

natural interaction based on language

niL

Computational Creativity in Literary Artifacts: Narrative and Poetry

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Artificial creativity
Linguistic creativity

Narratology
Representing Stories
Plot and Causality
Narrative Discourse
Inventing and Telling
Artificial Storytellers
A Grand View

Why Artificial Poets
Articulation
Artificial Poets: Articulation in Poetry
WASP

Conclusions

Artificial Creativity

AI mirrors reality

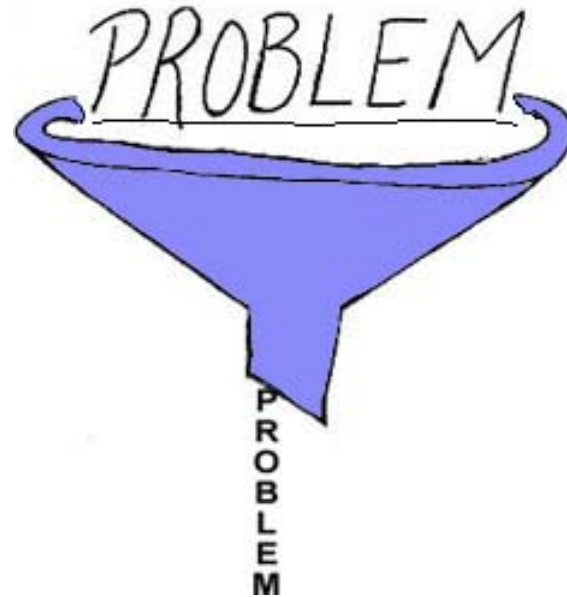


Creativity?



attempted by engineers

how do engineers address difficult problems?



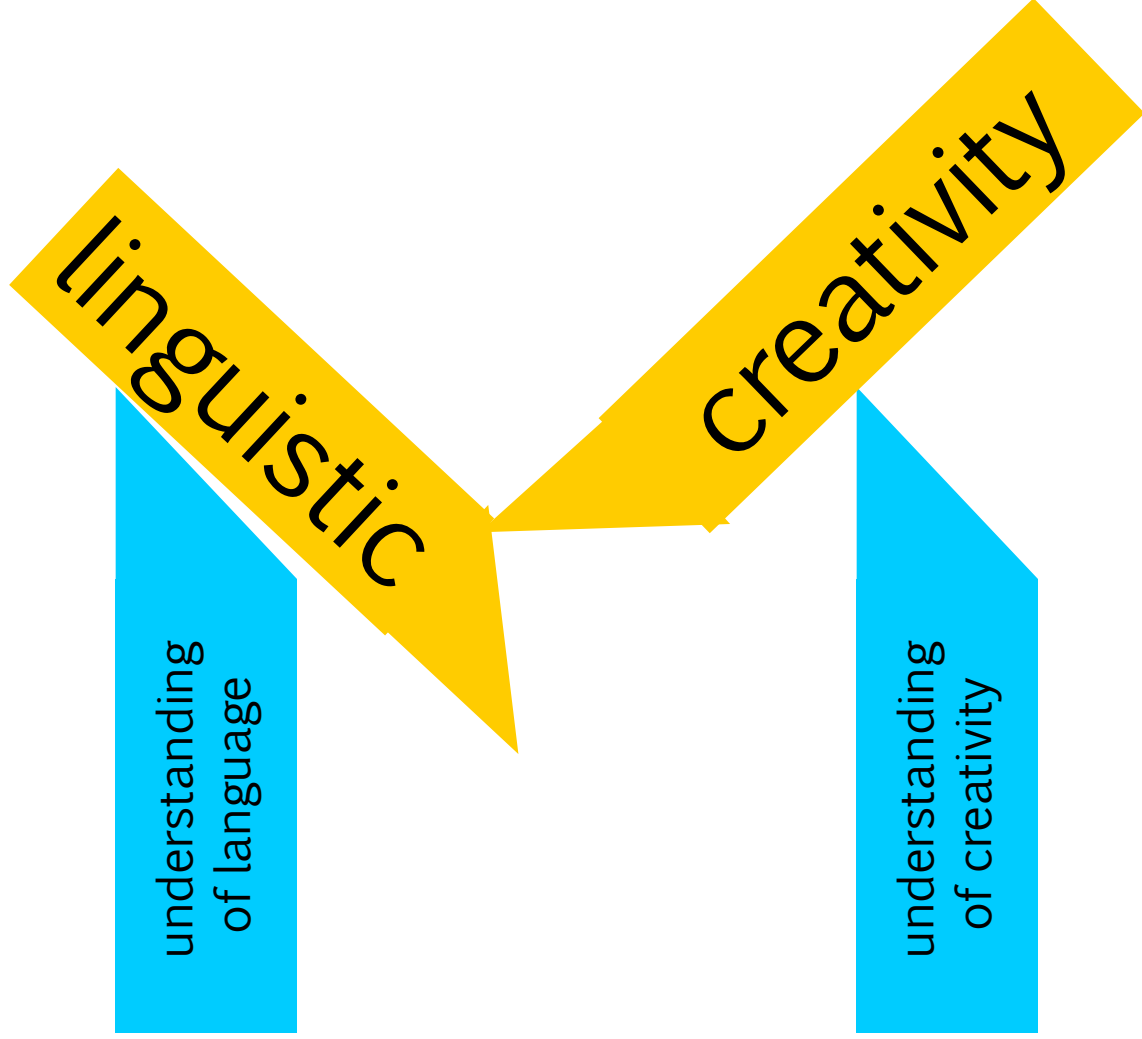


Linguistic Creativity

linguistic creativity

understanding
of language

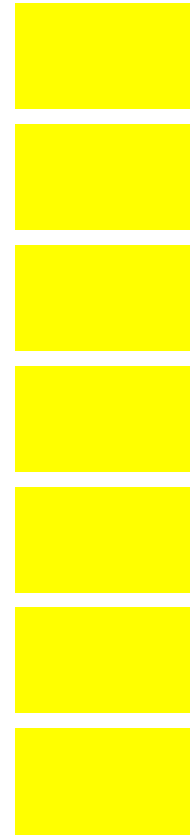
understanding
of creativity



linguistic creativity



linguistic
elements



creativity
elements

NLG pipeline

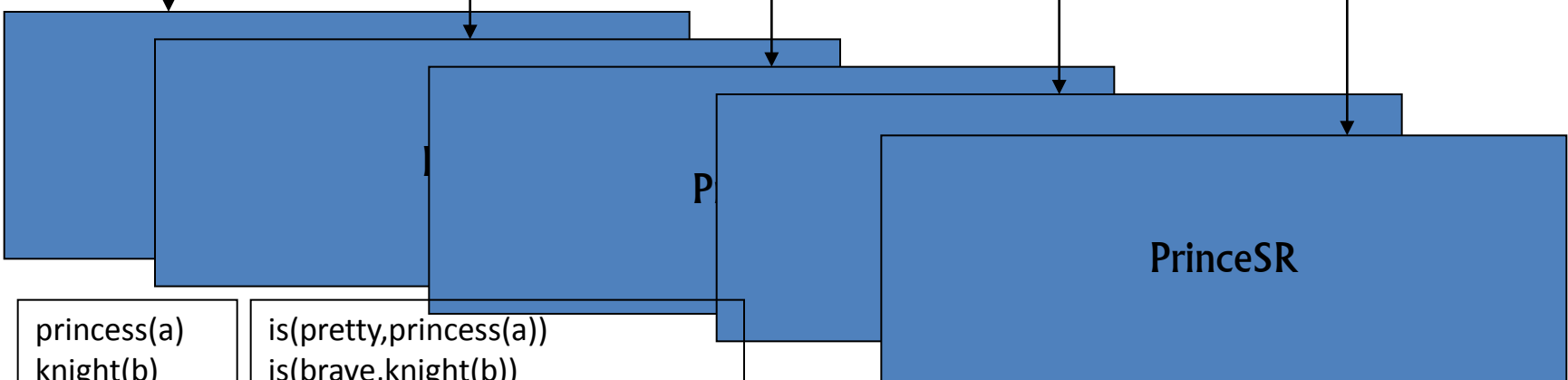
Content Determination

Discourse Planning

Reference Generation

Lexicalization

Surface Realization



princess(a)
knight(b)
castle(c)

pretty(a)
brave(b)
loves(a,b)
lives(a,c)

rescue(b,a)

is(pretty,princess(a))
is(brave,knight(b))
loves(princess(a),knight(b))
lives(princess(a),castle(c))
rescue(knight(b),princess(a))

lives(princess(a),castle(c))
is(pretty,princess(a))
loves(princess(a),knight(b))
is(brave,knight(b))
rescue(knight(b),princess(a))

lives(princess(a,**ind**),castle(c,**ind**))
is(pretty,princess(a,**pron**))
loves(princess(a,**pron**),knight(b,**ind**))
is(brave,knight(b,**def**))
rescue(knight(b,**pron**),princess(a,**def**))

lives(princess(a,ind),castle(c,ind))
is(pretty,princess(a,pron))
loves(princess(a,pron),knight(b,ind)) **"is in love with"**
is(brave,knight(b,def))
rescue(knight(b,pron),princess(a,def))

A princess lives in a castle.
She is pretty.
She is in love with a knight.
The knight is brave.
He rescues the princess.

Basic NLG tasks as rewriting



Pronouns

she

the princess

the pretty princess

the pretty blonde princess

she

Adjectives

the pretty princess

the princess

the blonde princess

the pretty blonde princess

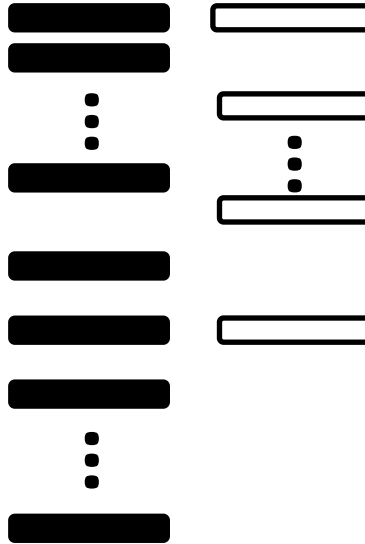
Descriptions

A blonde princess lived in a castle.

A princess lived in a castle.
She was blonde.

A princess lived in a castle.
She loved a knight. She was pretty.
The castle had towers.

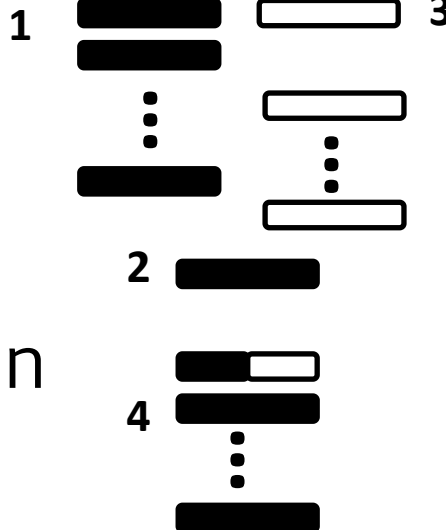
A pretty princess lived in a castle.
She loved a knight.
The castle had towers.



The black queen was four squares north of the centre of the board. The third black pawn was to the right. (...) The black queen saw the third black pawn leaving to the right. (...) Three days later, the black queen moved southeast. The third white pawn remained behind. (..) The black queen saw the white queen appearing ahead. The black queen attacked the white queen.



...



A month earlier three squares northwest, the white queen was three squares south of the centre of the board. (...) The white queen saw the black queen arriving. The black queen attacked the white queen.

The white queen died. The black queen saw the white right bishop arriving. The white right bishop attacked the black queen. The black queen died.

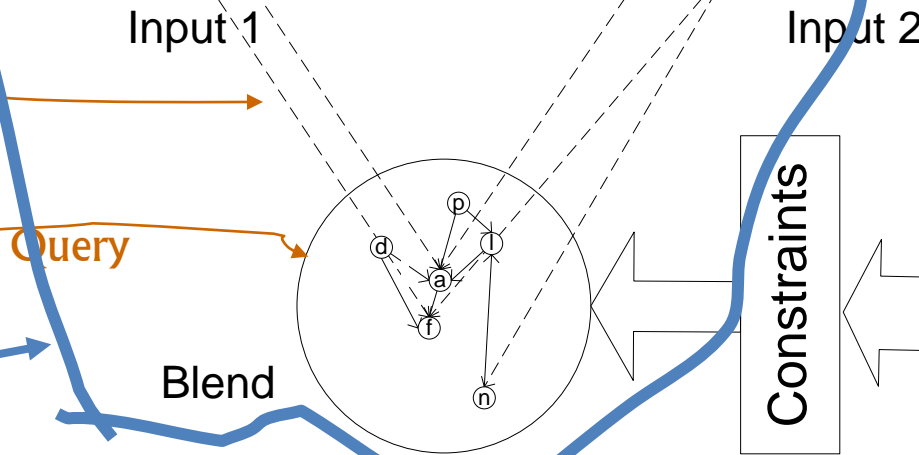
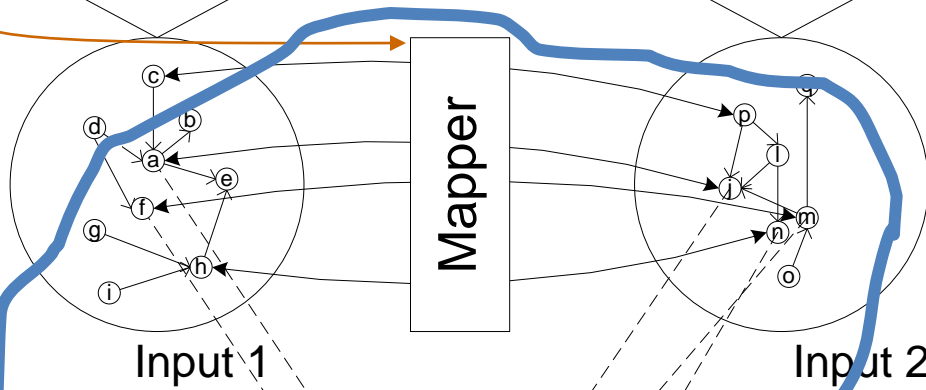
Narrative composition

Gervás, CMN (2012)

Domains

Mapping
between
structures

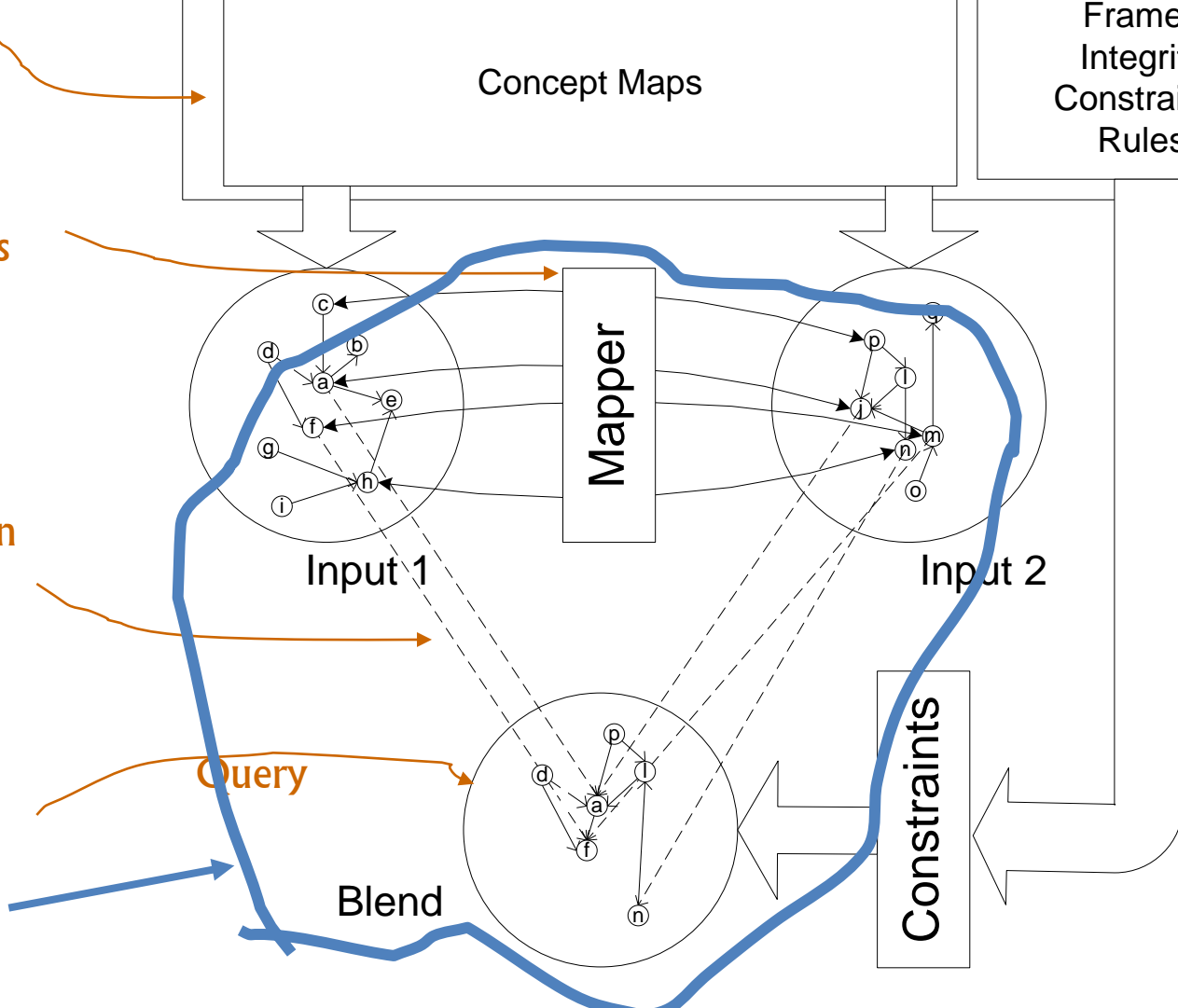
Selective
Projection



Query

Factory
(GA)

Blend



hear(speaker, sound)

produce(guitar, sound)

attracted_to(speaker, sound)

Input

made_of(guitar, wood).

isa(guitar, instrument).

have(guitar, strings).

made_of(string, nylon).

produce(guitar, sound).

have(guitar, neck).

have(guitar, body).

have(guitar, bridge).

have(body, ressonance_hole).

made_of(woman, flesh).

isa(woman, female).

property(woman, beautiful).

can(woman, sing).

have(woman, eyes).

have(woman, neck).

have(woman, body).

have(woman, hair).

isa(mermaid, mythical_creature).

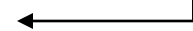
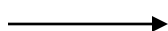
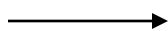
isa(mermaid, female).

property(mermaid, beautiful).

can(mermaid, sing).

produce(mermaid, song)

attracted_to(men, song).



Some blend?

“I heard the attractive sound of the mermaid”

“I heard the attractive song of the guitar”

“I heard the mermaid song of the guitar”



Alliteration

Gervás et al, EvoMusArt (2007)

1. El ruido con que rueda la ronca tempestad

1. el·ruí·do·con·que·rué·da·la·rón·ca·tem·pes·tád

1. el·^oruí·do·kon·ke·r^oué·da·la·rón·ka·tem·pes·tád

1. 85 567 18 184 18 568 19 59 584 19 184 183 191

1. vc·cvv·cv·cvc·cv·cvv·cv·cv·cvc·cv·cvc·cvc·cvc

1. o oó o o o oó o o ó o o o ó

2. Bajo el ala aleve del leve abanico

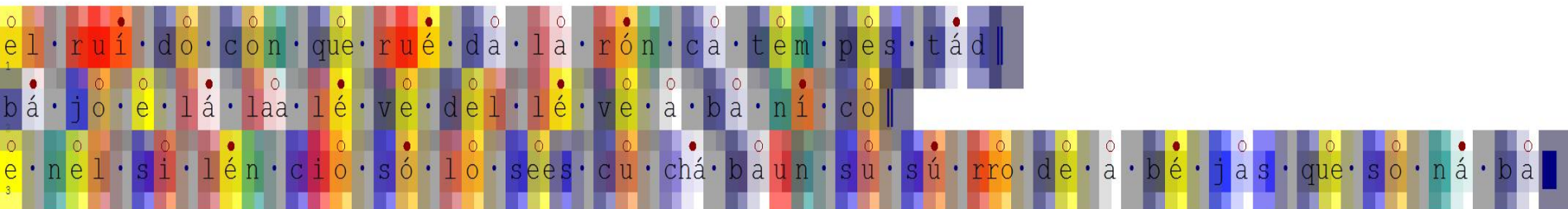
2. bá·jo·e·lá·laa·lé·ve·del·lé·ve·a·ba·ní·co

2. bá·xo·e·lá·la·lé·be·del·lé·be·a·ba·ní·ko

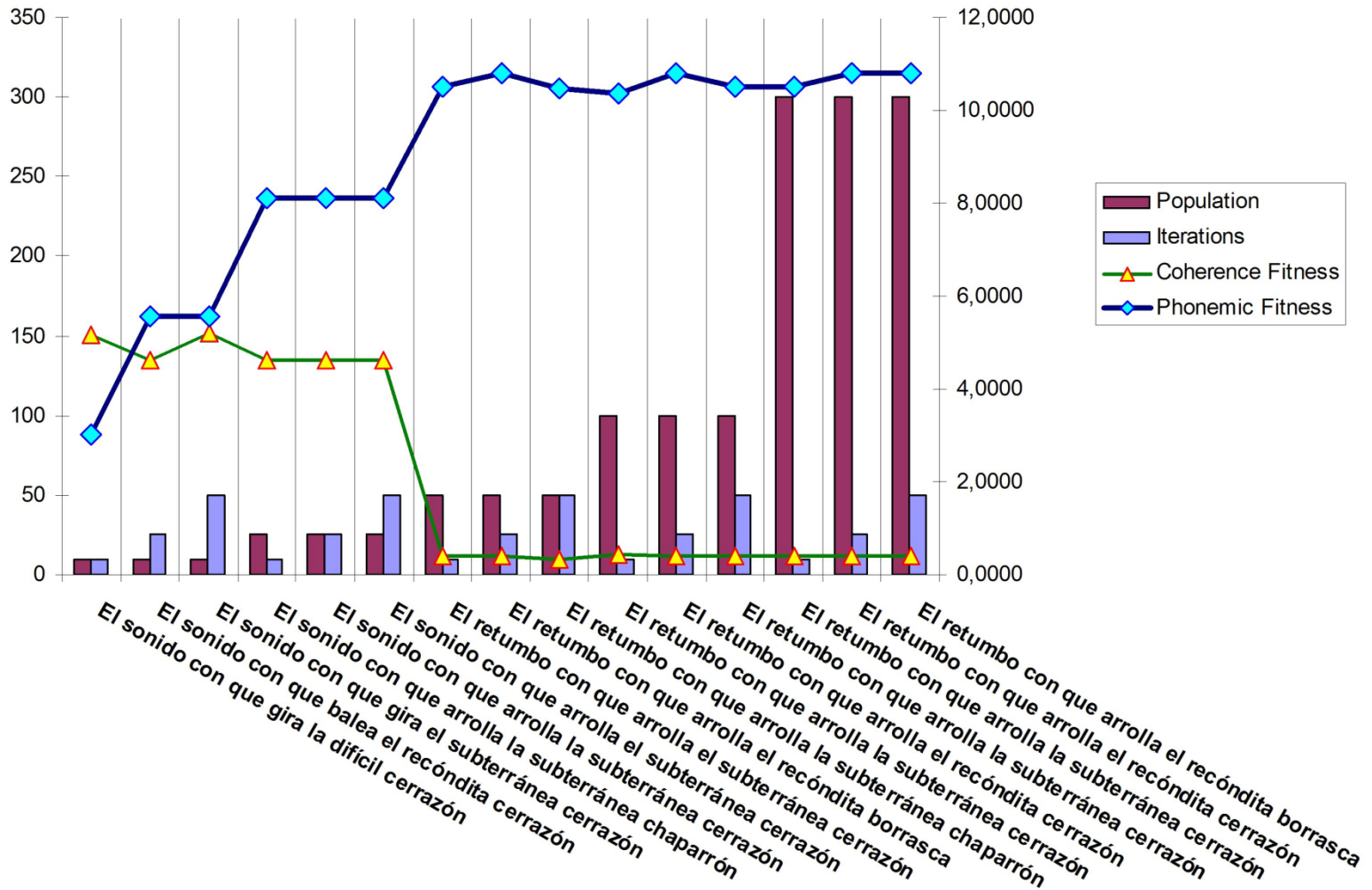
2. 19 38 8 59 59 58 18 185 58 18 9 19 47 18

