

# *Creative Evolutionary Systems* *-- Machine Writing*

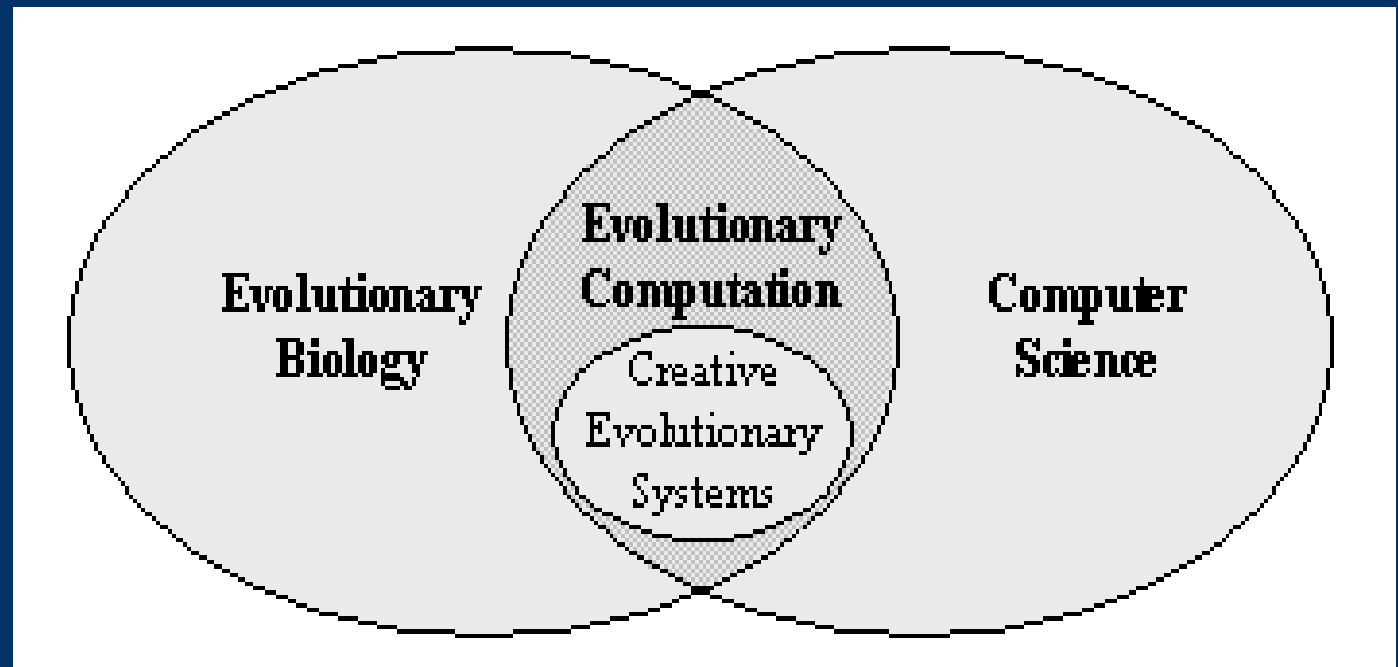
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# *Evolutionary Computation*

*Evolutionary  
computation sits  
at the intersection  
of evolutionary  
biology and computer  
science*



# *Creative Evolutionary Systems*

- A creative evolutionary system is a computer system that makes use of some aspect of evolutionary computation and is designed to
  - Aid our own creative processes, and/or
  - Generate results to problems that traditionally required creative people to find solutions.
- Creative evolutionary systems distinguish themselves by finding highly innovative and novel solutions.

