A Priori MODELING OF INFORMATION AND INTELLIGENCE

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ABSTRACT

This project explores *primitive structural fundaments* in information, and then in intelligence, as a model of 'thinking like nature' (natural informatics). It examines the task of designing a general adaptive intelligence from a low-order (non-anthropic) perspective, to arrive at a scalable, least-ambiguous, and most-general, computational/developmental foundation.

1 DISCUSSION: ASKING THE RIGHT QUESTION

What presents a central conceptual challenge in the advent of human level AI (HLAI) is essentially noted by various individuals, across diverse disciplines, as they each confront their own hurdles:

- *solving intelligence*, Demiss Hassabis, Google Deep Mind (Burton-Hill, 2016),
- *de-risking science*, Ed Boyden (2016), MIT Media Lab, neurology,
- *meaning as fundamental*, Brian Josephson (2016), Cambridge University, physics,
- *theory of meaning*, Shannon and Weaver (1949), classic information theory, and more.

Each individual or discipline has its own framing, but these nominally-diverse logical gaps can be seen as, and reduced to, one central issue.

Shannon and Weaver were likely first to see this issue as a missing *theory of meaning* but it has worn many faces since. Still deeper study distills the issue to differences in how we view and treat objective (quantitative) information, and subjective information (qualia) — where even basic notions of 'information' become a confused dualist concept.

For example, mathematics is occasionally called the King of Objectivity as it can omit subjective aspects in framing its arguments. But mathematics without *subjective elemental facts* becomes a fact-free science and is of little practical use. Only when the objective and subjective are linked do 'useful' results arise. If we look for other firm objective views, the standard model in physics and the periodic table are good candidates. But their fairly recent 'objective success' ignores the fact that they arose from a sea of *subjective elemental observations* later normalized via experiment and peer review. Only after enough material regularity was *subjectively discerned* and *subjectively named*, were the models then normalized (agreed) as being innately objective.

Our success with **objectified** *subjective* features is so vast that we may forget how objective roles are born of subjective notions. Objective traits cannot even be posited if not first sensed as subjective qualia. So, if we now seek to design something 'objectively intelligent', we confront the equal of designing a King of Subjectivity (Stanley and Lehman, 2015). The benefit of intelligence is, after all, to bring new subject matters to our attention, so we can later name objective gains. But we must first ask 'Intelligence about what exactly?', as all intelligences, even human, are unequal due to innate subjectivity. Also, in a manner akin to that seen in the standard model and the periodic table, what *subjective elemental facts* (or 'information') will be used to initiate that 'objective super-intelligence'? — if such a concept is even logically plausible.

Despite diverse opinions on the topic, this all points to an unavoidable subjective aspect in considering informational roles and in designing presumably-objective (super) intelligent systems.

2 CURRENT LITERATURE

In the literature, the need for solutions drives a large patchwork of diverse, incomplete, controversial, and competing views (Dennett, 2013). Most simplistic is *scientism*, claiming that if 'a thing' cannot be objectively measured it does not exist, seeking to eliminate subjectivity wholly from consideration (Peterson, 2003). Ironically, this shows the worst of subjective naiveté (Popper, 1972; Searle, 1995). Philosopher Daniel Dennett (1991) is a likely standard-bearer arguing that qualia are non-existent, ignoring the need for a functioning sensorium in 'evolution by natural selection'. Alternatively, philosopher David Chalmers (1998) asserts that qualia are beyond all scientific thought, while often alluding to an 'information theory' solution with no actual details ever offered. After Chalmers, others support a mystical 'panpsychism', with evolutionary biologist Stuart Kauffman (2014; Horgan, 2015) and neurologist Christof Koch (2012) as recent converts. Lastly, there is 'mysterianism' where some seem to throw their hands up and claim that no solution is ever likely (Dennett, 1991a). These and other unnamed views offer seemingly endless debate, but little more.

Conversely, success with Shannon's (1948) 'signal entropy' marks a vast informational pragmatism and decades of information technology leaps — in *objective* roles. Plain objective gains, versus endless debate, puts *subjectivity* in a poor light. Regardless, Shannon and Weaver saw signal entropy as 'disappointing and bizarre', in part due to a missing theory of meaning. Later informational studies convey a 'conceptual labyrinth' of subjective/semantic issues, even if using a Shannon-based start (Floridi, 2017). But recent gains in unsupervised machine learning point to a growing optimism in the possibility of designing an HLAI (LeCun et al., 2015; Rosa, 2017). Still, this requires unseen gains in modeling subjective roles, and as such, HLAI efforts remain 'fringe projects' (ICLR, 2017; Marcus, 2017).