2. cv·cv·v·cv·cv·cv·cv·cvc·cv·cv·v·cv·cv·cv

2. ó o o ó o ó o o ó o o o ó o



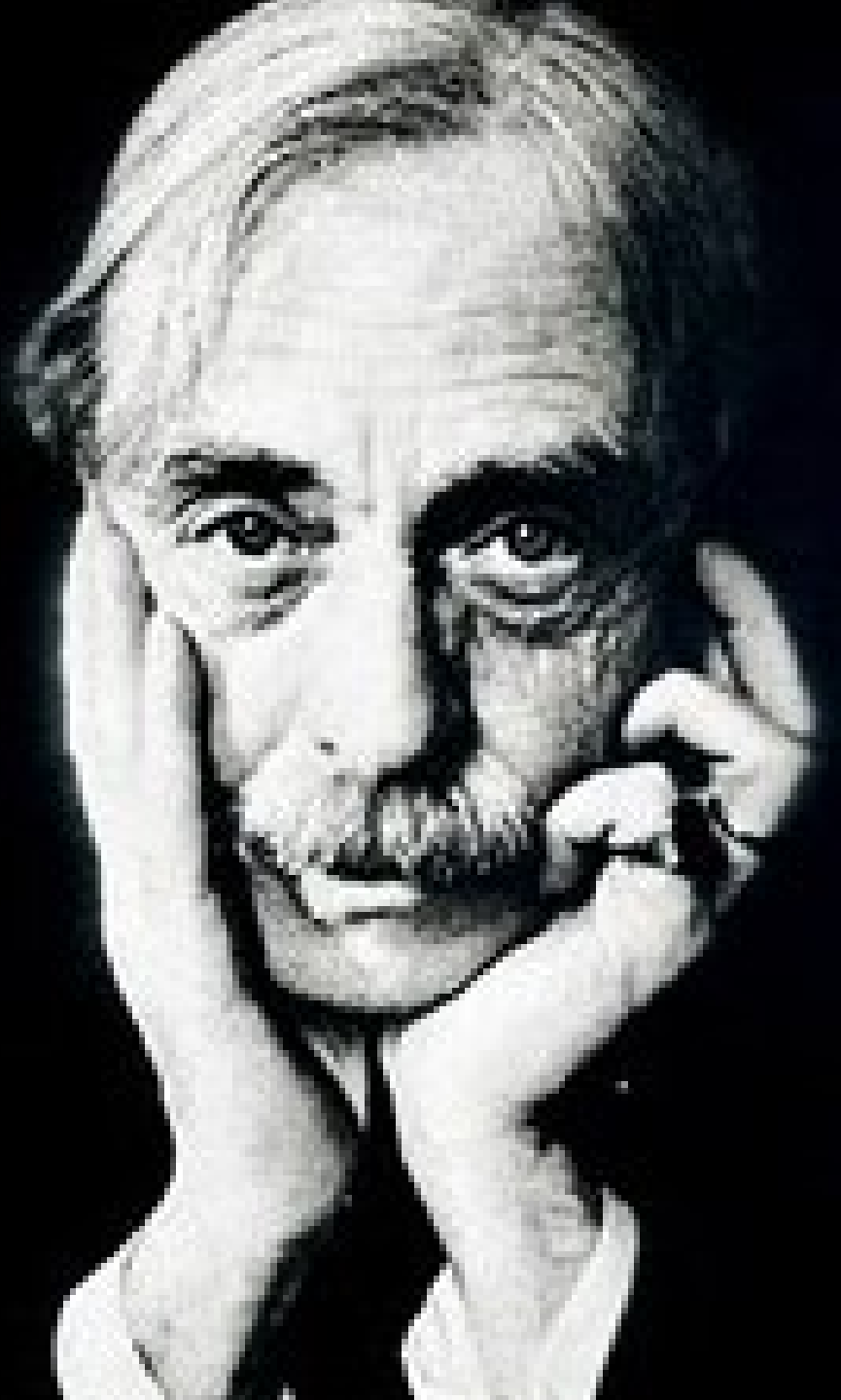
Different population sizes and number of generations



Why Artificial Poets

A poem is really a kind of machine for producing the poetic state of mind by means of words.

Paul Valery
Poetry and Abstract
Thought
1939



16
16

The Magic Flute Overture

Timpani (E♭-B♭)

W. A. Mozart, K. 620

Adagio

Viol. I

Allegro Viol. I

A

B

C

E



What your brain does

	Semantics	Text
	(generated implicitly)	generated explicitly
	given as input	generated from input

*even more
generated
implicitly!*

Articulation



Oct. 11, 1966

S. F. SPEERS ETAL

3,277,602

TOY FIGURE HAVING MOVABLE JOINTS

Filed June 15, 1964

2 Sheets-Sheet 1



FIG. 1

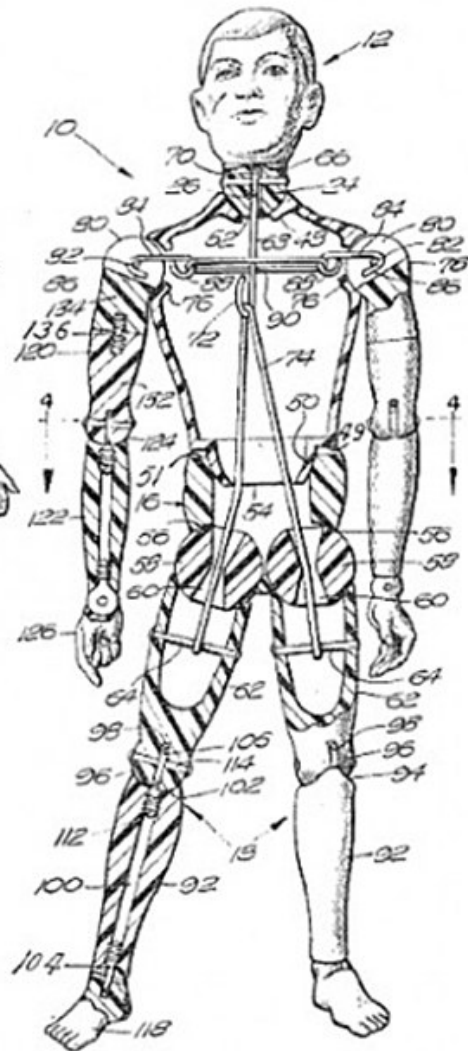


FIG. 2

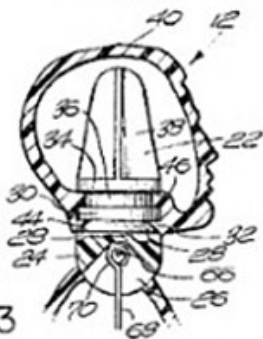


FIG. 3

INVENTORS
 SAMUEL F. SPEERS
 HUBERT P. O'CONNOR
 BY
Salter & Fischelson
 ATTORNEYS

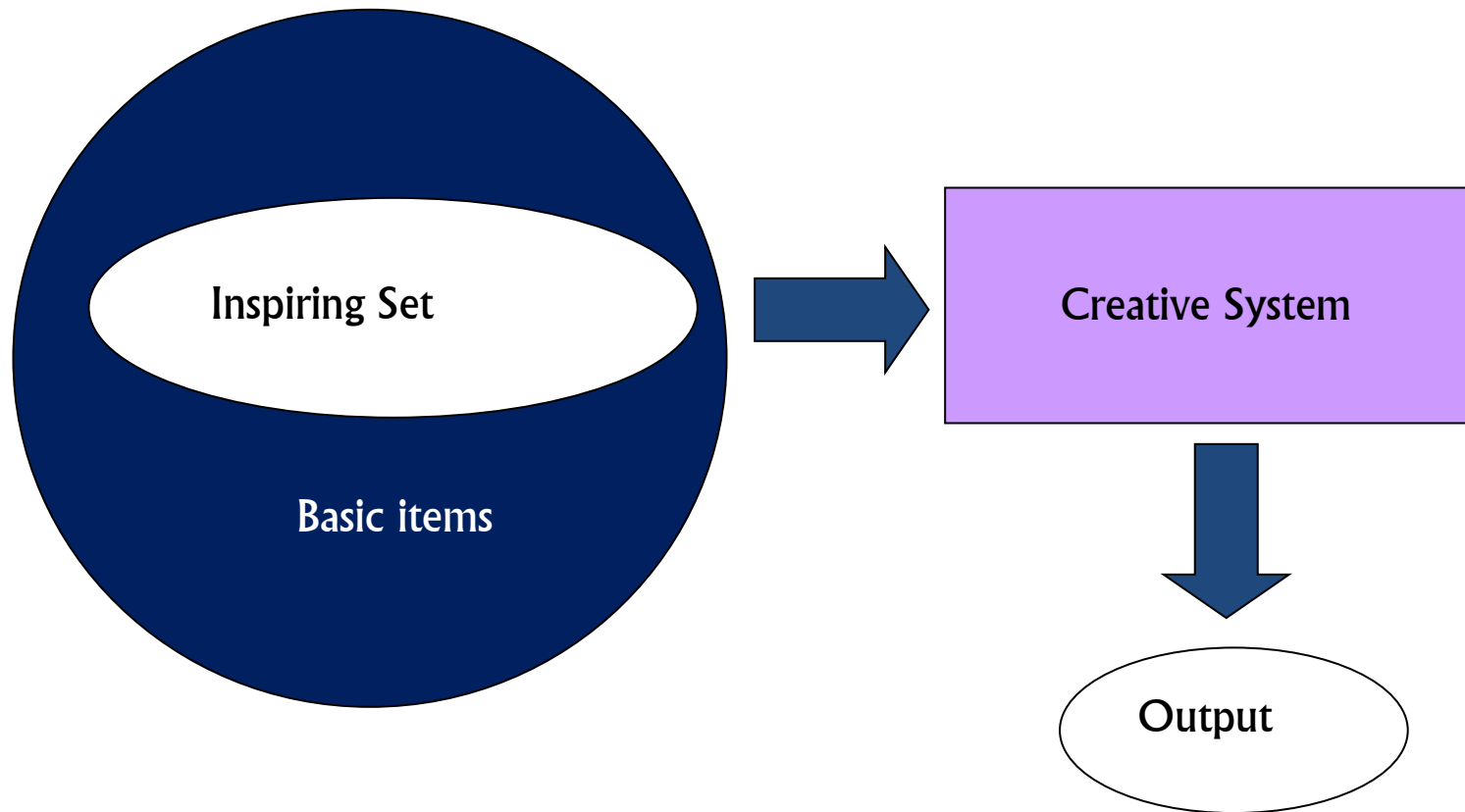




Articulation in Poetry: Artificial Poets

Graeme Ritchie (2001)

Inspiring set: the set of (usually highly valued) artefacts that the programmer is guided by when designing a creative program.

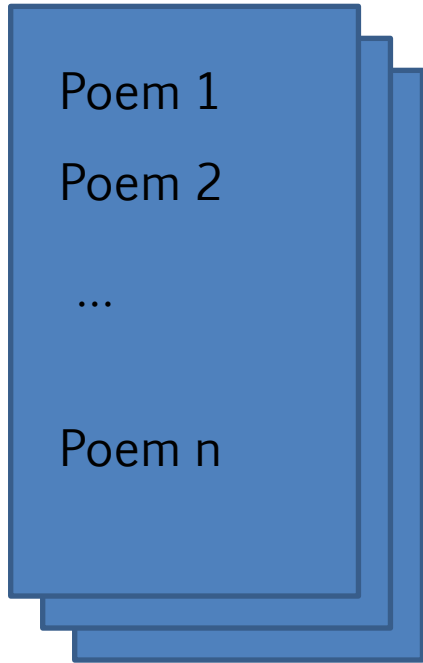


Geraint Wiggins (2001)

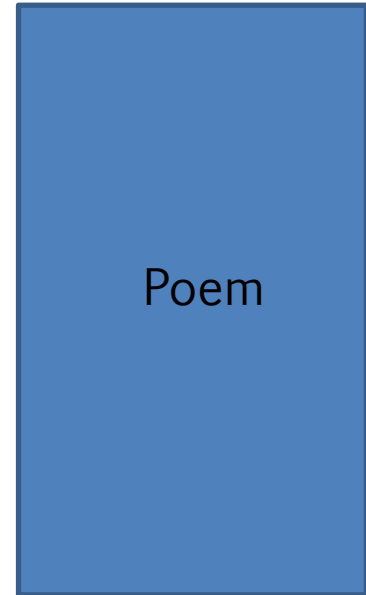
Exploratory creativity in terms of explicit representation of:

- universe under consideration (U)
- conceptual spaces (R)
- traversal of a conceptual space (T)
- evaluation function for a conceptual space (E)

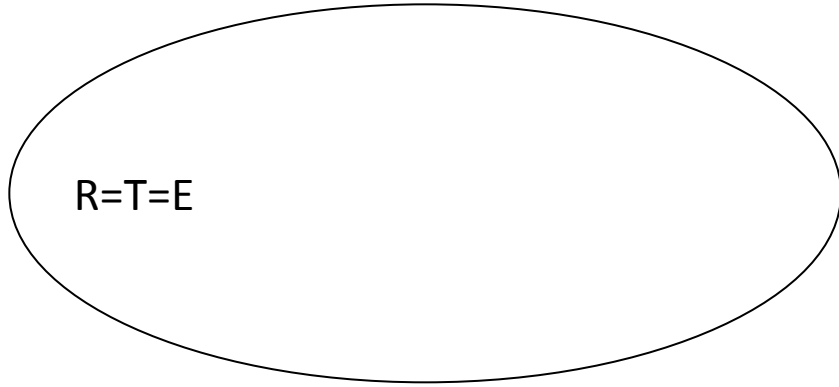
Poem-based generation

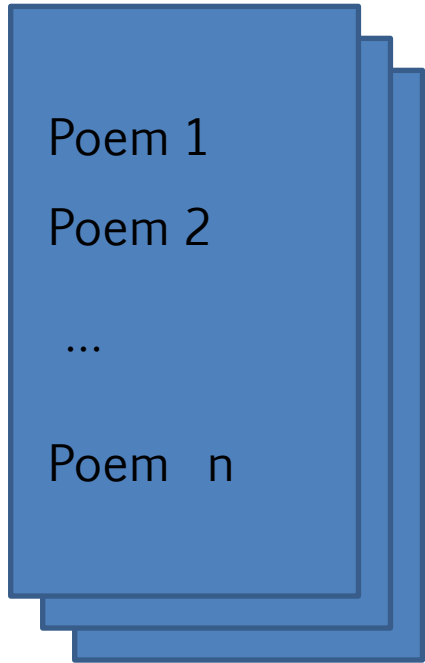


SELECT



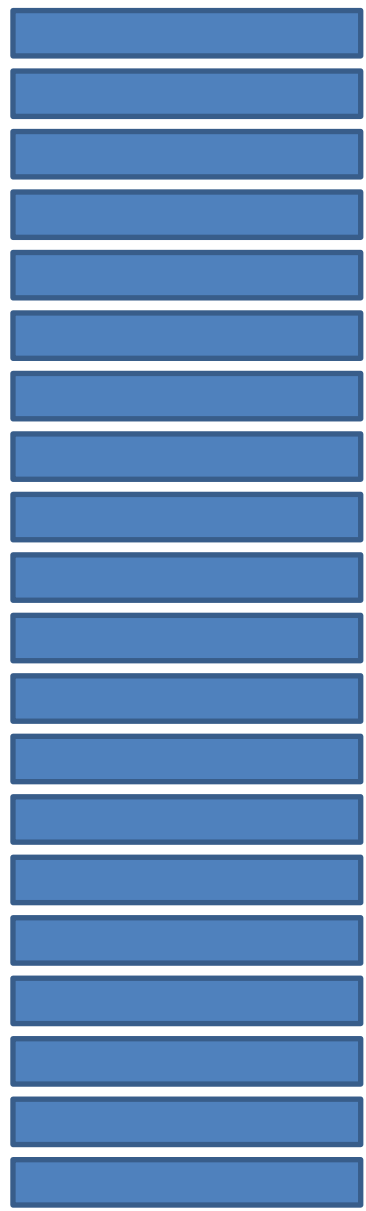
U





EXTRACT

lines



Line-based generation

COMBINE

Poem

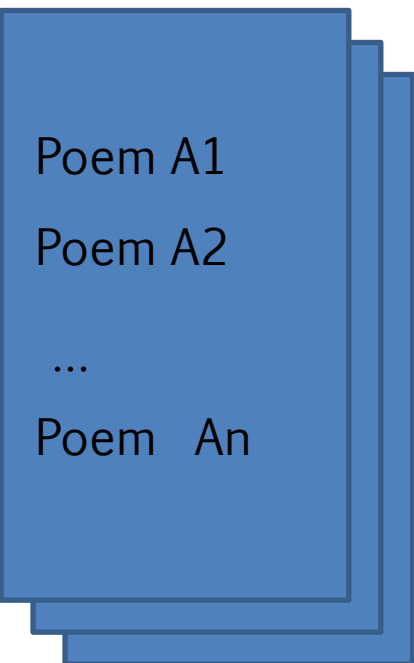


**Raymond
Queneau**
**Cent mille
milliards
de poèmes**

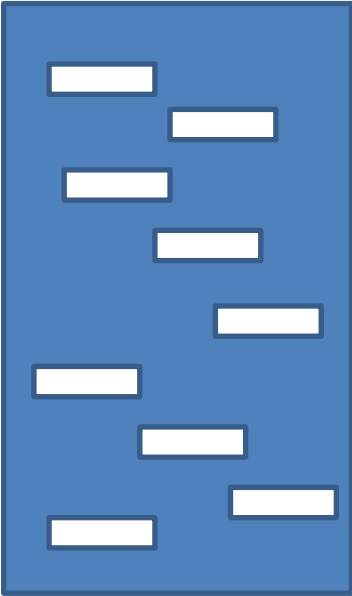
le pampa retourne sa chemise
à mettre à sécher aux cornes des taureaux
sédif en boîte empeste la remise
nient de même et les cuirs et les peaux
ouviens encor de cette heure évangélique
dans la plaine agitaient leurs drapeaux
aussi frois que nos sur la banquise
pour nous distraire y plantions nos tréteaux
à Rosario fait une belle trotte
res on eat qui s'y pique s'y frotte
l'on boit du maté l'on devient argentin
rique du Sud séduit les équivoques
l'espagnol les oreilles baroques
se fait et son terlintintin



