Computer Models of the Evolution of Premodern Religious, Philosophical, and Cosmological Systems

Steve Farmer, John B. Henderson, Michael Witzel, and Peter Robinson[1]

Introduction

This paper provides a short sketch of computer models of the evolution of premodern religious, philosophical, and cosmological systems. For details on the empirical grounds of the models, readers are directed to a companion piece on neurobiological and literate forces underlying the growth of these systems.[2] This paper is accompanied by three appendices: **Appendix A** contains charts that illustrate the systematic effects of a number of standard commentarial techniques (also included in our companion article); **Appendices B** and **C** provide a formal algorithm and flow chart for the simulation described below.

Over the past half decade, we have designed a number of simulations based on these ideas, combining findings from comparative textual research with what is known of the evolution of complex systems in general. Studies of complex systems have made major strides in the last decade, providing a variety of modeling ideas that can be directly adapted for historical use; enough is known of the linear and nonlinear behaviors of complex systems to ensure that a wide range of alternative methods should be useful in creating such simulations.[3] Below, we provide a brief overview of the design of one simulation that closely matches the structure of the cross-cultural model that has emerged from our textual studies.

Nonlinear models of correlative systems

We first realized that simulations of this sort might be possible in the late 1980s, when we found that correlative or mirroring systems of the general type we were investigating in religious and philosophical traditions were being intensely studied in various scientific fields. Depending on their levels of symmetry, correlative or mirroring systems are known to

[1] Contact information: Steve Farmer, Ph.D., Palo Alto, California, **saf@safarmer.com**; John B. Henderson, East Asian Studies, Dept. of History, Louisiana State University, **jbhende@lsu.edu**; Michael Witzel, Dept. of Sanskrit and Indian Studies, Harvard University; **witzel@fas.harvard.edu**; Peter Robinson, NASA-Ames Research Center; **robinson@ptolemy.arc.nasa.gov**. Thanks to Ralph Abraham and Rich Levinson for helpful discussions of our work.

[2] Steve Farmer, John Henderson, and Michael Witzel, "Neurobiology, Layered Texts, and Correlative Cosmologies: A Cross-Cultural Framework for Premodern History," *Bulletin of the Museum of Far Eastern Antiquities* 72 (2000 [2002]): 48-90. A PDF copy can be downloaded from **http://www.safarmer.com/neuro-correlative.pdf**.

[3] See our preliminary discussion in the paper referenced in the previous note. A partial list of alternative methods useful for our modeling purposes include diffusion limited aggregation (DLA) models, cellular automata, neural network models, spin-glass models, genetic algorithms, and nonlinear dissipative models like those described in this paper. Many popular overviews exist by now of modeling techniques useful in studying complex systems; see, e.g., Yaneer Bar-Yam, *The Dynamics of Complex Systems* (Reading, Mass., 1997) and Garnett P. Williams, *Chaos Theory Tamed* (Washington, D.C., 1997). One recent technical paper that we are finding useful in our continuing work is J.B. Rundle, K.F. Tiampo, W. Klein, and J.S. Sá Martins, "Self-Organization in Leaky Threshold Systems: The Influence of Near-Mean Field Dynamics and its Implications for Earthquakes, Neurobiology, and Forecasting," *Proceedings of the National Academy of Sciences USA* 19 (Suppl 1) (Feb. 2002): 2514-21.

mathematicians as "self-similar" or "self-affine" structures, or more generally as "fractals." Extreme correlative systems in premodern thought, of the type described in our companion article, are good examples of fractal systems in the history realm.

As Mandelbrot and others showed in the 1970s and 80s, evolving complex systems tend to develop fractal structures when they are repeatedly transformed by stereotypical operations — e.g., by simple feedback (or "iterative") mechanisms in which the output of each prior transformation becomes the input of each new one.[4] What we found interesting in this finding were the similarities between the dynamics of systems like these and evolutionary patterns found in layered textual traditions. Our textual studies suggested that emergent self-similarities (or correlative structures) in premodern cosmologies were byproducts of the repeated application to heavily layered traditions of relatively small sets of exegetical techniques. The combination of our findings with general studies of complex systems suggested the feasibility of designing computer simulations of these emergent structures in the historical sphere — adapting ideas involving feedback systems widely used to model the growth of similarly structured systems in the biological and physical sciences.[5]

In systems of this type, equations in the general form $\boldsymbol{x}(n+1) = f(\boldsymbol{x}(n))$, which can be both linear or nonlinear in form, can be used to represent the evolution over time of a system defined by a set of variables linked to a state vector $\boldsymbol{x}$. In the design of the simple simulation described below, each element of the state vector identifies textual byproducts, or what are termed "exegetical artifacts" in our model, as they emerge in successive layers of textual traditions.

