

Pasteur's Quadrant & The Science of Design

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Research is inspired by:

Considerations of use?

No

Yes

Yes

**Pure basic
research
(Bohr)**

**Use-inspired
basic research
(Pasteur)**

**Quest for
fundamental
understanding?**

No

**Pure applied
research
(Edison)**

I like this paper because it shifts our focus from research itself to research on research. -ZIYAN ZHU

From your commentaries

“Each of the three quadrants? But there are four? [...] Pure basic research would be of that which is reporting on physiological phenomena, like eye tracking against visual stimuli because it is insightful about how our bodies work but not necessarily explicitly applicable or useful in an applied sense.” - Steven Rick

“Example for Edison's quadrant : Placement of items in a supermarket. Once, Walmart decided to combine the data from its loyalty card system with that from its point of sale systems.” -Srishty Agrawal

“Use-inspired basic research: Human Factors Engineering: dedicated to understanding cognition and the human condition while creating interfaces, technology and policy directly affecting needs of humans” - Jasmine Roberts

Characterizing research ex ante or ex post.

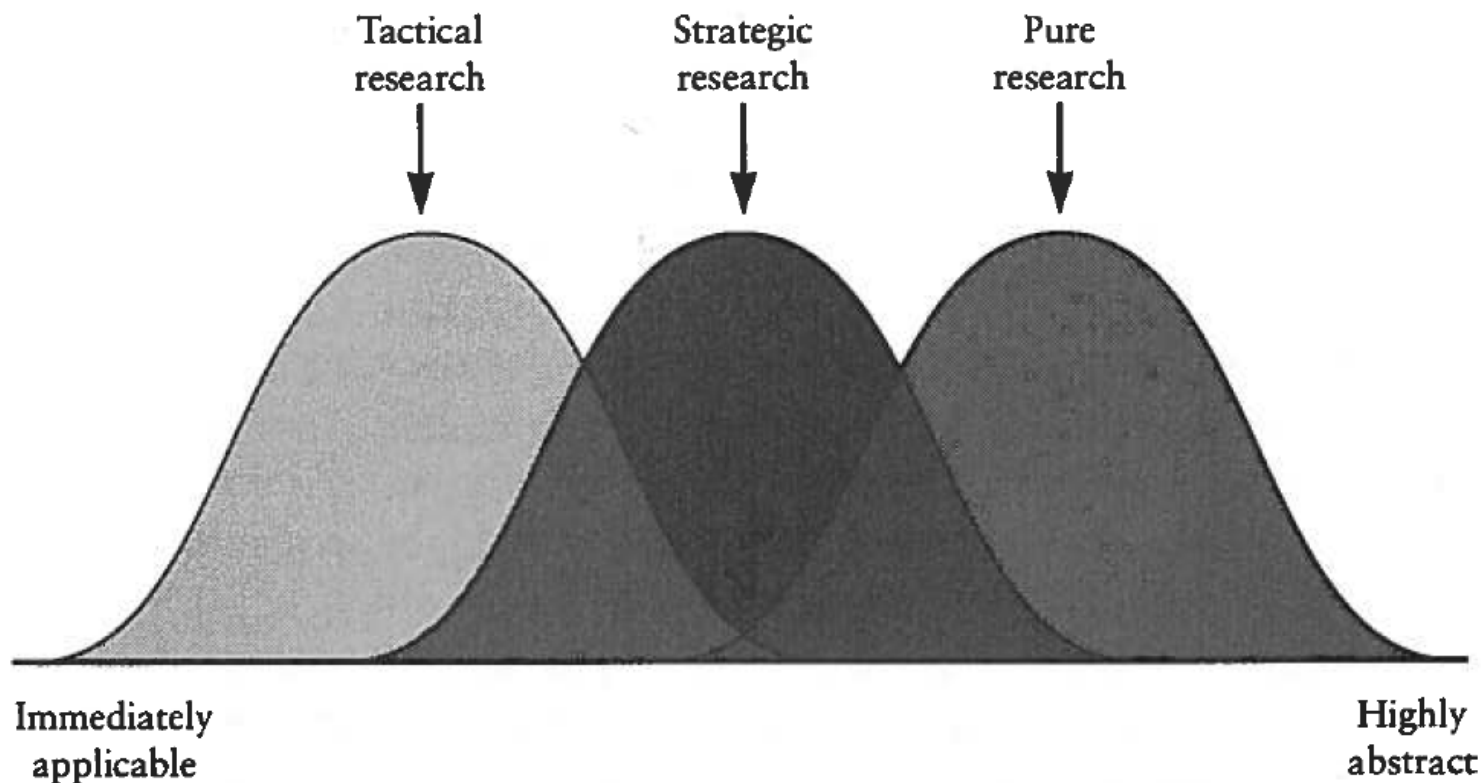
Activity

How did Stokes think research should be classified? Ex ante or ex post? What was his justification?

