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Requirements Engineering as Information Search and Idea Discovery

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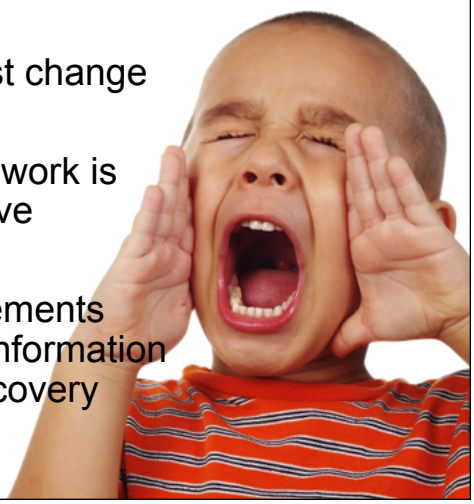
Some Scene-Setting

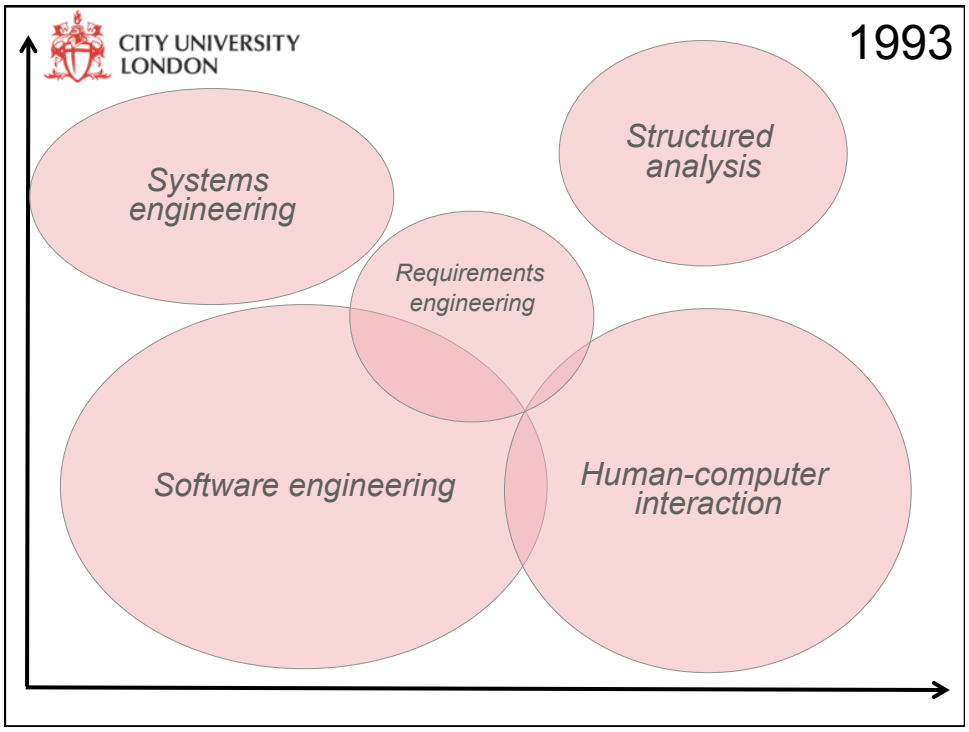
Requirement work is changing

Theories and tools must change

Modern requirements work is inherently creative

Convince that requirements engineering as creative information search and idea discovery