The easiest simulations of this type to develop, and the first expected to have significant research applications (especially as philological dating tools), are of purely numeric varieties — aimed, e.g., at studying how changing rates of textual flows affect levels of structural complexity in manuscript traditions. But it is also possible to construct more complex simulations, involving symbolic and not numeric operations, to picture the global evolution of correlative systems.

Consider the following sketch of a simulation of a symbolic (verbal) type; the simulation's design is admittedly crude, but it contains all the major features of more complex models of the same type. The simulation can be designed to run in either autonomous or interactive modes; in the latter case, a human assistant who assumes the role of "Apprentice Commentator" intervenes at key choice points in the simulation. Using a human assistant enhances the simulation's value as a heuristic tool and greatly simplifies computational operations. (In the classroom, we have even used simplified versions of this simulation using nothing more than paper, pencils, and few specially prepared "canonical texts.") Ideas for

[4] Benoit Mandelbrot, *The Fractal Geometry of Nature*. Updated and Augmented Edition (New York, 1983). Cf. H.-O. Peitgen and P.H. Richter, *The Beauty of Fractals: Images of Complex Dynamical Systems* (Berlin and New York, 1986), p. 5. It is noteworthy that Mandelbrot himself was fascinated by the fractal or correlative structures that he found in premodern cosmologies, although he did not recognize the iterative dynamics involved in their growth; for discussion, see S.A. Farmer, *Syncretism in the West: Pico's 900 Theses (1486): The Evolution of Traditional Religious and Philosophical Systems* (Tempe, Arizona, 1998), pp. 94-5, n. 91.

[5] One of us (Robinson) has also extensively developed the use of feedback systems in other contexts; see, e.g., Peter Robinson, "Automatic Grid Generation with Heuristic Feedback Control," NASA/TM-2001-2109831, NASA-Ames Research Center (November, 2001).

certain parts of the simulation (e.g., the "contradiction detectors" introduced in **Step 3**) have been borrowed from computer models designed to handle complex scheduling tasks in autonomous control systems used in the U.S. space program.[6]

A high-level description of the simulation follows (see **Appendices B** and **C** for a formal description of the simulation algorithm and a flow diagram). Each operational step in the simulation produces a set of textual products represented as an element of state vector (*x*):

1. Select **primitive sets of texts** representing ancient textual genres — short prayers, snippets of ritual or magical texts, court poems, epic or lyric poetry, dynastic histories, oracles, etc. **"Tag" sentences** dealing with certain types of statements (concerning divine forces, human virtues, ritual objects, etc.) as potential objects of exegesis. $\boldsymbol{x_1, x_2}$

2. Recombine subsets of these texts to create **stratified textual canons**. These canons will typically include numerous textual inconsistencies; for example, the tagged statement "god X is Y" may appear in one place in the canon, while "god X is not Y" or "god X is Z," etc., may appear elsewhere. $\boldsymbol{x_3}$

3. Apply contradiction detectors, or alternately use a human assistant, to **identify** and **prioritize** lists of **exegetical tasks** for each simulated textual canon. $\boldsymbol{x_4, x_5}$

4. Select a subset of **exegetical strategie**s out of a larger predefined set using best-fit rules for canons and/or types of exegetical tasks (a human assistant can also be asked to make the selection). If desired, different sets of strategies can also be randomly selected to generate competing subtraditions. $\mathbf{x_6}$

   (Reconciliative strategies are of the general type illustrated in **Appendix A**, the majority of which have correlative structural features; exegetical strategies of different sorts can be added to model anti-syncretic forces in traditions, which tend to develop in sync with extreme reconciliative tendencies.)

