Personal Computer Application Programs as Tools for Conceptualizing Aspects of Evolutionary Theory

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Introduction

- Why topic is of interest to a physicist
  - "Scientific literacy" often cited as critical for modern society
    - Presupposes accessibility of basic concepts in each discipline to "educated public"
  - "Intelligent non-specialist" should then be able evaluate and critique elements of "basic knowledge"
    - Should be possible at level of high school biology rather than purview of specialists

Challenges in Conceptualizing Evolutionary Theory

- Evolutionary theory includes concepts that are fairly straightforward to formulate
  - Example: “Natural selection”
    - Advantage of bright plumage may exist in attracting mates
    - Could explain why males having it tend to dominate particular population of birds.

Challenges in Conceptualizing Evolutionary Theory (continued)

- Other features are more difficult to conceptualize
  - Example: “Fossil record”
    - Typically shows organisms with long periods of stasis (S. J. Gould, “The Structure of Evolutionary Theory”)
    - Followed by apparent discontinuous change in morphology (“punctuated equilibrium”)

Heuristic Analogy as Offering Solution

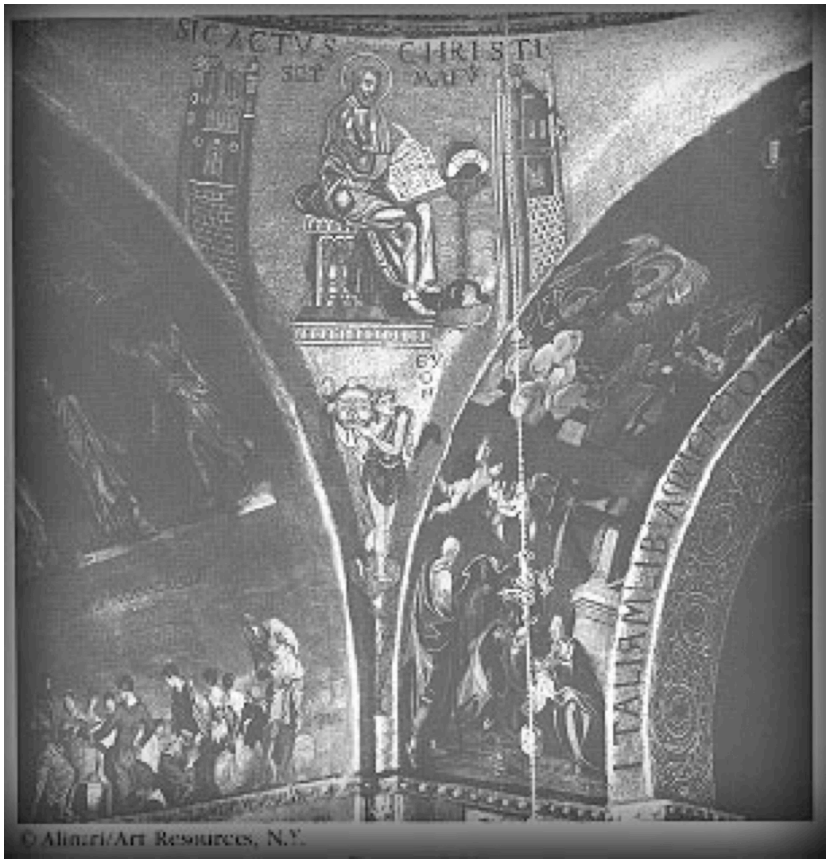
- Definition of “heuristic”
  - Etymology: German *heuristisch,* from New Latin *heuristicus,* from Greek *heuriskein* to discover; akin to Old Irish fo-*fúair* he found (Date: 1821)
    - Involving or serving as an aid to learning, discovery, or problem-solving by experimental and especially trial-and-error methods <*heuristic* techniques> <a *heuristic* assumption> ; *also* **:** of or relating to exploratory problem-solving techniques that utilize self-educating techniques (as the evaluation of feedback) to improve performance (Merriam-Webster Dictionary)

Heuristic Analogy as Offering Solution (continued)

– Approach follows Gould's famous use of "spandrels" in architecture to illustrate "preadaption" for artwork (S. J. Gould, S. J. and R. C. Lewontin, "The Spandrels of San Marco and the Panglossian Paradigm: A Critique Of The Adaptationist Programme")

The Spandrels of San Marco and the Panglossian Paradigm

- “The design [of the great central dome of St. Mark's Cathedral in Venice] is so elaborate, harmonious, and purposeful that we are tempted to view it as the starting point of any analysis, as the cause in some sense of the surrounding architecture. But this would invert the proper path of analysis. The system begins with an architectural constraint: the necessary four spandrels and their tapering triangular form. They provide a space in which the mosaicists worked; they set the quadripartite symmetry of the dome above.”

