A Conception Draft for Funding a Language+Culture Metaverse:

An Event Cruncher Stylus for True Digital Poiesis in Language and Culture Studies.

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Short Description

The present conception involves updating and elaborating the "<u>Grammar Cruncher</u>" Online Language Learning Application that has been developed as a collaboration between the UF Department of Languages, Literatures, and Cultures and UFIT and that is currently being used in UF's online Beginning German course sequence "Discover German." The Grammar Cruncher (GC)—the architecture of which (based on the *who?-what?-when?-where?-why?-and-how?* of things as described further below)—will be elaborated as an "Event Cruncher Stylus" (ECS) to be employed in and for the composition of a Language+Culture Metaverse.

Development of the following stages may occur sequentially or out of order pending specific funding possibilities:

Stage #1: Update of the existing Grammar Cruncher application: The GC is a drag and drop language learning tool with which students drag words as the "building blocks" of language from lists organized under the headings "Actions," "Actors," and "Modalities" and drop them into "positions" (the number and definitions of which have been set by the instructor) to *compose meaning* as applicable at the sentence-level (which for us means, simply but not exclusively, addressing the *who? what? when? where? how?* and *why?* of things). The dragging and dropping activity involves the tactual sense in the language learning process, hence it is a "digital *poiesis*" according to an encompassing understanding of "digital," i.e., the activity's functioning is shaped both by digital coding and by meaningful constructive actions of human fingers. The proposed updates to the GC will make the GC user interface more uniform and streamlined and incorporate large language models into the GC design to increase flexibility and usability, and to enable students to ascertain whether the language they are constructing is currently consistent with its global usage (see the verbal definition of "true" below).

Stage #2: The concept of meaning building based on the "crunching" of grammar that underlies the GC is elaborated as a cubic-octahedral virtual writing device called the Event Cruncher Stylus. The ECS will first be employed pedagogically in two new courses currently under

development: "Engineering the European Middle Ages" and "The History of Technology." At the event-crunching level of meaning-composition in these courses, students will manually operate the ECS to compose event simulations. In so doing they will continue to compose with "Actions," "Actors," and "Modalities" responding to the interrogatives *who? what? when? where? how?* and *why?* but using texts, sounds, and (moving) images assembled from online historical/cultural datasets (rather than words, as with the GC) as the "building blocks" of their digital compositions. The gathering of visual, audial, and textual data forming the building blocks for the composition of the C+L Metaverse by the ECS begins in this stage.

Stage #3: The ECS will be elaborated as a C+L Metaverse compositional device with which students will be able to work from *within* what they are composing. By this point if not sooner, ECS-based composition will also include the possibility of interacting with digital humans **as guides** (in a manner analogous to Dante's guidance by Virgil and Beatrice in the *Divine Comedy*). The design of the ECS involves "cubing" and "leveraging" the Greimas Square with the help of the initial three Platonic Solids (tetrahedron, cube, octahedron), as elaborated below.

At each of its stages, this project involves the efficient management of Actions, Actors, and Modalities and availing ourselves of the capacity of generative AI to compose meaning by providing answers to the basic questions posed parenthetically above (and here: *who? what? when? where? how?* and *why?*) with these answers being informed by and informing the range of senses from the visual to the audial to the haptic. The broader ongoing research question that presents itself alongside the more specific pedagogical and course development goals mentioned above is whether such *ongoing and balanced* multisensory attentiveness to all six of these questions might be a way, grounded in Languages and Humanities Studies, of being "true" in the verbal and transitive sense of this word: "to make level, square, balanced, or concentric: to bring or restore to a desired mechanical accuracy or form" (Merriam Webster).

Elaboration of Terms and Rationale

The substantival use of the verb "crunch" in "Grammar Cruncher" and "Event Cruncher" comes from the ongoing generation of narrative whether by an individual or a group as a *crunching* of continuity and discontinuity. Narrative is continuously *continuous* via plot lines, themes, etc. that enable one to keep track of where one is in an event sequence (i.e., story), including that of one's own life. Narrative is continuously *discontinuous* as an organization of mutable temporalities, localities, and causalities that are not yet determinatively or otherwise ultimately 'fixable' according to any currently available technological assessment measure. The famous double-slit experiment on the physics of light (see Young) including its later quantum variations, when put into simple language, teaches a lesson about narrative: like nature itself, narrative is simultaneously both continuous (for us like the *against*-axes of the Greimas Square or the vanishing point of linear perspective) and discontinuous (for us like the not-axes of the Greimas Square or the horizon line of linear perspective) and either one or the other depending on what we are looking for in it at any given moment (e.g. are we looking for an actor-a who?-or a temporal modality-a when?). To understand narrative as a stable whole thus involves the selfreflective activity to which we refer as "Event Crunching," i.e., "Grammar Crunching" transferred from the syntactic-narrative level of meaning construction via sentences to the cultural level of meaning construction via event simulations.

