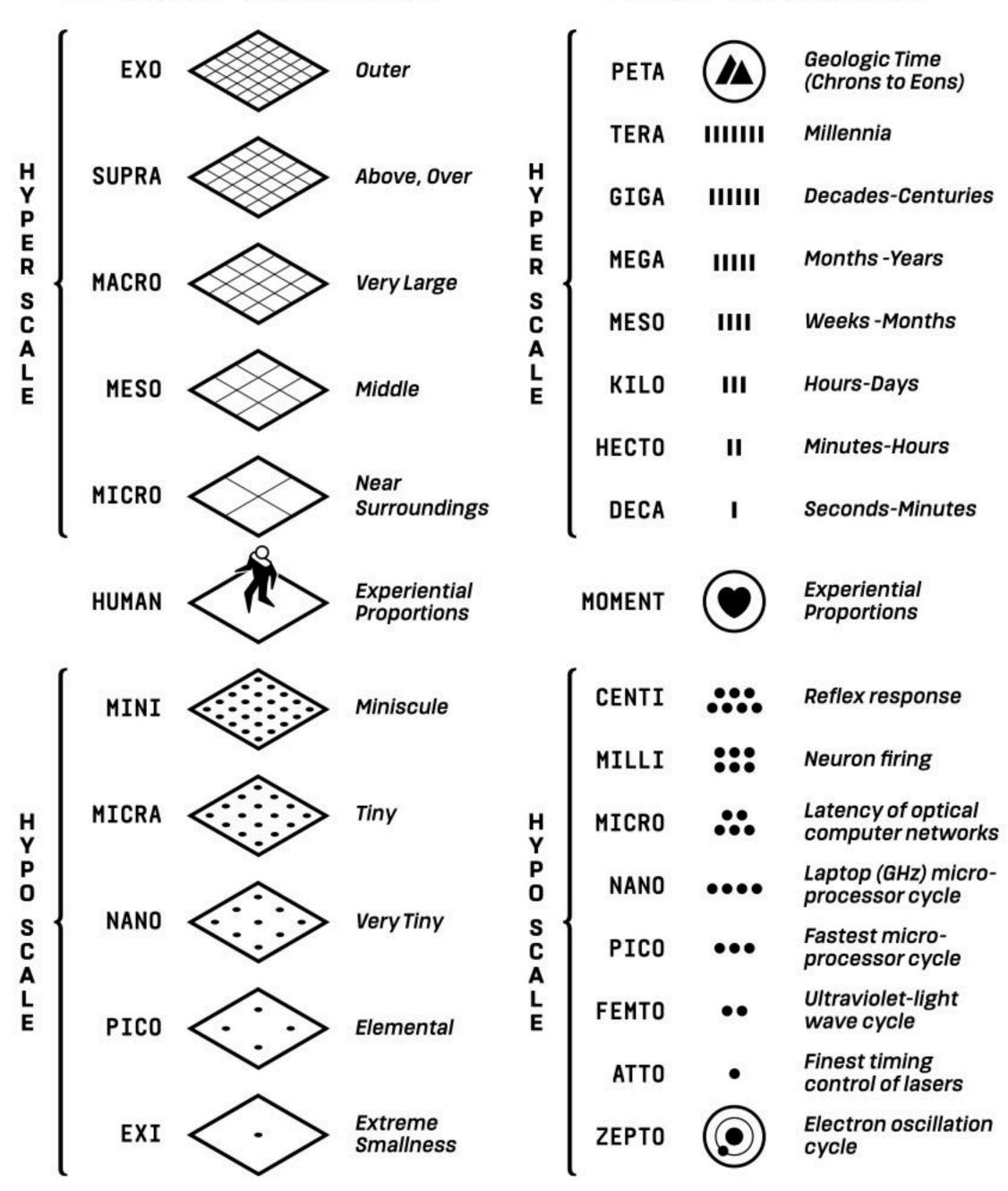




levels of scale

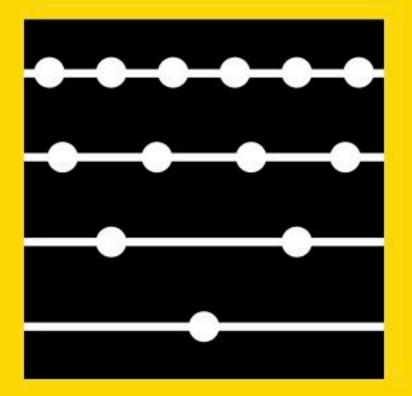


SPACE SCALES TIME SCALES

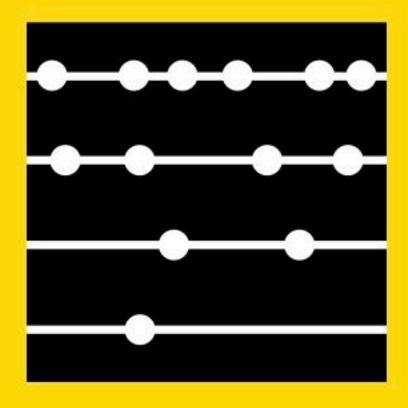


pace layers

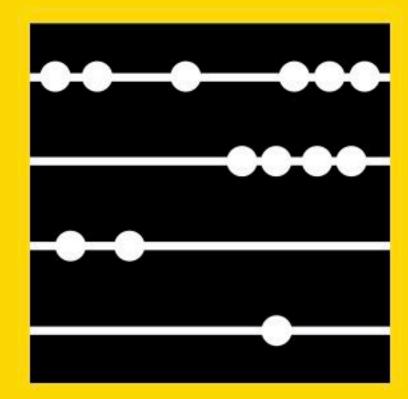
TIMING



PERIODIC

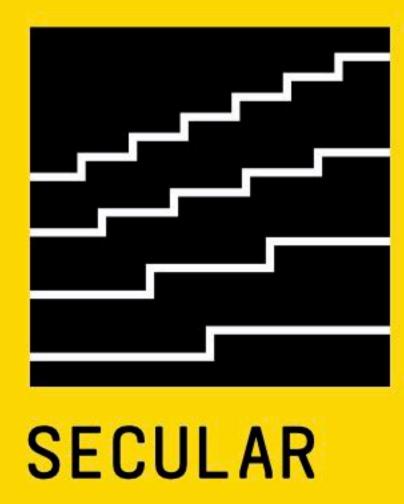


QUASI-PERIODIC



NON-PERIODIC

CHANGE



CYCLICAL CYCLICAL