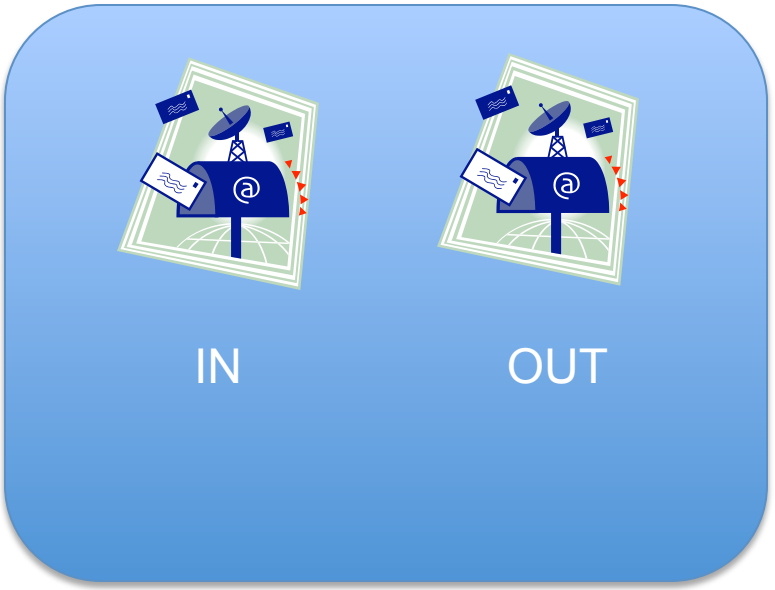


Heuristic model based on common personal computer applications program

- Electronic mail (“e-mail”) program illustrative of system able to “adapt”

Exhibits “stasis” for long periods of time under “constant” environment of novice user

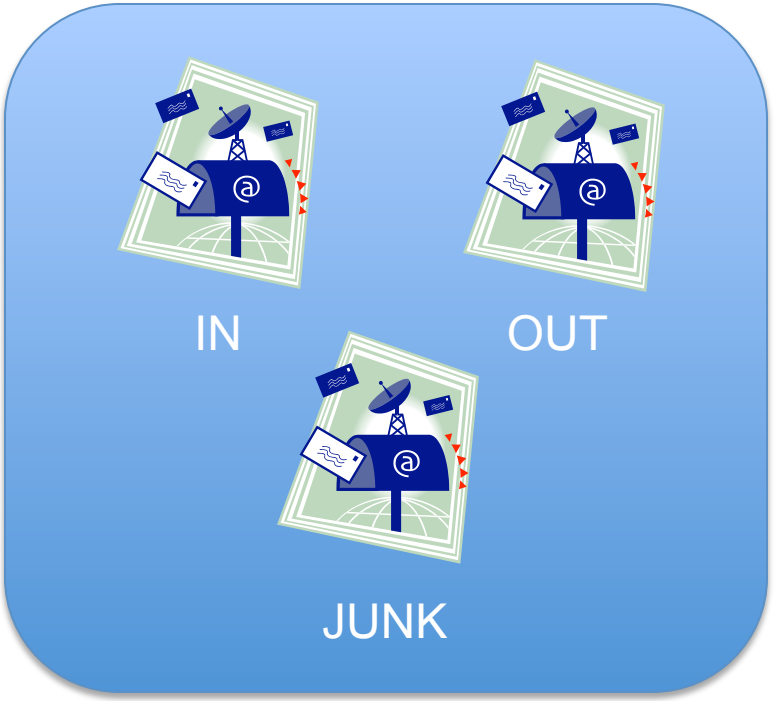
- Novice being someone who simply reads and responds to messages sequentially as they are received
- “Organism” instruction set:
  - Put incoming mail into “IN” box
  - Put outgoing mail into “OUT” box
  - Duplicate “IN” and “OUT” boxes (“organism”) after pre-specified number of clock pulses (“reproduction”)
  - Delete “IN” and “OUT” boxes after duplication (“death”)



Exhibits “instantaneous” changes when environment changes

- User with more experience might delete some e-mails without even looking at them
- E-mail program suddenly “creates” junk e-mail folder in response to this “environmental change”

