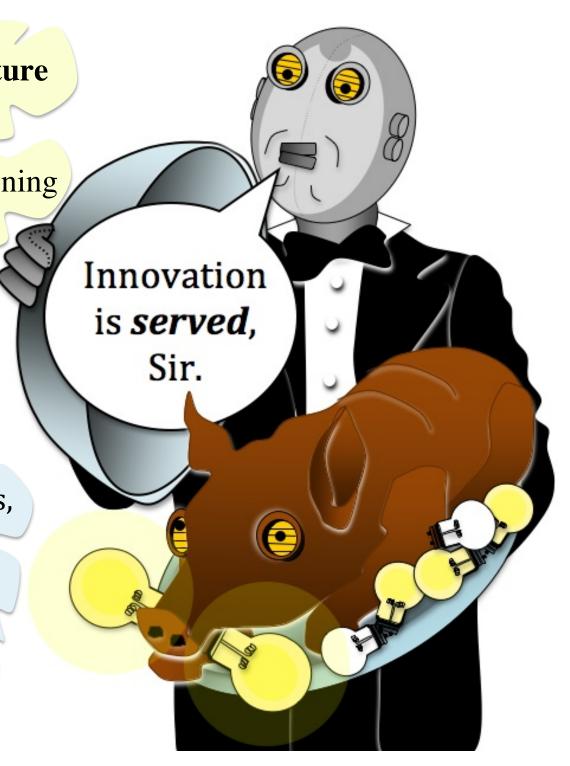


# COMPUTATIONAL CREATIVITY AS A WEB-SERVICE

A (Web-) Service-Oriented Architecture is "an architectural model that aims to enhance the efficiency, agility, and productivity of an enterprise by positioning services as the primary means through which solution logic is represented"

Well-designed services should be discoverable, autonomous and widely reusable, and should be flexible enough to compose in groups, while remaining loosely coupled to others. Services should also maintain minimal state information and use abstraction to hide the complexity of their inner workings and data.

Erl (2008)



### CREATIVITY IN LARGE ORGANIZATIONS

• Develop in-house experts/specializations



- Frequently Call on *External Creative Agencies*
- Agencies have expertise in *idea generation*,

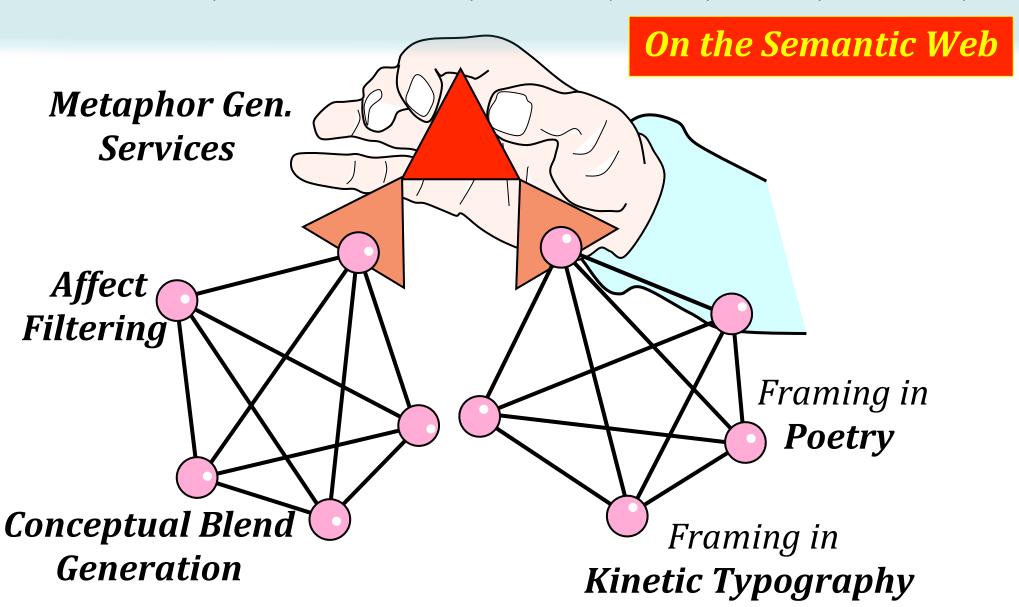
integration of ideas, and framing of ideas

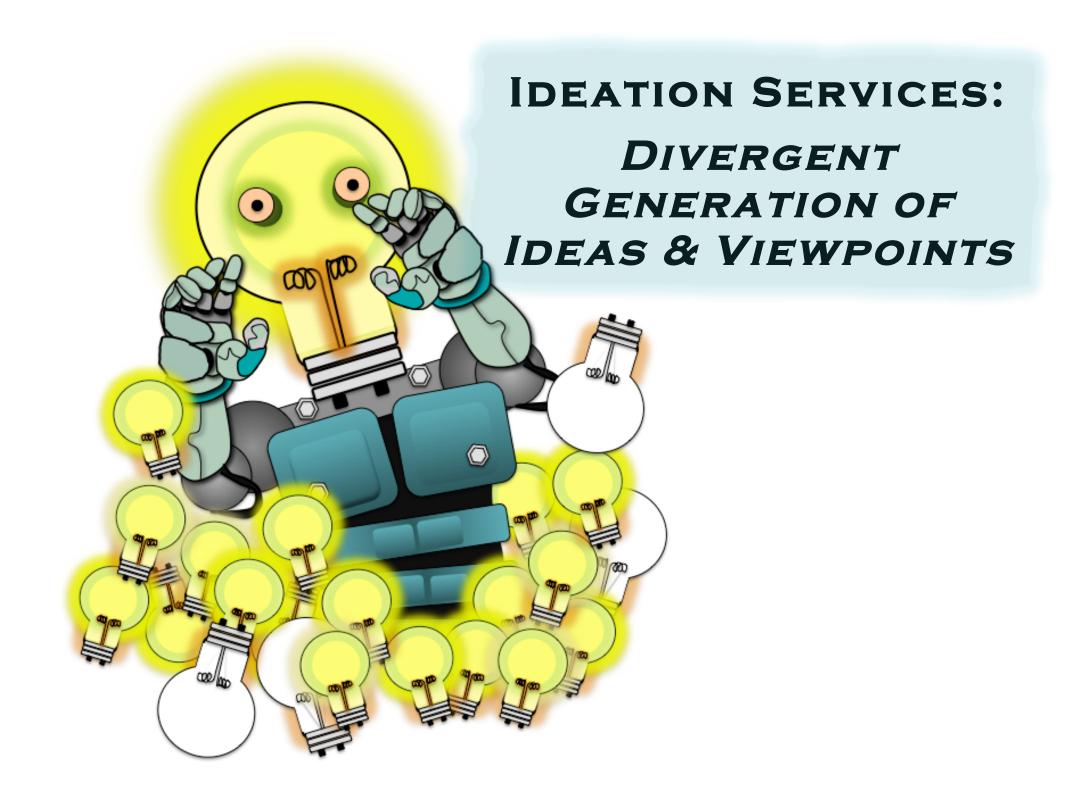
- Combine in-house and external capabilities
- External agencies learn from many different clients across many diverse commissions

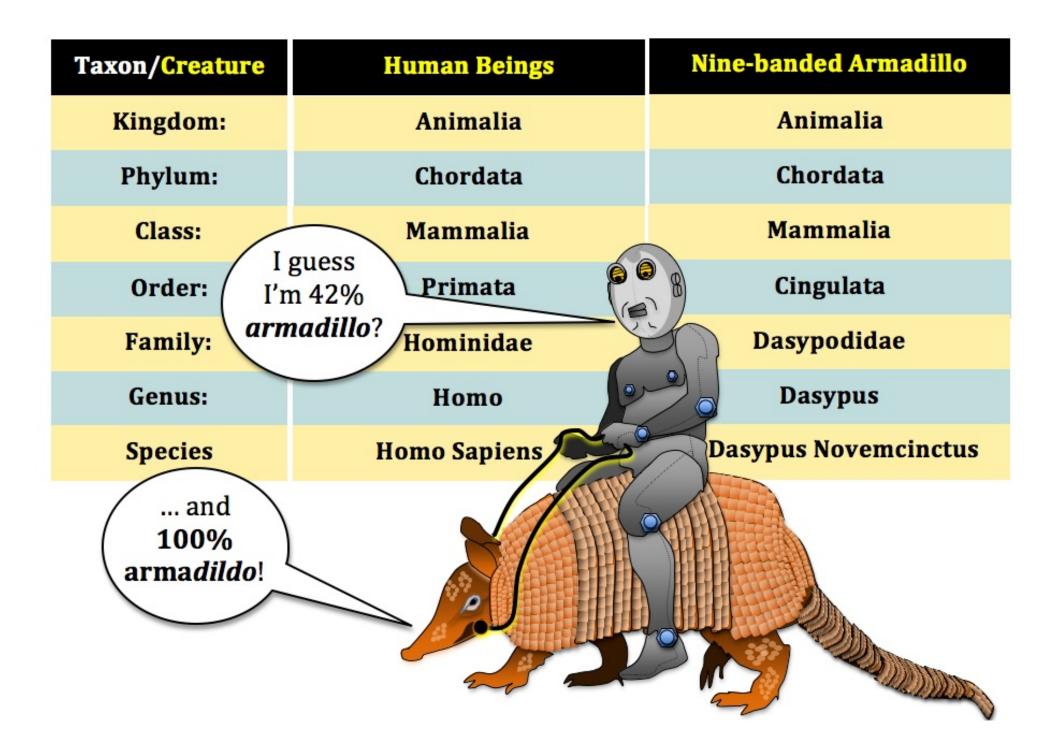
### **CREATIVITY IN SOFTWARE APPLICATIONS**

