



# Modeling Creativity

CASE STUDIES IN PYTHON  
TOM D. DE SMEDT



Universiteit  
Antwerpen

**SINT LUCAS ANTWERPEN**  
S<sup>t</sup> LUCAS UNIVERSITY COLLEGE OF ART AND DESIGN ANTWERP

Proefschrift voorgelegd tot het behalen van de graad van  
doctor in de Kunsten aan de Universiteit Antwerpen.

**PROMOTOR** Prof. dr. Walter Daelemans **CO-PROMOTOR** Lucas Nijs

# MODELING CREATIVITY

How can we simulate creativity ?

Tom De Smedt

**PROMOTOR**

Prof. dr. Walter Daelemans  
CLiPS Computational Linguistics Research Group

**CO-PROMOTOR**

Lucas Nijs  
EMRG Experimental Media Research Group

# MODELING CREATIVITY

How can we simulate creativity ?

Tom De Smedt

## **EDUCATION**

BA degree in software engineering

MA degree in audiovisual arts

PhD in arts

## **AFFILIATION**

Co-founder of EMRG

Post-doctoral researcher at CLiPS

# MODELING CREATIVITY

- generative art + selected artworks
- creativity in nature
- creativity in humans
- computer models of creativity
- creativity & language: PATTERN
- sentiment analysis

# GENERATIVE ART

rule-based systems inspired by nature & complexity  
using AI & Artificial Life techniques

selection of works



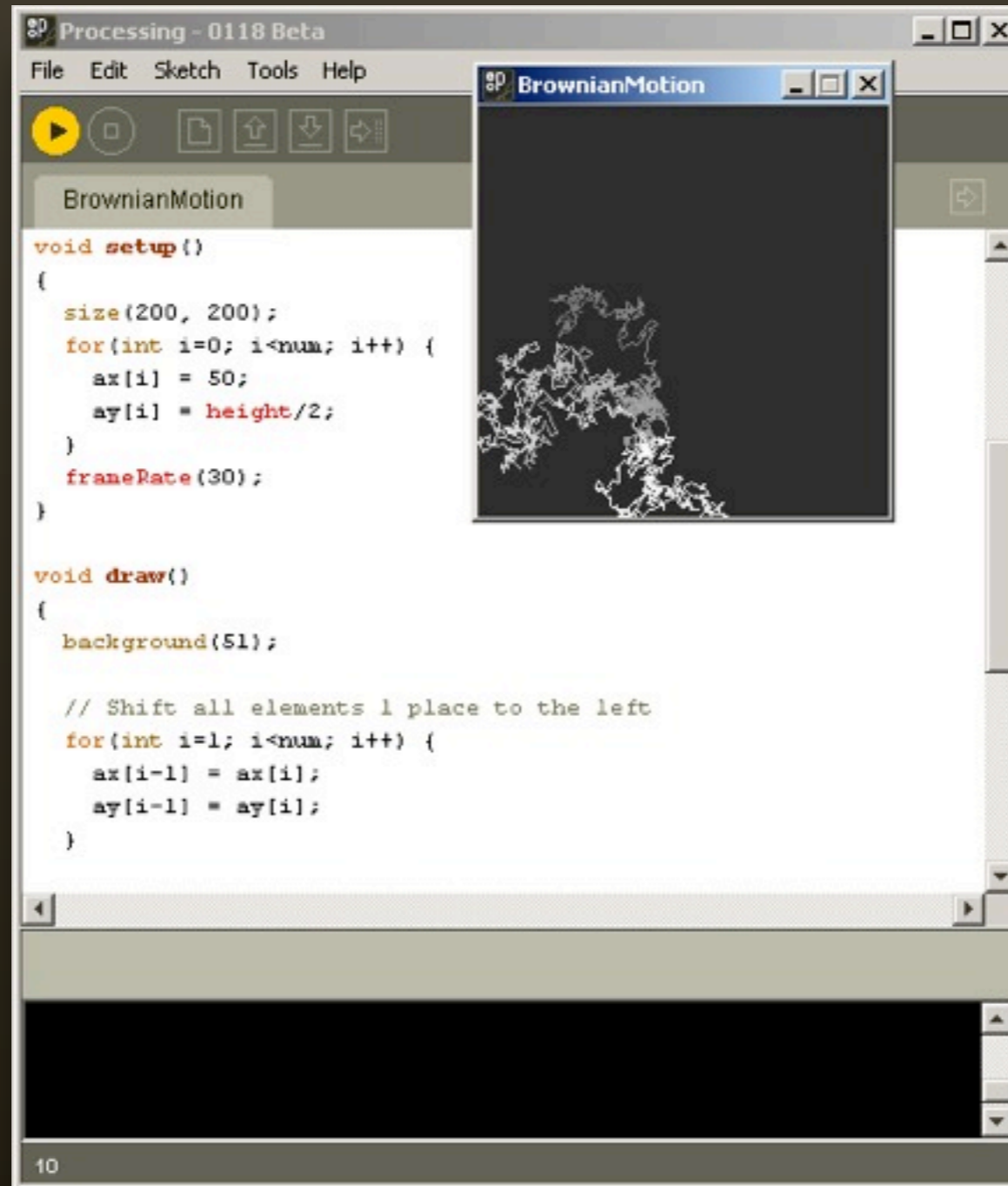
*Self-replication* – De Smedt & Lechat (2010)

rule 1 WINGS rotate to form SPIROS

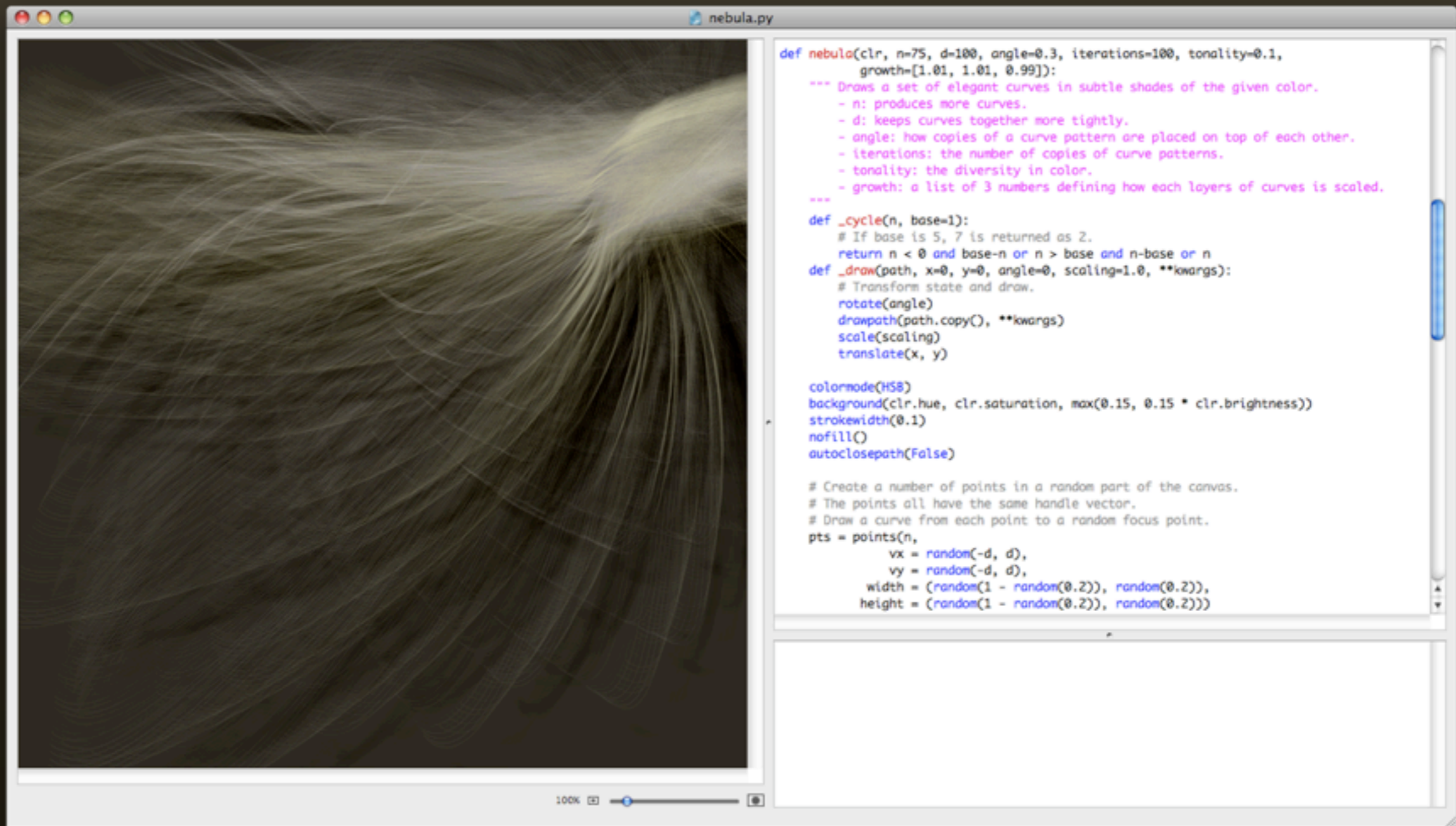
rule 2 WINGS advance to form CHAINS

rule 3 SPIROS spawn smaller SPIROS

rule 4 CHAINS curl near SPIROS



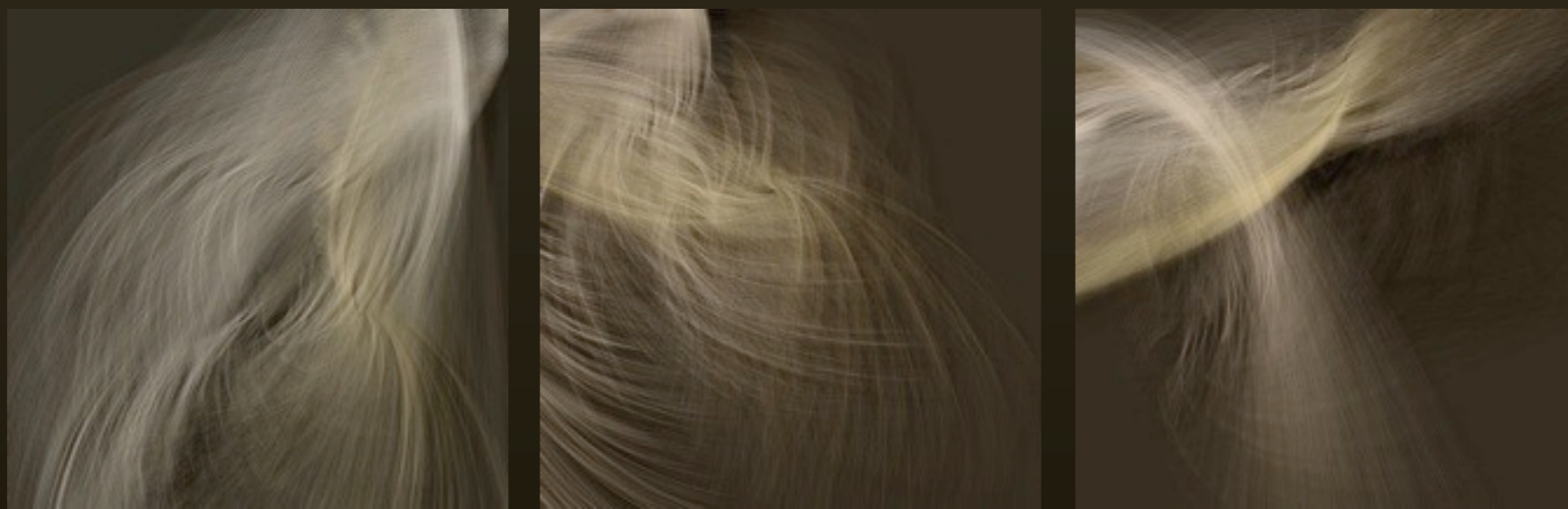
Processing, Casey Reas & Ben Fry (2001)



↑ ↑

NodeBox generates visual output based on Python programming code  
**De Bleser, De Smedt & Nijs (2003)**

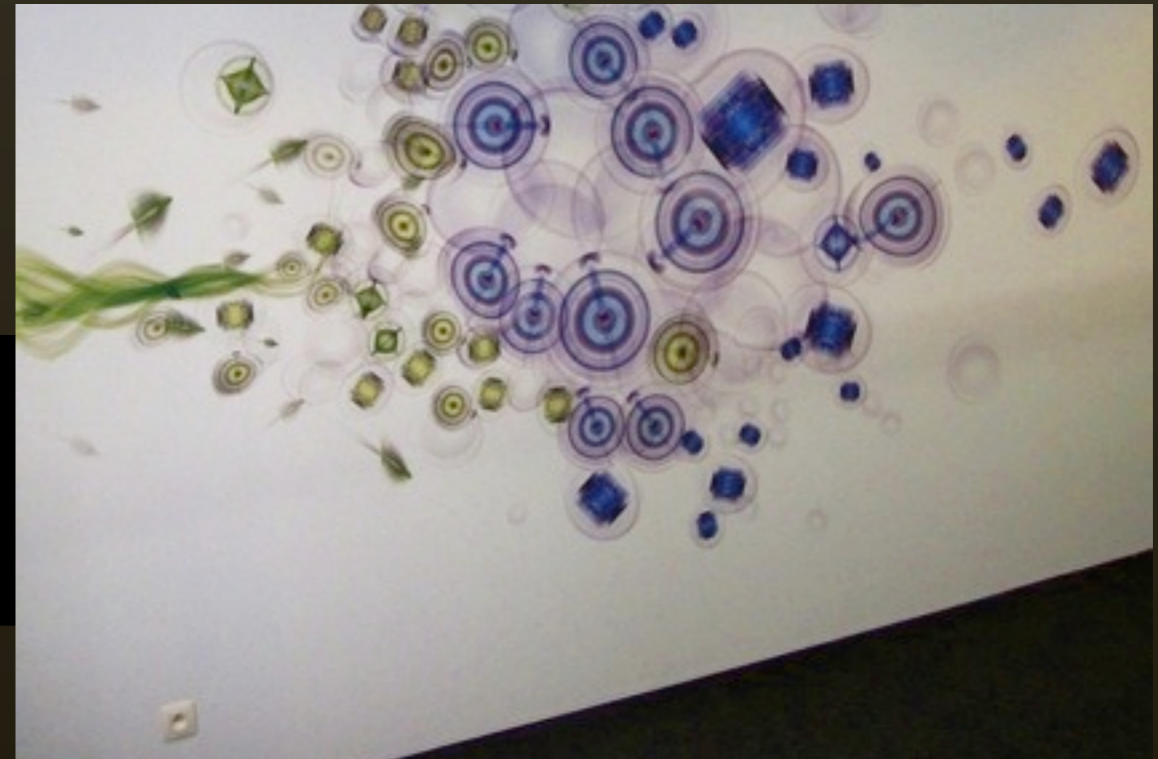




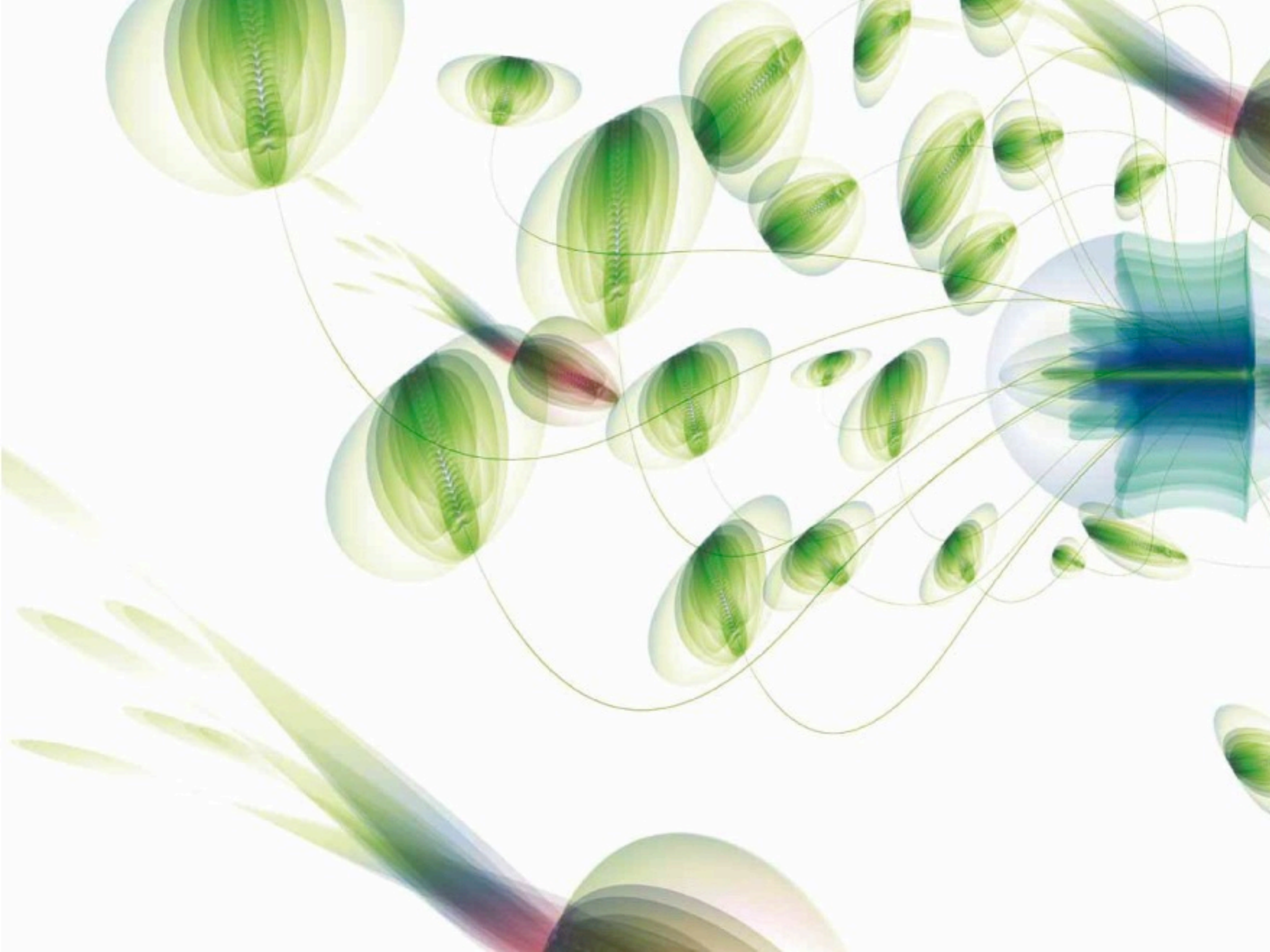
*Nebula* – **De Smedt**, Creativity World Biennale, USA (2010)