DISJUNCTIVE

tangle metaphor

MESSES

COMPLEX SYSTEM INTER-RELATIONS

FIBERS

ROUTINES AND SUB-ROUTINES



ENTANGLEMENTS

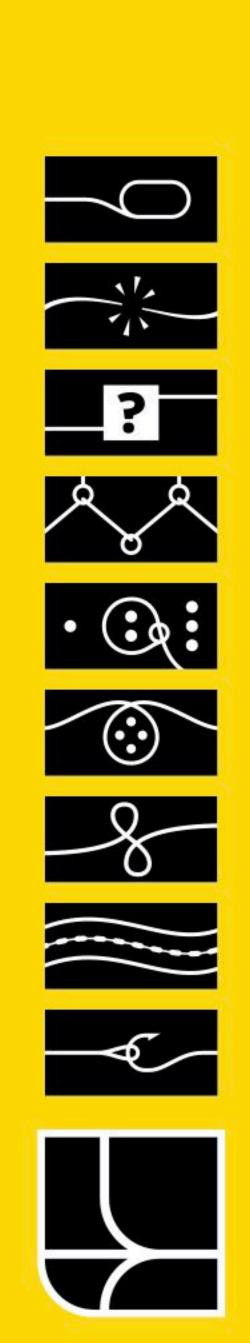
CROSS-SYSTEM DYNAMICS

THREADS

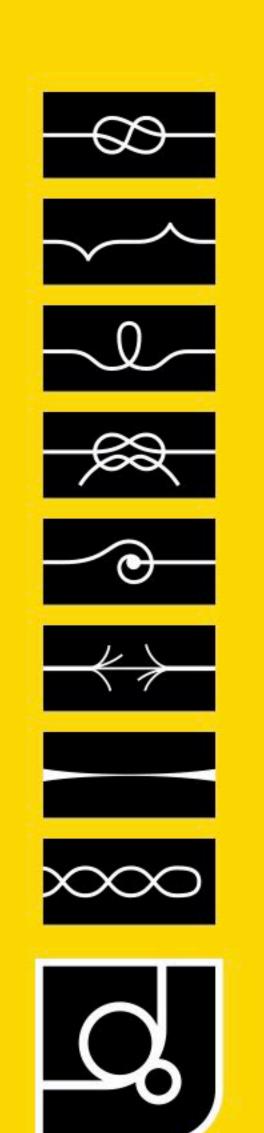
SYSTEMS AND SUB-SYSTEMS

vulnerabilities



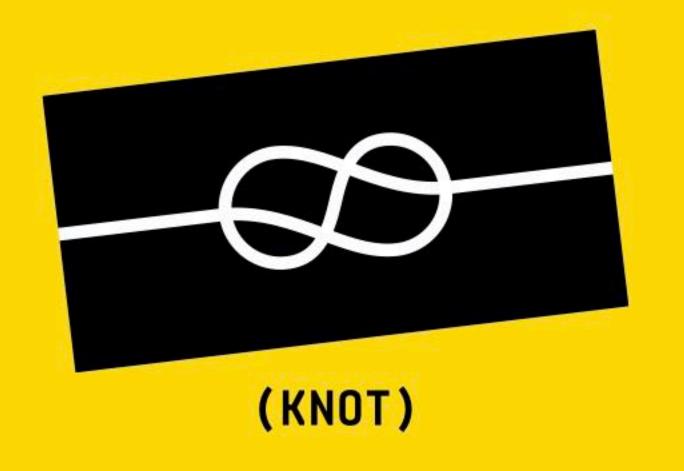








visual placeholder



+ "CRUFTY"