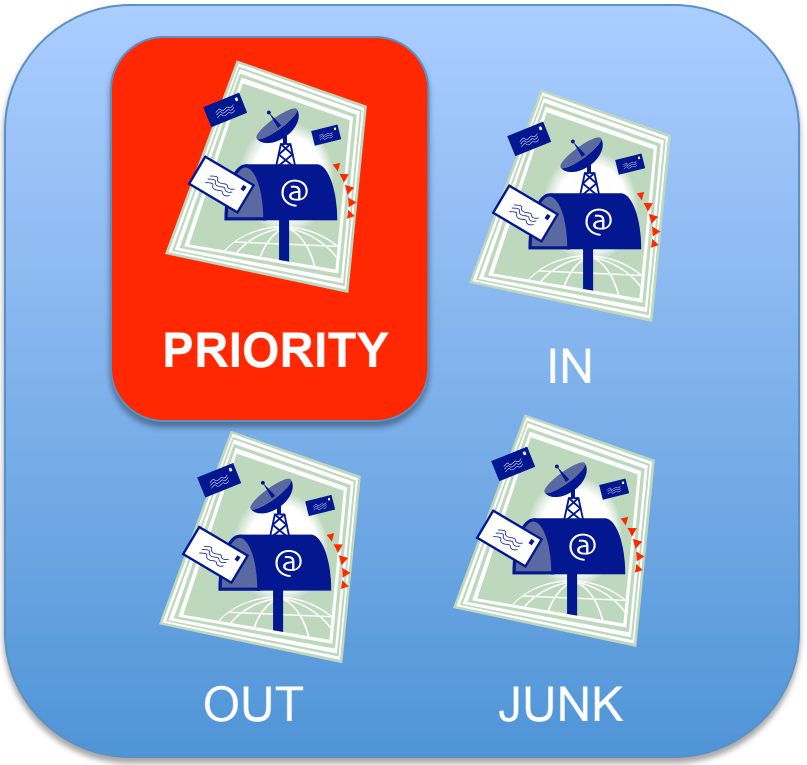
- “Organism” instruction set:
  - Put incoming mail into “IN” box
  - Put outgoing mail into “OUT” box
  - Put junk mail into “JUNK” box
  - Duplicate “IN”, “OUT”, and “JUNK” boxes (“organism”) after pre-specified number of clock pulses (“reproduction”)
  - Delete “IN”, “OUT”, and “JUNK” boxes after duplication (“death”)



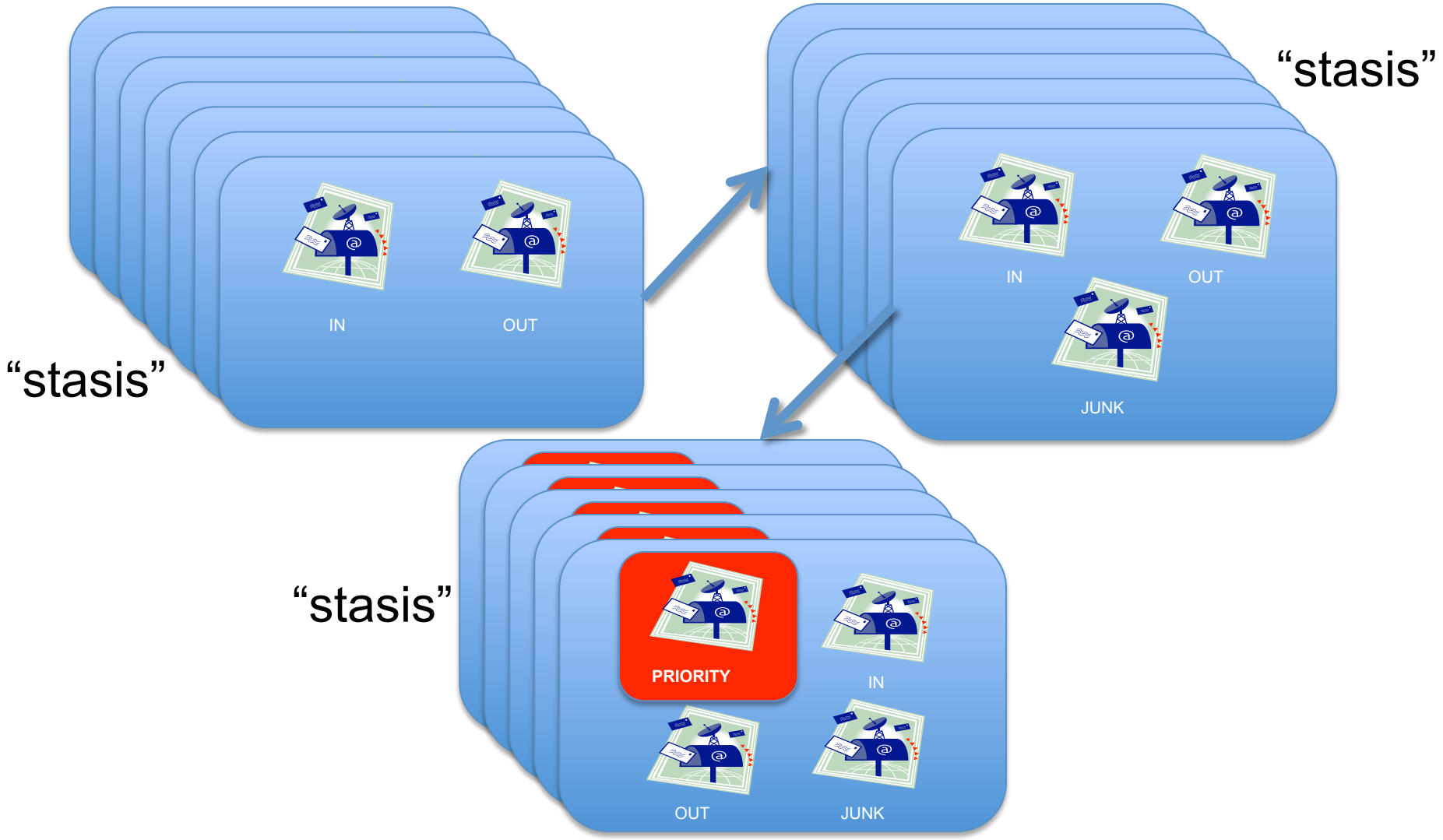
New (more complex) configuration in stasis until another environmental "stimulus" occurs