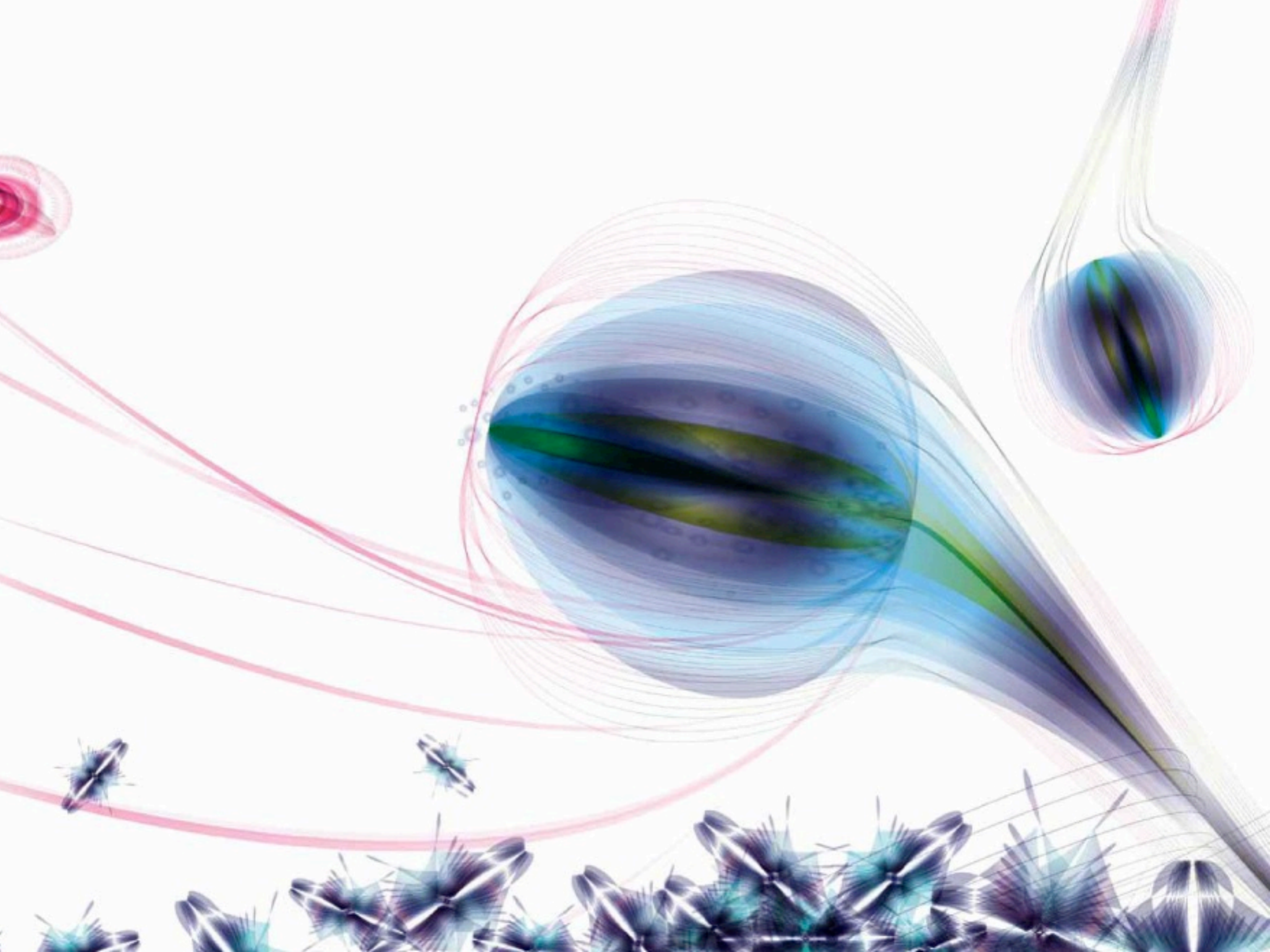


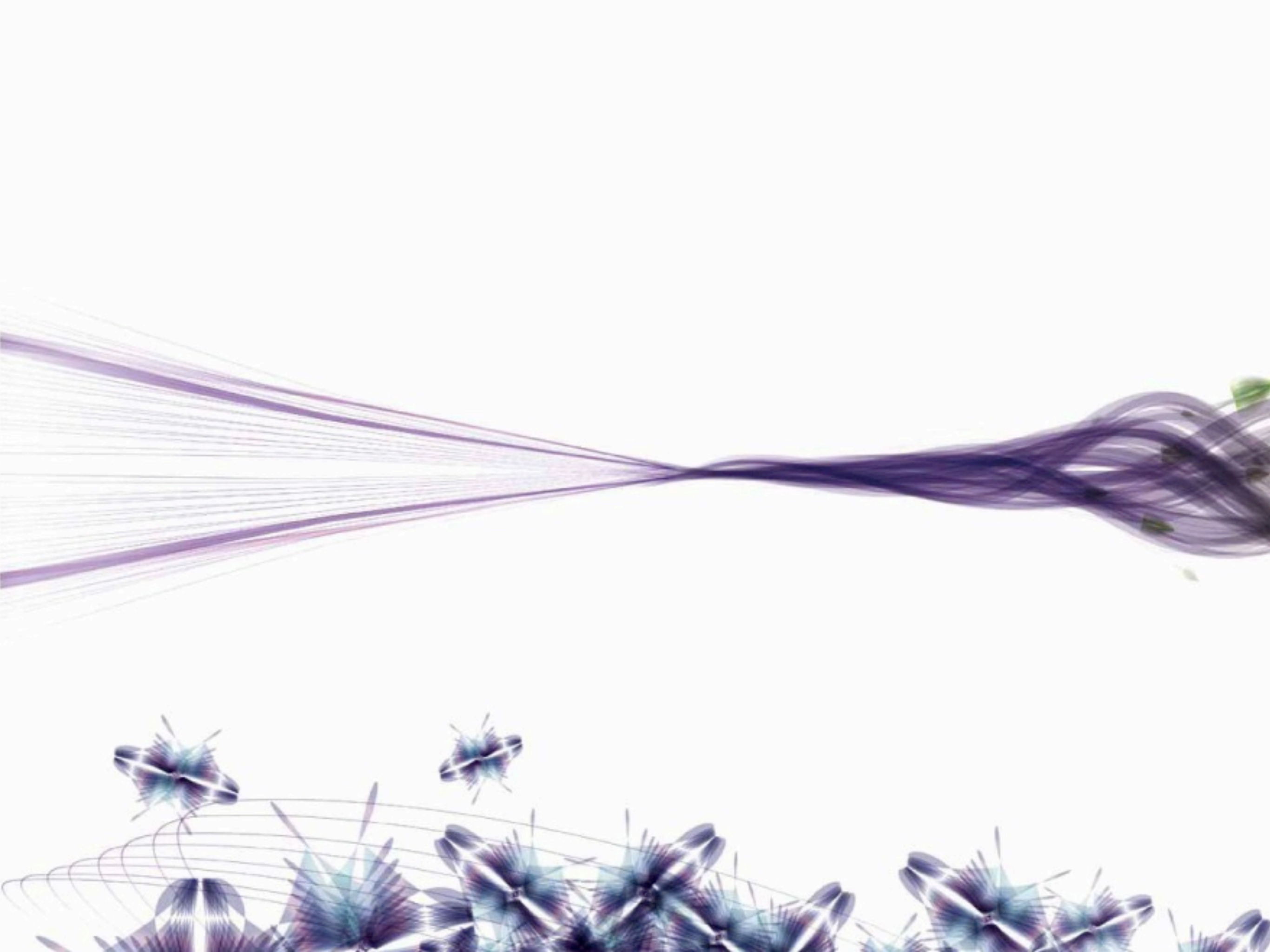
*Creature* – **De Smedt & Lechat**, Creativity World Biennale, USA (2010)



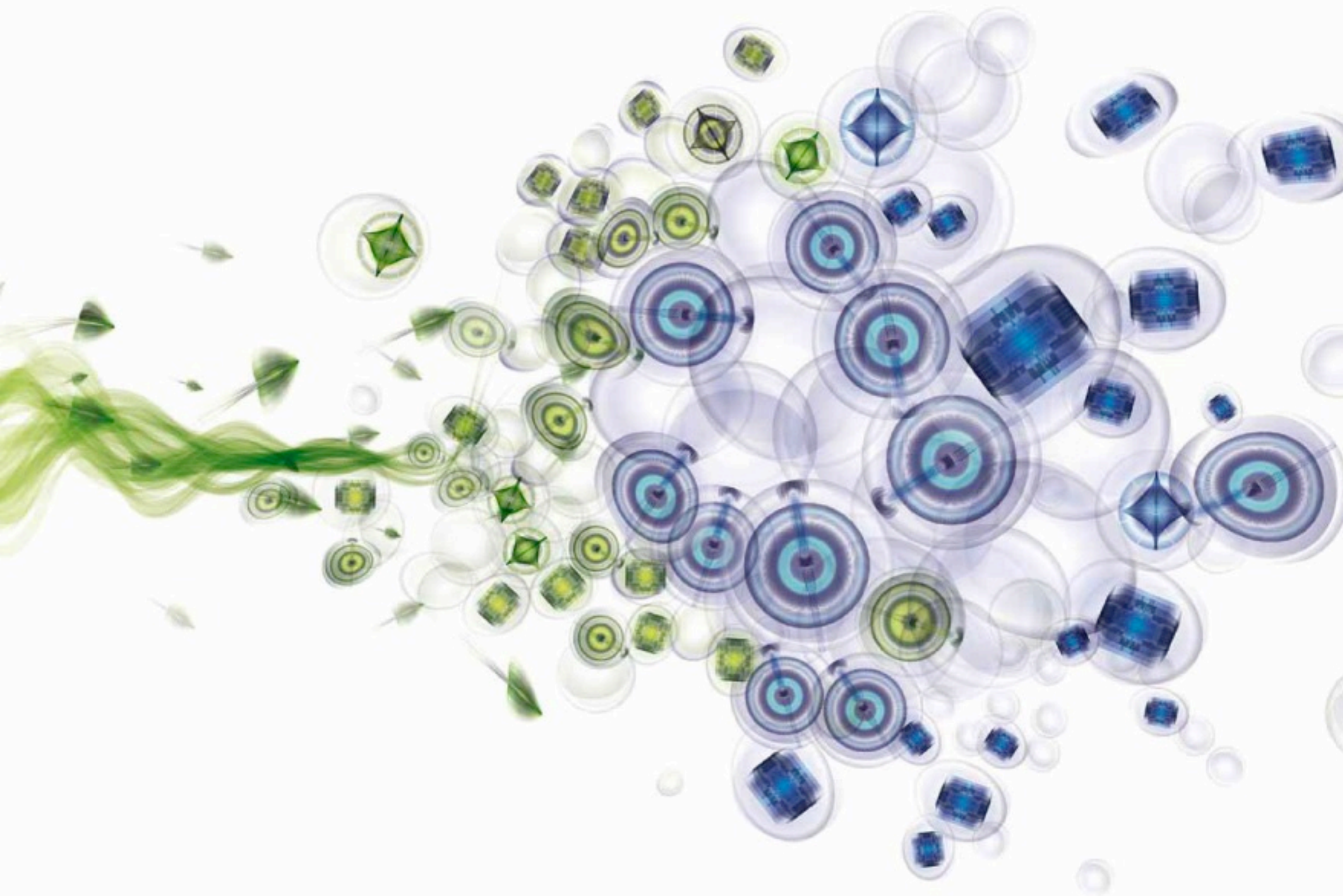
*Nanophysical* – Lechat & De Smedt, IMEC, permanent exhibition (2010)