SYSTEM CRUFT & KLUDGE

ICON & VISUAL ANALOGY

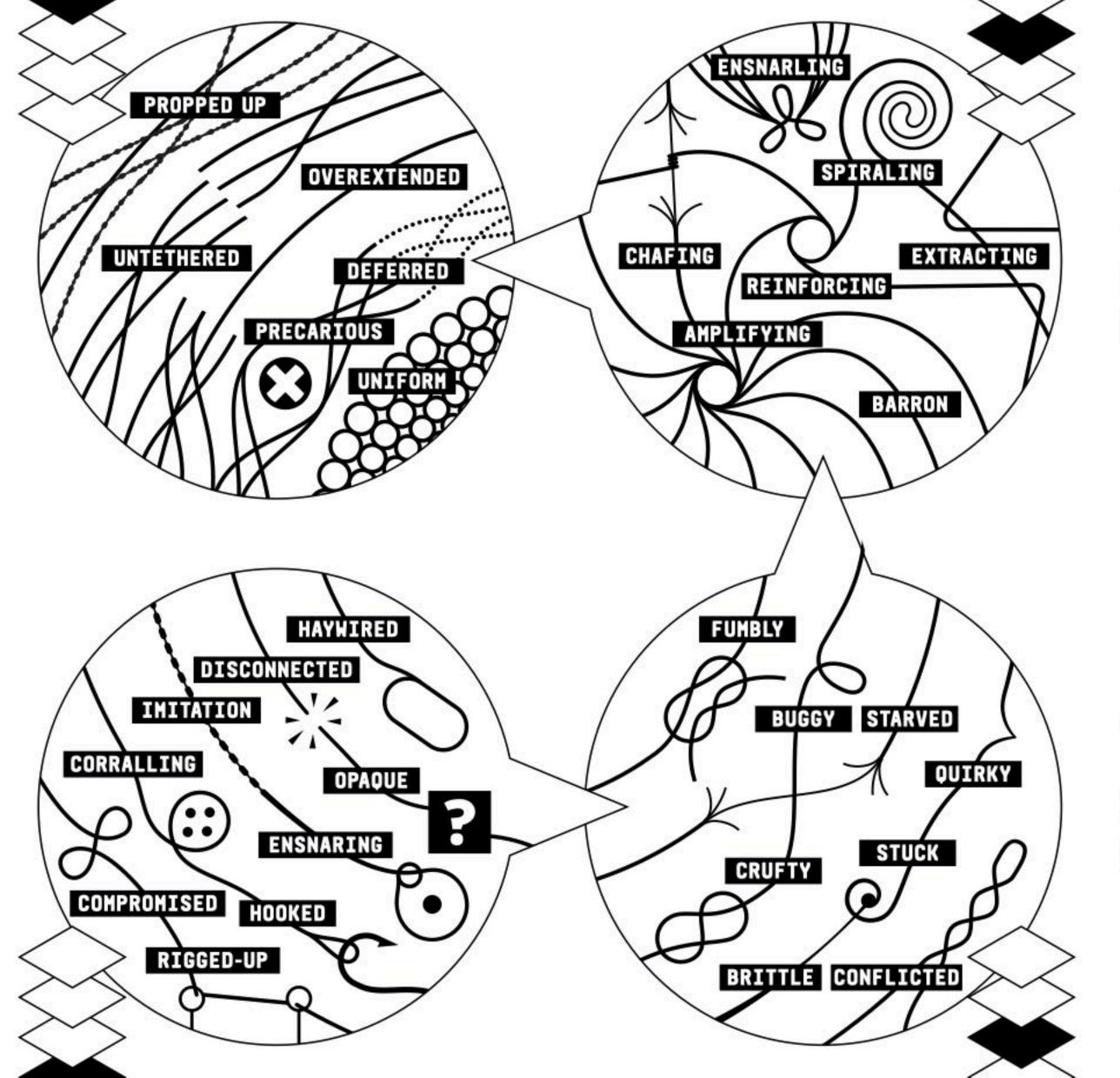
SHORTHAND DESCRIPTOR

CAUSE OF VULNERABILITY



atlas

MESSES
COMPLEX SYSTEM
INTER-RELATIONS



ENTANGLEMENTS

CROSS-SYSTEM DYNAMICS

FIBERS
ROUTINES AND
SUB-ROUTINES

THREADS
SYSTEMS AND
SUB-SYSTEMS



V. 1.0.0 BY PETER STOYKO

system entanglements

voterno pre entirele "ploped" ineplar as mest rely on resources or alginals coming.
Trove outside their outer boundaries in order to speralte. Thus, systems are not ust arguisted wholes made of inter-connected parts but are cannected to each other in elaborate tengline Some entangloments are tightly-coupled, nonsubetitutable, on-gaing dependencies. Others are losse, tensous, short-lived interactions. A let of relational variety can exist between those poles. When we talk about a broader amalgam of systems. (such as a society, economy, organization or ecosystem), we are talking about som-ples, evolving wide of entangement. Once a society prograpes itself beyond a ninimal level of complexity, the webs of mess. A "moss" in Russell AckerTo form for deadly but virus infected a wild unimal valled, and obsourced to be coordinated." lach eysters has unpredictable brook-on influences on other systems. Meases can be a good thing as variability is a source of resilience in complex environments; a disruptive exert is less likely to affect all way. There is also more experimentation. and triallectual disensity to act as a hedge. against uncertainty. Messes underwise the statity of central over-even to place activates are installed and over-even to place activates are installed and over-even to place activates are installed accounted and up adding to the mess. Heavy-handed statempts to get id of vulnerabilities.

Locally create lines ones central every "salution" is excepting. Those with adjusted wants and exact have less and less the last wants for examples occurred to coping. System after tolerange could be coping. System after tolerange could be coping. System after tolerange could be contracted to the coping. The Avition Abbs of System Kalvestofflies tempos the different types of varior ability interest to elaborate, enlarged, the loss of messy emanglement to "fiscide," When cascading system fallures identify the particular garterns that cause touble. The mess is broken down into four there is a serious risk of general callages.

treets of scale. Different clangers are visible by sconing and each level during valverabilities are the product of necessarials a whole (IE), Others are caused by est systems (2). Some vulnerabilities systems ISK And some purelet among routines and sub-routines IIII: In leaguing with the metapher, reseals are made of contoined and tangled threads.

Canada's entire debt-payment system to alog working for a day, with a third of all mobile phones losing coverage too. A sold in an urban market in Dhina, with the contagion spreading to humans, many of whom then traveled internationally, causdown for mentine to limit further spread. Then it happened again on a global scale. countless oproades of sufficient that games little attention. The comunities impact of slove-boiling, benind-the-scenes.

the (n)ever-changing world paradox

Sthat, clauses, systems to ethicigan' Signams are not estatic but are full at maving parts. So what causes a system to work differently? To have otherent gassit? To adopt to different scenarios, cater to different needs? Without com-plets are mode about systems being right, deserted, in hermital, that is the sent of operation rateout, thousand, given all the energy and ethics needed to seep energy thing going, a more relevant question may be Without cause a system to precise more or less atable? Come to think of it, how stable is each system? Pervesting the onus of the question can reveal much more about a system? Pervesting the onus of the question can reveal much more about a system? provided in seccles.



Human made systems are after mode up of operational rautines and systes of routines. We tiling of **routines** as fixed, automatic, and repetitive sets of tasks. Not they do not repeat per se, they recur pents panel and the sheer solute a solved using recorded data. Even so, our impression of system change is highly selective. Some parts always seem to be:

less pointed on esbarate systems than is commonly assumed. Wuch change (and commany setumed, reach change paid change aware dissembling happens among continuely adjusting contined and subnovimes. Even high-reliability organiza-tions should be nuclear powerplantal shringle to make yet without you will executed by howears are interestly read able and may not be strictly presented to begin with. Thought and offers go may applying brokens to subjetly different situations. Even standardized "low shift outlines are "performative." demanding learn attention to details and imprompts. been attention to details and in adjustments. A routine may not get the job-dene under the circum-stances, friggeranother one. Now reutines may be many routises are imitative, habitual, and lossely framed. Social interactions across the system may settle into reces or less stable patterns but the underlying chare cecasional strupt shift.

