DIMENSIONAL ANALYSIS OF MEDIA

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Non-representation of Empty Space

Space is seldom treated as a first class citizen. Traditional notations trample upon it in the name of representation. Of course, space is best not represented. Representing space, in a literal sense, uses it up. Phi is not, so to speak, The Empty Set. Phi is but a shadow of emptiness, pointing to nothingness only by mocking it. So we, as serious students of mathematics, calmly accept such fundamental rules as "The empty set is a member of every (?) set". As materialists, we concretize emptiness and place it everywhere, so as to anchor our ability to count the members of Power Sets.

The Empty Set has no members, and is unique. Let's put it into the background, semi-representing it through the non-representation of the blank page. Existent members can show up clearly as typographical or other ink-based indicators. We gain the utility of the blank page explicitly because we have adopted conventions that define the edge of the blank page. Even lacking the constraint of whitespace in the borders, our physical convention is to materially bound page-space with finite and humanly convenient page size.

The case for non-representation is strong in binary notations, since half of the binary pair can be cast into the void. In elementary logic, for example, a convenient spatial notation can be developed around one concept and therefore one notational element. The central idea is to not represent False. With False being built into the background space, we gain substantial notational and computational convenience with little cost. The sole disadvantage to one-concept spatial logic is its unfamiliarity.

False-as-background, if accepted, implies that the minimal basis for binary logic (and incidentally the basis of Western law, logic and computation) has been over-estimated since the Ancient Greeks.

Background processes, mapping operators onto the void, can easily be understood in terms of elementary logic. Assume the background is inclusive or. Elements sharing the same space are joined in disjunction.

In arithmetic, space is used naturally for addition. Children push blocks together to add them. When the blocks are encoded with A metric, physical space mimics counting.

Space embodies the metrics and the measure theory of our choice. As a culture, we have become addicted to Cartesian orthogonality. We waver on whether or not the measurement units should remain even remotely connected to our natural senses (the Kings measure). The challenging, desperately abstract

metric system shares a name with the study of abstract spaces with superimposed metric structures.

The Space of Virtual Reality

VR reminds us of portals, flying, context switching. Portals are used to change worlds, usually a literal signal to the system to load a new database. Portals are context-switches, with no sense of continuity or underlying structure. Bread crumbs are point trails with ordering as well as location. As a means of travel, portals are common in children's fairy tails. In particular, the Rabbit introduced Alice to one.

Under such radical transitions, Cartesian orthogonality is just too limited.

Some observations while stumbling across not a new continent, not a new planet, but a new reality:

How can the status of physical reality, our cherished Mother Earth, be compared to the output of a couple of LCDs? How can physical reality ever find justification for sharing the notion of reality-ness with a computer generated illusion called virtual reality?

The physical body "occupies" space. But a physical body does not displace space, as it would water and air. Our body shares space with space itself. Our massness is superimposed on top of space, without the faintest interaction with space. Space pervades matter.

Similarly, mass pervades virtual reality. We invariably bring our physical body into VR with us. Notice the turn of phase in the previous sentence, as we express pervasion, we separate our mind (perceptual processes...) from our body.

But it is our senses which mediate our experience with the world, and our senses can be tricked. In the tradition of mathematical discoveries (which are invariably named something horrible, such as negative, imaginary, complex, and chaotic), senses are tricked rather than permitted to convey non-standard information to the brain. They, of course, convey the information anyway, so the information is labeled an illusion to differentiate it from the physical. Virtual information, sensations created by illusions, are reputed to tell us about the working of our sensory systems. They tell us that there are ambiguities, that the physical is somewhat dangerous.

The Big Question

But for VR, danger is clearly the illusion. Physical harm can largely be eliminated. The Big Question of comparability shrinks to:

Under what circumstances should we be so motivated to leave direct conscious contact with our cherished physical environment to be immersed in a computer generated display?

This Question can too be shrunken:

Why watch movies? Why use a computer?

For entertainment and for information processing tasks.

The Big Question raises the ugly issue of just what is it we are talking about? What is VR? Does the discussion apply to Media? To cultural experience?

The definition of VR has spiraled outward for its narrow technical conceptualization. *Immersive computation.* Computer animation. Any image work with a computer. Television in general. Digital data and computational display of any sort. Any type of social and psychological alienation. *Cyberspace.*

Immersion is a fair analogy, as in scuba diving, but it makes little sense to immerse oneself in space. Space is not displaced, it is there whether or not we occupy it. Step away from immersion and we end up with computer graphics. Step away from designed CG objects and we reach image manipulation by digital means, such as enhancing the brightness of a photo or watching television. Step away from images, into sound for instance, and we encounter the idea of digital information. This leads quickly to an alienation form reality, into virtuality. Into cyberspace.