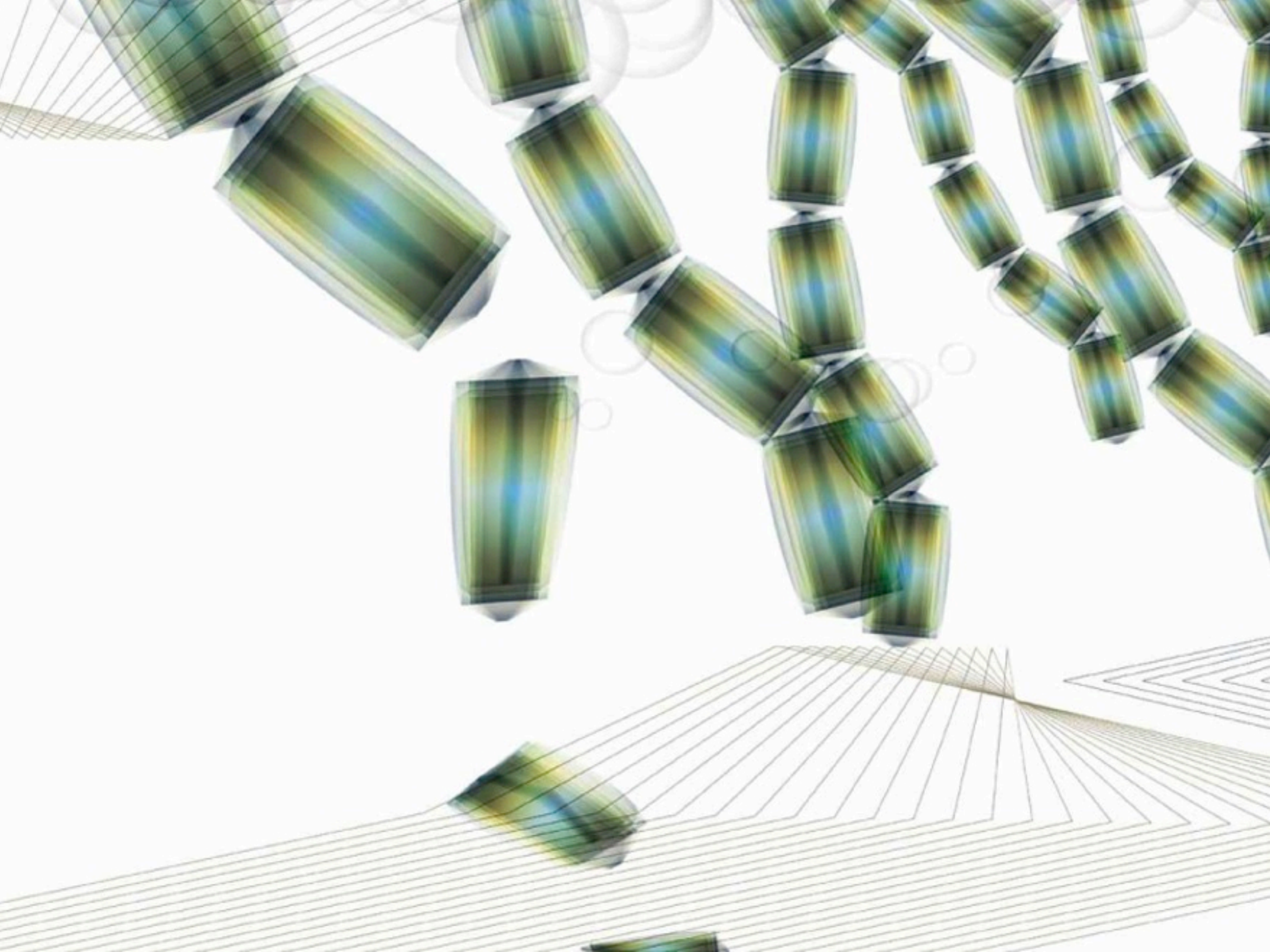


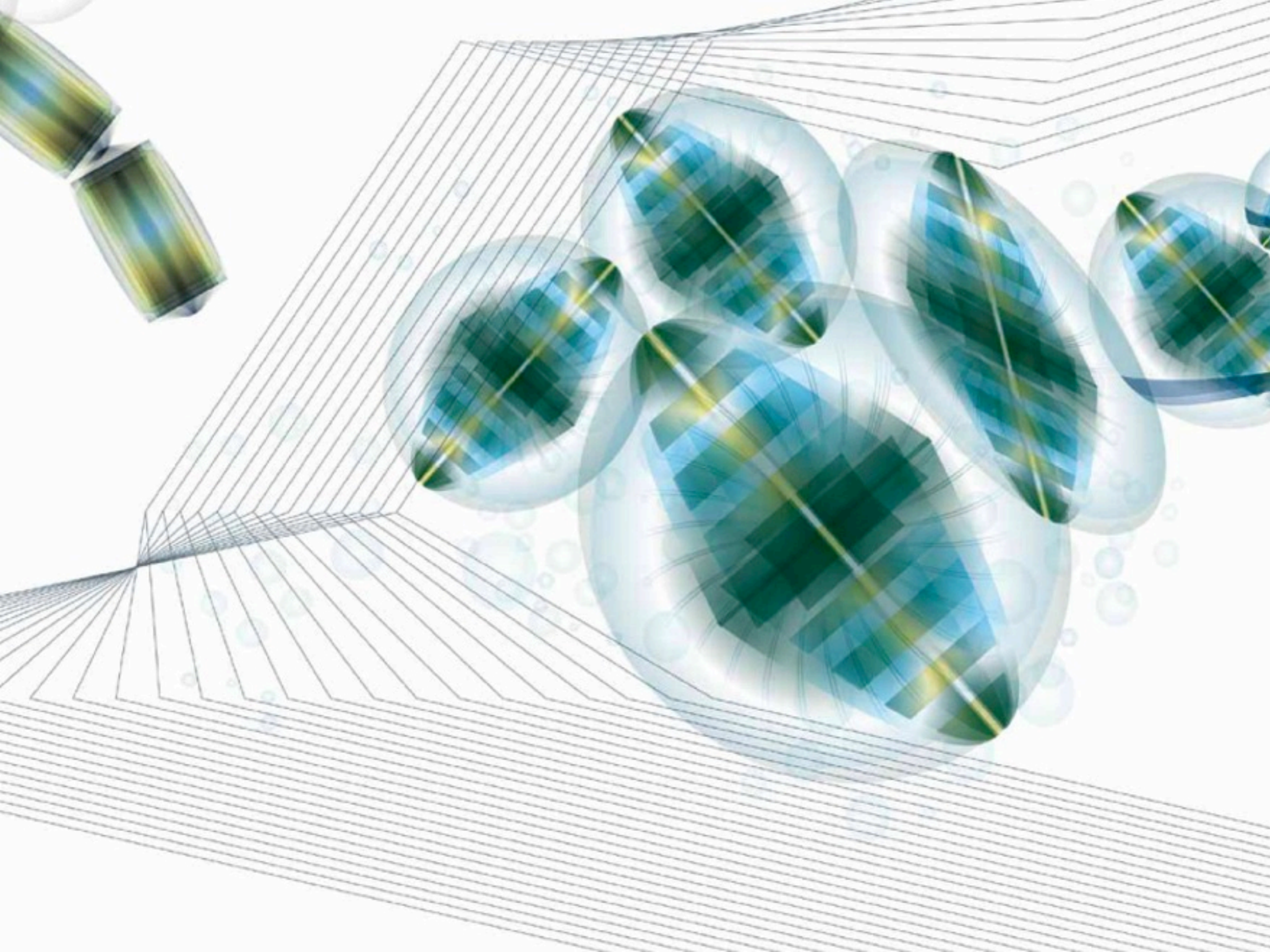


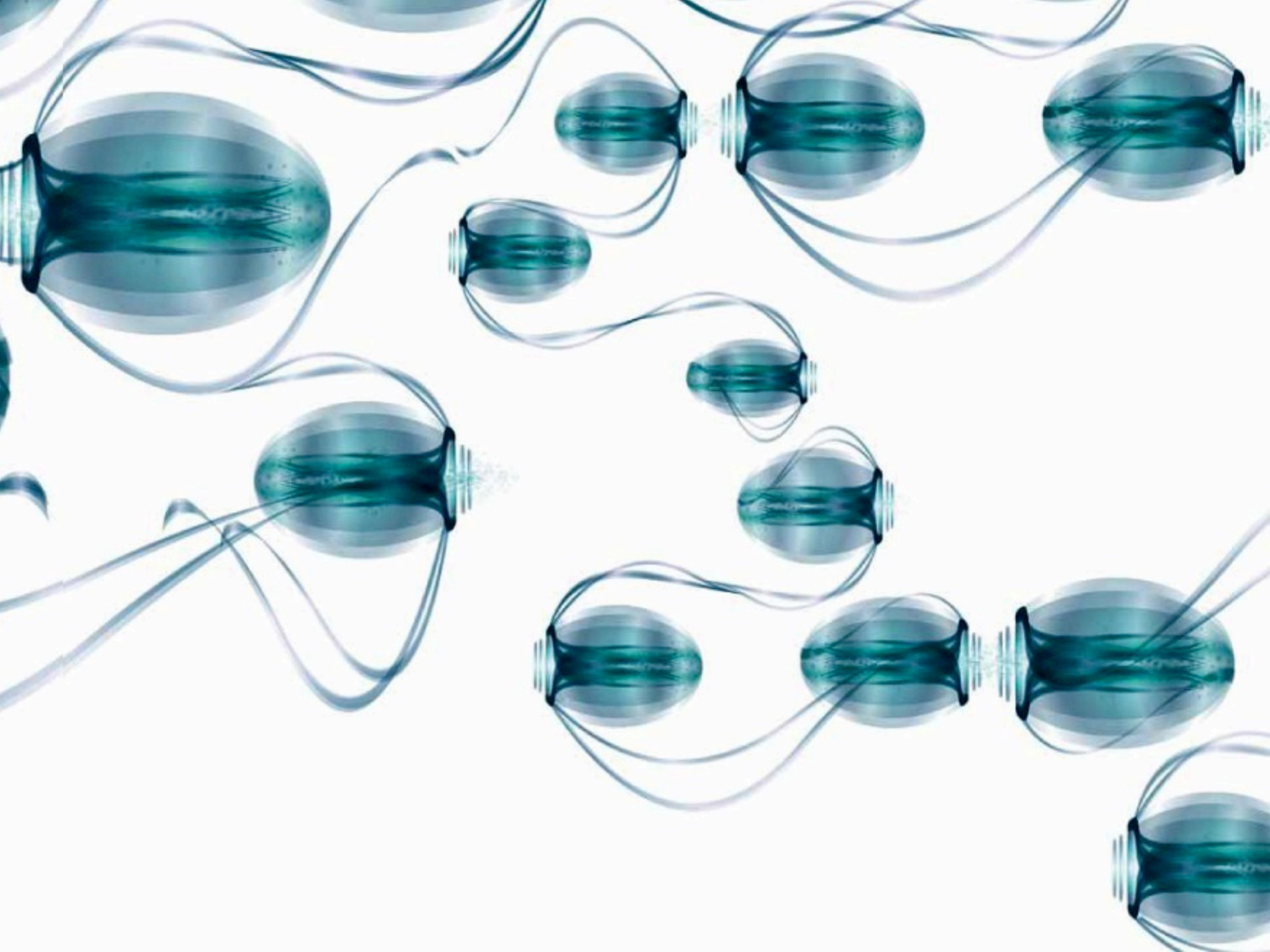


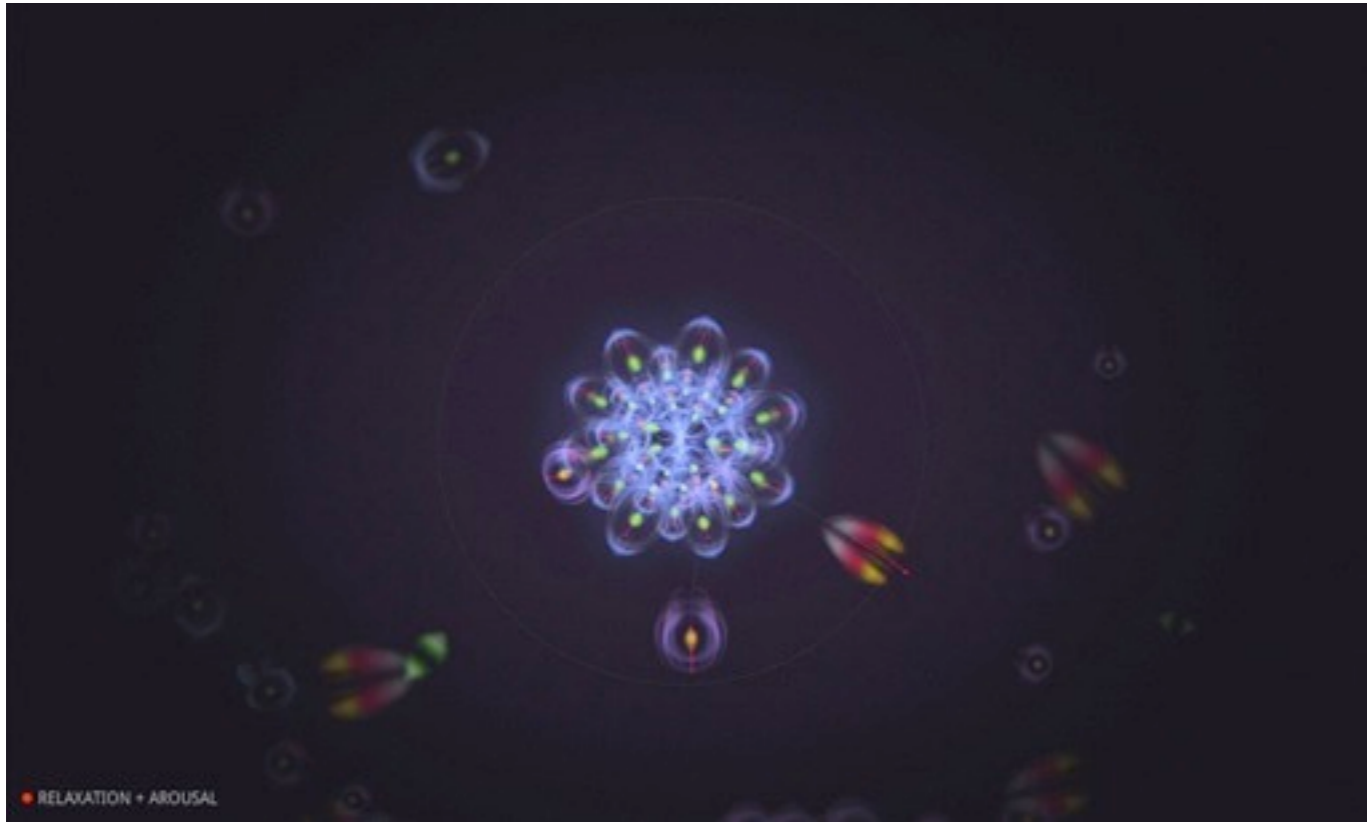




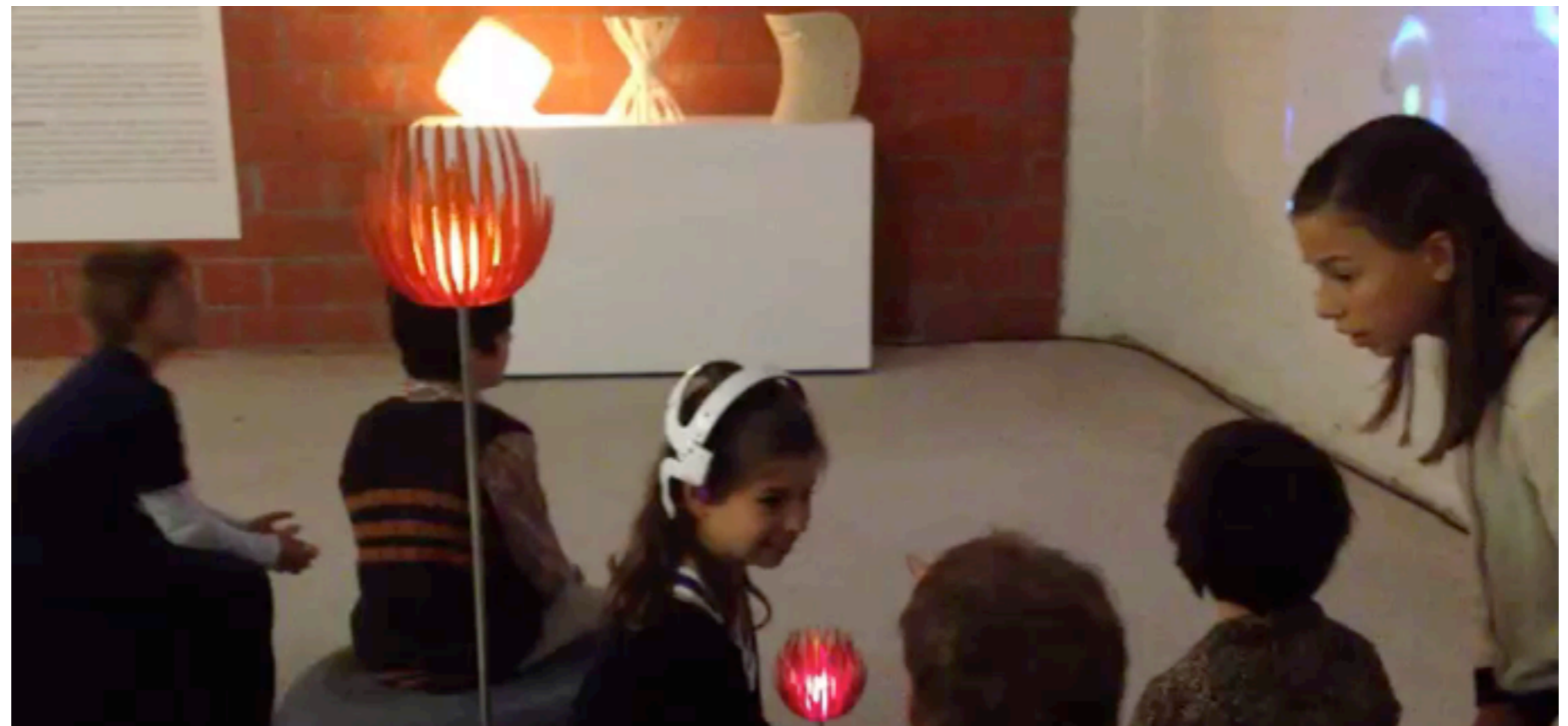








relaxation ↔ arousal  
in the **brain**



*Valence* – De Smedt, Menschaert, Lechat, Grundlehner, Augustynen (2012)



# PROGRAMS THAT ARE AUTHORS?

```
percolate.py
news = 'http://rss.nytimes.com/services/xml/rss/nyt/World.xml'~
news = choice(Newsfeed().search(news, cached=True))~
news = plaintext(news.title + ". " + news.description)~
~
images = []~
for w0, pos in tag(news.lower()):~
    if pos == 'NN': # nouns~
        try:~
            w = wordnet.synsets(w0)[0]~
            w = choice([w] + w.hyponyms())~
            w = choice(w.synonyms)~
            img = choice(Bing().search(w, type=IMAGE, cached=True))~
            img = Image(None, data=URL(img.url).download(cached=True))~
            img.save("percolate-%s.png" % w0)~
            images.append(img)~
        except:~
            pass~
~
def cutout(img, w, h, filters=(blur, desaturate, mirror)):~
    img = render(lambda: img.draw(80, 0, w-60, h), w, h)~
    img = choice(filters)(img)~
    img = mask(img, invert(gradient(w, h, type="radial")))~
    img = transparent(img, alpha=random(0.5, 1.0))~
    return img~
~
w, h = 400, 400~
def draw(canvas):~
    if canvas.frame == 1:~
        layers = [cutout(img, w, h) for img in images]~
        composition = solid(w, h, color(0))~
        for i in range(75):~
            composition = choice((screen, multiply))(~
                img1 = composition, ~
                img2 = choice(layers), ~
                dx = random(-w/2, w/2), ~
                dy = random(-h/2, h/2))~
            composition.draw()~
~
canvas.size = w, h~
canvas.draw = draw~
canvas.run()
```

Line: 36 Column: 25 Python Soft Tabs: 4 draw(canvas)

# PROGRAMS THAT ARE AUTHORS?



- find news (nytimes.com)
- find synonyms
- find images (Google)
- random pixel effects

# PROGRAMS THAT ARE AUTHORS?



- find news (nytimes.com)
- find synonyms
- find images (Google)
- random pixel effects
  
- bet → **jackpot**
- vehicle → **car** ...

“Europe's big **bet**: while electric **vehicle** charging stations are clearly the most ambitious part of the plan, the eight billion-euro package includes standards for developing hydrogen, biofuel and other natural **gas** networks.”





# PROGRAMS THAT ARE AUTHORS?

## INTERPRETATION BIAS

- “seems” creative ...
- but **unintentional** (random)
- ▶ mind creates narrative

car + green

gas + profit



how can we make it really creative?

what is creativity?

# CREATIVITY IN NATURE



# AGENT-BASED MODELING

Craig Reynolds (1987)

Flocks, herds and schools: A distributed behavioral model

*Proceedings of SIGGRAPH '87*



**SEPARATION**  
steer to avoid others

**ALIGNMENT**  
steer to mean heading

**COHESION**  
steer to flock centroid

# AGENT-BASED MODELING

one class, many instances

```
class Agent:
    def __init__(self, flock):
        self.flock = flock
        self.x = 0
        self.y = 0
        self.z = 0
        self.v = (0, 0, 0)
    def align(self):
        vx = vy = vz = 0
        for a in self.flock: # not very optimal!
            vx += a.v[0]
            vy += a.v[1]
            ...
```

**SEPARATION**  
steer to avoid others

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# AGENT-BASED MODELING

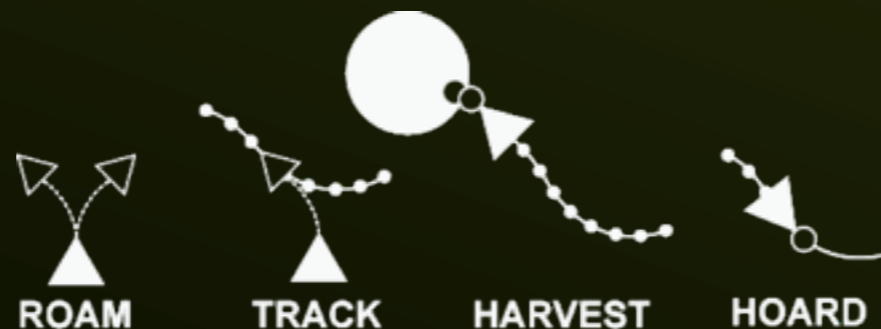
## SIMULATION

- multiple agents interact (e.g., ants)
- ▶ result is often unexpected, emergent

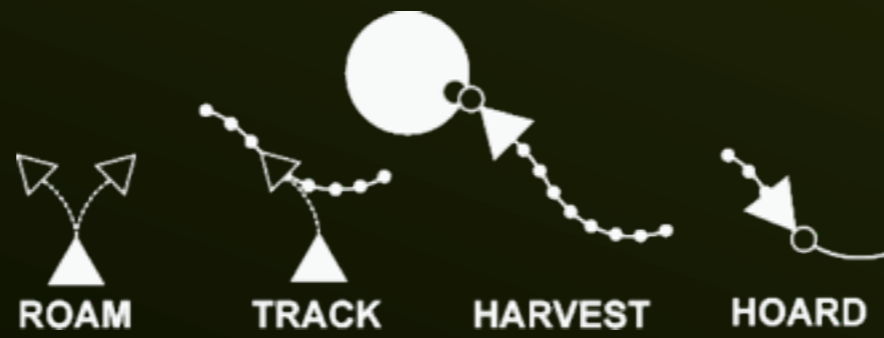
## AGENT

define behavior of one agent (e.g., ant):

1. roam
2. track scent trails to food
3. harvest nearby food
4. hoard food at nest, leaving a scent trail



# ANT COLONY SIMULATION



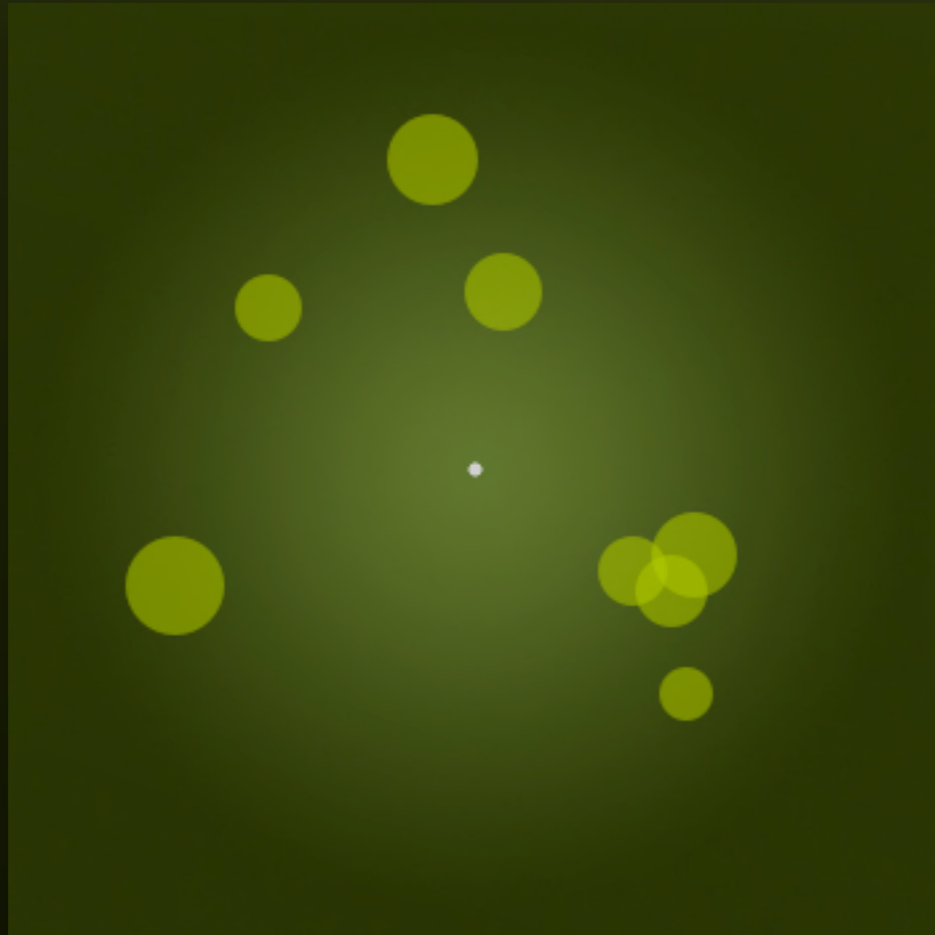
## ANT COLONY SIMULATION

**COOPERATION**  
ANTS FOLLOW SCENT TRAILS

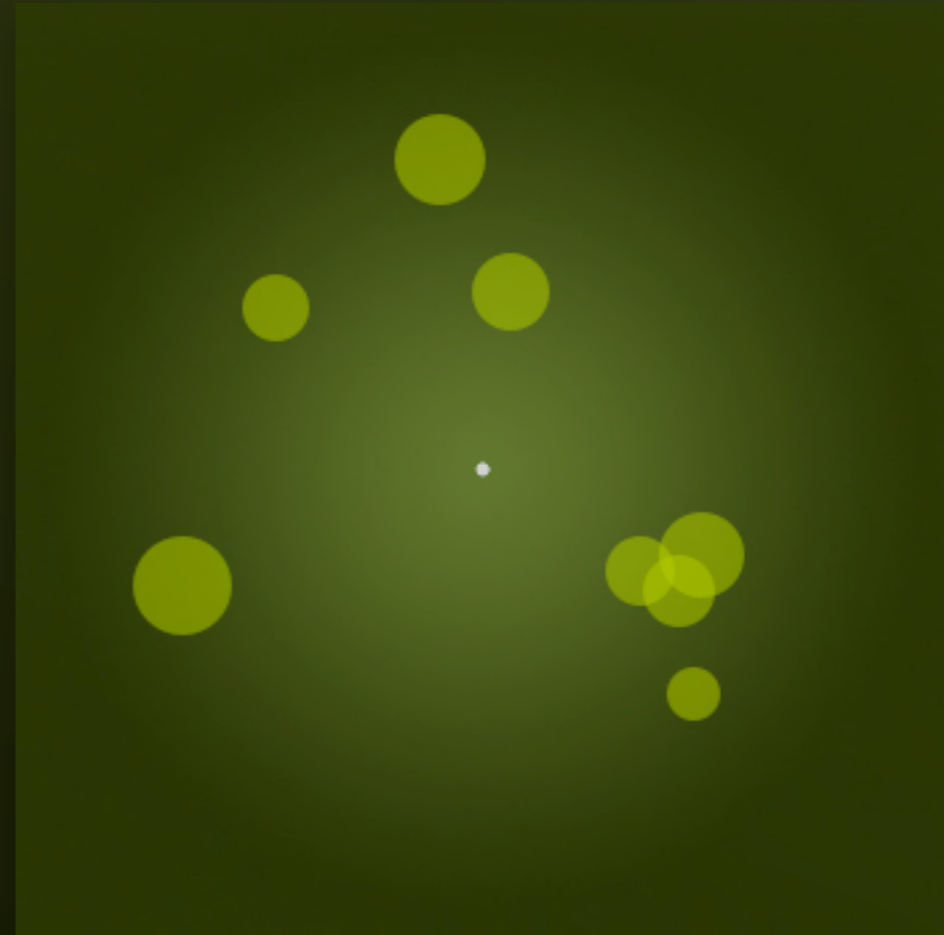
**SOLITARY**  
ANTS FORAGE INDIVIDUALLY



# ANT COLONY SIMULATION



**COOPERATION**  
ANTS FOLLOW SCENT TRAILS



**SOLITARY**  
ANTS FORAGE INDIVIDUALLY

# EVOLUTION

## **NATURAL SELECTION**

ants that cooperate have:

- more food
- better defenses
- ▶ better chances of producing offspring

## **EVOLUTION**

- offspring inherit the behavior (genes)
- ▶ cooperative behavior proliferates

## **VARIATION**

- offspring will have genetic variation →  
new, slightly different “tricks”



# COMPLEXITY

## **EMERGENCE**

colony exhibits complex behavior:

- collaborative foraging
- caterpillar herding ...
- ▶ while the parts (ants) are simple

## **COMPETITION**

colony interacts:

- with other colonies
- with other species (humans), seeds ...
- ▶ these must now adapt too

## **ECOSYSTEM**

colony is a system inside a bigger, dynamic system

## COMPETING ANT COLONIES



COLONY 3  
ABUNDANT RESOURCES

COLONY 1 ↔ 2  
COMPETITION FOR RESOURCES  
“PLUNDERING”

# GENETIC ALGORITHM

## POPULATION

candidate solutions (agents, algorithms):

- candidate = array or string
- ▶ data can be split & spliced

## FITNESS FUNCTION

- select top candidates
- recombine into a new population



# GENETIC ALGORITHM

Karl Sims (1994)  
Evolving virtual creatures  
*Proceedings of SIGGRAPH '94*



# GENETIC ALGORITHM



Jian Jun Hu & Erik Goodman (2002)  
The hierarchical fair competition (HFC) model  
*Proceedings of CEC '02*

ARGUMENT

CREATIVITY IN NATURE IS “BLIND”

the result of evolution and complexity  
with no predefined goal



## ARGUMENT

# NOTHING COMES FROM NOTHING

complex systems have interacting parts

DNA → cell → ant → ant colony → ecosystem ...

creativity is a complex of underlying factors  
(not a magical gift)



humans = intentional

PICCES MARIS CREAT DEVS AE VOLVCRES COELI

# CREATIVITY IN HUMANS

Robert Sternberg (1998)  
Handbook of Creativity  
*Cambridge University Press*

Margaret Boden (2003)  
The creative mind: Myths and mechanisms  
*Routledge*

Gilles Fauconnier & Mark Turner (2003)  
The way we think: Conceptual blending and the mind's complexities  
*Basic Books*

# CREATIVITY IN HUMANS

“A poet is a light and winged thing, and holy, and never able to compose until he has become inspired, and is beside himself and reason is no longer in him.” – Plato

## **HISTORY**

only god(s) create stuff :

- ▶ man can be divinely inspired

## **PRESENT**

irrationality persists :

- belief systems, thinking hats, luck charms ...
- obsessive-compulsive behavior
- substance abuse

# CREATIVITY IN HUMANS

## PRESENT

creativity  $\neq$  art or the divine:

- ▶ everyone solves problems creatively  $\approx$  learning
- everyday creativity (**LITTLE-C**)
- historical creativity (**BIG-C**)

LITTLE-C



LITTLE-C



LITTLE-C



BIG-C



# TALENT

a complex of factors :

- HEREDITY** ▶ creativity does not run in families (intelligence does)
- ENVIRONMENT** ▶ creativity = challenging childhood & peer group
- PERSONALITY** ▶ creativity = non-conformism, ambition, broad interests, introversion
- INTELLIGENCE** ▶ creativity = IQ  $\geq$  120 + hard work
- EXPERIENCE** ▶ creativity = 10,000 hrs of deliberate practice
- KNOWLEDGE** ▶ creativity = knowledge → the building blocks for new ideas
- MOTIVATION** ▶ creativity = curiosity, interest & enjoyment in a task  
( $\neq$  money or rewards)

# KNOWLEDGE

building blocks for new ideas

SPORK



## NOVELTY

new idea = combination of known ideas

- ▶ spoon + fork = spork

## APPROPRIATENESS

new idea = useful or useless

- ▶ knork? knoon?

