# On Boundaries

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Abstract:

*"Do numbers exist" is a well-known question in philosophy. The following short reflection began as an attempt to answer this question and quickly devolved into a larger question about the existence of boundaries, both real and conceptual. The conclusion suggests a possible way to tie-in black hole event horizons to the Big Bang. The author is not a physicist and has no way to check the mathematical viability of the physics aspects of the suggested answers.*

"Do numbers exist" is a well-known question in philosophy. Numbers only exist if entities exit. "Two of rock" only makes sense if the universe fundamentally contains "rocks", or more broadly – "objects". Objects are separated from one another by the empty space between them, but all objects contain mostly empty space in between their constituting particles. A conceptual boundary line between two real objects therefore necessitates to quantitatively asses the amount of empty space within and between objects and then to draw a symbolic dividing line between them; two solid objects are, at some level, a single cloud of particles where some particles have clumped in one place and some particles in another. This is a mathematical problem most commonly known as support vector machine (SVM) unsupervised classification. An SVM draws a line (classifier) between the points of a data set, separating it into two or more sets of points. We have therefore made a full circle: an SVM requires numbers and quantification, e.g. of particle locations and distances, to work: "numbers require numbers for their existence".

The real question however, is whether or not classification actually works. Can "dumb" automata perform classification and unsupervised learning, leading to a result or consequences within the universe that can be said to tangibly exist? Unsupervised learning within the universe leads to the invention and creation of concepts and symbolic thinking, which leads to supervised learning and general intelligence. The unquestionable existence of intelligence in the universe means that unsupervised learning, which ought to have been the first step to general intelligence, exploits a real and tangible property and reality of the fabric of the universe. "I am, therefore thinking exists" proves the existence of the minimum requirements for the existence and evolution of intelligence - which is quantification, as required for the existence of conceptual boundaries or classifiers, which are needed for the creation of symbolic concepts though unsupervised learning.

"Do real physical boundaries exist" is a separate and equally interesting question. Black hole event horizons likely do exist, but the mathematics describing them has historically given people trouble - mathematics dislikes singularities and divisions by zero. This is an indication that boundaries, such as event horizons, don't actually exist. There is nothing on the other side of event horizons; event horizons are the edge of the universe and all of the universe is contained within its own boundaries. This is a truism: nothing which cannot be interacted with can be said to be part of the universe. If it doesn't interact then it doesn't exist.

The following neat vision, for lack of a better word, might describe what actually happens when an event horizon is created and grows to its steady-state radius. The conclusion and end result of the

description of this vision renders the beginning of its description below, both only half-correct and fully complete at the same time.

Matter doesn't actually fall into an event horizon after the event horizon is created. High gravity fields and the curvature of space-time they create mean enormous time dilation at the event horizon, to the point where time actually stops at the event horizon. No particle moves at the event horizon or could in any shape or form "cross" the event horizon from the perspective of a distant observer. An easy way to visualize this would be to say that the "speed of time" remains the same as for a distant observer, but the masses of particles within a high gravity field increase. Conservation of momentum then means that the velocity of a particle decreases, as the particle enters a gravity field. An infinite mass would result in zero velocity, as required by conservation of momentum. This also means that mass effects begin to dominate other forces; electron clouds could hypothetically be crushed by inertia alone between two colliding atoms which have seen their effective masses increase due to their location in a high gravity field. Another way to visualize this would be to imagine a curving 2D space with a time vector orthogonal to its surface denoting movement in time, e.g. with a magnitude "c". If this 2D space then becomes so curved that the local orthogonal time vector is turned 90 degrees to the side compared to the time vector of a distant observer, then the distant observer would perceive the "speed of time" of the curved space as zero. At the same time, the event horizon would look like it is traveling towards the observer at “c” (extreme blue shifted). If this is correct, then there is also the corollary for a spherical universe which is “moving in time at c”, that the equator of the multidimensional sphere would appear to be moving away from an observer at a pole at speed “c” while being frozen in time; this would be a byproduct of observation along curving space and not an actual movement/expansion.

It is tempting to postulate that event horizons don't therefore exist, and that no local space is ever fully orthogonal to the space of a distant observer - all matter is perpetually falling into but never reaching the event horizon. This postulate suffers from a flaw - the creation of an event horizon, within a neutron star, implies event horizon growth by engulfing matter already in close proximity to the initial point of creation of the event horizon. This matter cannot be lost to the universe as the event horizon grows in radius. This could mean that the event horizon pushes this matter outwards through some unknown mechanism, and keeps it exactly at the event horizon such that matter both doesn't fall into the event horizon and at the same time contributes to the overall mass which shapes the event horizon. A neater or complementary solution suggests itself: the universe is turned 90 degrees to its side at the event horizon. It's a 4D real-world Lorentz transformation, which converts the former temporal dimension into a spatial dimension or vector. All matter at all event horizons in the universe begins to exist simultaneously at "zero" time, because its temporal coordinates and vectors are converted into spatial coordinates and vectors, as the 4D local universe is turned orthogonal to itself. A former spatial coordinate and vector becomes the new temporal dimension which is somehow equal to zero. This then becomes the Big Bang; all event horizons "are" the Big Bang and all matter at them exists in and at the beginning of all ("zero") time, from the perspective of a distant observer. The temporal coordinates of all event horizons are all equal to zero, which makes then simultaneous and places them at the beginning of all time.

It might also be useful to pursue matter/energy-space duality - the idea that matter/energy can be converted into space and vice versa. Maybe all matter at the event horizons is converted into space, "to and at the Big Bang", and then space is somehow converted back into matter shortly thereafter.