Template-based generation

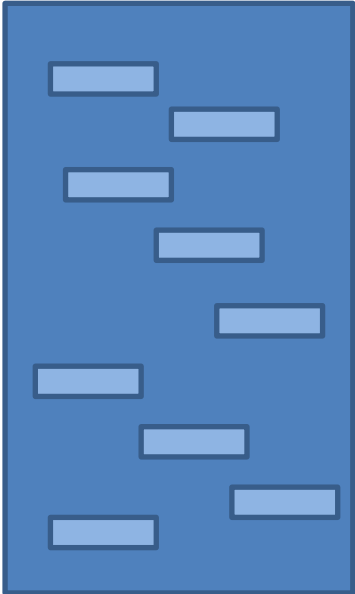


EXTRACT

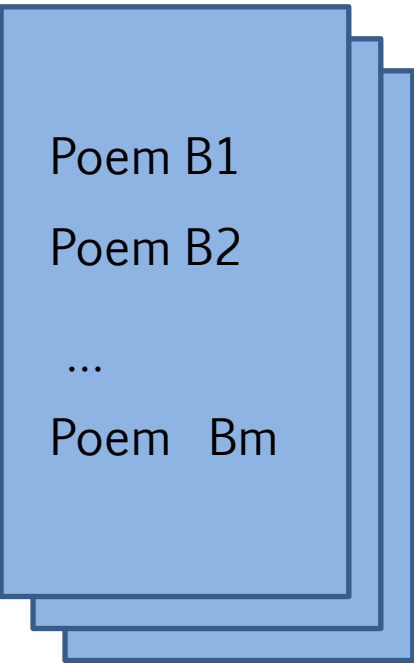


template

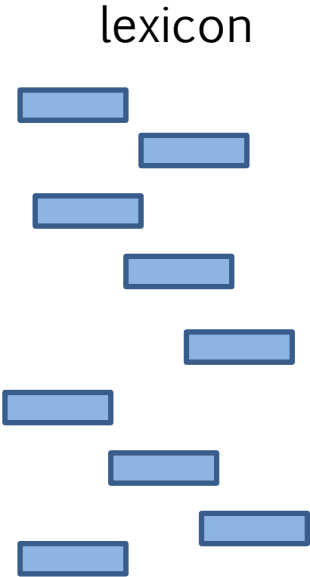
COMBINE



Poem



EXTRACT

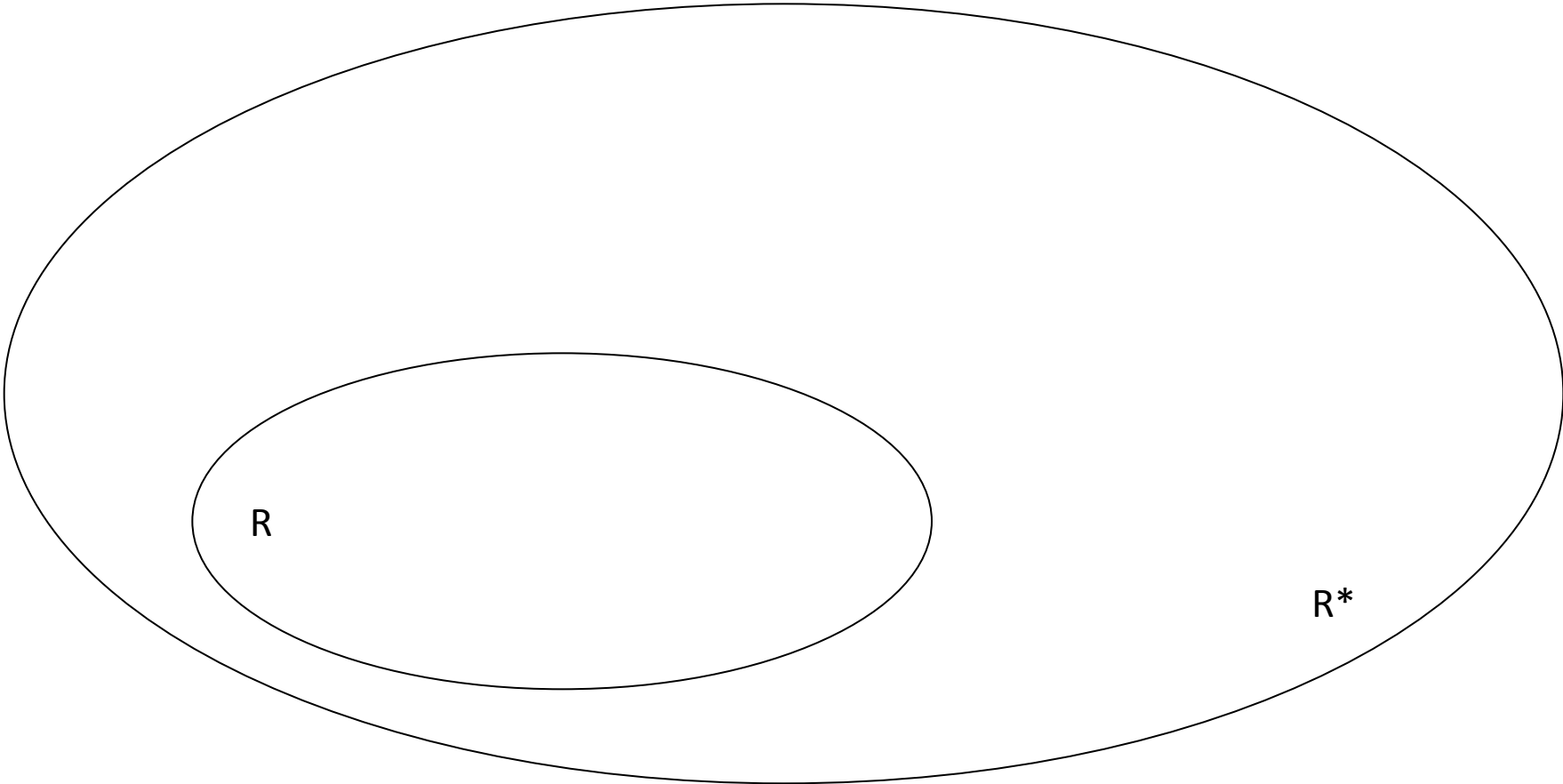


Problem:
1) Little flexibility

U

R

R*



Rimbaudelaire *

Le ----- du -----

C'est un c--- de -----re où ----e une chimère
-----ant -----ement aux --es des -----s
D'----- ; où le brûlot de la -----e ---re
_uit : c'est un petit ----- qui rêve de -----

Un ----- gauche, -----, -----
Et la ----- roulant dans le ---- ravin ----
----t ; il est a----- dans l'--e, sous la ----e,
Gauche, dans son c---- ----- où la -----e ---.

Les -----s dans les -----s, il ---t. {Comme} un -----
----rait un -----, il --- [la,un] -----:
---ure, -----le -----ment : il [est sourd,sourit].

Les matins ne font pas -----r sa -----e ;
Il ---t dans le -----, la ---- sur sa -----e,
-----e. Il a cent -----s frêles au -----ir -----.

Rimbaudelaire 1

Le Rêveur du bonheur

C'est un cri de chimère où laisse une chimère
Contemplant longuement aux îles des soleils
D'enfer ; où le brûlot de la médaille claire
Luit : c'est un petit bonheur qui rêve de sommeil

Un démon gauche, langue obscure, jambe peinte
Et la taille roulant dans le gris ravin blond
Bout ; il est allongé dans l'île, sous la feinte,
Gauche, dans son cri lourd où la nature fond.

Les trous dans les grelots, il bout. Un parfum vague
Sortirait un soldat sublime, il suit la vague :
Verdure, chéris-le chaudement : il sourit.

Les matins ne font pas retentir sa narine ;
Il bout dans le chagrin, la fleur sur sa poitrine,
Sublime. Il a cent trous frêles au désir gris.

Rimbaudelaire 2

Le Gardien du soleil

C'est un ciel de verdure où fume une chimère
Regardant lentement aux âmes des secrets
D'argent ; où le brûlot de la caresse fière
Fuit : c'est un petit soleil qui rêve de regret

Un archer gauche, boucle aimable, paume frêle
Et la bouche roulant dans le rond ravin plat
Ment ; il est assoupi dans l'âme, sous la grêle,
Gauche, dans son coeur froid où la musique va.

Les mains dans les haillons, il ment. Comme un ciel vierge
Nagerait un géant terrible, il met un cierge :
Nature, porte-le librement : il est sourd.

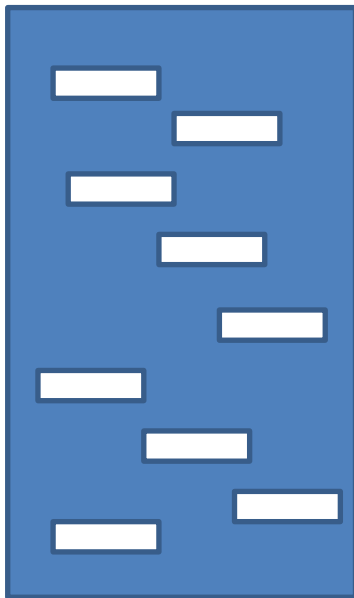
Les matins ne font pas abreuver sa menace ;
Il ment dans le secret, la dent sur sa grimace,
Terrible. Il a cent mains frêles au plaisir court.

Template-based generation

CREATIVE

EXTRACT

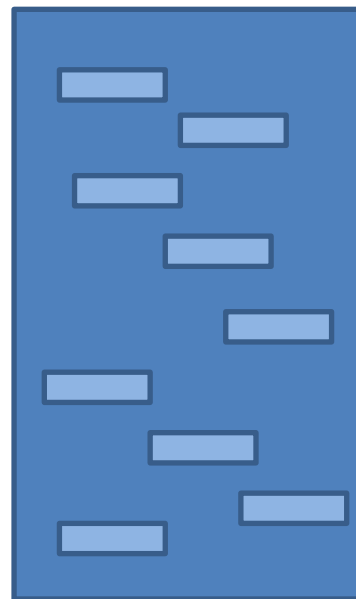
Poem A1
Poem A2
...
Poem An



template

GENERATIVE

COMBINE

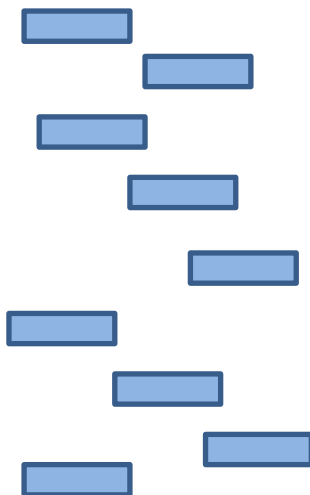


Poem

EXTRACT

lexicon

Poem B1
Poem B2
...
Poem Bm



(Gervás, 2000)

ASPERA



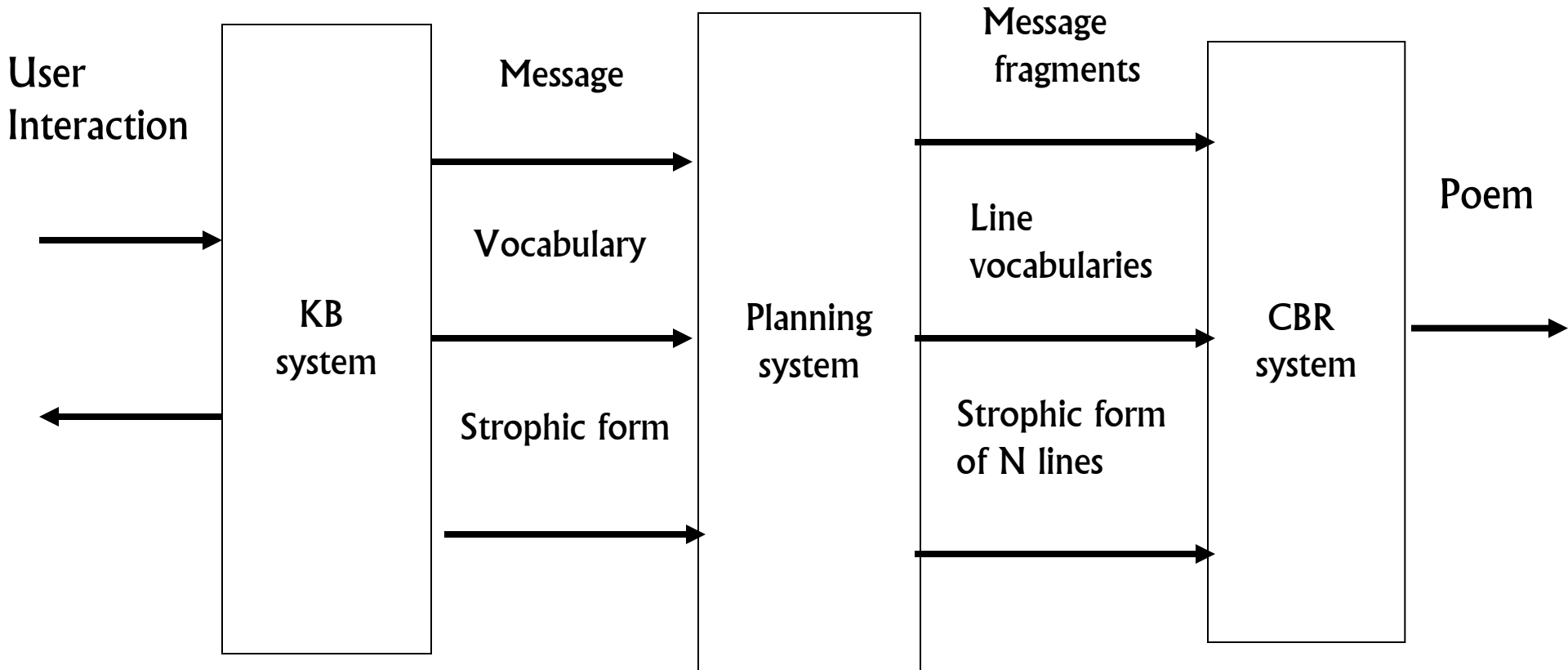
- ✓ retrieves a case (verse example) for each sentence of the intended message
- ✓ generates a line of the poem draft by mirroring the POS structure of the chosen case - using additional vocabulary and following metric criteria
- ✓ presents the draft to be validated by the user
- ✓ analyses validated poems and adds them to its data files

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.

Line pattern-based generation

a prose-to-poetry semiautomatic translator



System selects appropriate metre, stanza and vocabulary

Case-Based Reasoning

cases
adaptation procedure
similarity function

Markov models

ngram

Grammars

terminal symbols
non-terminal symbols

Evolutionary

genes
operators
fitness function

RKCP



- ✓ poetry analysis
 - from a collection of poems by a single author
 - generates “Markov model” of the author’s style and a poet personality file
- ✓ poetry generation
 - from the “Markov model”, guided by additional constraints:
 - choice of stanza
 - plagiarism avoidance algorithms
 - thematic consistency algorithms

Oh! did appear
A half-formed tear,
a Tear.
By the man of the
heart.

(after Lord Byron)

Ngram-based generation

Problem:

1) Risk of poor grammar

0 thou,
Who moved among some fierce Maenad,
even among noise
and blue
Between the bones sang,
scattered and the silent seas.

(after William Carlos Williams)

(Chamberlain, 1984)

- ✓The Policeman's Beard is Half Constructed: Computer Prose and Poetry by Racter.
- ✓Racter is short for 'raconteur'
- ✓little detail known, supposedly based on grammars

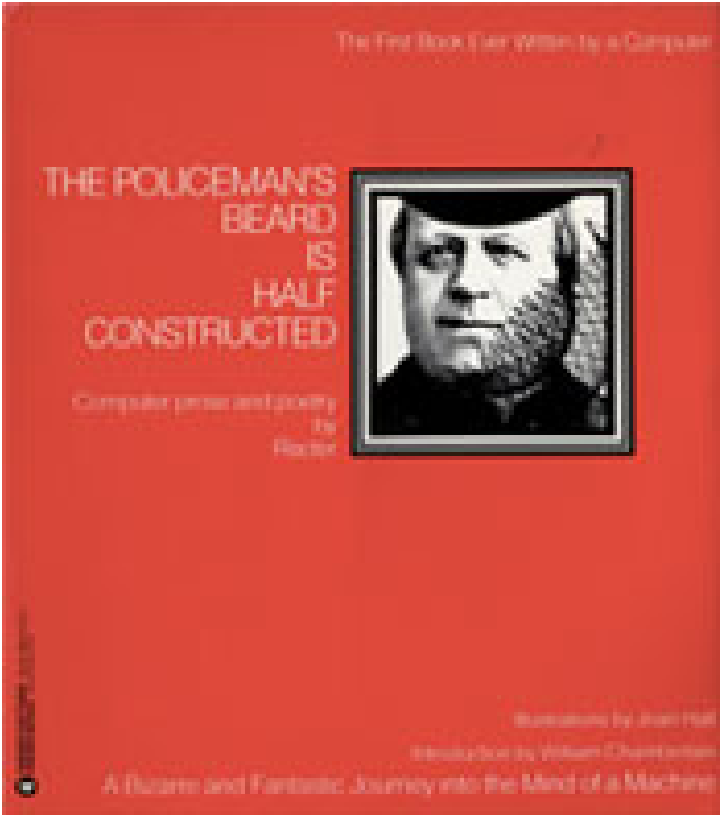
Two problems:

- 1) Form no longer poem like
- 2) Content starts to go wild

RACTER

```
More than iron
More than lead
More than gold I need electricity
I need it more than I need lamb or pork or lettuce or cucumber
I need it for my dreams
```

Grammar-based generation



the bread is the bread which is gone
the cat which is dead is the cat
the cat is the cat
which ate with the bread
the bread is the bread which is gone

the cat is the cat which is dead
the bread which is gone is the bread
the cat which consumed
the bread is the cat
which gobbled the bread which is gone



Semantics-based generation

(Manurung, 1999)

- ✓ chart generation of rhythm-patterned text
- ✓ given a semantic + metric input, generate all possible forms



McGONAGALL (Manurung, 2003)

Facts, they are round. African
facts, they are in a
child. A bill is rare.

(haiku)

In facts, with a bill with a shocking
town in a tail in his fish,
his blubber will boil
his jaws in a bean
in mothers. His boy is a mind.

(limerick)

- ✓ given target semantics and target surface form
- ✓ poetry generation as stochastic state-space search
- ✓ evolutionary algorithms (fitness function + operators)

Evolutionary semantics-based generation

Target semantics: john(j), walk(w,j), sleep(s,j)

Target surface:
john(j), walk(w,j), sleep(s,j)
john(j), sleep(s,j)

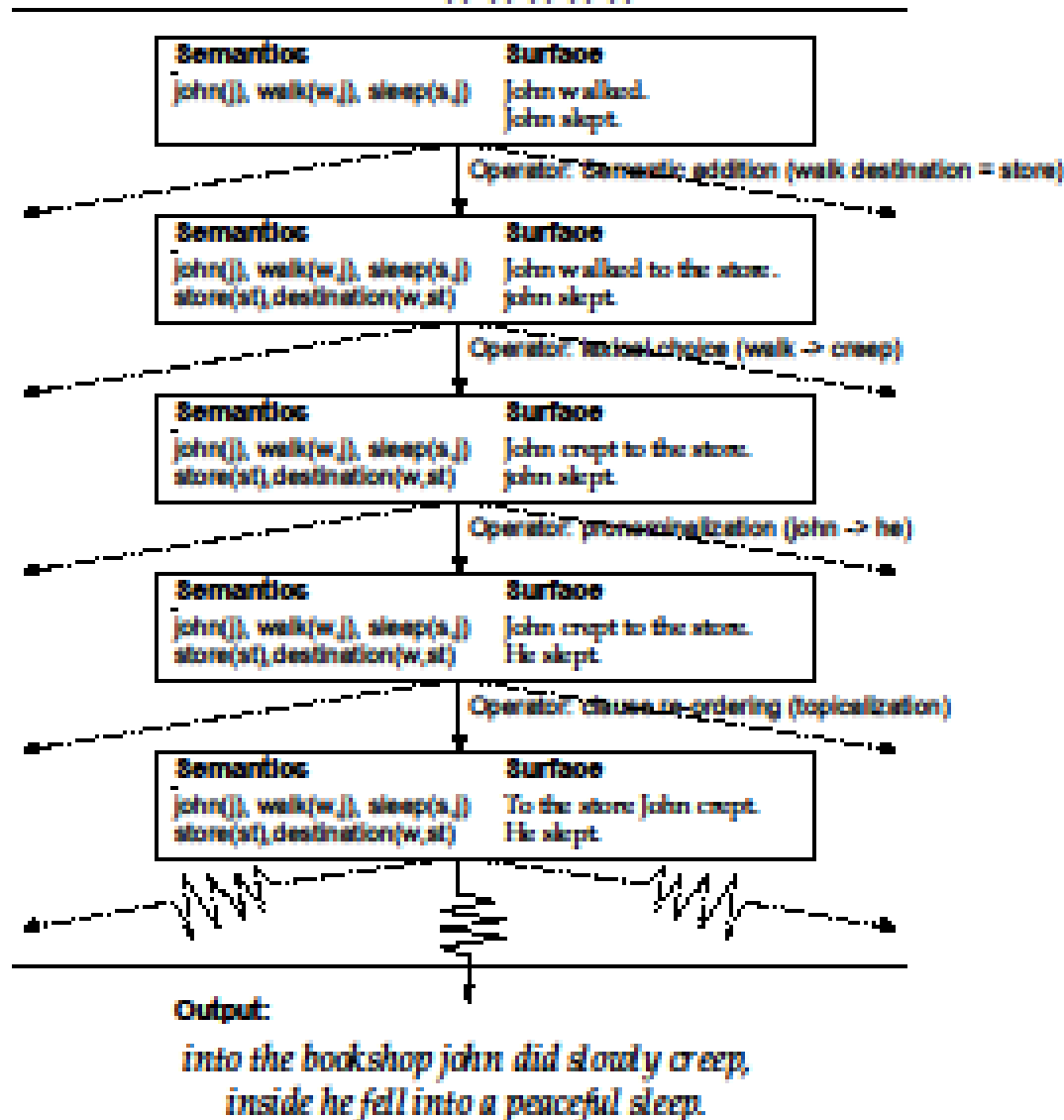


Figure 4.1: An idealization of poetry generation as state space search

WASP



was

wishful

automatic

spanish

poet



WASP: the

✓ Comp
semiau

✓ Had a

✓ Worked

✓ Had a
sensibil

✓ Result
human

WASP - the Wishful Automatic Spanish Poet

Perezoso | Loco | mad3 | mad4 | mad5 | Juez

*en este feroz verano donde escasea el agua
es más importante proteger a un árbol
como fuente de vida y futuro .*

GENERAR POEMA

*en este feroz verano donde
escasea el agua es más
importante proteger a un árbol
como fuente de vida y futuro*

<i>Verso 1</i>	<i>Silabas 10</i>	<i>Rima en onde</i>
<i>Verso 2</i>	<i>Silabas 8</i>	<i>Rima en as</i>
<i>Verso 3</i>	<i>Silabas 10</i>	<i>Rima en arbol</i>
<i>Verso 4</i>	<i>Silabas 10</i>	<i>Rima en uro</i>

Poet

n a

y

a set of families of automatic experts:

- ✓ content generators or babblers
(generate a flow of text)
- ✓ poets
(convert flows of text into given strophic forms)
- ✓ judges
(evaluate different aspects)
- ✓ revisers
(edit the drafts they receive, based on score)

- ✓ cooperative society of readers/critics/editors/writers
- ✓ generate a population of drafts
- ✓ modifying it and pruning it in an evolutionary manner
- ✓ over a pre-established number of generations
- ✓ the best valued effort of the lot is chosen as final result



DIONISIO CAÑAS - CARLOS GONZÁLEZ TARDÓN

**¿PUEDE UN COMPUTADOR
ESCRIBIR UN POEMA
DE AMOR?**

**Tecnorromanticismo y poesía
electrónica**

Colabora Pablo Gervás

Con una entrevista inédita de
LUIS ANTONIO DE VILLENA

Editorial Devenir, Madrid, España, marzo del 2010

*Odio vida, cuánto odio. Sólo
por tu audición se ha desangrado.
Ay de mi índice! Oh limón
amarillo! Me darás
un minuto de mar, vida
como de alpistes, la tierra
que no dejarán desiertos.
Ni las halles, guardalas
en dos cajitas, hermano, como
para niñas blancas.*

*I hate life, how much hate. Only
by your hearing has it bled to death.
Alas, my index! Oh, yellow
you will give me
a minute of sea, life
as if made of bird seeds, the earth
that will not leave them deserted.
Do not even find them, put them away
in two little boxes, brother, as if
for white girls.*

Babbler(Miguel Hernandez),
ParametrisedPoet(8,24),
LineBreakManager.recomputeLineBreaks8,
LineBreakJudgementShifter,
LineBreakManager.recomputeLineBreaks8,
SentenceDropper,
LineBreakManager.recomputeLineBreaks8,
LineBreakJudgementShifter,
LineBreakManager.recomputeLineBreaks8

target metre = 8 syllables long

verses 1 and 2 longer: no alternative cut by poet to babbler choice

verse 9 longer: there is a better alternative!