5. Apply these exegetical strategies to a limited set of the exegetical tasks identified in the canon. The application of these strategies to those tasks generates **exegetical artifacts**, which commonly amplify correlative properties in the texts. $\mathbf{x_7}$

6. **Collect exegetical artifacts** in commentarial systems, whose general forms are defined by simple templates. $\mathbf{x_8}$

7. Combine textual canons and commentarial systems to **create stratified traditions** (systematic compilations of canons and derivative texts). $\mathbf{x_9}$

8. Apply **textual degradation rules** to selected levels of tradition (shuffle or discard parts of texts, etc.) to mimic entropic or dissipative processes in textual traditions; different degradation rules can be assigned to canons and commentarial systems. $\mathbf{x_{10}}$

9. **Iterate starting at step 3**. Input can be added before each new loop from other "tagged" primitive texts or mature traditions evolving in parallel — turning the system from a "closed" into an "open' syncretic system. Run the simulation until all

[6] See, e.g., the papers in *Technical Report FIA-92-17*, NASA Ames Research Center, Artificial Intelligence Research Branch (May, 1992).

inconsistencies in the traditions, or in any partitioned sets of those traditions, are eliminated.

While "toy" simulations like this are extremely simple, they are capable of creating correlative structures of the same types generated by repeated exegetical processes in stratified textual traditions. These byproducts tend to grow in complexity with each iteration of the simulation; simultaneously, their self-similarities and internal consistencies tend to increase. The fact that (1) the general quality of texts is degraded after each iteration (**Step 8**) while (2) correlative structure is fed into those traditions on each loop (as a result of the repeated application of the exegetical applied in **Step 5**) guarantees that the system as a whole will evolve in self-similar ways in a progressive fashion.[7] (This progressive development holds so long as the system remains closed to new textual input; to model more realistic historical conditions, primitive texts can be reinjected into the system on each iteration in **Step 9**, attenuating this development.) It is, in fact, possible to observe levels of self-similarity growing in each layer of tradition, roughly mimicking the ways in which such structures developed historically in commentarial and scholastic traditions.

When "best-fit" rules are used to link exegetical strategies to exegetical tasks (**Step 4**), the first systematic byproducts that emerge in such simulations are abstract objects — primitive dualities, monotheistic deities, abstract cosmological principles, primitive sets of elements and virtues, and so on — set in simple cosmological frameworks. (Depending on which exegetical methods are applied, and what texts they operate on, abstract pantheons of gods may also emerge.) The evolution of primitive structures of this type is followed by the growth of more complex systems, as later exegetical artifacts "fill out" those simple frameworks. After many iterations, expanded syncretic-correlative systems (analogous to those seen in Neo-Confucianism, Neo-Platonism, or Hindu or Buddhist scholastic traditions, etc.) emerge from the repeated integration of earlier layers of texts; whether those systems are laid out in hierarchical or temporal frameworks (in both linear or cyclical varieties) depends on which exegetical strategies are driving the system. No matter how these strategies were selected in early levels of tradition, that selection will be reinforced by positive feedback in later iterations, generating "path dependencies" in traditions of the same type seen in other evolving complex systems.[8]

The speed with which systematic artifacts arise out of the textual flux is associated with the rate with which inconsistencies are eliminated from the textual canons; this rate can in turn be linked to the degrees of initial contradiction in the texts (determined in **Step 3**), which vary with the genre and "temporal depth" of different canons. Rates of information flows in the system are further associated with the number of exegetical acts performed in each iteration in **Step 5**, and with the rates of information loss (or dissipative processes) that take place in each loop in **Step 8**. Adjustments to these "tuning parameters" can be introduced to simulate special historical conditions — developments in communications technologies, rises and falls in literacy

---

[7] The interplay between losses and gains of information is central to the development of emergent self-similarities in nonlinear dissipative systems in general. For discussion, see the references in note 2 and our brief discussion in "Neurobiology, Layered Texts, and Correlative Cosmologies."

[8] For technical references on the concept of historical path dependencies, which have been most extensively studied in economic systems, see "Neurobiology, Layered Texts, and Correlative Cosmologies," note 7.

rates, the introduction of high-fidelity mnemonics, shifts in levels of travel and cultural contact, textual losses and revivals, political expansions and contractions, institutional constraints on information flows, and so on — that in an historical sense deeply impacted developments in premodern traditions. (Obvious analogies include the ways in which innovations in communication technologies have transformed modern traditions.)

So long as the textual traditions being simulated contain significant levels of internal contradictions, linguistic output in the simulations (in the form of simple verbal statements) eventually develop the kinds of distinctive proportionalities typical cross-culturally of scholastic systems.[9] It is possible to add functions to the simulation to allow the abstraction of numerological features out of those systems as self-similarities grow or to translate correlative verbal structures into charts or graphic forms. Political, social, religious, scientific, and/or economic selection rules can be added to the textual degradation rules in **Step 8** to simulate historical conditions that favor the survival of one type of correlative system over another.