Event (or Grammar) Crunching brings together continuity and discontinuity via the ongoing and variable arrangement of the three basic constituent linguistic/humanist building blocks that we posit in this proposal as the "stuff" of linguistic and cultural events: 1) Actions (verbal constructions), 2) Actors (the subjects, objects, and possessors of actions), and 3) Adverbial modalities pertaining to the temporalities, localities, and causalities involved in actions. Our understanding of narrative or storytelling as something "stable" via such ongoing *crunching* of continuity and discontinuity (that proceeds by way of the objects of analysis qua building blocks of Languages and Humanities Studies) is analogous to something psychologists Radvansky and Zacks define in their recent book in cognitive, neural terms as the "Event Horizon Model" in this way:

The Event Horizon Model proposes that as people experience activities, they segment them into discrete events. Segmentation happens simultaneously on multiple timescales, chunking activity hierarchically into smaller subevents and larger superevents. At any timescale, the current event is actively maintained as a working memory representation, and at the same time a long-term memory representation is constructed that can provide a permanent basis for retrieval of information about the event long after it is over. (28)

The "Event Horizon" so described—the simultaneous continuities and discontinuities of which are manifest—is basically a narrative or *story*. In this proposal, the neural "chunking" of events to which Radvansky and Zacks refer which people undertake (without necessarily thinking about it) to maintain a coherence of experience corresponds to what for us is the self-reflective, *conscious* activity of "crunching" as a combinatorial exercise involving the mentioned building blocks of language and culture. "Stylus" (Merriam Webster: "an instrument for writing, marking, or incising: such as an instrument used by the ancients in writing on clay or waxed tablets; a hard-pointed pen-shaped instrument for marking on stencils used in a reproducing machine; a cutting tool used to produce an original record groove during disc recording; a pen-shaped pointing device used for entering data [such as positional information from a graphics tablet] into a computer) gives a name to the quadratic-octahedral virtual writing utensil in which the questions *who? what? when? where? how?* and *why?* are connected to big data models leading to possible answers to these questions that are rendered on screens with the help of generative AI in the form of composable and recordable event-simulations.

The term "digital" as used in this proposal refers both to the binary ciphers 0 and 1 (and hence to the binary number system—about which more below), but besides this and just as importantly to the word's biological sense of pertaining to the actions of human fingers (i.e., "digital" used in the senses of "tactile," "tactual," "haptic"; see Fulkerson 2013 and 2023). The Event Cruncher as device operates "digitally" in the double-sense of the device's organization as a binary and geometric progression (re. *geometric* see the citation of Leibniz below) and as a writing utensil "held" in (virtual) hands and operated with (virtual) fingers as simulations of the user's. By further implication, "digital" is meant to suggest *sensory* in a robust way that does not come to rest in the ("long distance") senses of vision and hearing as determinative or definitive of "finished" experience.

Poiesis, etymological relative of poetry, means quite simply to *make*. Digital *Poesis* involves bringing together making and experiencing in a way consistent with the Event Horizon Model of

Radvansky and Zacks which shows *experiencing* to be a cognitive *making* and vice versa. In the case of the Event Cruncher Stylus (to be described and visualized in greater detail below in its articulation with the updated Grammar Cruncher Application) such *making as experiencing* involves a crunching of events into stories that proceeds according to what Leibniz called the *"celebrated property of the geometric progression by twos* in whole numbers" characteristic of the binary number system," and also consistent with the way Nobel laureate Frank Wilczek understands the Platonic Solids as manifestly evident of "nature's deep design" (also see R. Johnson). The "narrative" produced via such "digital *poesis*" as a geometric progression consistent with properties of the binary number system and Platonic solids will thus be assumed to be anchored in physics and biology as well as in Languages and Humanities Studies (thus suggesting, from our Languages and Humanities Studies-based perspective, an interdisciplinary synthesis going in the direction of social, physical, and biological sciences and STEM disciplines that might remain an ongoing research direction).