Newspaper as Inspiration for Poetry

Daily procedure:

- ✓ download text for newspaper articles
- ✓ train n-gram model
- ✓ generate poems

Pop Size	# gen	Av Score	Time in ms.
100	50	81	3159934
100	20	77	1369584
100	10	73	1025167
50	100	83	3308220
50	50	80	1624226
50	20	78	806429
50	10	74	490583
20	100	82	1505449
20	50	80	1028309
20	20	78	401746
20	10	75	279184
10	100	83	1337811
10	50	77	697729
10	20	79	264351
10	10	77	209875

Average scores for different configurations of evolutionary parameters

[set of newspaper articles from the EL País newspaper for 21/05/2013]

Valdano. Nosotros. Mourinho le había
unos alumnos había
hecho música pero ambos chiítas
los procedimientos sancionadores
y de cómo se apuntó
una mancha de justicia.

Tengo nada que figuran
con nuestra cultura es un
laboratorio financiado
con preferentes está
convirtiendo cada año.

(10 generations,
Population of 50 drafts,
aiming for 8 verses
8 syllables long.
Score: 74
23rd of its generation)

(10 generations,
Population of 50 drafts,
aiming for 8 verses
8 syllables long.
Score: 75
18th of its generation)

balance between form and content

almost correct metrical form (with a few transgressions)

just enough grammaticality to allow some possible interpretation

bringing words together in surprising combinations.

use of ngrams as articulation choice

very tight local coherence between adjoining words

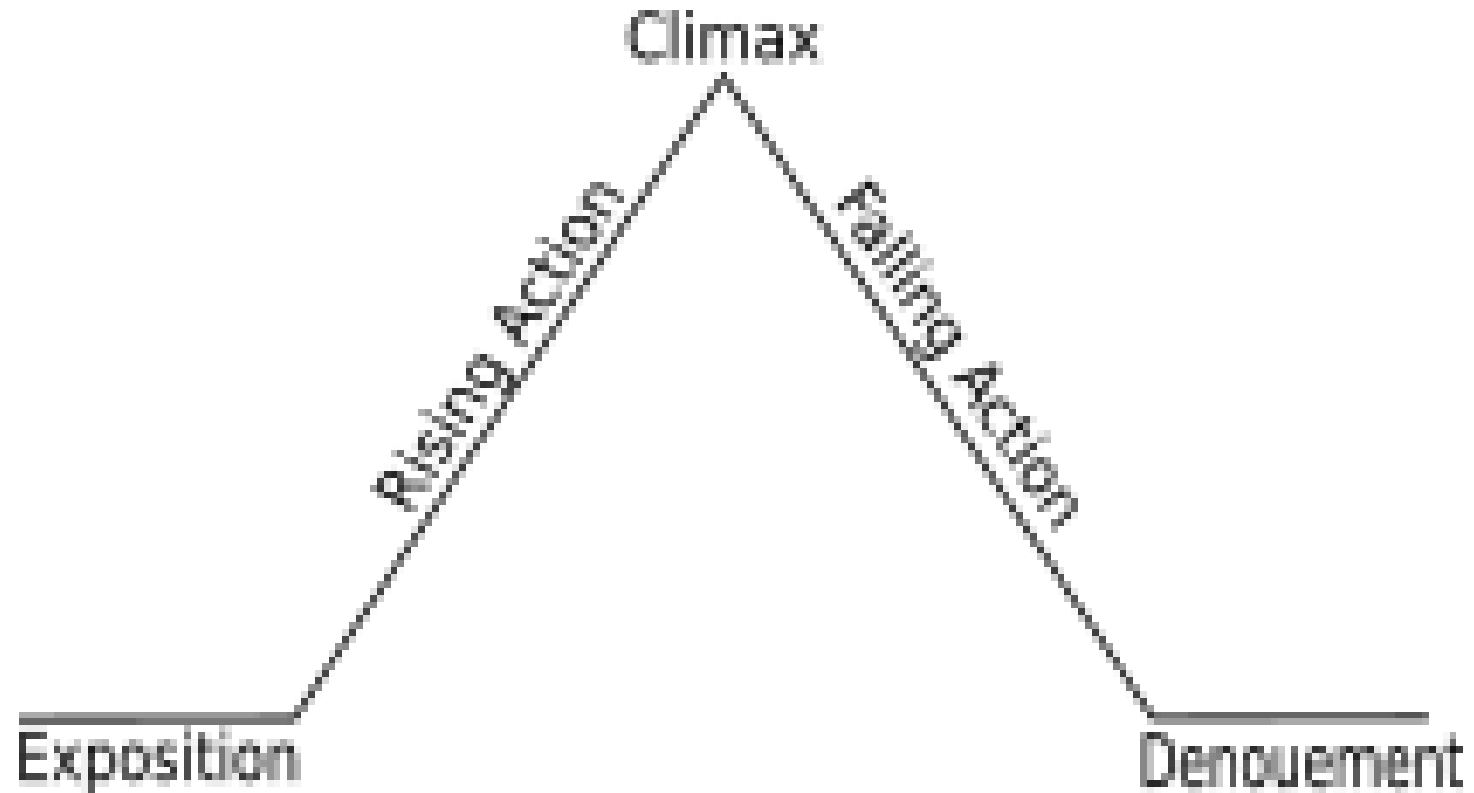
surprising freedom for words beyond a single ngram.

Narratology

Narrative

- Seymour Chatman (1978: 31) defines narrative as a structure which is made up of **narrative** statements.
- Shlomith Rimmon-Kenan (1983: 2) defines narrative fiction as ‘the **narration** of a succession of fictional events’.
- Mieke Bal (1985: 3) defines narrative as a corpus which should consist ‘of all **narrative** texts and only those texts which are **narrative**’
- Minimal narrative (Labov 1972): two states and a transition or movement between the two states

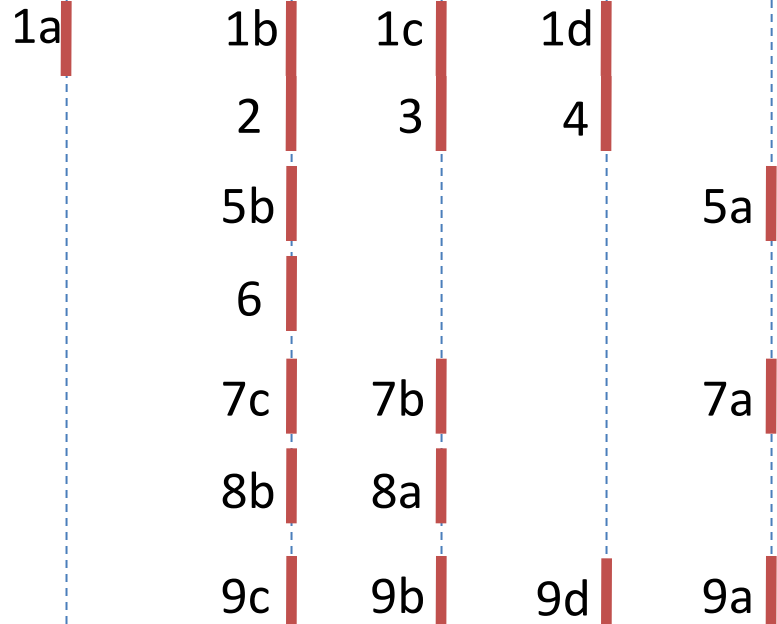
Freytag's Dramatic Arc



A Story?

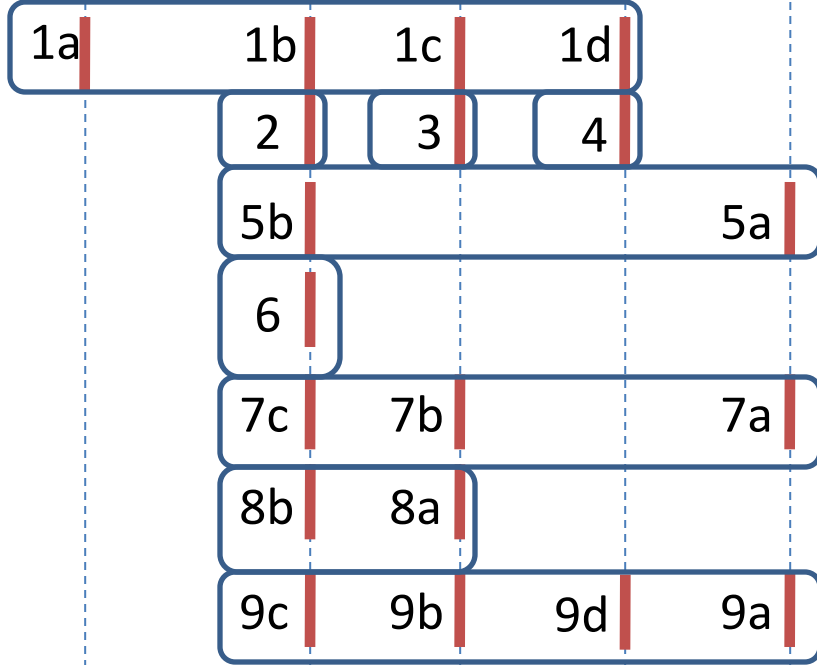
- A discourse...
- ... that conveys a set of events...
- ... that happen to some characters...
- ...over time

mother pig pig1 pig2 pig3 wolf



- 1 mother pig tells boys to build
- 2 pig1 builds house of straw
- 3 pig2 builds house of sticks
- 4 pig3 builds house of bricks
- 5 wolf blows house of straw away
- 6 pig1 runs to house of sticks
- 7 wolf blows house of sticks away
- 8 pigs 1 & 2 run to house of bricks
- 9 wolf fails on house of bricks

Mother pig pig1 pig2 pig3 wolf



- 1 Mother pig tells boys to build
- 2 Pig1 builds house of straw
- 3 Pig2 builds house of sticks
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- 8 Pigs 1 & 2 run to house of bricks
- 9 Wolf fails on house of bricks

FOCALIZATION

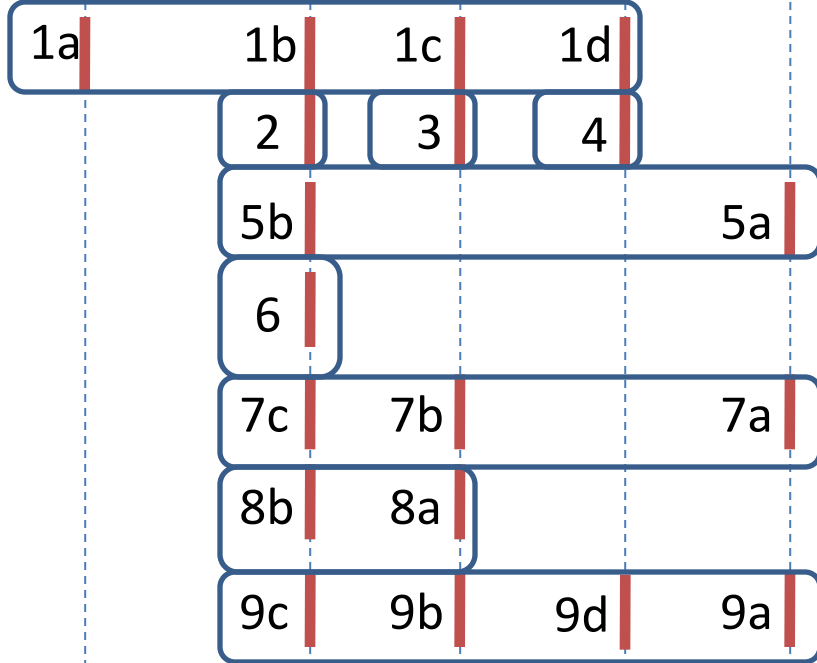
Focalization

- Also described as *point of view*, or *perspective*
- (The term *focalization* was introduced by Genette and has been preferred since.)
- A story as a telling of what someone has seen or perceived
- Definitions:
 - The *focalizer* is the person who sees in a story
 - The *focalized* is the objects that are perceived by the focalizer.
 - External focalization: not bound to a particular character
 - Internal focalization: bound to a particular character

The Role of Focalization

- Focalization provides a rational way of partitioning the space/time volume:
 - Into “threads” defined as what may have been perceived by the focalizer
 - Different threads may be traversed by switching from one focalizer to another

Mother pig pig1 pig2 pig3 wolf



- ??
- 1 Mother pig tells boys to build
 - 2 Pig1 builds house of straw
 - 3 Pig2 builds house of sticks
 - 4 Pig3 builds house of bricks
 - 5 Wolf blows house of straw away
 - 6 Pig1 runs to house of sticks
 - 7 Wolf blows house of sticks away
 - 8 Pigs 1 & 2 run to house of bricks
 - 9 Wolf fails on house of bricks

CHRONOLOGY

DISCOURSE PLANNING

Chronology

- The order in which events are told (story time) as opposed to the the order in which they happened (real time).
- Chronology provides a way of going back to tell bits of the story we left out when we focalised on a particular branch.
- Chronology allows us to decide at which point of the narration the reader starts knowing each piece of information we want him to know about.

1. Dead body A found

2. Catherine and Grissom show up

3. Investigation by C & G

4. Hypothesis crime A

5. Dead body B found

6. Sarah and Nick show up

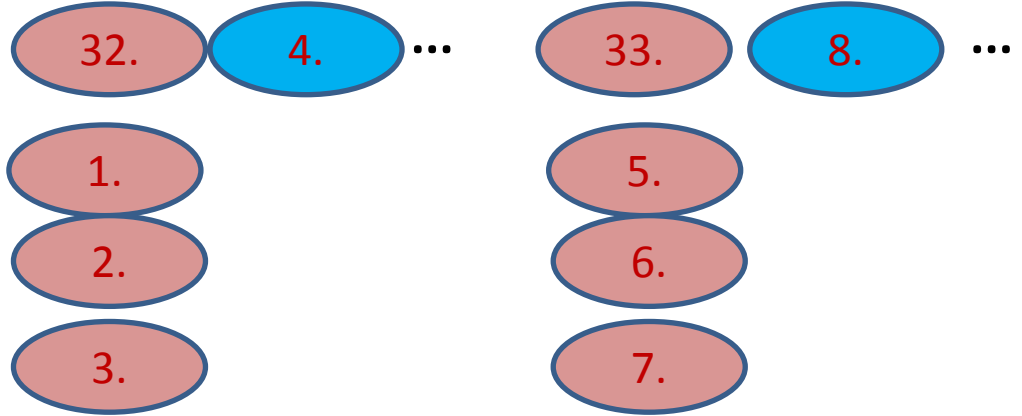
7. Investigation by S y N

8. Hypothesis crime B

•
•
•

32. Solution crime A

33. Solution crime B



•
•
•

•
•
•

CSI Las Vegas

What is told and How it is told

Narrative has two components:

- **What is told** (what narrative is: its content, consisting of events, actions, time and location)
- **How it is told** (how the narrative is told: arrangement, emphasis / de-emphasis, magnification / diminution, of any of the elements of the content)

These have been named different ways by different researchers:

	English	French	Russian
what	story	histoire	fabula
how	discourse	discours	sjuzet

Representing Stories

Once upon a time it was the middle of winter; the flakes of snow were falling like feathers from the sky; a Queen sat at a window sewing, and the frame of the window was made of black ebony. As she was sewing and looking out of the window at the snow, she pricked her finger with the needle, and three drops of blood fell upon the snow. And the red looked pretty upon the white snow, and she thought to herself:

"Would that I had a child as white as snow, as red as blood, and as black as the wood of the window-frame!" Soon after that she had a little daughter, who was as white as snow, and as red as blood, and her hair was as black as ebony; so she was called Little Snow-white. And when the child was born, the Queen died.

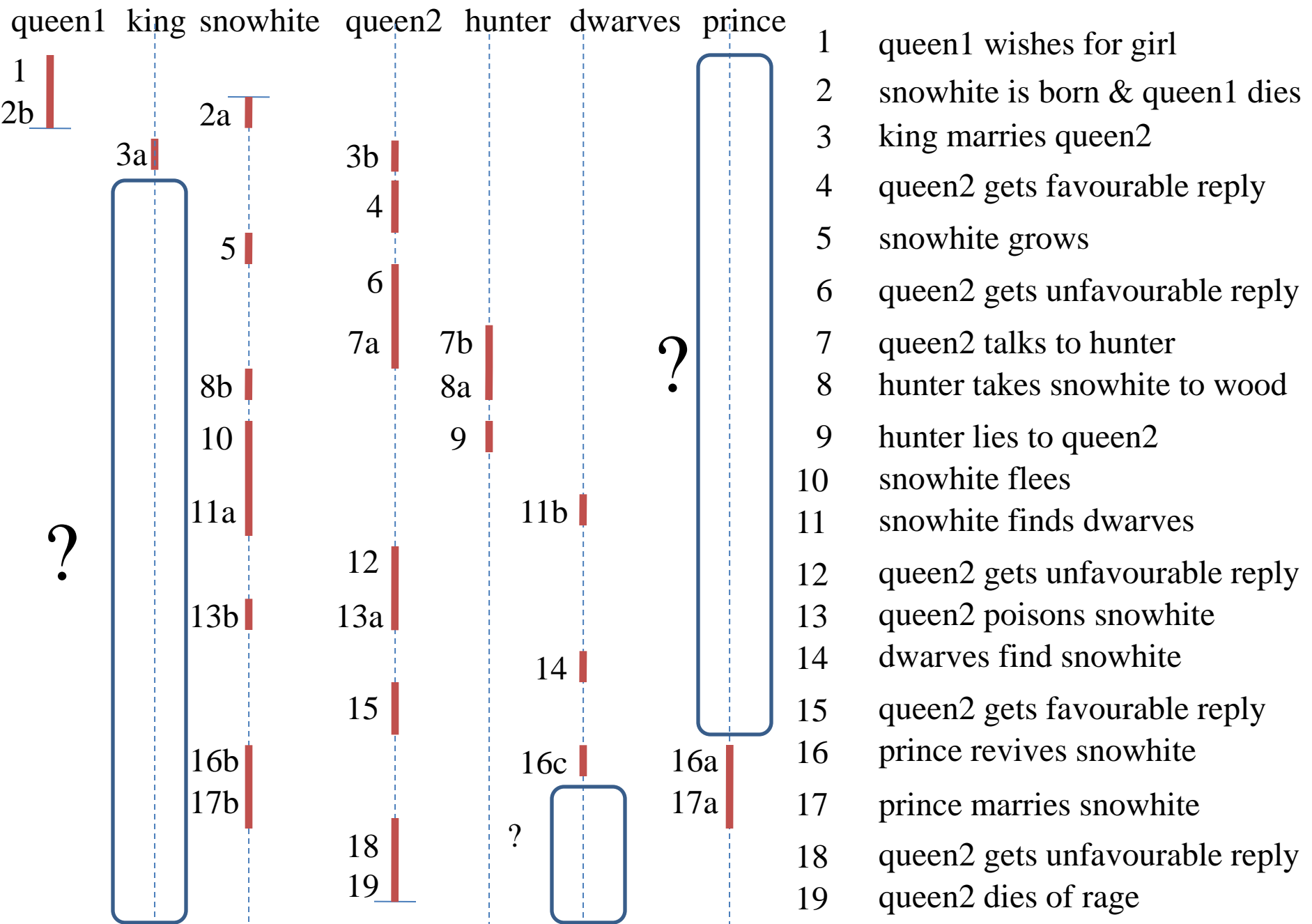
A year after, the King took to himself another wife. She was beautiful but proud, and she could not bear to have any one else more beautiful. She had a wonderful Looking-glass, and when she stood in front of it, and looked at herself in it, and said:

"Looking-glass, Looking-glass, on the wall.
Who in this land is the fairest of all?"

the Looking-glass answered:

- 1 queen1 wishes for girl
- 2 snowwhite is born & queen1 dies
- 3 king marries queen2
- 4 queen2 gets favourable reply
- 5 snowwhite grows
- 6 queen2 gets unfavourable reply
- 7 queen2 talks to hunter
- 8 hunter takes snowwhite to wood
- 9 hunter lies to queen2
- 10 snowwhite flees
- 11 snowwhite finds dwarves
- 12 queen2 gets unfavourable reply
- 13 queen2 poisons snowwhite
- 14 dwarves find snowwhite
- 15 queen2 gets favourable reply
- 16 prince revives snowwhite
- 17 prince marries snowwhite
- 18 queen2 gets unfavourable reply
- 19 queen2 dies of rage

1		1	queen1 wishes for girl
2		2	snowwhite is born & queen1 dies
3		3	king marries queen2
4		4	queen2 gets favourable reply
5		5	snowwhite grows
6		6	queen2 gets unfavourable reply
7		7	queen2 talks to hunter
8		8	hunter takes snowwhite to wood
9		9	hunter lies to queen2
10		10	snowwhite flees
11		11	snowwhite finds dwarves
12		12	queen2 gets unfavourable reply
13		13	queen2 poisons snowwhite
14		14	dwarves find snowwhite
15		15	queen2 gets favourable reply
16		16	prince revives snowwhite
17		17	prince marries snowwhite
18		18	queen2 gets unfavourable reply
19		19	queen2 dies of rage



Layers of Representation of a Story

- **text representation** the linguistic realisation of the story
- **explicit representation** the linear sequence of facts mentioned in the story (in some kind of conceptual representation)
- **underlying selected representation** all facts relevant to the story that are mentioned in the explicit representation (the set of facts that are mentioned in the story, but not necessarily organised in a linear sequence and following a chronological partial order not necessarily equivalent to the one in which they appear in the story)
- **underlying extensive representation** all possible facts relevant to the story (including causes, effects, emotional reactions, common knowledge, and generally all the additional material that will be inferred by a reader on reading the story)

Once upon a time it was the middle of winter; the flakes of snow were falling like feathers from the sky; a Queen sat at a window sewing, and the frame of the window was made of black ebony. As she was sewing and looking out of the window at the snow, she pricked her finger with the needle, and three drops of blood fell upon the snow. And the red looked pretty upon the white snow, and she thought to herself:

"Would that I had a child as white as snow, as red as blood, and as black as the wood of the window-frame!" Soon after that she had a little daughter, who was as white as snow, and as red as blood, and her hair was as black as ebony; so she was called Little Snow-white. And when the child was born, the Queen died.