Whose goals are to be consulted?

Can the two dimensions be reduced to one?

Figure 3-6. *Australian Modification of Linear Model*



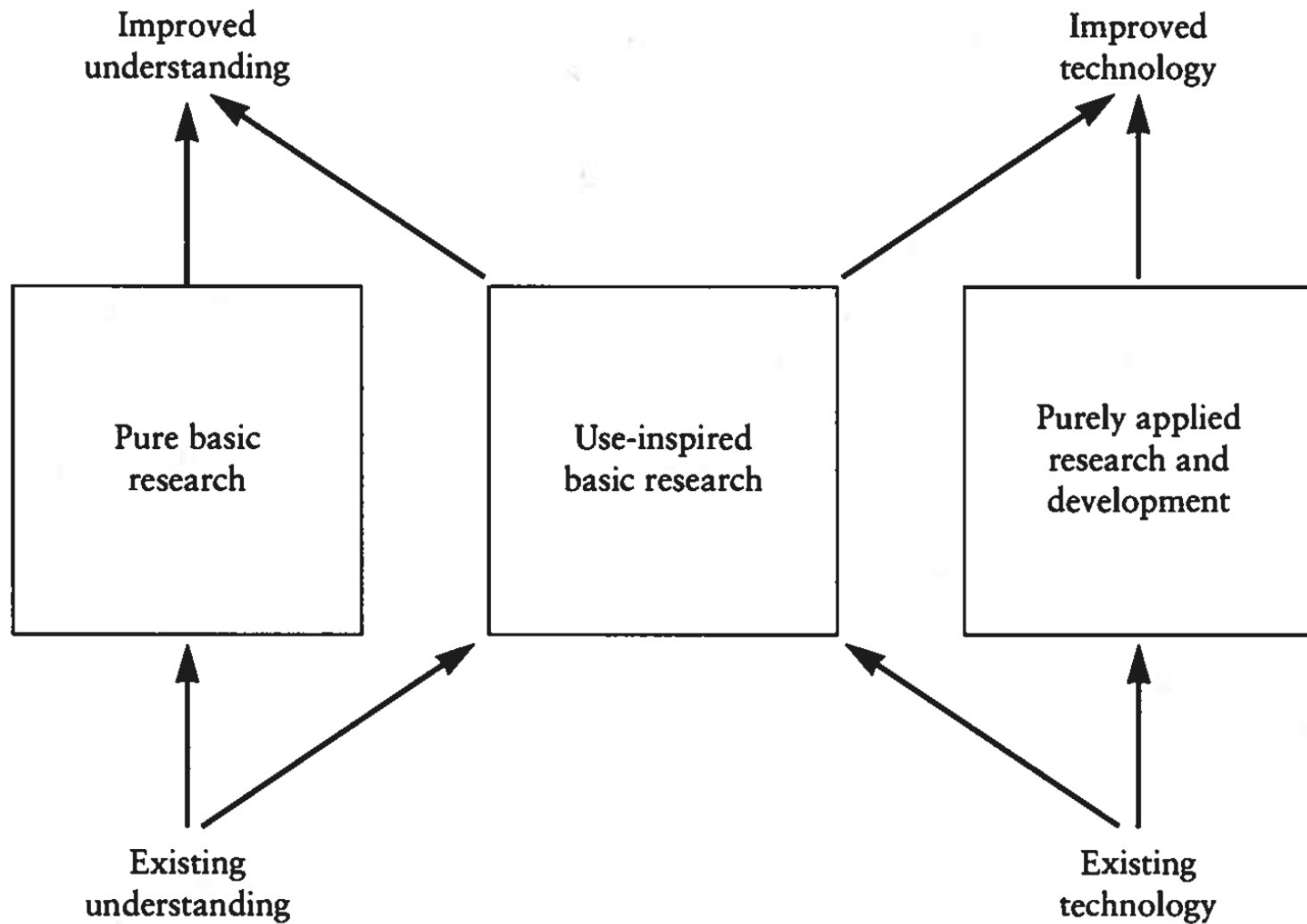
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Time to application.

Rethinking the Dynamic Paradigm

To replace the linear model of the postwar paradigm, we need a clearer understanding of the links between the dual but semiautonomous trajectories of basic scientific understanding and technological know-how.