The hexahedron (cube) as the Platonic solid at the heart of digital *poiesis* as process and built into the Event Cruncher Stylus as one of its two constituent components (along with the octahedron by which it is leveraged) is not only the most versatile of the five Platonic Solids in providing the greatest number of symmetrical correspondences to the others. Beyond this, it is the only one to incorporate "true" *horizontal* and *vertical* lines in the form of exclusively ninetydegree vertices (thus going beyond the tetrahedron in this regard). The cube resides in the human psyche as a basic structure that emerges expressively and creatively via the house or dwelling as "poetic image" (see Bachelard); it brings to the fore values attached to vertical vis-à-vis horizontal orientations in cultural arrangements generally (see Irigaray).

The "Studies in the Languages and Humanities" part of the title is meant generally to include both studies in university courses in (foreign) languages and Humanities (such as "Discover German" and "Engineering the European Middle Ages") as well as studies in the broader scholarly sense of research that extend all the way to the "cutting edge." Regarding the latter, the ECS points in the direction of a new and different kind of storytelling, based on the view of AI as the latest of epochal technological tools associated with historical-cultural paradigm shifts in the encoding and communication of information. Though it is happening comparatively in an electronic blink of the eye, AI's emergence is possibly as consequential as the development of the technology of writing in the first few millennia B.C.E.; see Ong). Such a view would be consistent with UF English Professor Gregory Ulmer's conception of "electracy" as a new teaching and research frontier for the Humanities: "What literacy is to the analytical mind, electracy is to the affective body." AI promises to be as consequential as the main technological shifts occurring during the era of literary writing, including the transition from scrolls to codices in the early centuries of the common era (during and very much involved in the formative stages of Christianity; see McNeely & Wolverton); the European transition from a scribal-based to a typographic culture with the invention of the printing press in the fifteenth century (giving rise to the possibility of mass education, at first driven by humanist ideals but shortly thereafter combined with different kinds of confessional indoctrination in the period following the Protestant Reformation; on the dynamics of the printing press see Füssel); to gramophone, film, and typewriter as technologies developed and refined in the nineteenth and twentieth centuries (see Kittler) which harnessed text, vision, sound, and touch in individualized ways that anticipate

the advent of the personal computer and the ever increasing digital "data-crunching" capacities of quantum computing and AI.

We understand these previous technological tools, as well as the discursive, linguistic, and humanistic cultural practices associated with and driven by them, as different ways of managing the temporalities, localities, and causalities of things in ways corresponding to the above-cited verbal definition of the word "true" (even if the adjectival "true" and nominal "truth" have tended to be given greater occidental importance than the verbal/adverbial ones). This project thus might afford the possibility of addressing the question of the "ethics" of AI from a unique perspective grounded in (University of Florida) Languages and Humanities Studies in the balanced multisensory way outlined above, by "aligning" as best we can this newest technological information management system in the *truest* possible way with earlier ones that did the same thing according to their own different limitations and possibilities. In emphasizing the importance of trying to do justice to all the questions—to the *who? what? when? where? how?* and *why?*—it seems appropriate here to speculate that such alignment might initially need to be as "thickly descriptive" as possible, consistent with the approach of anthologist Clifford Geertz, pending the findings of ongoing research.

With respect to the potential practical pedagogical value of this project, bountiful critical literature bolsters its central idea that digital poesis—as an experiential making of narrative qua simulative *storytelling*—would be an effective learning strategy in numerous different ways. Storytelling has been shown to capture learners' attention and engage them emotionally, making the learning experience more enjoyable and memorable, thus helping with information retention, and understanding (see Cioè-Peña, et.al.; E. Johnson, et.al.). Stories provide a meaningful context for learning by connecting concepts and information in a narrative format, which aids in comprehension, as learners can relate new knowledge to familiar or relatable experiences (see P. Johnson &. Golombek; Shi). Research shows that storytelling enhances memory and recall by creating mental images, associations, and narratives that help learners retain and retrieve information more effectively (see Alagöz & Köksal; Su & Jia). Stories evoke emotions, which can deepen the learning experience and lead to increased motivation, empathy, and personal connections with the subject matter (see Gallo & Zollo; Salimi & Farshadnia). Well-crafted stories often present challenges, conflicts, or dilemmas that require critical thinking and problemsolving skills, which learners use to analyze situations, consider different perspectives, and develop solutions within the story context (see Burke et. al.; Asli & Özdemir; Maxwell et. al.). Finally, storytelling can incorporate cultural or social aspects, thus enabling learners to explore different perspectives, values, and experiences (see Kennedy & Thompson; Kyei-Blankson, et.al.).