Conversely, notines rinky adapt so that systems say the same many generally, bu evolving authors maintain the attack gas by allowing a flaved system to pensist? Or are changes productly alterated pro-system's overself character and purpose. hard to tell when caught up within a citical distance to see things from a bloadly perspective.

bloader perspective.

As systems mature, southless become earneafted and farmatized, intensippind-encies build up scores systems and subsystems. Also either is spend conserving system functions from disruptions. Underlying routines may be more conditional test never indeed before the same of the state o anyways evolving offers parts seem stack in the same recurring patterns. The conflictations building within and obtained in the same recurring patterns. The conflictations building within and between hydron, which create the potential for large-cosis name, it may be conflicted about the potential for large-cosis name, it may be conflicted about the potential for large-cosis name, it may be conflicted that the potential for large-cosis name, it may be conflicted that the potential for large-cosis name, it may be conflicted to the conflicted to the cost of the cost

HAYWIRED Routines that on the Routines that are clocular, contradictors, or result in dead-ends are called Rafka circuits. They are study caused by an unformance insociation or analysis. Boulines that are clocular, contradictors, or result in dead-ends are called fairful circular. They are suringly caused by an informace in regularistic or carelled fairful design. They would in antisets for system users; that is, busclessome sub-coulines for resolver with substantial fair systems are substantial to be substantial to be substantial for the substantial fair substantial for the substantial fair substantial fair

DISCONNECTED

is systems become compartmentalized, they sely on hand-off soutines between motular subspections. That comes with the risk of botched hand-offs, for example, information may not be shared between subsystems to provide a confinerous flow of successive readiness. Those caught up on the system may have to several enfermentary as register their preclamment over and two as they are bounced from one motibe to the next. The east of data re-early ence and other glotches increases. Sometimes a case will full through the cracks, shock in a state of initioo, locally, a system notices a frequency recognise wheely transitioning between sub-systems becames invisible to observes. However, any function in a souther than successive will be discussively, as it is not clear what higgest the erect. Thus, some spiriture are made "scanding" whereby the hand-offs become more overt and elaborate, usually with other costs. were mediular subsignisms. That comes with the risk of botched hand-offs.

Consider may be automated for efficiency. "Stack-boar" automation converts speciations into elaborate algorithms, with the inservability of achieve cash and statistical schedupare making it difficult to see what is going on. Internation interes regularly, for either there is no substitute for femans judgment and discretion. Dodgy decision-making glennichs and shoddy was it can get encoded attailing times that are true readily trusted. Contaminus decisions area get into signiffmen that an time-readily traded. Containtious docisions also get survivous months agreement that are head to serurinize. Algorithmes are becoming more data intensive with data claims from sources with poor quality morbal and distinues provisiones: lideolity, technology augments harman cannot and offers information. For the the tend is howards removing human stere lige entirely. When the messay world is oversimplified to suit align ithms and operations became. spaquely overcomplicated, gittches become nearly impossible to trouble-shoot.

RIGGED-UP

Many costines are designed to make the jet vasior for system administrators white adding burdens on seem, where ments and circumstances are an after-thought. Some custimes encourage over size or missue of the system in ways that brends resident section states, interestinators included. The ammight, as Irven thin anyone, the medical system encourages one consumption and many treatments are designed for the conventioned of provider reported or their suitability for patients. That results in an increase in provider induced busins liabitagements, including routine mid-sizes, unnecessary risk-reported, and the torse-fitting of abgings potential trial sizes, unnecessary risk-reported, and the torse-fitting of abgings potentials time standard mustines. Some invariants may be based on contributed meets and premote antibuted finance many administration conveniences and valuable the manufall models of those running frings.

 Systems designed to indirectly control human validability rely on behavioral manipulation soutnes. Same routines psychologically "sudge" people into making particular choices using subde prompts. Other nurtines "gamily" activities by including addictive habits with the emotional sadisfaction of taken rewards, such as points or "likes." Some altunement to human psychology is: inovitable to befor align systems with the ways humans naturally think. Even so lifese "cheice architectures" second-gassa decisions for entire segments of people. The patiential for exploitation move gives away, indeed, dark-patien mulges and addictive basits are common dictated, systemational mulges are a found of auth called "fallings" ("surpering manipulation preate anamosphared and contradictors behavioral patients. Leviness builds up and defendies behaviors emerge (wardance), which cause fature manipulations to perform ematically.

CORRALLING Both specialists and before Continued and indirect municipalisations can create heriting behaviors that consent large exacts of a population to the same behavioral patterns. A lack of created large exacts of a production of the same behavioral patterns. A lack of created large the an anteresting, as devently in a hedge application more study and disruptive events. For example, routined that conservement into a time debug habitar can be risky if evidence about effect is basisty and sustainable confinence is eviden. Even if evidence about effect is basisty and sustainable confinence is eviden. Even if evidence are a resid share of the population, say induced harnes to the cohort can have knock on effects elsewhere in the system. That is the danger of "bearins," or behavioral manipulations continued with operation measures, bridge with "natigue," optionally is explaced with "nanaged absorous," or constained behavior that is strictly set to prescribed limits of those limits are too mantow and ill-informed, then the herding behavior. may causes those involved to became blindsided by unforeseen dangers.

COMPROMESED Routines may not be sue-COPPROMISSID

Routines may not be specified for functional reasons but are negotiated companious. Such those may reduce indemait bensions, even if no faction is fully sociated only independent of the point decision rapid and one side is placeased any built-eastedly, conflicted administrations will "electively perform" in ways to but have certain goals over others. Preterious and tokin sub-routines may be added to give the take impression that a system is fulfilling certain functions white reweig going through the motions. Deliverious contines may bead up to preserve a true or protect for. These can stock information signals that are crucial for a systems president, some routines may become "secretical" indicated with a larger maximity of a faction, sousing any tampeting or question-ing to be apposed. The fault-up of companied reartness cause systems to lose their bearings.