(Bently, Corne, 2002)

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# *Evolutionary Computation*

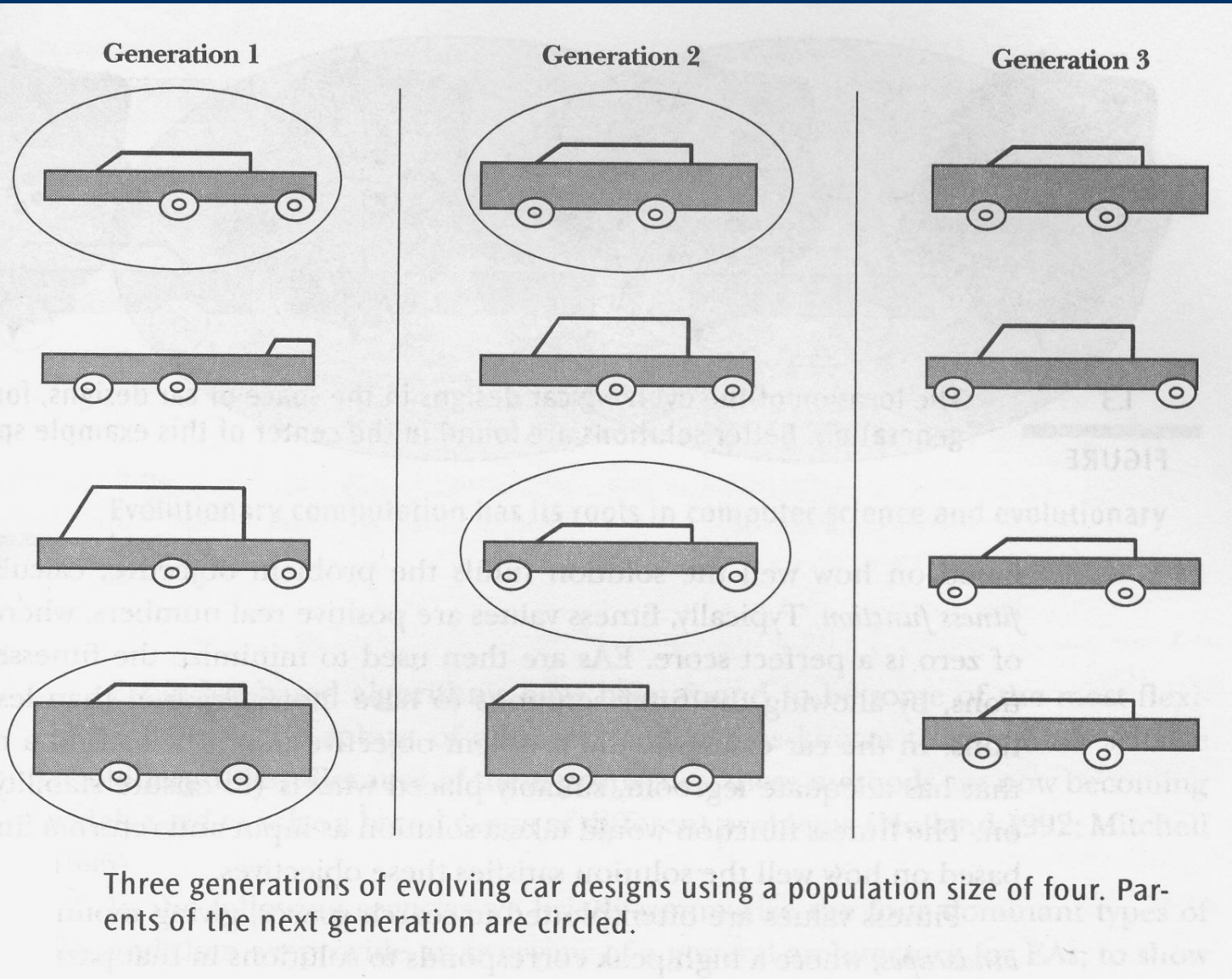
- Evolutionary Computation -
    - is a search strategy loosely based on natural/biological evolution.
    - can search vast spaces under strong constraints.
    - has been successfully applied in areas usually reserved for human creativity:
      - art & music – aesthetic constraints
      - (industrial) design - functionality constraints
      - engineering - physical constraints
      - Science, drug discovery – structure constraints
  - It is interesting to observe that very little work has been done in the realm of literature...
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# *How does Evolutionary Computation work?*

- 1) Determine initial (random) population
- 2) Select a set of individuals to be parents
- 3) Perform crossover and mutation
- 4) Compute the new generation of individuals, new population
- 5) Does one of the individuals satisfy the problem constraints?
  - Yes – DONE!
  - No – go back to step 2.