Framed Dimensions

The *essence* of a representation is the boundary of the space that contains the representational information. The various forms of media and entertainment span the scope of available dimensional reductions of framed representational space.

Technological media reduce the dimensionality of reality, they abstract reality by removing a select band of information. Live television, for instance, removes one spatial dimension and changes scale. It also narrows the bandwidth of perception to visual.

TABLE OF MEDIA DIMENSIONALITY

MEDIA	*BOUNDARY*	*DIMENSION*	
		space	*time*
SOUND			
spoken word	silence	1	forward
music	silence	1	forward
telegraph	stop	1	forward
radio	knob	1	forward
telephone	ring	1	forward
record	groove edge	1	forward
command line interface	cursor	1	forward
page	paper edge	1	multiple
book	cover	1	multiple
VISION			
painting	frame	2	0
photograph	paper edge	2	0
live television	tube, screen	2	forward
projector	screen	2	forward
motion picture	screen	2	multiple
television	tube, screen	2	multiple
recorded television	tube, screen	2	multiple
personal computer	screen	2	multiple
desktop interface	screen	2	multiple
TOUCH			
sculpture	physical edge	3	0
inclusive interface	reality	3	forward
EXPERIENCE			
live theater	stage	reality	
tourist attraction	gates	reality	
automobile	body	reality	
airplane	fusilage	reality	

The entries in the above table are intended to be suggestive, and are not authoritative.

Spatial dimensions refer to the physical presentation of the media; temporal dimensions refer to the flow of time within the medium. Most technological media can reverse time flow.

Framing and Re-framing

The general notation for a representational space is a closed circle on a flat page. Inside is the representation, outside is the sentience providing meaning.

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The foundation of representation is the frame (or boundary) which differentiates between the representation and the physical reality which pervades it. The frame of the image on the television identifies a space of encoded scan lines with operational rules distinctly different from those of physical reality.

Frames around representational space provide a fundamental choice for the participant. We can observe the frame from the exterior or we can participate within the frame. Our attitude toward the information within a frame changes drastically when shifting from interior, participatory experience to exterior, analytic observation.

Some frames have lately changed from exterior to interior: Participatory theater, telepresence machines, spatial art forms (Christo), and VR.

VR changes the frame on digital information. The frame, which differentiates representation from reality, embodies semantics, since it mediates between the purely symbolic space inside from the real world of experience outside.

A profound shift occurs when we use technology to cross the boundary between representation and reality. During the Gutenberg era (1600-1900?), printed words provided a somewhat mystical leap from abstract symbolism, scrawls on a page, to activation of the imagination. Words, and more generally symbols, manage to freeze time, to pass real physical activity by. Rather than reaching out and grabbing a word, we have devised words as physical bypass mechanisms, capable of holding a thought over time. Words are also cleverly constructed to be one dimensional. They can be unfolded over time by reading sequential elements. They can be unfolded over space by spatial conventions which let us stack strings in lines over two dimensions, and in pages into three dimensions. This clever representational strategy gives us abounding paper surface onto which we can stack the myriads of words needed to unfold an experience.

Words

Due to the low dimension of strings of words, their ratio of information (semantics) to elements (syntax) is low. It takes a lot of words to tell a story.

In their most fundamental form, words are binary strings, sequences of bits. Bits can be processed efficiently by the linear generation industry, companies which mimic the linearity of the printed word by transporting bit-encoded pulses very quickly over long thin wires. It took the microwave industry to introduce space to information distribution.

Words not only transcend time, they manage to freeze physical activity. People read without moving. Television also manages to eliminate physical activity. TV uses two dimensional arrays of image information; it differs from books only in the spatial dimensionality of the representation presented the viewer.

Words then have removed us from physical reality, both in time and in space. Words allow us to elaborate...

We formalize our communication tools (binary sequence encoding) using the mathematics of pattern matching and substitution. The edifice of symbolic structure erected upon the two dimensional plane of paper began to crumble when technology introduced framed sound, first as the telegraph, then the telephone, and later radio and recorded music. Once only found through direct experience with the real world, sound now could be channeled between hand held boxes. The cost was dimensional compression, natural sound had its spatial component removed.

Technological Abstraction

Our culture has generated many technologically framed abstractions of reality, each of which allows us to capture, to make free of time and space, a representation of reality, a shadow of experience.

In general, all technological devices frame reality. The frame of the technology provides a representational space on the inside, a space with non-physical rules that captures and reduces a slice of reality. The light bulb, for example, frames light. The glass housing of the bulb delimits a representational space on its inside. That space contains a thermo-mechanical representation of natural light (i.e. the Sun).

VR is essentially a multi-sensory shift of our relationship to the frame of digital information. We move our perspective from outside (as observers of symbolic processes displayed on a screen) to inside (as participants in a computational environment displayed as a virtual reality). We call external interaction with symbols "interpretation"; we call participation within symbols "experience".