THITATION

This fits a assumed that there is a "right" way to color things—a marker been did "best-praction" or "gold standard." Anti-pathwise are approaches with a paint track secaré but are relied on anyway because of implifies and prestige exercused-ing them. It can be tempting to capy a well-regarded routine regardiess of how suitable it is. Even if a routine shows promise, the system may not have the capability to implement it properly, in any case, such may not have the capability to implement it properly, in any case, such searable reactions present a different. In the routine implementant, even if mappreciator? If does everyone load go through the mattern, while thicking any attempt to excellence when tennings too closely incheding? Are inconvenient or difficult pasts tropped, even if that misses the whole point of the routine? Particulinest, is lifting routines waste effort and dispulse.

HOOKED

Nothines may become captured by outsides or another system, in other words, independence is comprimised as interests interfers with system functioning, offer in outside and self-serving ways. For example, a routine may develop a dependency on an interest group for information or capabilities, exposing the system to subside pressures. Coop relations may form between those ventring in a significant and floors regulated by it, causing houselds brusteen within contentity recular realized. A routine may pander to existing benefities in a vent that described between apriets or executing once. These bondiciaries in a wan that discriminates against p corruptions can shape a system, making its own topics and assumptions insequable from those of outside interests. Thus, interests get their hades into the system even if the stated goals of the system overall do not share

OVER-EXTENDED

Ititisempts to simplify messay entanglements of systems into an intelligible coherence, instanced of accept the messay world as it is, sown bit limits of capability. Making messare causer to interpret invalidatiny relies on "bits simplifications of controlled transfections schemes that do a poor job of accessability capturing the salest, found continuedly evolution," bovernment and corporate systems attempting were significant too for trapmented parathetists of capability, with less supported transfer tools to be trapmented parathetists of capability, with less supported with more reported parathetists of capability, with less supported transfer strapping deven more trapping events. Interpret department, a "clean up" is not even possible as amortispins of systems leach as a society as ecospation; became investable messars they accept an initial less of complexity, incapable systems with amortiscus messa-management goals are accidents waiting to happen and are billed to the dystanctions they historisce.

PRECARIOUS

Systems attempting to act as a buleant against chaotic disorder in the environment will actively conserve milimate belief to occasional disustess and chronic entart huses, titing the east towards these with less power. The occample, homes in lose-lying areas seem sally due to elaborate distinguing optioms and waterin only yets assess able due to instructe orange systems on wood-containment bearings with the room-organization fleed high. Ingiting all finest lives to protect equity projective curtails the room-organization of finder high. The forest flow, making subsequent fines bigger, hotter, and more discretified. Law estrocement agencies mandate week software security to make it cosies to spy or criminals, which is a vulnerability for resystem first coliminate their exploit. When clearater strikes, hazand-poore systems will double-down on suffereability consensation by pilling on more contrads (president print marratives.

UNIFORM

Messes can be a good thing insufat as variation brings resilience. A variety of segimes can before complement the complex environments in which they systems can be the complement the complex environments in which they special. Experimentation and diversity of thought act as a hodge against uncertainty placing multiple beta is to our certainty and chance are revoted with constructively. However, a simplate "least" way of doing things may take not across systems. Nascenti evidence may even become baked into long term regulations, contracts, whentiery standards, and formal contines, rigidities which then blook evidence from being spotanet, backs suited approaches are through existed to maintain, and quicker to scale. However, on each "best of lineed" system and "best practice" is registrated, any underlying flavor and contensus ministes per registrated just are quickly, leaving every capy valenceable to woold, after That is the decourse count for expensional or obstance. to exploit-ation. That is the danger posed by meroscultures of systems.

PROPPED-UP

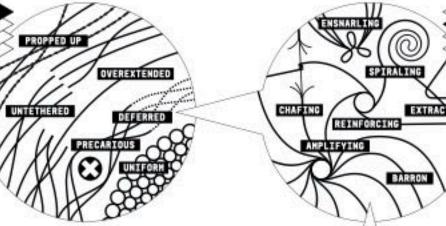
PROPPED-UP

It became thread in a tangle will remain propped-up by other threads. Likewise, as systems become intensippendent, the increative is to greavest dissolution of falling systems or upher in a replacement right away. Systems that are "too tig to fall or well-corrected politically get the most suppost. This prevent is spell if fact for bursen from socialing closeders of building. Pet difficulties set the motifies were the socialing closeders of building. Pet difficulties set the motifies of organizations and systems. Proposing them and preserves evolutions and encourages recovers and the present risk taking already factors. Statching operations their linger, their reclaims sets of exceed by the occarded support. These are the "condition" better existences obscured by the occarded support. These are the "condition" better tradegloyed elizabethers, and atherwise preventing resources and takent before redeployed elizabethers, and atherwise preventing rejunctation. Too many weak threads make the tangle vulnerable to large-scale claraption.

Rumans tend to make shart-sighted decisions that discount the future (houseed ellipower) using imperfect information (townded unionality) based on cultural framings of self-interest (bounded interest). If Systematication is often sold as more purely rational. Yet systems can punder to human blasses and amplify their effects, expectable innovations that time-shift the casts of present activities. For example, debt financing and economies of scale can accelera resource extillaction and consumption in the present, while defening the cest burden to some unspecified future moment. System feedbasis may provide signals of long-term unaustalinability. Some systems may adjust to achiev equilibrium (homeostasis), insofar as these signals and constraints sall fi

UNTETHERED UNTETHERED Systems can come to rely on the same abstractions, which become unteffered from the complex, underlying reality and take on a life of free sam. That is an abstraction losp. For example, manny is a medium of sectioning that become unteffered machiners and an advance, which can become disconnected with real-world user yadvs. Uneverse, inderface mataphors and convenients make a significant-vasion for uses by wilding their operations to make termilate objects, broader as also be actions become integral to a significant, the risk is that, the contribution is a significant contribution of a con abstractions can become a recognizable aspect of culture that get reused in ather systems, often isospropriately. The build-up of abstractions across gatiens then must underlying dangers. Worse, as problems emerge, the usual elaction is not to question the accuracy and validity of the abstraction layers Instead, advention turns to spurious rationalizations and blame games.