# Evolving a Car Design



**Possible Constraints:**  
*Air Resistance*  
*Wheelbase*  
*Center of Gravity*  
*Cabin Size*

# *Types of Evolutionary Computation*

- Genetic Algorithms
  - Large populations of individuals that evolve under crossover and mutation (Holland, 1975) .
- Evolution Strategies
  - Also called (1+1)-ES, because only a single parent produces a single child at each generation through mutation (Rechenberg, 1973).
- Collaborative Evolutionary Computation
  - Evolutionary computation that actively involves the user, either GA or ES.



# *Types of Evolutionary Systems*

- Goal-oriented Evolution
  - Attempt to find a solution to a problem under given (static) constraints
- Open-ended Evolution
  - A system is “situated”, in the sense that it adapts to continuously changing constraints
  - There is no solution, but only the best possible adaptation to the current set of constraints





# *Why is Evolutionary Computation on Text so Difficult?*

- Other domains have highly stylized constraint rules:
    - Harmony theory in music
    - Visual composition rules in 2&3 D art
    - Physics/Mathematics in (industrial) design
    - Electrical and mechanical foundations for engineering
    - Structural chemistry in drug discovery
  - Text or Narrative does not possess these rules:
    - Almost an infinity of different symbol combinations to form words, sentences, paragraphs, pages, etc.
    - Abstract semantics rooted in context and common sense – difficult to codify
    - Extremely loose composition rules – some syntactic rules, almost no semantic rules – almost all rules can be bent for effect and tension.
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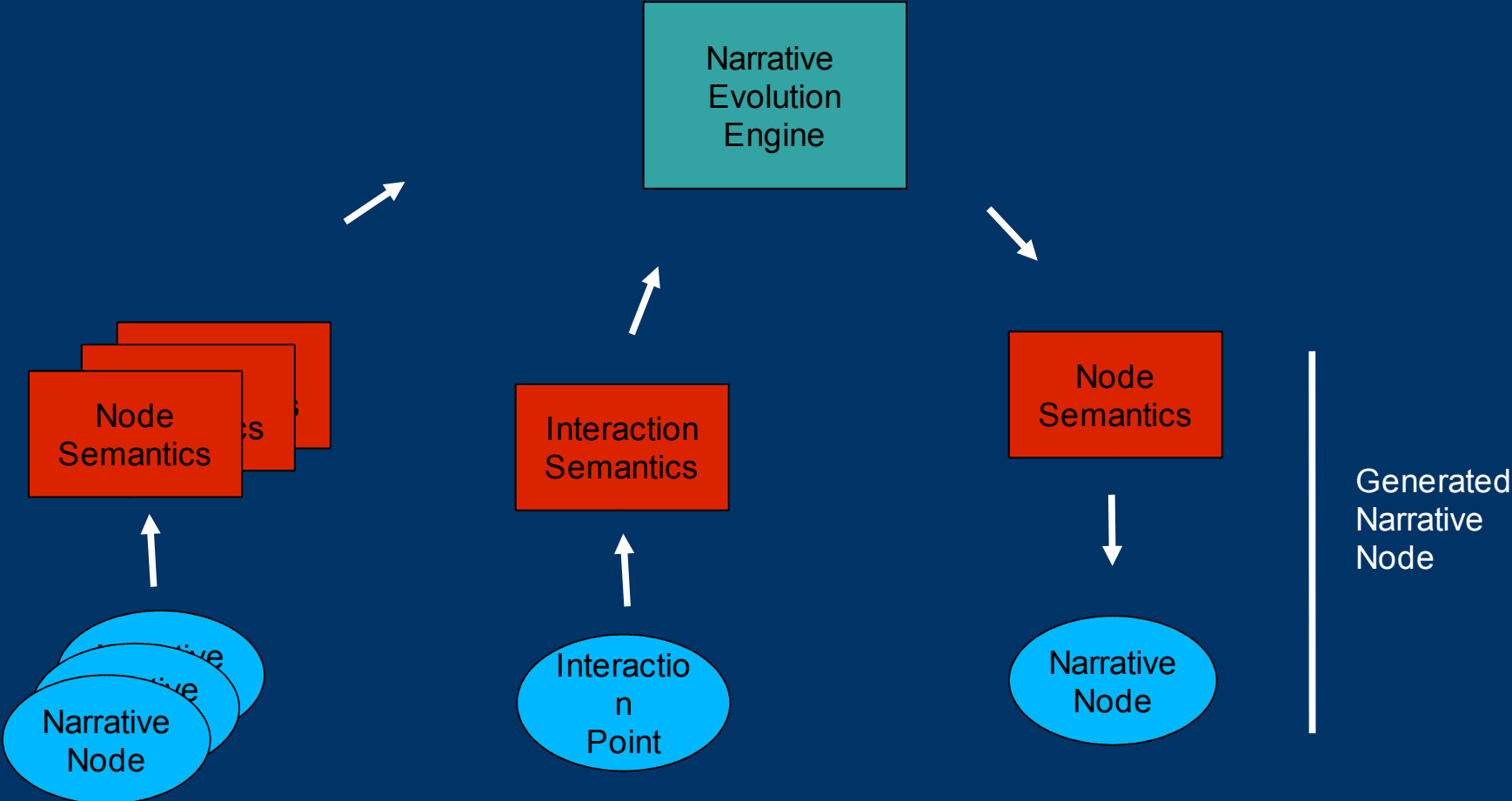
# *Creative Evolutionary Systems - Machine Writing*

