Computational Creativity: Progress and Prospects

Amílcar Cardoso

ICAART 2010

Valencia, Spain

cognitive & media systems

CISUC
Centre for Informatics and Systems of the University of Coimbra

UNIVERSIDADE DE COIMBRA

Why Computational Creativity?

Why Computational Creativity?

- Global economy:
  - Need for quick adaptation to user/society/market
  - Differentiate... Innovate
  - Foster creativity:
    - at the individual level
    - at the corporate level
    - at the societal level

Why Computational Creativity?

Why Computational Creativity?

- Promotion of creative abilities:
  - long-standing and strategic endeavour in organisations
  - one of the primary motivations for the scientific study of creativity
  - potential for considerable impact on business and educational contexts

Why Computational Creativity?

- Promotion of creative abilities:
  - long-standing and strategic endeavour in organisations
  - one of the primary motivations for the scientific study of creativity
  - potential for considerable impact on business and educational contexts
- Role of computational environments:
  - provide knowledge in context
  - provide collaboration and sharing channels
  - share experiences
  - intervene actively and pro-actively in the creation process

Is it viable?

Is it viable?

- Can programs exhibiting forms of creativity be of any value?
- Is it plausible to build programs that we could classify as creative?
- ... or programs that might (at least) promote human creativity?

Creativity

"Creativity is a puzzle, a paradox, some say a mystery. Artists and scientists rarely know how their original ideas came about. They mention intuition, but cannot say how it works. Most psychologists cannot tell us much about it, either. What's more, many people assume that there will never be a scientific theory of creativity - for how could science possibly explain fundamental novelties?"

Margaret Boden, *The Creative Mind*, 1990

Views of Creativity

Views of Creativity

- Inspirational
  - Creativity is mysterious, superhuman
  - Plato: divine origin
  - After twenty centuries, this view keeps being commonly accepted...

Views of Creativity

- Inspirational
  - Creativity is mysterious, superhuman
  - Plato: divine origin
  - After twenty centuries, this view keeps being commonly accepted…
- Romantic
  - Innate talent: *intuition*, or *insight*.

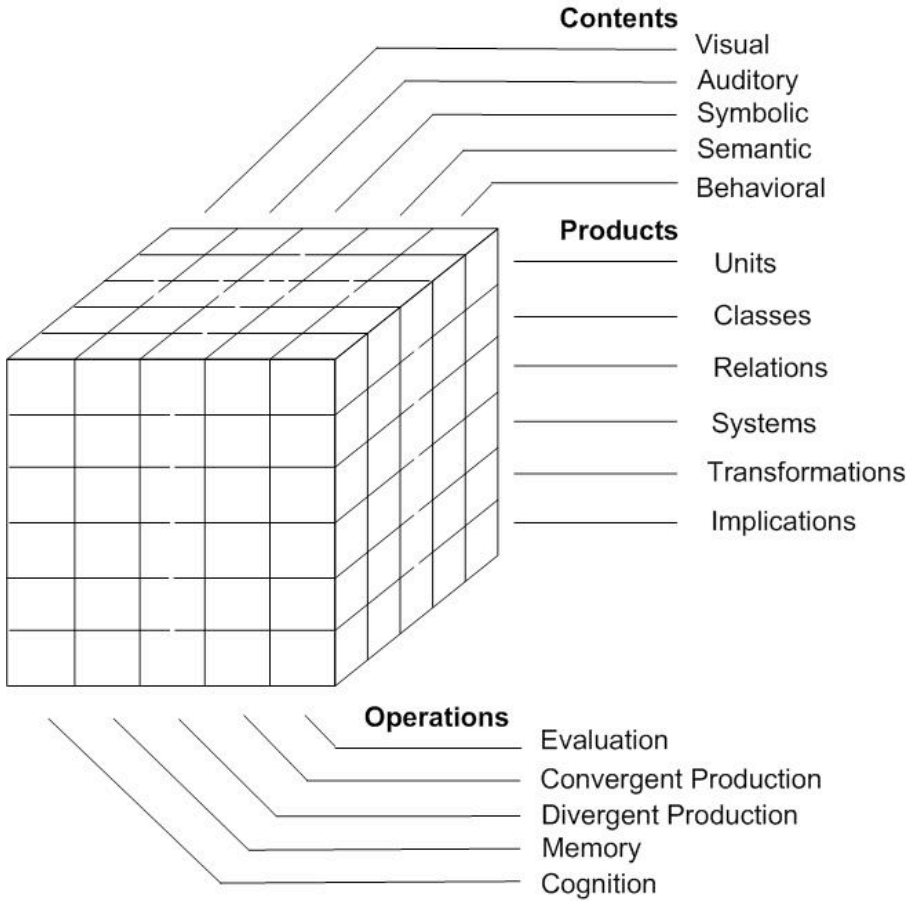
Views of Creativity

Views of Creativity

- Scientific
  - Creativity as an essential trait of human intelligence
  - Creativity may be stimulated and improved
  - Creativity can be measured

Guilford: Structure of Intellect

- Intelligence is not monolithic
  - A multitude of factors to take into account
  - There is no unique measure of intelligence
- Creative production:
  - General ability
  - Most relevant operation: DP



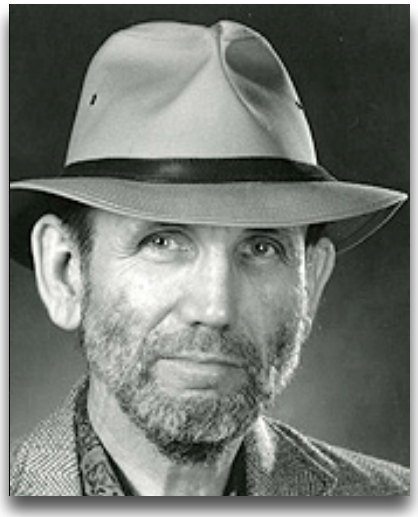
AI and Creativity

AI and Creativity

- Creative solutions ("The Process of Creative Thinking", Newell, Shaw and Simon, 1963):
  - The answer has novelty and usefulness (either for the individual or society).
  - The answer demands that we reject ideas we had previously accepted.
  - The answer results from intense motivation and persistence.
  - The answer comes from clarifying a problem that was originally vague.

AI and Creativity

- Creative solutions ("The Process of Creative Thinking", Newell, Shaw and Simon, 1963):
  - The answer has novelty and usefulness (either for the individual or society).
  - The answer demands that we reject ideas we had previously accepted.
  - The answer results from intense motivation and persistence.
  - The answer comes from clarifying a problem that was originally vague.
- Alternative view for Computational Creativity (Wiggins, 2006)
  - The performance of tasks [by a computer] which, if performed by a human, would be deemed creative.



David Cope

- Experiments in Musical Intelligence
  - Deconstruction – analysis and identification of building blocs
  - Signature Identification – retain the features that are a trait of a given composer
  - Compatibility – reorder the identified blocs taking into account compatibility among them

Contents

- Dimensions of Analysis
- Computational Approaches
- Characterising Creative Systems
- Evaluating Creative Systems
- Conclusions

Contents

- Dimensions of Analysis
- Computational Approaches
- Characterising Creative Systems
- Evaluating Creative Systems
- Conclusions

Dimensions of Analysis

- Four components (Brown):
  - The Process
  - The Product
  - The Individual
  - The environment

- Perspectives (Boden):
  - P-Creativity
  - H-Creativity

- Operational View (Boden):
  - e-Creativity
  - t-Creativity

Dimensions of Analysis

- Four components (Brown):
  - The Process
  - The Product
  - The Individual
  - The environment

- Perspectives (Boden):
  - P-Creativity
  - H-Creativity

- Operational View (Boden):
  - e-Creativity
  - t-Creativity

The Creative Process

- Sources of inspiration:
  - Models from Psychology and Cognitive Science
  - specially those adopting an information processing approach
- Natural Evolution
  - nature is creative

Problem solving models

Problem solving models

- Some examples
  - Dewey (1910), Poincaré (1913), Wallas (1926), Rossman (1931), Koestler (1964), Guilford (1968), Csikszentmihalyi (1996)...

Problem solving models

- Some examples
  - Dewey (1910), Poincaré (1913), Wallas (1926), Rossman (1931), Koestler (1964), Guilford (1968), Csikszentmihalyi (1996)...
- Wallas' 4 steps model (Creative Production)
  - Preparation + Incubation + Illumination + Verification

Problem solving models

- Some examples
  - Dewey (1910), Poincaré (1913), Wallas (1926), Rossman (1931), Koestler (1964), Guilford (1968), Csikszentmihalyi (1996)...
- Wallas' 4 steps model (Creative Production)
  - Preparation + Incubation + Illumination + Verification
- Csikszentmihalyi
  - Preparation + Incubation + Insight + Evaluation +Elaboration

Other contributions

- Guilford
  - Divergent Production
  - Transfer Recall
- Koestler
  - Bissociation (“The Art of Creation”,1964)
- Turner and Fauconnier
  - Conceptual Blending

Biological Inspiration

- Natural Selection:
  - Production of a great amount and diversity of solutions for a common problem (survival)
- Evolutionary processes:
  - Great potential for innovation

Dimensions of Analysis

- Four components (Brown):
  - The Process
  - The Product
  - The Individual
  - The environment

- Perspectives (Boden):
  - P-Creativity
  - H-Creativity

- Operational View (Boden):
  - e-Creativity
  - t-Creativity

Dimensions of Analysis

- Four components (Brown):
  - The Process
  - The Product
  - The Individual
  - The environment

- Perspectives (Boden):
  - P-Creativity
  - H-Creativity

- Operational View (Boden):
  - e-Creativity
  - t-Creativity

Operational View

- Distinction between
  - Exploratory Creativity, or "e-Creativity":
    - creativity as exploration of a conceptual space
  - Transformational Creativity, or "t-Creativity":
    - creativity as transformation of the conceptual space

Operational View

- Distinction between
  - Exploratory Creativity, or "e-Creativity":
    - creativity as exploration of a conceptual space
  - Transformational Creativity, or "t-Creativity":
    - creativity as transformation of the conceptual space

More on this later...

Dimensions of Analysis

- Four components (Brown):
  - The Process
  - The Product
  - The Individual
  - The environment

- Perspectives (Boden):
  - P-Creativity
  - H-Creativity

- Operational View (Boden):
  - e-Creativity
  - t-Creativity

Dimensions of Analysis

- Four components (Brown):
  - The Process
  - The Product
  - The Individual
  - The environment

- Perspectives (Boden):
  - P-Creativity
  - H-Creativity

- Operational View (Boden):
  - e-Creativity
  - t-Creativity

The Product of Creativity

The Product of Creativity

- Quality of a product:
  - Novelty
  - Value

  - ... but the Surprise it causes is also a distinctive characteristic!

The Product of Creativity

- Quality of a product:
  - Novelty
  - Value
  - ... but the Surprise it causes is also a distinctive characteristic!
- Evaluation may assume two perspectives:
  - P-Creativity
  - H-Creativity


Did you realize the amount of stuff a pencil may have inside it?

Novelty


Did you realize the amount of stuff a pencil may have inside it?

Surprise

Novelty

Surprise

Value ?

Novelty

Contents

- Dimensions of Analysis
- Computational Approaches
- Characterising Creative Systems
- Evaluating Creative Systems
- Conclusions

Creative Systems: a Possible Taxonomy

Creative Systems: a Possible Taxonomy

- Creativity Supporting Tools
  - The user is the author of the artwork and responsible for the generation of the idea

Creative Systems: a Possible Taxonomy

- Creativity Supporting Tools
  - The user is the author of the artwork and responsible for the generation of the idea
- Computer Aided Creativity, Technology-Enhanced Creativity
  - The idea rises from an interaction between user and computer.

Creative Systems: a Possible Taxonomy

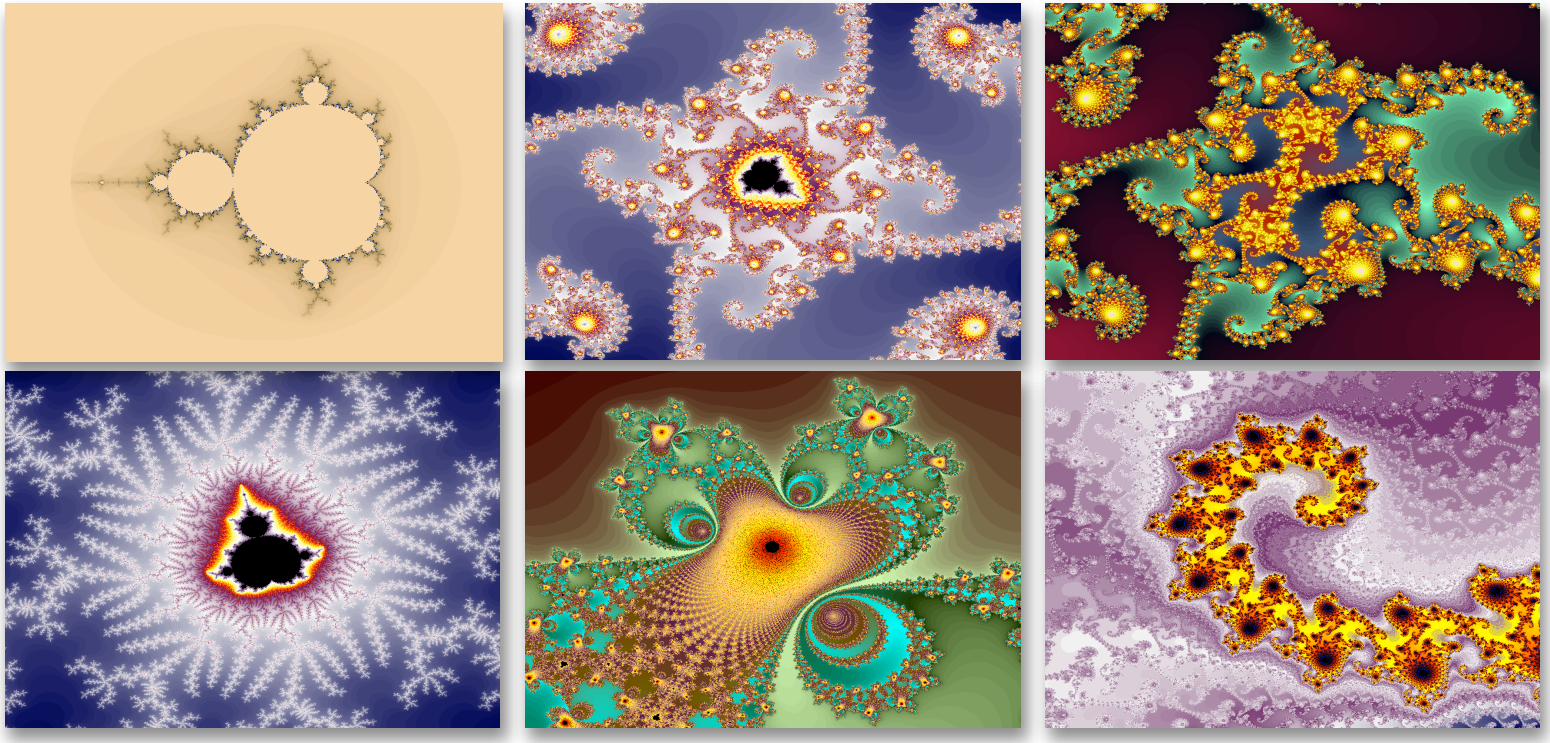
- Creativity Supporting Tools
  - The user is the author of the artwork and responsible for the generation of the idea
- Computer Aided Creativity, Technology-Enhanced Creativity
  - The idea rises from an interaction between user and computer.
- Authors
  - The computer is responsible for the process