- User reads messages from **particular sender (like spouse)** before all others
- E-mail program suddenly "creates" priority e-mail folder in response to this "environmental change"

- "Organism" instruction set:
  - **Put incoming mail from spouse into "PRIORITY" box**
  - Put incoming mail into "IN" box
  - Put outgoing mail into "OUT" box
  - Put junk mail into "JUNK" box
  - Duplicate "PRIORITY", "IN", "OUT", and "JUNK" boxes ("organism") after pre-specified number of clock pulses ("reproduction")
  - Delete "PRIORITY", "IN", "OUT", and "JUNK" boxes after duplication ("death")



Changes occur within one “generation”



Example conceptualizes evolutionary principle of “punctuated” equilibrium

- Illustrates development of complex from simple
- Does not require “ad hoc” idea of “preadaptation” that allows changes to occur

Conserved core processes represented in “organism instruction set”

- “The processes that generate the anatomy, physiology, and behavior of the organism in the course of its development and comprise the organism’s phenotype… some of these processes have been unchanged for hundreds of millions or even billions of years.” (M. W. Kirschner and J. C. Gerhart, “The Plausibility of Life”)

Selector genes represented by "expression" of mailbox-creating code

- "Genes [e. g. Hox genes]… that are expressed in the compartments of an animal's body plan… The selector proteins of each compartment activate or repress a suite of target genes for conserved core processes selected to occur or not occur in each compartment." (M. W. Kirschner and J. C. Gerhart, "The Plausibility of Life")

Description of fundamental concept in popular literature

- “The primary fuel for the evolution of anatomy turns out not to be gene changes but changes in the regulation of genes that control development.” (Sean Carroll, University of Wisconsin at Madison, quoted in “Modern Darwins,” National Geographic, February 2009)

Broader implications of e-mail model

- Original simplicity refers to “phenotype” of initial e-mail structure
- Complex computer code needed to enable changes (“adaptations”) to occur
  - Illustrates “hidden” complexity at “genotype” (“code”) level
    - » Program looks for “keywords” that appear repetitively in messages that are deleted without being read
    - » Program uses “keywords” to designate messages as “junk” as soon as they are received
    - » Program creates mailbox that “spontaneously” appears for “junk” messages

Programming in nature?

- “French paleontologist Anne Dambricourt Malassé, for example, has argued that generative transmutation (she calls it “dynamic ontogenetic determinism”) gave rise to *Homo sapiens* and that it was programmed to occur cross-species at a given time. Needless to say, programming points to a programmer and therefore design.” (Dembski and Wells, “The Design of Life”)

Impetus for broader thinking and discussion about science and faith

- Science: Mechanisms that might allow such complexity to arise
  - Models to assess probabilities
- Faith: Reasons why some mechanisms are chosen over others
  - Assumption that God does not exist trumps low probability of any “non-theistic” explanation