## THINKING STYLES

different ways to think

- combine ideas
- explore an idea
- transform the knowledge space → add new ideas & relations
- ▶ flexibility = creativity



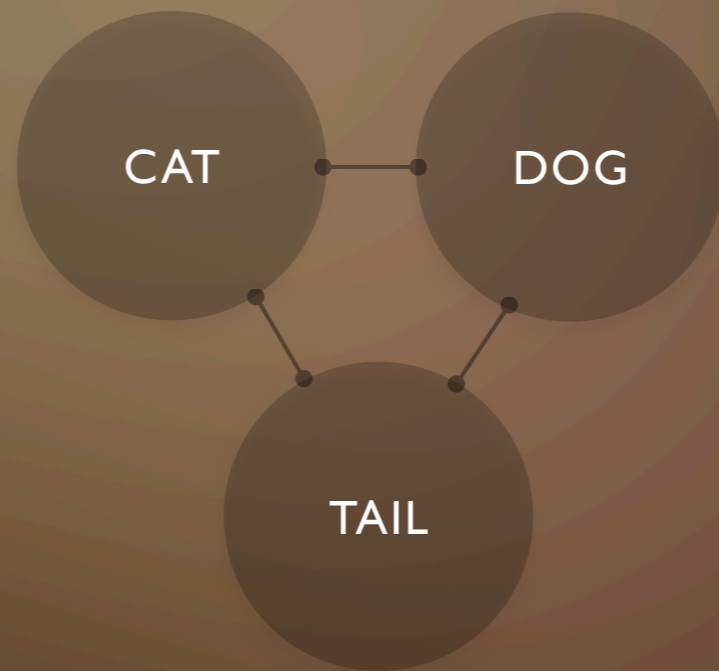
KNOON / SPIFE

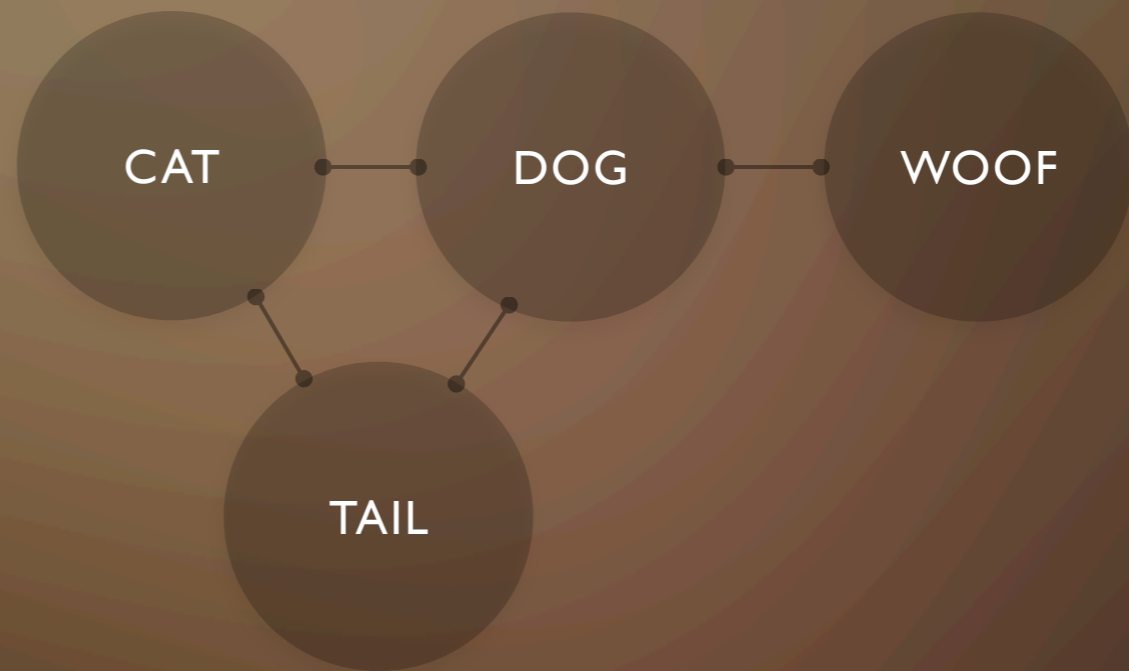


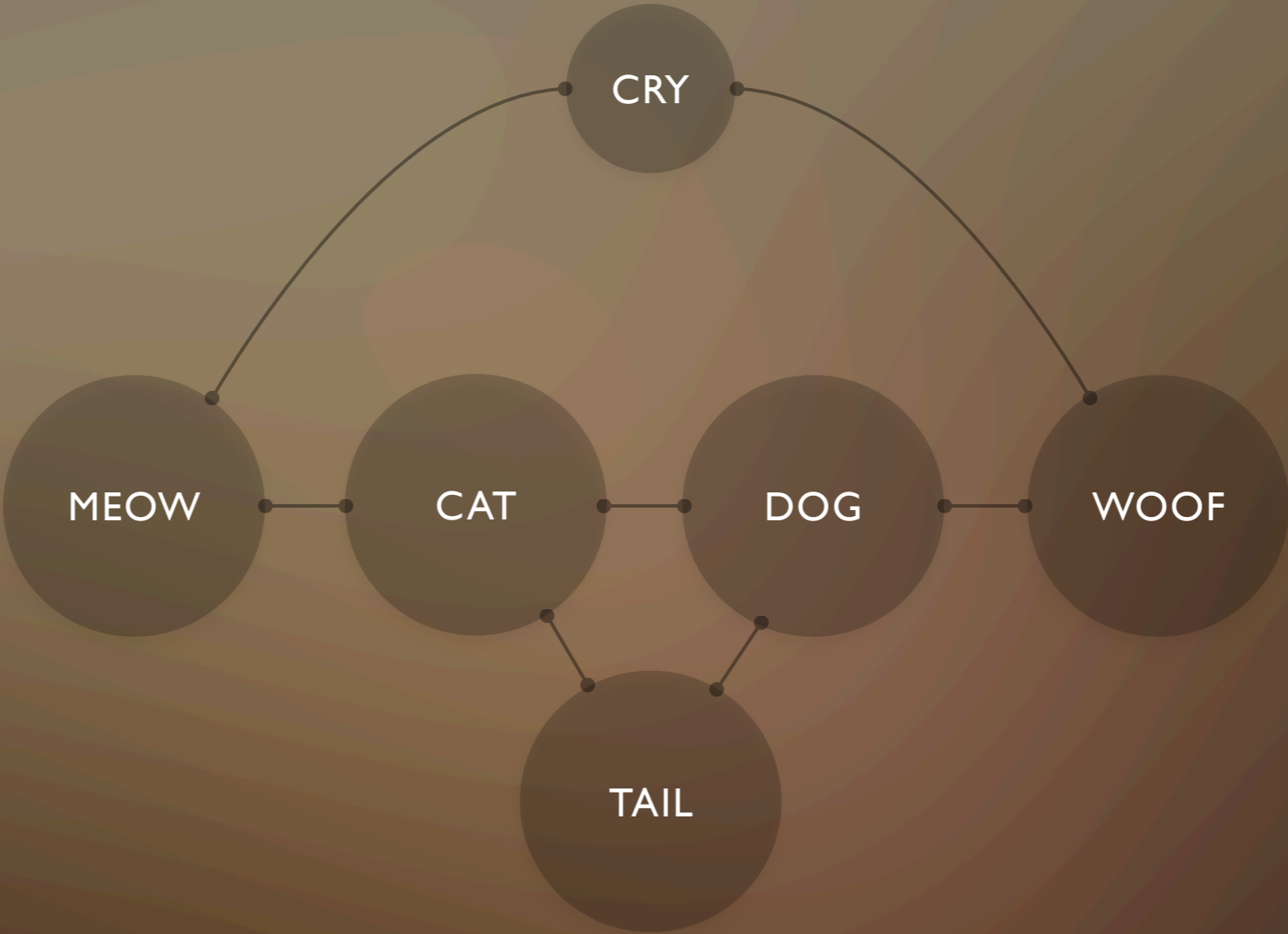


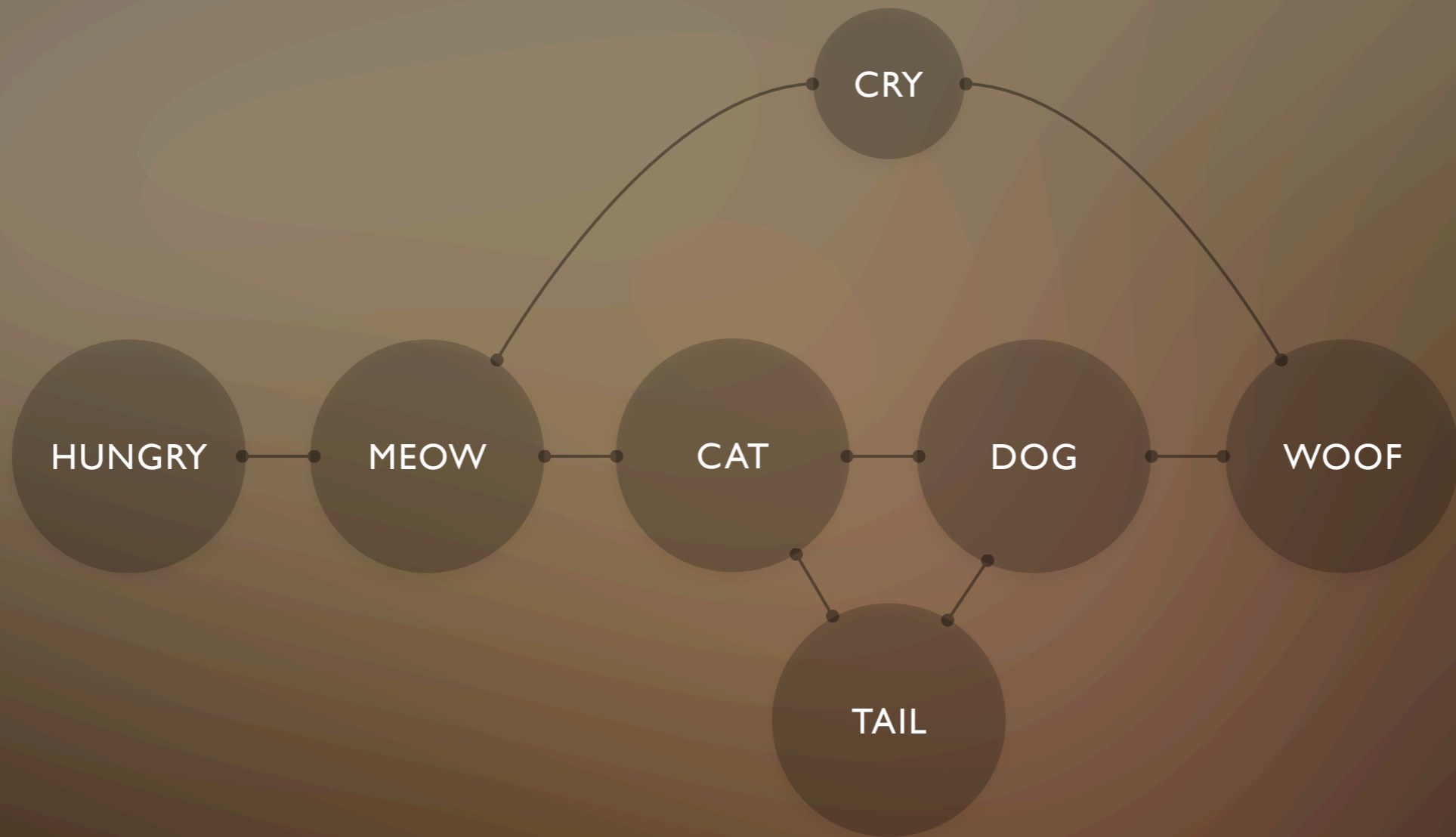


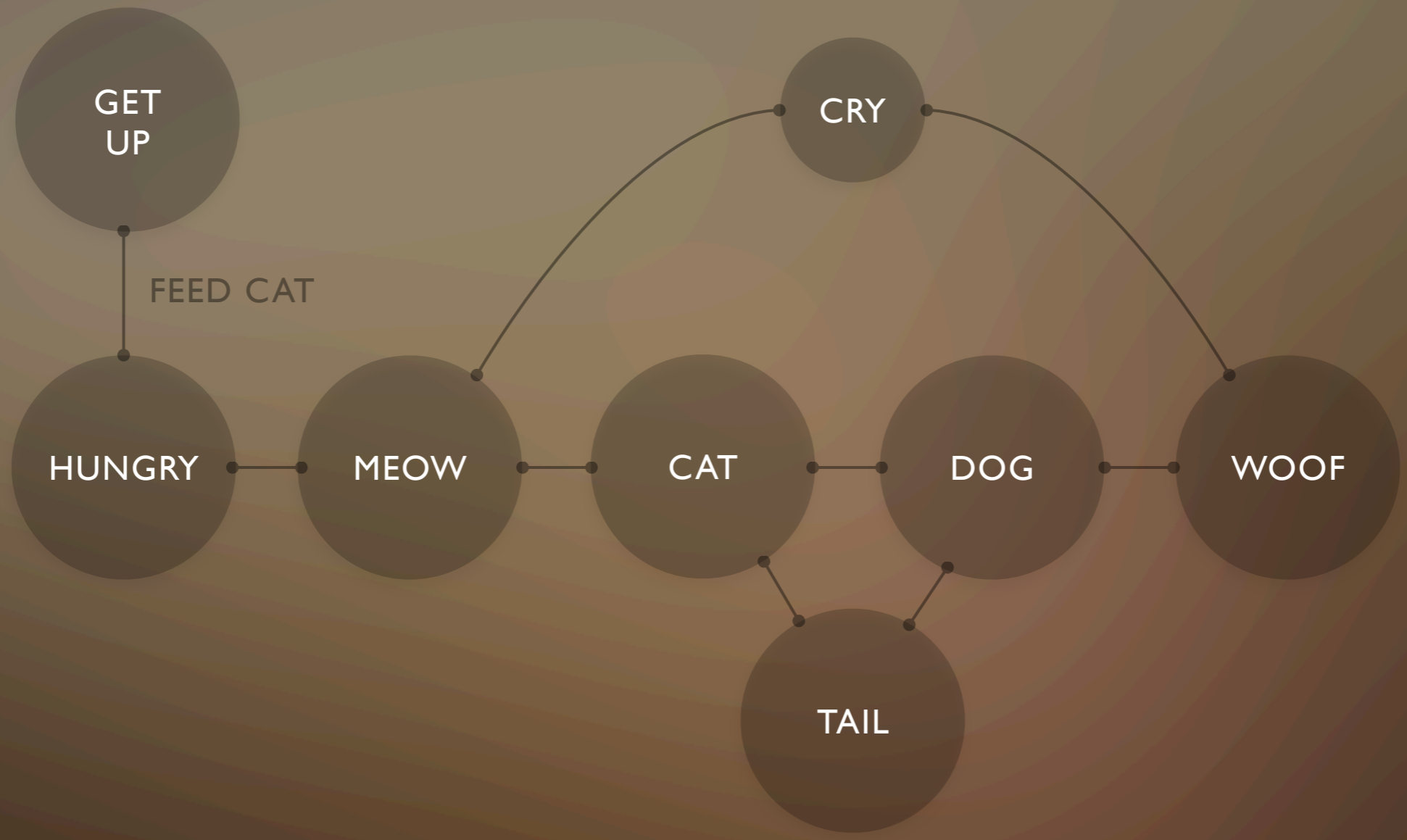


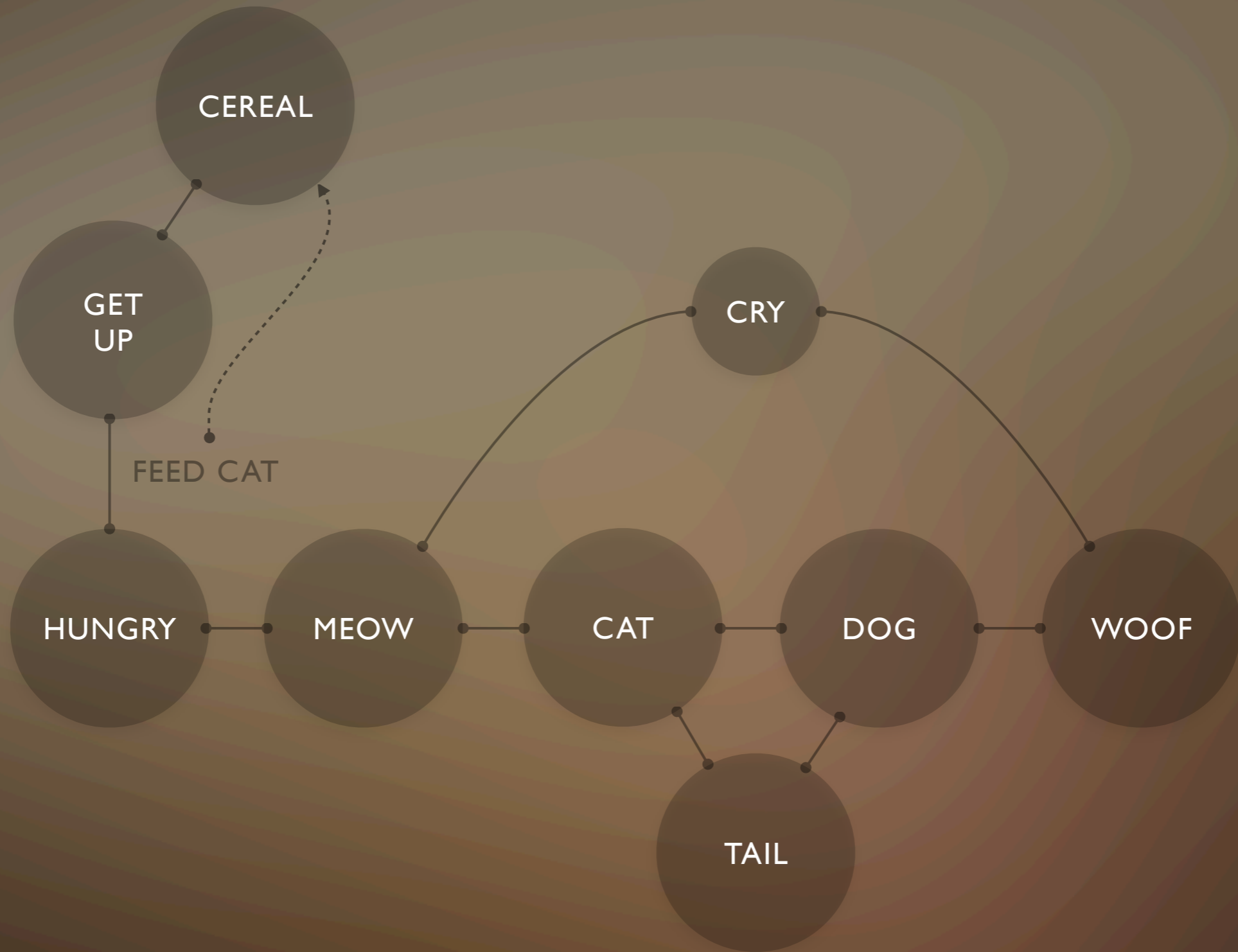




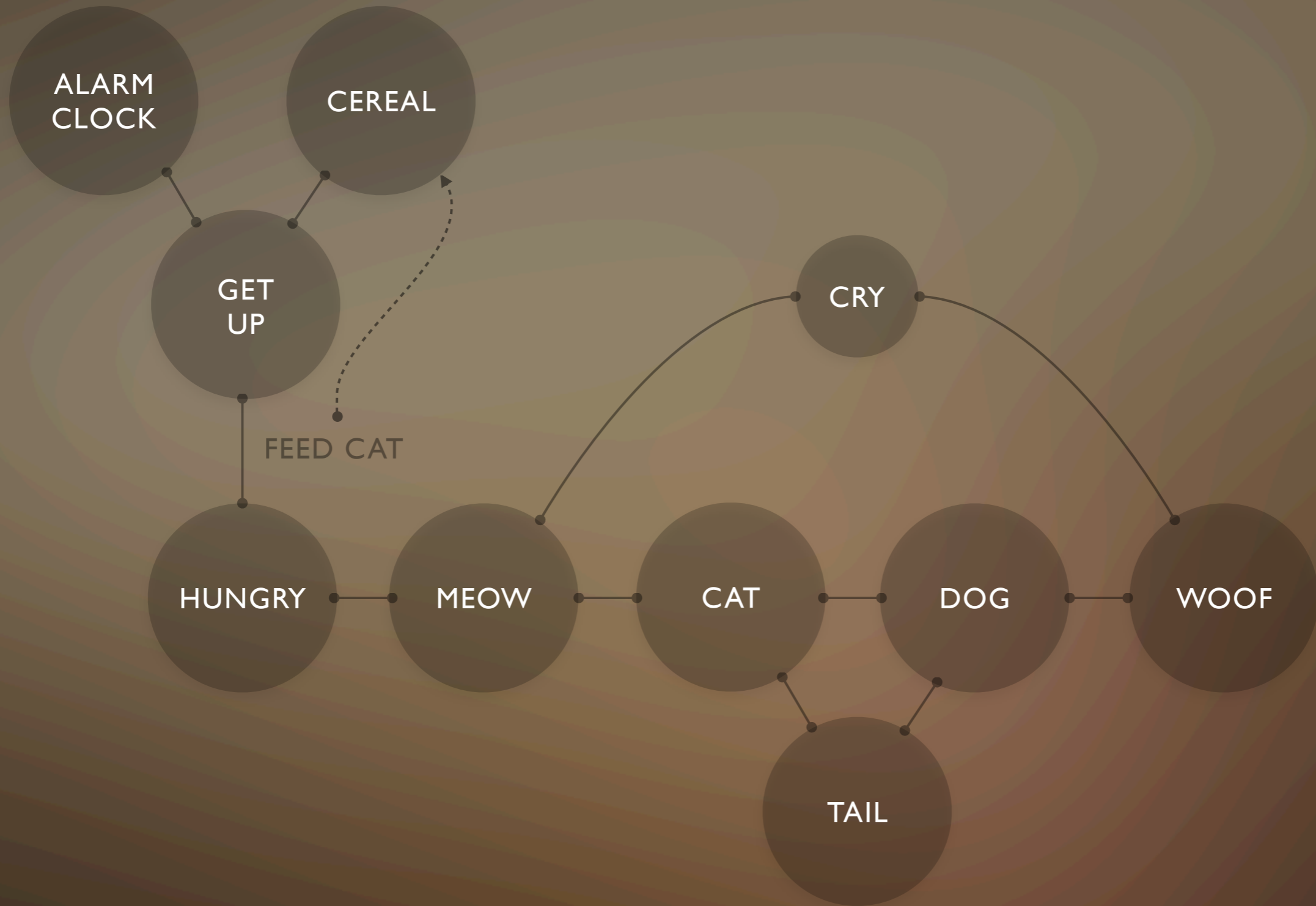


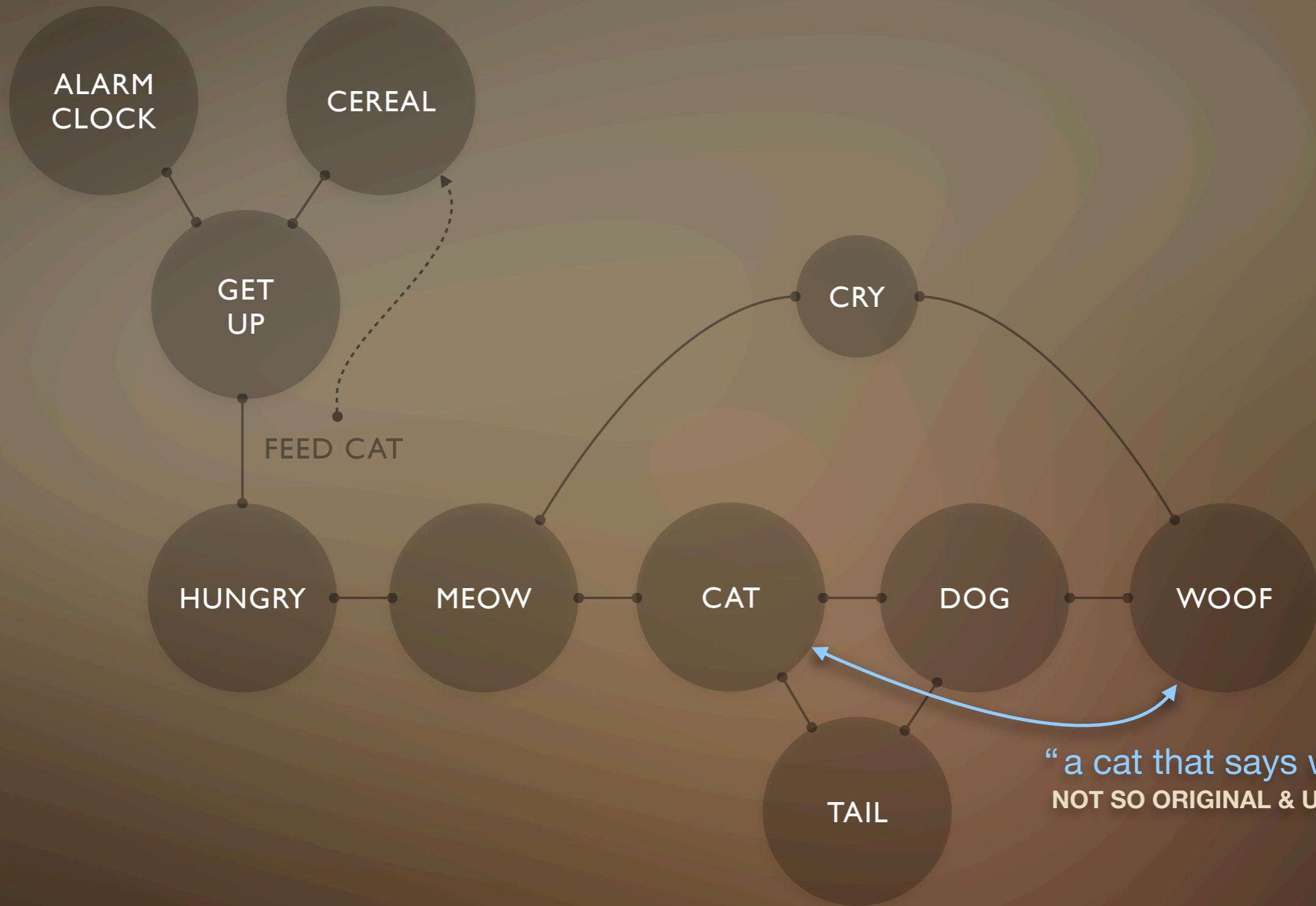




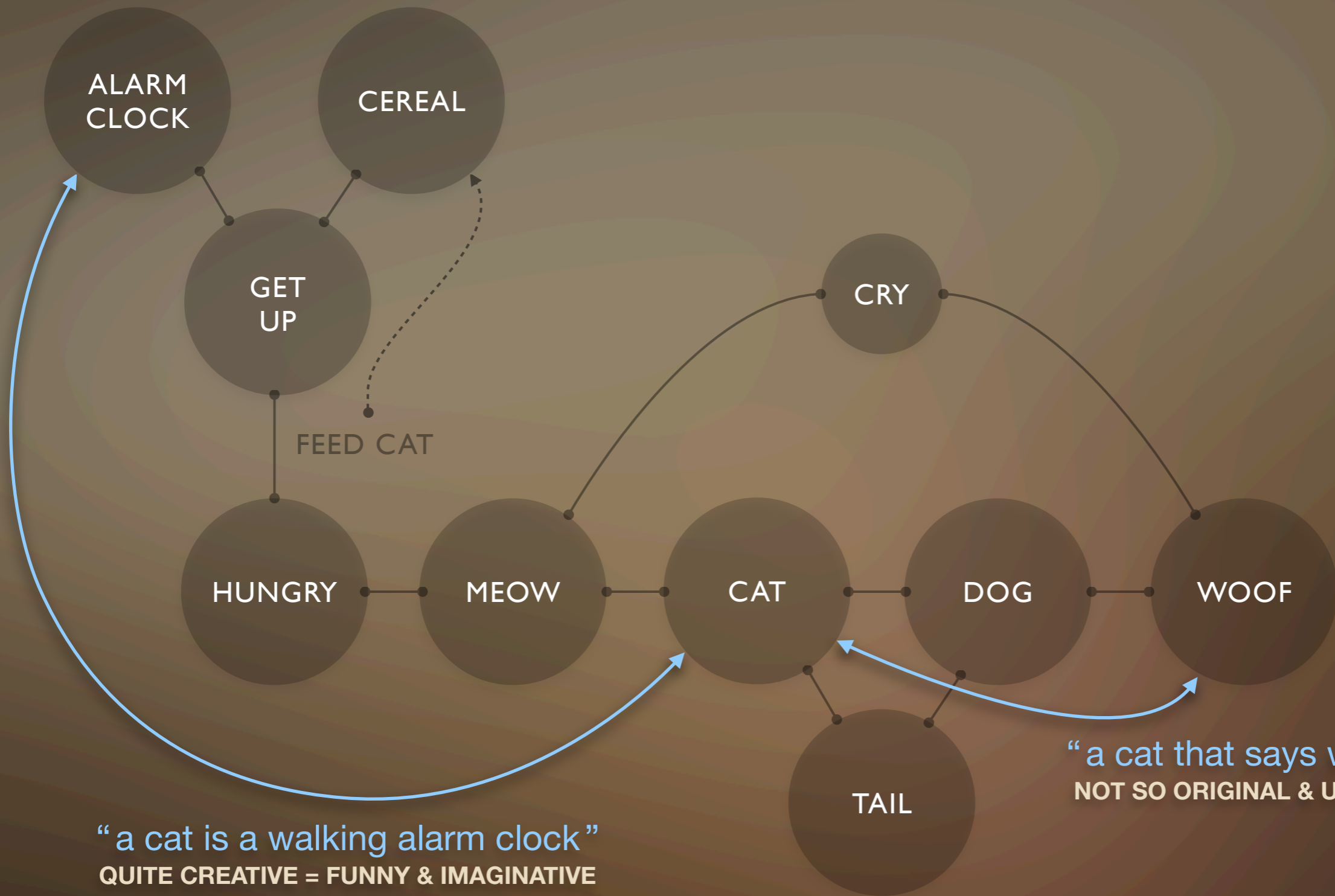








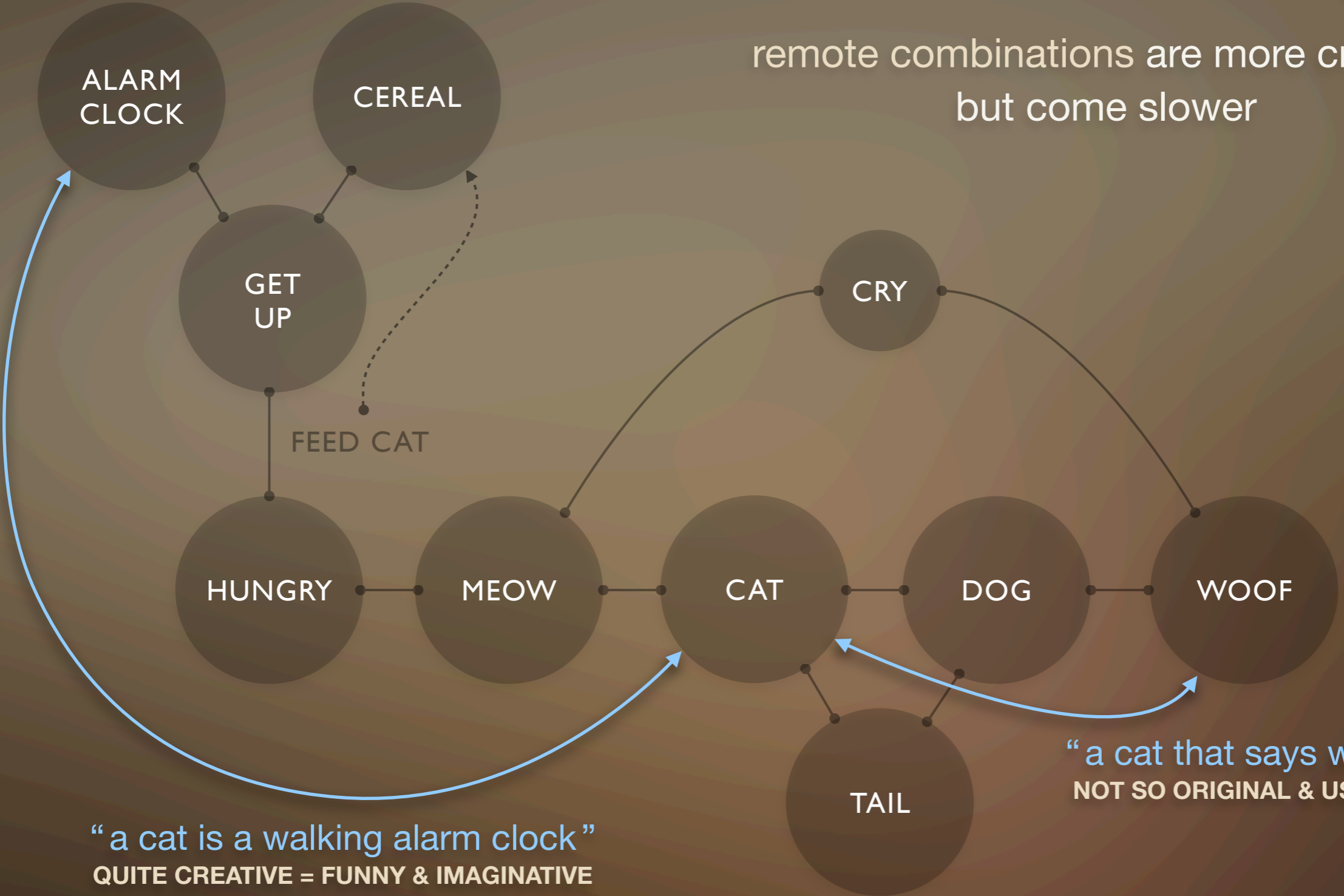
“a cat that says woof”  
NOT SO ORIGINAL & USEFUL



“a cat is a walking alarm clock”  
QUITE CREATIVE = FUNNY & IMAGINATIVE

“a cat that says woof”  
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remote combinations are more creative  
but come slower



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# IMAGINATION