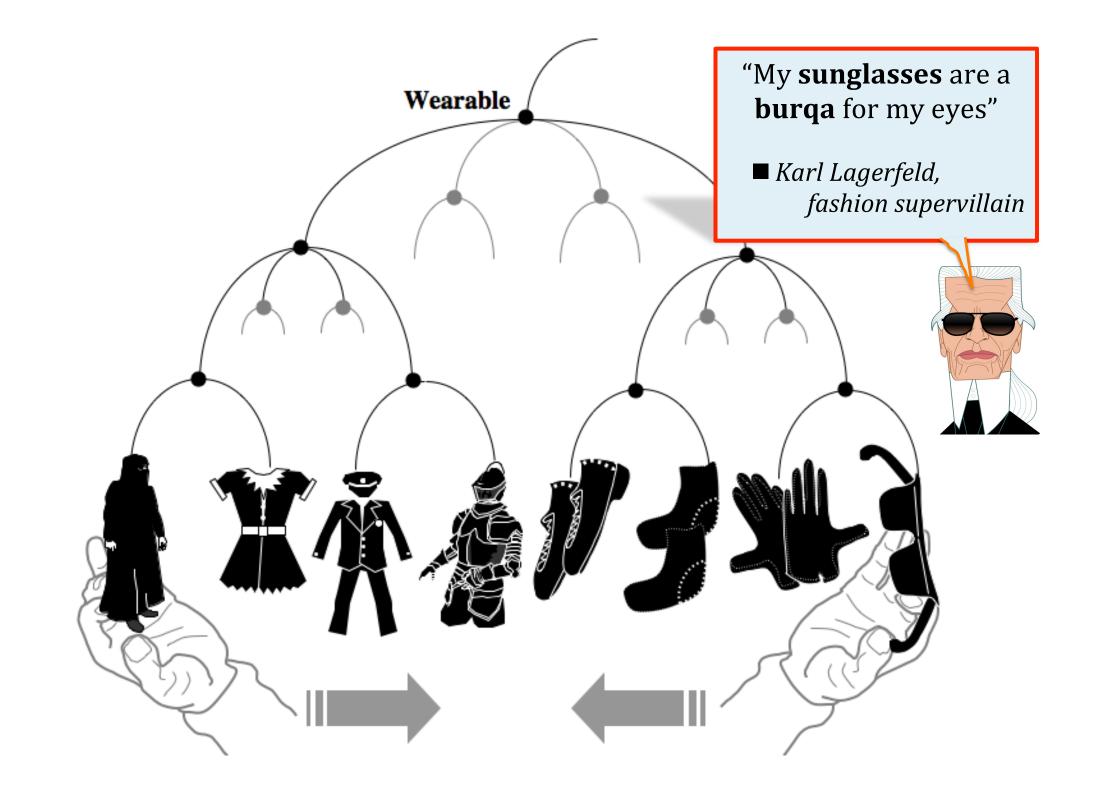
- Inbuilt task-specific functions and capabilities
- May Call on External Creative Web Services
- Such Services have expertise in idea generation,
- idea composition, and the framing of ideas
  - No Need to implement fluid **CC** State-of-the-Art
  - External services can learn from many different client apps across many diverse commissions