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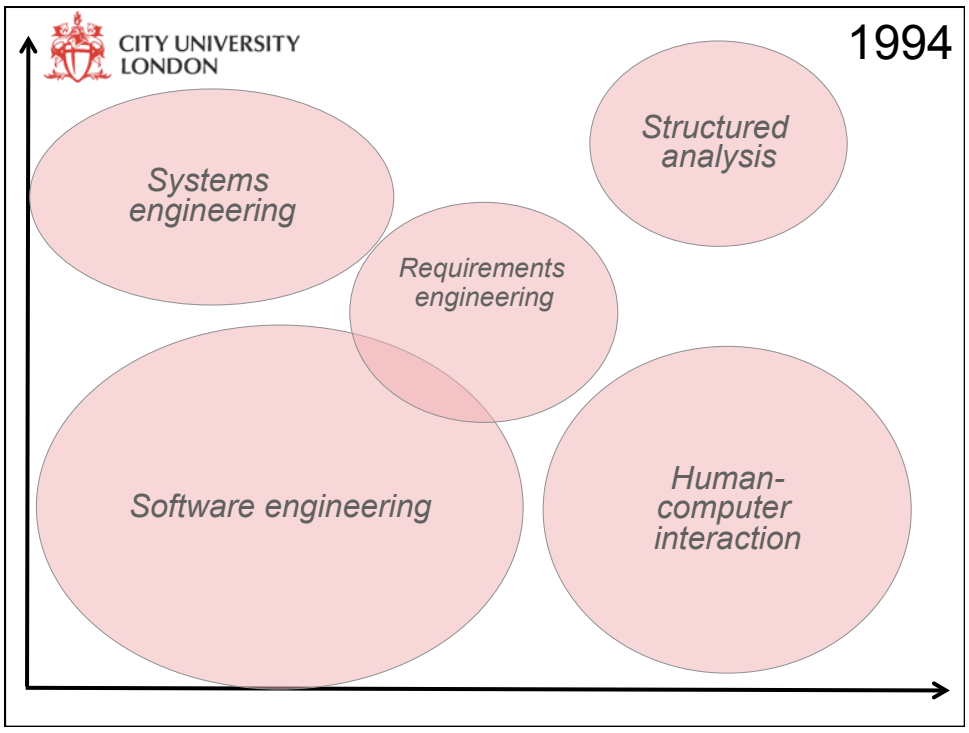
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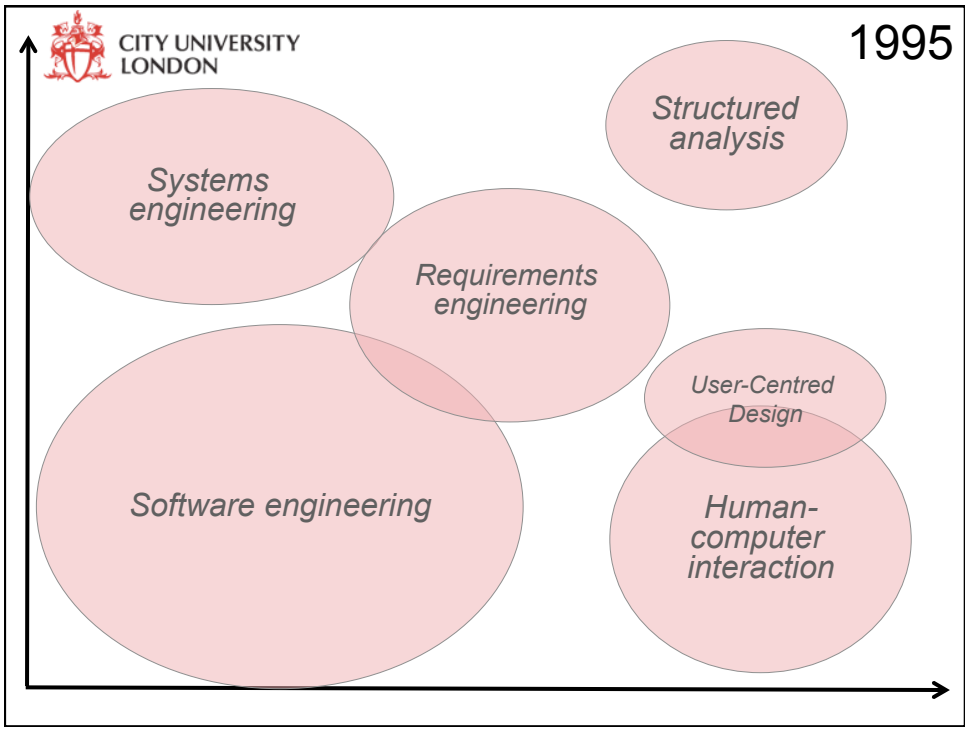
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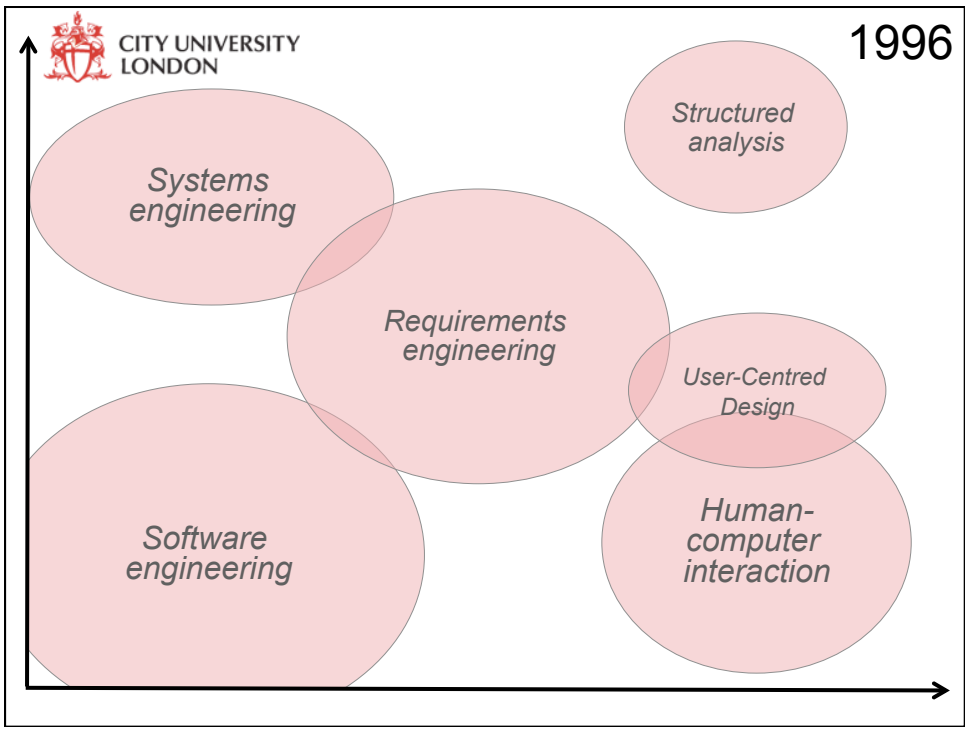
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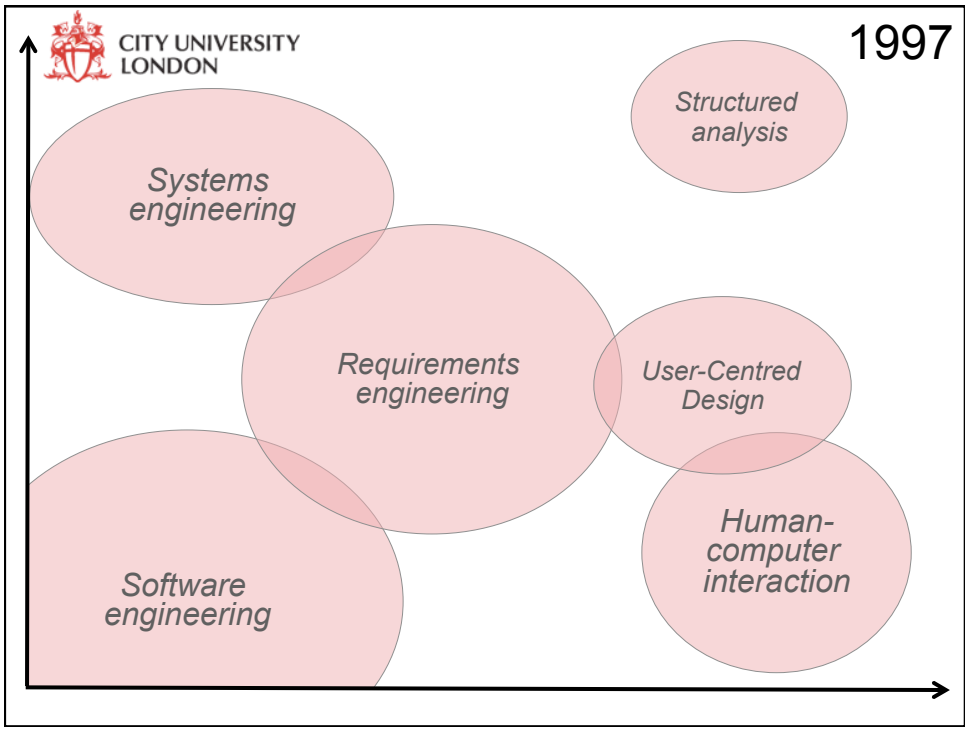