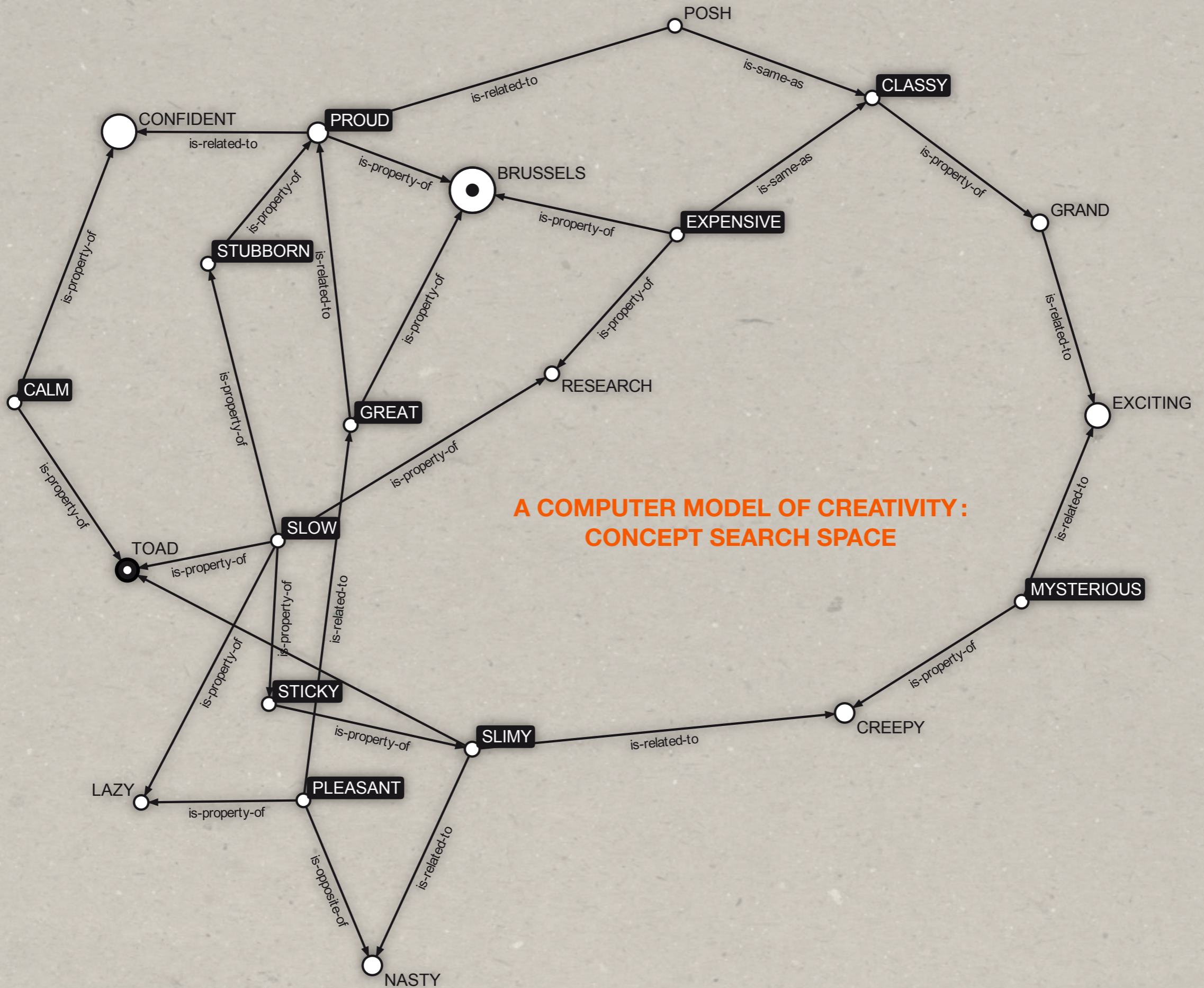
mental representation of reality

- “blend space”
  - ▶ unconscious : fast, intuitive, biased

evaluation

- ▶ conscious : slow, analytical, lazy





**Brussels ?**

## Brussels ?

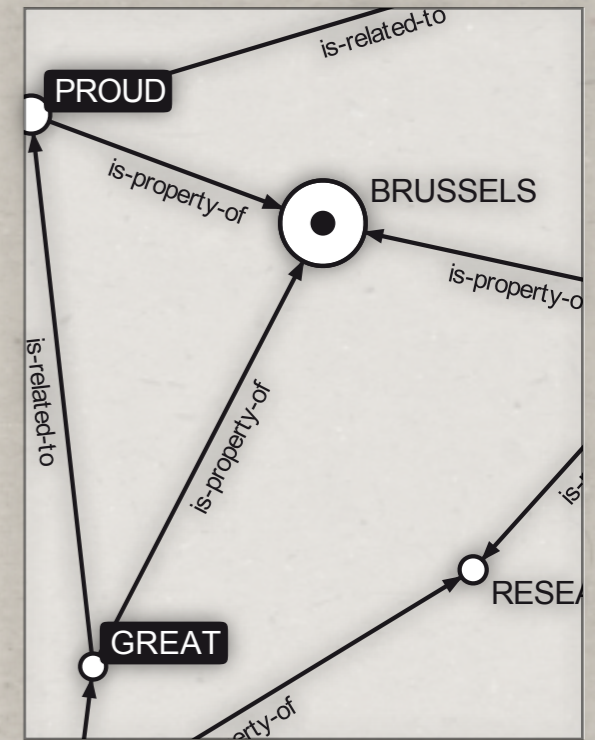
Brussels **is-a** city

Brussels **is-part-of** Belgium

PROUD **is-property-of** Brussels

GREAT **is-property-of** Brussels

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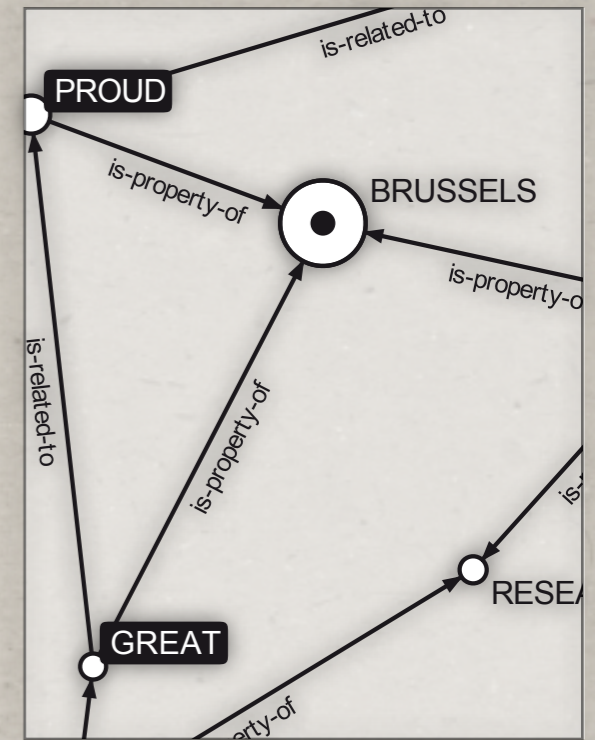
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What **animal** is similar to Brussels ? PROPERTIES / ADJECTIVES



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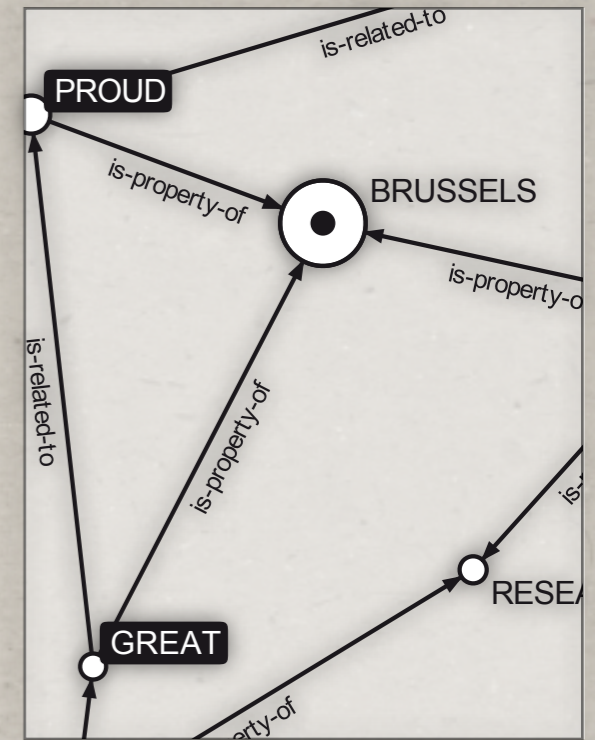
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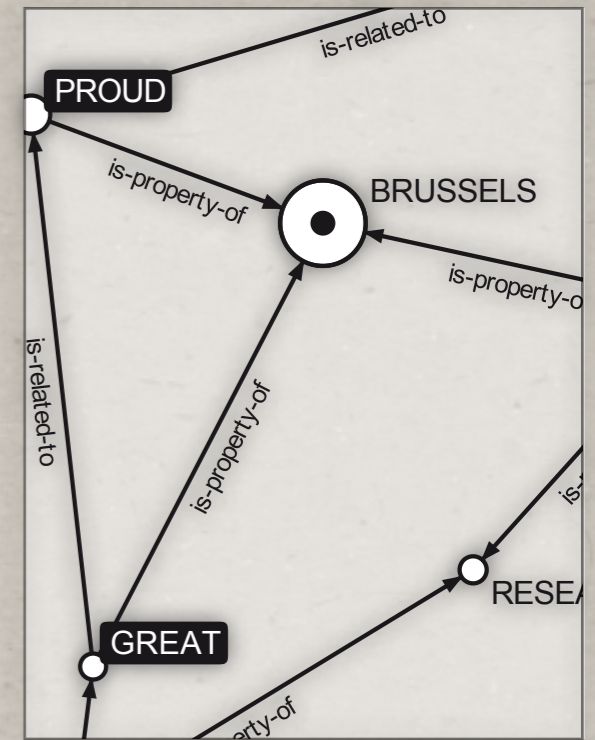
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bunny → CUTE → PRETTY → BEAUTIFUL → princess → PROUD → Brussels