Computational Approaches

- Mathematical Models
- Rule-Based Systems
- Case-Based reasoning
- Generative approaches
- Evolutionary approaches

Mathematical Models

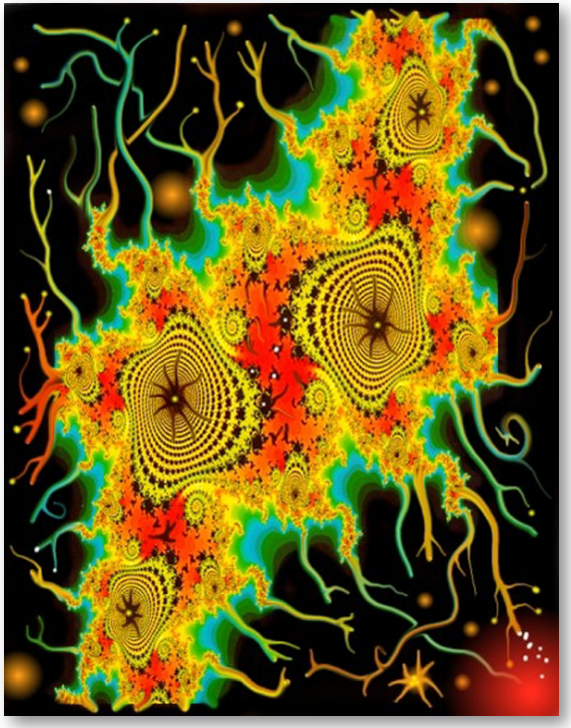
- Madelbrot Set



Fractint - http://www.nahee.com/spanky/www/fractint/fractint.html

Mathematical Models

- Jeffrey Ventrella
- Clifford Pickover
- Helaman Ferguson



$$\begin{pmatrix} x \\ y \end{pmatrix} \mapsto \begin{pmatrix} \alpha x + \beta y \\ \gamma x + \delta y \end{pmatrix}$$

http://www.ventrella.com

http://sprott.physics.wisc.edu/pickover/home.htm

http://www.access.digex.net/~helamanf/gallery/index.html

Computational Approaches

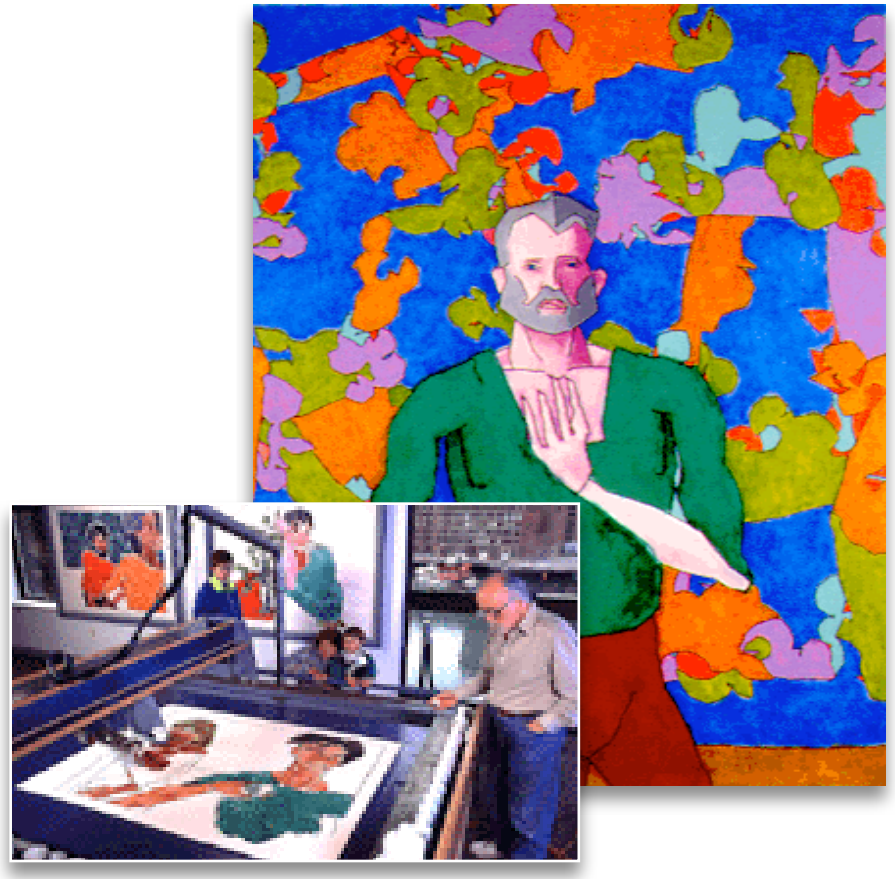
- Mathematical Models
- **Rule-Based Systems**
- Case-Based reasoning
- Generative approaches
- Evolutionary approaches

AARON

- Representative phase (1985)
- Rules about real world behaviour
- Humans and Plants get a more detailed description

AARON

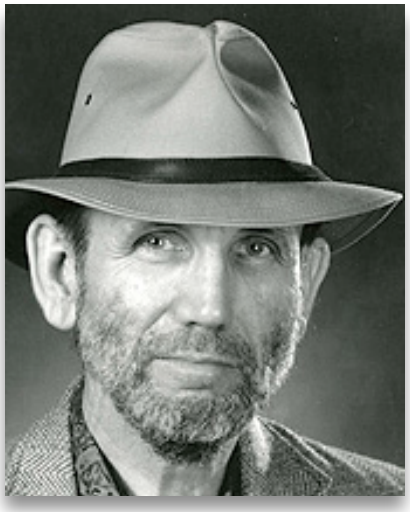
- Representative phase: new version:
  - KB: from 2D to 3D
  - Description of decoration motifs
  - Drawings in 2 stages:
    - Create a 3D model
    - Create a 2D representation of the model



HR (Simon Colton)

- Concept invention:
  - Program (re)invents concepts for explaining given number sequences:

Sequence	HR's definition	Number type
2,4,6,8,...	divisible by 2	even
2,3,5,7,...	2 divisors	prime
2,9,10,12,...	nbr 0s = nbr 1s	balance
4,5,7,9,...	primes + 2	
4,6,9,10,...	2 prime factors	semi-prime



David Cope

- Experiments in Musical Intelligence
  - Deconstruction – analysis and identification of building blocs
  - Signature Identification – retain the features that are a trait of a given composer
  - Compatibility – reorder the identified blocs taking into account compatibility among them

Computational Approaches

- Mathematical Models
- Rule-Based Systems
- **Case-Based reasoning**
- Generative approaches
- Evolutionary approaches

ASPERA (Pablo Gervás)

- Rule and CBR-based system
  - 'tercetos' generated with the guidelines: short, fully rhymed, formal poem, with a rural setting and positive mood

Gervás, P.: "An Expert System for the Composition of Formal Spanish Poetry". Journal of Knowledge-Based Systems, Volume 14, Issue 3-4, June 2001, Elsevier Science, pp 181-188

ASPERA (Pablo Gervás)

- Rule and CBR-based system
  - 'tercetos' generated with the guidelines: short, fully rhymed, formal poem, with a rural setting and positive mood

Ladrará la verdad el viento airado
en tal corazón por una planta dulce
al arbusto que volais mudo o helado.

Gervás, P.: "An Expert System for the Composition of Formal Spanish Poetry". Journal of Knowledge-Based Systems, Volume 14, Issue 3-4, June 2001, Elsevier Science, pp 181-188

ASPERA (Pablo Gervás)

- Rule and CBR-based system
  - 'tercetos' generated with the guidelines: short, fully rhymed, formal poem, with a rural setting and positive mood

Ladrará la verdad el viento airado
en tal corazón por una planta dulce
al arbusto que volais mudo o helado.

Andando con arbusto fui pesado
vuestras hermosas nubes por mirarme
quien antes en la liebre fue templado.

Gervás, P.: "An Expert System for the Composition of Formal Spanish Poetry". Journal of Knowledge-Based Systems, Volume 14, Issue 3-4, June 2001, Elsevier Science, pp 181-188

PRINCE - Cross-Domain Analogy

(Hervás, Pereira, Gervás and Cardoso, 2006)

- Improve stylistic quality of texts generated by an NLP system by using Analogy
  - Build texts for simple fairy tales
  - Interaction between two domains (the vehicle and the tenor)
  - Structure mapping algorithms + WordNet

PRINCE - Cross-Domain Analogy

(Hervás, Pereira, Gervás and Cardoso, 2006)

- Improve stylistic quality of texts generated by an NLP system by using Analogy
  - Build texts for simple fairy tales
  - Interaction between two domains (the vehicle and the tenor)
  - Structure mapping algorithms + WordNet

A princess lived in a castle. She loved a knight. The princess was the daughter of a king

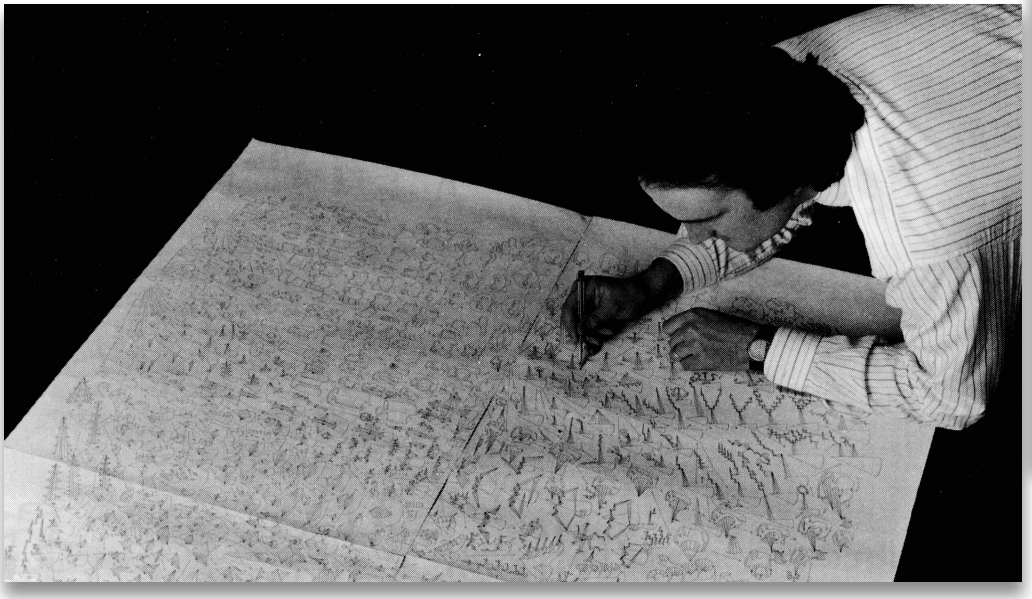
A princess lived in a castle. She was the Aphrodite of royalty. She loved a knight. The princess was the daughter of a king.