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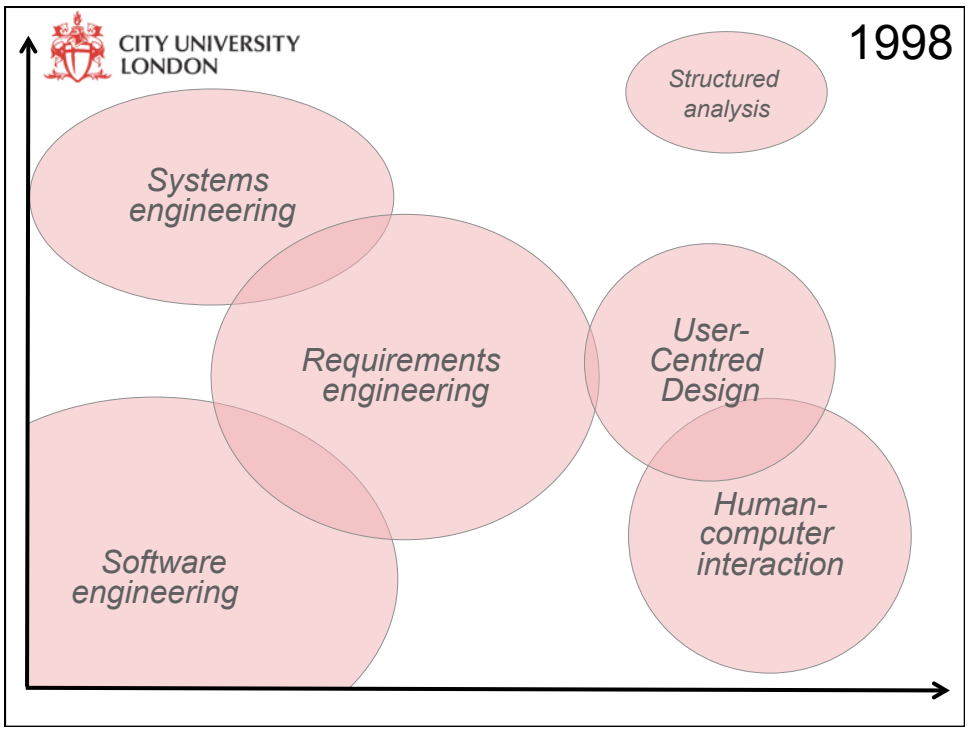
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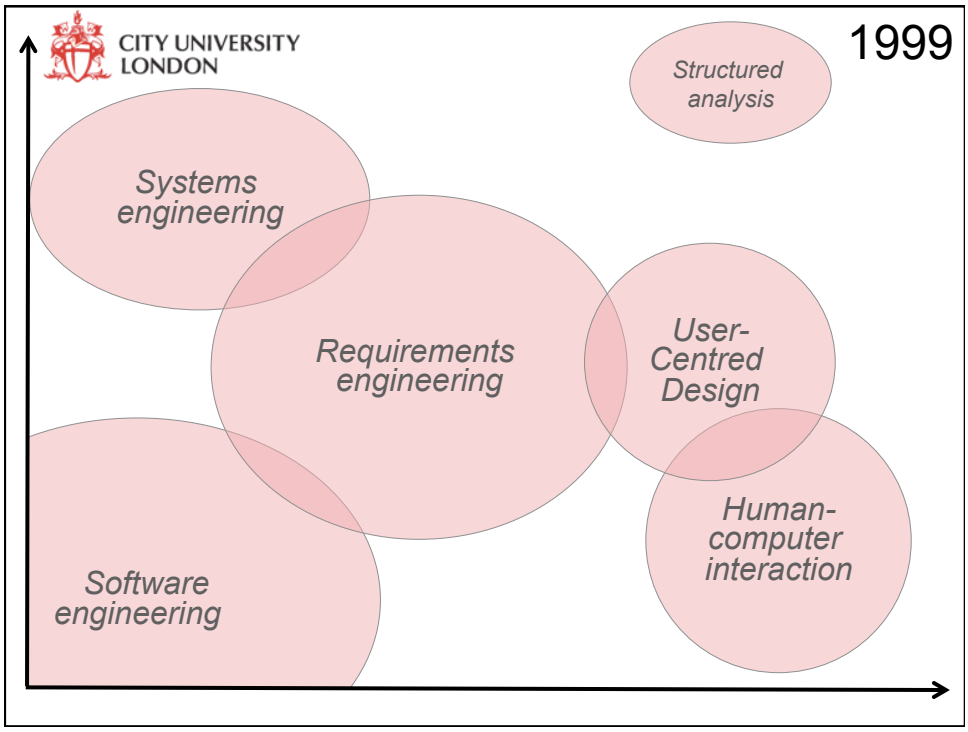
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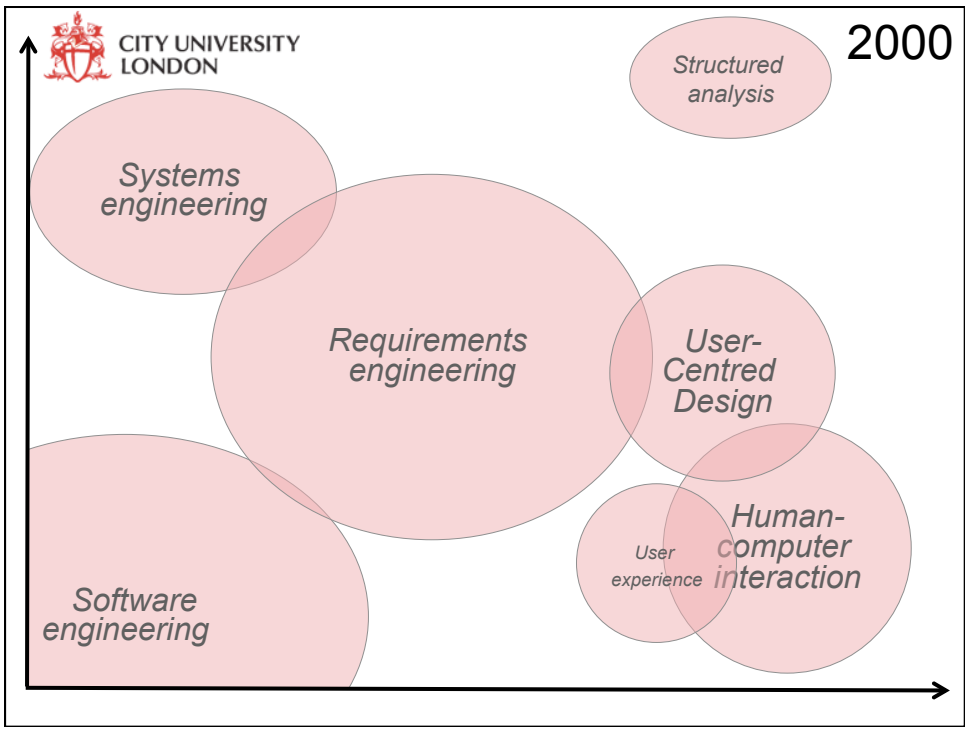
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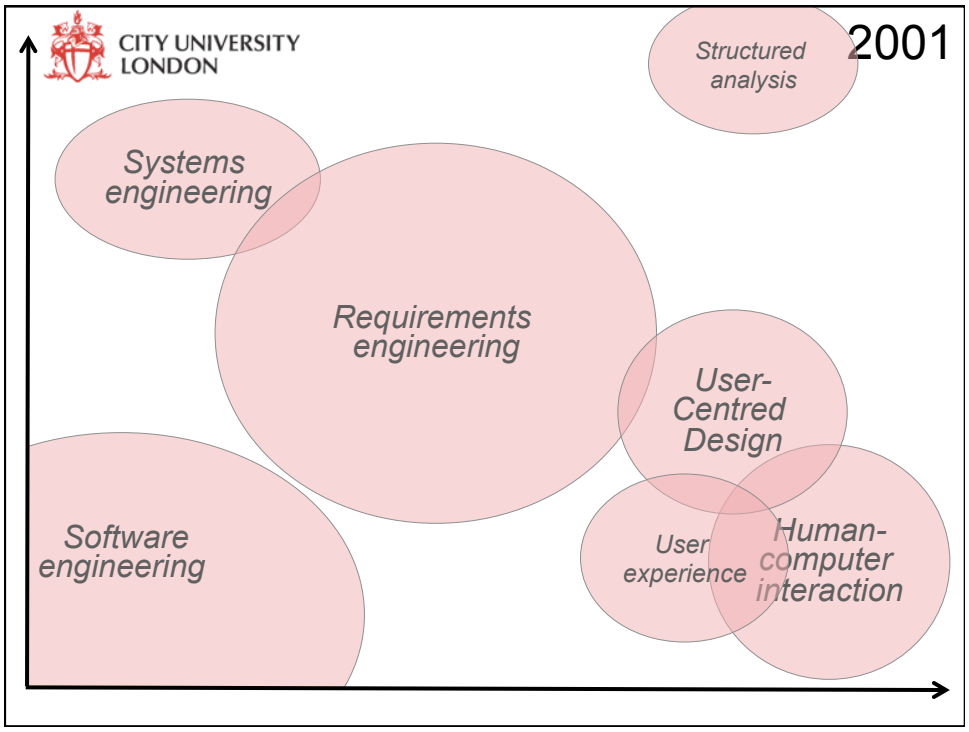
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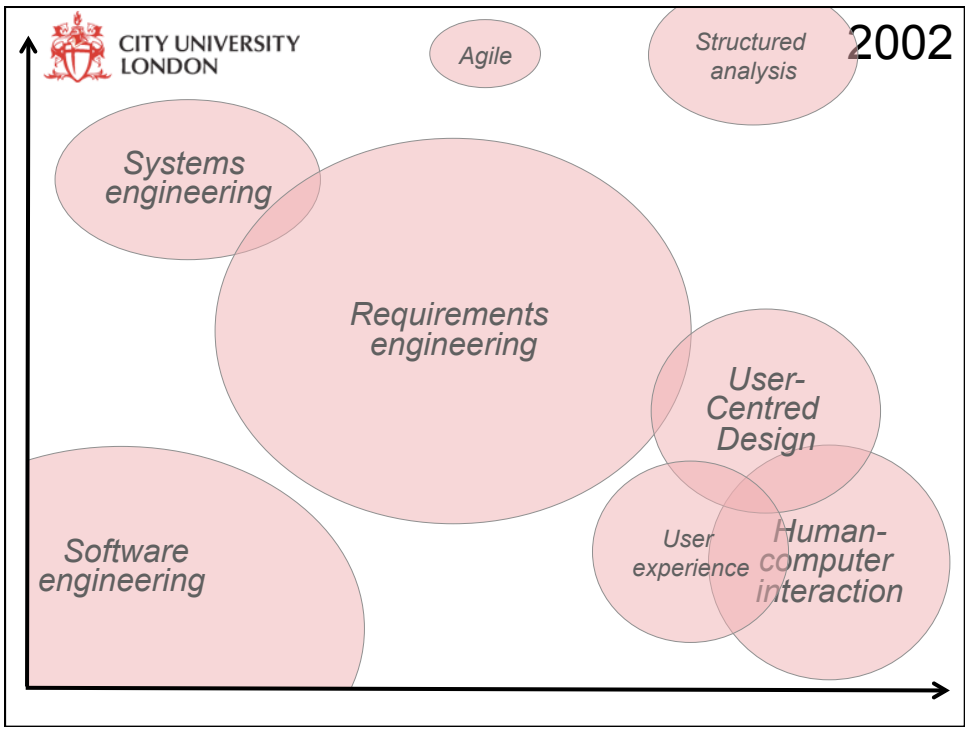