bunny → SOFT → ROMANTIC → PASSIONATE → RED → color → GREEN → Brussels



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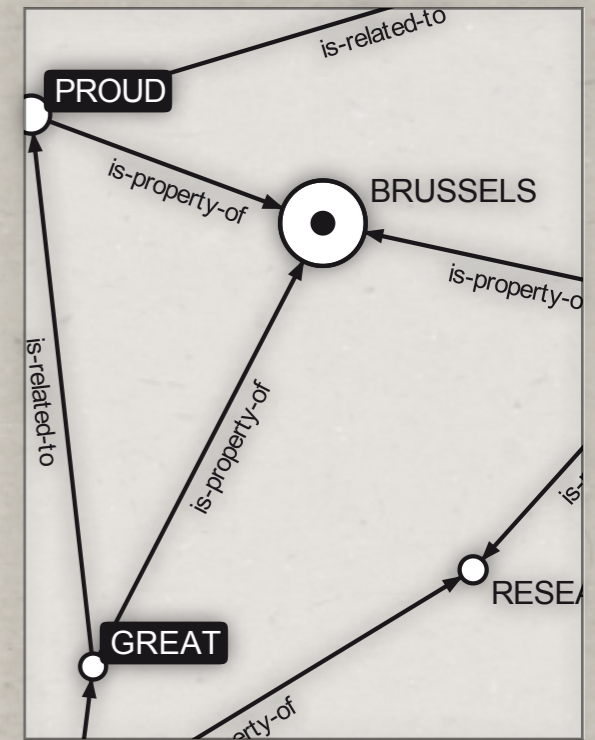
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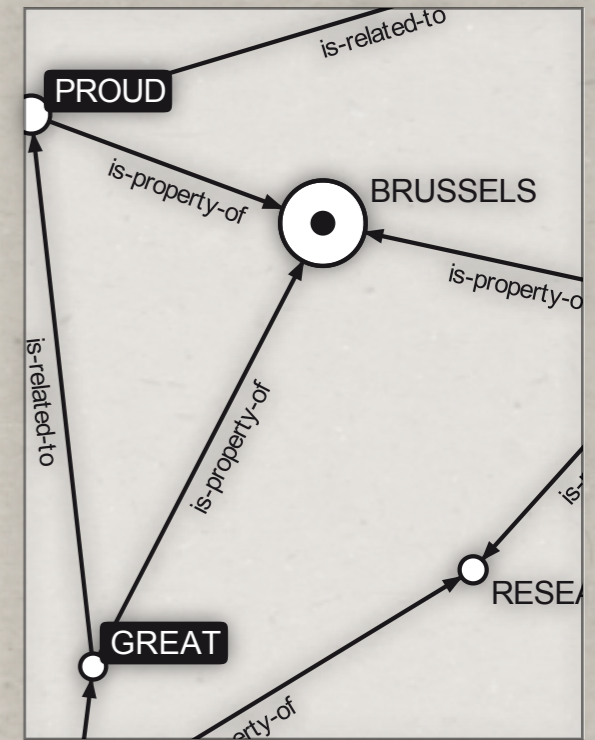
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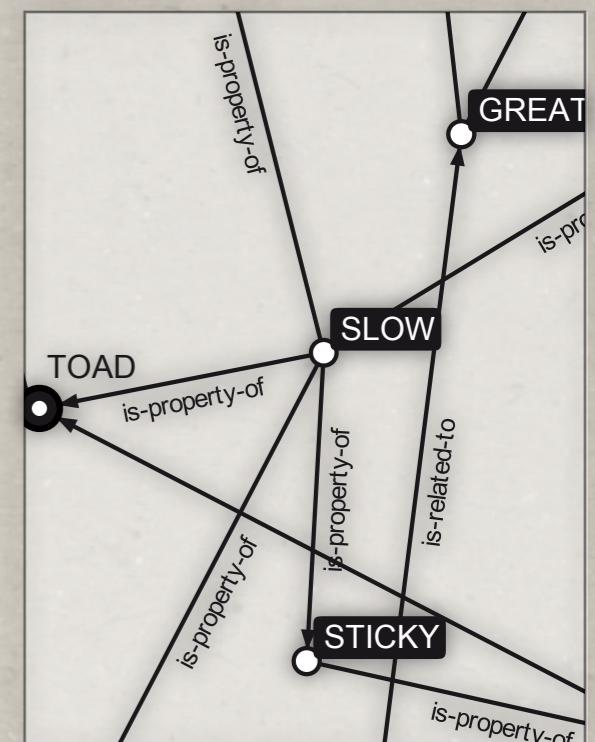
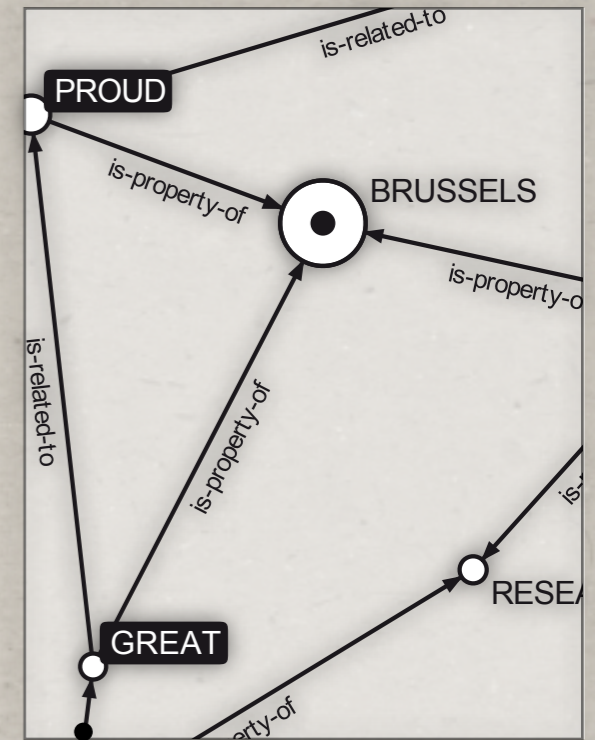
### 2. a **toad** ?

toad → GREEN → Brussels

toad → PROUD → Brussels

toad → PROUD → GREAT → Brussels

toad → UGLY → CREEPY → Mona Lisa → PROUD → Brussels



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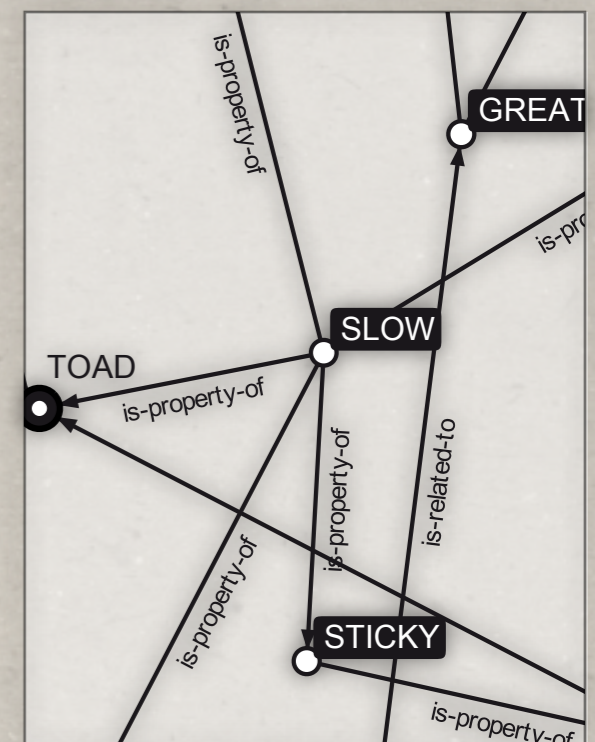
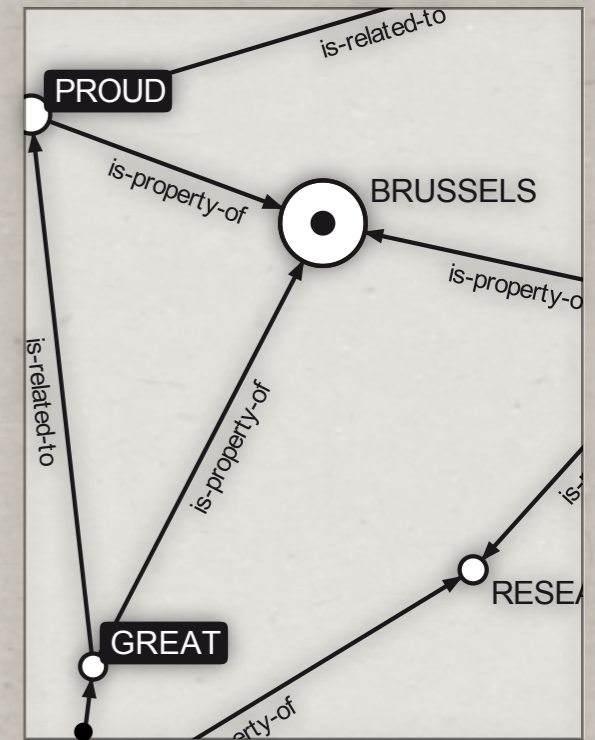
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**MULTIPLE SHORT CONNECTIONS**



VISIT BRUSSELS







is **Brussels-toad** a useful creative solution, or a stupid idea?

how can the program evaluate “usefulness”?

... **conscious** machines?

**feedback** by peers?

# SEMANTIC NETWORK OF COMMON SENSE

10,000 related concepts (manual annotation)

	<b>is-a</b>	<b>is-part-of</b>	<b>is-opposite-of</b>	<b>is-property-of</b>	<b>is-related-to</b>	<b>is-same-as</b>
CULTURE	573	491	25	1,060	1,060	74
NATURE	673	222	10	640	364	31
PROPERTIES	29	5	98	303	258	35
PEOPLE	340	44	3	80	91	13
GEOGRAPHY	233	292	0	36	11	3
MEDIA	109	75	2	148	143	5
HISTORY	33	35	1	32	86	9
EMOTION	28	18	3	66	72	3
SOUND	24	23	0	44	29	1
SCIENCE	12	26	1	33	38	4

chocolate **is-related-to** Brussels (CULTURE)

tasty **is-property-of** chocolate (PROPERTIES)

Easter Bunny **is-related-to** chocolate (PERSON)

rabbit **is-part-of** hole (NATURE)

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GEOGRAPHY	233	292	0	36	11	3
MEDIA	109	75	2	148	143	5
HISTORY	33	35	1	32	86	9
EMOTION	28	18	3	66	72	3
SOUND	24	23	0	44	29	1
SCIENCE	12	26	1	33	38	4

chocolate **is-related-to** Brussels (CULTURE)

tasty **is-property-of** chocolate (PROPERTIES)

Easter Bunny **is-related-to** chocolate (PERSON)

rabbit **is-part-of** hole (NATURE)

automatic? “ \* feels \* ” web queries

# SEMANTIC NETWORK OF COMMON SENSE

## SPREADING ACTIVATION

find the conceptual halo

- concepts related to root
- concepts related to those concepts
- ▶ chocolate = candy, kitchen, TASTY, HUNGRY, ...

## CENTRALITY

find salient properties in halo

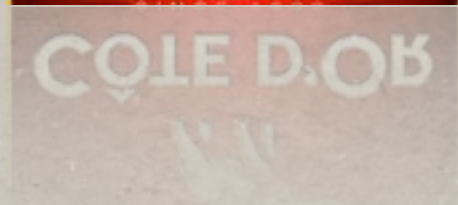
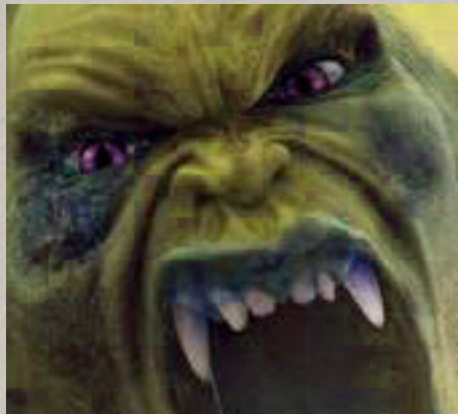
- left-side concepts in **is-property-of** relations
- high betweenness centrality (Brandes)
- ▶ HUNGRY

## SHORTEST PATHS

find strong paths to the blend candidate

- shortest path length between properties (Dijkstra)
- ▶ an ogre is also very HUNGRY
- ▶ an ogre is hungrier than Abraham Lincoln

# SEMANTIC NETWORK OF COMMON SENSE



## SPREADING ACTIVATION

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- ▶ an ogre is also very HUNGRY
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# SEMANTIC NETWORK OF COMMON SENSE

```
from pattern.graph import Graph
from pattern.db import CSV

g = Graph()
data = 'pattern/graph/commonsense/commonsense.csv'
data = CSV.load(data)
for concept1, relation, concept2, ctx, weight in data:
    g.add_edge(
        concept1,
        concept2,
        type = relation,
        weight = min(int(weight) * 0.1, 1.0))

def halo(node, depth=2):
    return node.flatten(depth)

def field(node, depth=3, fringe=2):
    def traversable(node, edge):
        return edge.node2 == node and edge.type == 'is-a'
    g = node.graph.copy(node.flatten(depth, traversable))
    g = g.fringe(depth=fringe)
    g = [node.graph[n.id] for n in g if n != node]
    return g
```

```
PROPERTIES = [e.node1.id for e in g.edges if e.type == 'is-property-of']
PROPERTIES = dict.fromkeys(PROPERTIES, True)

cache = {} # Cache results for faster reuse.

def properties(node):
    if node.id in cache:
        return cache[node.id]
    g = node.graph.copy(nodes=halo(node))
    p = (n for n in g.nodes if n.id in PROPERTIES)
    p = reversed(sorted(p, key=lambda n: n.centraliity))
    p = [node.graph[n.id] for n in p]
    cache[node.id] = p
    return p

def similarity(node1, node2, k=3):
    g = node1.graph
    h = lambda id1, id2: 1 - int(g.edge(id1, id2).type == 'is-property-of')
    w = 0.0
    for p1 in properties(node1)[:k]:
        for p2 in properties(node2)[:k]:
            p = g.shortest_path(p1, p2, heuristic=h)
            w += 1.0 / (p is None and 1e10 or len(p))
    return w / k

def nearest_neighbors(node, candidates=[], k=3):
    w = lambda n: similarity(node, n, k)
    return sorted(candidates, key=w, reverse=True)

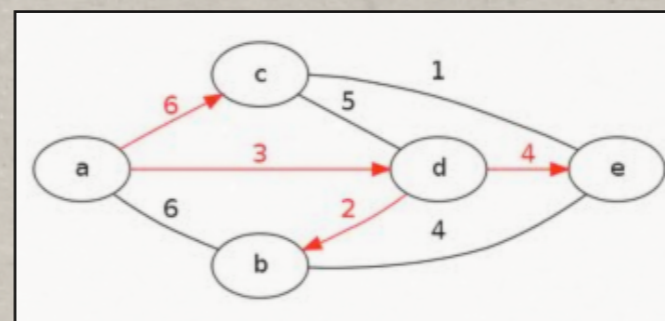
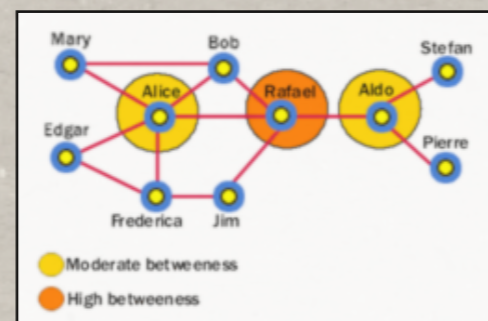
print nearest_neighbors(g['creepy'], field(g['animal']))
```

# SEMANTIC NETWORK OF COMMON SENSE

Douglas Hofstadter (1996)  
*Fluid concepts and creative analogies*  
*Basic Books*

Ulrik Brandes (2001)  
*A faster algorithm for betweenness centrality*  
*Journal of Mathematical Sociology*

Edsger Dijkstra (1959)  
*A note on two problems in connexion with graphs*  
*Numerische Mathematik*



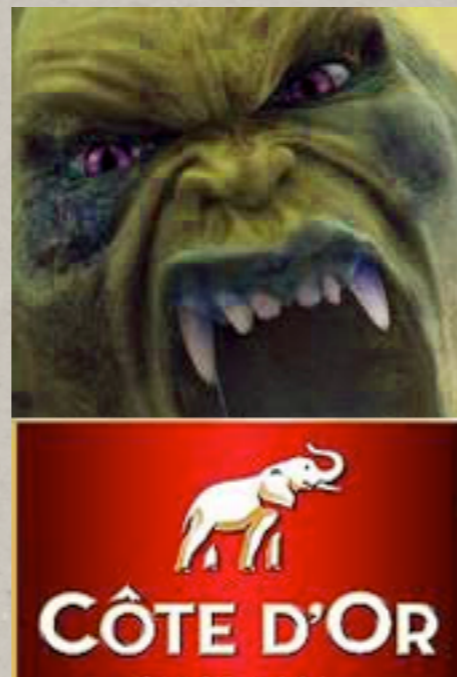
is **ogre-chocolate** a useful creative solution, or a stupid idea?

how can the program evaluate “usefulness”?

... **conscious** machines?

**feedback** by peers?



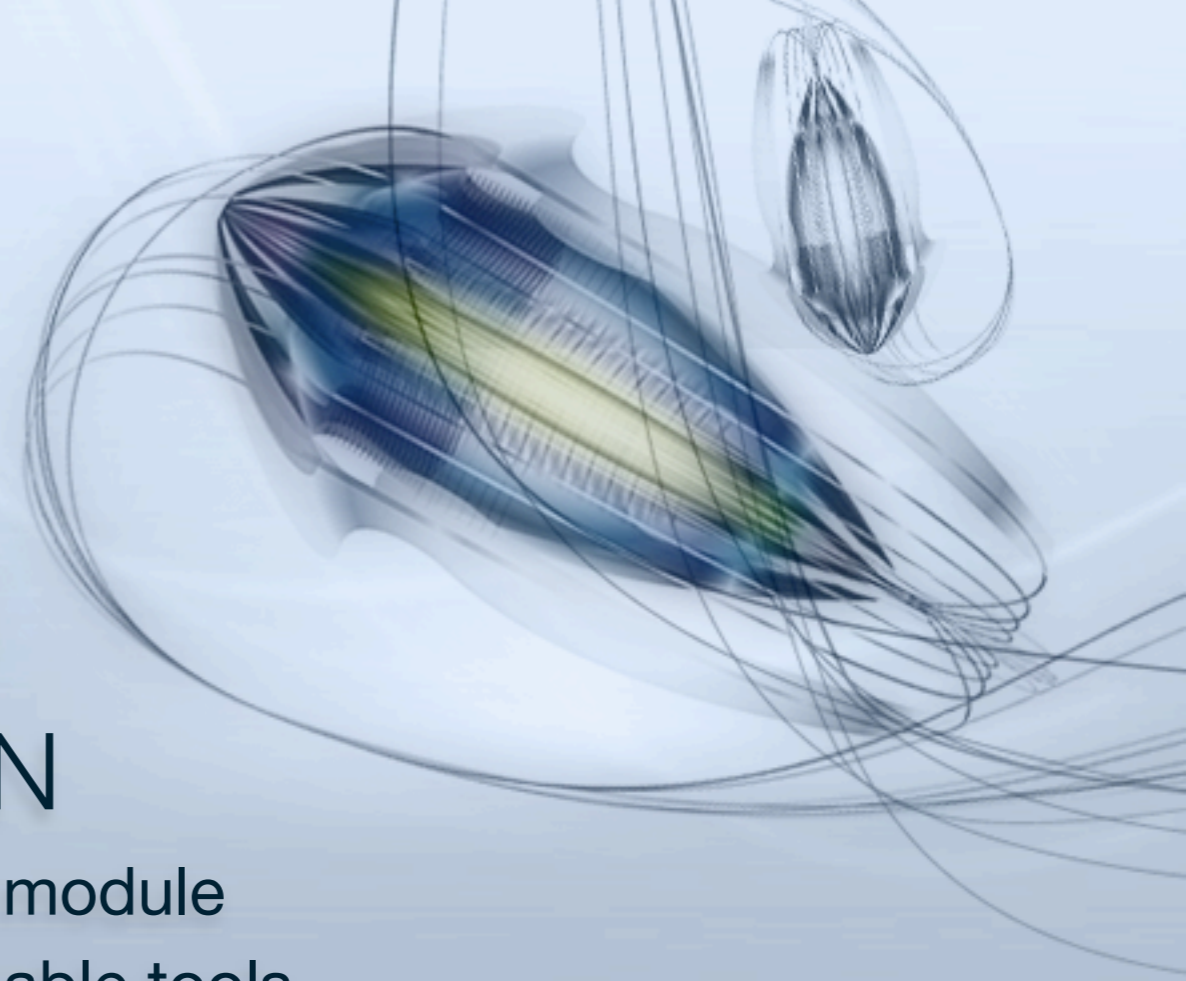


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# PATTERN

Python web mining module  
a collection of combinable tools  
for a range of AI-related tasks

**De Smedt & Daelemans (2011)**

PATTERN

# WEB MINING

retrieve text & images from WWW

Google bing YAHOO!

facebook ↑



WIKIPEDIA  
*The Free Encyclopedia*

wikia

flickr™

PW



PATTERN

# WEB MINING

retrieve text & images from WWW

```
from pattern.web import Wikipedia, plaintext
w = Wikipedia(language='en')
article = w.search('ogre')
for section in article.sections:
    print section.title
    print plaintext(section.source)
```

```
from pattern.web import Twitter
t = Twitter(language='en')
for tweet in t.search("chocolate"):
    print tweet.text
```

PATTERN

# NATURAL LANGUAGE PROCESSING

parts of speech, grammar, uncertainty, subjectivity

English, Spanish, German, Dutch, French

PATTERN

# NATURAL LANGUAGE PROCESSING

parts of speech, grammar, uncertainty, subjectivity

English, Spanish, German, Dutch, French



**Tweets** [All](#) / No replies



**Rupert Murdoch** @rupertmurdoch

15 Dec

Terrible news today. When will politicians find courage to ban automatic weapons?

Expand

PATTERN

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parts of speech, grammar, uncertainty, subjectivity

English, Spanish, German, Dutch, French



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Expand

**WHO?**

Rupert Murdoch

**WHEN?**

December 15

PATTERN

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**WHO?**

Rupert Murdoch

**WHEN?**

December 15

adjective

noun

politicians

WHO ?

find

DOES

courage

WHAT ?

to ban automatic weapons

WHY ?



PATTERN

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WHY ?