In looking forward, a practical middle ground holds few names. Philosopher John Searle (2004) calls for 'biological naturalism' as a crucial foundation, framing ontological and epistemic aspects in objective and subjective roles (Searle, 2015). But again, no further detail on a model is offered. For example, Searle argues humans may process qualia, but other biological systems (like a tree) do not, without saying why those biological systems should differ (personal communication, 30 April 2014). As a modest advance, philosopher Luciano Floridi (2017) offers a *General Definition of Information* (GDI) that partly differentiates semantic roles. But questions remain on GDI's true efficacy (Chapman, 2010). Lastly, astrophysicist Sean Carroll (2012) attempts to find a synthesized vista by assembling notable intellectuals from diverse disciplines for a focused 'naturalism' discourse, but with no cohesive *meaningful* result.

The strongest hint (to date) of a likely solution comes from neuro-anthropologist Terrence Deacon (2013), using a type of 'entropic analysis' as a foundational synthesis (Dennett, 2013). He references Claude Shannon's signal entropy, Boltzmann's thermodynamic entropy, and Darwinian natural selection as innately complementary views (a Shannon-Boltzmann-Darwin model). But the model's purely thermodynamic core makes it irreconcilable with a true physics based view (email exchange, January 2017). Also, the work is littered with confusing/unneeded neologisms and nearly impenetrable prose (Dennett, 2013; Fodor, 2012; McGinn, 2012). The model thus lacks clarity. Beyond Deacon's work no other models are seen, except for the view posited herein – which roughly tracks Deacon's view in a more plainly reductive manner.

3 POSITED MODEL: NATURAL INFORMATICS, OR 'THINKING LIKE NATURE'

This project frames a path through that *subjective-objective* bind by detailing a naturally scalable core, with evolving complexity, as we see with nature. It thus also mirrors/anticipates a growing richness we might hope to see in ever-more intelligent informational systems. In broad terms, the posited model synthesizes Shannon *signal entropy*, Batesons (1979) *differentiated differences*, and Darwinian *natural selection* to present a unified general model (a Shannon-**Bateson**-Darwin model). This contrasts to Deacon's Shannon-**Boltzmann**-Darwin model. Empiric examples of the model are briefly developed, using the step-wise logic below. These examples are also explored further in three papers and a video (see APPENDIX) that support a larger body of work on Natural/Core Informatics.

The steps detailing this *naturally scalable core* are as follow:

- What is *Information*? (an *a priori* view of information . . . the 'key challenge')

— subjective and objective (qualitative and quantitative) **entropic traits** are named as distinct but necessarily interdependent, and crucial to all 'information',

— divergent **representational** modes for objective and subjective roles, with growing complexity, are next detailed,

— divergent **computational** aspects of evolving complex objective and subjective traits are then named (e.g., problems of 'transition and emergence'),

- What is *Meaningful* Information? (exploring vital subjectivity . . .)

  — diverse scientific roles (the standard model, the periodic table, genomics, and natural selection) are shown with distinct computational features, and with distinct types of *functional meaning* (differences in **objectified** *subjective* logic),

  — an essential 'key' (metadata bridge) is named as needed to reconcile those diverse functional types within one system, and to allow a cohesive natural informatics to arise,

  — that metadata bridge is then detailed and shown to support three distinct types of *meaningful roles*: materially direct (non-adaptive), discretely adaptive (coded), and temporally adaptive (selection). They thus mark a 'key *differentiated* logic' (re Bateson).

- How is *Adaptive Logic* Generated? (focusing on subjective adaptivity . . .)

  — an 'adaptive key' with *material* and *behavioral* implications, is named as 'a lever', affording a practical foundation for general analysis (i.e., a 'computational trope'),

  — this *general/universal key* is next deconstructed to detail three lever classes and three innate computational roles, that naturally afford **numerous** adaptive options,

  — those computational roles are then mapped in relation to Shannon signal entropy, to mark natural 'entropic types' that join to initiate a sense-making interpretive system,

- How are Adaptive Options *Selectively Optimized*? (given many adaptive options . . .)

  — myriad adaptive options thus exist, but they must now be reduced by the innate *happenstance* of evolution by natural selection (e.g., problem of 'uncontrolled variables'),

  — only *functional reduction* optimizes those options, as driven by natural selection,

  — *happenstance* is thus framed as a general 'agent + force = result' logic that affords a simplistic *reducing model*, which innately makes 'the *subjective*' into 'the **objective**',

  — *reductive logic* is then shown to hold a natural dualist-triune dimension of . . . 3232 . . . as an extensible fractal 'topological key', within a larger logical (adaptive) continuum,

  — lastly, that *topological key* is explored in relation to chaos theory as a way to structurally/computationally/cognitively model happenstance and logical reduction.