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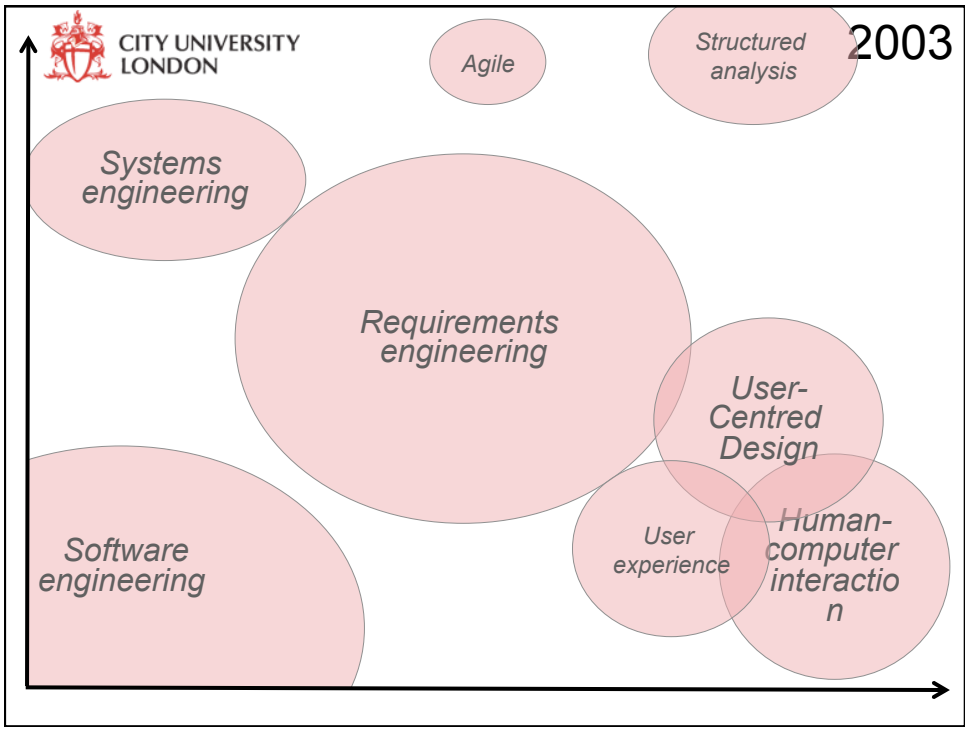
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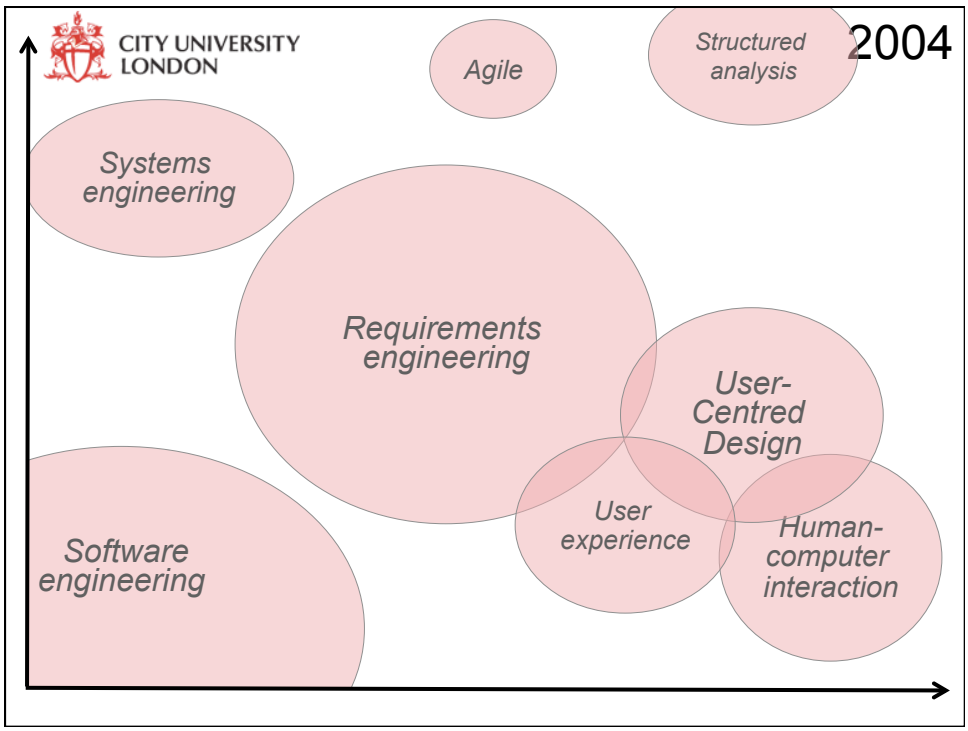
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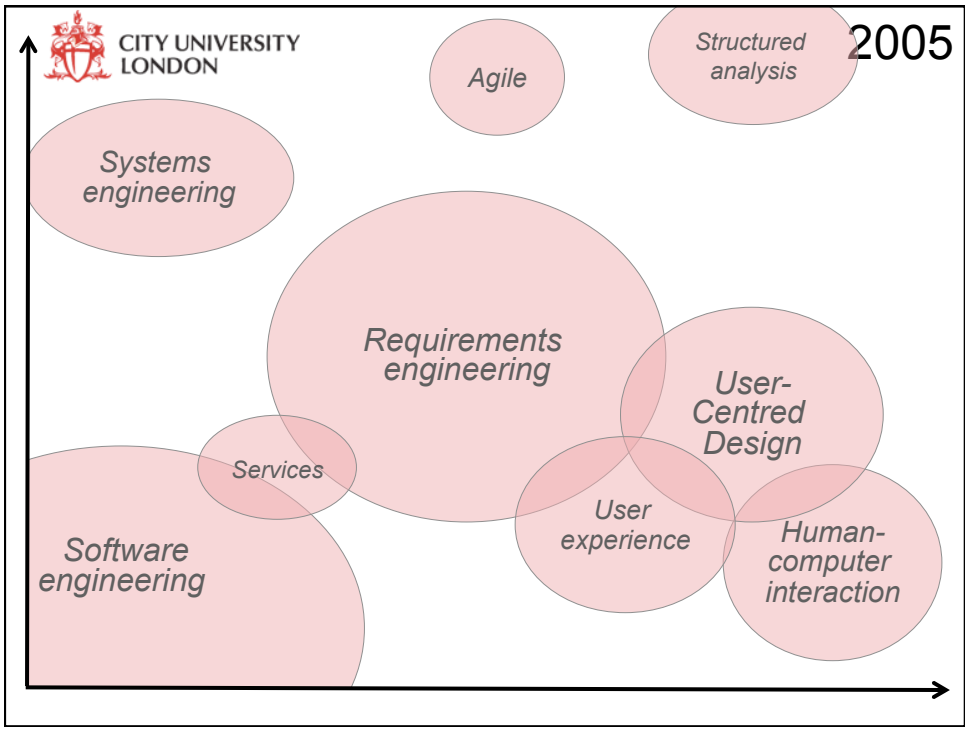
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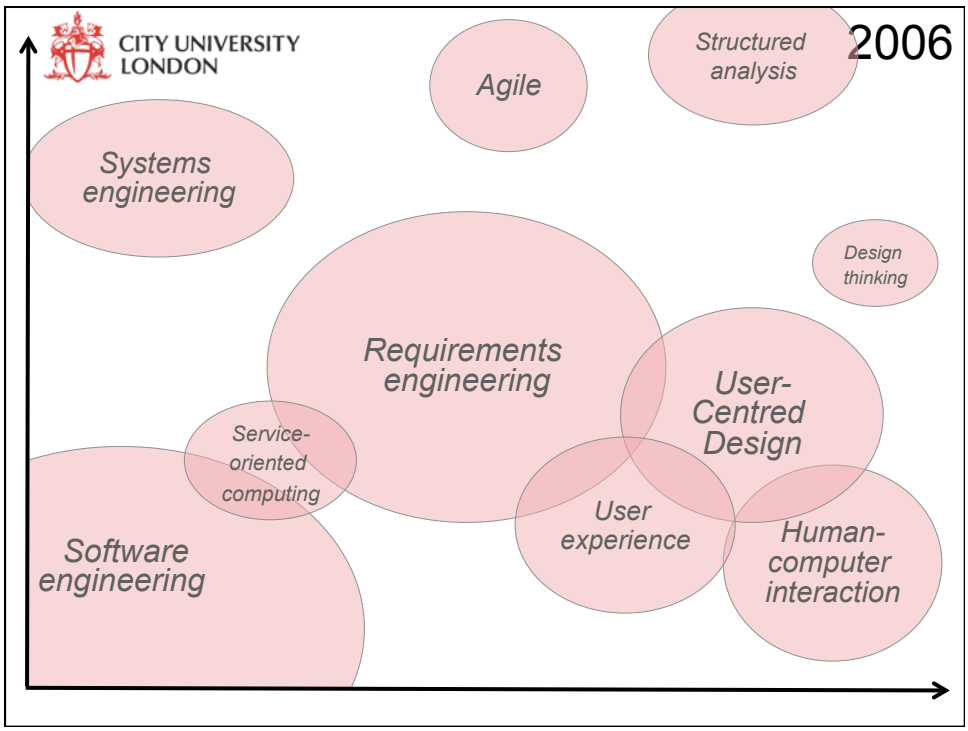