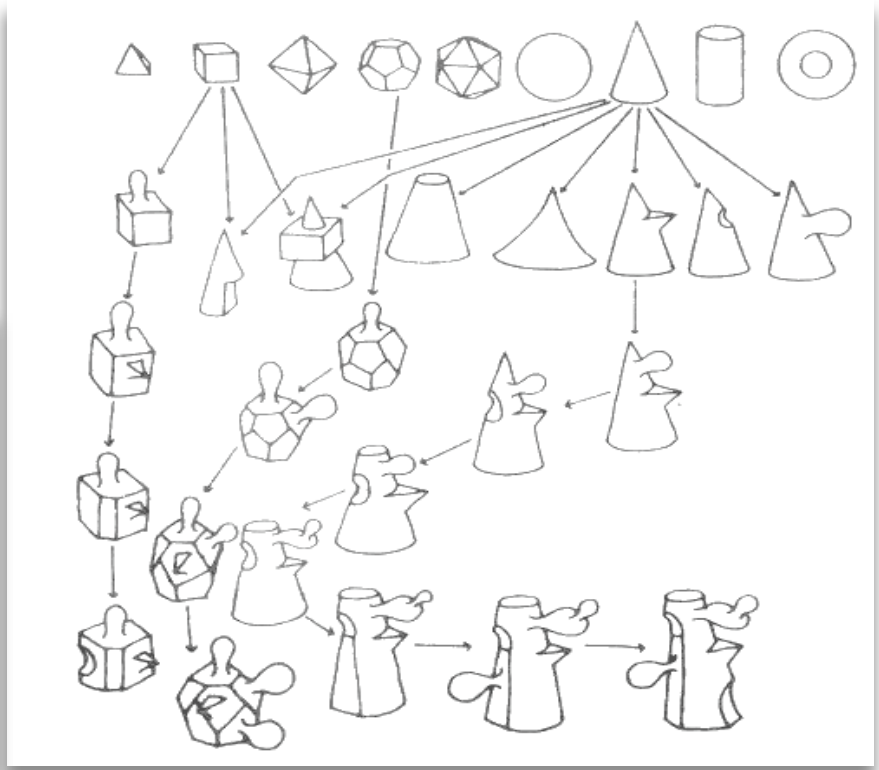
Computational Approaches

- Mathematical Models
- Rule-Based Systems
- Case-Based reasoning
- Generative approaches
- Evolutionary approaches

William Latham

- Inspiration
  - Crystal Growth
  - Repetition of simple steps

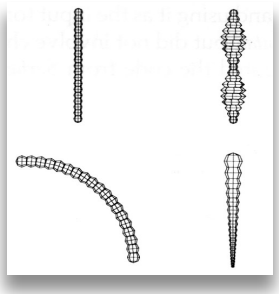


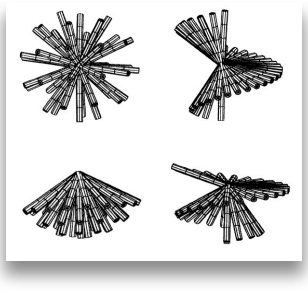


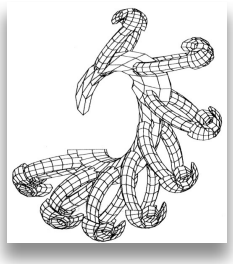
http://www.artworks.co.uk

William Latham

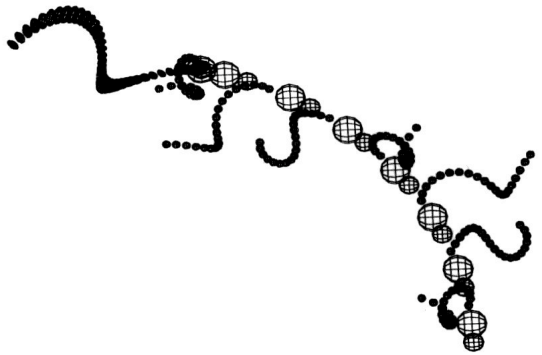
- Primitives







- Combination



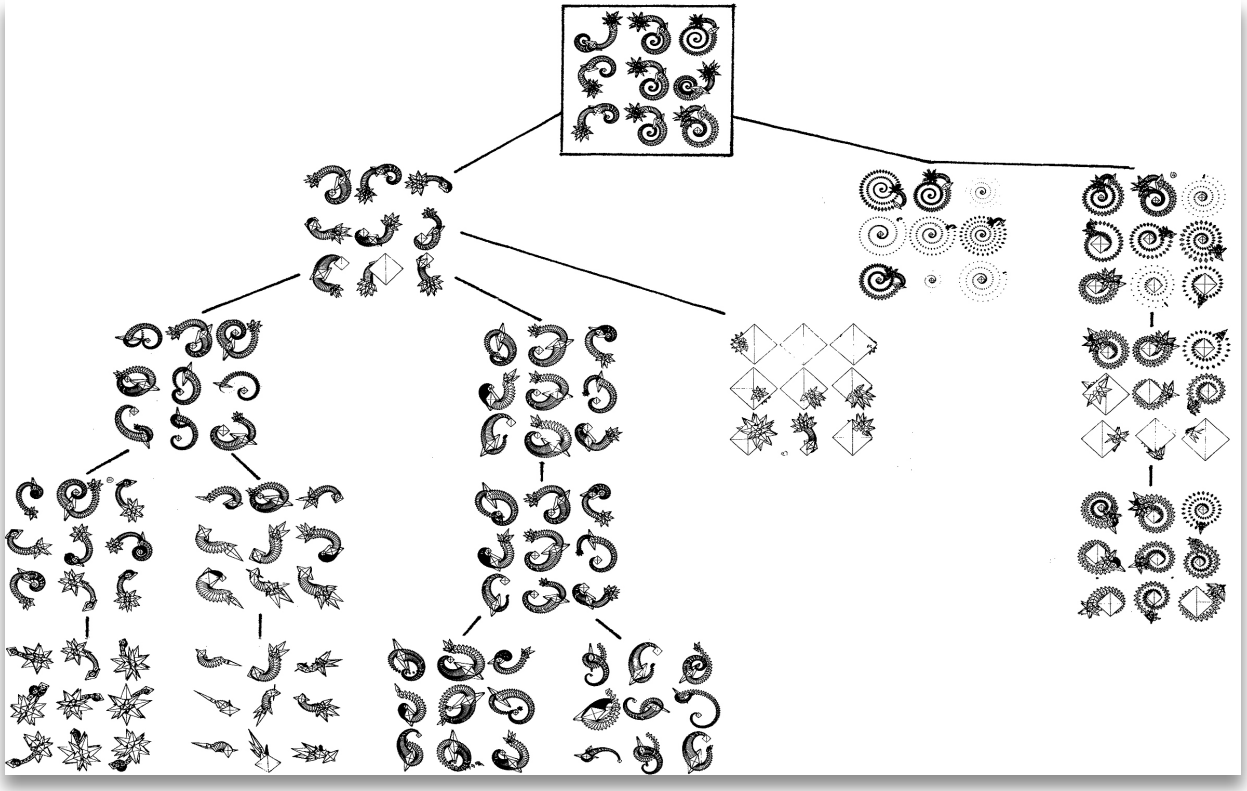
```
hh1: = horn ribs (20)                /*  make a horn with 20 ribs */
       sphere (0.4)                  /*  out of spheres */
       stack (12) twist (400,2) bend (60); /* deformed thus */

hhorn: = (horn ribs (20)             /*  another horn */
          sphere (1)                 /*  uses three input forms */
          sphere (1.5)               /*  two sphere of different size */
          (csg (hh1) xrot (90))      /*  and the old horn */
          stack (40) twist (400) bend (40))
       ¢                             /*  This makes a list of horns */
         (horn ribs (40)             /*  that joins this one */
          ellipsoid (1, 0.5, 0.3)    /*  to the tail of the other. */
          stack (20) twist (400,4) bend (40))
```

http://www.artworks.co.uk

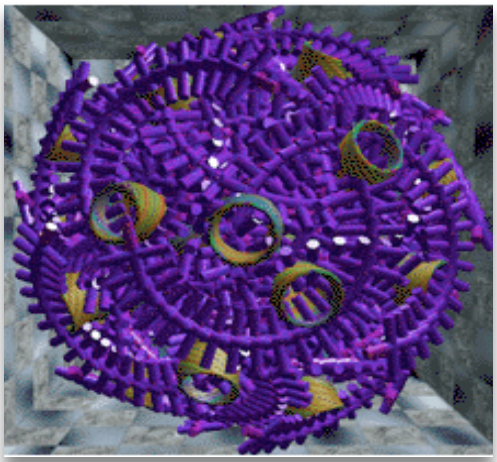
William Latham

- Exploration

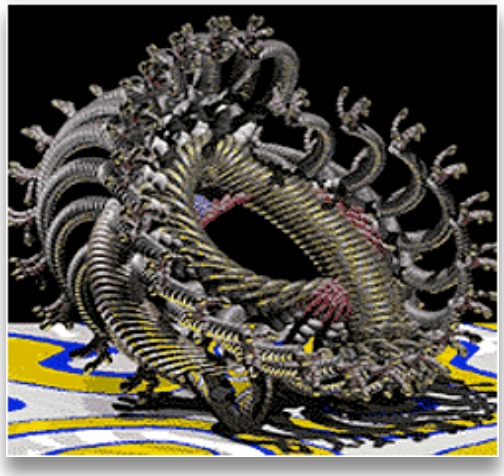


http://www.artworks.co.uk

William Latham

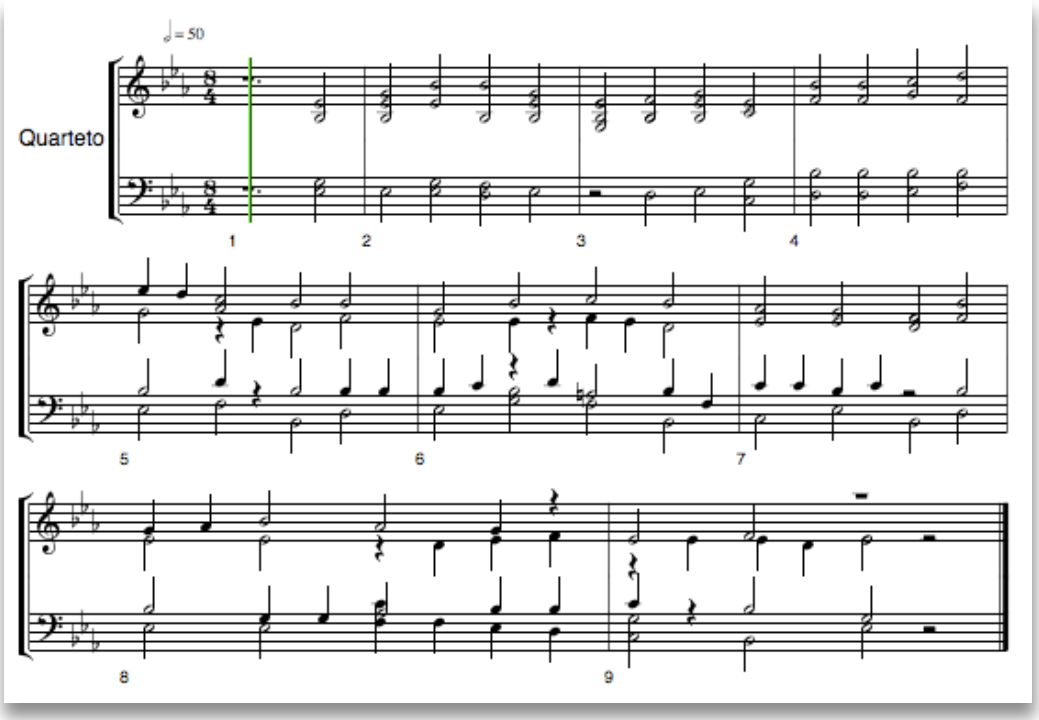






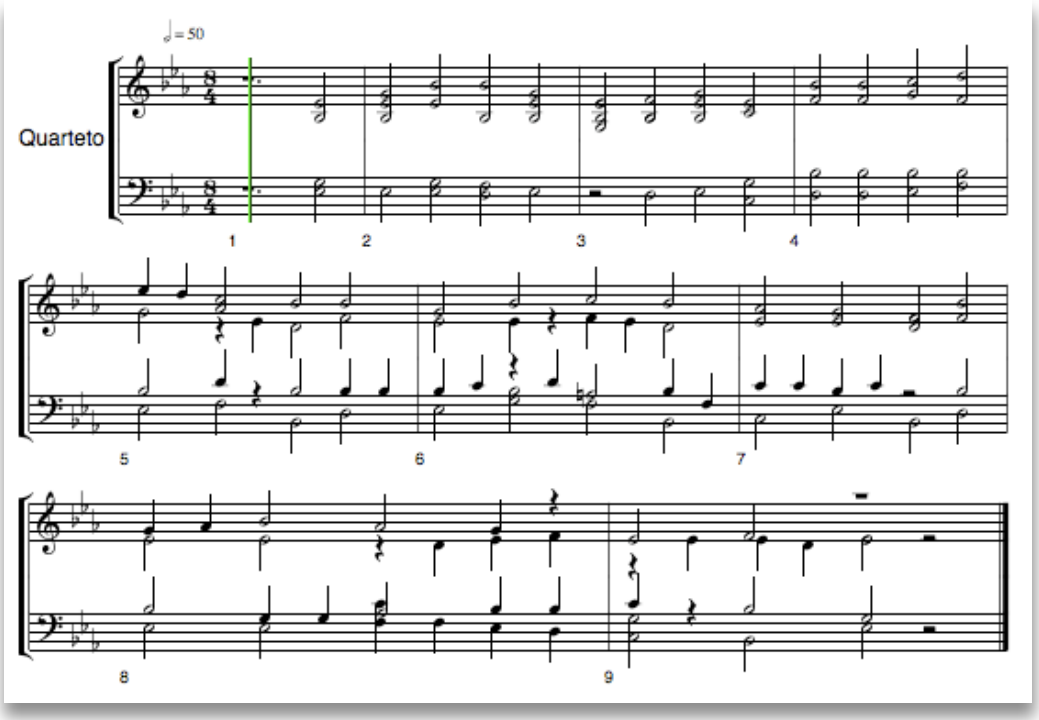

Ray Whorley, G. Wiggins

- Given a soprano part, add alto, tenor and bass such that the whole is pleasing to the ear.
- Uses statistical models of four-part harmony



Ray Whorley, G. Wiggins

- Given a soprano part, add alto, tenor and bass such that the whole is pleasing to the ear.
- Uses statistical models of four-part harmony



Computational Approaches

- Mathematical Models
- Rule-Based Systems
- Case-Based reasoning
- Generative approaches
- Evolutionary approaches

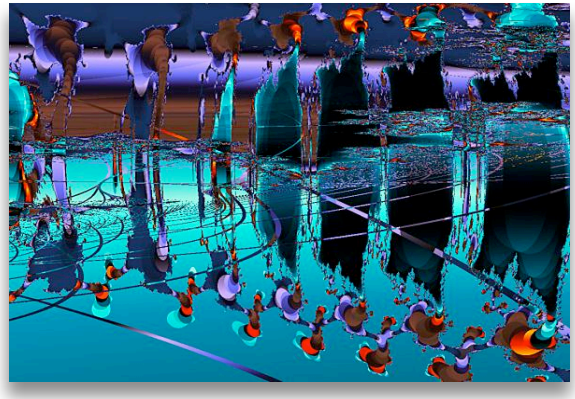
Karl Sims

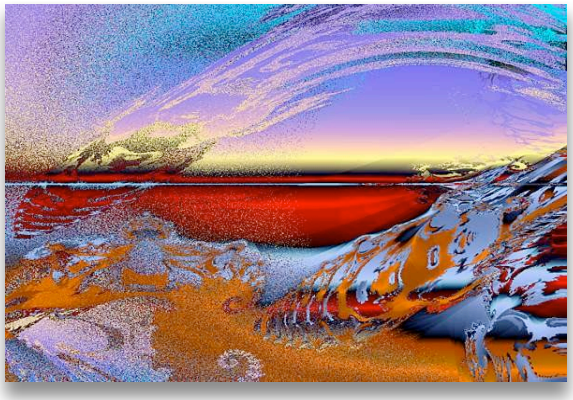
- Genetic Programming
- Evolves programs that generate images.