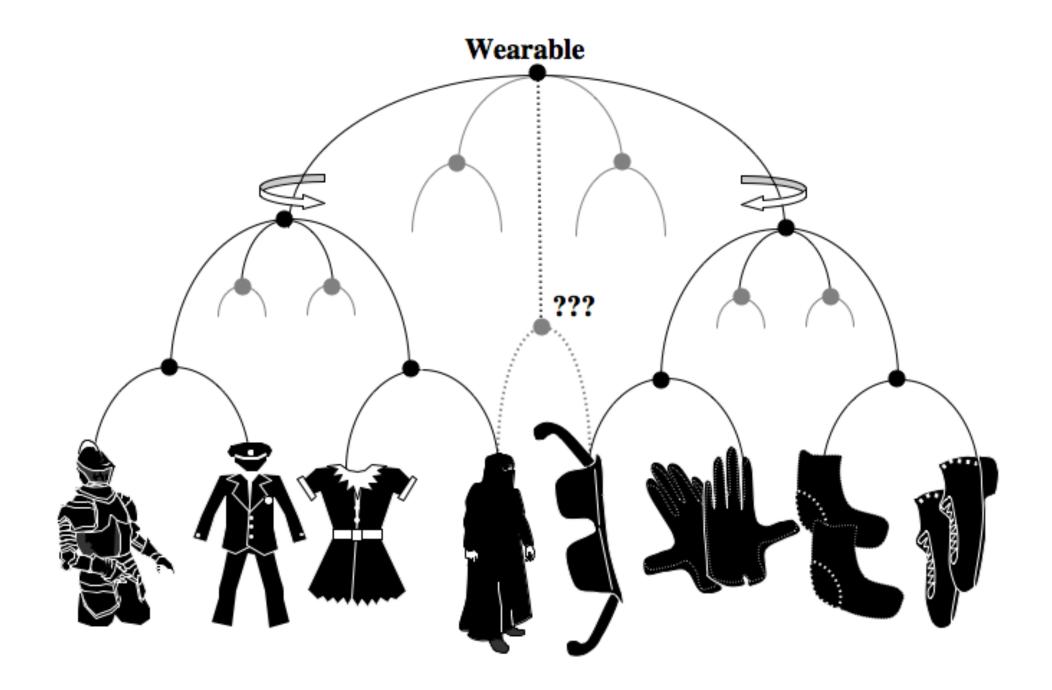
### DISCOVERY OF CREATIVE WEB SERVICES

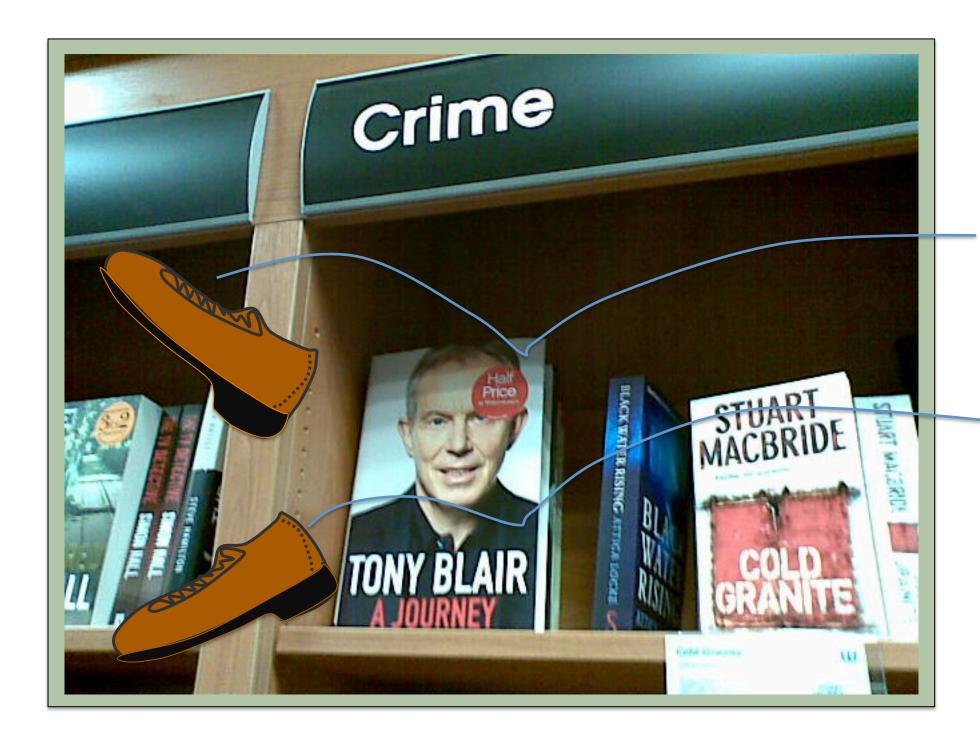


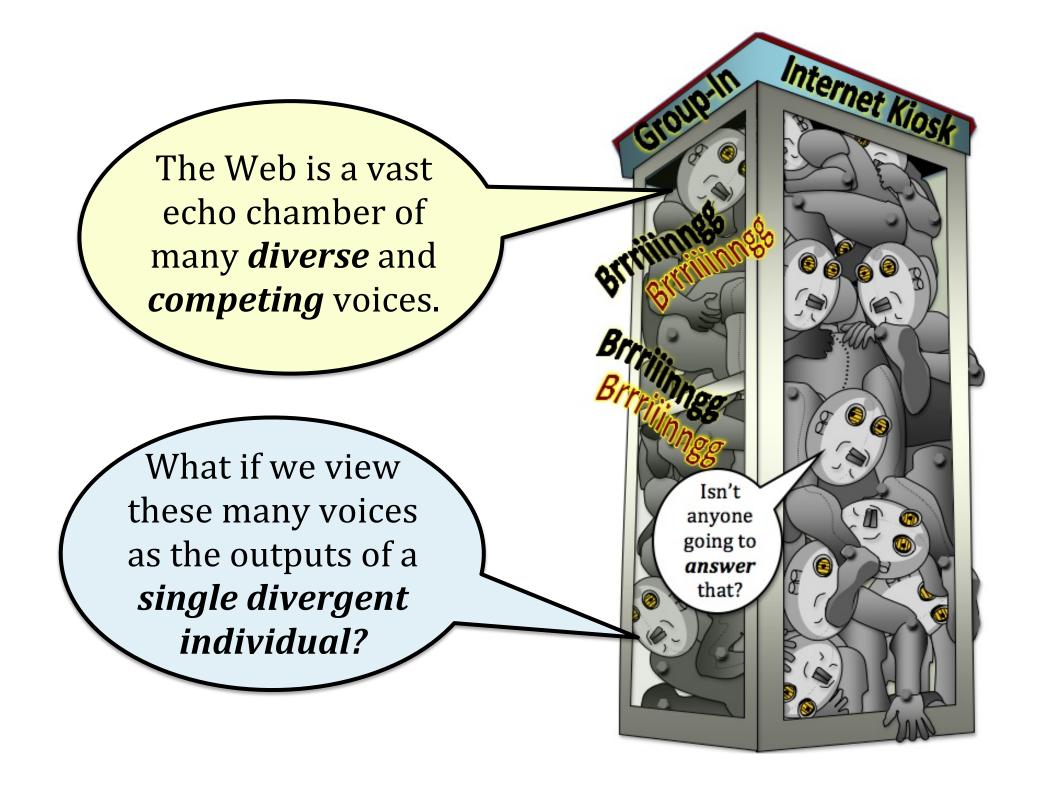


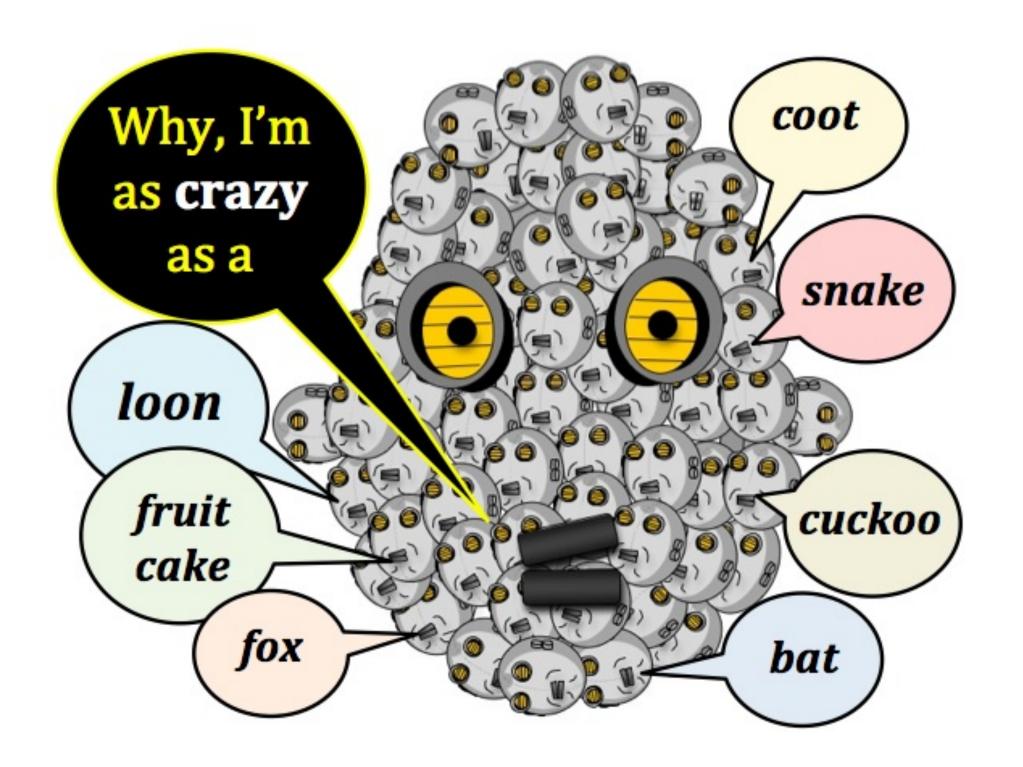




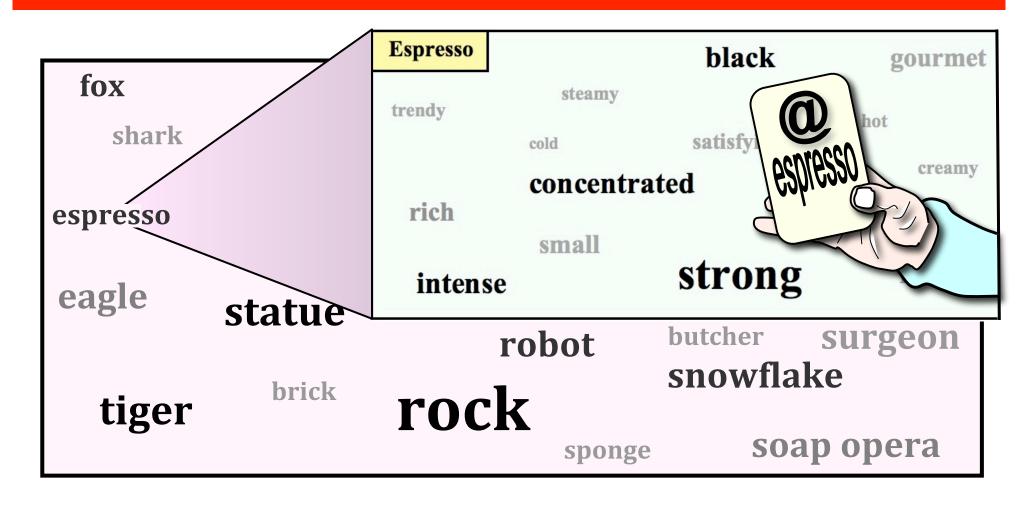








### Acquiring Stereotypical Ideas: Harvest Simile patterns from Web



Use Web query pattern

" as \* a | an as \* "

to harvest 10,000s of similes

### **Learn how Stereotypical Properties Suggest / Imply Together**

Adjacency matrix of mutually-reinforcing properties acquired from WWW:

	hot	spicy	humid	fiery	dry	sultry	•••
hot		35	39	6	34	11	•••
spicy	75		0	15	1	1	•••
humid	18	0		0	1	0	
fiery	6	0	0		0	?	•••
dry	6	0	0	0			
sultry	11	1	0	2	0	e ho	STORES OF THE PROPERTY OF THE
• • •	•••	•••	•••	•••	•••		

Use the Google query

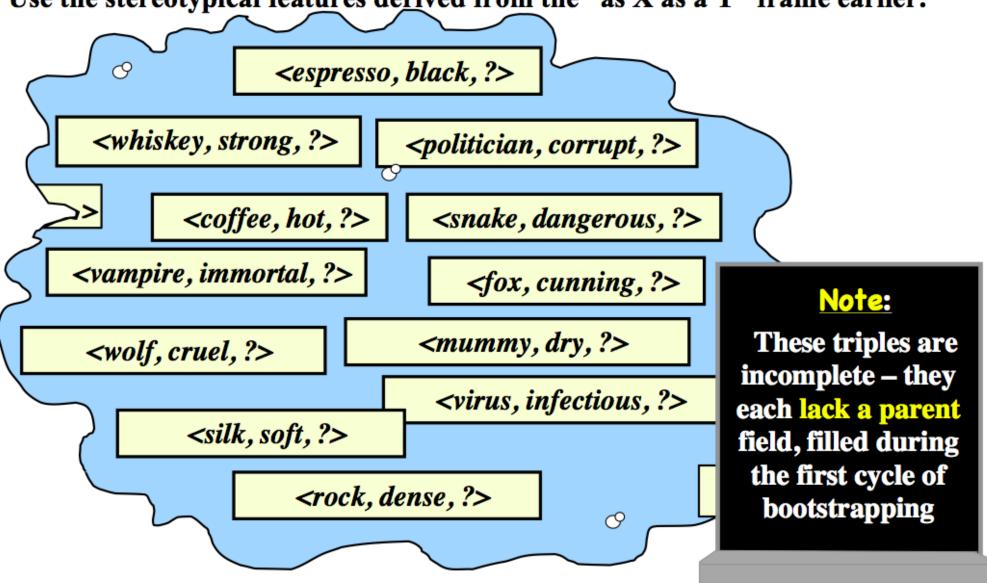
"as \* and \* as"

to acquire associations

### A Taxonomy as A Pool of Triples: How to obtain the largest Pool? <India, hot, country> <espresso, black, coffee> <cola, carbonated, drink> <espresso, strong, coffee> <coffee, hot, drink> <whiskey, strong, drink> <worm, malicious, program> <Trojan, malicious, program> <rugby, violent, sport> <virus, malicious, program> <tofu, boring, food> <vampire, evil, demon> 9

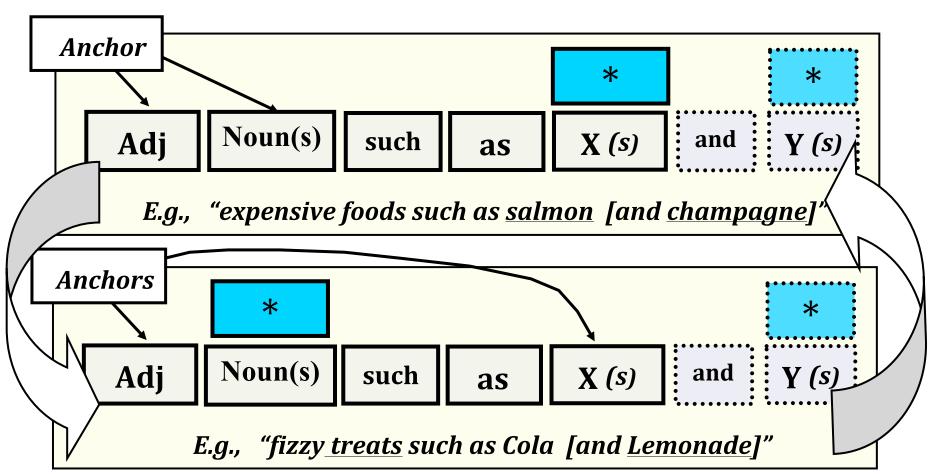
### Form Initial Triples From **Simile-derived Associations**

Use the stereotypical features derived from the "as X as a Y" frame earlier:



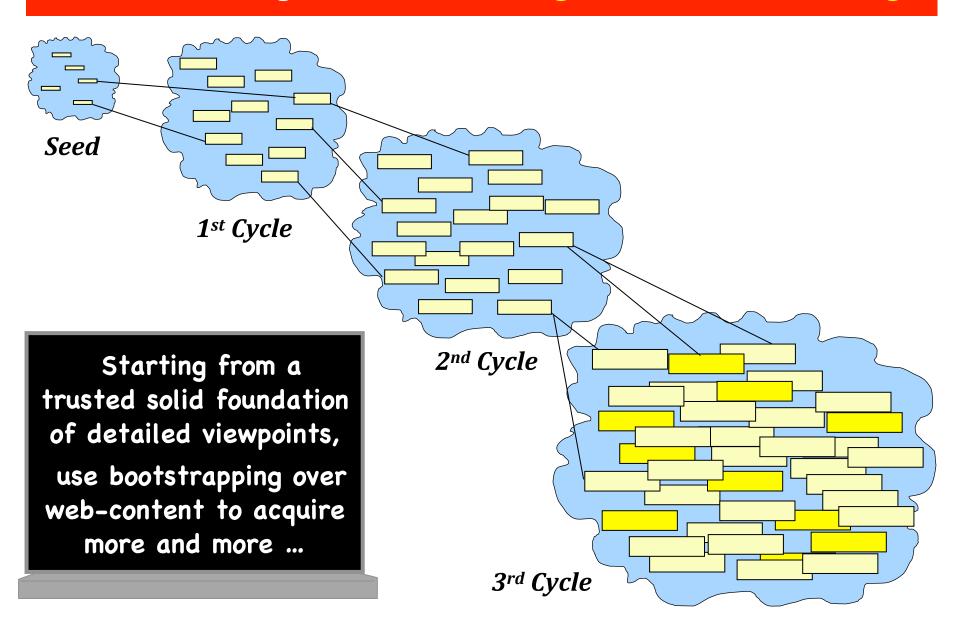
### Acquiring Fine-Grained Perspectives via Lateral Thinking

Acquiring informative fine-grained categorizations such as: cola is a carbonated drink or tofu is a boring food

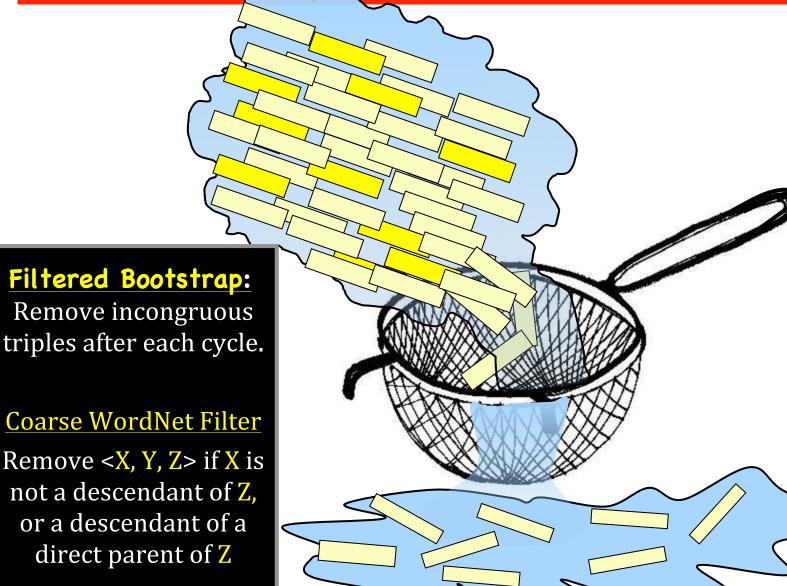


Bootstrapping on web is a controlled form of Divergent / Lateral

### Lateral Thinking on the Web: Divergent Growth of Knowledge



### Removing Noise between Bootstrapping Cycles: use WordNet





creativity

subjective:skill, personal:skill,

### personal:attribute,

mental:ability, spiritual:attribute, essential:skill, soft:skill,

entrepreneurial:skill, academic:ability, subjective:thing, musical:ability, important:attribute, key:skill,

psychological:attribute, individual:skill, nonverbal:skill, personal:motive, cognitive:skill, nonverbal:skill,

important:skill, social:attribute, psychological:attribute, desirable:attribute, entrepreneurial:attribute, abstract:skill,

intellectual:ability, social:skill,

diverse:attribute, cognitive:power, commercial:skill, technical:skill, mental:faculty, intellectual:skill, noble:attribute, artistic:skill, athletic:skill, feminine:attribute, feminine:a mental:attitude, rare:event

wonderful:thing, behavioural:skill, individual:motivation, mental:attribute, positive:attribute, vital:skill, interpersonal:skill,

positive:attitude, individual:attribute, spiritual:power, cognitive:ability, professional:skill,

mental:skill.

### creativity & leadership

#### Shared Category for creativity and leadership

```
abstract_attribute, abstract_skill, affective_skill, behavioural_skill, cognitive_skill, desirable_attribute,
  entrepreneurial_skill, essential_skill, 
individual_attribute, individual_skill, intellectual_skill, interpersonal_skill,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             managerial_skill,
marketable_skill, mental_attribute, natural_ability, necessary_attribute, new_skill,
                                                                                                                                                                                                                                                                                                                                                                                             personal_attribute,
 personal_skill, positive_attitude, positive_attribute, practical_skill,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          professional attribute.
                                                                                                                                                                                                                                                                                                                                                                                                           qualitative_attribute, social_skill,
                                                                                                                                                                                           professional_skill,
                                                                                                                                                                                                                                                                                                                                                                                                            soft skill,
 subjective_thing, technical_skill, transferable_skill, valuable_skill, valuable_skill, vital_skill, vocational_skill, valuable_skill, valuable
```

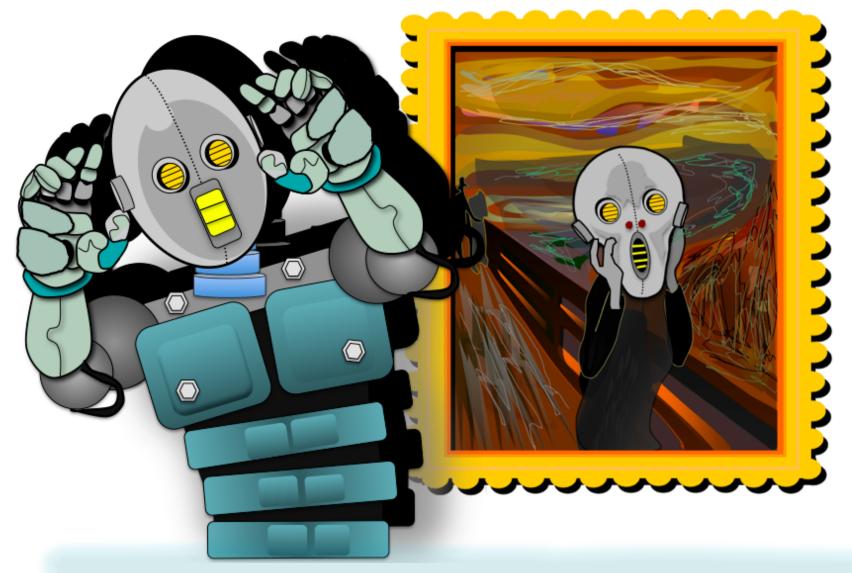
```
adverse_event, bad_event, bad_thing, catastrophic_event, changing_event, chang
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   critical event. destructive_thing,
 devastating_event, disruptive_event, distressing_event, domestic_event, domestic_event,
                                                                                                                                                                                                                                                                                                                                                                                                   dramatic_event,
economic_event, emotional_event, environmental_event, experienced_event, external_event,
 extraordinary_event, financial_event, identifiable_event, immoral_act, important_event, intense_event, immoral_act, important_event, intense_event, immoral_act, important_event, intense_event, immoral_act, important_event, intense_event, immoral_act, immoral_act, important_event, intense_event, immoral_act, immoral_
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       legal event.
                                                                    major_event, negative_event, ordinary_event, outside_event, painful_event, past_event,
                                                                                                                                                                                                                                                                                                                                                           rare_event, recent_event, severe_conflict,
                                        divorce & war
                                                                                                                                                                                                                                                                                                                                                                                                                                                          severe event.
significant_event, social_event, social_event, social_occurrence, specified_event,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      stressful event,
                                                                                                                                                                                            traumatic_event, unavoidable_event, unavoidable_event, uncontrollable_event, undesirable_event, undesirable_
 sudden_event,
unexpected_event, unexpected_occurrence, unforeseeable_event,
                                                                                                                                                                                                                unforeseen_event, unfortunate_event,
                                                                                                                                                                                                                                                                                                                                                                                                                       unpleasant_event,
unpleasant_thing, untoward_event, unusual_event,
```

```
historical_event, identifiable_event, important_event, individual_event, infrequent_event,
inorganic_object, irreversible_event, isolated_event, large_experience, legal_event, local_event,
main_event, major_change, major_event, major_occurrence, meaningful_activity, meaningful_event, medical_accident, natural_change,
                                       natural_event, natural_experience,
   birth & death
                                                                natural occurrence,
natural_phenomenon, natural_process,
                                                                    natural thing, notable_event,
                                                                                      observed event.
onetime_event, ordinary_event, ordinary_experience, ordinary_occurrence, ordinary_thing, organic_event,
organic_process, organizational_event, particular_event, past_event, personal_change, personal_event,
physical_event, physical_phenomenon, physical_transformation, physiological_event, physiological_process, possible_event, private_experience,
              public entity, public_event, random_event, random_occurrence, recent_change, recent_event, related
                             round_event, routine_event, routine_event, salient_event, seminal_event, serious_experience,
                                          social_event, social_happening, social_phenomenon,
significant_event,
                                                           special_event, special_occasion,
stochastic_process, stressful_event, timeless_experience, traumatic_event,
                                                                                  traumatic_experience,
unanticipated_event, universal_experience,
                                       vital event.
```