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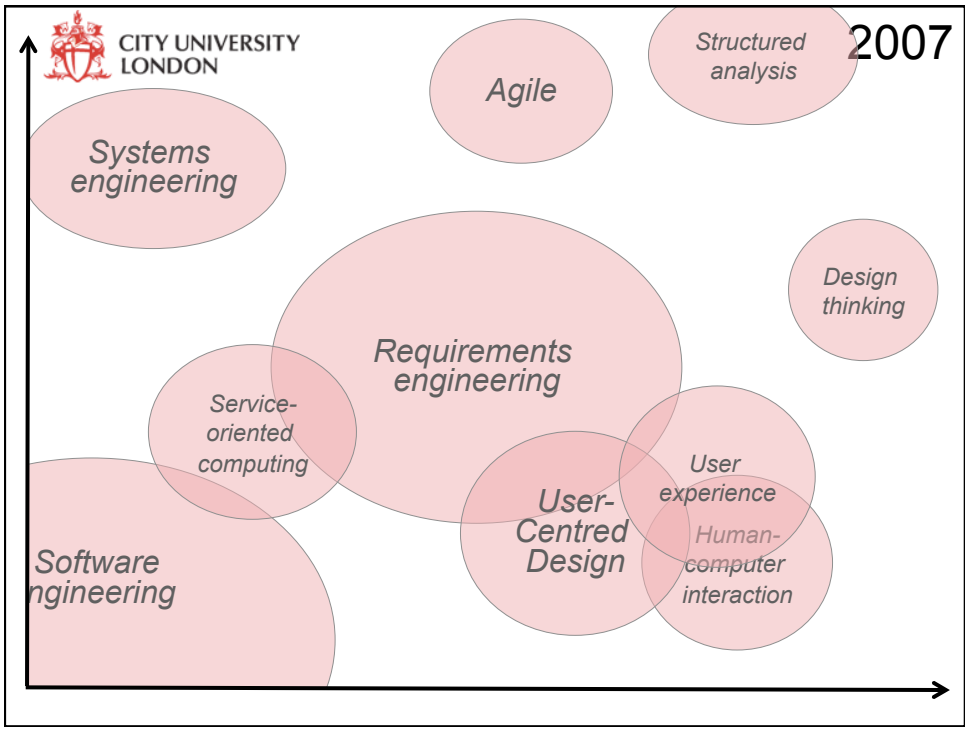
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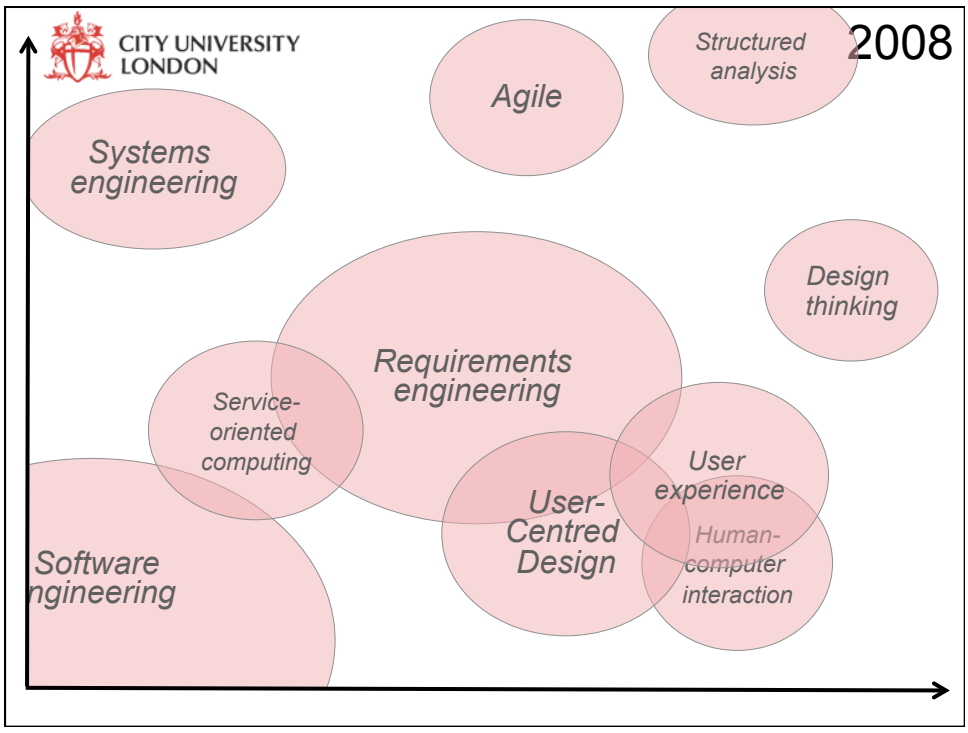
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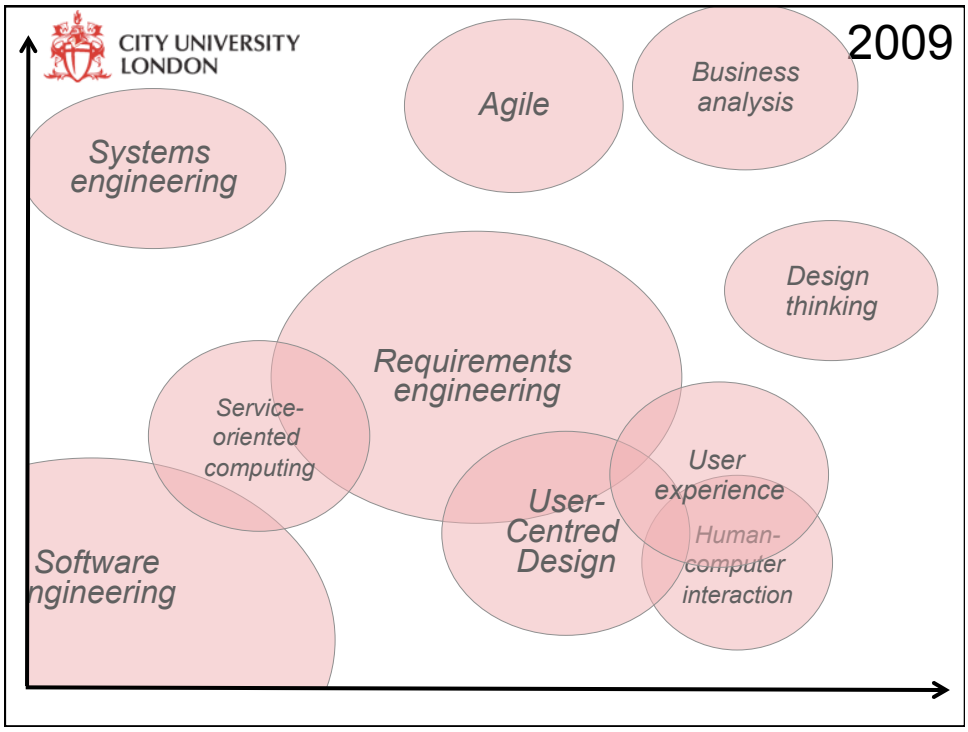
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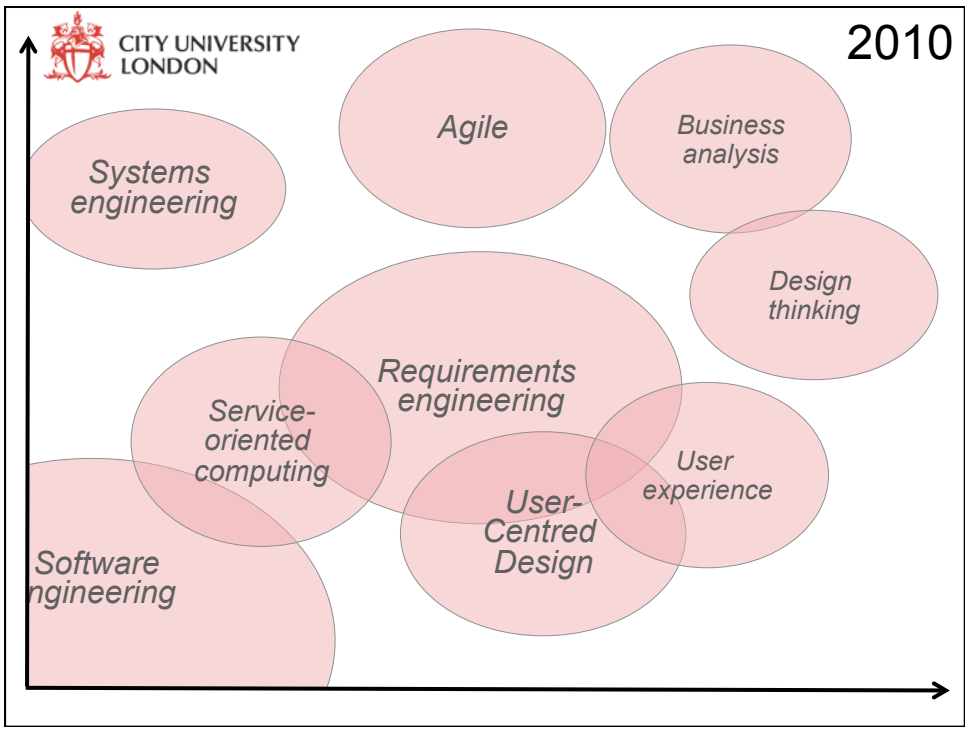
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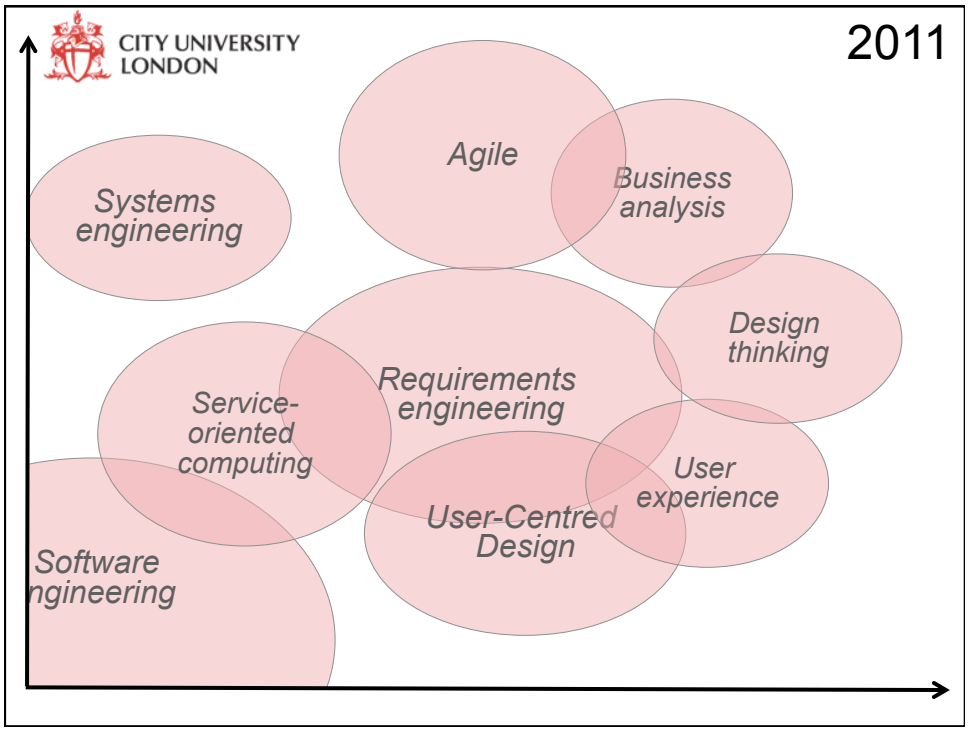