More complex versions of the simulation should allow the modeling not only of the growth of correlative systems but of their collapse as well. When the structural complexity of certain types of systems approaches critical thresholds, their sensitivity to slight perturbations increases, resulting in states in which even minor events can trigger their collapse. This is the phenomenon known in one class of models as self-organized criticality, or SOC.[10] These thresholds are related to the relative ease with which information flows through distant parts of the system, which can be correlated in turn with the system's relative levels of self-similarity. At such thresholds, individual elements in the system become sensitive not only to influences from nearby elements but to those in distant regions of the system; a classical example in physics involves long-range spin alignments in ferromagnetic systems just below Curie's point.

The rates of growth of complex systems of this type are controlled by tuning parameters that can be pictured as representing different types of energy pumped into those systems. The nature of this "energy" depends on what kind of system is being modeled; it might be food in biology, labor and raw materials in economics, or information flows in layered historical models like ours. When those rates increase, those flows can push the complexity of these systems to critical thresholds, causing them to decompose in dramatic fashions.

The classical example in SOC involves the collapse of a sandhill, which has been studied both empirically and in computer simulations. As sand is piled higher in the hill, the slope of the hill eventually reaches a critical level; after a critical threshold is passed, any additional sand added to the pile will cause avalanches of increasingly large magnitude that will eventually push the slope back below the critical level. To put this another way: as the complexity of the sandhill

---

[9] For some extreme examples, see *Syncretism in the West*, p. 67 and *passim*.

[10] For details, see P. Bak, C. Tang, and K. Wiesenfield, "Self-Organized Criticality," *Physical Review A* 38 (1988): 364-74; P. Bak and K. Chen, "Self-Organized Criticality," *Scientific American* 246 (1) (1991): 46-53; P. Bak, "Self-Organized Criticality: A Holistic View of Nature," in George A. Cowan, David Pines, and David Meltzer, eds., *Complexity: Metaphors, Models, and Reality* (Reading, Massachusetts, 1994), pp. 477-496. A number of alternate methods have recently been proposed to model threshold events of this sort; see, e.g., the paper by Rundle et al. referenced in note 2.

approaches critical levels, correlative links between distant regions of the hill increase until the system becomes vulnerable to collapse in response even to small perturbations.

Analogies exist here again to the historical behavior of correlative systems, which became increasingly vulnerable to attack the more complex and self-similar those systems became.[11] As Galileo discovered at his personal cost, correlative cosmologies by late-traditional times were so cohesive that criticism of any one part of the system was interpreted as a threat to the whole: As King James I supposedly put it to the Puritans, "No Bishop, no King." In computer simulations of correlative systems, rates of information flows can be adjusted to ensure that those systems eventually reach states of self-organized criticality. Simulated scientific, philological, or religious attacks on those systems can be pictured as occurring whenever the "conceptual distance" between those systems and earlier levels of tradition, or between those systems and models of empirical reality, reach critical levels.[12] At that point, special rules can be applied (e.g., in **Step 8**) to allow those systems to decompose in a realistic fashion.

It is amusing to imagine simulations in which best-fit rules at critical points cause "flips" in exegetical methods (in **Step 4**) from syncretic to anti-syncretic modes — simulating increased skeptical tendencies that emerged in sync with extreme syncretic tendencies in all premodern periods of textual expansion.[13]

Heuristic uses of the model

The simulations discussed above focus on global patterns in the evolution of correlative systems; other types of models based on the same principles can be designed to explore the micro-behavior of traditions in specific periods — e.g., during the textual explosions of the fourth century BCE in Eurasia, discussed in our companion article, or in later eras in which scholastic systems evolved at accelerated rates.

In the last decade, we have tested the historical model underlying these designs against a broad range of data in Old and New World traditions. We have also considered ways in which simulations based on that model might be designed to help date heavily layered texts of uncertain origins. Besides using more formal stylometric tools, textual scholars often sort out different levels of stratified texts "intuitively," assigning relative dates to different textual layers according to the levels of concreteness, abstractness, or complexity that they find in the concepts embedded in those layers. Intuitive methods of this sort can be formalized with the help of computer simulations, even allowing guesses about absolute dates when structural developments and rates of information flows in those simulations are compared with similar developments in traditions for which reliable chronological records are available. In general, from a better understanding of how variations in textual flows flows affect structural growths in traditions, studied "experimentally" in such simulations, it should be possible to fill in holes in the records of one tradition by extrapolating from data available in others. We anticipate in particular future uses of

[11] Cf. *Syncretism in the West*, pp. 133 ff.