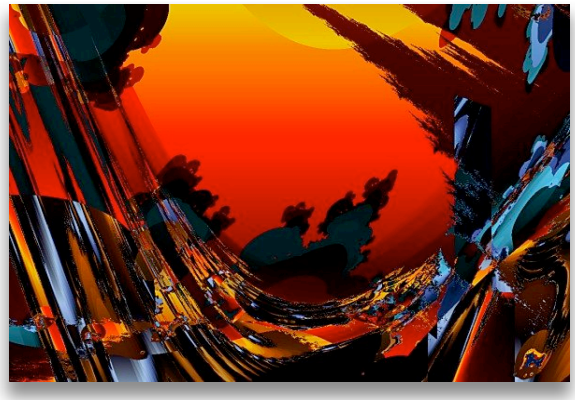
http://www.biota.org/ksims/

Steven Rooke

- Similar to Karl Sims work
- Uses fractal primitives





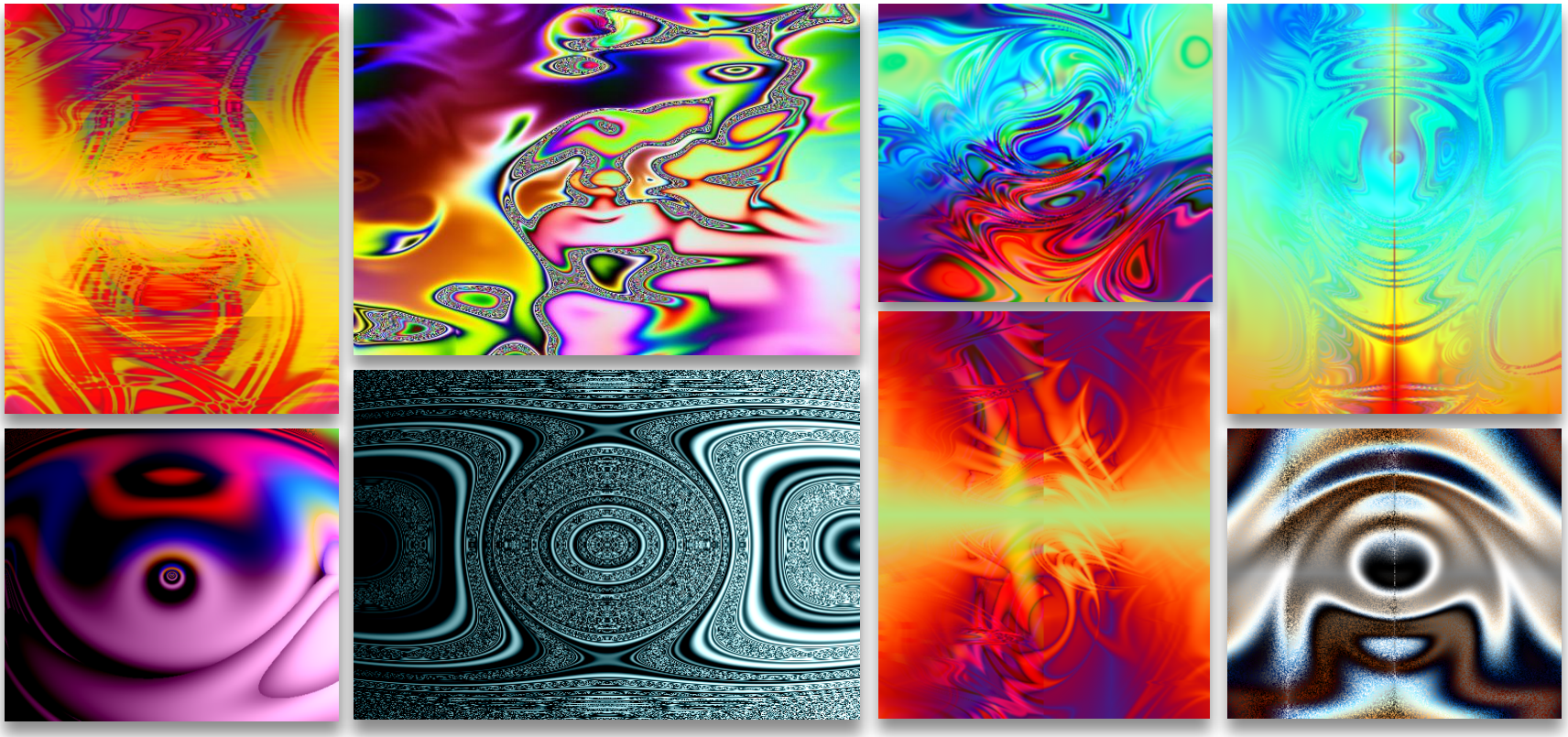


NEvAr - Interactive Evolutionary Art
(Machado and Cardoso)

- Genetic Programming

NEvAr - Interactive Evolutionary Art
(Machado and Cardoso)

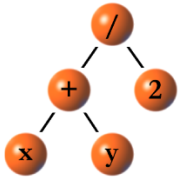
- Genetic Programming

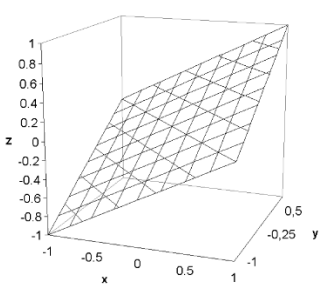


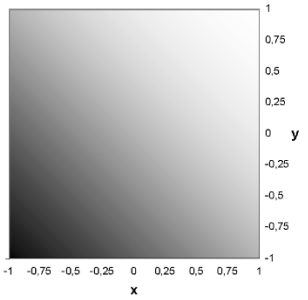
NEvAr – Representation

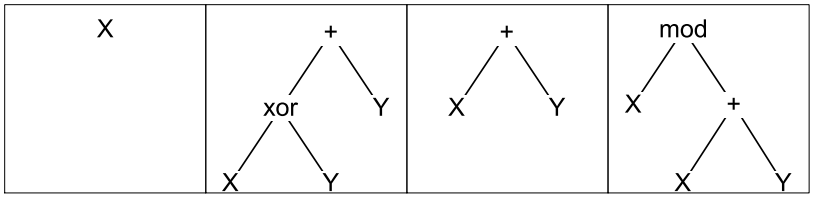
- The individuals are trees
  - Function Set
    - +, -, ×, %, sin, if, xor, …
  - Terminal Set
    - x, y, Constants
    - 3d-vectors (for color)

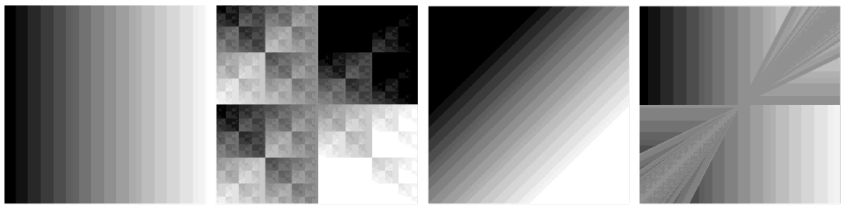
- Example :
  - f(x,y)=(x+y)/2











NEvAr (Penousal Machado)

- What image corresponds to the following formula?

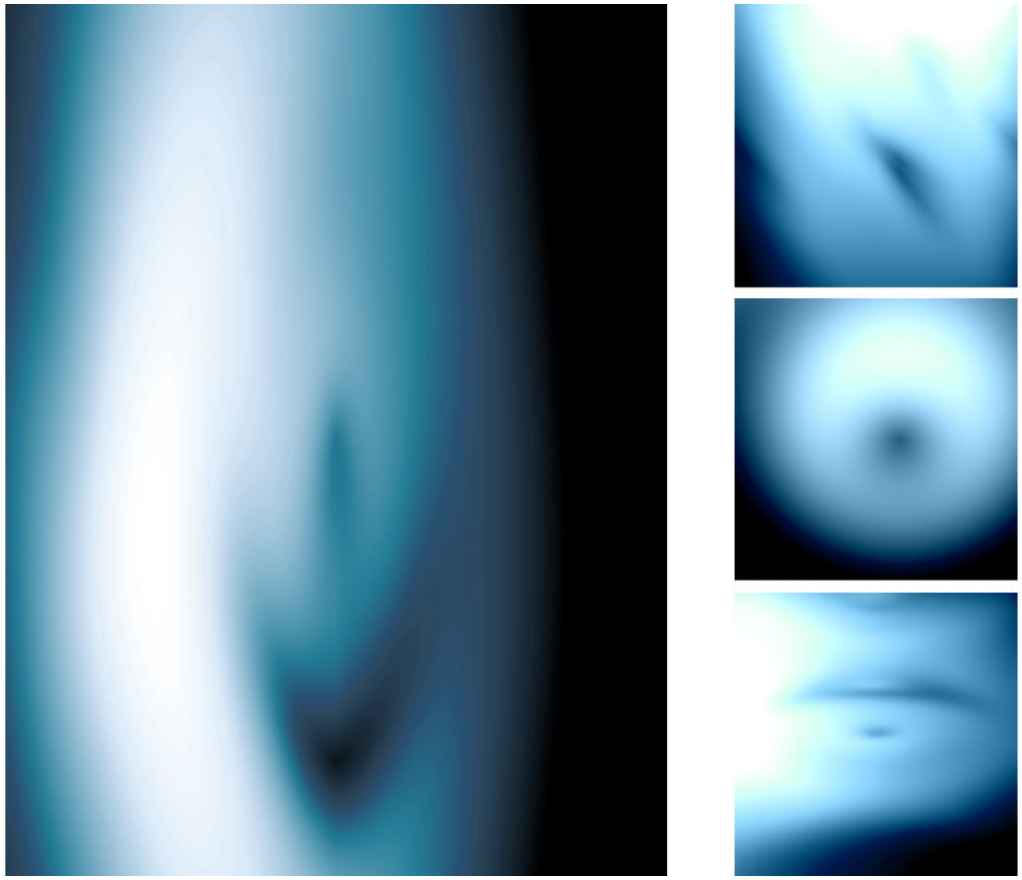
  - (- (sin (hypot (if (expt X) (round -0.902219 0.205664 0.594897 0.721305) (atan (- -0.902219 (- (if (expt (* X (- (sin (hypot (if (expt (abs Y)) 0.195410 -0.523118 0.917722 (atan (- Y (- (if (expt (* Y (max (atan (hypot (if (abs X) 0.195410 -0.523118 0.917722 (atan (- Y (- (if (expt (* (if (pow (tan X) 0.283853) (and (mod X X) (if -0.578784 Y -0.082064 0.779778 0.665456)) (warp -0.820978 0.326090 X)) X)) 0.195410 -0.523118 0.917722 (atan (- (sin (hypot 0.205664 0.594897 0.721305 Y)) X))) Y)))) X)) X))) 0.195410 -0.523118 0.917722 (atan (- (sin (hypot (sin X) Y)) X))) Y)))) X)) (+ (expt X) (max (round -0.902219 0.205664 0.594897 0.721305) -0.190344 0.713248 0.436567))))) 0.195410 -0.523118 0.917722 (atan (- (sin (hypot (sin X) Y)) (expt (abs X))))) Y)))) X)) (+ (expt X) (max (round -0.902219 -0.190344 0.713248 0.436567) -0.190344 0.713248 0.436567)))

http://www.dei.uc.pt/~machado/NEvAr

NEvAr (Penousal Machado)

http://www.dei.uc.pt/~machado/NEvAr

NEvAr (Penousal Machado)