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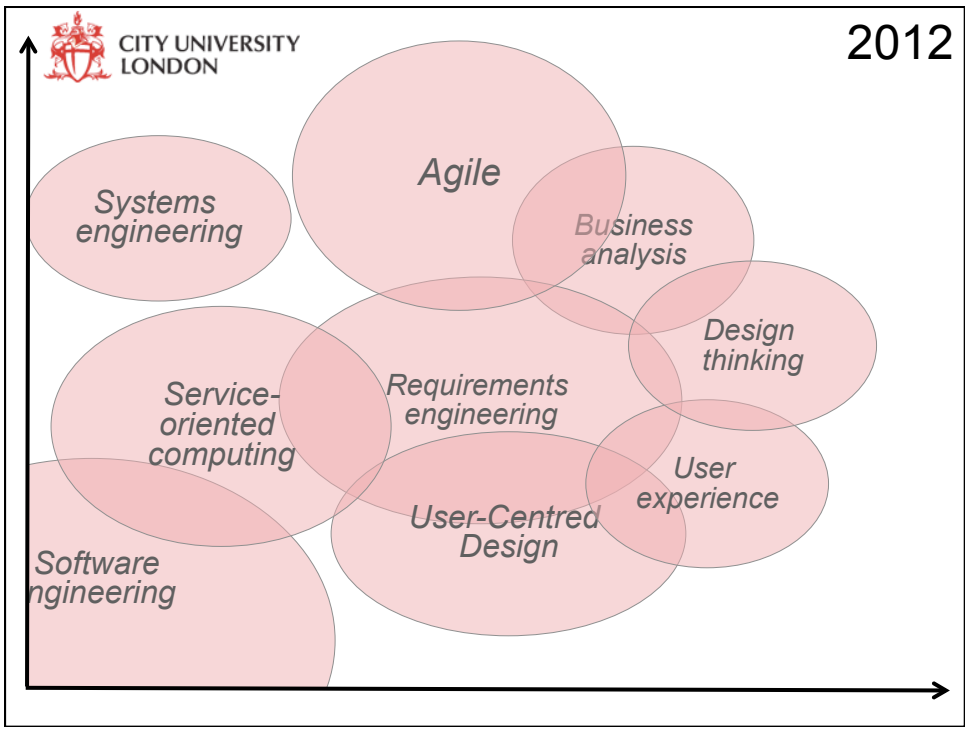
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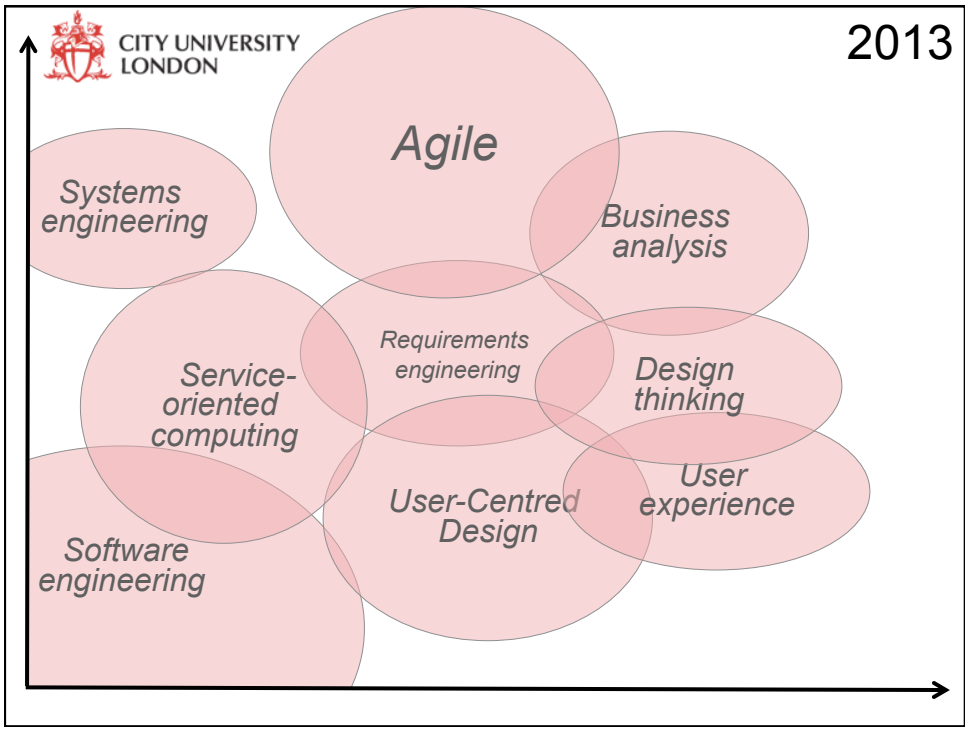
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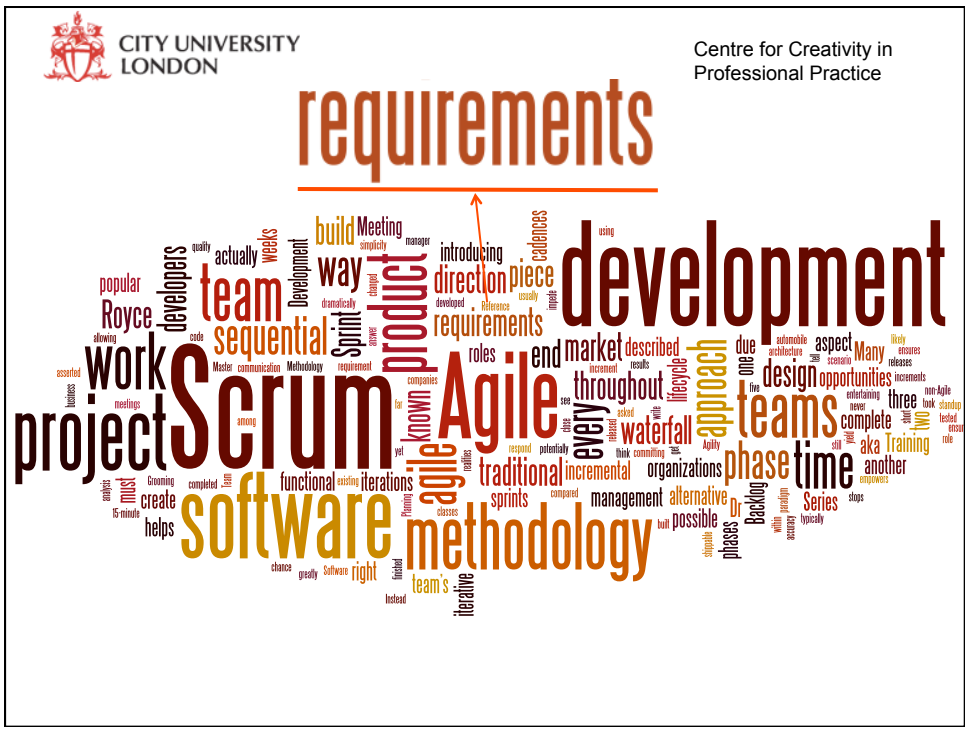
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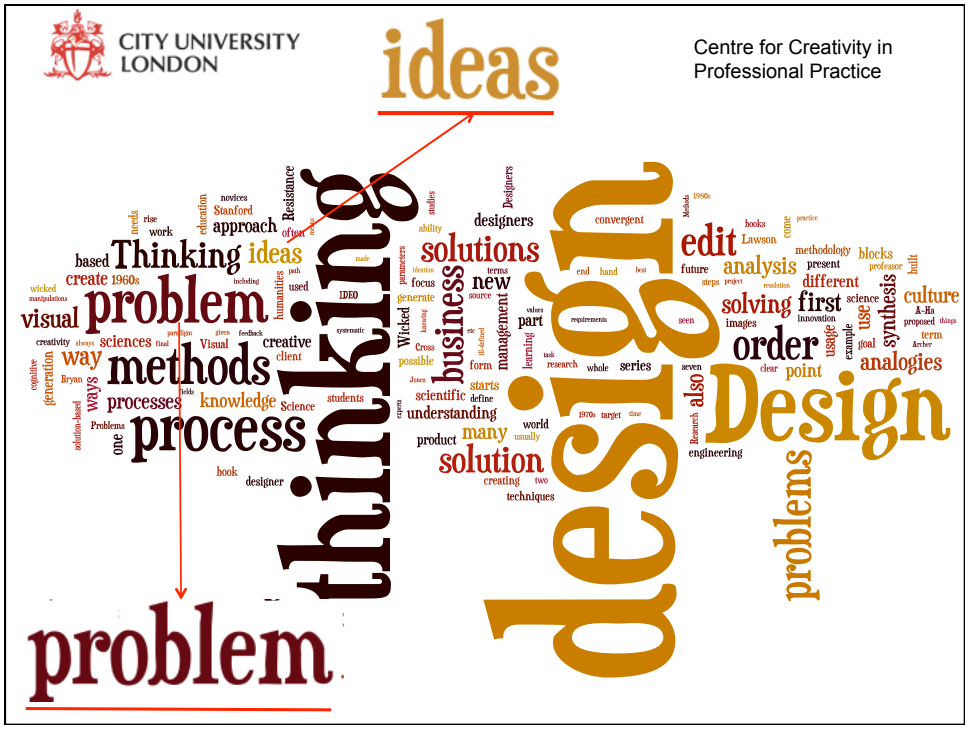