[12] Measures of this nature might be drawn from quantitative estimates of "cognitive dissonance," developed in the mid 1950s, or from recent network models of similar phenomena.

[13] "Neurobiology, Layered Texts, and Correlative Cosmologies," pp. 69-70; *Syncretism in the West*, chapt. 4.

simulations of this type in helping date chronologically uncertain or textually depleted areas of premodern history, like those frequently encountered by specialists on ancient Indian or Mesoamerican traditions.

In closing, we would like to emphasize that simulations of the type discussed above are intended as nothing more than auxiliary tools in historical research. Their object is to assist in cross-cultural studies of premodern history, not to replace traditional textual research. Those simulations nevertheless potentially have powerful heuristic uses, providing further confirmation of views advanced over a quarter of a century ago by the mathematical biologist Robert May — that very simple models driven by feedback processes can be used to simulate the evolution of very complex systems.[14] Whatever the limitations of our initial designs, we are confident that models of their general class will have a long future in premodern textual research.

[14] Robert May, "Simple Mathematical Models with Very Complicated Dynamics," *Nature* 261 (1976): 459-67. For discussion of a wide range of models of this class, see Stuart A. Kauffman, *The Origins of Order: Self-Organization and Selection in Evolution* (New York and Oxford, 1993).

Appendix: A Few Systematic Effects of Exegetical Strategies

The following is a short list, intended to be illustrative and not exhaustive, of a few exegetical strategies that had major systematic effects. The majority of these strategies had a reconciliative purpose: to harmonize traditions, to unveil the hidden unity in canonical sources, to reconcile new traditions with old ones, or to co-opt the ideas of warring traditions or subtraditions. Which strategies were preferred in different traditions — and hence which types of cosmologies tended to evolve within those traditions — depended in part on (1) the ease with which those methods solved given exegetical tasks and (2) the frequency with which those methods showed up in earlier layers of tradition. The inbreeding of traditions over long periods resulted in the cross-cultural growth of multilayered correlative systems that by late traditional times exhibited high levels of structural complexity, formal consistency, and self-similarity. Partially counterbalancing these developments were anti-scholastic (or classicist) movements that tended to grow in strength the further traditions drifted from the sense of their base texts; the seesaw battle of syncretic and anti-syncretic forces was a major theme in the history of thought until the final collapse of high-correlative systems in early modern times.

EXEGETICAL STRATEGY	DESCRIPTION	TYPICAL BYPRODUCTS
Correlation of gods from different polytheistic traditions.	Gods of different traditions are ordered in abstract series, or viewed as bodily parts of superior deities, for reconciliative ends.	Generation of early pantheons of gods in ancient Egypt, Mesoamerica, India, Greece, etc. Similar tendencies in Chinese "folk" religion.
Fusion of different gods or concepts of god in one or more tradition.	Conflicting concepts of gods are fused to create transcendental deities.	Initial appearance of proto-monotheistic or monotheistic traditions.
Transcendent fusion of conflicting moral or intellectual concepts in one or more tradition.	Conflicting uses of terms are integrated to create abstract universal concepts.	'Heaven,' *dharma*, *Logos*, the 'One,' Platonic theory of ideas, etc. Abstract dualistic frameworks are created for later cosmological developments.
Paradoxical fusions of divine beings or cosmic principles.	Conflicting references to divine beings or cosmic principles are identified in paradoxical ways to demonstrate the unity of a body of texts.	Simultaneously transcendent and immanent gods; paradoxical Confucian-Daoist 'Way'; Buddhist, Christian, and Hindu trinities; dualistic deities in Tibetan or Mesoamerican traditions, etc.
Assignment of divine beings, sages, or inferior creatures from various traditions to hierarchical or emanational series.	Key concepts in different traditions are harmonized by assigning those concepts to different levels of reality.	Grades of Confucian sages and worthies; Buddhist and Hindu avatars and saints, etc.; gnostic aeons and Neo-Platonic henads; orders of demons and angels, etc.
Syncretic fusion of multiple or conflicting stories concerning ancient sages, philosophers, and tradition founders in an evolving canon.	Multiple stories of sages, philosophers, and tradition founders are harmonized by transforming those figures into semi-divine or divine beings.	Eventual transformation of Confucius, Laozi, Socrates, Plato, Buddha, Jesus, etc., into semi-divine or cosmic beings.
Systematic correlations of conflicting references to single deities.	Conflicting references to a deity are identified as inferior manifestations of that deity.	Abstract schemas of the names and powers of god in Islamic and Christian scholasticism; the kabbalistic *sefirot*, etc.