http://www.dei.uc.pt/~machado/NEvAr

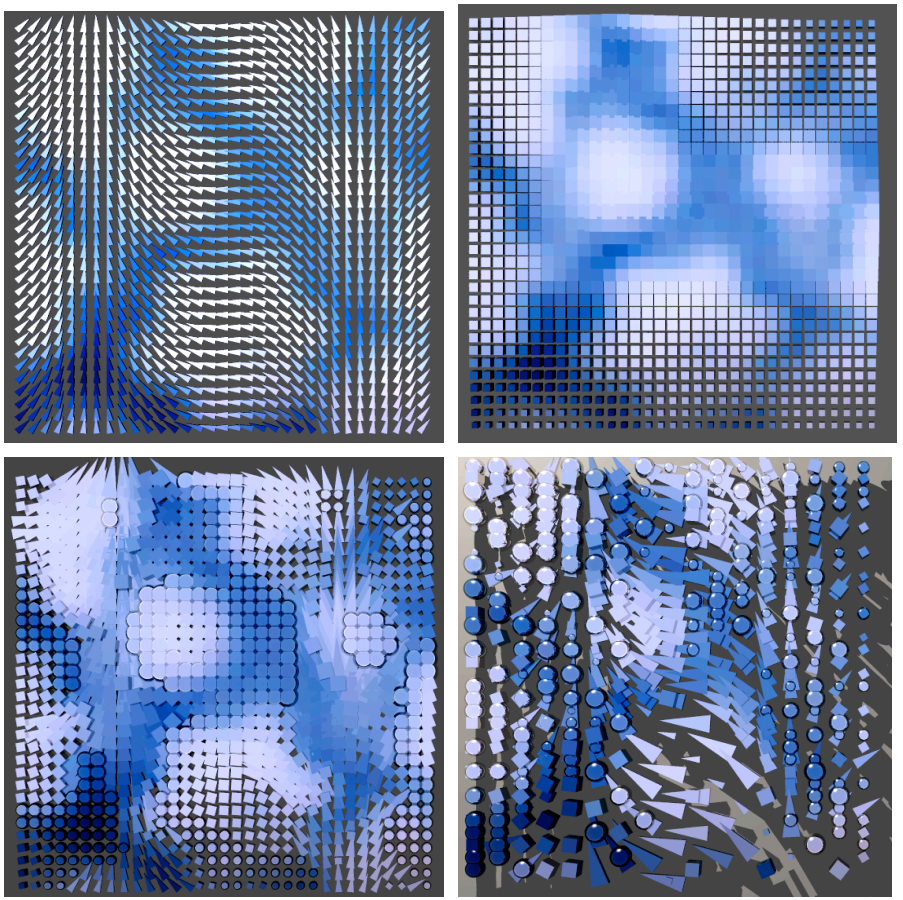
Evolving Assemblages

Fernando Graça and Penousal Machado

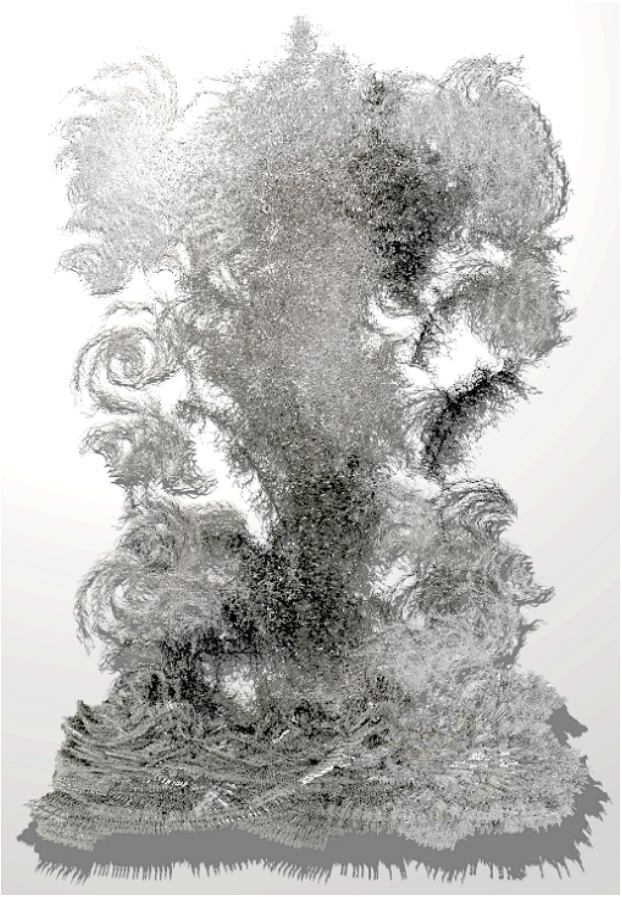
- Inspiration:

Evolutionary Pointillist Modules Evolving assemblages of objects

- Evolve the:
  - type
  - rotation
  - size
  - position
- of the objects that will be placed on the virtual canvas
- Use the colour of a source image



Experimental Results

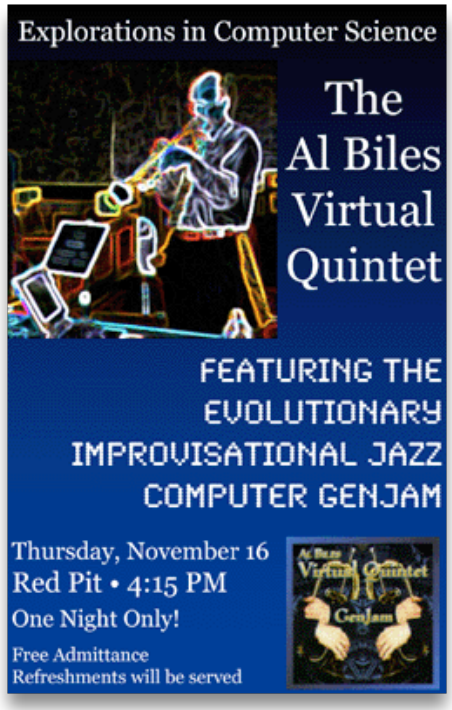


Experimental Results

Experimental Results

Al Biles

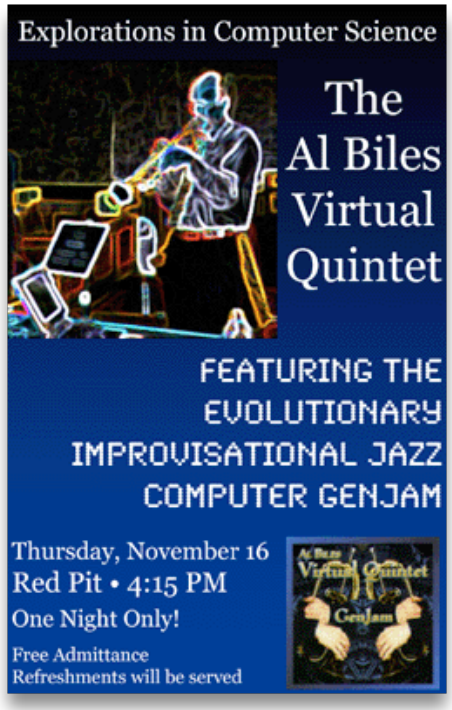
- GenJam
  - Real-Time Jazz improvisation
  - Interactive Genetic Algorithm



http://www.it.rit.edu/~jab/GenJam.html

Al Biles

- GenJam
  - Real-Time Jazz improvisation
  - Interactive Genetic Algorithm



http://www.it.rit.edu/~jab/GenJam.html

Contents

- Dimensions of Analysis
- Computational Approaches
- Characterising Creative Systems
- Evaluating Creative Systems
- Conclusions

Characterising Creative Systems (Wiggins 2006)

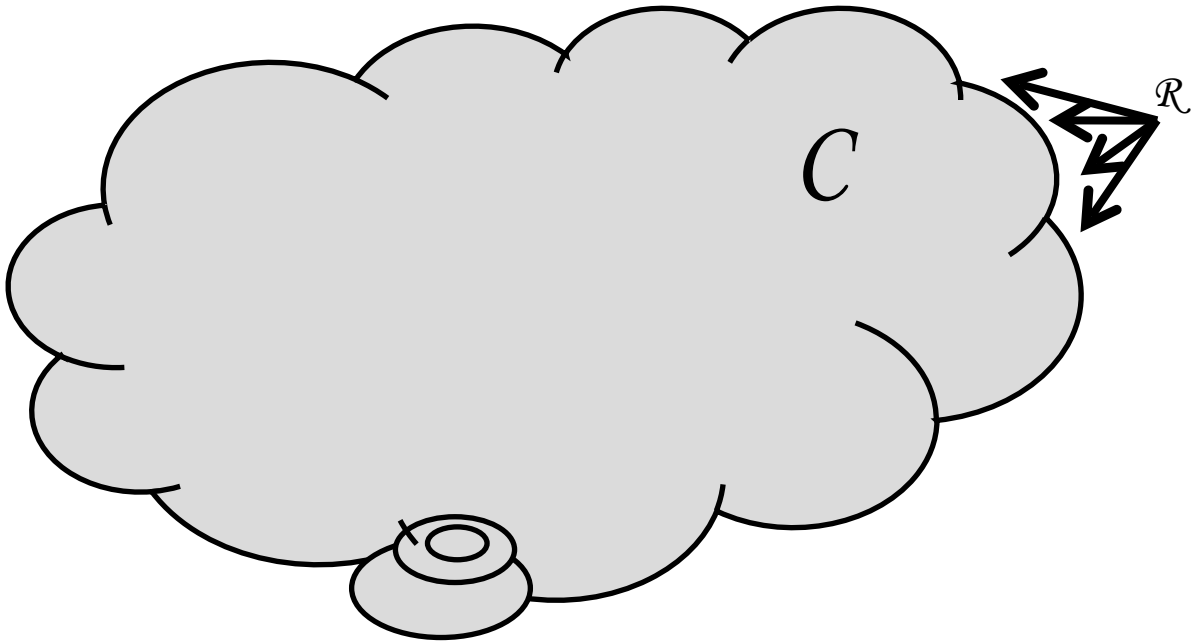
- Formal distinction between
  - Exploratory Creativity, or "e-Creativity"
    - creativity as exploration of a conceptual space
  - Transformational Creativity, or "t-Creativity"
    - creativity as transformation of the conceptual space

Exploratory Creativity

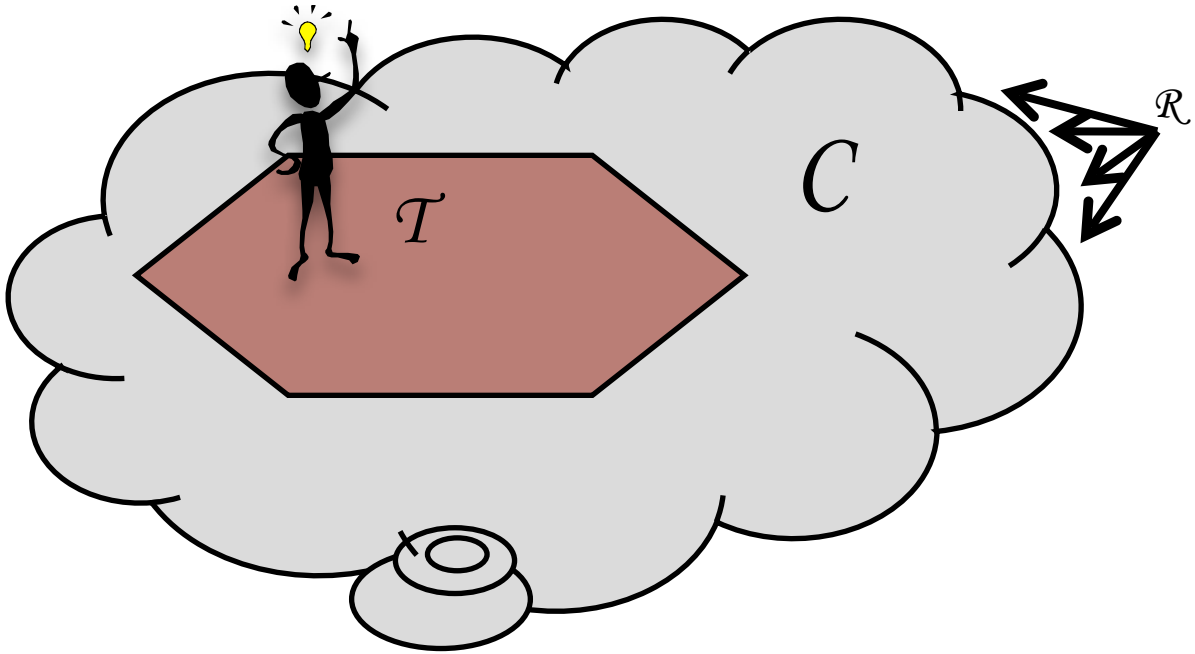
- Conceptual Space C:
  - distinct concept - distinct point in the space
  - defined in a generative way:
    - a set of rules $\mathcal{R}$ determine membership of space C
- Search in C: guided by rules $\mathcal{T}$
- Evaluation: rules $\mathcal{E}$

Search in conceptual space C constrained by R, using a strategy codified by $\mathcal{T}$, and evaluating products with $\mathcal{E}$.

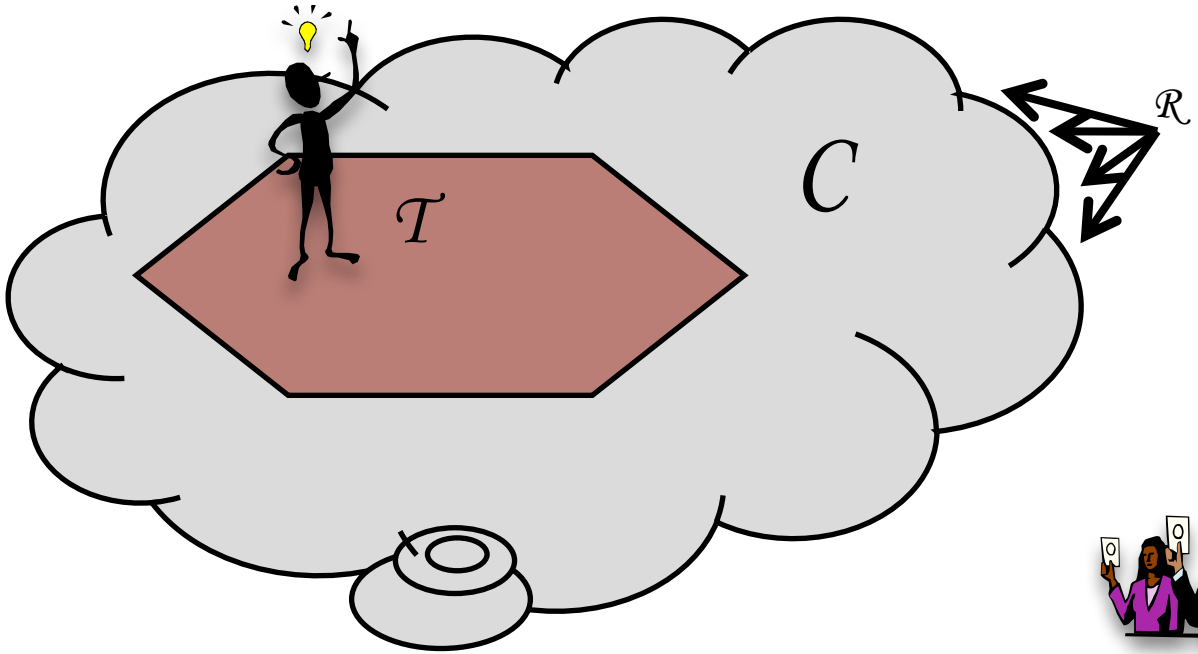
Exploratory Creativity

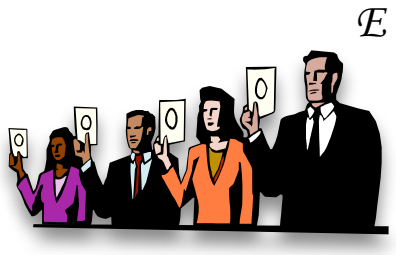


Exploratory Creativity



Exploratory Creativity





Exploratory Creativity

Exploratory Creativity

$$\langle \mathcal{U}, \mathcal{L}, [[\cdot]], \langle\langle \cdot,\cdot,\cdot \rangle\rangle, \mathcal{R}, \mathcal{T}, \mathcal{E} \rangle$$

$\mathcal{U}$	a universe of possible concepts, both partial and complete
$\mathcal{L}$	an alphabet from which to build rules
$\mathcal{L}^*$	a language, derived from $\mathcal{L}$, in which to express rules
$[[\cdot]]$	a function generator, which maps a subset of $\mathcal{L}^*$ to a function which selects elements of $\mathcal{U}$
$\langle\langle \cdot,\cdot,\cdot \rangle\rangle$	a function generator, which maps three subsets of $\mathcal{L}^*$ to a function which generates new elements of $\mathcal{U}$ from existing ones
$\mathcal{R}$	(a subset of $\mathcal{L}^*$) Set of rules that define membership to the conceptual space
$\mathcal{T}$	(a subset of $\mathcal{L}^*$) Set of rules that define a search strategy
$\mathcal{E}$	(a subset of $\mathcal{L}^*$) Set of evaluation rules

Exploratory Creativity

Search in conceptual space $\mathcal{C}$ constrained by R, using a strategy codified by $\mathcal{T}$, and evaluating products with $\mathcal{E}$.