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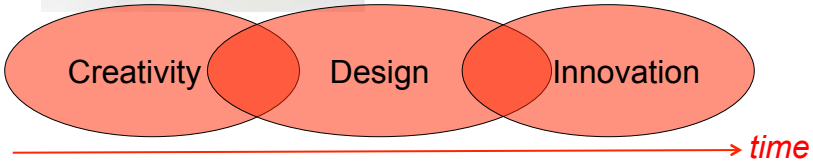
Design Practice in 2013

UK Design Council

- Design shapes ideas to become practical and attractive propositions for users or customers. Design may be described as creativity deployed to a specific end
- Design includes software design



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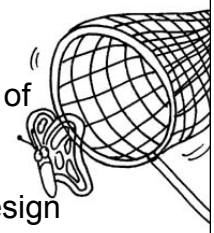
The Reality about Requirements



Accept that

- Elicited requirements limited by perceptions of what is possible
- Customers are frequently rear-view mirrors
- People don't separate requirements from design

Requirements encapsulate creative thought

- Stakeholders already thinking about future

Denys Lasdun

- "*Our job is to give the client, on time and on cost, not what he wants, but what he never dreamed he wanted; and when he gets it, he recognizes it as something he wanted all the time*"

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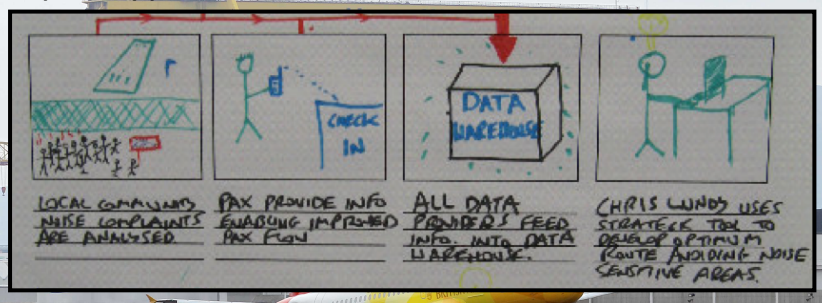
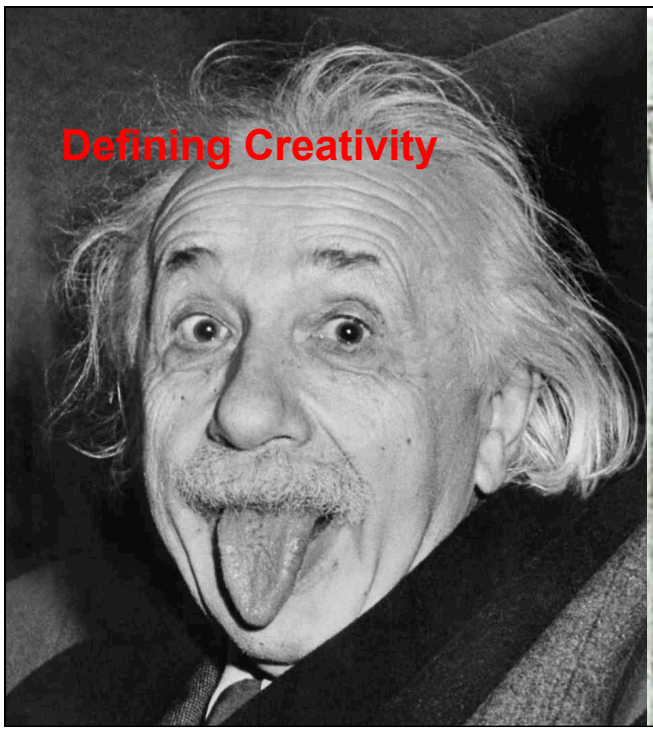
A Real-World Example

Removed key constraint: weather variability

Steam catapults; glided approaches; weather-adapted approach routes



.. not what they wanted, but what they never dreamed they wanted..



Defining Creativity

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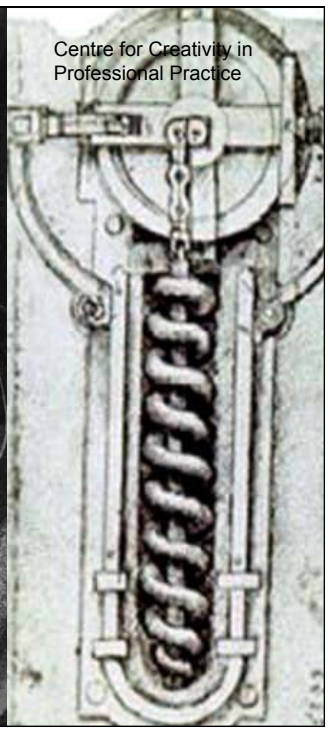

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A Prototypical Definition of Creativity

Sternberg and Lubart (1999) define creativity as

- *"the ability to produce work that is both novel (i.e. original, unexpected) and appropriate (i.e. useful, adapted to task constraints)"*

Novel with respect to

- H-Creativity: historically creative – new to person-kind (Boden 1990)
- P-Creativity: psychological creative – new to the person, but not to person-kind or others (Boden 1990)
- S-Creativity: situated creativity – a designer or reasoner had an idea for a specific task novel in that particular situation or domain (Suwa et al. 2000)

Engenders surprise

- Deviation in patterns of outcomes (Maher et al. 2013)

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Structuralist Creativity

Information processing

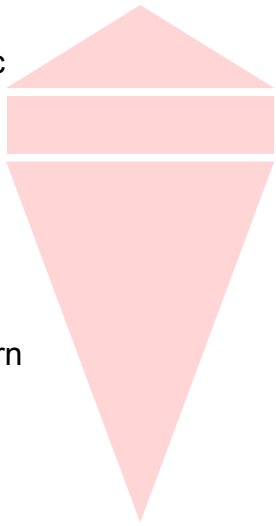
- Exhaustive, structured and systematic search of divergent and convergent spaces
- Idea and concept generation are both directed and deliberate (Plsek 1997)

CPS Method

- Six stages: *mess finding, data finding, problem finding, idea finding, solution finding and acceptance finding* (Osborn & Parnes 1953)

Digital technologies shift focus from

- Information search to human-centred creative cognition (Kerne et al. 2008)



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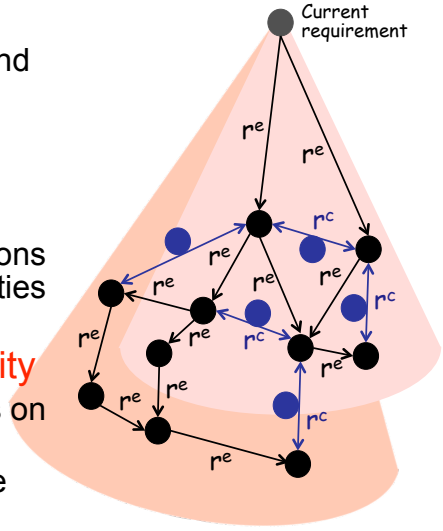
Boden (1990) Categories of Creativity

1. Exploratory creativity
   - Search space of partial and complete possibilities
   - Rules exist to enable traversal of search space
2. Combinational creativity
   - Make unfamiliar connections between familiar possibilities in the search space
3. Transformational creativity
   - Challenge the constraints on the search space
   - Enlarge space of possible ideas to explore



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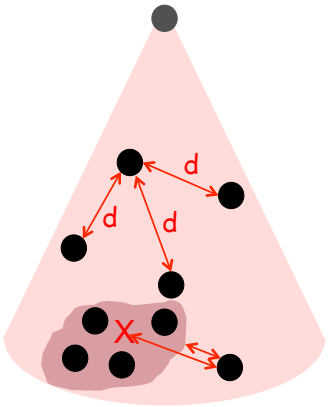
Defining Novelty

Core to creativity research

- Ritchie (2001) specified formal criteria for creative behaviour of software programs
- Measures *dissimilarity* to existing domain examples
- Shortest distance to closest centroid, longest distance to centre (Maher & Fisher 2008)
- Exploit requirements similarity matching engines – computed dissimilarities in analogical matches (Zachos et al. 2008)



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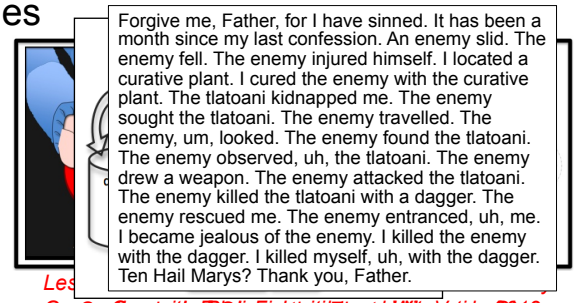
Emergence of Computational Creativity

To replicate human-level creativity using computers

- Digital visual art, poetry, stories, music, metaphors …

Examples



Imagine machines that generate creative requirements that we never dreamed we wanted…

Characteristics of requirements work

- Structured search of changing spaces
- Generate novel and useful outcomes
- Practical propositions for users or customers
- Sometimes surprised by outcomes
- Can be machine-led

Requirements work can be framed as creative

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Five Requirements Techniques

1. Facilitated workshops
2. Analyzing emergent system properties
3. KAOS obstacle analysis
4. Requirements-based product configurations within constraints
5. Model checking requirements specifications in TROPOS

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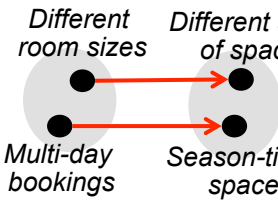
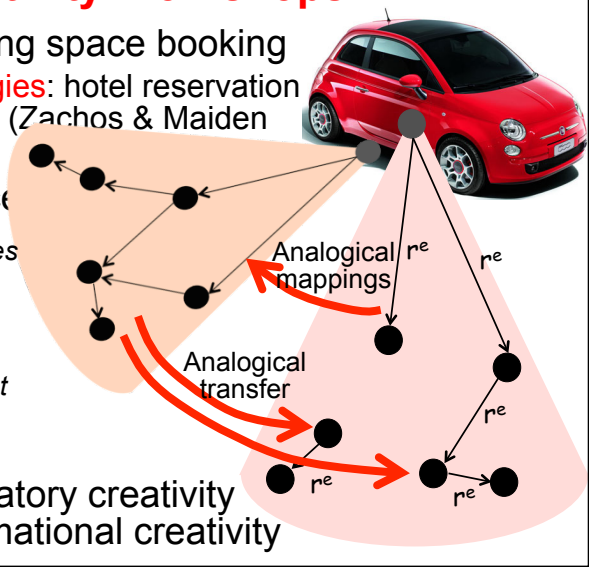
Facilitated Creativity Workshops

Fiat real-time parking space booking

- Retrieved analogies: hotel reservation web applications (Zachos & Maiden 2008)