- Considerations:
    - Extracting semantics from given text/narrative
    - Allowing user interaction with the evolving text
    - Specifying, representing, and enforcing narrative composition rules for text evolution
  - Solution:
    - Mark-up language
      - Semantics
      - Interaction
      - Composition
  - System Design:
    - Open-ended, collaborative (1+1)-ES system drawing from a database of narrative nodes for the narrative evolution.
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# *Principles of the Mark-up Language*

- Identify individual narrative nodes
  - Map narrative nodes into the semantic domain
  - Identify user interaction points
  - Map interaction points into the semantic domain
  - Evolution is accomplished in the semantic domain and then projected back into the syntactic domain
  - Composition is done in the syntactic domain
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# Machine Writing



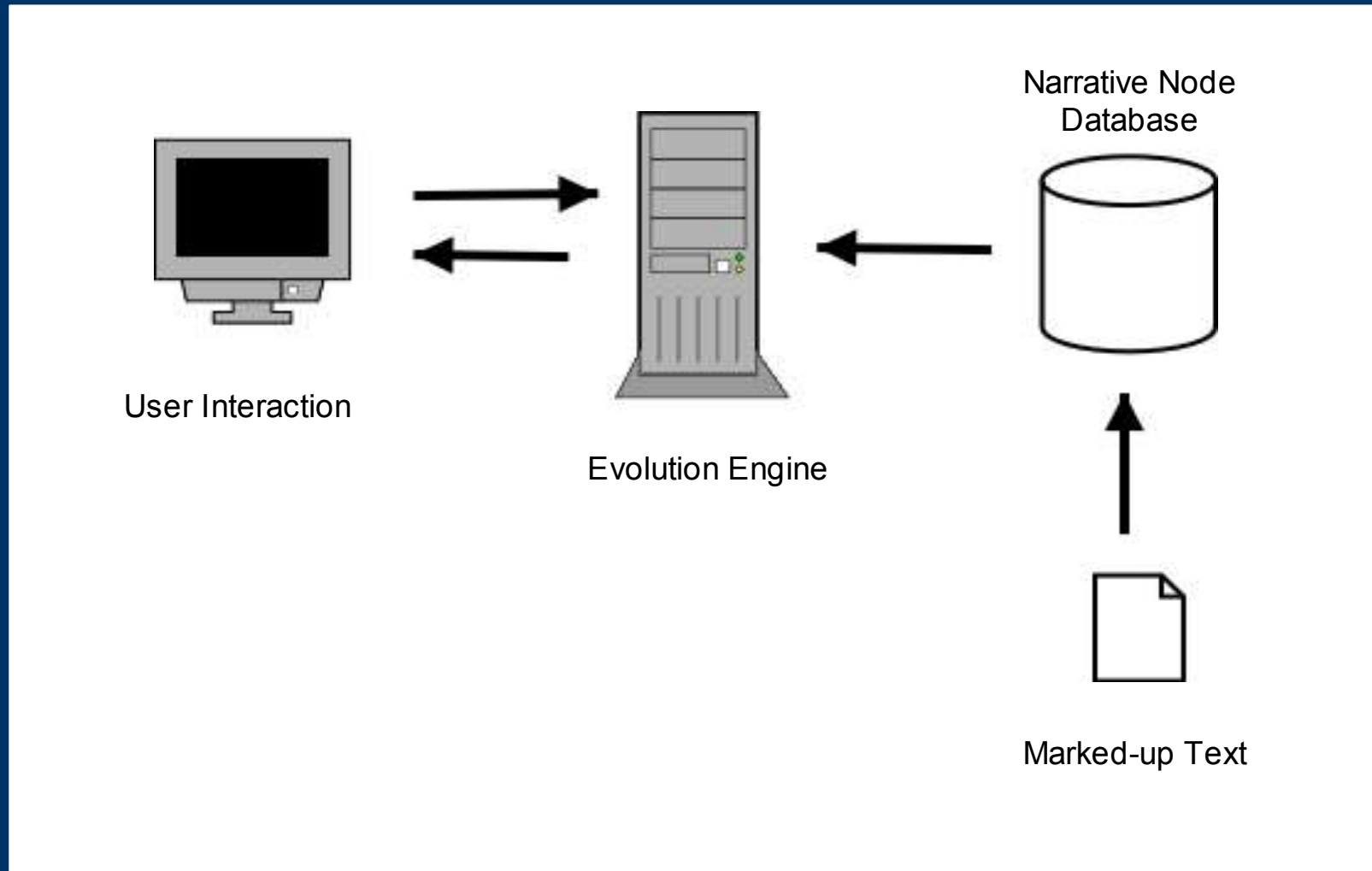
# The Mark-up Language

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{\node \meta="incorrigible, wake, refrain, halt, June, begin"  
  {\sen Will she {\lnk \meta="vanish" disappear}? }  
  {\sen I said to you, "be careful. Today is a strange day, and  
    that was the end of it."}  
  {\sen I had written impassioned letters that expressed the urgency  
    of my situation.}  
  {\sen I wrote to you that it would be a violation of our exchange,  
    in fact, a {\lnk criminal} negligence if I were to fail to come  
    through.}  
  {\sen To hand to you the consecrated sum of your gifts, the secret  