A year after, the King took to himself another wife. She was beautiful but proud, and she could not bear to have any one else more beautiful. She had a wonderful Looking-glass, and when she stood in front of it, and looked at herself in it, and said:

"Looking-glass, Looking-glass, on the wall.
Who in this land is the fairest of all?"

the Looking-glass answered:

text representation

explicit representation

- 1 queen1 wishes for girl
- 2 snowwhite is born & queen1 dies
- 3 king marries queen2
- 4 queen2 gets favourable reply
- 5 snowwhite grows
- 6 queen2 gets unfavourable reply
- 7 queen2 talks to hunter
- 8 hunter takes snowwhite to wood
- 9 hunter lies to queen2
- 10 snowwhite flees
- 11 snowwhite finds dwarves
- 12 queen2 gets unfavourable reply
- 13 queen2 poisons snowwhite
- 14 dwarves find snowwhite
- 15 queen2 gets favourable reply
- 16 prince revives snowwhite
- 17 prince marries snowwhite
- 18 queen2 gets unfavourable reply
- 19 queen2 dies of rage

queen1 king snowwhite queen2 hunter dwarves prince

1
2b

3a

2a

5

3b

4

6

7a

8b

10

11a

12

13b

13a

15

16b

17b

7b

8a

9

11b

14

16c

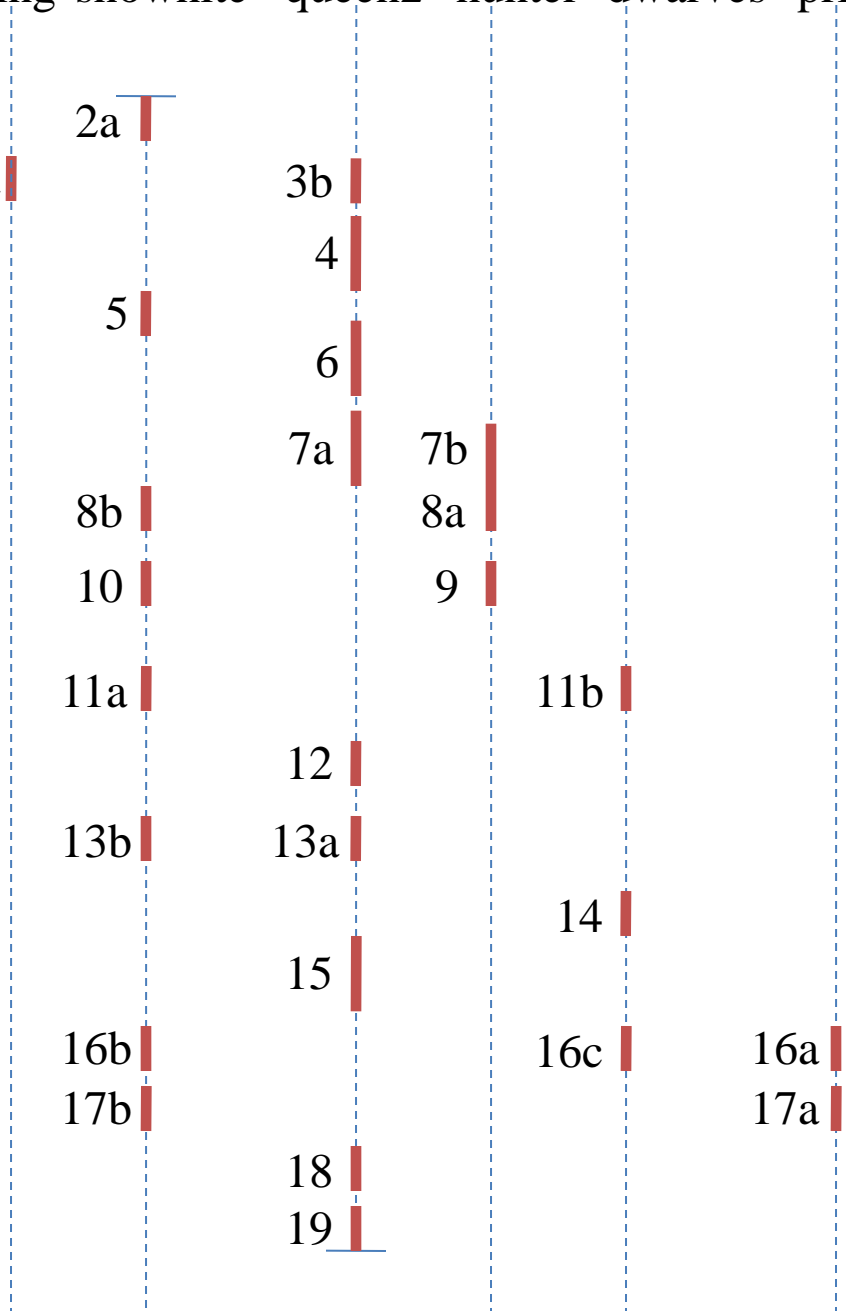
16a

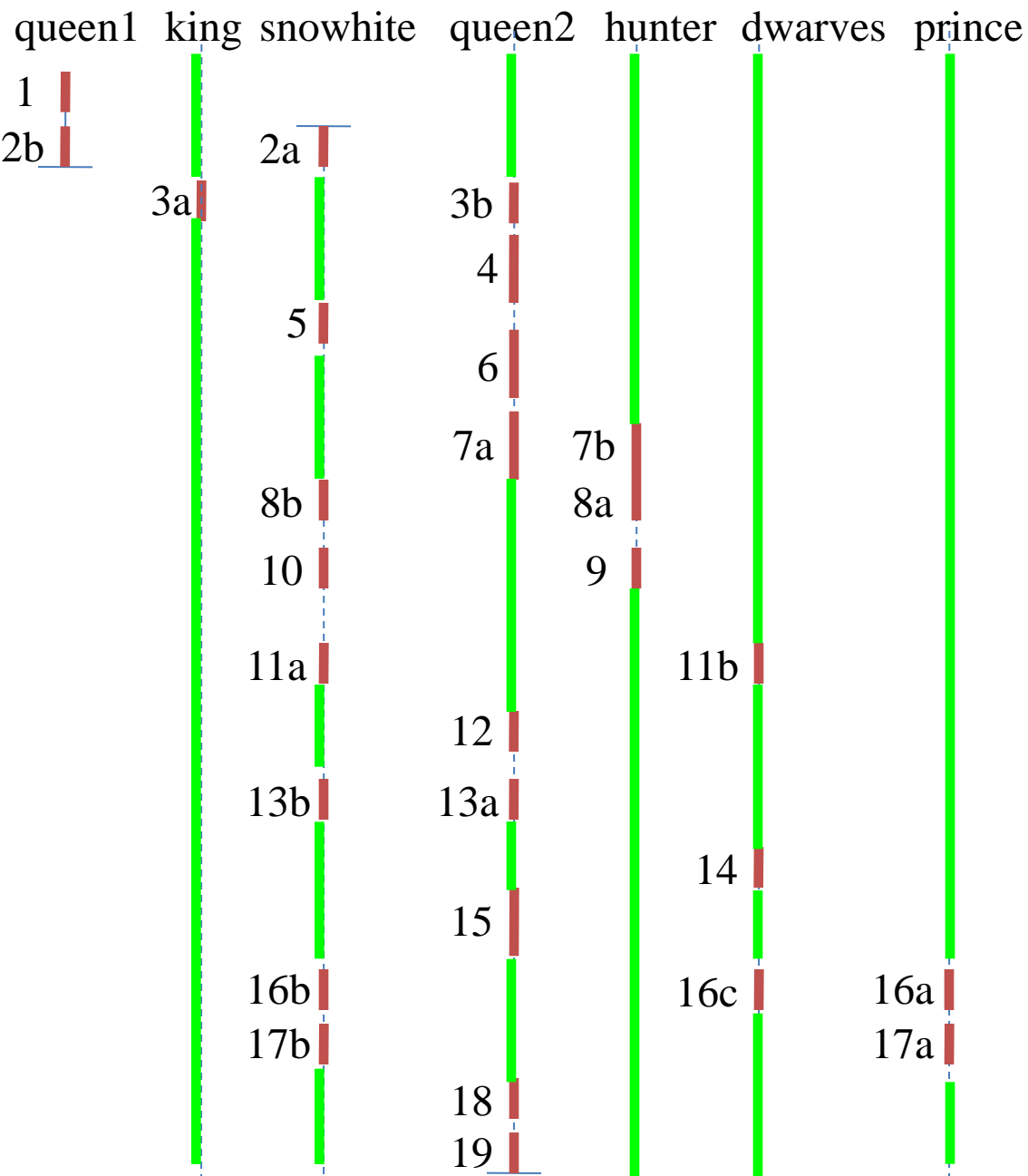
17a

18

19

**underlying
selected
representation**





**underlying
extensive
representation**

Caveat

- No claim of cognitive plausibility.
- The human brain probably deals with these problems in radically different ways.
- A computational analysis of the problem must handle such elements as we can represent and handle in symbolic terms.

Plot and Causality

Story and Plot

E.M. Forster's (1927):

- narrative requires only events in time sequence (chronology)
- "plot" however, also requires cause

The famous example:

- **"The king died and then the queen died"**
chronology = narrative.
- **"The king died and then the queen died of grief"**
chronology + causality = plot

- 1 queen1 wishes for girl
- 2 snowwhite is born & queen1 dies
- 3 king marries queen2
- 4 queen2 gets favourable reply
 - 5 snowwhite grows
 - 6 queen2 gets unfavourable reply
 - 7 queen2 talks to hunter
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 - 14 dwarves find snowwhite
 - 15 queen2 gets favourable reply
 - 16 prince revives snowwhite
 - 17 prince marries snowwhite
 - 18 queen2 gets unfavourable reply
 - 19 queen2 dies of rage

queen1 king snowwhite queen2 hunter dwarves prince

1
2b

3a

2a

3b

4

5

6

7a

7b

8b

8a

10

9

11a

11b

12

13b

13a

15

14

16b

16c

17b

16a

17a

18

19

CONTENT SELECTION

?

?

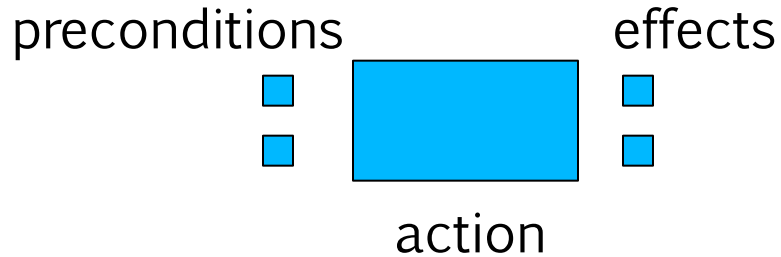
- 1 queen1 wishes for girl
- 2 snowwhite is born & queen1 dies
- 3 king marries queen2
- 4 queen2 gets favourable reply
- 5 snowwhite grows
- 6 queen2 gets unfavourable reply
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- 14 dwarves find snowwhite
- 15 queen2 gets favourable reply
- 16 prince revives snowwhite
- 17 prince marries snowwhite
- 18 queen2 gets unfavourable reply
- 19 queen2 dies of rage

?

The Planning Approach

- ✓ A line of research has focused in the production of narrative by means of planning algorithms.
- ✓ The set of events to be included in a narrative are generated as the solution to a planning problem (reach a desired outcome from a given initial state)
- ✓ This ensures that all the events in the resulting narrative are, by construction, linked by causal chains
- ✓ Such narratives provide explicit examples of the causal relations behind a given story.

Preconditions, Actions, Effects



Preconditions

Action

Effects

X not married

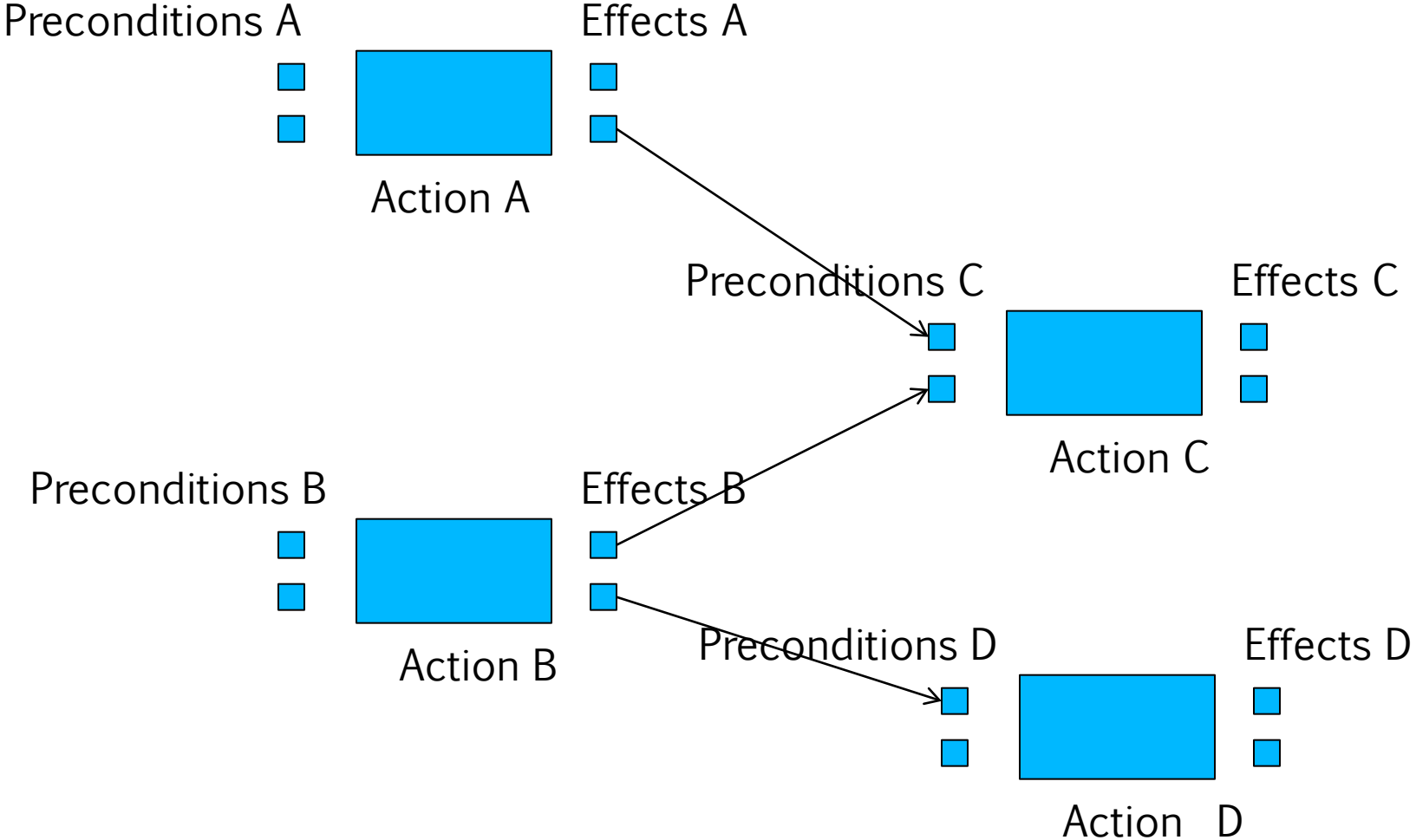
Y very beautiful

X sees Y

X falls in love Y

X wants to marry Y

Causal Links



Little Red Riding Hood

Wolf

Plan A
(go to granny's)

Plan B
(pick flowers)

Plan C
(short cut)



Plan D
(eat girl)

[...]

Multiple plans
Change of plans
Conflicting plans

TIME



Narrative Discourse

Genette's Narrative Discourse

Narrative mood

- Narrative distance
- Function

- Narrative levels

Narrative instance

- Narrative voice
- Time of narration
- Focalization

Narrative time

- Order
- Speed
- Frequency

Function

- Narrative function
 - he just tells
- Directing function
 - he interrupts the story to comment on its organization
- Communication function
 - he addresses the text's potential reader in order to establish or maintain contact with him or her
- Testimonial function
 - he comments on the truth, precision, or sources of the story, or his emotional involvement with it
- Ideological function
 - he interrupts his story to introduce instructive comments or general wisdom concerning it

Order

Relation between the sequencing of events as they actually occurred and their arrangement in the narrative.

Departure from chronological order is called *anachrony*.

- *analepsis* (the narrator recounts after the fact an event that took place earlier than the present point in the main story) and
- *prolepsis* (the narrator anticipates events that will occur after the present point in the main story).

Speed

Introducing differences between the time the story takes to happen and the time taken to tell it.

Four narrative movements:

- **pause** (the event-story is interrupted to make room exclusively for narratorial discourse such as static descriptions),
- **scene** (narrative time corresponds to the story's time, as in dialogue),
- **summary** (some part of the event-story is summarized in the narrative, creating an acceleration), and
- **ellipsis** (the narrative says absolutely nothing about some part of the event-story).

LRRH pull bobbin

latch go up

LRRH push door open

LRRH step inside cottage

FUNCTION : NARRATIVE

SPEED: SCENE

Then she pulled the bobbin, and the latch went up, and Red Riding-Hood pushed open the door, and stepped inside the cottage.

SPEED: PAUSE

It seemed very dark in there after the bright sunlight outside, and all Red Riding-Hood could see was that the window-curtains and the bed-curtains were still drawn, and her grandmother seemed to be lying in bed with the bed-clothes pulled almost over her head, and her great white-frilled nightcap nearly hiding her face.

FUNCTION: COMMUNICATION

SPEED: PAUSE

Now, you and I have guessed by this time, although poor Red Riding-Hood never even thought of such a thing, that it was not her Grannie at all, but the wicked Wolf, who had

FUNCTION : NARRATIVE

SPEED: SCENE

hurried to the cottage and put on Grannie's nightcap and popped into her bed, to pretend that he was Grannie herself.

And where was Grannie all this time, you will say? Well, we shall see presently.

Wolf hurry to cottage

Wolf put on Grannie's nightcap

Wolf pop into Grannie's bed

Wolf pretend to be Grannie

LRRH pull bobbin

latch go up

LRRH push door open

LRRH step inside cottage

FUNCTION : NARRATIVE

SPEED: SCENE

Then she pulled the bobbin, and the latch went up, and Red Riding-Hood pushed open the door, and stepped inside the cottage.

SPEED: PAUSE

It seemed very dark in there after the bright sunlight outside, and all Red Riding-Hood could see was that the window-curtains and the bed-curtains were still drawn, and her grandmother seemed to be lying in bed with the bed-clothes pulled almost over her head, and her great white-frilled nightcap nearly hiding her face.

FUNCTION: COMMUNICATION

SPEED: PAUSE

Now, you and I have guessed by this time, although poor Red Riding-Hood never even thought of such a thing, that it was not her Grannie at all, but the wicked Wolf, who had

FUNCTION : NARRATIVE

SPEED: SCENE

ORDER: ANALEPSIS

hurried to the cottage and put on Grannie's nightcap and popped into her bed, to pretend that he was Grannie herself.

FUNCTION : COMMUNICATING/DIRECTING

And where was Grannie all this time, you will say?

Well, we shall see presently.

SPEED: PAUSE

Inventing and Telling

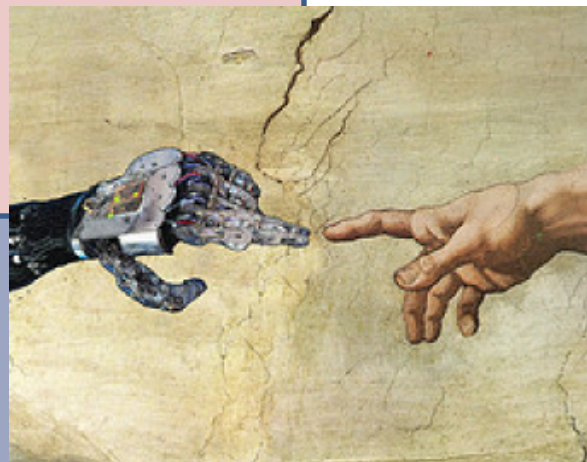
AI

Reality

human
behaviour

telling about
human behaviour

telling stories

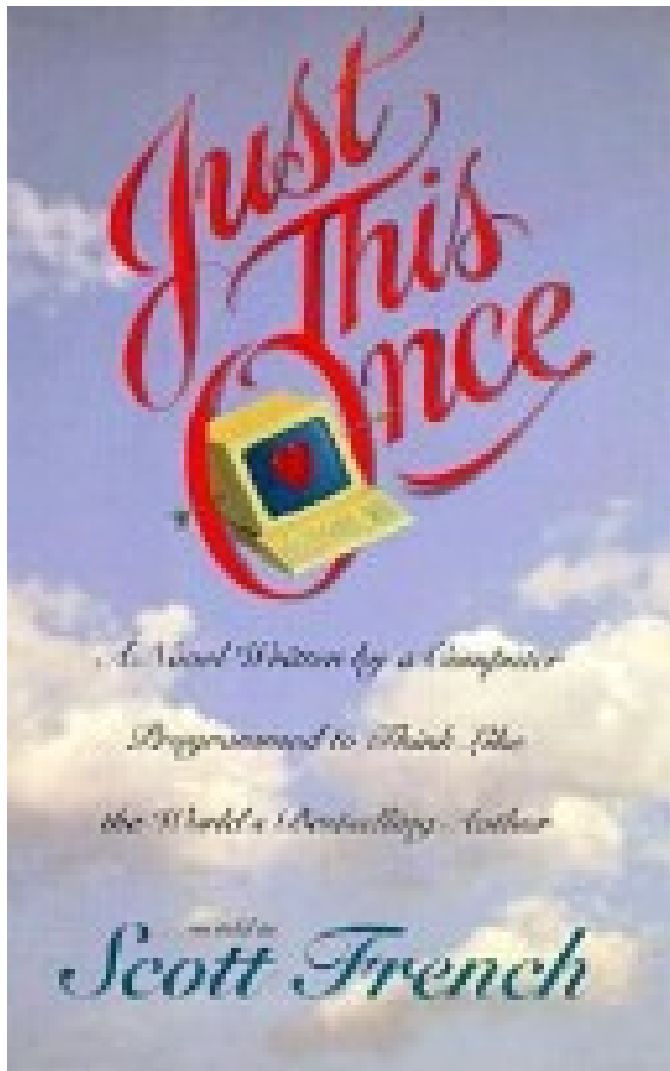


fiction

inventing plausible
human behaviour

inventing stories

Artificial Storytellers

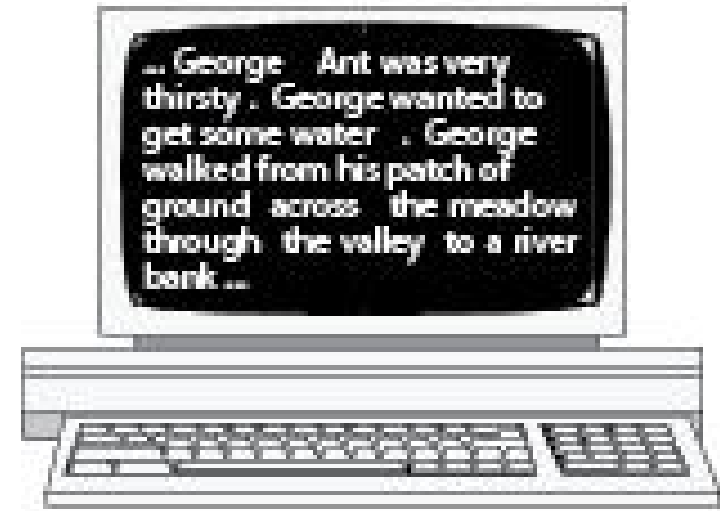


An experiment by the author to program a computer to write a book in the same exact style and language of best-selling author Jacqueline Susann. The author spent years programming the computer. He wanted to know what kind of book Jackie would have written had she been alive in 1993. The result is "Just This Once", a beautifully written (albeit computer generated) piece of literature that very much resembles Ms. Susann's other works. (French, 1994)

ISBN 10: 1559721731 / ISBN 13: 9781559721738

TaleSpin (Meehan 1977)

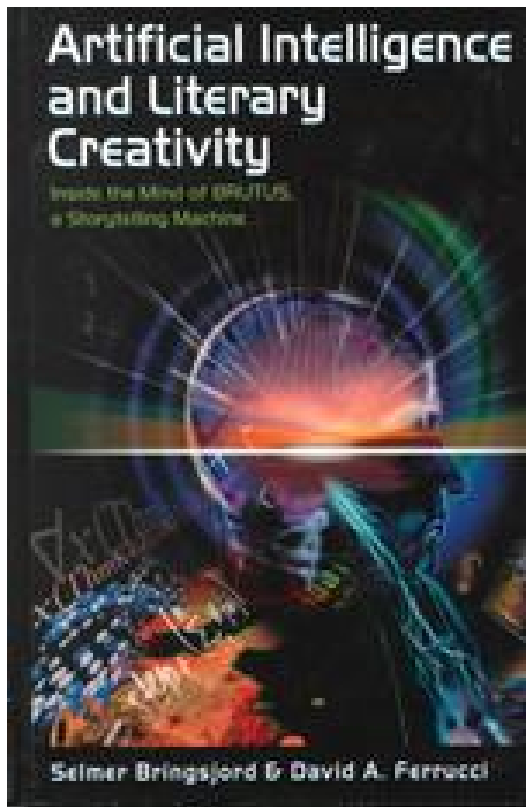
- ✓ writes short stories about woodland creatures
- ✓ gives each a goal and runs simulation



John Bear is somewhat hungry. John Bear wants to get some berries. John Bear wants to get near the blueberries. John Bear walks from a cave entrance to the bush by going through a pass through a valley through a meadow. John Bear takes the blueberries. John Bear eats the blueberries. The blueberries are gone. John Bear is not very hungry.