Analogical inference





Exploratory creativity
Transformational creativity

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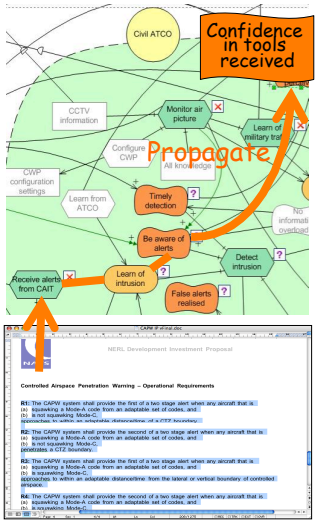
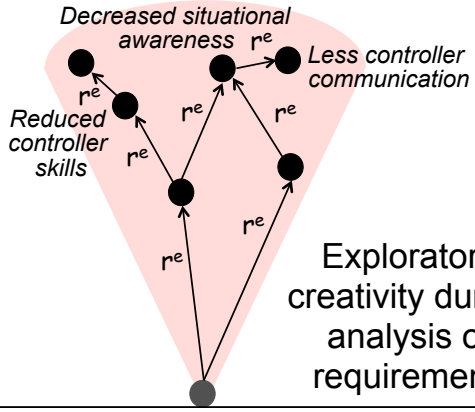
Analyzing Emergent System Properties



Emergent qualities of system from new software requirements

– (Maiden et al 2007)



Exploratory creativity during analysis of requirements

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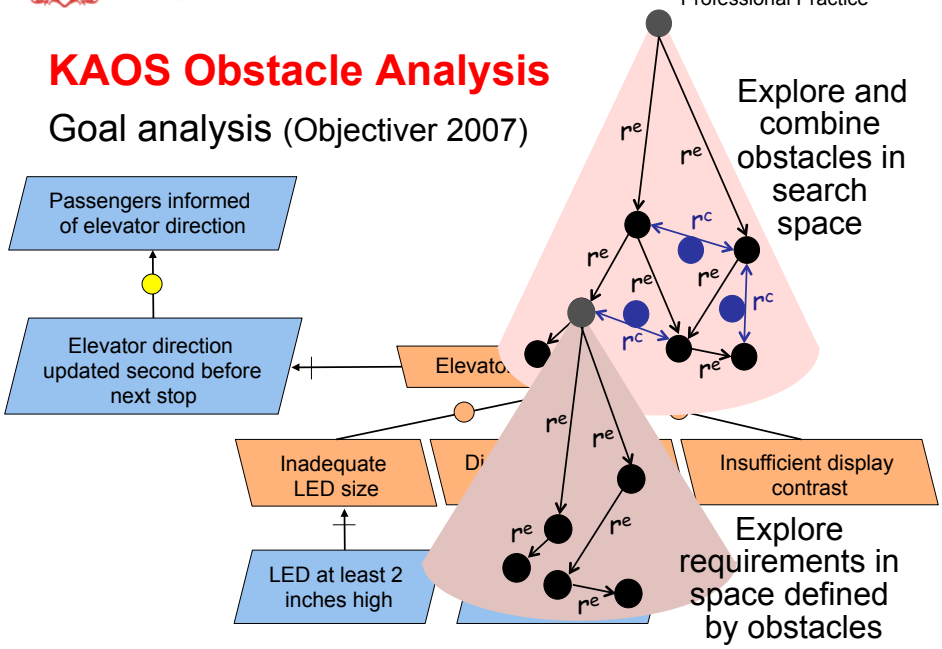
KAOS Obstacle Analysis

Goal analysis (Objectiver 2007)



Explore and combine obstacles in search space

Explore requirements in space defined by obstacles

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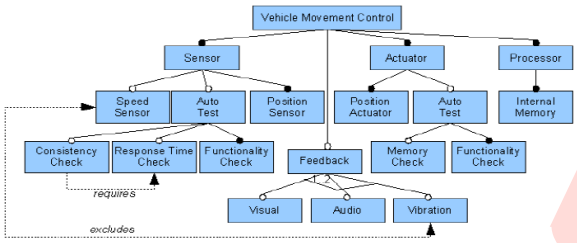
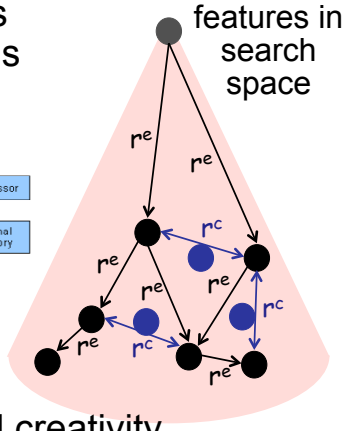
Requirements-Based Product Configurations within Constraints

Discover permitted combinations of different product configurations

– Salenisi et al. (2010)



Combine features in search space



Combinational creativity

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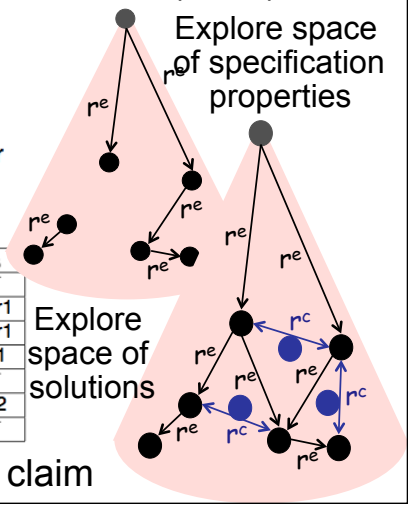
Model Checking Requirement Specifications

i*/TROPOS specification (Fuxman et al. (2001)

Avoid unreasonable claims

Dependency CoverDamages
Fulfillment
assertion condition for dependee
cl.car.runsOK → ∃rep : RepairCar
(rep.cl = cl ∧ **Fulfilled**(rep))

Explore space of specification properties

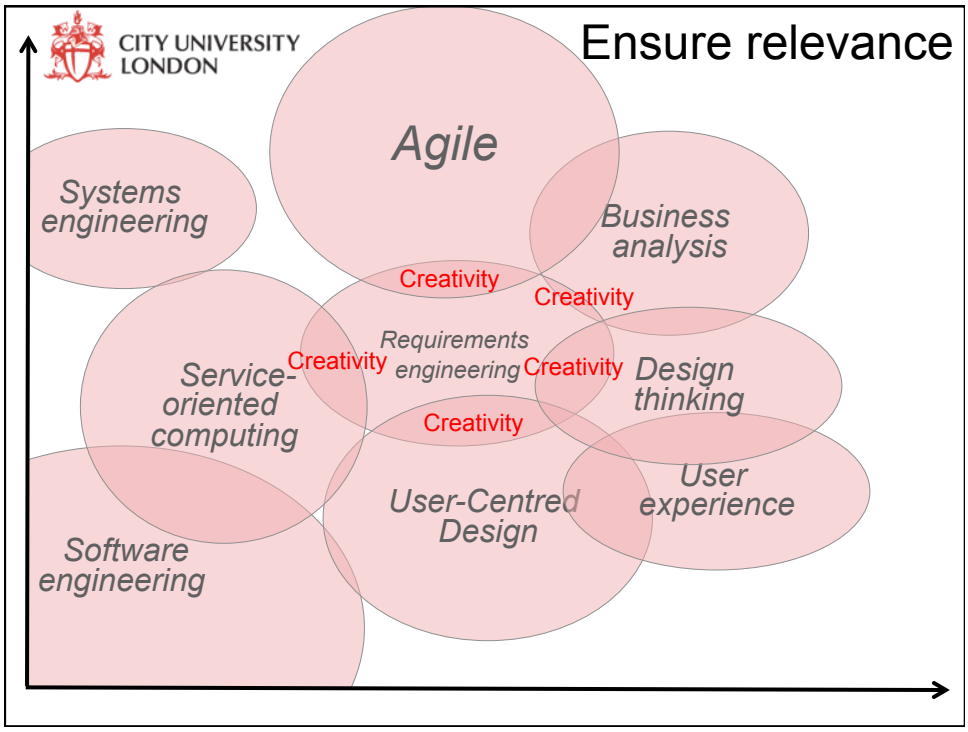


Generates counter-examples

	t_1	t_2	t_3	t_4	t_5
car1.runsOK	⊤	⊥	⊥	⊤	⊤
cl1.car		car1	car1	car1	car1
cl2.car		car1	car1	car1	car1
cov1.cl		cl1	cl1	cl1	cl1
Fulfilled(cov1)		⊥	⊥	⊥	⊤
rep1.cl			cl2	cl2	cl2
Fulfilled(rep1)			⊥	⊤	⊤

Explore space of solutions

One solution– to repair before claim



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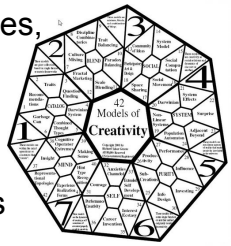
BEFOCUS

"Creatify" Your Requirements Work

Reframe as creative information search and idea discovery

- Structured search of spaces of requirements, emergent qualities, obstacles, configurations, specification properties
- Generates novel and useful outcomes that surprise
- Practical propositions for users



Encourage you to exploit

- Creativity theories and models
- Wide range of creativity support tools
- New types of computational creativity capability

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Remember……

Creativity is

- A macro-economic driver for growth
- Needed by businesses
- Funded by governments
- Available to help from requirements work

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