Project Overview

Stage 1: Update of the Existing Grammar Cruncher Language Learning Application



GRAMMAR CRUNCHER

Logo developed for the Grammar Cruncher Application, produced as a collaboration between the Department of Languages, Literatures, and Cultures (LLC) and CITT. For more information on the GC see: <u>https://languages.ufl.edu/people/faculty-alpha/will-hasty/german-grammar-cruncher/</u>

For sake of simplicity and consistency, the number of instructor-defined positions is here set to six corresponding to the affordances of the "cube" on which the development of the Event Cruncher Stylus in stages 2 and 3 of this project will be concentrated:



In the currently existing Grammar Cruncher Language Learning Application, the total number of possible positions and their definitions is set by the instructor. Above is a simple rendering of a sentence-to-be-built with six grammatical positions arbitrarily (for the sake of consistency) corresponding to the number of the faces of a cube. In the existing Grammar Cruncher Application, below the positions would be a list of vocabulary (i.e., as the above-referenced "building blocks" of language) divided into Actors (nouns), Actions (verbs), and different kinds of Modalities (temporal, spatial, and causal modifiers of different kinds). Right clicking on any word or phrase in that list provides an English definition (for words in any foreign language) and all different possible morphological forms (declinations for nouns and conjugations for verbs in the case of German, for example). Left clicking on words and holding, students drag the "building blocks" from below, drop them into the positions above, and then make whatever edits they need to make based on the grammatical information about the building block to which they have immediate access in order to produce sentences that are correct (i.e., "true") as possible. The concept behind the GC is to "crunch" grammar by delivering only the grammar that is relevant for construction of a particular sentence by a particular student when and where it is needed and useful as this constructing of meaning is ongoing.

In the current version of the Grammar Cruncher, the positions are located at the top of the screen and sentence building involves navigating between the top and the bottom of the main GC page (structured in its current form so that one loses sight of the one upon navigating to the other). Also, when students right-click for grammatical information, they are brought to another page for declinations, conjugations, etc. These three proposed updates to the Grammar Cruncher will streamline its functions by putting everything (positions, building blocks, and grammatical information) on the same main page, thus enabling the students to maintain a continuous overview of the entire information flow and sentence building process as they are engaged in it:

- 1. Students will not need to navigate between the positions above and the building blocks of language below as is the case in the current design. Positions and draggable and editable building blocks will be on the same page and continuously viewable and clickable.
- 2. The current need to right-click and move to a different page for grammar information on a particular building block with which a student is working will be replaced by tabs that automatically open up and contain grammatical information about a word as soon as the word begins to be dragged.
- 3. A new addition to the Grammar Cruncher in this proposed upgrade will be integration of a Large-Language-Model based way in the user interface for students to check whether the words they are constructing for a given position are consistent in meaning and usage with (i.e., *true* to) the way those words are used in a variety of other contexts.

<u>Stage 2: Design and Implementation of the Event Cruncher Stylus—Screen Based Event</u> <u>Simulation from the *Outside*</u>

The dynamics of linear perspective as these were developed during the European Renaissance period (see Edgerton) offer terms and perspectives that are useful for the description and illustration of the dynamics of the Event Cruncher Stylus structure and functions. It is commonly stated that linear perspective with its basic constituent elements of the horizon line and the vanishing point presents a compelling "illusion of three-dimensional depth on a flat two-dimensional surface." The fact is that linear perspective defines a real capacity to see things in a three-dimensional, volumetric way in terms of a (potential) "container." Connecting to our definitions of terms and rationale above, extension along a two-dimensional *continuous* plane (in the form of the "horizon line") is "crunched" together with a "vanishing point" that involves a *discontinuous* orientation of depth that serves (potentially) to contain (something viewable, hearable, touchable, etc.). We might refer to this illustration that borrows the fresco of Leonardo's famous fresco in Milan as "Tetrahedral Last Supper":