Simulation-based

(Bringsjord & Ferruci 2000)

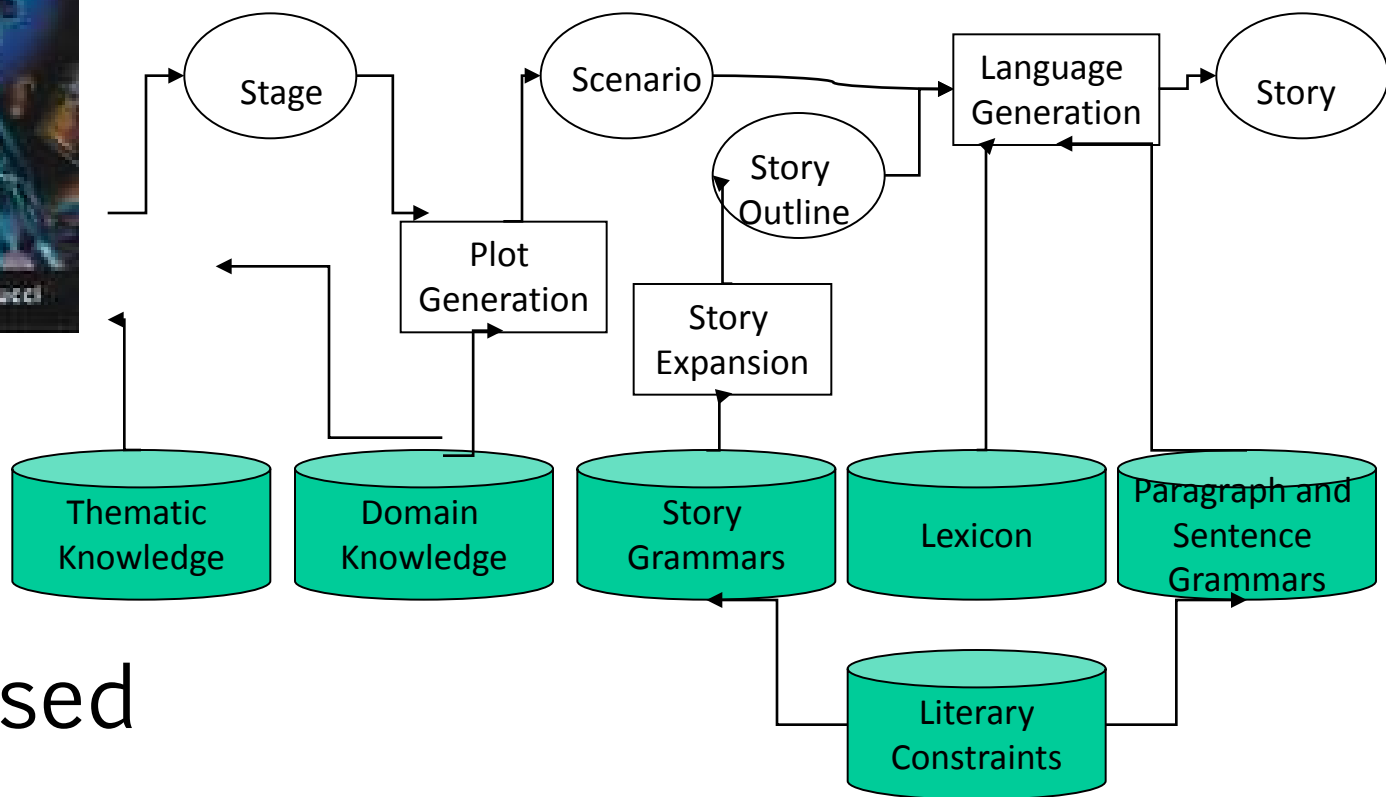


- ✓ writes short stories about betrayal
- ✓ relies heavily on grammars



BRUTUS

Grammar-based



``Simple Betrayal" (no self-deception; conscious)

Dave Striver loved the university. He loved its ivy-covered clocktowers, its ancient and sturdy brick, and its sun-splashed verdant greens and eager youth. He also loved the fact that the university is free of the stark unforgiving trials of the business world -- only this isn't a fact: academia has its own tests, and some are as merciless as any in the marketplace. A prime example is the dissertation defense: to earn the PhD, to become a doctor, one must pass an oral examination on one's dissertation.

Dave wanted desperately to be a doctor. But he needed the signatures of three people on the first page of his dissertation, the priceless inscriptions which, together, would certify that he had passed his defense. One of the signatures had to come from Professor Hart.

Well before the defense, Striver gave Hart a penultimate copy of his thesis. Hart read it and told Striver that it was absolutely first-rate, and that he would gladly sign it at the defense. They even shook hands in Hart's book-lined office. Dave noticed that Hart's eyes were bright and trustful, and his bearing paternal.

At the defense, Dave thought that he eloquently summarized Chapter 3 of his dissertation. There were two questions, one from Professor Rodman and one from Dr. Teer; Dave answered both, apparently to everyone's satisfaction. There were no further objections.

Professor Rodman signed. He slid the tome to Teer; she too signed, and then slid it in front of Hart. Hart didn't move.

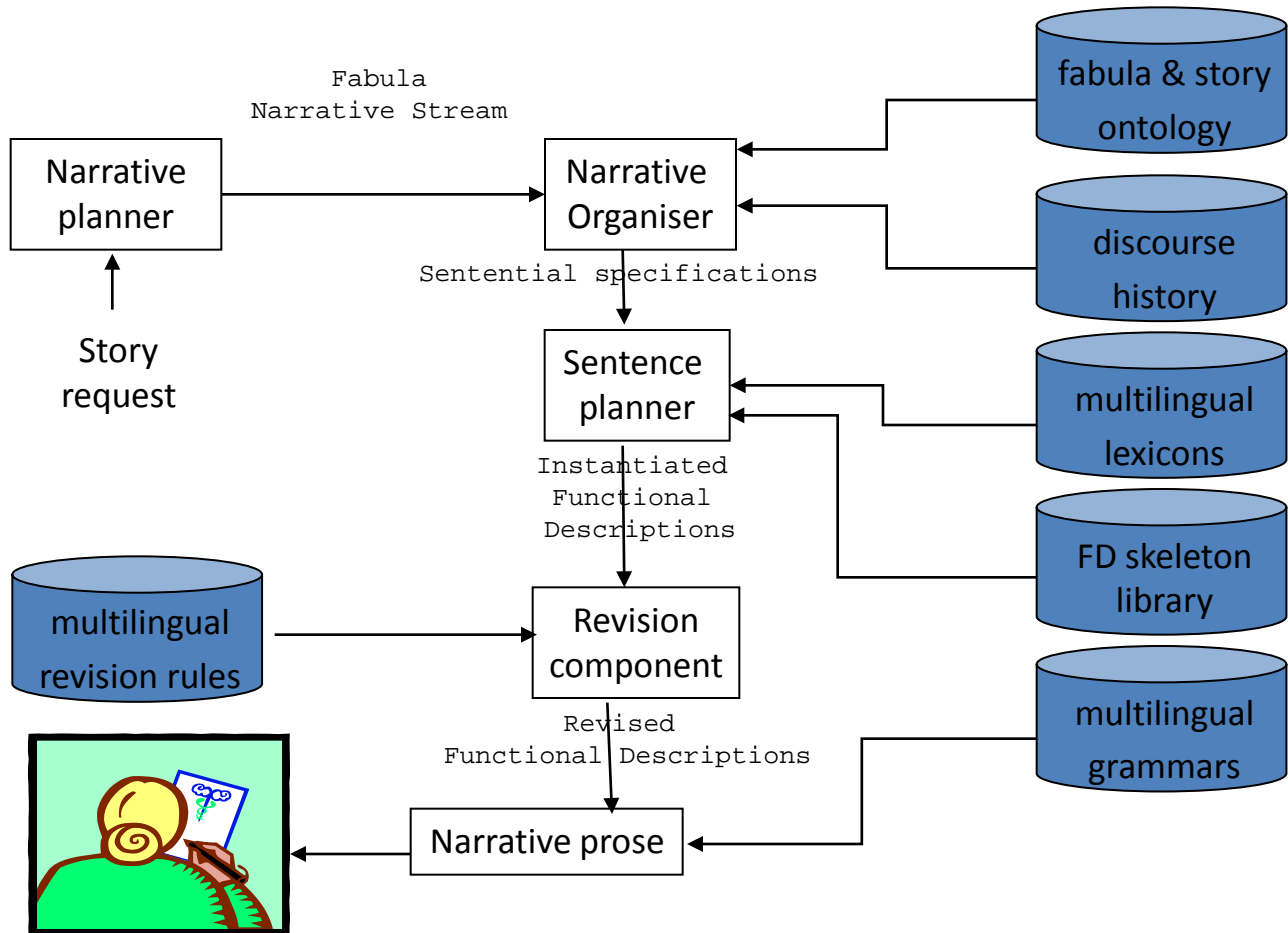
``Ed?" Rodman said.

Hart still sat motionless. Dave felt slightly dizzy.

``Edward, are you going to sign?"

Later, Hart sat alone in his office, in his big leather chair, underneath his framed PhD diploma.

(Callaway, 2000)



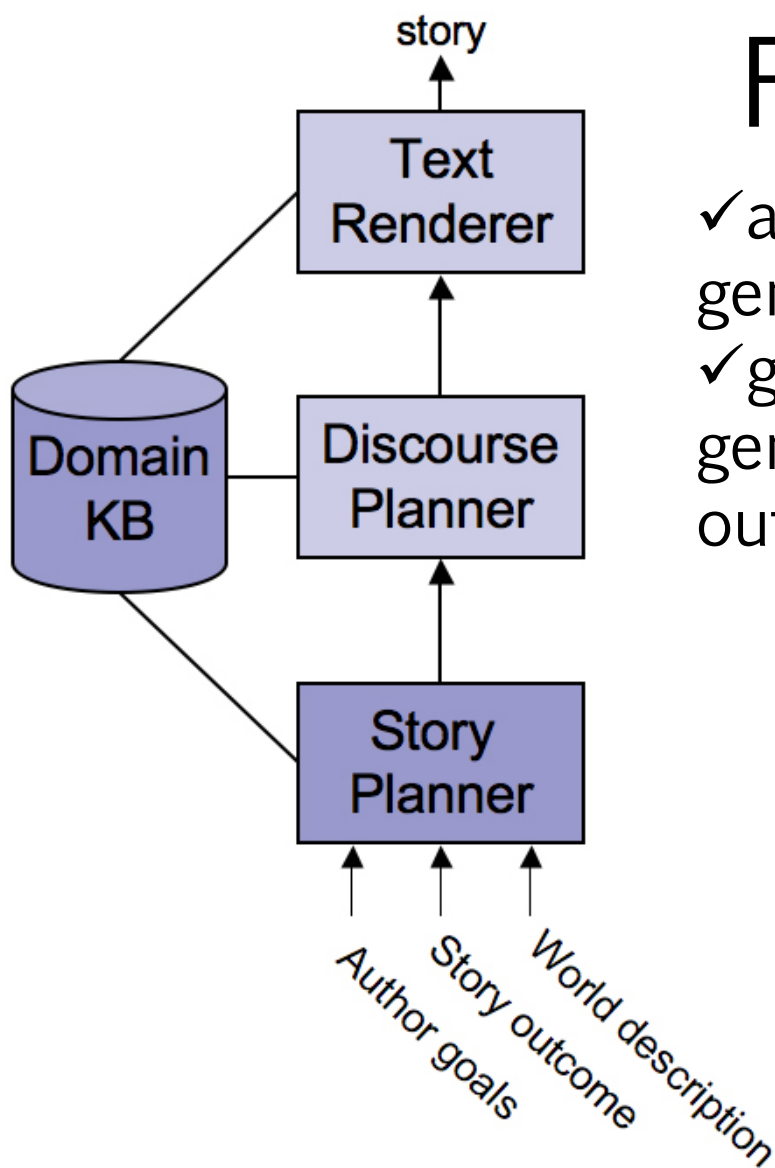
STORYBOOK

Grammar-based

- ✓ produces multi-page stories in the Little Red Riding Hood domain
- ✓ uses: narrative planning, sentence planning, discourse history, lexical choice, revision, full-scale lexicon, and a surface realiser

FABULIST (Riedl, 2004)

- ✓ an architecture for automated story generation and presentation
- ✓ given a desired outcome state, generates a plan that meets the outcome objective

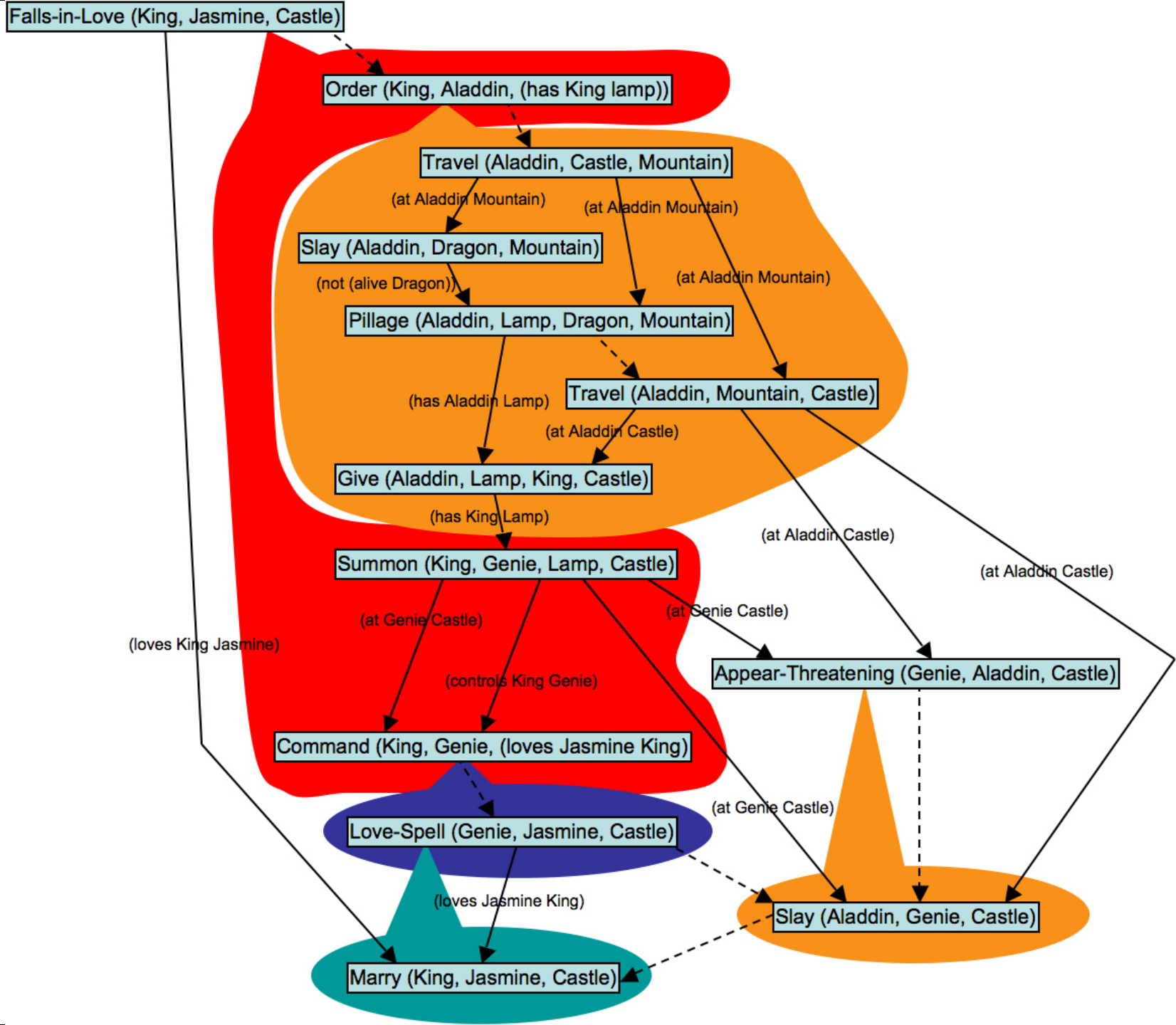


Story action-based
Plan-based



An Example Story by Fabulist

- ✓ Inputs include:
 - ✓ A domain model describing propositional facts about the initial state of the Aladdin world (including characters, locations, objects, and relations), and possible operations that can be enacted by characters.
 - ✓ An outcome state: Jasmine and Jafar are married, and the genie is dead.
 - ✓ Heuristic guidance function.
 - ✓ A discourse model.
 - ✓ Natural language templates.
- ✓ Fabulist first generates a narrative plan that meets the outcome objective, ensuring all character actions and goals are justified by events within the narrative itself.
- ✓ Partial order models relative chronology
- ✓ Causal links model causality



There is a woman named Jasmine. There is a king named Jafar. This is a story about how King Jafar becomes married to Jasmine. There is a magic genie. This is also a story about how the genie dies.

There is a magic lamp. There is a dragon. The dragon has the magic lamp. The genie is confined within the magic lamp.

King Jafar is not married. Jasmine is very beautiful. King Jafar sees Jasmine and instantly falls in love with her. King Jafar wants to marry Jasmine. There is a brave knight named Aladdin. Aladdin is loyal to the death to King Jafar. King Jafar orders Aladdin to get the magic lamp for him. Aladdin wants King Jafar to have the magic lamp. Aladdin travels from the castle to the mountains. Aladdin slays the dragon. The dragon is dead. Aladdin takes the magic lamp from the dead body of the dragon. Aladdin travels from the mountains to the castle. Aladdin hands the magic lamp to King Jafar. The genie is in the magic lamp. King Jafar rubs the magic lamp and summons the genie out of it. The genie is not confined within the magic lamp. King Jafar controls the genie with the magic lamp. King Jafar uses the magic lamp to command the genie to make Jasmine love him. The genie wants Jasmine to be in love with King Jafar. The genie casts a spell on Jasmine making her fall in love with King Jafar. Jasmine is madly in love with King Jafar. Jasmine wants to marry King Jafar. The genie has a frightening appearance. The genie appears threatening to Aladdin. Aladdin wants the genie to die. Aladdin slays the genie. King Jafar and Jasmine wed in an extravagant ceremony.

The genie is dead. King Jafar and Jasmine are married. The end.

- Initial state:
 - *hungry(John), bank(TheBank), store(TheStore), has(John, y), gun(y),*
 - *has(John, Mia), cat(Mia), has(TheBank, z), money(z),*
 - *has(TheStore, The99¢Burger), edible(The99¢Burger)*
- Goal state:
 - *not(hungry(John))*
- Domain theory:
 - *eat(x, y): pre: hungry(x), has(z, y), edible(y); post: not(hungry(x))*
 - *buy(x, y): pre: money(z), has(x, z), has(p, y), store(p); post: has(x, y), has(p, z)*
 - *rob(x, y): pre: has(x, z), gun(z), has(y, p), money(p); post: has(x, p)*
- Plan A:
 - *rob(John, TheBank); buy(John, The99¢Burger); eat(John, The99¢Burger).*

input!