Exegetical Strategy	**Description**	**Typical Byproducts**
Allegorical methods applied in hierarchical frameworks.	Abstract philosophical or religious ideas read out of (or into) non-philosophical works.	Intensified hierarchical visions of reality. Transformation of poetic and other non-philosophical works into cosmological treatises (Homer, *Spring and Autumn Annals*, etc.)
Allegorical methods applied in a temporal framework (typology).	Concepts or persons in earlier traditions are pictured as imperfect anticipations of concepts or persons in later ones.	Growth of analogical views of time in progressive (linear) frameworks.
Compilational or allegorical strategies applied in cyclical temporal frameworks.	Conflicting stories, concepts, divine beings, or temporal events in canonical texts are reconciled by assigning them to different eras in a cyclical temporal framework.	Multiple creations and destructions of the world in Greek or Mesoamerican traditions; concept of avatars and multiple Buddhas, etc.; reconciliative use of the "five phases" (*wuxing*) in Chinese historical writings.
Compilational strategies in hierarchical frameworks.	Conflicting stories, concepts, or cosmological schemes are joined in a hierarchical manner.	Multileveled visions of heaven and hell in Christian, Buddhist, Hindu, and Mesoamerican traditions; complex faculty psychologies; etc.
Syncretic syllogisms.	Disjoined snippets of texts are conjoined to unveil their hidden unities. Heavy use in Vedic, Neo-Confucian, Midrashic, and similar commentarial traditions.	Increased reverence towards holy books; intensified word magic, bibliomancy, etc.
Standard scholastic distinction.	Apparent conflicts in authorities are reconciled by adding appropriate verbal modifiers to the concepts of those authorities.	Reality becomes increasingly complex, correlative, and (normally) hierarchical.
'Double-truth' models.	Religious or philosophical authorities are reconciled by distinguishing complementary realms of truth.	Bifurcations of reality in the three-treatise school of Buddhism; similar developments in Neo-Confucian, Vedantic, Averroistic, and Latin scholastic traditions.
Mystical letter/glyph interpretations and/or anagrammatic manipulations of sacred canons.	Mystical letter/glyph interpretations and anagrammatic readings introduced to demonstrate the hidden unity of canonical texts.	Glyphomancy in China, anagrammatic manipulations of texts in India, the Middle East, and the West. Intensified linguistic realism, fusion of mysticism and calligraphy, etc.
Higher-level fusions of systems of correspondences.	Presyncretized (correlative) concepts found in earlier texts are conjoined in increasingly abstract forms.	Abstract numerologies of the type found in Shao Yong or Joachim of Fiore. Extreme syncretic-correlative systems with amplified magical properties in medieval and early modern times.