Think of the tetrahedron at center as a real "container" holding the parts of the Last Supper as something that is really happening within it (we are looking through its transparent fourth face into its interior; the tetrahedron is tilted forward towards us, and dotted lines indicate depth extension into the background). The tetrahedron thus seems to show itself as a simple and efficient way nature has of making a container out of continuity and discontinuity. It possesses

four faces (as it must do, if not a sphere, to be symmetrically volumetric) and it affords (when tilted forward towards the viewer *just so*) a horizon line and a vanishing point (somewhere in that landscape visible in the center window behind Christ). But it does not possess the affordance of a true and maximally efficient vertical intersecting with a true and maximally efficient horizontal, so living in a tetrahedron would be like living under a sloped roof in the attic.

A true vertical and horizontal working together is first given by the hexahedron, as we see here in this "Cubic Last Supper":



The volumetric cube with its true horizontal and true vertical orientations in its relationship to, and by contrast with, the tetrahedron's capacities seems analogous to the binary numbers 10 and the binary number 01 in being the first two consequential numeric-geometric nominals. These orientations forming part of the cube's greater geometric complexity and amplitude than the tetrahedron quite visibly allow for a greater amount of the Last Supper (imagined) as real event to be "contained" as one can see by comparing the above two illustrations (such greater containing of the event leading to the interesting question whether it would, as such, be *truer* to the event or simply more of it). Here too the cube is tilted just so towards us so that we see through the transparent sixth side closest to us into the more distant background encompassed by the cube's other five sides.

The vanishing point in this tilted "Cubic Last Supper" is achieved by postulating that the cube through which we are looking is itself enclosed by a larger octahedron (as we the observers could also potentially be), one of the sides of which (outlined in red) extends into even remoter distance on the other side of Christ. That *we* could be (virtually) contained by the event within such a larger octahedral structure (correspondingly to be rendered as VR) is something to which we turn in part three of this project.

One of the numerous affordances of the cube as an efficient (if not the most efficient) volumetric container of meaning—stepping now outside of the event content of the Last Supper and considering the potential of this Platonic solid more abstractly—is that it lends itself via its inclusion of a true horizontal and a true vertical to being fleshed out as a volumetric elaboration of the "Semiotic Square" developed by Algirdas Greimas:

Greimas Semiotic Square



If the Semiotic Square arrives at the meaning of S_1 via a semantic network of contrary and contradictory relations to S_2 that involves the doubling of an initial doubling (*not*- S_1 [i.e., S_2] and *against*- S_1 are doubled in *not*- S_2 [i.e., S_1] and *against*- S_2), then both such a "Square" (seemingly on its way to greater complexity and more doublings) on the one hand and the cube considered abstractly as digital device for the containment of meaning on the other hand would seem to invite being fleshed out together volumetrically. The virtual cube as component of the Event Cruncher Stylus proposes to serve this purpose.

The ways in which *against or contrary* positions vis-à-vis *not or contradictory* positions of the GCS cube faces could be defined leaves room for variation and experimentation, *as long as the terms used are appropriately reflective of against vis-à-vis not dymanics in ways that could be deemed to be "true.*" We propose beginning development of the GCS using these definitions of the faces of the cube within it that correspond to the *who?-what?-when?-where?-how?-* and *why?-* questions we set out to address and that are also consistent with Kant's epistemological critiques of the temporal, spatial, and causal apriori limits of knowledge¹:

¹ Our model of "crunching" and Radvansky's and Zack's model of neural "chunking" would share the commonality of adopting this Kantian epistemological framework as "baked in"; see Radvansky & Zacks discussion of Kant, 3)



As indicated, a portal is to be included in the ECS-build for the purpose of importing language constructed in the Grammar Cruncher to the event level at which one works with the ECS.

Mention was made above in the discussion of the tetrahedral and cubic versions of Leonardo's "Last Supper" that the polygons are tilted towards the viewer *just so*. In the discussion of the cubic version, reference was made to the cube itself being enclosed by a larger octahedron. Stepping again outside the Last Supper as event and abstracting dynamics, here is that overall event structure from an outside perspective:



The Event Cruncher Stylus external view

Much could be said of the octahedron's binary and geometric characteristics vis-à-vis those of the tetrahedron and cube (and their respective numbers of faces, vertices, and edges as different ways of "crunching" continuity and discontinuity); continuing interdisciplinary consideration of these would form part of this project as an ongoing research endeavor.