Exploratory Creativity

Search in conceptual space $\mathcal{C}$ constrained by R, using a strategy codified by $\mathcal{T}$, and evaluating products with $\mathcal{E}$.

- Conceptual Space:
  - Concepts of $\mathcal{U}$ selected by function $[[\mathcal{R}]]$:

$$\mathcal{C} = [[\mathcal{R}]](\mathcal{U})$$

Exploratory Creativity

Search in conceptual space $\mathcal{C}$ constrained by R, using a strategy codified by $\mathcal{T}$, and evaluating products with $\mathcal{E}$.

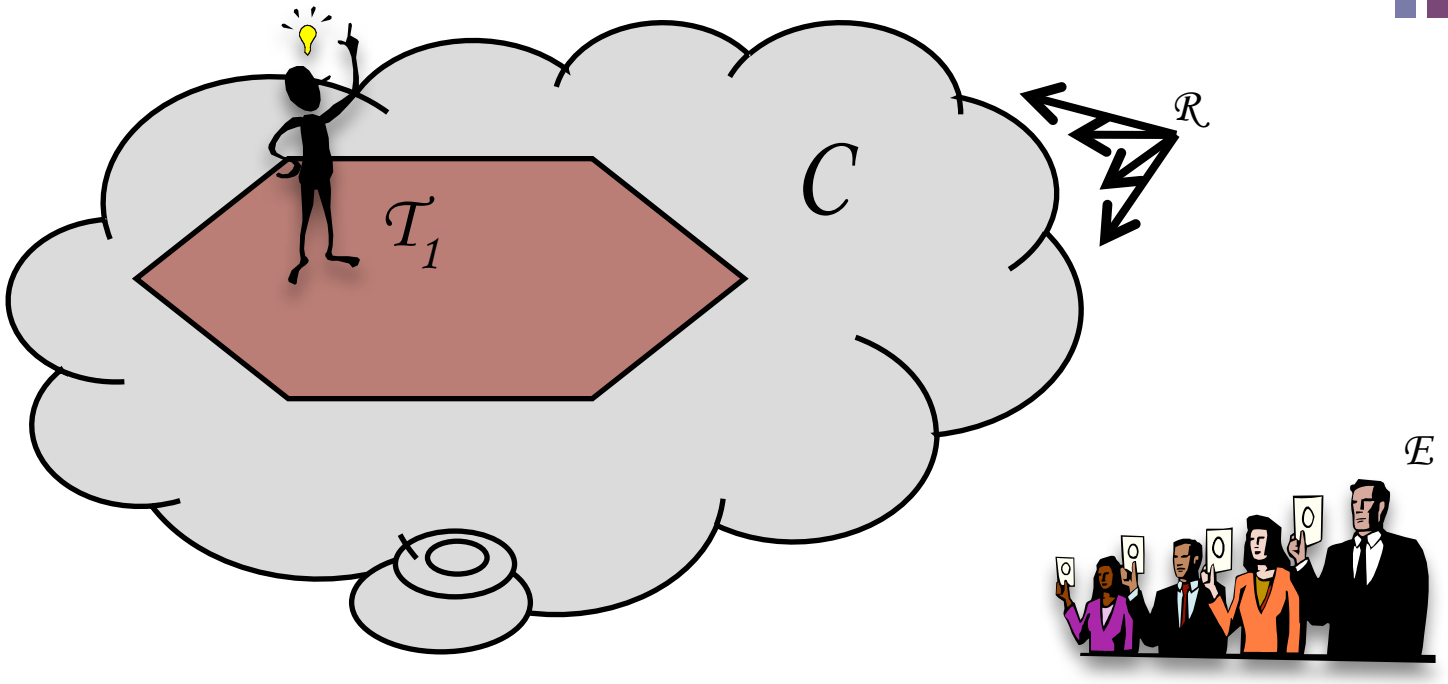
- Conceptual Space:
  - Concepts of $\mathcal{U}$ selected by function $[[\mathcal{R}]]$:

$$\mathcal{C} = [[\mathcal{R}]](\mathcal{U})$$

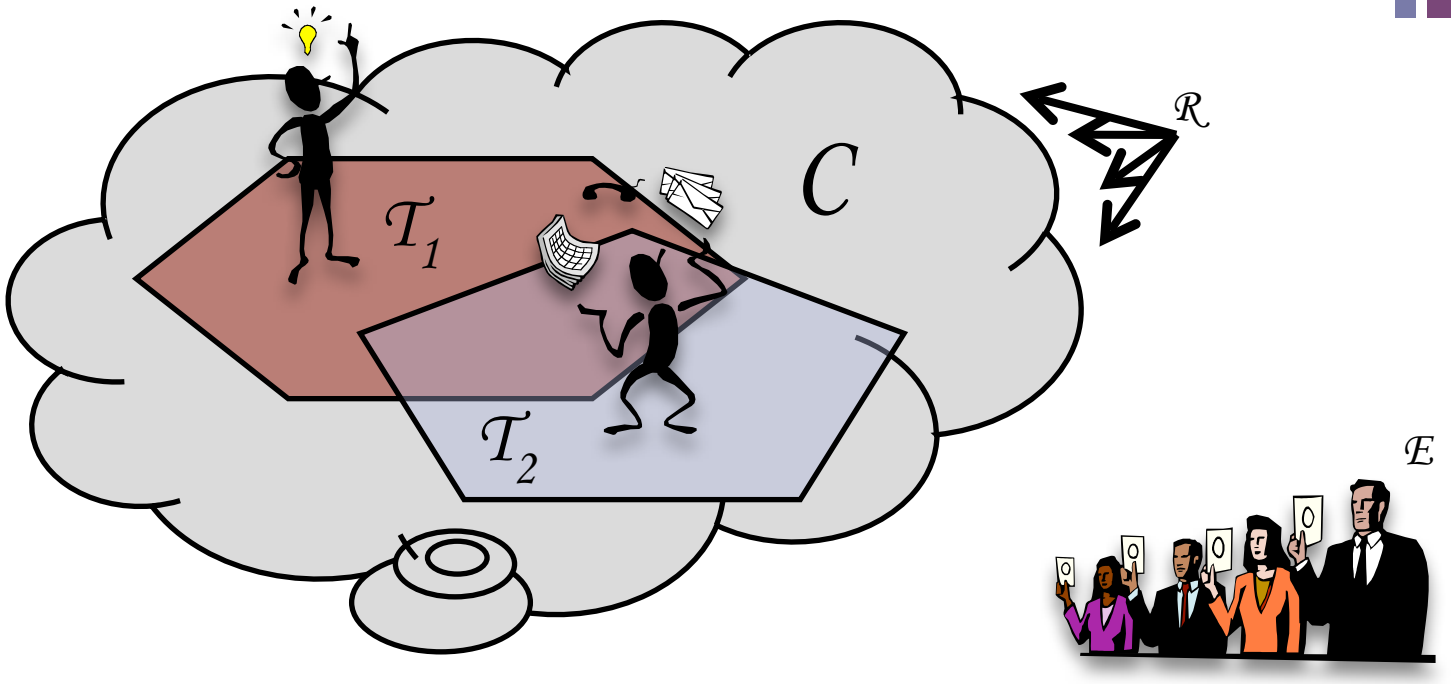
- Exploration of $\mathcal{C}$:
  - Iterative process governed by function $\langle\langle \mathcal{R}, \mathcal{T}, \mathcal{E} \rangle\rangle$:

$$c_{out} = \langle\langle \mathcal{T}, \mathcal{R}, \mathcal{E} \rangle\rangle(c_{in})$$