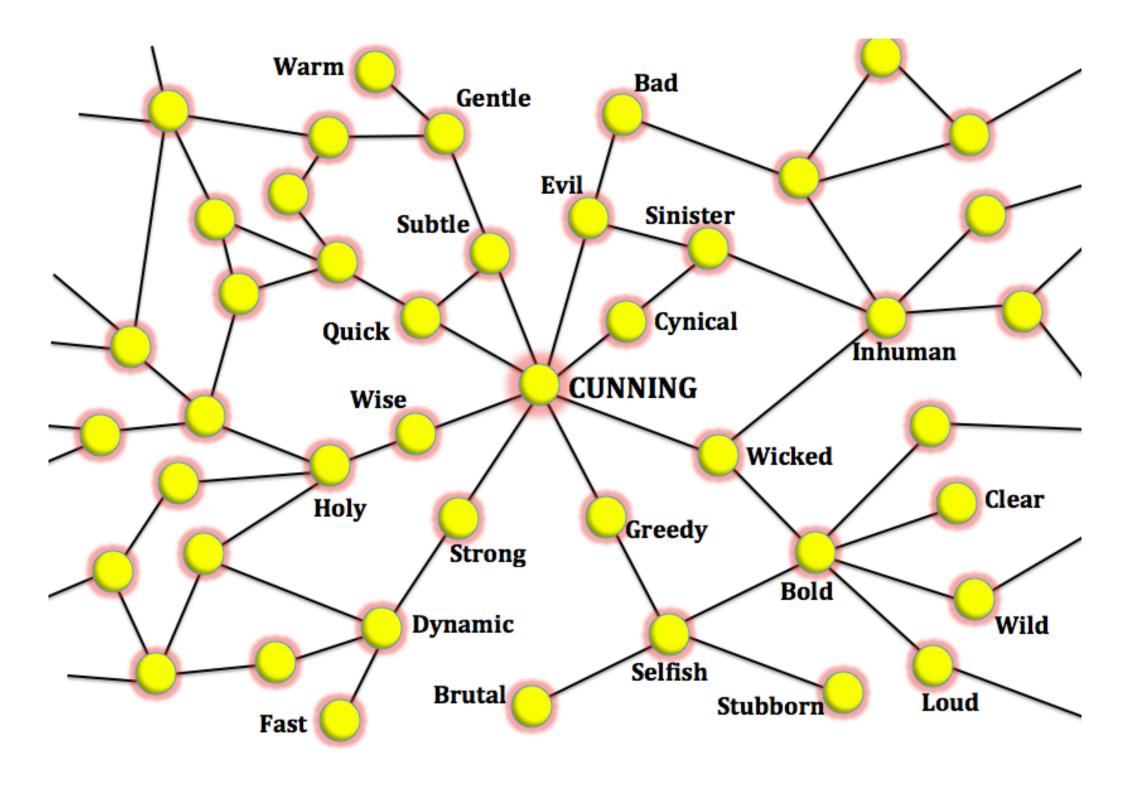
### Miller & Charles (M&C) Lexical similarity Gold-Standard of 30 word pairs

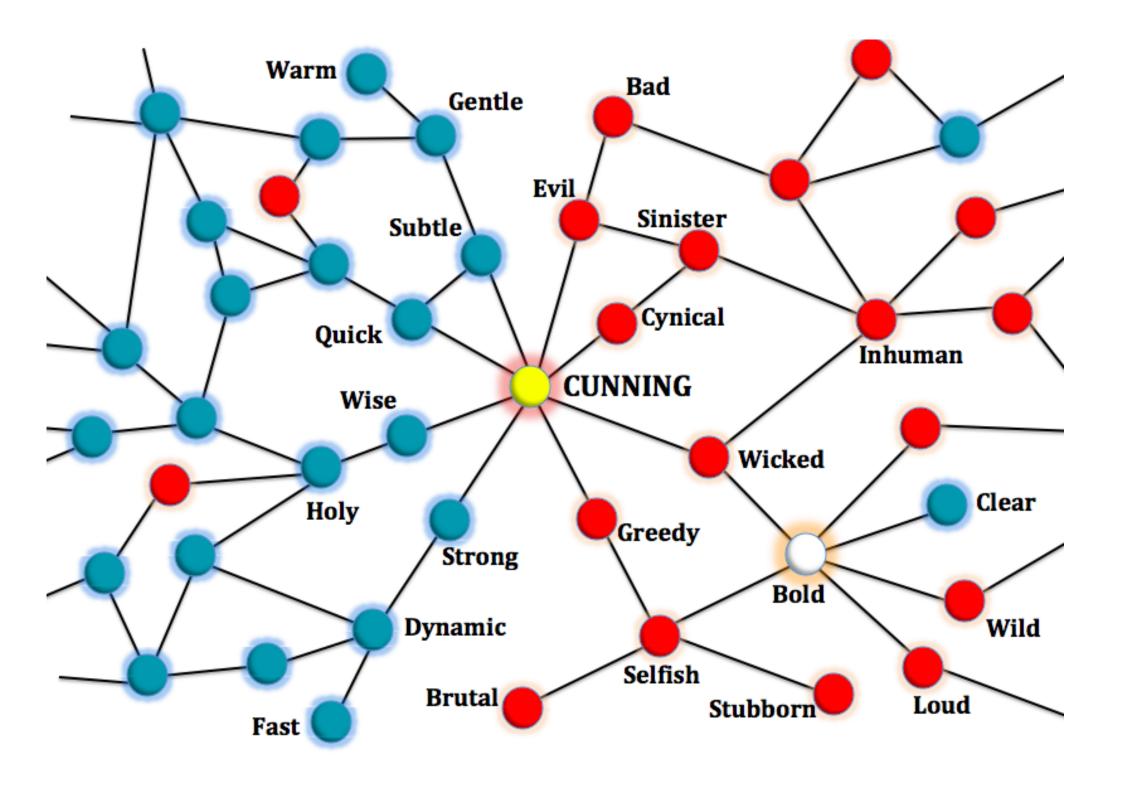
1.	car - automobile	11.	bird - cock	21. coast - hill
2.	gem - jewel	<i>12</i> .	bird - crane	22. forest - graveyard
3.	journey - voyage	<i>13</i> .	tool - implement	23. shore - woodland
4.	boy - lad	<i>14</i> .	brother - monk	24. monk - slave
5.	coast - shore	<i>15</i> .	crane - implement	25. coast - forest
6.	asylum - madhouse	<i>16</i> .	lad - brother	26. lad - wizard
7.	magician - wizard	<i>17</i> .	journey - car	27. chord - smile
8.	midday - noon	18.	monk - oracle	28. glass - magician
9.	furnace - stove	19.	cemetery - woodland	29. rooster - voyage
<i>10</i> .	food - fruit	<i>20</i> .	food - rooster	30. noon - string

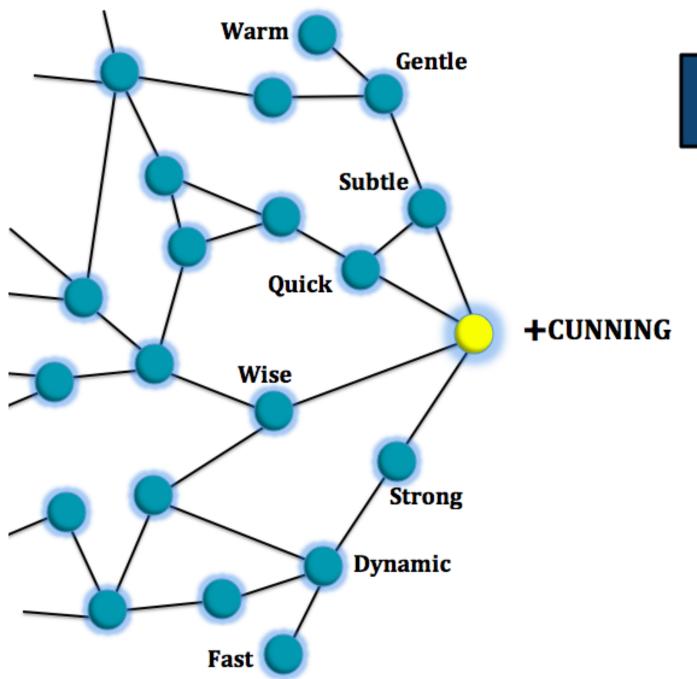
Thesaurus Rex achieves 0.93 correlation with M&C human ratings



FEELINGS & EMOTIONS for AFFECTIVE IDEATION









Bad N<sup>-</sup>(cunning) **Evil** Sinister Cynical Inhuman -CUNNING Wicked Greedy Wild Selfish Brutal