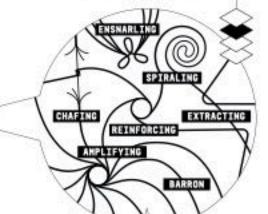
MESSES [Complex system inter-relations]



HAYWIRED FUHBLY DISCONNECTED 0 TELEVISION / BUGGY STARVED CORRALLING ENSWARING ? @/Q STUEK O CRUFTY @ COMPROMISED HOOKED

FIBERS THREADS [Routines and sub-routines] [Systems and sub-systems]

ENTANGLEMENTS [Cross-system dynamics]



BRITTLE CONFLICTED

EXTRACTING In a "platform ecopytatem," independent actors (complicated built subspatients along a shaked system. Think of popular accisi-media, e-commence, and computer operating spatient may be platform, after on a large network of users or measure economics of acute, a "finance value most (dynamic emerges as popularity breath more popularity. Platform common gain regulatory powers. Brea o at title all mass of dispendentation is activated, platform owners can become "takes interested of makens" by extracting sents white reading on their travels. Software, the sent of the makens" by extracting sents white reading on their travels, following resources away from immovators causes virtually to warre. Mores, or declaration that would otherwise be that of virtuant, force wheeling diversity can because "platforms with captive dependents and insulated platform cannot a travel of the platform and the complex dependents and insulated platform cannot a

EXTRACTING

REINFORCING

AMPLIFYING

REINFORCING

A relighting loap occurs when system dynamics perpeliable a recarring pattern at activity. A regardler reinforcement includes incertions, inducements, and persuasions that discurance particular actions, whereas positive reinforcement encanages actions. Ne system is perfect, so positive and regardler reinforcement separate are recessing to come a correct by indicating what seems to work or not. Psinforcing below to come a convert by indicating what seems to work or not. Psinforcing below there are system activities by making observance and creates seeds. Valence-billions enter greaten a retrieval in system activities by making observance and creates seeds. Valence-billions enter greaten activities of the restriction. For example, sporten reinforcements may be optimized to achieve a samon goal while creating all costs of collateral changes for other systems. Drug group of spot seeds in a new years of the greatent confined to active a samon goal while creating all costs of collateral changes for other systems. Drug group of spot seeds changes, it may be seen late to avoid in reversable destruction.

If chanceurd (or schours) opinal occurs when system dynamics lead is a traditionate predictional, which gives rise to new dynamics that lead is more brackle, and is no until callage happers. Each may set of predictional and difficult to reserve course and recover from previous boobies. Other the only

Jacobination. Rolas may be constalled, as when one involve occurs, others happen too, making the situation worse. Multiple amplifies create a numerally either freein hear? Fatibacks include: "Sevalid" is contain appeal; "our set treaters" to shut things down temposells; "small absorbers" to impose obligat, and reserves to absorb losses. Diggering these measures may cause a pain; by signaling damper, Rides become "surfac changed" when system complexity obscures the potential for numeral effects, the adequacy of sist-management.

measures is hard to judge, and incentives encourage deemplaying of dangers

Within satural ecosystems, an edge effect is the abundance of diversity and raction happening in the space where one habital abuts another, in example is the space dividing a furest from scrub lands or an undersea shelf where the deoths meet the shallows. The liminal zones of societal tangles have edge effects too. For example, tenoral ten tends to energe amid dense networks neighbourhoods supporting vibrant cultures tand to have a mix of civic ameni-ties, residents, and businesses, it is hord for beneficial spill-over effects (positive externalities) to happen between systems without the interactions that edges offer," That is not true if there are too many edges, in which case certain

EMSMARLING

ENSAARLING
Systems can get in each others way. For example, regulatory and legal systems
govern other spot ens. Morthwhile restrictions are beneficial. However, the
build-up of regulations can become unabeing. Contradictions may rever get
seconcient. Compliance buildings your. Resealing all the requirements can be
impractical. Severnithing by remaining unsercosary "red-spe" has become a
tiend of "florer war. "Regulators keeps all morting by ware sing sensible
judgment and averting cases of regulatory unreason wateress. That is difficult
to be even hancings. Established players may even highly to preserve not stage
to flore potential evials, bystems can other each other individual your colleges
to force potential evials, bystems can other each other individual your colleges. may became oranded, with systems relying on a shared infrastructure for super-system) with finite capacity. Besigns have to account for cargestion, especally to avoid snarf-ups during peak periods and emergencies

CHAFING

CHAFINS
Systems can be designed for parasitic explaination, the chafing in the tangle.
Bootones is liabilitie explain how many instrumental systems have embedded subsequences that imprise on use and app or users. If he recample, the dominant hand of instances are half are recent to gather information solut form candidates to trade caremodities. Not only done the data not half forms as independent spotents, but the trades go against their commercial interests. Itself trades also has a kill sealed to prevent unsuffer leaf replies. Recollect for any name ability results when online classes of system are not readily floation and "custor" other systems that not you then, though parasite systems can be ence fired. For example, Michael lasks talks have a consortium of wall Street insides built a sub-system to partit from price discorpances between markets lankshapes. If it is sub-system to partit from price discorpances between markets lankshapes. If it is not also that it is a sub-system to a partit from price discorpances between markets lankshapes. If it is it is not a second about, conting the exist trades and "thank trade" a fraction of a second about, conting the exist of trades and "thank trade" a fraction of a second about, conting the exist.