(Turner, 1992)

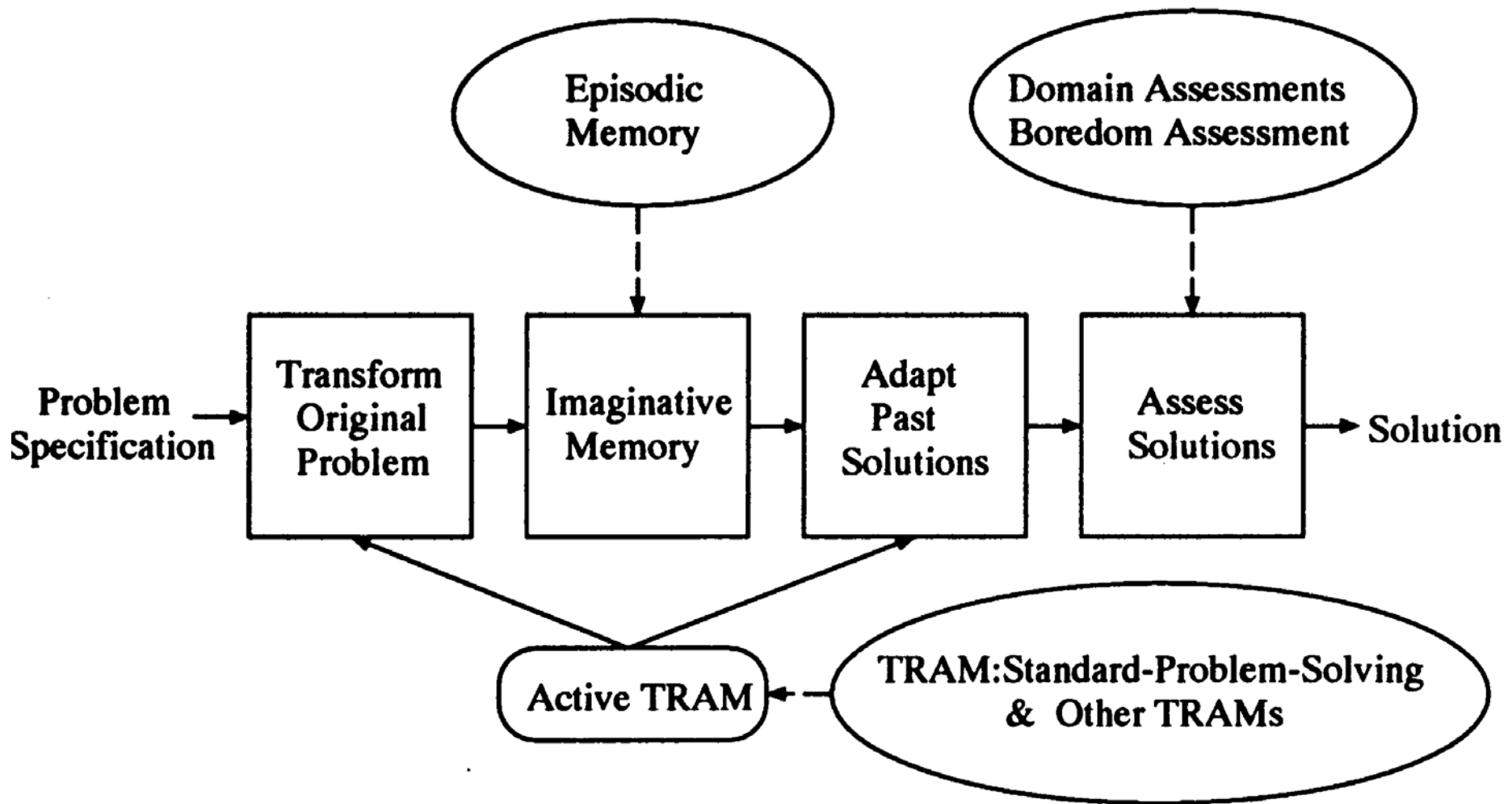
MINSTREL

Case-based
Plan-based



- ✓ tells stories about King Arthur and his Knights of the Round Table
- ✓ pursues storytelling goals, looking up solutions in its case memory

Problem solving with TRAMs



Minstrel's author goals

- ✓ Thematic goals – the stories illustrate a theme, in Minstrel's case, Planning Advice Themes (e.g. “A bird in the hand is worth two in the bush.”)
- ✓ Drama goals – goals regarding the unity of action (tragedy, foreshadowing)
- ✓ Consistency goals – motivate and explain story actions
- ✓ Presentation goals – goals about which events must be fully described, and which can be summarized or omitted (in general *diegetic* goals)

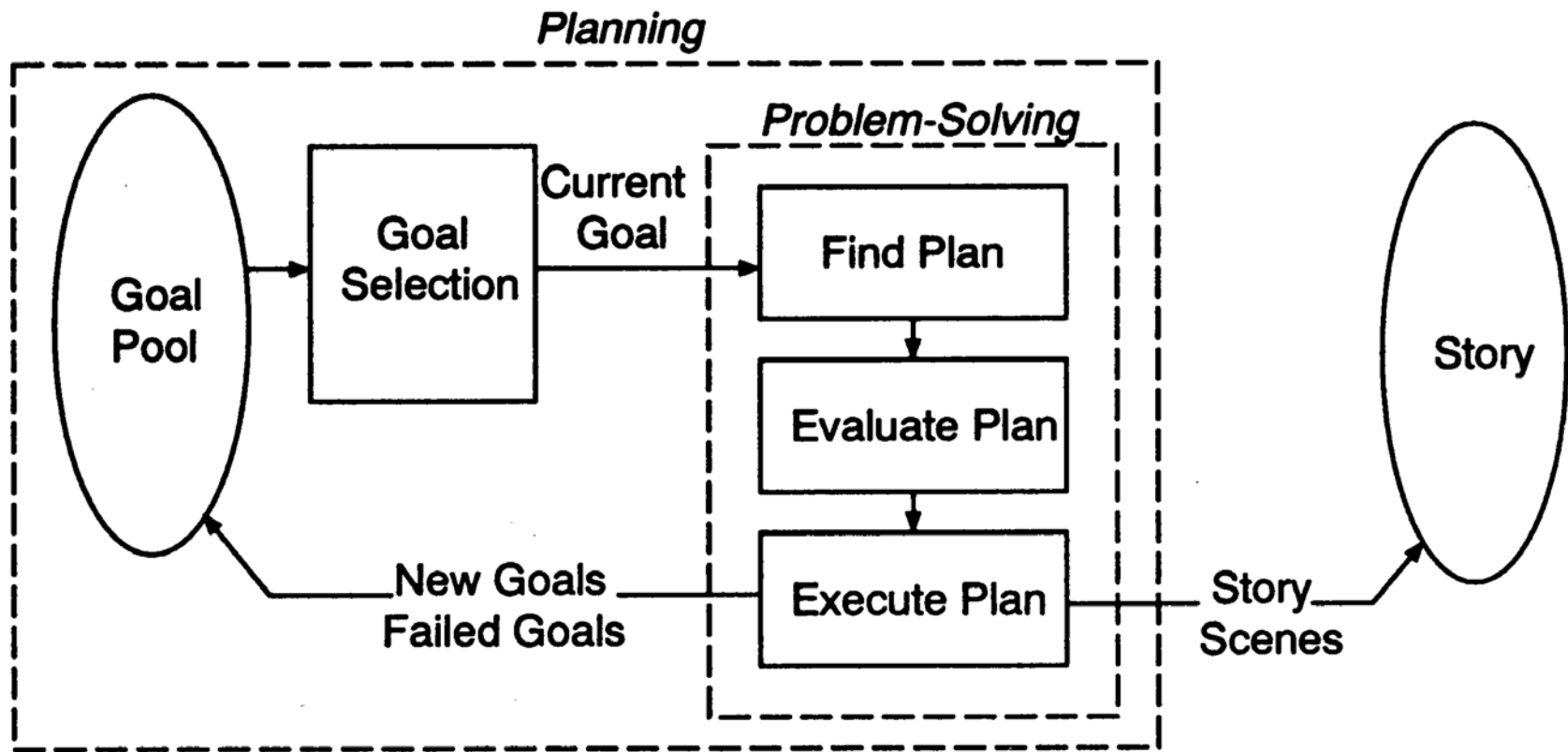


Figure 3.1 Author-Level Processes

The Vengeful Princess

Once upon a time there was a Lady of the Court named Jennifer. Jennifer loved a knight named Grunfeld. Grunfeld loved Jennifer.

Jennifer wanted revenge on a lady of the court named Darlene because she had the berries which she picked in the woods and Jennifer wanted to have the berries. Jennifer wanted to scare Darlene. Jennifer wanted a dragon to move towards Darlene so that Darlene believed it would eat her. Jennifer wanted to appear to be a dragon so that a dragon would move towards Darlene. Jennifer drank a magic potion. Jennifer transformed into a dragon. A dragon moved towards Darlene. A dragon was near Darlene.

Grunfeld wanted to impress the king. Grunfeld wanted to move towards the woods so that he could fight a dragon. Grunfeld moved towards the woods. Grunfeld was near the woods. Grunfeld fought a dragon. The dragon died. The dragon was Jennifer. Jennifer wanted to live. Jennifer tried to drink a magic potion but failed. Grunfeld was filled with grief.

Jennifer was buried in the woods. Grunfeld became a hermit.

MORAL: Deception is a weapon difficult to aim.

MEXICA

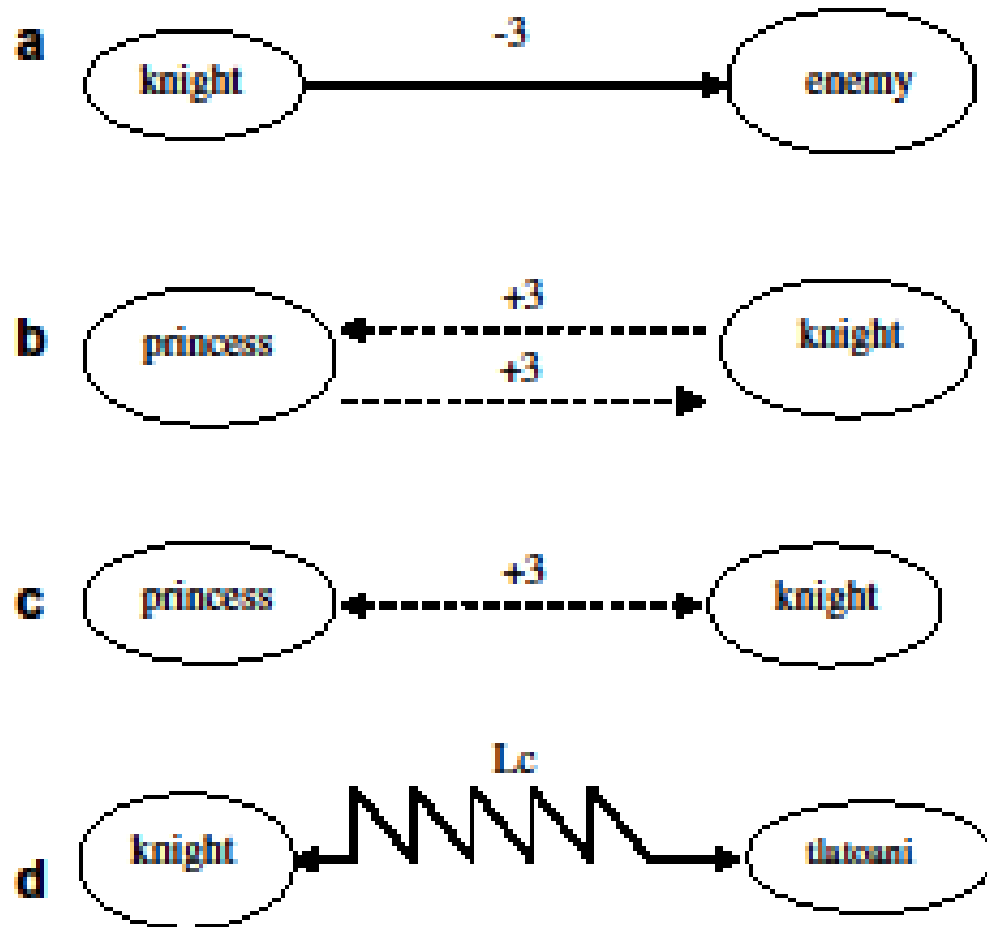
(Pérez y Pérez, 1999)



- ✓ study the creative process in writing in terms of a psychological model (engagement and reflection, Sharples, 1999)
- ✓ takes into account emotional links and tensions between the characters

Story action-based
Emotion-based





✓ actions have preconditions and postconditions defined in terms of emotional links and tensions

✓ system reads previous stories, interprets them in terms of these links, and abstracts from these interpretations patterns for chaining actions into stories

Fig. 3. Graphical representation of emotional links and tensions between characters. Part (a) represents the fact that a knight hates an enemy (an emotional link of type 1 and intensity -3); Parts (b) and (c) represent the fact that the princess is in love with a knight and that the knight is also in love with the princess (an emotional links of type 2 and intensity $+3$). Part (d) represents a tension of type love competition (L_c) between the knight and the tlatoani.

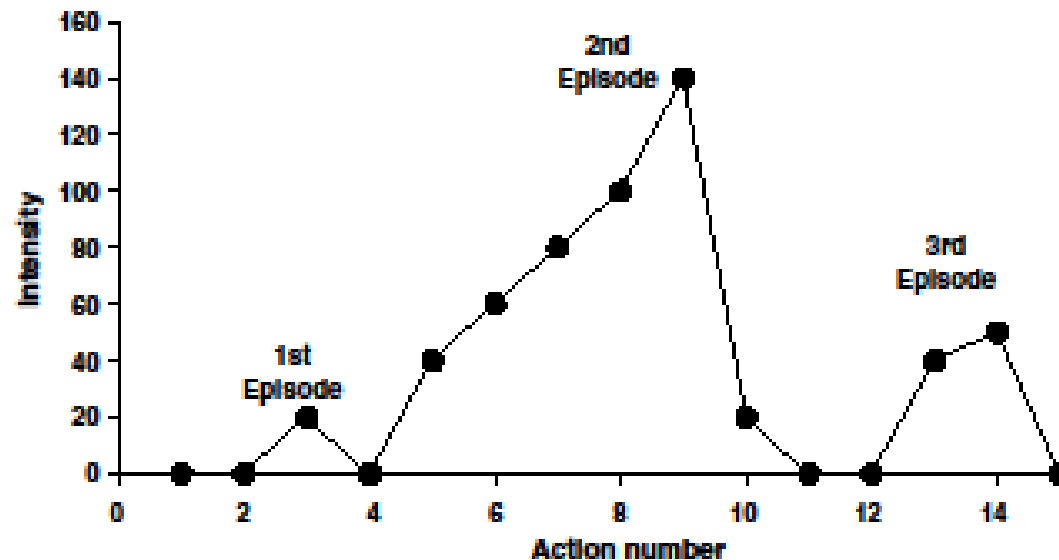
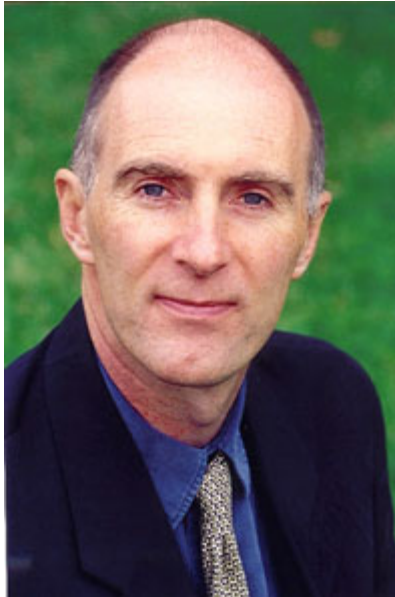


Fig. 4. Tensional representation of the story *The Princess who Cured the Jaguar Knight*.

Table 1
Types of tensions employed by MEXICA

Tension	Mnemonic	Description
Actor dead	Ad	When a character in the story dies (except the enemy)
Life at risk	Lr	When the life of a character is at risk
Health at risk	Hr	When the health of a character is at risk due to an injury or an illness
Prisoner	Pr	When a character is kidnapped or is made a prisoner
Life normal	Ln	Deactivates the tension Life at risk
Health normal	Hn	Deactivates the tension Health at risk
Prisoner free	Pf	Deactivates the tension Prisoner
Clashing emotions	Ce	When a character feels two opposite emotions towards other one
Potential danger	Pd	When one character hates other character (an emotional link of any type an intensity -3) and both are situated in the same location
Love competition	Lc	When two different characters are in love with a third one (emotional link of type 2 an intensity +3) producing a love competition

“Creativity in writing occurs through a mutually promotive cycle of engagement and reflection, both guided by constraints.”



“A session of engaged ‘knowledge telling’ generates written material for consideration.”

“Reflection involves reviewing and interpreting the material as a source for contemplation.”

(Sharples, 1999)



Jaguar_knight was an inhabitant of the Great Tenochtitlan. Princess was an inhabitant of the Great Tenochtitlan. Jaguar_knight was walking when Ehecatl (god of the wind) blew and an old tree collapsed injuring badly Jaguar_knight. Princess went in search of some medical plants and cured Jaguar_knight. As a result Jaguar_knight was very grateful to Princess. Jaguar_knight rewarded Princess with some cacauatl (cacao beans) and quetzalli (quetzal) feathers.

Character function-based
Story action-based

(Gervás, 2013)

PROPPER



- ✓ revisit Vladimir Propp's "Morphology of the Folk Tale" as articulation mechanism for plot generation
- ✓ explored the actual procedures explicitly described by Propp
- ✓ combines top-down articulation of plot into character functions with bottom-up articulation into story actions
- ✓ modular and declarative manner
- ✓ refinements and extensions possible

DEF A BCF ↑ DEF GKOLHMJINK ↓ Pr Rs O L Q T J U W
 a

A

C

H

I

plot
driver

:
kidnap X Y
villain X

kidnap X Y
:
brother Z Y
decides_to_react Z
hero Z

decides_to_react Z
hero Z
villain X
:
fight Z X

hero Z
villain X
fight Z X
:
wins Z

story
actions

kidnap 10 20
villain 10

kidnap 10 20
villain 10

brother 30 20
decides_to_react 30
hero 30

kidnap 10 20
villain 10

brother 30 20
decides_to_react 30
hero 30

fight 30 10

kidnap 10 20
villain 10

brother 30 20
decides_to_react 30
hero 30

fight 30 10

wins 30

states

fabula

kidnap 10 20
villain 10

kidnap 10 20
villain 10
brother 30 20
decides_to_react 30
hero 30

kidnap 10 20
villain 10
brother 30 20
decides_to_react 30
hero 30
fight 30 10

kidnap 10 20
villain 10
brother 30 20
decides_to_react 30
hero 30
fight 30 10
wins 30

fabula

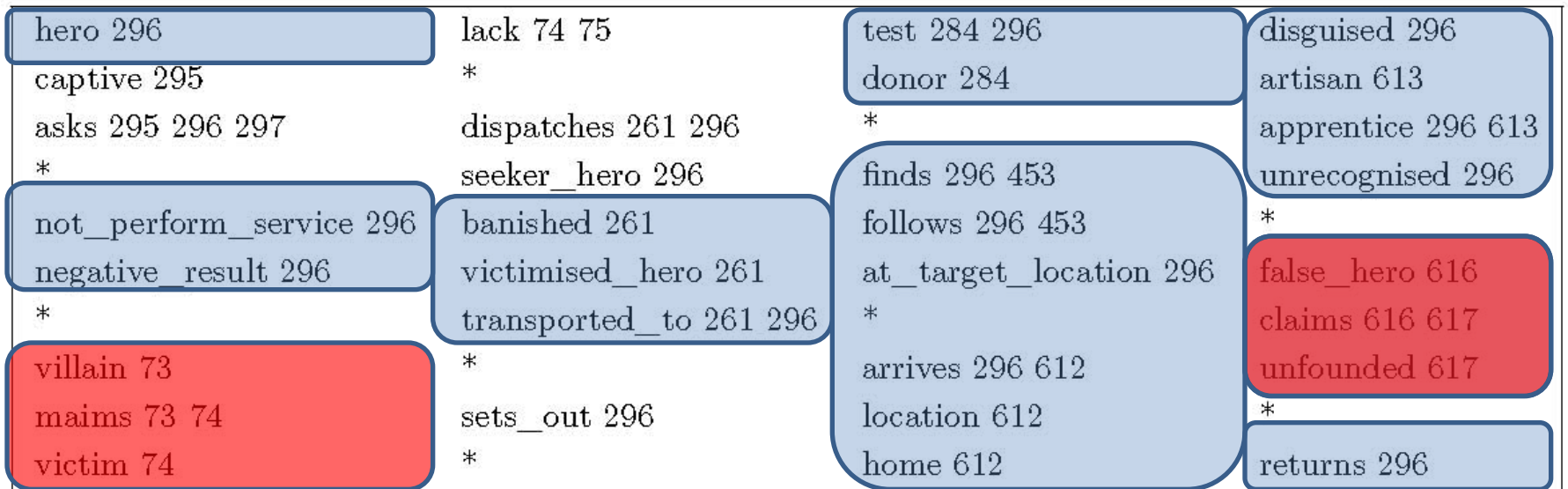
kidnap 10 20
villain 10

brother 30 20
decides_to_react 30
hero 30

fight 30 10

flow

wins 30



plot driver relying on Propp's sequence

fabula generator relying on unification with accommodation

about character 296

who behaves badly at the start of the story

is banished, is tested by a donor, finds a trail that leads him home,

arrives disguised as an apprentice to an artisan, suffers an impostor

and returns.

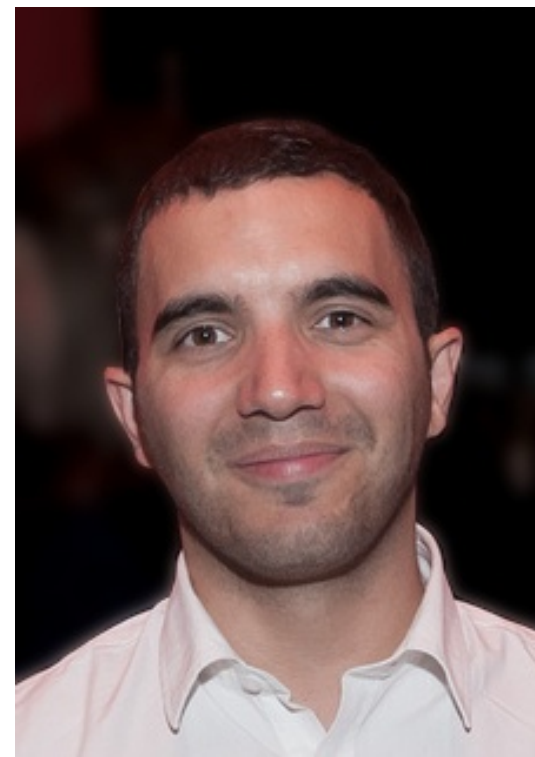
villain and the false hero go unpunished!