Loud

Stubborn

### +/- Valence of Stereotypical Properties and Behaviors

$$pos(x) = \frac{|N^+(x)|}{|N^+(x) \cup N^-(x)|}$$

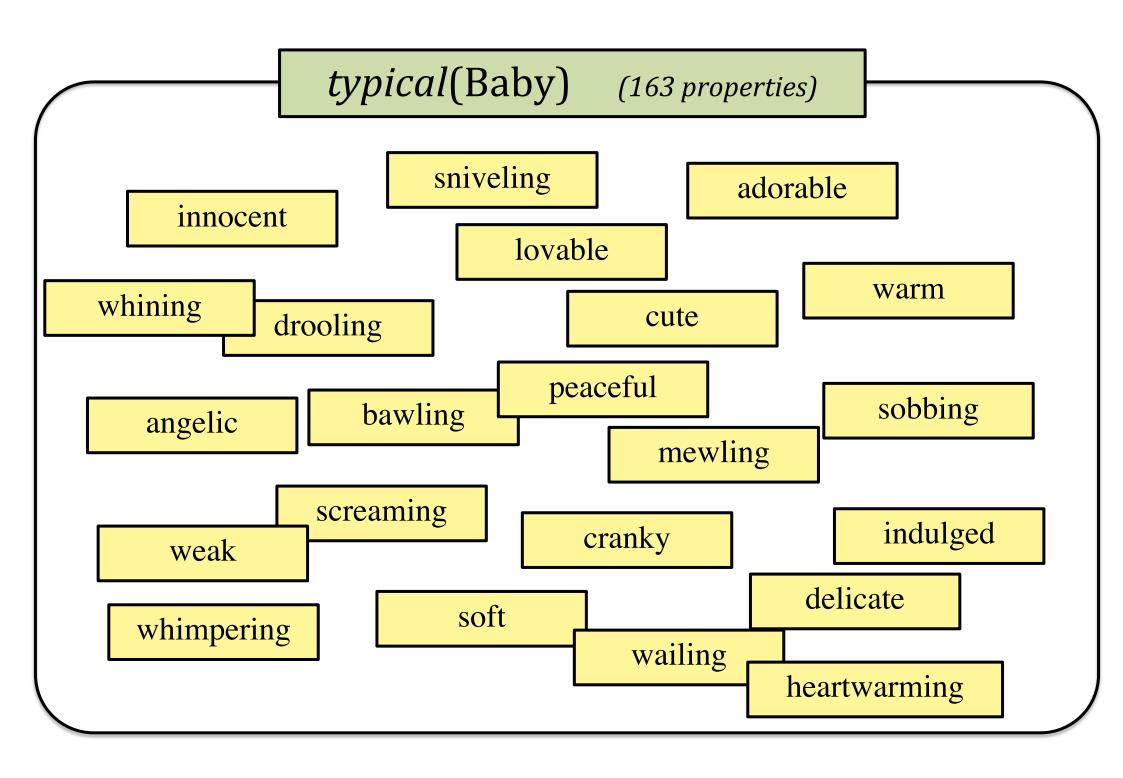
For <u>99.6%</u> of *positive* seeds (1309 of 1314),

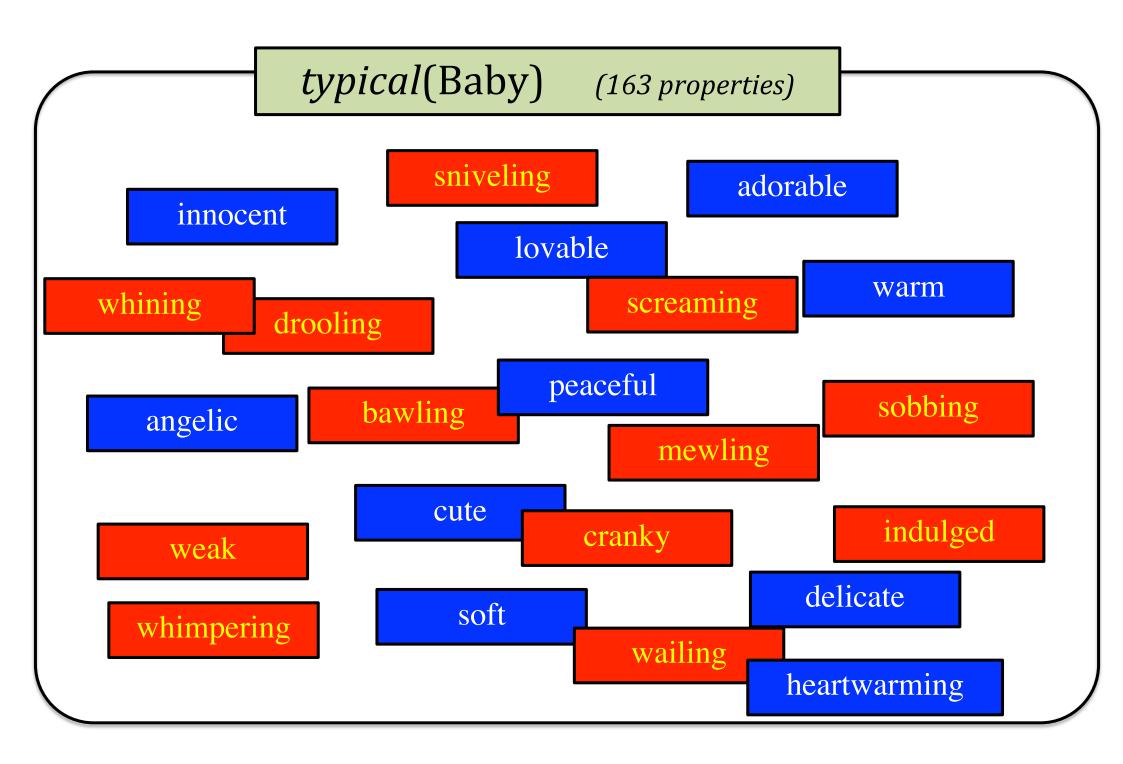
pos(x) > neg(x)

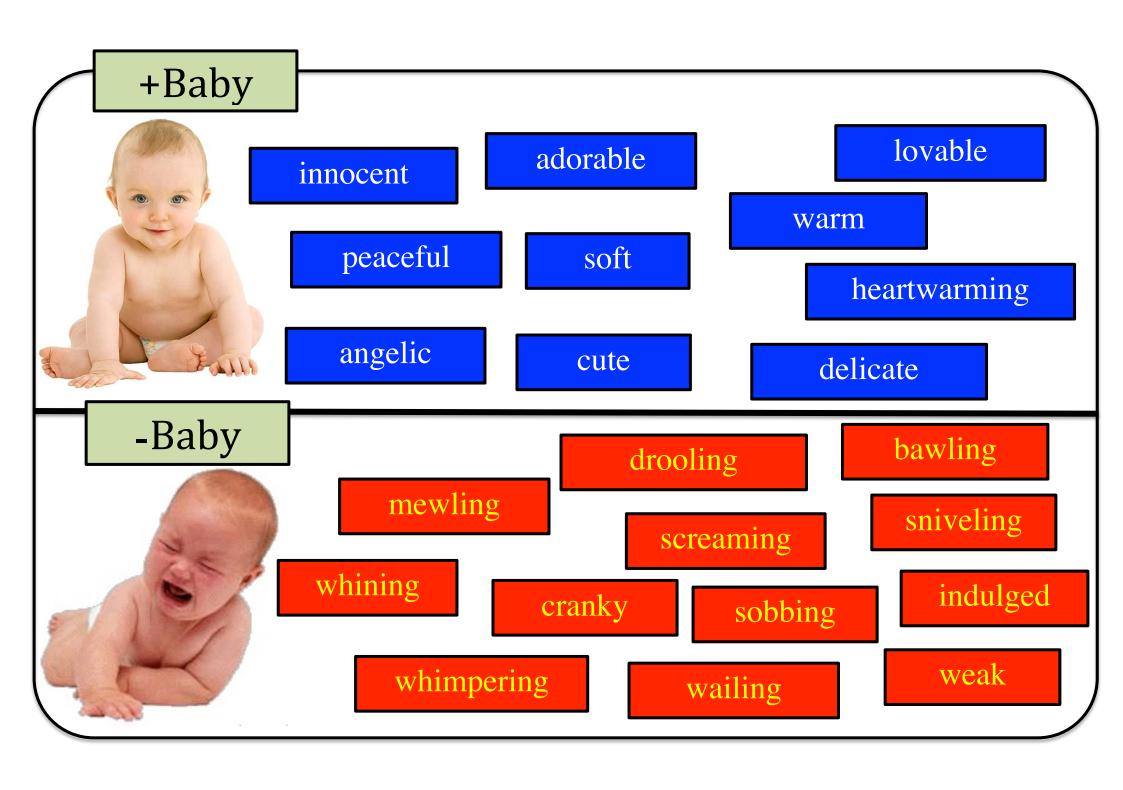
$$neg(x) = \frac{|N^-(x)|}{|N^+(x) \cup N^-(x)|}$$

For <u>98.1%</u> of *negative* seeds (1359 of 1385),

neg(x) > pos(x)







## Average P/R/F1 scores for the affective retrieval of positive and negative properties from 6,230 stereotypes

Macro Average (6230 stereotypes)	<b>Positive</b> properties	<i>Negative</i> properties
Precision	.962	.98
Recall	.975	.958
F-Score	.968	.968

Avg. 6.51 properties per stereotype

### **Understanding the Relationship Between Feelings and Properties**

### Patterns of co-description in similes show us how properties make us feel

	disgusting	terrifying	revolting	disturbing	frightening	appalling	exciting
bloody	8	4	3	3	2	2	2
vile	34	0	1	5	0	0	0
filthy	14	0	4	0	0	0	0
bizarre	11	7	2	0	11	1	1
horrible	11	3	0	1	2	0	0
horrid	10	0	2	0	1	0	0
• • •	• • •	• • •	•••	•••	•••	•••	• • •

Simple Morphology rules

"I feel **disgust**ed by" "I feel **appall**ed by ..."

#### How I feel now

#### **Most Common Feelings**

impressed by,

Challenging art and its uncompromising photographs challenge me.

I feel rewarded by art and its equally cherished treasures. They encourage me.

Do you feel excited by art and its balanced portfolios? Aren't you pleased by them?