“His last diagram (Figure 3-7) is a great view on how research is conducted today (in my mind) and provides a more holistic picture. I wished he had spent more time discussing the interplay between these forces and perhaps provide some opinion on the matter.” -VINCENT CHAN



Implications for Policy

Activity

If you were the US government, what proportion of research funding would you direct into each of the quadrants? Fill out the quadrants and convince your neighbor that you are a better fake government than them.

—Agendas of use-inspired basic research can be built only by bringing together informed judgments of research promise and societal need.

Activity

Develop your own way of classifying research. Why is your system better than any of the representations discussed by Stokes?

(2-3 minutes)

Summary

Research should be classified in an appropriately high dimensional space.

Research goals not results should drive this classification.

Scientific knowledge and technological advances interact with the quadrants to guide the direction of research.

Iterate the representation of research until it leads to the desired outcome: better policy decisions.

The Science of Design

Activity

In what ways is the Science of Design an accurate representation of your design process? How is it different?

(2-3 minutes)

A formalised view of design

“... academic respectability calls for subject matter that is intellectually tough, analytic, formalizable, and teachable. In the past much, if not most, of what we knew about design and the artificial sciences was intellectually soft, intuitive, informal and cookbooky.”

From your commentaries

- "One of the downsides of the paper was that it was very theoretical and lacked examples."
- "Downside of the paper is that is highly theoretical for the most part with few concrete examples that describe how to use some of the techniques described."
- "It talks about some really high-level ideas so that it seems quite difficult to understand."
- "This paper tasked my brain. What the author is trying to convey in this paper is a little obscure."

A formalised view of design

- Optimising vs satisficing
- Inner environment vs outer environment
- Possible worlds
- Allocation of resources for search
- The shape of design: hierarchy

Satisficing - from your commentaries

- “Dealing with the rule of diminishing returns, eventually a design alternative passes some satisfactory threshold and the problem would be considered complete.” - Vincent
- "Problems where there is a definite Yes/No solution, are not suitable for the approach suggested in the paper." - Srishty
- "For example, in the medical industry, many design decisions are made where people's lives are at stake. In such cases, it is crucial to expend the necessary resources to ensure the solution is optimized." - Yasmine

The diet problem: the inner environment?

<i>Command variables</i>	Quantities of foods
<i>Fixed parameters</i>	Prices of foods
	Nutritional content
<i>Constraints</i>	Nutritional requirements
<i>Utility function</i>	- Cost of diet

The diet problem: the inner environment

<i>Command variables</i>	Quantities of foods
<i>Fixed parameters</i>	Prices of foods
	Nutritional content
<i>Constraints</i>	Nutritional requirements
<i>Utility function</i>	- Cost of diet

The diet problem: possible worlds?

<i>Breakfast</i>	Eggs	Bacon
	Toast	Smoothie
<i>Lunch</i>	Salad	Granola bar
	Sandwich	Leftovers
<i>Dinner</i>	Pasta	Steak
	Burger	Burrito

The diet problem: 4^3 possible worlds

<i>Breakfast</i>	Eggs	Bacon
	Toast	Smoothie
<i>Lunch</i>	Salad	Granola bar
	Sandwich	Leftovers
<i>Dinner</i>	Pasta	Steak
	Burger	Burrito

Activity: the problem of choosing classes

<i>Command variables</i>	Quantities of foods
<i>Fixed parameters</i>	Prices of foods
	Nutritional content
<i>Constraints</i>	Nutritional requirements
<i>Utility function</i>	- Cost of diet

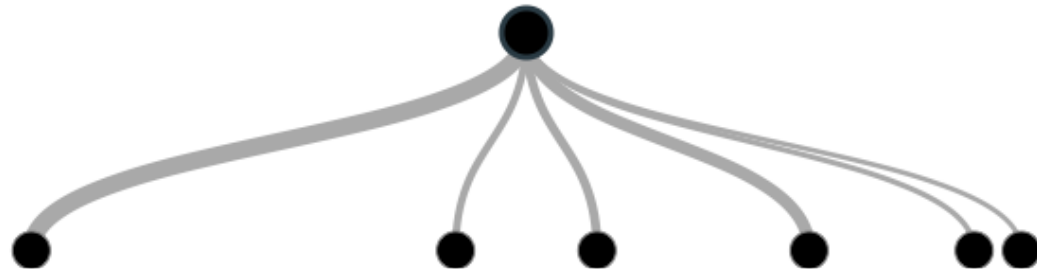
(2-3 minutes)

Allocation of resources: an example from highway design

- “... the ‘promise’ of a plan is represented by a probability distribution of outcomes that would ensue if it were pursued to completion. The distribution must be estimated by the engineer - a serious weakness of the method ...”