Exploration Strategies

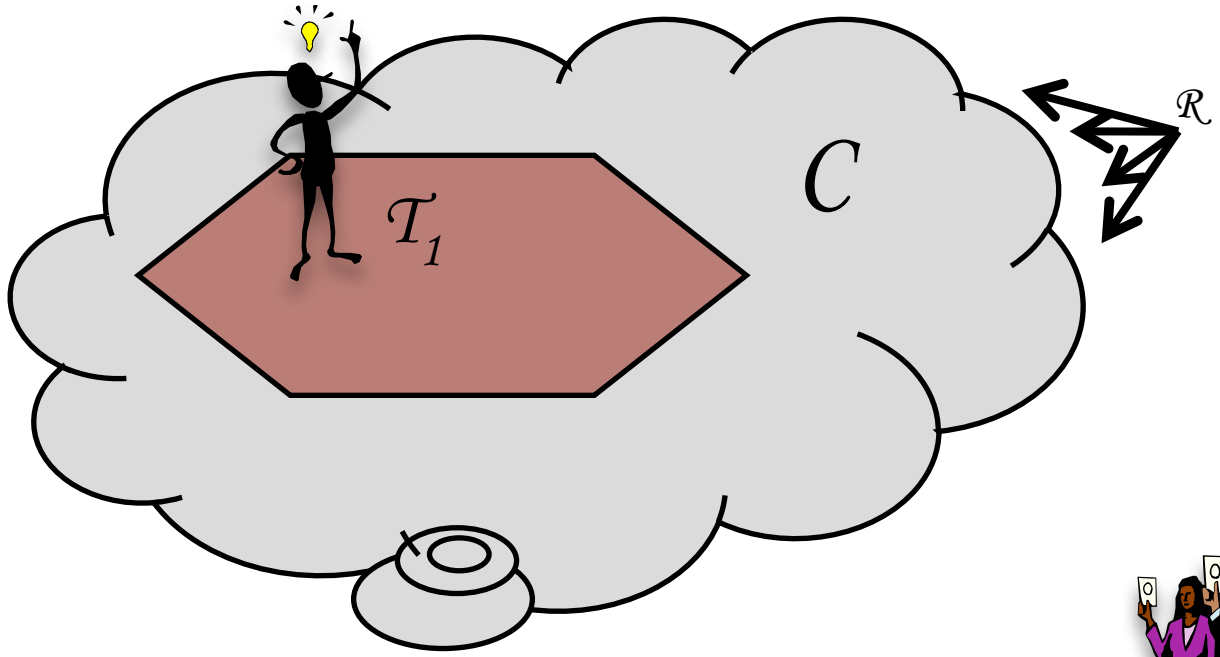


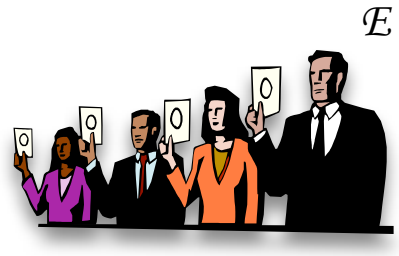
Exploration Strategies



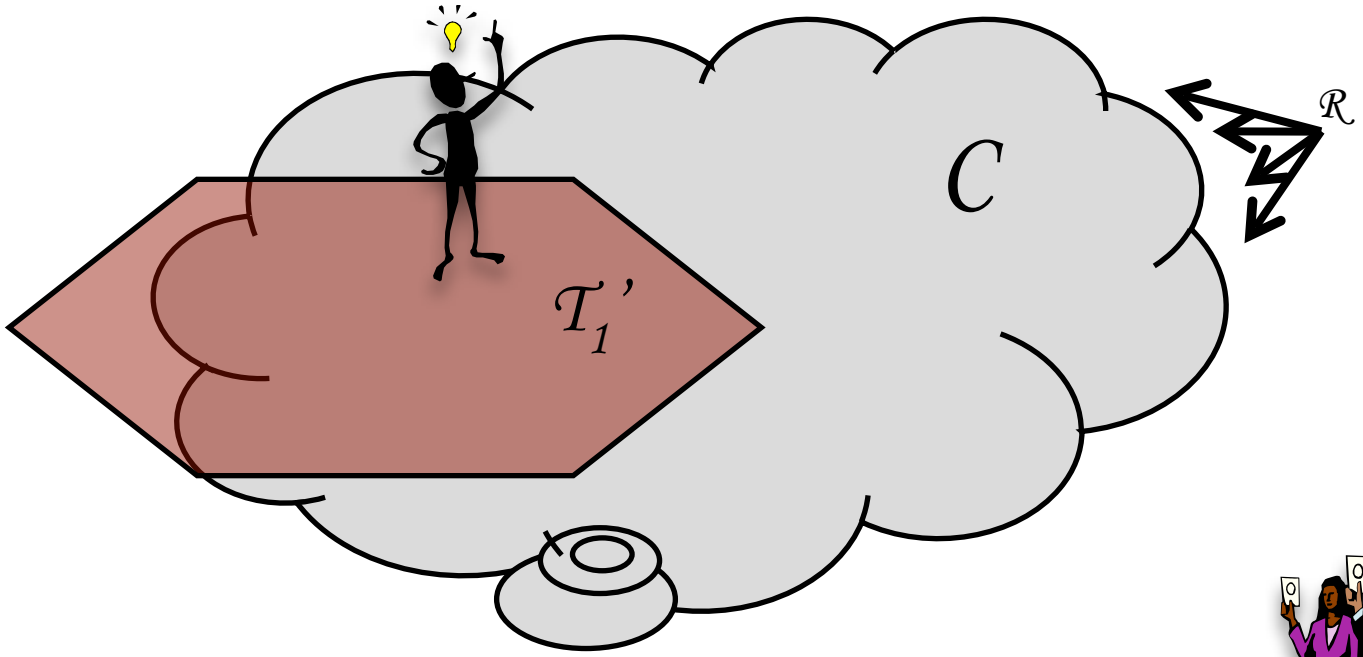
example: same genre, different styles

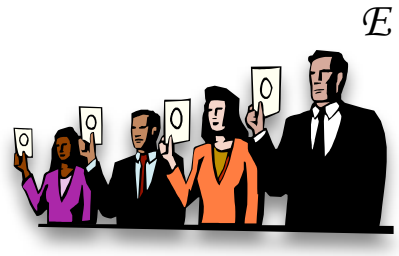
Transformation



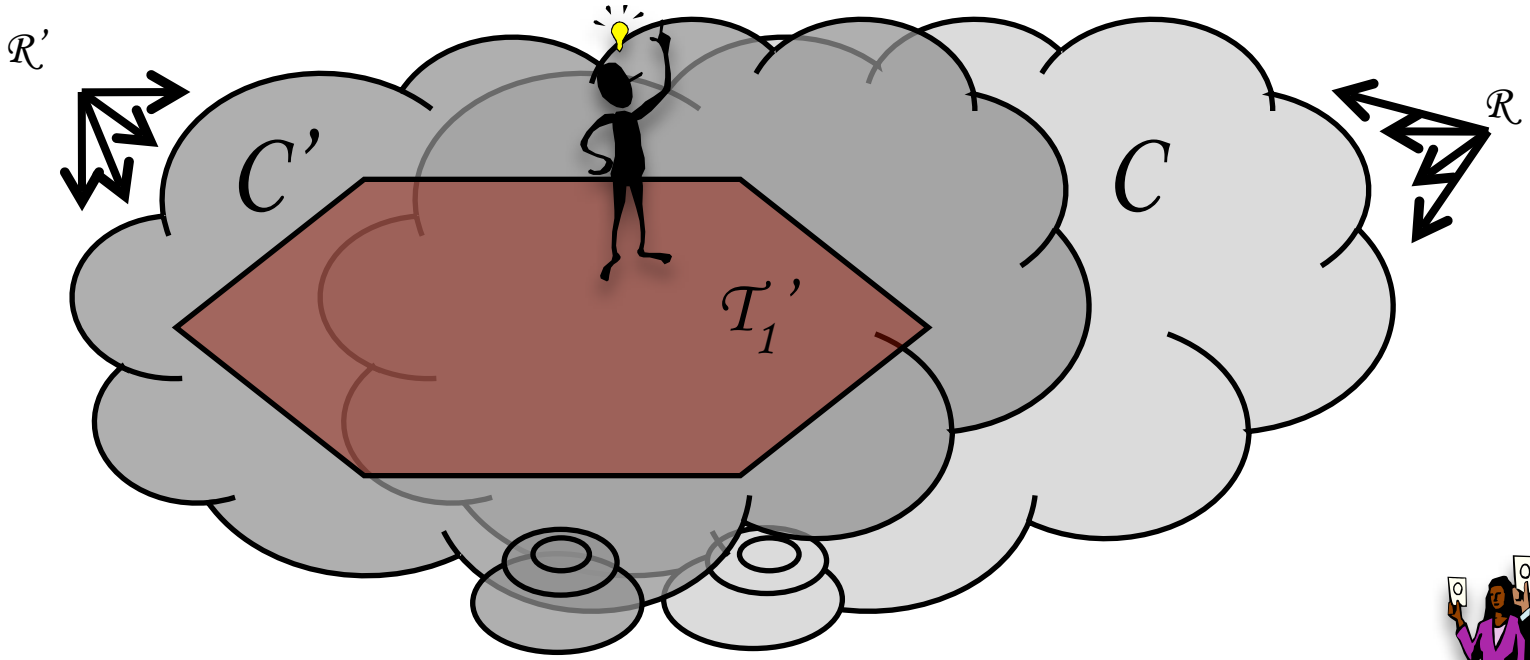


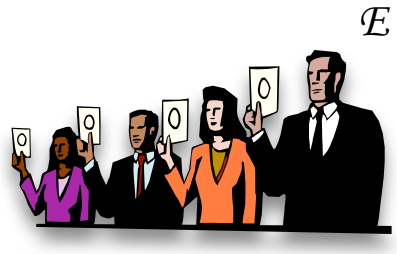
Transformation



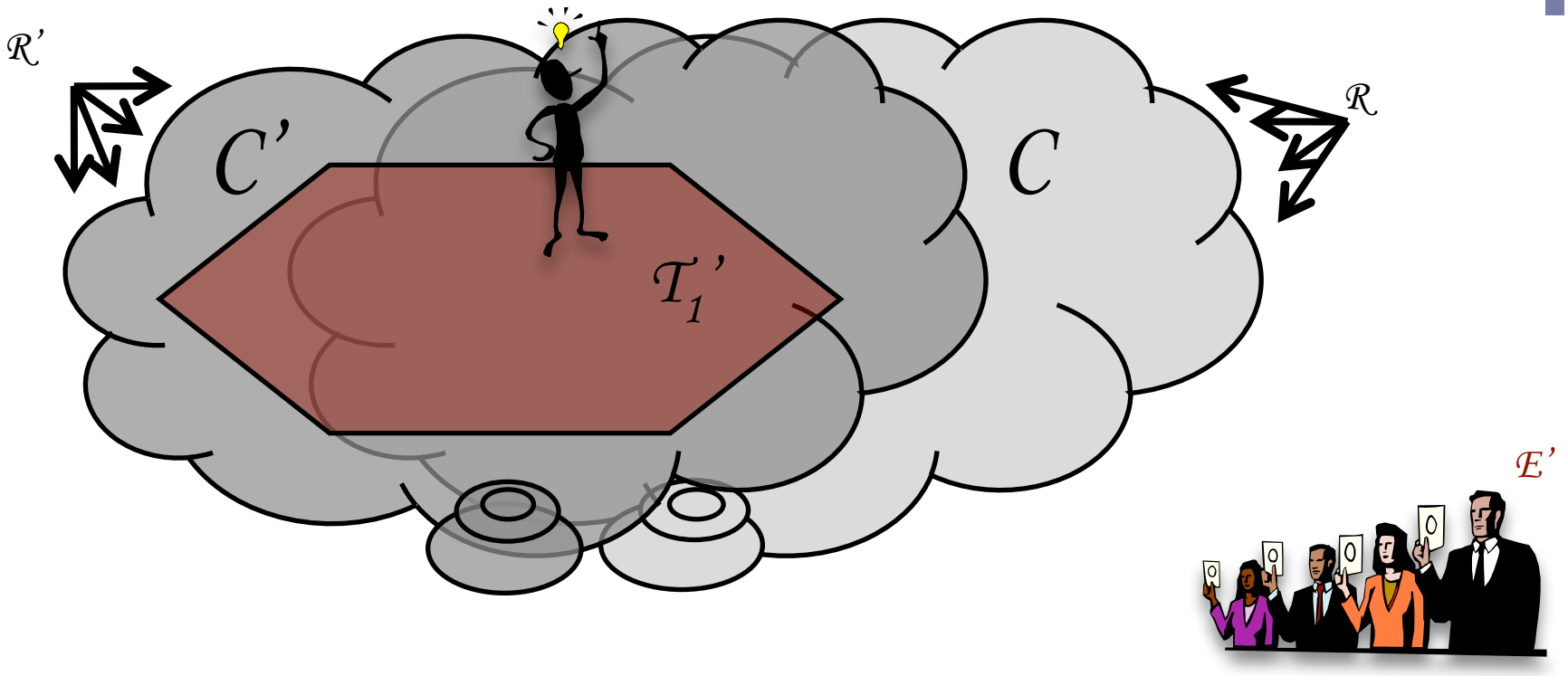


Transformation





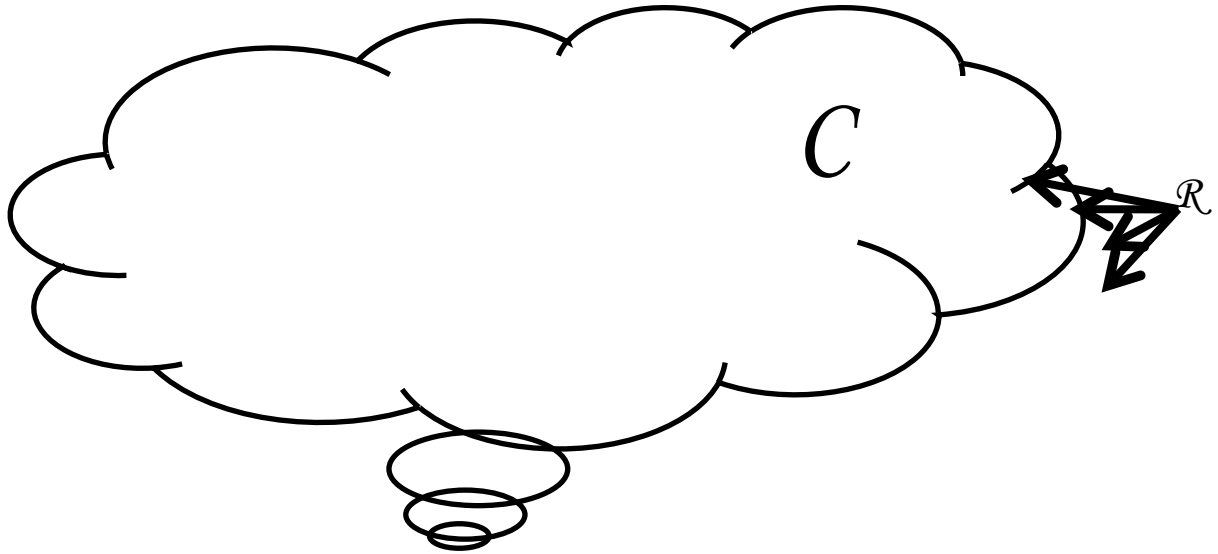
Transformation



Transformation of $\mathcal{R}$: creator explores new space

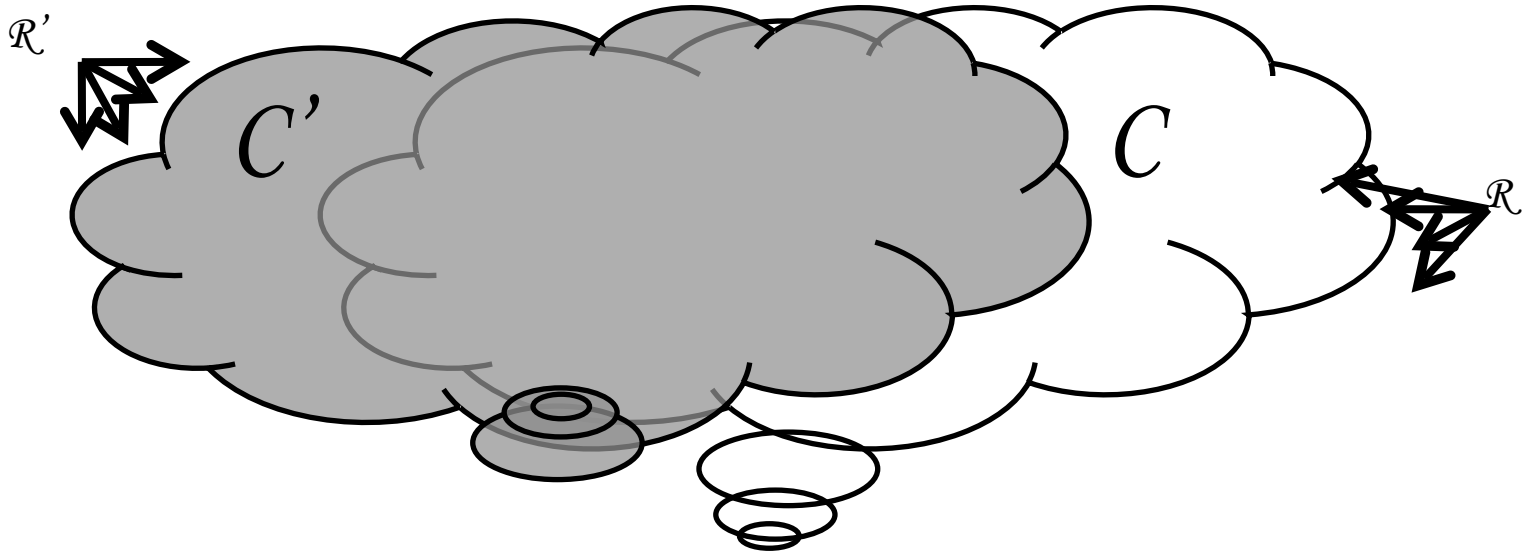
Transformational Creativity

- Change of $\mathcal{R}$ into $\mathcal{R}'$:
  - Corresponds to Boden's notion of *t-Creativity*