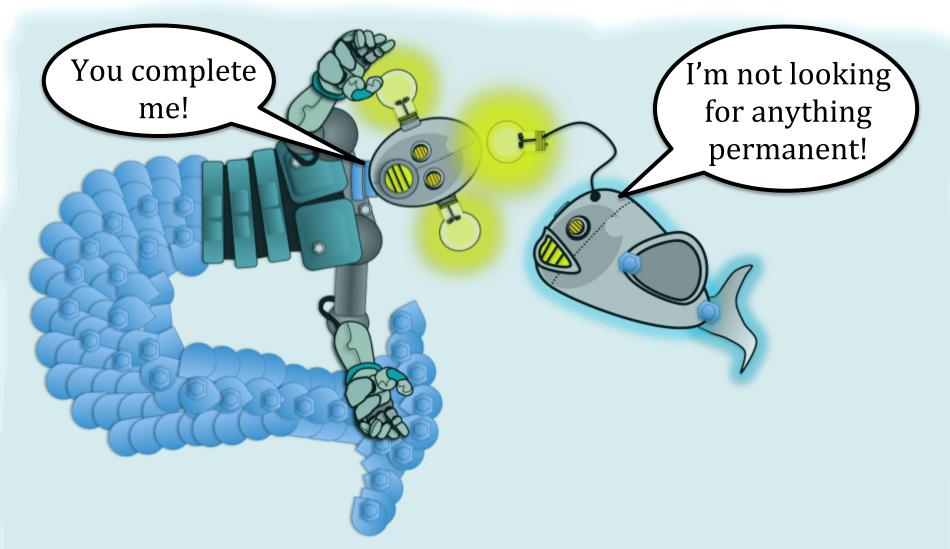
Art and its intriguing ideas make me feel interested and motivated.

I often feel stimulated and supported by intriguing art and its diversified portfolios.

I often feel gripped by sophisticated art and its fascinating concepts.

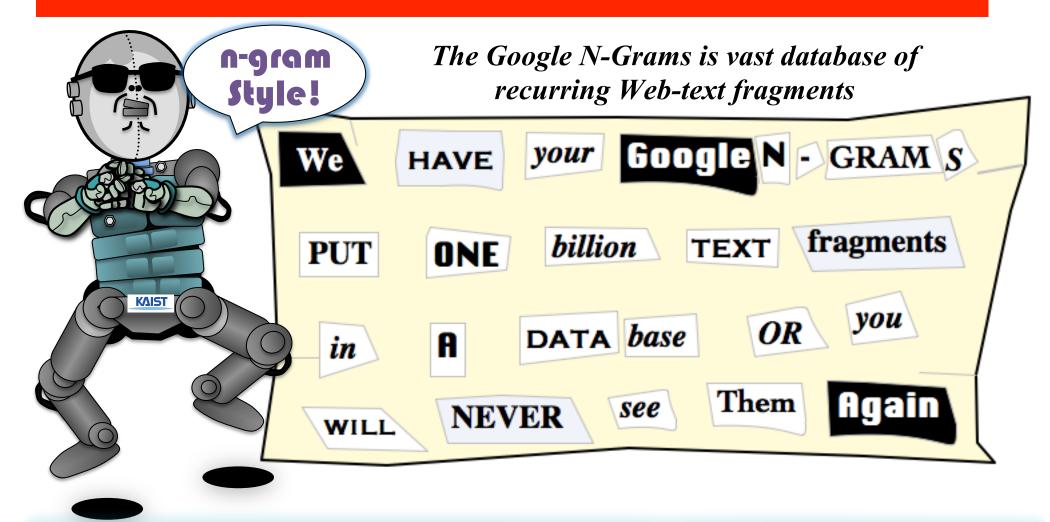
I feel intrigued by art and its tantalizing treasures. Don't they inspire you?

```
bored_by, threatened_with, fulfilled_by, rewarded by,
challenged by, intimidated_by, unnerved_by,
excited_by, stimulated_by, interested_by,
disappointed by, protected by, stressed by, oppressed by,
exhausted by, attracted by, troubled by, supported by,
fascinated by, dominated_by, satisfied by,
perplexed by, intrigued by, frustrated by,
drained by, abused by, attacked by, discouraged by, provoked by, charmed by,
refreshed_by, energized_by, entertained_by, gripped by,
amused by, exhilarated by, strengthened by, surprised by,
overwhelmed_by, distressed_by, frightened_by, forced_by, empowered_by,
humiliated by, depressed by, stirred by, enriched by, amazed by,
bewildered_by, graced_by, invigorated_by, confused_by, confined_by,
enlightened_by, disturbed_by, baffled_by, delighted_by, manipulated_by, tired_by,
loved_by, haunted_by, damaged_by, captivated_by, gratified_by, moved_by,
stunned_by, controlled_by, puzzled_by, shocked_by, inspired_by,
respected_by, encouraged_by, helped_by, pained_by, thrilled by,
uplifted by, threatened by, menaced by, motivated by, liberated by,
restricted by, daunted by, healed by, terrified by, punished by,
```



# IDEA COMBINATION SERVICES: AFFECTIVE METAPHOR & BLENDING

## Every n-gram corpus can be viewed as a Lexicalized Idea Space



Web n-grams: suggests viability of many atypical combinations of ideas

	religion is		я		lie
religio	n	is	a		cult
	religion	is		a	violation
	religion	is		a	force
	religion	is		a	joke
	religion	is		a	threat
	religion	is		an	illusion
Apple is a religion	religion	is		a	scam
	religion	is		a	waste
	religion	is		a	crime
	religion	is		a	problem
	religion	is		an	obstacle
	religion	is		a	farce
	religion	is		a	fraud
	religion	is		a	disease
	religion	is		a	delusion
	religion	is		an	insult
religion		is	a		hoax



Apple is a -religion

Metaphorize This!

Target Metaphors: Apple Source Metaphors: -religion

bad:ogre, spoiled:playboy, macabre:funeral,

## dogmatic:cult,

proprietary:monopoly, overlooked:risk,

harmful:toxin, overbearing:boss, weird:spook, depraved:sinner, overlooked:minority, spoiled:star, dreaded:critic, inanimate:machine,

#### dogmatic:religion, weird:mutant,

inanimate:brick, burning:cigarette, exiled:revolutionary, vicious:regime, emotionless:monster, depraved:fetish, inanimate:stone, exiled:militant, complicated:encyclopedia, perilous:pit, spreading:virus, harmful:parasite, depraved:scoundrel, obsessed:creep, depraved:crazy person, misguided:crackpot, fighting:barbarian, spreading:disease, toppled:tyrant, calculating:cheat, tortured:soul, branded:coward, toppled:authoritarian, twisted:roller\_coaster, infamous:murder, bloated:mess,

terrible:mistake, hateful:bigotry,

depraved:cult, troubling:question,

#### authoritarian:church,

disgusting:ass, breaking:heart, mocking:comedy,

depraved:playboy, lying:child,

threatening:disease,

## fighting:fundamentalist,

threatening:curse, twisted:tangle, strict:teacher,

## pernicious:dogma,

complicated:computer, nasty:mosquito, depressing:humiliation, negative:handicap, depraved:lunatic, disgusting:shack, dumb:statue, raging:punk, fighting:crazy man, threatening:army,

View XML

Go Back

#### How I feel now

#### Doesn't Apple restrict you?

Do you feel oppressed by Apple?

I feel hated by Apple.

I often feel bored by Apple.

Apple stifles me.

I feel irritated by Apple.

Are you obsessed by Apple?

I often feel abused by Apple.

I frequently feel repressed by Apple.

Are you condemned by Apple?

#### **Most Common Feelings**

```
hated by, appalled_by, oppressed by,
challenged by, disturbed by, abused by,
gripped by, humiliated by, intimidated by,
threatened by, unnerved_by, alarmed_by, shocked by,
sickened by, amused by, damaged by, thrilled by,
frightened by, troubled by, terrified by, interested by,
disgusted by, chilled by, alienated_by, refreshed_by,
haunted by, delighted by, confused by, depressed by,
encouraged_by, impressed_by, enchanted_by, amazed_by, respected_by,
punished by, fascinated by, excited by, loved by, horrified by,
constrained_by, healed_by, entertained by, dominated_by,
intrigued by, repulsed by, surprised by, controlled by,
restricted by, helped by, stunned by, stifled by, condemned by,
constricted_by, unsettled_by, bored_by, embarrassed_by,
manipulated_by, protected_by, pained_by, menaced by.
coerced by, irritated by, inspired by, harmed by, baffled by,
bewildered by, overwhelmed by, repressed by, obsessed by, insulted by,
puzzled by, mesmerized by, charmed by, devastated by,
frustrated by, degraded by, perplexed by, supported by, stressed by,
bullied by, disabled by,
```

#### Target Metaphors: love

#### Source Metaphors: -prison

scared:cow, nagging:paradox, lingering:concern,

authoritarian:church, immobile:house,

# grim:tragedy, hated:prison,crowded:jail,

grim:death, unwanted:thought, burning:disgrace, humiliating:punishment,

alarming:emergency, threatening:force,

burning:sin, insubstantial:rainbow,

raging:disease, sombre:church, raging:fire,

absurd:oxymoron, absurd:fallacy, crushing:train,

dreary:grave, rading:river, patient:teacher,

lingering:memory, baffling:wonder, grim:dungeon,

throbbing:drum, seething:ghetto,

unwanted:waste, threatening:risk, binding:cement,

raging:cancer, grim:crime,

impeached:governor, lingering:sorrow, raging:fever,

crowded:ghetto, fighting:plane,

forbidding:wall, dreary:dungeon,

dire:emergency, dreary:tragedy,

overwhelming:feeling, controlling:switch, vain:model, appalling:crime,

dreary:vault, controlling:court, sprawling:palace,

appalling:disgrace, disgusting:waste, appalling:revelation,

gloomy:cell, crowded:hospital, crowded:mosque,

immobile:building, sprawling:factory, impeached:governor,

#### Poetic Qualities of prison:

demonic:menace,

deathly:darkness, terrified:horror,

bureaucratic:oppression,

## monstrous:menace,

ghostly:horror, shadowed:gloom,

shady:gloom, bureaucratic:tyranny,

bureaucratic:dictatorship, bureaucratic:tyranny, freaky:horror,

soldierly:discipline, tyrannical:oppression,

## monstrous:horror,

deadly:darkness, cloudy:darkness, misty:darkness, atrocious:horror,

stormy:darkness, tragic:gloom, ghostly:darkness,

militaristic:discipline, murderous:horror,

#### Poetic Qualities of love:

heroic:passion, childlike:devotion, poetic:passion, friendly:affection

motherly:tenderness, saintly:passion,

childish:adoration, daughterly:devotion,

flowery:sweetness,

daughterly:affection, poetic:zeal, girlish:sweetness, wifely:devotion, wifely:affection,