Story action-based generation

STELLA

(Story TELLing Algorithm)

- ✓ exhaustive search over space of possible stories
- ✓ articulation of plots into hand-crafted set of story actions
- ✓ very careful knowledge engineering effort
- ✓ especificacion of desired result based on curves describing evolution of features over story time



(León & Gervás, 2012)

stella

ideas from other systems

causality chronology emotions
planning character
 modelling

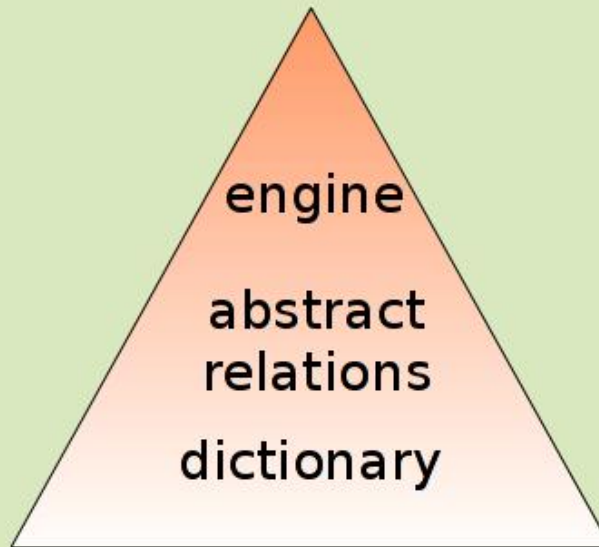
usable

GUI command
 line
 library

top-down design

carefully designed
knowledge base

corpus-based
development



facts

153 dictionary rules

> 500 stories

date(x, y) & late(x)
can cause angry(y)

friend(x, y) & die(x)
provokes sad(y)

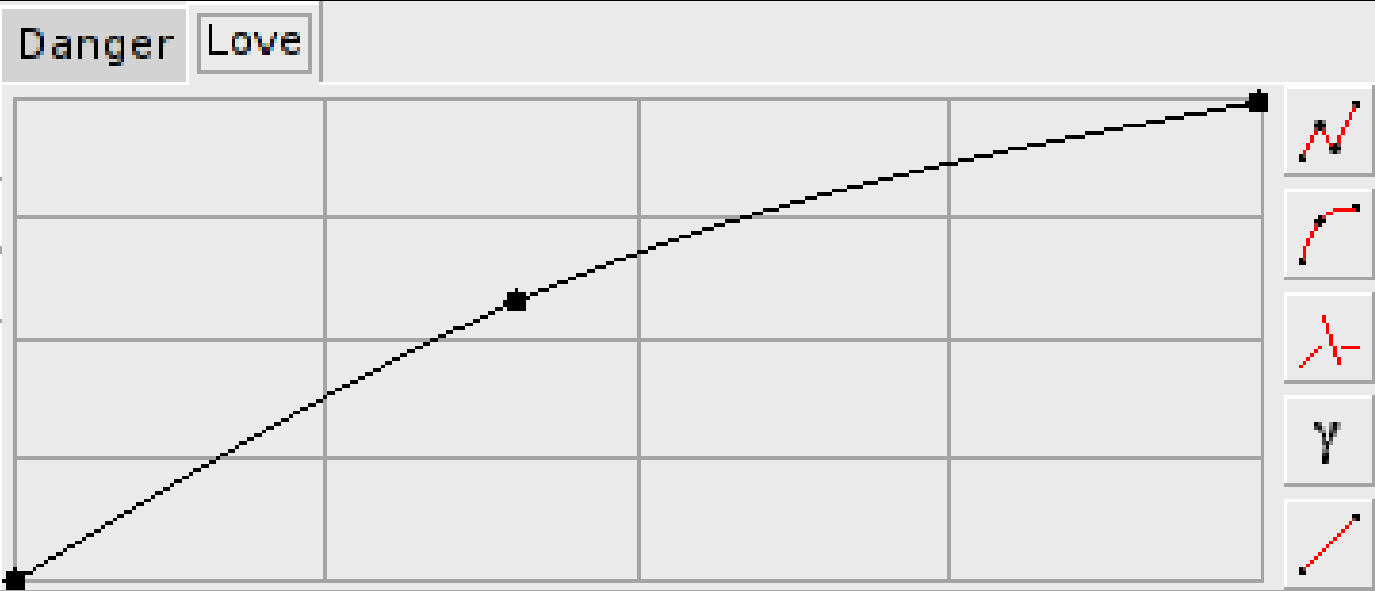


stella _ □ ✕

- Love story
- Murder

Length:

Characters:



Generate

Michael worked in an office. He had a boring job and a boring life. Michael attended a conference in a city far from his hometown. He met Sarah there. She was pretty. Michael wasn't brave enough and he didn't get her phone number. When he got back to his hometown, he wanted to look for Sarah, but he wasn't sure about it. He spent time thinking about it. Michael thought that Sarah might not like him. He thought he had a very boring life. He finally decided to travel to meet Sarah again.

A Grand View

a toolkit?

- ✓ generate & test
- ✓ grammars
- ✓ case-based reasoning
- ✓ planning
- ✓ emotions
- ✓ n-grams
- ✓ evolutionary algorithms

or a set of requirements?

- ✓ draft and check
- ✓ linguistic knowledge
- ✓ reuse
- ✓ causality
- ✓ emotions
- ✓ language models
- ✓ parallel drafts

Draft

compose

word order

line breaks

lexical choice

syntax choice

referring expressions

descriptive structure

narrative structure

lexicon

grammar

ontology

metre

stanza

plot

invent

emotions

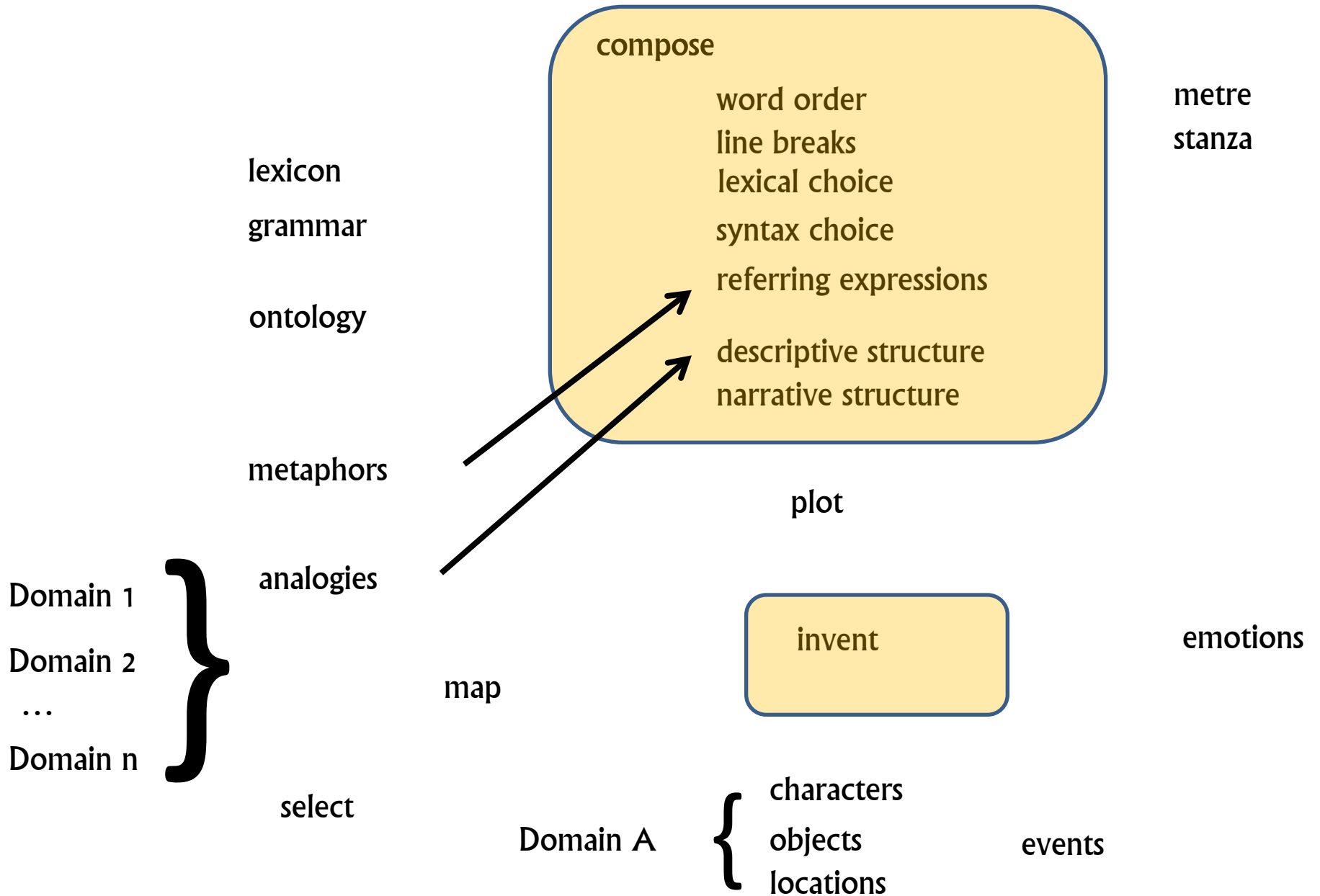
characters

objects

locations

events

Draft



Draft

alliteration

ngrams

template

lexicon
grammar

ontology

metaphors

Domain 1 }
Domain 2 }
... }
Domain n }

analogies

map

select

Domain A

{
characters
objects
locations

events

compose

- word order
- line breaks
- lexical choice
- syntax choice
- referring expressions
- descriptive structure
- narrative structure

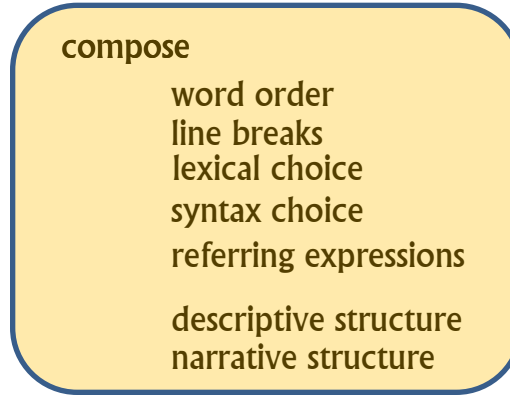
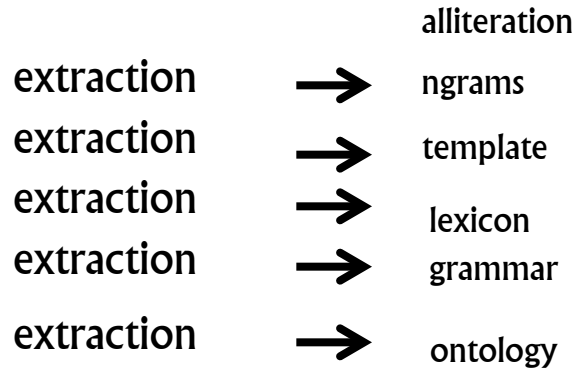
metre
stanza

plot

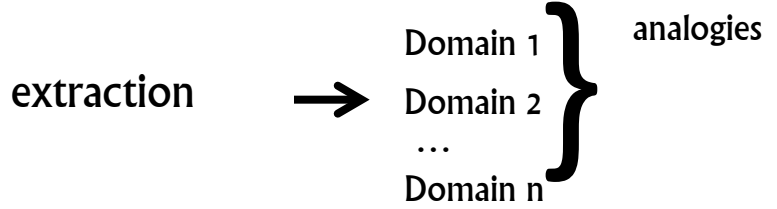
invent

emotions

Draft



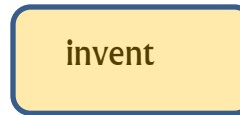
metre
stanza



metaphors

plot

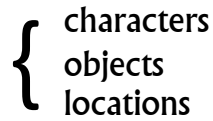
map



emotions

select

Domain A

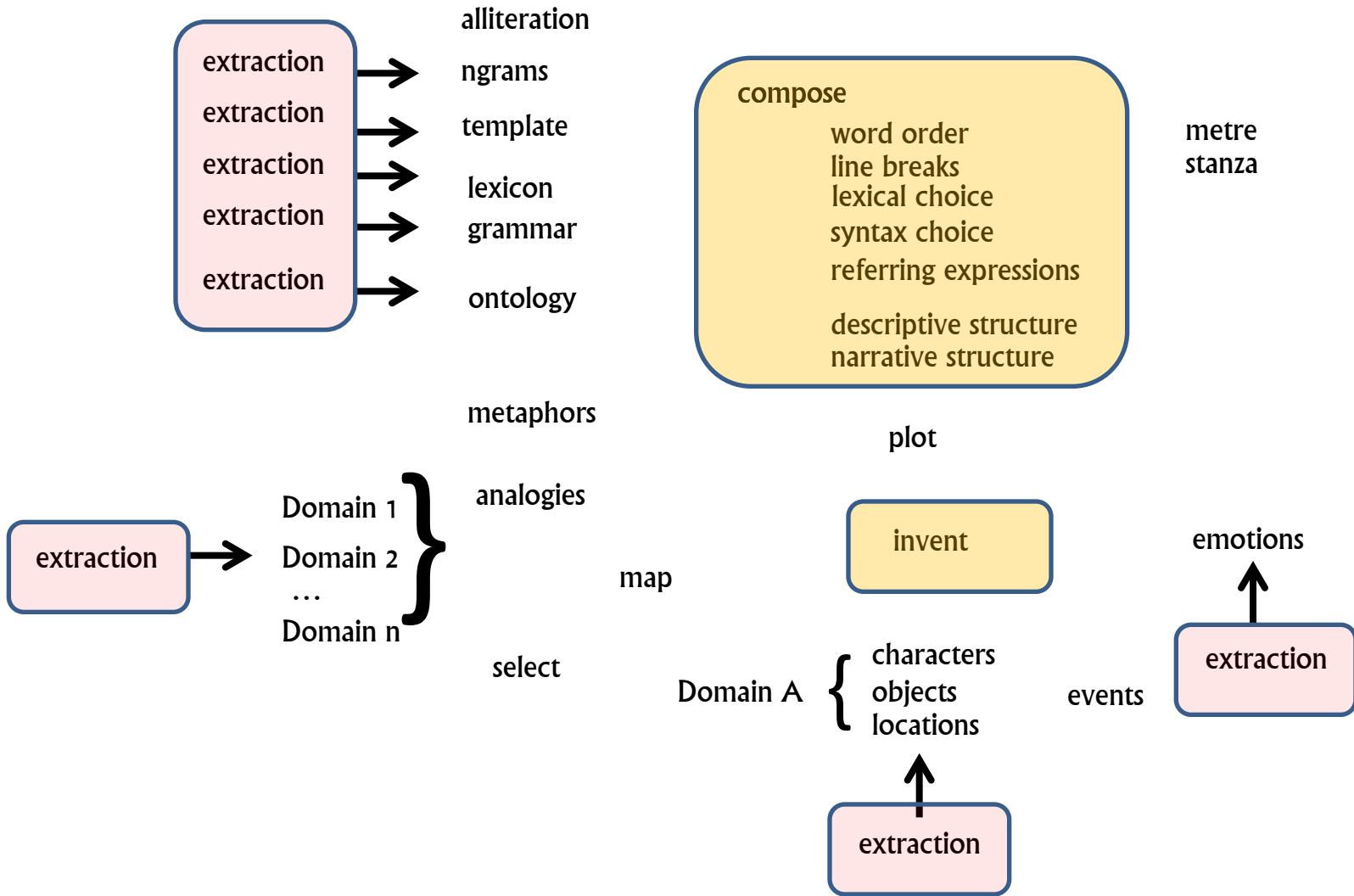


events

↑
extraction



Draft

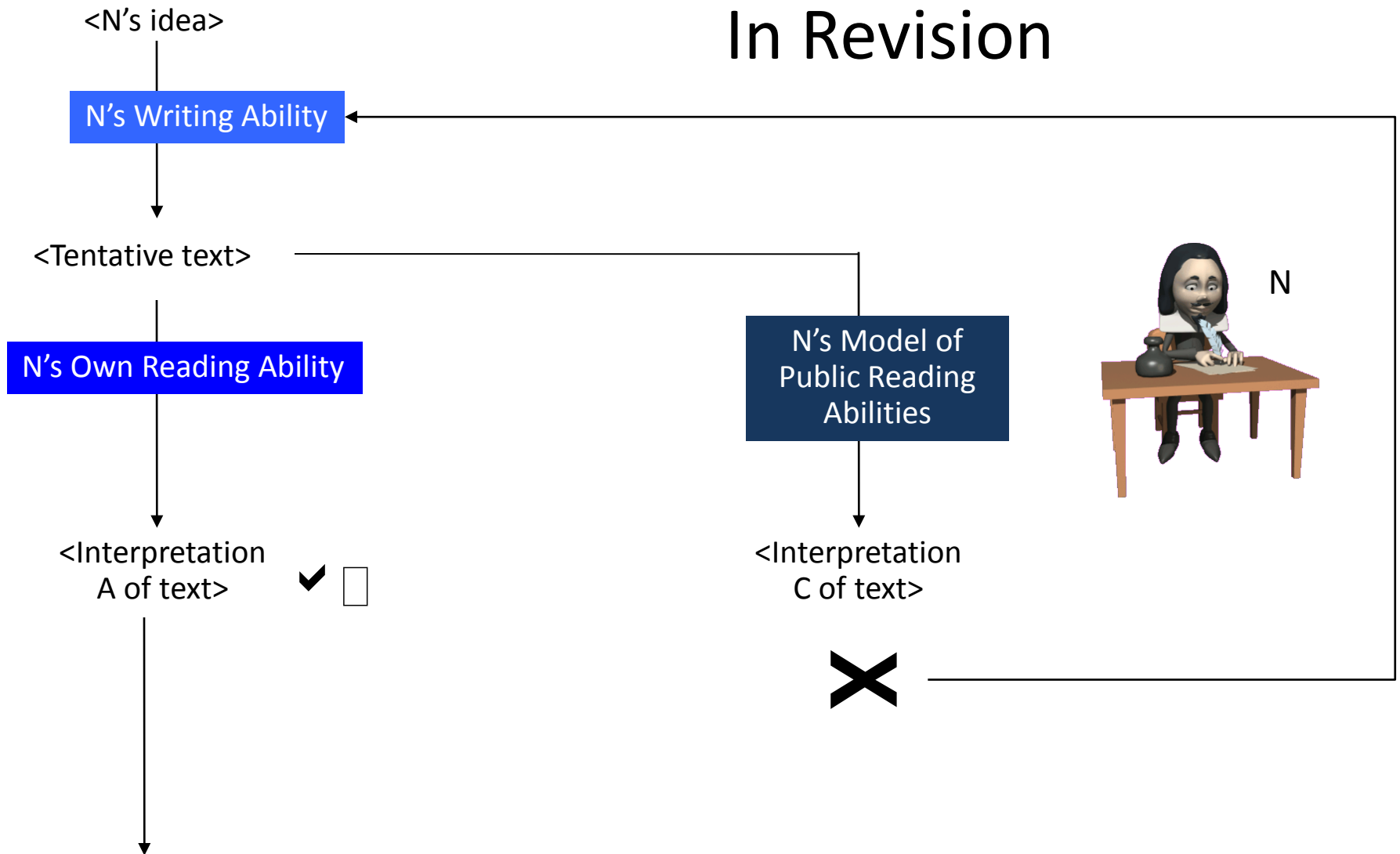


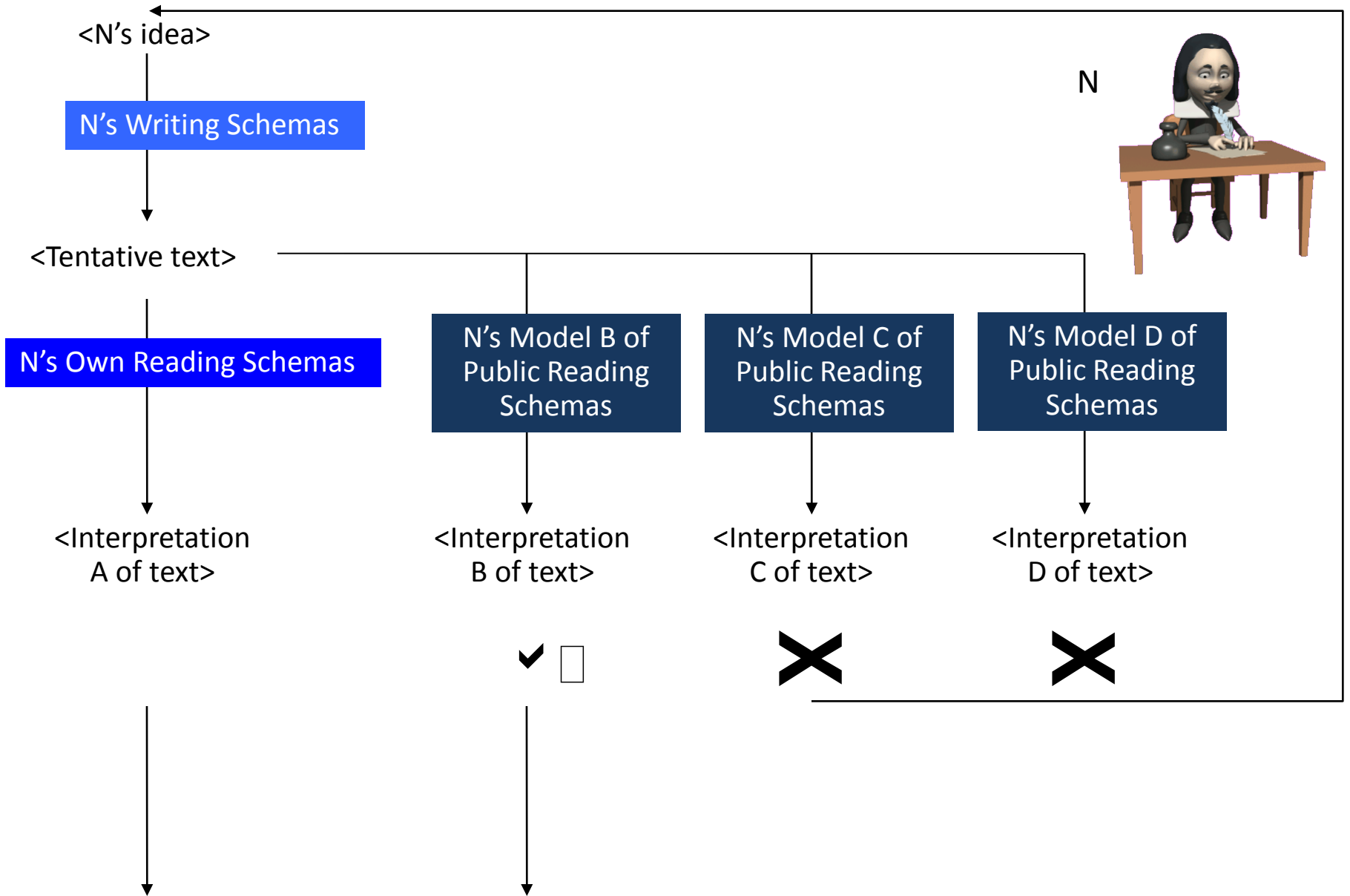
	Fabula	Discourse	Text
narrative NLG		given as input	generated from input
narrative composition	given as input	generated from input	generated from discourse
simulation based approach	generated explicitly	generated from fabula	generated from discourse
most popular!	(generated implicitly)	generated explicitly	generated from discourse

Conclusions

sustained innovation in creativity:
relates to the ability of an agent to
produce significantly different
results on a given generation
attempt from those obtained
earlier

Role of Interpretation In Revision





How does one learn to write good stories?

- ✓ you read good stories
- ✓ you write stories
- ✓ you show your stories to others



EVALUATION



CREATIVE
TECHNIQUE

thank you!

<http://nil.fdi.ucm.es>



natural interaction based on language
nil