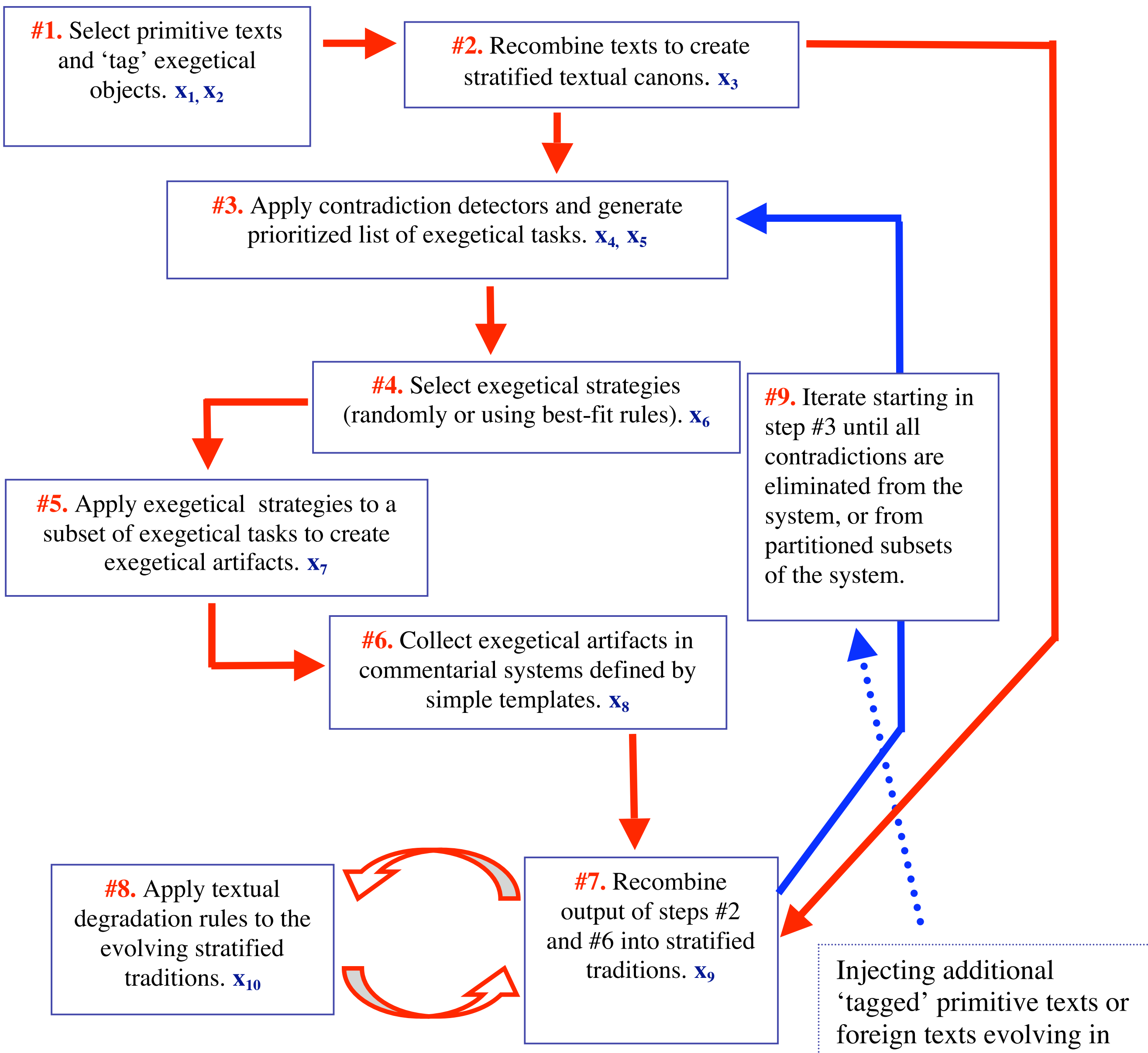
For detailed discussion of individual strategies, see Farmer, *Syncretism in the West*, and Henderson, *Scripture, Canon, and Commentary*: *A Comparison of Confucian and Western Exegesis* (Princeton, 1991). For discussion of exegetical methods opposing these strategies, see Henderson, *The Construction of Orthodoxy and Heresy: Neo-Confucian, Islamic, Jewish, and Early Christian Patterns* (Albany, 1998).

Appendix B: Algorithm/program information flow

The following is a brief formal description of the algorithm used in the simulation described above. Program operators appear in italics; data transformed by those operators appear in plain text.

```
Algorithm exegesis-process (prepared_sources)
        primitive_texts = select_subset_from (prepared_sources)
        tagged_primitive_texts = tag_concepts (primitive_texts)
        stratified_textual_canons = randomly sort and recombine_subsets_ (tagged_primitive_texts)
        loop until no contraditions
                contradictions = detect_contradictions (stratified_textual_canons)
                exegetical_tasks = prioritize_contradictions (contradictions)
                exegetical_strategies = select_exegetical_strategies (exegetical_tasks)
                exegetical_artifacts = apply (exegetical_strategies, exegetical_tasks)
                commentarial_systems = match_templates_to_artifacts (exegetical_artifacts)
                tradition = combine (commentarial_system, textual_canons)
                dtraditions/dt = apply_degradation_rules (tradition)
                tradition = dtraditions/dt + tradition
        end loop
end algorithm
```

Appendix C: Simulation Flow Chart



Rates of information flow in each step and rates of dissipation defined in step #8 serve as tuning parameters that regulate the system’s linear and nonlinear behaviors. So long as the system remains in the linear domain, the complexity and correlative (or ‘self-similar’) structure of layered textual traditions increase with each iteration.