The implication of this analysis is that designing an HLAI+ likely requires a sequence of computational roles, rather than a 'one-step algorithmic treatment'. Also, using this step-wise model implies a range of 'interpretive tendencies', *adjacent possibilities* (Kauffman, 2003), or *stepping-stones* (Stanley and Lehman, 2015) typical to chaos theory, rather than firm predictive results. Still, such a model can aid human inventiveness, but more likely in a non-autonomous HLAI+ role. Finally, this model focuses on defining a *simple adaptive logic*, rather than targeting 'complex (higher-order) adaptive systems'. More detail is available in the video and papers linked below.

4 APPENDIX: SUPPLEMENTARY MATERIAL

The video and papers listed here provided further detail on this step-wise analysis.

Title: *ONE PROBLEM - ONE THOUSAND FACES*: IS4IS 2015 (International Society for Information Studies, conference presentation) — addresses the first bullet point in Section 3.

Link: `https://vimeo.com/140744119`

Abstract: This video (23 minutes) gives a broad view of *a priori* notions of information. It names an initial general 'theory of meaning' and 'theory of information' that emphasize scalable **primitive** *subjective* and *objective* facets. In brief, the model synthesizes Shannon entropy, Bateson's different differences, and Darwinian selection (S-B-D) to derive *meaningful information* across diverse disciplines. In the video: Basic issues and questions are framed (2:30 minutes). Known meaningful metadata traits are detailed (2:30 minutes). Next, metadata's role is fully deconstructed in remaining minutes to name universal *a priori* facets. Lastly, the model is re-constituted 'from the ground up' to present a fully synthesized S-B-D *a priori* view. Text for the video voice-over can also be read or downloaded at: `http://issuu.com/mabundis/docs/oneprob.fin`

Title: *A GENERAL THEORY OF MEANING* — details the second bullet point above.

Link: `https://issuu.com/mabundis/docs/abundis.tom`

Abstract: This essay targets a meaningful void in information theory, as named by Shannon and Weaver (1949). It explores current science (i.e., the standard model in physics, the periodic table, etc.) in relation to 'information' and consciousness. It develops a bridge to join these topics by framing meaningful information, or a natural (core) informatics. The goal of this study is to posit a general theory of meaning, where three types of informational meaning are detailed. As such, the model uses type theory to re-frame classic conflicts that arise across diverse informational roles — as essential Bateson-like (1979) *differentiated differences*. (11 pages; 5,400 words).

Title: *NATURAL MULTI-STATE COMPUTING* — supports the third bullet point above.

Link: `https://issuu.com/mabundis/docs/multistate`

Abstract: This essay covers *adaptive information* in humans and other agents, and complements a related *General Theory of Meaning* (Abundis, 2016). It names a computational logic needed for minimal adaptivity. It shows how levers, as a computational trope, typify meaningfully adaptive roles for many agents and later afford the advent of simple machines. To develop the model: 1) Three lever classes are shown to compel a natural informatics in diverse agents. 2) Those lever classes are next deconstructed to derive a scalable creative logic. 3) That logic is then detailed as holding three entropic-computational roles. 4) Lastly, that adaptive logic is used to model tool creation. The analysis thus frames systemic creativity (natural disruptions and evolution) in various roles (discrete, continuous, and bifurcations) for many agents, on diverse levels, to depict a general adaptive intelligence. Lastly, it also shows signal entropy and thermodynamic entropy in linked material roles (14 pages; 5,700 words).

Title: *SELECTION DYNAMICS AS AS ORIGIN OF REASON* — covers the fourth bullet point.

Link: `https://issuu.com/mabundis/docs/lgcn.fin.4.15`

Abstract: This essay maps the interplay of dispersive force (natural selection, generic entropy) and agents striving to abide that force, as *cognitive adaptation*. It extends a view of Shannon information theory and a theory of meaning framed elsewhere (Abundis, 2016). The study starts by pairing classic selection pressure (purifying, divisive, and directional) and agent responses (flight, freeze, and fight), for a general model. It next details environs-agent exchanges as Selection Dynamics within that model. Selection Dynamics are then shown in relation to chaos theory, with a fractal-like topology. Lastly, that dualist-triune topology is explored as sustaining many evolutionary and cognitive traits, to mark an informational/cultural fundament. (10 pages; 5,000 words).

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