The role of a theory of semantics also shifts. In traditional semantic theory, syntax is anchored to meaning by a map from representation to that what is represented. The word house points to an object house. In VR the necessity of an external (real) referent for syntax goes away, replaced by a

pseudo-external which is experienced directly. Semantic rules link representation to experience. In VR, the representation is experienced directly, as semantics. No cognitive interpretation is necessary.

Syntax Vs. Semantics in Math

We know that syntactic forms can have wide variance while identifying the same object. In math, for example,

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(x = x) = (y = y)

1 + 1 = 2

x + y = y + x

x * (y + z) = (x * y) + (x * z)

(if a then b) = ((not a) or b)
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The equal sign specifies semantic invariance, the truth that one side means the same as the other side. However, the symbols, the variables take on very different uses in each of the above examples.

Propositional logic consists of truth, the absence of truth (called falsity), and syntactic confusion. Confusion can consist of syntactic tangles, which require mere computation to undo, or indeterminate elements, which generate Predicate logic. Terms (complex structures of elements) are indeterminate in many different ways. For example:

The existence of a term may be difficult to demonstrate, as in Fermat's Theorem:

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(Exists (n>2) x^n + y^n = z^n)
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The termination of a functional term may be difficult to assure, as in looping functions:

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(if P then (looping-function) else (return))
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Here, the seemingly harmless evaluation of P may cause the program to fail to halt.

Natural Semantics

Choice of representation often effects our ease of interaction with syntactic structures. In particular, computer graphics specializes in mapping from mathematical algorithms to visual scenes. Recently technology has permitted

increasingly dimensionally complex scenes to be generated from digital information. We have moved from the command line to the graphic interface to 3D CAD to interactive multimedia, to immersive VR.

Each of these evolutes map binary streams onto varying degrees of depth of experience. But VR has added a fundamentally new element. The command line, being interpreted fro outside its representational space, required a semantic boundary, a map from syntax to intention. The graphic interface provides a metaphor but not a map. The desktop has limited composability of elements. 3D CAD, with screen-based flythrough, restores experience to digital data and provides a fundamental distinction between natural semantics and binary semantics. Binary semantics is inaccessible to the human mind, it maps to nothing in our experience and overwhelms our native pattern-matching capabilities. To a two year old, books have binary semantics, but they are, as the toddler will soon discover, strongly mapped onto spoken words, and thus accessible to experience through simulation. Mathematics, for counter-example, as the vast majority of teens discover, has no natural map onto experience. Math teachers invariably require the student to embed complex symbol manipulation routines into their minds.

Interactive multimedia is the halfway house to digital experience. It recognizes multiple sensory inputs, dynamics, and importantly, manipulation of all forms of symbolic structures. It fails to provide inclusion, contenting itself to display of syntactics.

Natural semantics is the polar to binary semantics. It's essence is a trivial map between representation and experience. Photos of real things are generally recognized quickly. We process more information more efficiently when viewing photos that when viewing text for many reasons, such as:

the use of a higher dimensional media (2D > 1D)
the visual cortex is highly developed
little effort is required to construct an image

But the frame of a photo still compresses away much information, information that can be more successfully captured by film, by interactive models, by digital realism.

The case for natural representation is clear in the example of architectural models:

binary, ie:	01010101000
drawing engine specification, ie:	Polyline[(000), (010),...]
architectural blueprint	
pixel display	
3D model	
stereo pixel display	
inclusive VR	

Putty

Each of these representations is of the same thing, say a house. Different computational machines convert on to another. Our sense of participation, of experience, of accessibility, increases as the representation approaches a natural semantics. VR does not attempt to recreate natural reality. In crossing the boundary from external/objective/observational/abstract to internal/subjective/participatory/experiential, we abandon the external referent that was the sole purpose of a semantic theory. The model is sufficient to provide direct experience, it becomes the semantic object it represents. Similarity, when interacting with the physical world, we take the physical house to be the natural object it is.

This, by the way, is a general observation about environments and ecologies:

Semantics is context.

This statement is stronger that its situated cousin (semantics is contextual), context dependent (and context defining) representations are self-semantic.

Still we have a gradation of natural to binary representation inside representational space, inside information.

The base case is a participant inside an otherwise empty VR, experiencing the void. Other representations do not permit the experience of the base case; they are all void-unfriendly.

As we add apparent information, we use technological devices. Binary strings defined by software instructions generate images on the computer screen that we interpret, to some degree, as a representation of reality. Higher quality renderings are "more real". But all we are actually differentiating is differences in binary streams and hardware display capabilities. The essential fact is that once any experience is mediated by a digital or analog representation (ie is technologized), it is the same *putty* in the eyes of the machine. And the putty can simulate experience, dimensionality, reality.

Our Big Question is: why are we blind to the difference between actual and virtual?