UNCERTAIN

when + will

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UNCERTAIN

when + will

terrible

NEGATIVE

## PATTERN

# NATURAL LANGUAGE PROCESSING

parts of speech, grammar, uncertainty, subjectivity

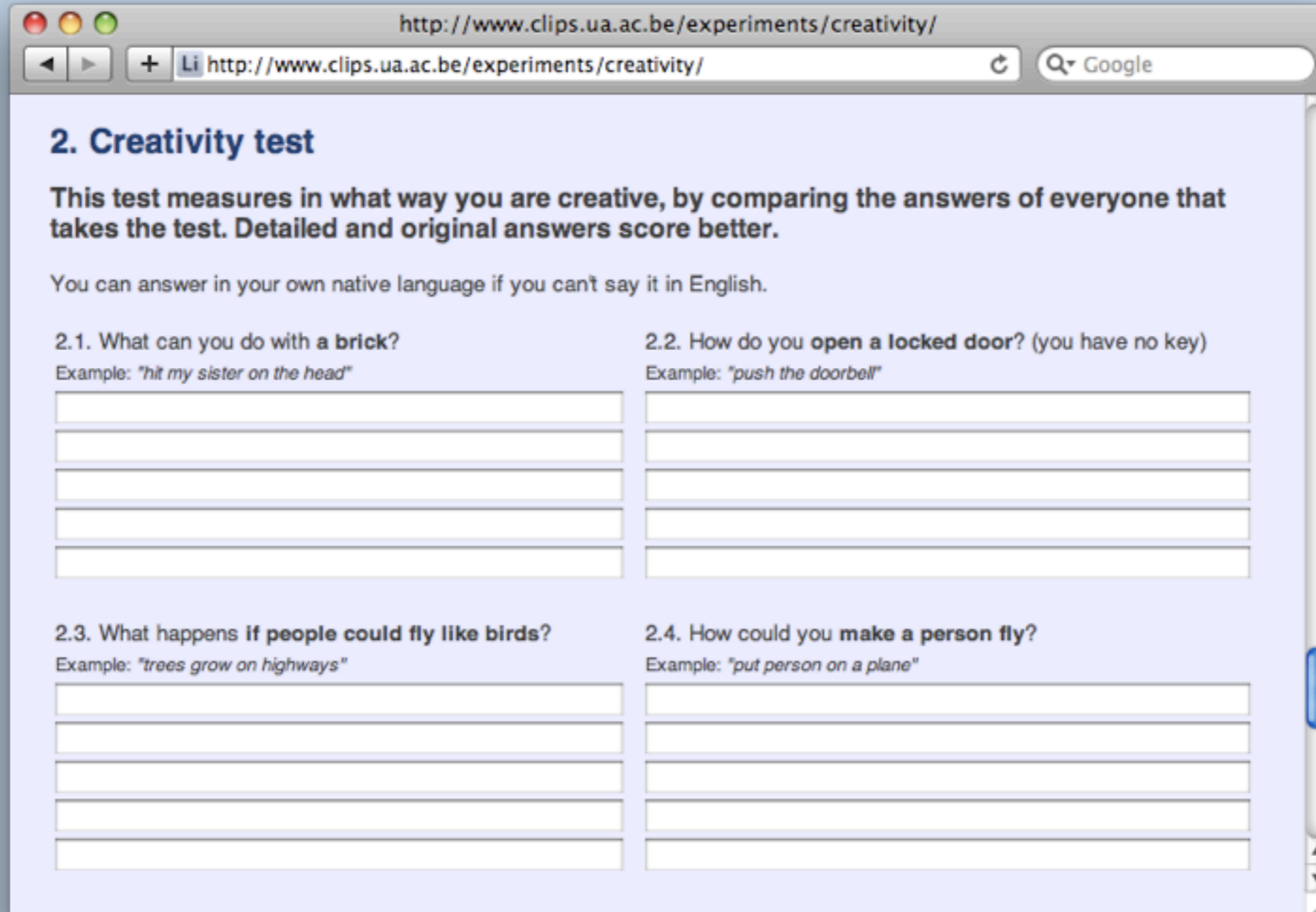
```
from pattern.en import parsetree

s = 'The black cat sat on the mat.'
s = parsetree(s, tags=True, chunks=True, lemmata=True)
for sentence in s:
    for word in sentence.words:
        print word.lemma
        print word.tag
```

word	tag	chunk	lemma
The	DT	NP	the
black	JJ	NP	black
cat	NN	NP	cat
sat	VB	VP	sit
on	IN	PP	on
the	DT	NP	the
mat	NN	NP	mat
.	.	-	.

PATTERN

# MACHINE LEARNING



The image shows a screenshot of a web browser window. The address bar contains the URL <http://www.clips.ua.ac.be/experiments/creativity/>. The page title is "2. Creativity test". The main content area has a light purple background and contains the following text:

**2. Creativity test**

**This test measures in what way you are creative, by comparing the answers of everyone that takes the test. Detailed and original answers score better.**

You can answer in your own native language if you can't say it in English.

**2.1. What can you do with a brick?**  
Example: *"hit my sister on the head"*

**2.2. How do you open a locked door? (you have no key)**  
Example: *"push the doorbell"*

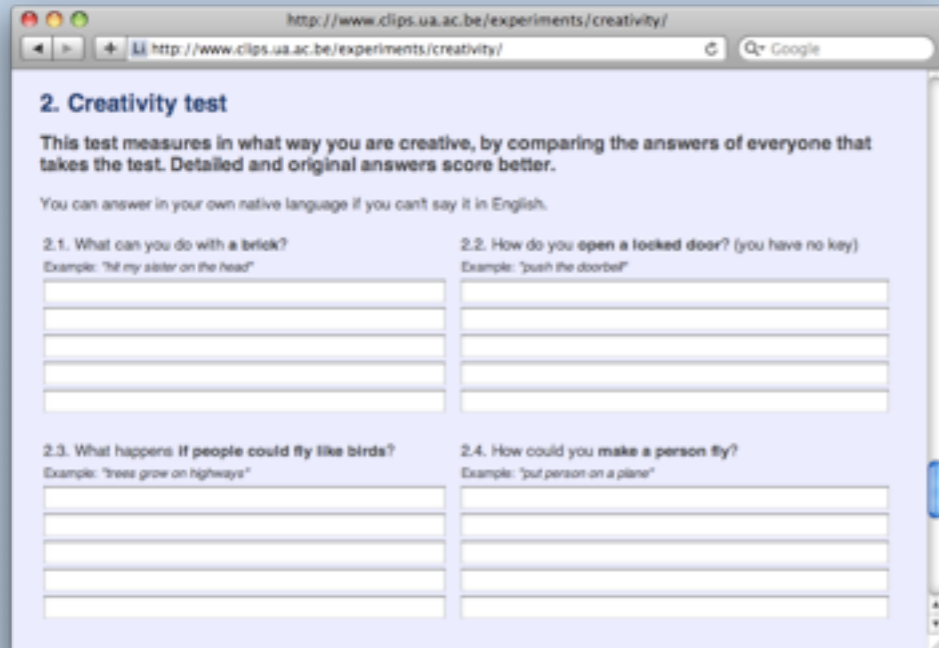
**2.3. What happens if people could fly like birds?**  
Example: *"trees grow on highways"*

**2.4. How could you make a person fly?**  
Example: *"put person on a plane"*

Each question is followed by five empty text input fields for providing answers.

PATTERN

# MACHINE LEARNING



http://www.clips.ua.ac.be/experiments/creativity/

2. Creativity test

This test measures in what way you are creative, by comparing the answers of everyone that takes the test. Detailed and original answers score better.

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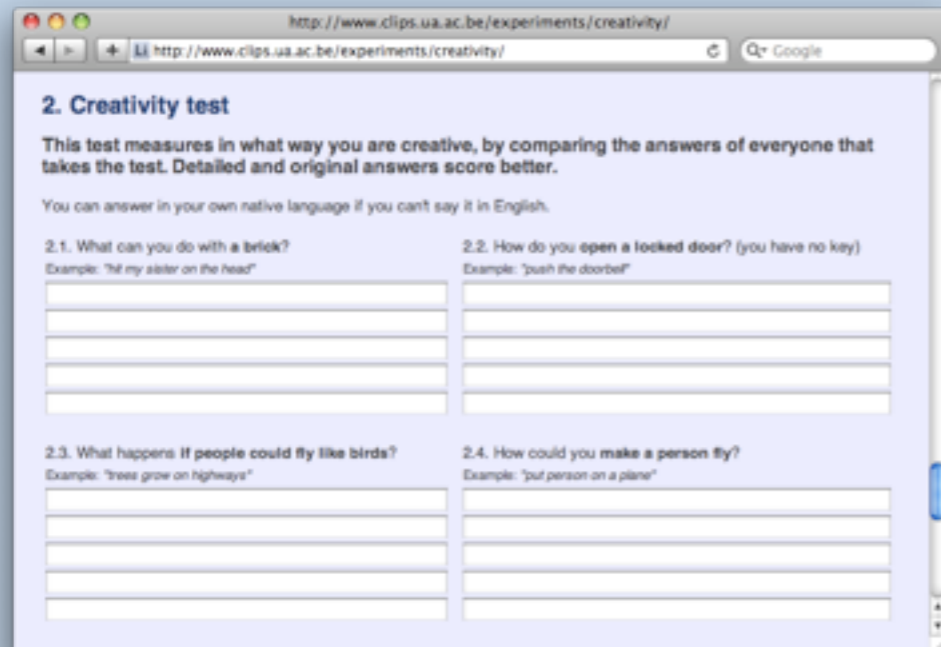
2.3. What happens if people could fly like birds?  
Example: "trees grow on highways"

2.4. How could you make a person fly?  
Example: "put person on a plane"

PATTERN

# MACHINE LEARNING

“How do you open a locked door?” (you have no key)



The image shows a screenshot of a web browser displaying a creativity test page. The page title is "2. Creativity test". Below the title, there is a paragraph explaining the test: "This test measures in what way you are creative, by comparing the answers of everyone that takes the test. Detailed and original answers score better." and a note: "You can answer in your own native language if you can't say it in English." There are four questions listed in a 2x2 grid:

- 2.1. What can you do with a brick? Example: "hit my sister on the head"
- 2.2. How do you open a locked door? (you have no key) Example: "push the doorbell"
- 2.3. What happens if people could fly like birds? Example: "trees grow on highways"
- 2.4. How could you make a person fly? Example: "put person on a plane"

Each question has a text input field with three lines for writing an answer.

knock on door

knock knock!

knock on door and yell loudly

look under doormat?

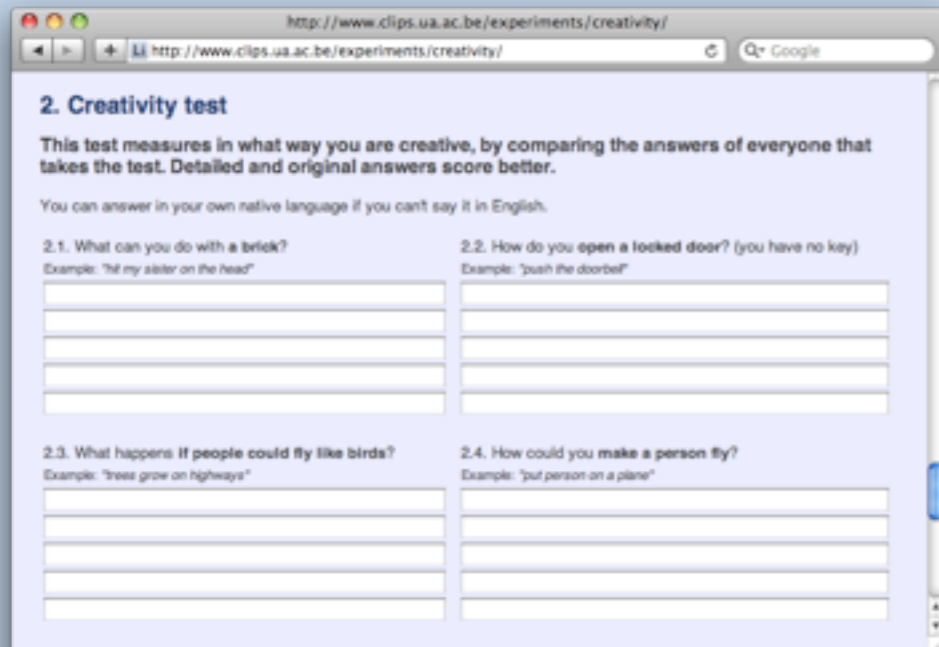
spare key is under doormat

get the bull from the nearby field  
wave a red flag in front of door

PATTERN

# MACHINE LEARNING

“How do you open a locked door?” (you have no key)



knock on door

knock knock!

knock on door and yell loudly

look under doormat?

spare key is under doormat

get the bull from the nearby field  
wave a red flag in front of door

**KNOCK**

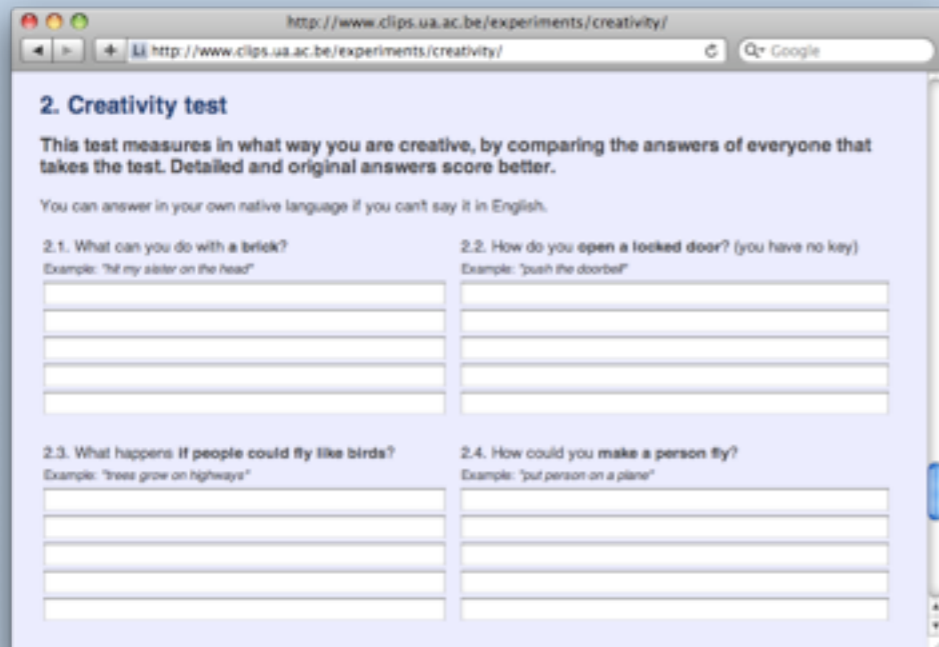
**DOORMAT**

?

PATTERN

# MACHINE LEARNING

“How do you open a locked door?” (you have no key)



knock on door

knock knock!

**KNOCK**

knock on door and yell loudly

look under doormat?

**DOORMAT**

spare key is under doormat

get the bull from the nearby field  
wave a red flag in front of door

?

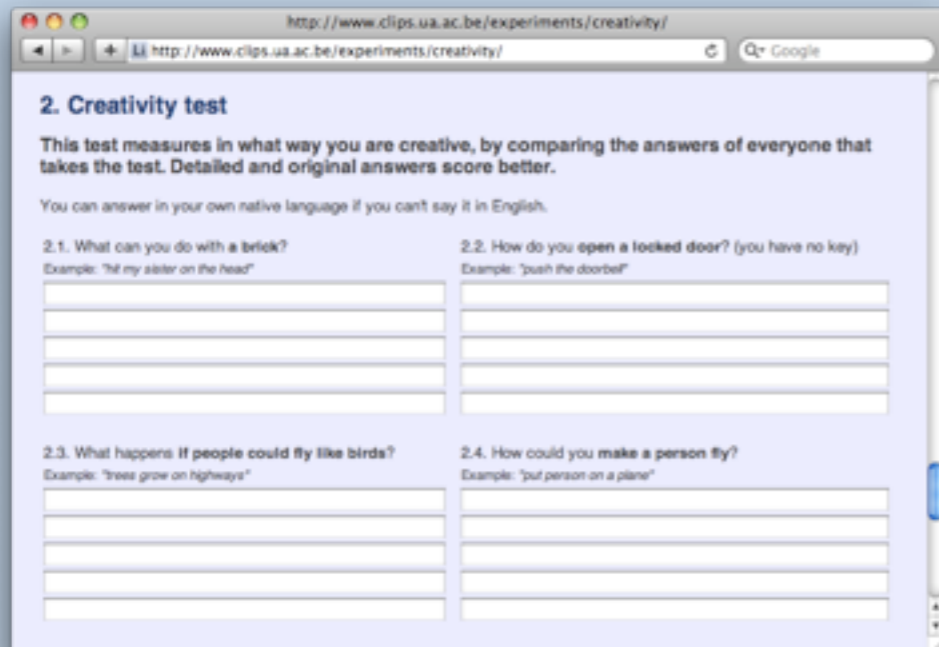
no similar answers → unique → more creative



PATTERN

# MACHINE LEARNING

If the program recognizes creative answers, can it generate **more creative** ones?



The screenshot shows a web browser window with the URL <http://www.clips.ua.ac.be/experiments/creativity/>. The page is titled "2. Creativity test" and includes the following text: "This test measures in what way you are creative, by comparing the answers of everyone that takes the test. Detailed and original answers score better." and "You can answer in your own native language if you can't say it in English." There are four questions with example answers and text input fields:

2.1. What can you do with a brick? Example: "hit my sister on the head"	2.2. How do you open a locked door? (you have no key) Example: "push the doorbell"
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>

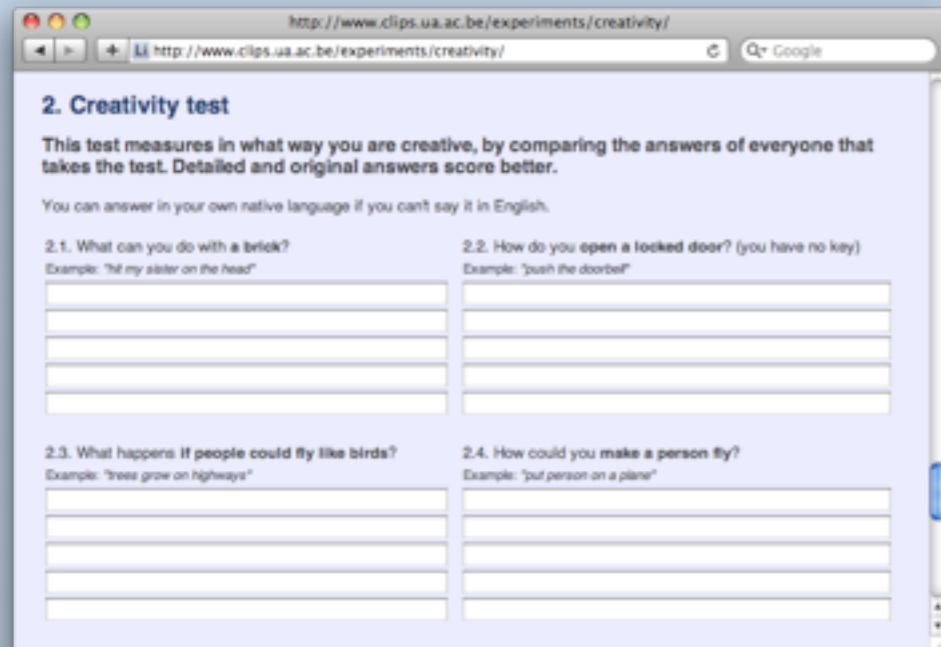
  

2.3. What happens if people could fly like birds? Example: "trees grow on highways"	2.4. How could you make a person fly? Example: "put person on a plane"
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>

PATTERN

# MACHINE LEARNING

If the program recognizes creative answers ,  
can it generate **more creative** ones ?



A screenshot of a web browser displaying a creativity test page. The browser's address bar shows the URL <http://www.clips.ua.ac.be/experiments/creativity/>. The page title is "2. Creativity test". Below the title, there is a paragraph explaining the test: "This test measures in what way you are creative, by comparing the answers of everyone that takes the test. Detailed and original answers score better." and a note: "You can answer in your own native language if you can't say it in English." The test consists of four questions, each with a text input field and a "Submit" button. Question 2.1: "What can you do with a brick?" with example "hit my sister on the head". Question 2.2: "How do you open a locked door? (you have no key)" with example "push the doorbell". Question 2.3: "What happens if people could fly like birds?" with example "trees grow on highways". Question 2.4: "How could you make a person fly?" with example "put person on a plane".

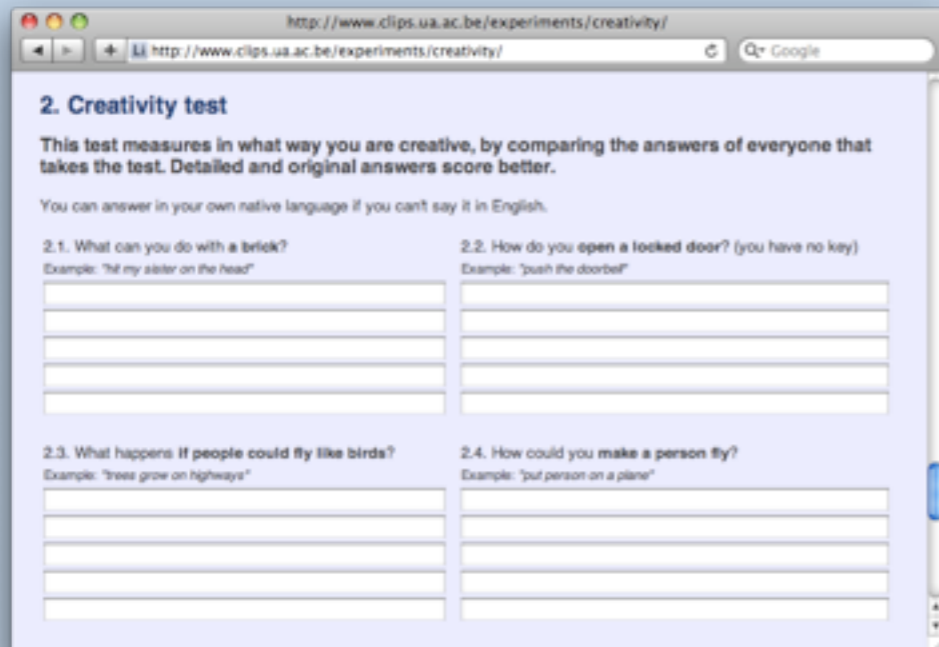
“Stubbornly club the door  
with a graceful albatross  
from a pungent swamp.”



PATTERN

# MACHINE LEARNING

If the program recognizes creative answers ,  
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A screenshot of a web browser displaying a creativity test page. The page title is "2. Creativity test". Below the title, there is a paragraph explaining the test: "This test measures in what way you are creative, by comparing the answers of everyone that takes the test. Detailed and original answers score better." and a note: "You can answer in your own native language if you can't say it in English." The test consists of four questions arranged in a 2x2 grid:

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- 2.3. What happens if people could fly like birds? Example: "trees grow on highways"
- 2.4. How could you make a person fly? Example: "put person on a plane"

Each question has a set of five empty text input fields for answers.

“Stubbornly club the door  
with a graceful albatross  
from a pungent swamp.”