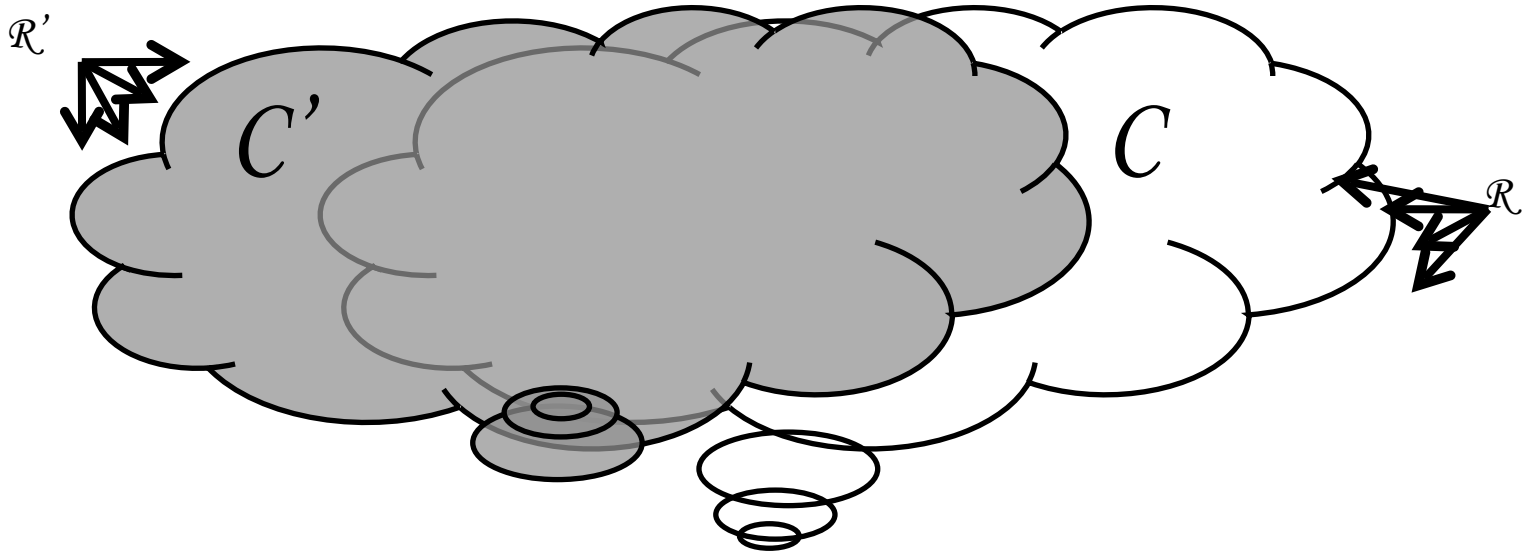
Transformational Creativity

- Change of $\mathcal{R}$ into $\mathcal{R}'$:
  - Corresponds to Boden's notion of *t-Creativity*



Transformational Creativity

- Change of $\mathcal{R}$ into $\mathcal{R}'$:
  - Corresponds to Boden's notion of *t-Creativity*



Search in a Universe of Concepts of new conceptual spaces C', C''...
constrained by $\mathcal{R}'$, $\mathcal{R}''$
(Exploratory Creativity at a meta-level)

Contents

- Dimensions of Analysis
- Computational Approaches
- Characterising Creative Systems
- Evaluating Creative Systems
- Conclusions

Assessing Creative Systems

- Graeme Ritchie (2001, 2007)
  - Features for Assessing Creativity

- Rating schemes:
  - Typicality
  - Value

Assessing Creative Systems

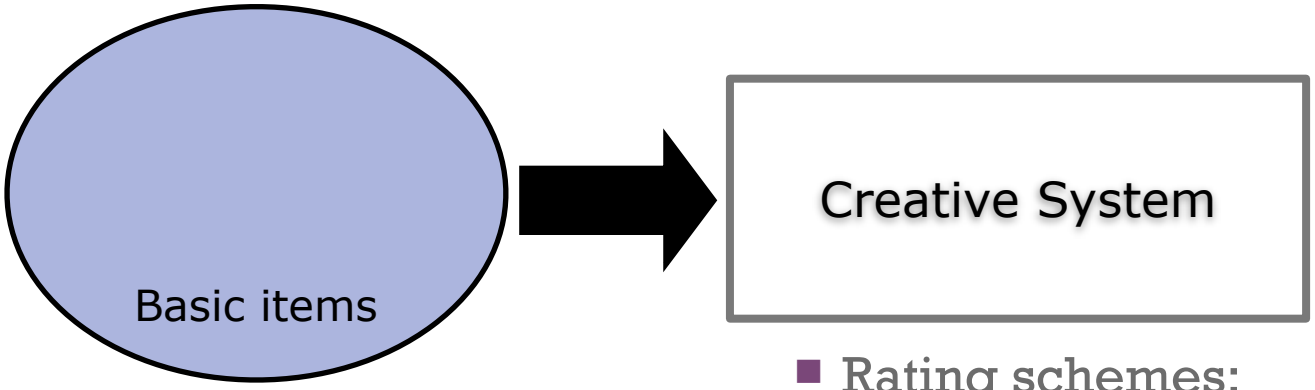
- Graeme Ritchie (2001, 2007)
  - Features for Assessing Creativity

Creative System

- Rating schemes:
  - Typicality
  - Value

Assessing Creative Systems

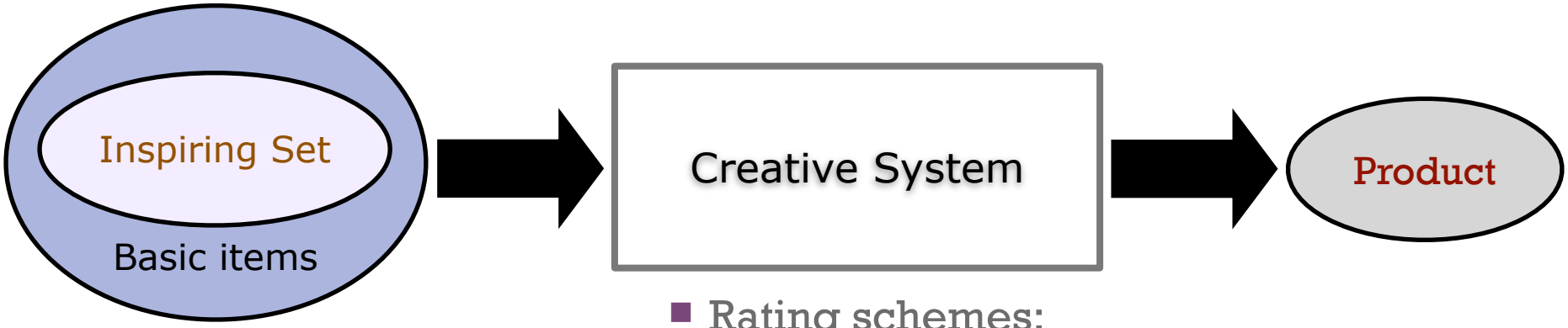
- Graeme Ritchie (2001, 2007)
  - Features for Assessing Creativity



- Rating schemes:
  - Typicality
  - Value

Assessing Creative Systems

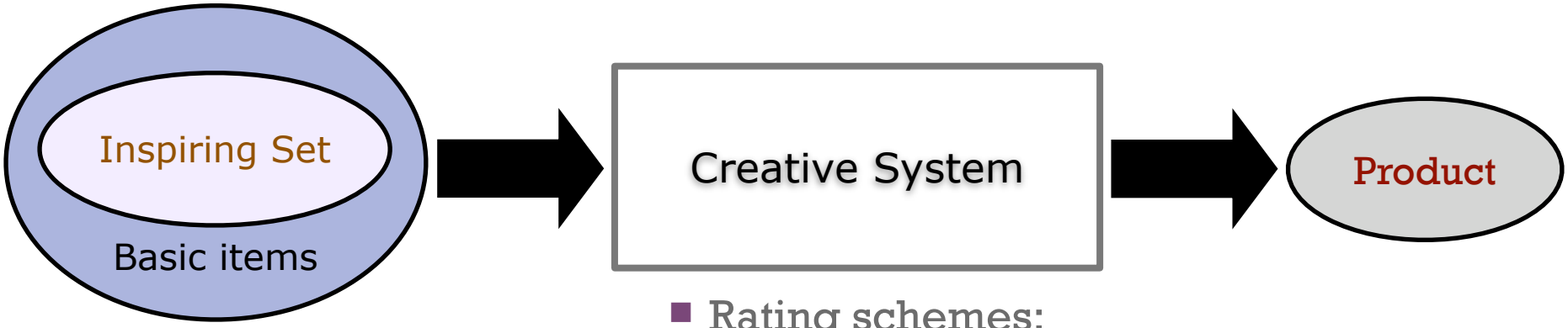
- Graeme Ritchie (2001, 2007)
  - Features for Assessing Creativity



- Rating schemes:
  - Typicality
  - Value

Assessing Creative Systems

- Graeme Ritchie (2001, 2007)
  - Features for Assessing Creativity



- Rating schemes:
  - Typicality
  - Value

What about surprise?

Evaluating Aesthetics

- What makes an image aesthetically appealing?
- Are there any Universal Aesthetic Principles?
- How to replace the user?

Evaluating Aesthetics

- Some influential works::
  - Aesthetic Measures - Birkhoff (1928)
  - Information Aesthetics - Bense (1965)
  - Chaos and Art - Arnheim (1966)
  - Algorithmic Aesthetics - Stiny and Gips (1978)
  - Computing Aesthetics - Machado and Cardoso (1998)
  - Fractal Aesthetics - Taylor et al. (1999)
  - Neurological Basis - Ramachandran & Hirstein (1999)
  - Inner Vision: An Exploration of Art and the Brain - Zeki (1999)
  - Emergent Aesthetics - Ramos (February 2002)
  - Exact Aesthetics - Staudek (July 2002)
  - Learning Aesthetic - Machado and Cardoso (2006)

Contents

- Dimensions of Analysis
- Computational Approaches
- Characterising Creative Systems
- Evaluating Creative Systems
- Conclusions

Computational Creativity

Computational Creativity

- To model, formulate or replicate creativity using a computer, to achieve one of several ends:
  - to construct a program or computer capable of human-level creativity (Authors)
  - to better understand human creativity and to formulate an algorithmic perspective on creative behaviour in humans
  - to design programs that can enhance human creativity without necessarily being creative themselves (computer-aided creativity, technology-enhanced creativity - TEC, ...)

Computational Creativity

- Motivation:
  - More effective computational tools for artistic, architectural technical and scientific applications
  - Support processes of innovation in business and educational contexts
  - Interesting, Multidisciplinary research work
  - Contribute to understand human creativity

Future

- Challenges:
  - Evaluation
  - Convergence (models, taxonomies)
  - Society
  - Applications
  - Critical Mass

EU FP7

EU FP7

- European funding and priorities for ICT research (2007-2013)
  - Although the ICT sector is itself worth 6-8% of the EU's GDP, their importance goes well beyond that - ICTs are also vital to:
    - meeting the globalisation challenge by boosting innovation, creativity and competitiveness throughout the economy; (...)

EU FP7

- European funding and priorities for ICT research (2007-2013)
  - Although the ICT sector is itself worth 6-8% of the EU's GDP, their importance goes well beyond that - ICTs are also vital to:
    - meeting the globalisation challenge by boosting innovation, creativity and competitiveness throughout the economy; (…)
- Objective 4.2, "Technology-enhanced Learning"
  - Target outcomes:
    - (…) Reinforce the links between individual and organisational learning, and creativity: embedding learning experiences in organisational processes and practices, through innovative systems embracing talent, knowledge, workflows, collaborative innovation and competency management; (…)

Some related FP Projects

- COLLABORATION 4 INNOVATION
  - A study on Collaborative Work: Productivity, Creativity and Innovation Impacts and Implications
    - http://www.cdt.ltu.se/projectweb/4329536d76129/Index.html
- id-Space
  - Build an environment to aid distributed teams of innovators who want to collaborate on product design by making use of earlier results by themselves or even others.
    - http://www.idspace-project.org/
- CReATE - ICT Innovations in Creative Industry
  - Creating a Joint Research Agenda for promoting ICT-Innovations in

Some related FP Projects

- CReATE - ICT Innovations in Creative Industry
  - Creating a Joint Research Agenda for promoting ICT-Innovations in Creative Industries across Europe
    - http://www.lets-create.eu/
- DESIRE: Creative Design for Innovation in Science
  - Initial Training Network
  - Bring together expertise in human computer interaction, psychology, arts and design
    - http://www.comp.lancs.ac.uk/%7Ecorina/DESIRE/
- U-CREATE - Creative Authoring Tools for Edutainment Applications
  - http://www.u-create.org/

AISB Symposia on AI and Creativity in Arts and Science	Workshops on Creative Systems	EvoMusArt, EuroGP
Edinburgh, UK, 1999		
Birmingham, UK, 2000		
York, UK, 2001	ICCBR'2001, Vancouver, Canada	
London, UK, 2002	ECAI'2002, Lyon, France	
Aberystwyth, UK, 2003	IJCAI'2003, Acapulco, Mexico	Colchester, UK, 2003
1st. IJW on Computational Creativity 2004, EWCBR, Madrid, Spain		Coimbra, Portugal, 2004
2nd. IJW on Computational Creativity 2005, IJCAI, Edinburgh, UK		Lauzanne, Switzerland, 2005
3rd. IJW on Computational Creativity 2006, ECAI, Riva del Garda, Italy		Budapest, Hungary, 2006
4th. IJW on Computational Creativity 2007, London, UK		Valencia, Spain, 2007
5th. IJW on Computational Creativity 2008, Madrid, Spain		Napoli, Italy, 2008
		Tübingen, Germany, 2009
1st. Int. Conf. on Computational Creativity 2010, Lisbon, Portugal		Istambul, Turkey, 2010

AISB Symposia on AI and Creativity in Arts and Science	Workshops on Creative Systems	EvoMusArt, EuroGP
Edinburgh, UK, 1999		
Birmingham, UK, 2000		
York, UK, 2001	ICCBR'2001, Vancouver, Canada	
London, UK, 2002	ECAI'2002, Lyon, France	
Aberystwyth, UK, 2003	IJCAI'2003, Acapulco, Mexico	Colchester, UK, 2003
1st. IJW on Computational Creativity 2004, EWCBR, Madrid, Spain		Coimbra, Portugal, 2004
2nd. IJW on Computational Creativity 2005, IJCAI, Edinburgh, UK		Lauzanne, Switzerland, 2005
3rd. IJW on Computational Creativity 2006, ECAI, Riva del Garda, Italy		Budapest, Hungary, 2006
4th. IJW on Computational Creativity 2007, London, UK		Valencia, Spain, 2007
5th. IJW on Computational Creativity 2008, Madrid, Spain		Napoli, Italy, 2008
		Tübingen, Germany, 2009
1st. Int. Conf. on Computational Creativity 2010, Lisbon, Portugal		Istambul, Turkey, 2010

2nd. Int. Conf. on Computational Creativity 2011, Mexico City

Shameless promotion...