In the meantime, theory is put into practice (see Hasty) by virtually implementing such a cube enclosed by such an octahedron as our Event Cruncher Stylus. It is assumed that the octahedral outer structure of the ECS includes the capacity to leverage the cube within (of which it can be regarded as an elaboration) into different perspectives corresponding to and consistent with but adding additional complexity and differentiation to the six faces of the cube. For example—now with the content of the course "Engineering the European Middle Ages" in mind and based on the work of cultural historian Georges Duby on *Feudal Society Imagined*:



Work on event simulation using the ECS would involve the designations on the octagonal faces being "buttons", the pushing of which would import pertinent data consisting of texts, images,

and video material into the event simulation on which students are working on a course project or researchers are working on an interdisciplinary Languages and Humanities project. In stage 2 of the project, the functions of ECS would be articulated with a control panel (that could be used for purposes of aligning text as event blueprint, spoken texts as monologue or dialogue within the event-simulation, images, videos, objects imported from databases, etc.) including a "run" button to "crunch" the data assembled by students or researchers into an event simulation as digital poesis that plays out on the "stage" of the device screen:



Computer Monitor

Sketch of Device Screen while working with GCS

Using a cursor, students would drag the ECS to perspectives such as those shown on the previous page, press buttons to add specific data corresponding to *who? what? when? where? how?* and *why?* and then press the "run" button in the control panel when they are ready to crunch their event simulation to the stage.

On the previous page above, the cubic/octagonal ECS is depicted as standing in a vertical position (even if we are viewing it from front-above-left from cube center) in a way that brings about a *true* horizonal and vertical positioning of the cube. As part of the ongoing endeavor to use the ECS for digital *poiesis* compositions in a way that is (at least) adverbially *true*, the ECS would ideally be constructed in such a way that it would stand in such a vertical orientation only if data were imported into the event-simulation in response to all of the above questions (via front, back, left, right, top, and bottom) so as to enable a balance. Lacking such balance, the ECS would *ideally* (i.e., corresponding to the adverbial "ethics" to which we have been alluding via *true*) lean, tip over, or wobble. Ideally, it will be possible to build such an equilibrium functionality into the ECS.

<u>Stage 3: Design and Implementation of the Cruncher Stylus—VR-Based Event Simulation from</u> <u>the Inside</u>



View from the outside looking in.



View corresponding to center inside of cube looking out front, back, left, right, top, and bottom sides.

In the above discussion of the "Cubic Last Supper," it was suggested that we might imagine ourselves as the viewers of this event and our witnessing/participatory activity itself being enclosed in/by a broader octagonal structure. This perspective is realized in the third year of project development as immersive VR experiences made by students/researchers from within the events they are crunching. By this time, it is assumed that ongoing project development along the lines outlined in the above pages and HiPerGator computing capacity will enable digital humans (possibly simulations of historical figures) to be integrated and play a guiding role in the event simulations being crunched.

Finally, being (able to be) positioned within the event (as well as outside of it) and recognizing that the one position is connected to the other position "self-reflectively" will provide another manner of testing the degree to which a given event-simulation is *true*. Within an "unbalanced" and thus correspondingly "wobbly" event simulation, our sensitivity to the degree to which the event simulation is being created and is occurring in a manner that is true will be haptic as well as visual. Ideally, such functionality could be built into the ECS as ongoing project so that by the time it becomes possible to "get in" to a given simulation, students/researchers will already have an idea based on the outside view how stable the experience is likely to be.

The Sustainable Online Network for Global-Cultural Studies Initiative as possible Research Forum



https://songs.clas.ufl.edu/

The Sustainable Online Network for Global-Cultural Studies (SONGS) Initiative, which has existed since 2018, provides a platform for the interdisciplinary study of issues pertaining to "global-cultural sustainability." Focal points of past events and symposia have been climate change and its effects, and issues pertaining to immigration.

This coming fall 2023, the SONGS Initiative will also begin hosting events pertaining to the role Artificial Intelligence could play in global-cultural sustainability.

The SONGS Initiative provides a platform, consistent with the ideas driving research and development of the ECS, for online conferences, colloquia, and events pertaining to the numerous broader research questions that have been referenced in the above proposal.

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