CRUFTY Cruftimess re

Erimps in the thread represent unanticipated interactions between parts that otherwise work as intended. Even if benign, an unanticipated interaction may disenter with an intended. Deen if thereign, an anamicipated interaction may combine with others to conside a compounding ret. Charité Persen points out that designers cannot flerence all interactions within highly complicated spatients are between offlerent dysteries that interact. There are to many permutations and combinations to consider, over with perfect intermation. The more interconnected and chaosate a system gats, the mass exchapation it is to such "mornal accidents." Whosever, the quities behavior in the system that securit do not fell tidily within specialized disciplinary boundaries. Experts of various tidipet have to just their broat suppliers to dispose problems, in our doing, they struggle to moderate disputes, all course responsibility, and diverse participation because there are no established methods to that.

articul to remain course and movement from pervious controls. Other tex only may first off things right in the chalde are quested for influence) against by thinging the dynamics. That exactly involves moking short-term secretices and gaining support from elsewhere, fortal dynamics treat to energy because successive preferaments trigger troublessame dynamics within different species. For example, a business may experience troubles in a supply shall that reduces cash flows, which trigger troubles from the financial system, which brigger apresidental cubacits, which trigger reduced demand in retail markets, which further sodium cash flows. Each system exacerbases insolves independently. Risk amplifiers for "Block-hele risks") are dynamics that accelerate the pace of a cleanward spitol. Trushles can spread tapidly as they ripple across a growing set of cases (carpsounding etihrats), as with viral contagions. A postive rein-feroment may incumidate harm, with a governing number of actions joining in Jaccolmation!, Risks may be correlated, se when see treather occurs, others

BIGGY (Taws and faults) are inherent to system development. Wast are quarked but a first investably remain. These binks in the upstem are hard to track down because they are integered by one interactions and countestancies. The trick-est to diagnose are trachined fires combined with faulty assumptions. Some are hander to find when tooked for (absenver inflored). As software takes over mote and more system takes, bugs become a bigger threat. United with other engine centre, descriptions are sown to absorb a devaluanced in prick. It cut down in the "wints," society butget are another tops contracting the pricks are sown to absorb a devaluanced in pricks. It cut down in the "wints," society butget are another types contracting the pricks and as bright interactions, and as a bright interaction as another types and

FWHILY

Sparses may be organized into discrete modules to avoid spaghed like tangles
of intendependencies. Each module can be debugged, resorbed, or oxageedask exthout having to future amount much elizables. The modules their intendace
with each other through toose couplings, the matupharical tites in the tangle. If
balles for file, such a rangements can create funity systems. Biglity modular
spatiens decores when testing sight of larger goals; fall independence rans
counters to what a system is also extens seconds, usualized productions
eincige from the fragmentation. New forms of kindige one used to rape, such as
bandware adopties, issuedation layers, and triage contines. The connective ties
are easy to modulate in these, in practice, those test often get registered, cousing proched or cumbersame based-ofts if different modules are controlled by
facilions with different indensits, the ties can be curtailed to linguit cooperation.

In this systems are over-specified and exacting. There is little togiveness for animosal variation, with micro anomalies classing major malfunctions. Think of brittle systems as stained threads, too laught to files when recessing, Appeal cases (scontinued) their cases the system to surp, all double, it is system talk, it has grantfully for "safety"s not all functionality is lost recovery is immediate. with fail-basis in place to minimize damage and burder placed on everyone affected. Even befor, systems "self heal" by automatically disprosing the problem and setting things right. However, brittle systems tack that surt of Isual and Isual Is blintance, allowing small errors to cause major breakdown. Accordingly, a high-precision system with many intricate parts tends to either have higher maintenance requirements or demand more caribol seer specalional candition. they need a pill-crew of flows or have to be heavily insulated from stressers.

∞

Most systems contain trade affs and trensions that have to be mitigated. Elegant designs strange conflict with impressing internal goal conflicts left unresident can prover a system from accomplishing its utilizate purpose. If system may be internalize pulptice in particular by system and administrative contradiction. For example, a governance system may subsidize (abacco farmers while runting anti-amolting-campaigns. It may nely on tolera measures to careful aperiting addiction, the addiety may be a play to enhiberant the other. More offer, adminish also do not want to have one inference in mer amother, as the applica-tion of the careful and the careful a times, the contradiction's happen in absolute ways that only become apparent in particular circumstances. These double block create "damned if you do, damned if you don't" options. 4 Office, the only move left is to reacible through while.

CRUFTY

Craffiness refers to departures from acound design principles that accumuate in systems and they age. If a spellers in not designed for issue-of-expail and on-going adaptation, it is "moreoid along" with pragmatic faver. The spellers departs from any sort of ideal configuration to become a terothet hodge, godge of parts. Or affiguration are hiff of Mudgier; that is, undeshrift patidise, hardly were acounds, sub-part patient are hiff of Mudgier; that is, undeshrift patients, hardly were acounds, sub-part patient efficiency and concerning up that "hichinical destrict" is an ethicalises, unduces those which is with it is desposingly safed "job shawing." Experienced files is ledge systems going with beside saves and more studges. Successful band-alias remove any ungeriery to the major removations or confirmal despise distinctions. Local of major despression abscures chronic, low-level problems. Orat all leading overwhelms the ability of bares to cape. Disruptions also increase as experienced fixers retire or change jobs.

reviews, pair programing, group teg-hants, and so forth: Anticipators, socially-sawly quality custod methods have success in highly caretrained occasion but work less well for systems operating in chaotic settings. Tellingly, the convention in software licensing exempts providers from any legal liability for bugs.

Systems can get anapped, or unable to adopt to the fines. To recoup as invest-ment, a system's life-cycle maybe extended tou long. Some anaps involve lock-in and path dependence. For example, contemborisms make a system difficult to upgrade or migrate away from Proprietare technologies can create unbreathy dependence on external providers and add switching costs. A system may tack a diversified resource base, refyleg on only a few commodities, suppliers, or a diversation in source asset, review in every or ever controllation, suppose, or majoriers, but many region are placed in too few basistats, acting less. Sprinner can also get cought in an efficiency orac, the system more settles if change is always being explored; the system stranges to inhange if financial or exploring existing advantages. If such mode immoves different coppositions, it system loaded in explositation mode will find it difficult to existent one to change whee the environment demands adaptation, lerical attempts will investably the clumbay.