    you imparted persistently and without knowledge, these  
    expressions of your will that lured, and, in a cumulative  
    fashion, became a message.}  
}  
  
{\node \meta= "disappear, criminal, incorrigible, wake"  
  {\sen {\lnk \meta="refrain" A street}, a house, a room.}  
}
```

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# System Architecture



# Research Directions

- Semantics
    - Right now we only consider keywords as our semantics
    - Are there other more expressive means for semantics?
    - Will more expressive semantics allow us a more context sensitive selection of new narrative nodes during evolution?
  - Composition
    - We currently do composition by purely syntactic means - “randomly select a narrative node close to the user interaction point and replace it with a new narrative node during evolution”
    - Not very satisfying – should incorporate some additional semantic and syntactic compositional rules
  - “Foreign Text” Acquisition
    - Have the engine acquire text – web spidering, etc.
    - Issues to consider: automatic markup, semantic mapping
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# References

- Rechenberg, I., 1973. *Evolutionstrategie: Optimierung Technischer Systeme nach Prinzipien der Biologischen Evolution*. Stuttgart: Fromman-Holzboog Verlag.
- Holland, J. H., 1975, *Adaptation in Natural and Artificial Systems*. The University of Michigan Press, Ann Arbor.
- Bentley, P., Corne, D., (Eds.), 2002, *Creative Evolutionary Systems*, Morgan Kaufman.