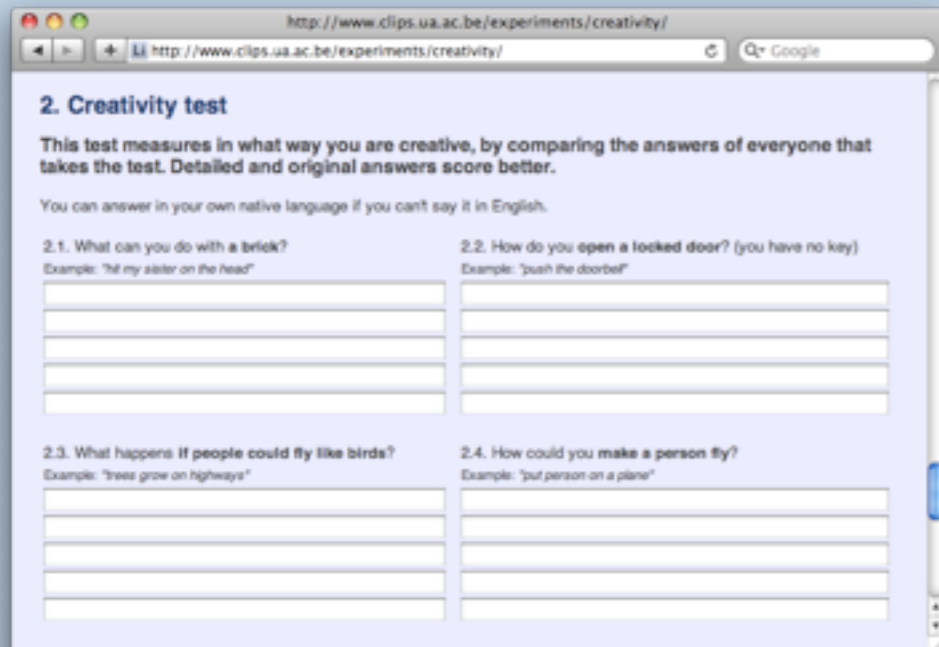
“Rawly storm the door  
with a dry business lunch  
of primitive crustaceans.”

(nonsensical, flawed)

## PATTERN

# MACHINE LEARNING

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can it generate **more creative** ones ?



The screenshot shows a web browser window with the URL <http://www.clips.ua.ac.be/experiments/creativity/>. The page is titled "2. Creativity test" and includes instructions: "This test measures in what way you are creative, by comparing the answers of everyone that takes the test. Detailed and original answers score better." and "You can answer in your own native language if you can't say it in English." There are four questions with example answers and input fields:

2.1. What can you do with a brick? Example: "hit my sister on the head"	2.2. How do you open a locked door? (you have no key) Example: "push the doorbell"
<input type="text"/>	<input type="text"/>
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<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
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<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>

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(nonsensical, flawed)

### TEST RESULTS FOR 187 PERSONS

no significant correlation between  
being an artist and creativity

PATTERN

# MACHINE LEARNING

Guilford's creative thinking test (1956)

ask participants to come up with  
as many answers as possible to open-ended questions

originality	unusual answers +1, unique answers +2
fluency	+1 for each answer
flexibility	+1 for each category of answer
elaboration	+1 for each detail

PATTERN

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Guilford's creative thinking test (1956)

ask participants to come up with  
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trivial ←

PATTERN

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trivial ←

“break down door with a crowbar”

PP

PATTERN

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ask participants to come up with  
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	originality	unusual answers +1, unique answers +2
trivial ←	fluency	+1 for each answer
clustering ←	flexibility	+1 for each category of answer
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↓  
“break down door with a crowbar”

**PP**



PATTERN

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Guilford's creative thinking test (1956)

ask participants to come up with  
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cluster outliers ←	originality	unusual answers +1, unique answers +2
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$$\cos(\theta) = \frac{\sum_{i=1}^n A_i \times B_i}{\sqrt{\sum_{i=1}^n (A_i)^2} \times \sqrt{\sum_{i=1}^n (B_i)^2}}$$

**cosine distance** = text similarity metric  
 $A_j$  and  $B_j$  are word counts

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- A** knock on door
- B** knock knock!
- C** look under doormat?

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$A_j$  and  $B_j$  are word counts

- A** knock on door
- B** knock knock!
- C** look under doormat?

feature	<b>A</b>	<b>B</b>	<b>C</b>
door	1	0	0
doormat	0	0	1
knock	1	2	0
look	0	0	1
on	1	0	0
under	0	0	1

PATTERN

# MACHINE LEARNING

cluster outliers ←	originality	unusual answers +1, unique answers +2
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clustering ←	flexibility	+1 for each category of answer
	elaboration	+1 for each detail

“break down door with a crowbar”  
PP

$$\cos(\theta) = \frac{\sum_{i=1}^n A_i \times B_i}{\sqrt{\sum_{i=1}^n (A_i)^2} \times \sqrt{\sum_{i=1}^n (B_i)^2}}$$

**cosine distance** = text similarity metric  
 $A_j$  and  $B_j$  are word counts

predicting unusual answers  
hierarchical clustering

cosine distance

P 0.72

R 0.83

77%

- A** knock on door
- B** knock knock!
- C** look under doormat?

feature	<b>A</b>	<b>B</b>	<b>C</b>
door	1	0	0
doormat	0	0	1
knock	1	2	0
look	0	0	1
on	1	0	0
under	0	0	1



PATTERN

# SENTIMENT ANALYSIS

predict subjective opinion in text

adverbs & adjectives

+0.5	good	bad	-0.5
+1.0	fantastic	horrible	-1.0
+0.3	interesting	annoying	-0.4

“That book was horrible.”

NEGATIVE

“Her new artwork is interesting.”

POSITIVE

http://archives.lesoir.be/

Le Soir PDF Le Soir 17h Je m'abo

# LE SOIR

Lalibre.be - Trop d'attention médiatique pour D...  
http://www.lalibre.be/actu/politique-bel...

Shopping Bonnes affaires Rencontres

vidéo

la libre .be

Polémique  
Président du Parlement flamand  
ce N-VA ouvertement séparatiste  
choque: "Les Wallons tendent à se séparer  
main et nous y déposons de l'argent"

Accueil Actu Economie Culture S

LA LIBRE.BE • ACTU • POLITIQUE BELGE

Recommend 2 people recommend the first of you

## Trop d'attention médiatique pour D... Wever, pas assez pour la N-VA

ABONNEMENT

- La Libre Belgique
- Le journal en pdf
- Les newsletters
- Contactez-nous
- Nos coordonnées
- Syndication

ACTU

- Politique belge
- Belgique
- International
- Bruxelles
- Brabant
- Gazette de Liège
- Hainaut
- Flandre

Mis en ligne le 29/12/2011

**Bart De Wever a atteint de son taux de couverture de 42%, alors que son parti ne pèse que 34% dans un classement des dix candidats flamands ayant obtenu le plus de voix au Sénat.**

Le président de la N-VA, Bart De Wever, a reçu une attention médiatique disproportionnée au cours des négociations de formation du gouvernement, tandis que son parti n'a pas fait l'objet d'une couverture suffisante, selon des chercheurs de l'université d'Anvers, qui ont passé au crible quelque 68.000 articles de la presse flamande.

"Bart De Wever en CD&V krijgen te veel aandacht" - Binnenland - De Morgen

DM http://www.demorgen.be/dm/nl/989/Binnenland/article/detail/1370097/2011/12/29/

MAANDAG 28 JANUARI 2013

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# DMorgen.be

NIEUWS SPORT GELD MUZIEK OPINIE PLANET WATCH TECHNOCITY MAGAZINE CULTUUR & MEDIA

BINNENLAND BUITENLAND WETENSCHAP GEZONDHEID STAND DER DINGEN

## "Bart De Wever en CD&V krijgen te veel aandacht"

29/12/11, 12u47



© belga.

N-VA-voorzitter Bart De Wever en CD&V kregen tijdens de regeringsonderhandelingen disproportioneel veel media-aandacht, terwijl N-VA als partij onderbelicht bleef. Dat besluiten onderzoekers van de Universiteit Antwerpen uit een analyse van 68.000 artikels op de Vlaamse nieuwssites.

**NUTTIGE LINKS**

- Enquête De Morgen
- Officiële website N-VA
- Officiële website CD&V
- De integrale Nota - De Wever
- Bart De Wever info

**MEER OVER**

- Politiek | Pers | N-VA | CD&V | Bart De Wever
- Fabiola doekt stichting om erfenis te regelen alweer op
- Open Vld staakt verzet tegen benoeming Jan Briers
- Gouverneur Denys betreurt controvers...

...ijkt dat de N-VA opdook in een...  
...t van alle artikels, terwijl de partij...  
...29 procent van de stemmen.  
...wezig in 42 procent van de...  
...een 'personencultus' rond Bart

Lees De Standaard waar en h...  
computer, iPhone, iPad, iPo...  
Lees de krant online »  
Meer over de digitale edities

## NEWSPAPER SENTIMENT

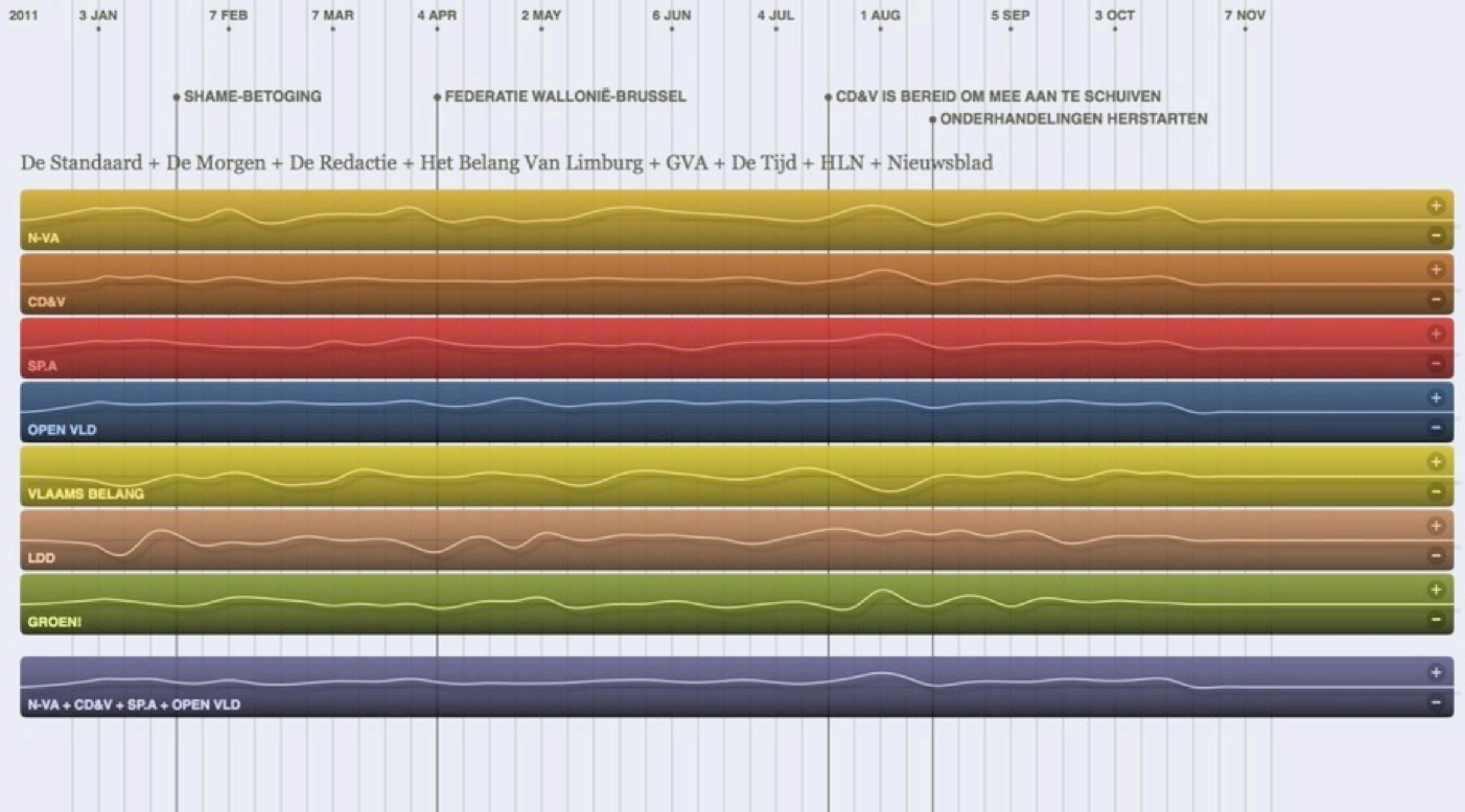
right-wing → more negative press coverage

De Standaard + De Morgen + De Redactie + Het Belang Van Limburg + GVA + De Tijd + HLN + Nieuwsblad



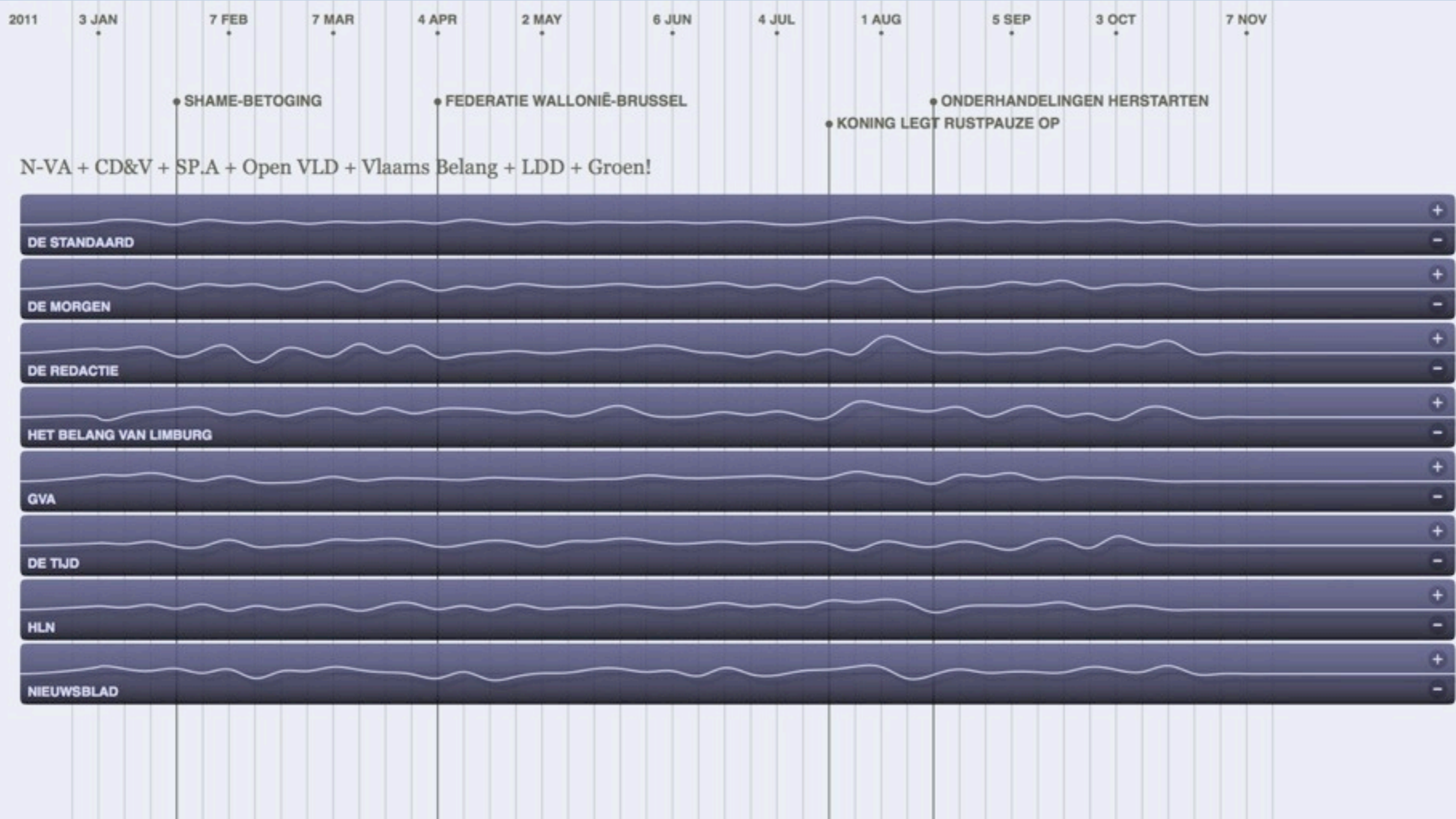
# NEWSPAPER SENTIMENT

small party → more subjective coverage



# NEWSPAPER SENTIMENT

regional newspaper → more subjective

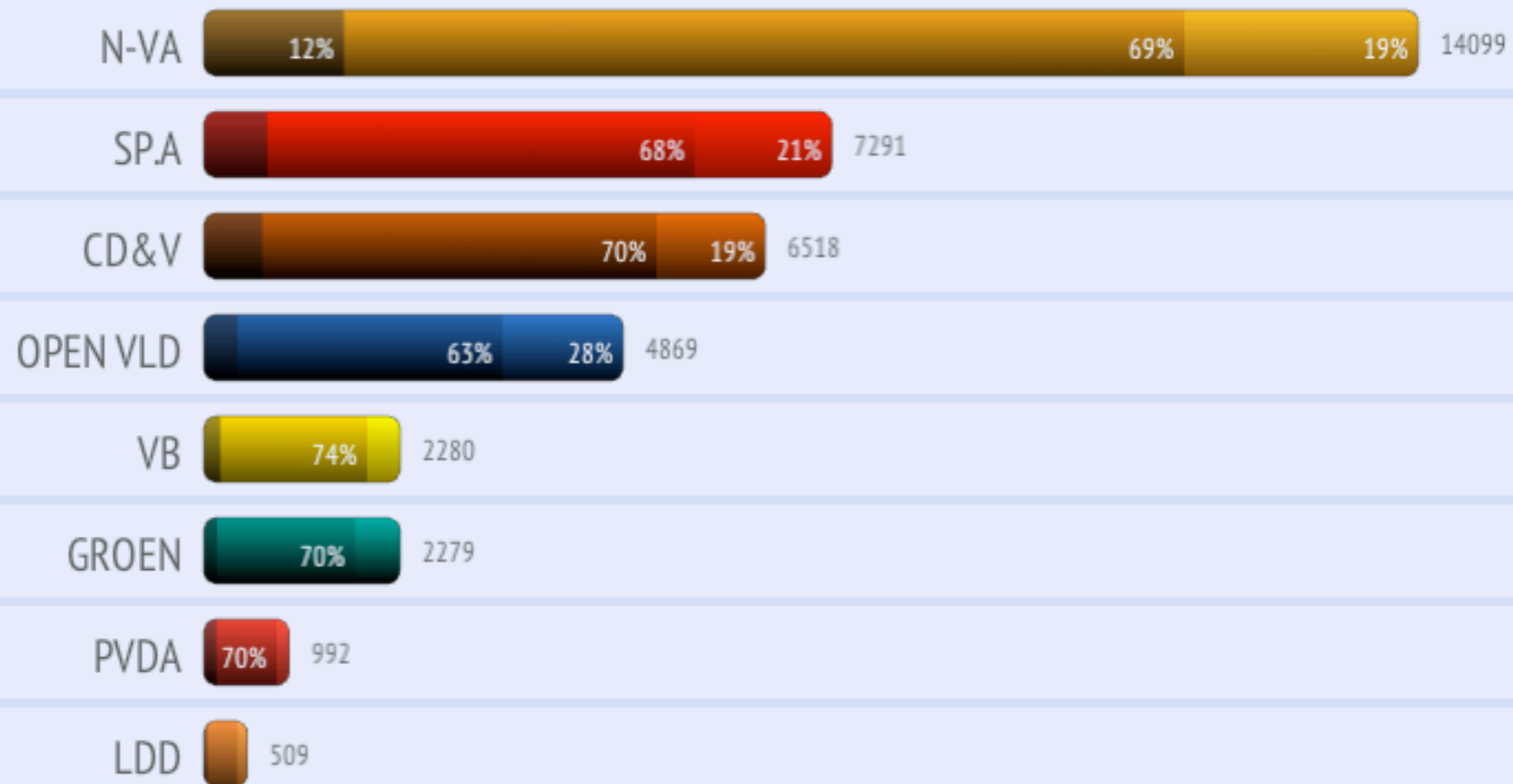




# Politieke berichten op Twitter (10/7-27/1/2013), opinie

DONKER = negatieve berichten

LICHTER = positieve berichten

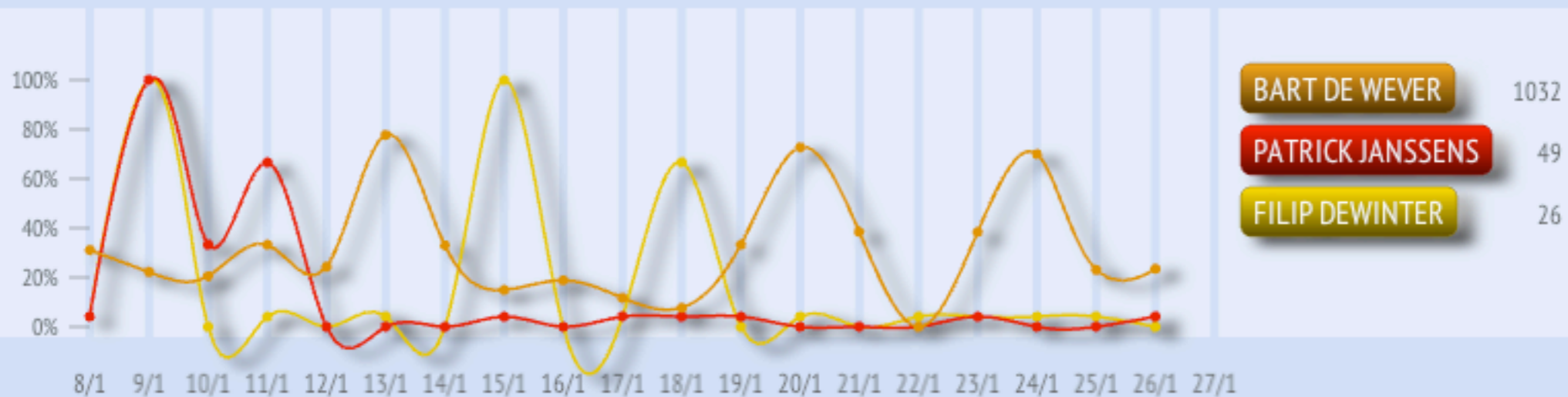


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# Politieke berichten op Twitter – Antwerpen top 3, opinie

LAATSTE 20 DAGEN

POSITIEF



8/1 9/1 10/1 11/1 12/1 13/1 14/1 15/1 16/1 17/1 18/1 19/1 20/1 21/1 22/1 23/1 24/1 25/1 26/1 27/1

NEGATIEF

GEMIDDELDE

	POSITIEF	NEGATIEF
Orange	+31.3%	-9.4%
Red	+0.0%	-0.0%
Yellow	+26.7%	-10.0%

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... where did Patrick Janssens go ?



PDF

<http://bit.ly/modeling-creativity>

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