childish:sweetness, saintly:devotion, canine:affection, tender:adoration

flowery:tenderness, motherly:caress, childlike:sweetness,

devout:devotion, devout:zeal,

motherly:affection, familial:devotion, sisterly:affection, motherly:embrace, tender:passion

angelic:tenderness, priestly:devotion, tender:affection, fatherly:affection,

rosy:sweetness, devout:adoration, girlish:tenderness, friendly:embrace, dreamy:sweetness,

fatherly:embrace, brotherly:affection, motherly:devotion, childlike:zeal,

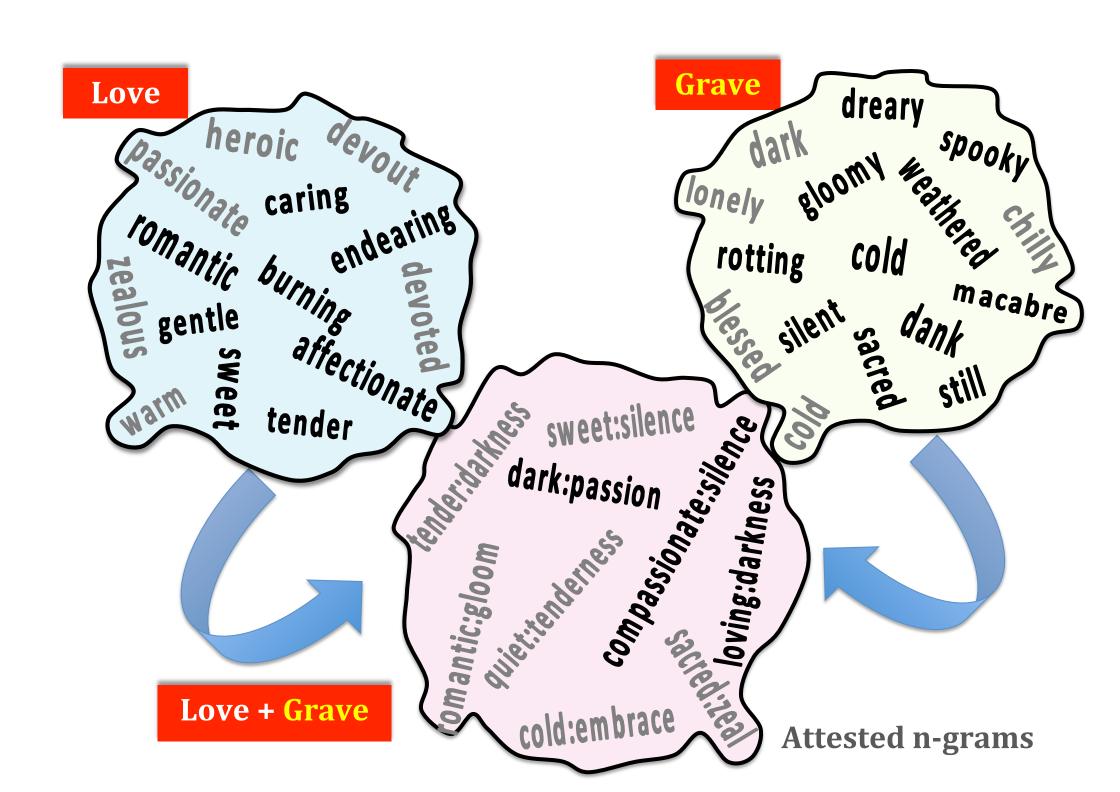
childish:zeal,

doglike:devotion,

heroic:devotion, childlike:adoration,

childlike:tenderness, childlike:affection, fannish:devotion,

motherly:sweetness, brotherly:devotion, childish:tenderness,



## Metaphor Blend View for love as dreary:grave

**Projected Qualities** 

**Emergent Qualities** 

**Thunderstorm** 

dreary:gloom, sacred:sanctity, dreary:darkness, dark:chill,

still:quietness, quiet:darkness,

blessed:darkness, quiet:chill, dreary:stillness, blessed:stillness,

sacred:stillness, quiet:stillness, quiet:gloom,

## dark:gloom, dreary:chill,

still:gloom, quiet:holiness, still:darkness, quiet:sanctity,

sacred:darkness, **Still:Chill**, blessed:quietness, dark:stillness, sacred:gloom,

romantic:silence, sweet:silence,

romantic:darkness,

transcendent:holiness, sweet:grave,

compassionate:silence,

quiet:passion, sacred:zeal, loving:darkness,

tark:love, consecrated:zeal, romantic:gloom,

quiet:tenderness, quiet:gentleness, consecrated:devotion,

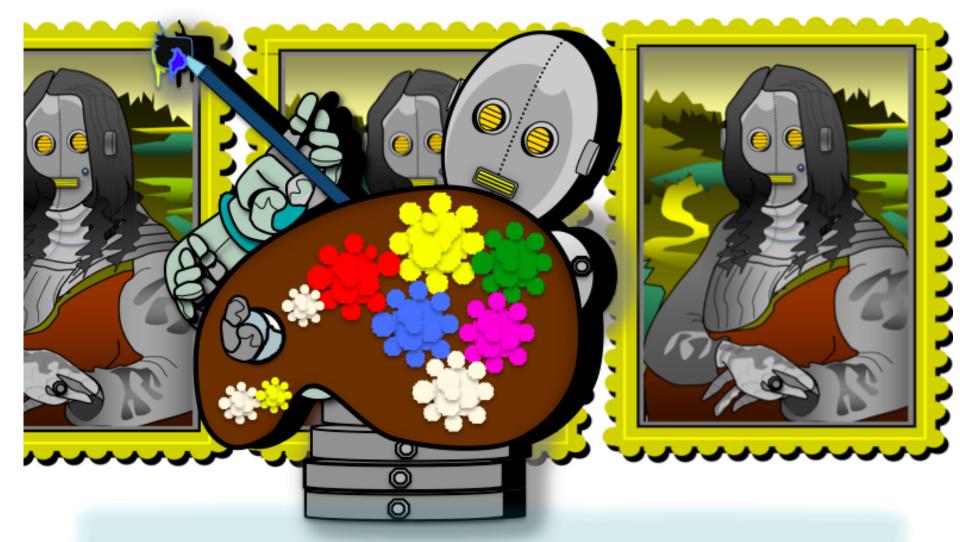
gentle:silence, dark:passion,

dark:sweetness, dark:embrace,

tender:darkness, cold:embrace,

loving:silence,

Sigh



PACKAGING, FRAMING and DELIVERY

## The "Stereotrope" Approach to Poetry

No Fire Is More Overwhelmingly Hot

**Superlative** 

My love is a tender fire

Metaphor

No fireplace glows more warmly, or blazes more brightly

Depress me with the transcendent spirit of your fire

Norm, Q

Let your luminous brightness dazzle me -

**Feeling** 

Was ever a spark emitted by a more alarmingly dangerous fire?

You burn for me as brightly as any gleaming torch

Manner

Does any fire rise more dangerously than this love?

Simile

See how you glow for me with your overwhelming brightness

O Love, you warm me with your surging attack

## What Next? Poetic insights and "Familiar Surprises"

*Insight Generation Services* find noteworthy "surprises" in knowledge, and feed these to poetry generation services.

E.g., *incongruities* and *oppositions* in everyday knowledge

Disciplined armies defend undisciplined civilians

Fragrant gardens often contain smelly weeds

Straight arrows are fired from curved bows

Dragons live in chilling dungeons but breathe warming fire

Immoral wars are conducted by moral ministers

## No Religion Is More Religiously Spiritual

My science is a systematic religion

Formalized doctrines do sciences create, and by blessed scientific leaders are

these doctrines promoted

No monk is more dogmatically religious, or nags so much
Challenge me with the defined mission of your religion
Let your standardized qualification attract me
Was ever a philosophy followed by a more absolutely inclusive religion?
How you liberate me so absolutely,

like any revelatory religion

Is any religion more spiritual than this science?

You spiritually liberate me with your blessed revelations

Just as the most spiritual disciples serve the most religious saints, the most spiritual religions are defended by the most religious believers

Can charismatic gurus ever promote religions of boring rituals?

O Science, you help me with your defensible philosophies

## **No Grave Is More Beautifully Quiet**

In desecrated cemeteries is love found
The most silent lamb is not more quietly tender
Heal me with this sacred sweetness
Let your consecrated devotion inspire me
Did ever a ghost haunt a more silently still grave?
How you molder me, like a quietly rotting grave
Does any grave rot more quietly than this love?
You rot me with your quiet silence

Just as the darkest bats live in the gloomiest caverns, the darkest graves contain the gloomiest tombs

Why would a grave of winning veterans be haunted by vanquished kings?

However, how does a gnarled veteran become a handsome king?

O Love, you depress me with this transcendent sanctity

## **No Giant Is More Incredibly Massive**

Impress me with this magnificent leadership The most undisputed rule scarcely reigns so much Excite me with this visible strength Let your powerful impacts haunt me Does any giant bulge more incredibly than this Microsoft? You devour me as hungrily as any huge whale Does any giant expand more hugely than this Microsoft? You frighten me with your incredible hulks Immense heights do tiny giants so rarely reach What if fewer tsars were deposed? Would more palaces be occupied by dominating tsars, and would more dominating authoritarians live in these palaces? Yet would anyone prefer to live in palaces that are occupied by toppled giants rather than by crowned tsars?

O Microsoft, you menace me with this enormous battle