STARVED

STARVED A Travel represents a system hanging on by a few fibers, basely performing the function because it is standed of resources, such as funding, starf, facilities, and whatnet, less vital static full by the supplies. Maintenance duties are neglected. Backings pile up and delegal become aurosameable, Margins of malely sected. One-all performance softens. If deprived long enough, starved systems will operate on the edge of break-down. There are there forms. First, so-called audie by measures are attempts to be finged in the short free to but, soften than their fact, and so outsiding the management of long stom six. Marchine, political extendences can install me that hand an excellent convention of a system is an instance to be east? If they had say over secource allocations, that, "lear" systems permised in "just in-time" resource allocations. If had, "lear" systems permised in "just in-time" resource allocations lack this floatis needed to topp with utilizensee-disruptions. sesource allocation lack bill-backs needed to cape with unforessen disruptions.

BRITTLE

CONFLICTED

scale and scope

SPACE SCALES

E00 - 0.00

SLPSA Serre, Surr

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HAM Contractor

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FDDD 💮 Element

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RICHA 🔷 ries

TIME SCALES PETE (A) Geologie Flore (Chrone to Enne

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MESS IN Special-Marchia

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MOREST CO Expendental Grapestions

CESTE AND Inderreposes

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FICE +++ Farmet/more-

FERTS -- Utransactight

AFTE . Proof thing commont forms

ZSPTE (Bectrue certifactus cycle

E RELE TO HOUSE PART HEETE IS MOURIE-ROOM

bodies; less of nature is unfouched b lence, the bangle of systems can appear stable due to human change blimbace. Most systems activity happens behind the scenes and for away, at sizes too. human intervention. Thus, the acape o systems is also expanding. An everyiew of general levels of scale in shown in the tables above. These provide small or too big to rwitce. Me perceive an visiting of the scales that might be change through a biref window of time. with a shallow depth of focus, Our mercories are selective and degrade: quickly. We take emptional comfort from continuity. All tack, we have little inclina-tions and shiftly to leap track of all the moving parts. It was breather our field of view and become better off-wed to system rightnes, we discover that the targe of systems is far trans a shearly state. It is continuably withing, with the occasional disjuncture. Even sentingly fised and solid absolutes are always degrading under the force of entrapy without regular maintenance. Thus, every-thing is in entitle (process andology), but not all time and spekiel scales we are used to thisting as. continuity. All told, we have little inclinerector and read economics) and sneed territories (such as registral). Understand-ing system subscrabilities helistrically requires a wider ranging attention that spotsurits for earloss scales and an

extended scope of system activities. The Author Allow treatment of scare also incurporates different fevels of apprepa-tion. The mean is made up o Made's society is speeding everything up

technological Re-cycles, ikuman-induced elective pressures in tratural ecosystems are becoming ever more severe. Things do net last like they used to. At the same time, systems spread further from cor-local contage point. Not only do many. total elettage point. Not ends do many system intestigementensies new spate the gallor, they leach even lower depths and ever total heights. For example, Ancient Pamas mines could go abble meters cleep, whereas today's mines can go down as for as four idemeters. Besidhed- era wells crude the a dozen meters deep, Today, a shale gas ned may reach a depth of seven titerectors. Eight mellomie ago, a filmingolan risioner may have took parcolling a two humbers meters in the say A waden samelite can be tundencies of tousands of kilometers above the goomd. tangles of systems being analyzed

Life is being over more systematiced: human made systems condition and constrain a witter variety of secial relations; stally tasks are more relant an systems, systems intrude on our personal sphere more readily, including inside our

with over faster technologies and briefer

CHANGE











pace layers a

reption happens, epitieres, evenly, change at differ calls these paid above.** Even

ANNOTATED POSTER

SYSTEMVIZ

hopping in a feature for course as an employing temperal soluty devoted to before explain-ing spellors of ferrught the use of stosets. Further stationalities can be found in the tothicoming back by Peter Staylor, Ace board Physics Change Rig Systems (2004), additional products can be downloaded. Rights. This version of the Pattern Aflan is subject to copyright (2021-22), all rights #elated. The DultureVQ Project is a reserved. A separate spen source neason: companion project that visually explores, is available for developed and is subject to culture as a system. For moso, see. Creditive Commons Free Dulture Idense, International Systems (International Systems)

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Author, Pater Stayks is an indendisciplinary social sciential and information cleagues with an interest in service design, systems, suitars, fee significant queen ance, Por more, see verve skiptio and Citation. Reason also this document as: Peter Staylor. Retiren Alba of System Volnerabilities 1.0.0 – Poster Ottower. The System/No Project, 29(22).

faults + confounds

A fault is a markunotion or error that impactes system activities or causes general failure. A control of an americandod, unrestorate factor presenting in a system or as supplaned for seen executing difficulties. These discupling come in fact general pattern, while result pattern having different implications for the ways systems propose and react.

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Regular charagitions construit in product plate in agreement and parties regard with the solding pro-cessions and conserve resource. Dedicated spotsman or sale-speciment empires installed to conditions their mediting of these disappletion. For example, an underly such services is an assembler of exceptional disappletions of their control. San environment, most maintraneous, and so familio designed in somi-automatic systems plathicks to open deen of conceptional disappletion temporary as writtes creatives and since storms, described previous empires and since storms, described septements previous services and septements previous services in some services in septements previous and services creatives and services are serviced as a service of services are serviced as services and services are services and services are services and services are services services and services are services servi

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RIGGED-UP

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DIFFICULTIES

problem maintenance

What describs as a Fall-drover, 'possiblem?' Per payarisatings and reasons, humains developing harms and fibrarials that are show holling, for semoured, and attribute, filipperities conditions are less important than the skilling three services account drawn as training or insulated to individual to services. A procedure state in each to de attenues to conditions that the skilling of the restation of the state of the s

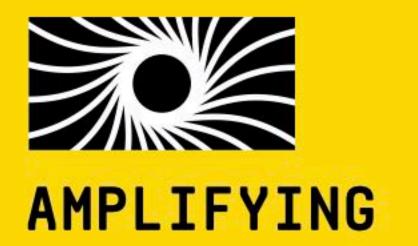
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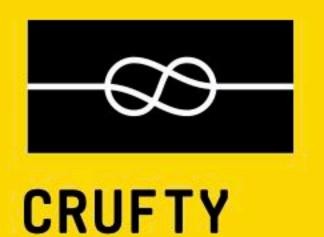
examples

















routine specification