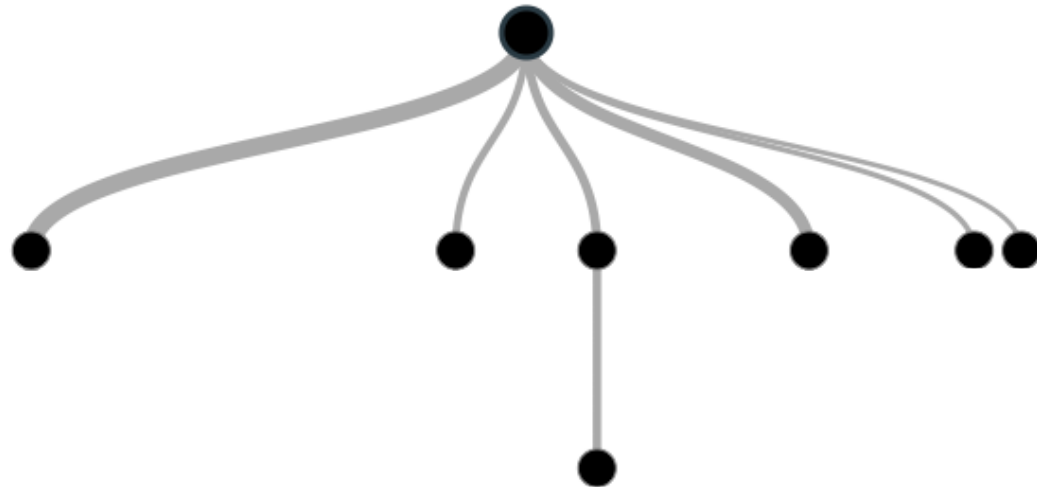


all
possible
houses



all
possible
houses

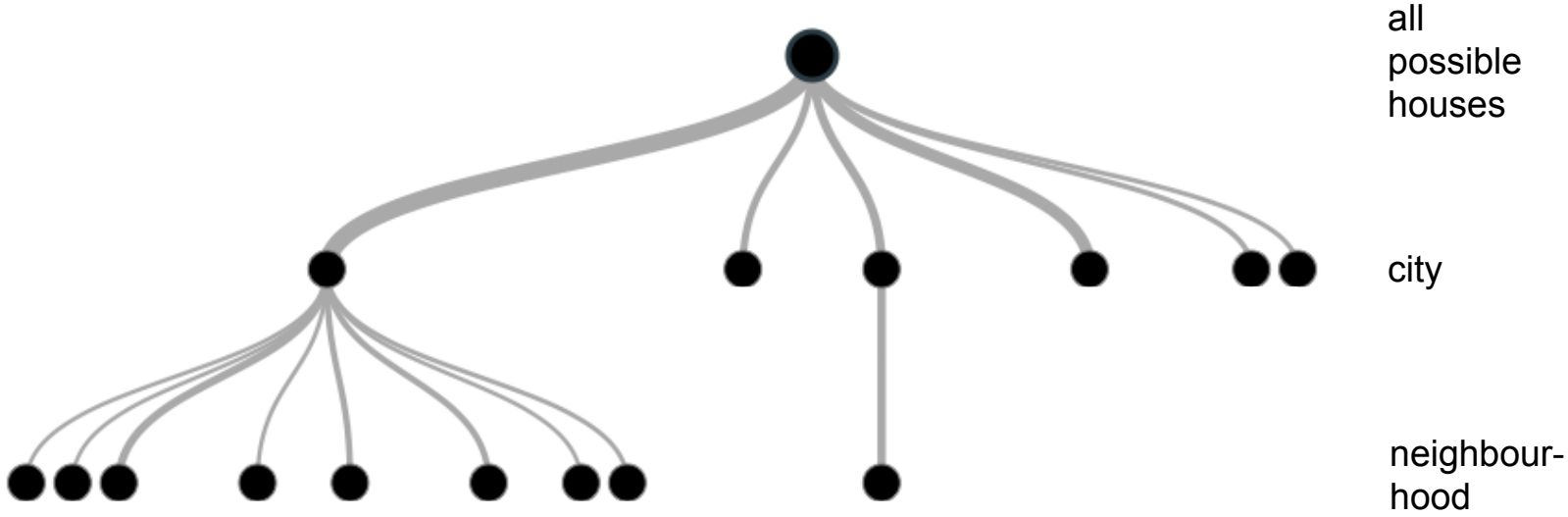
city

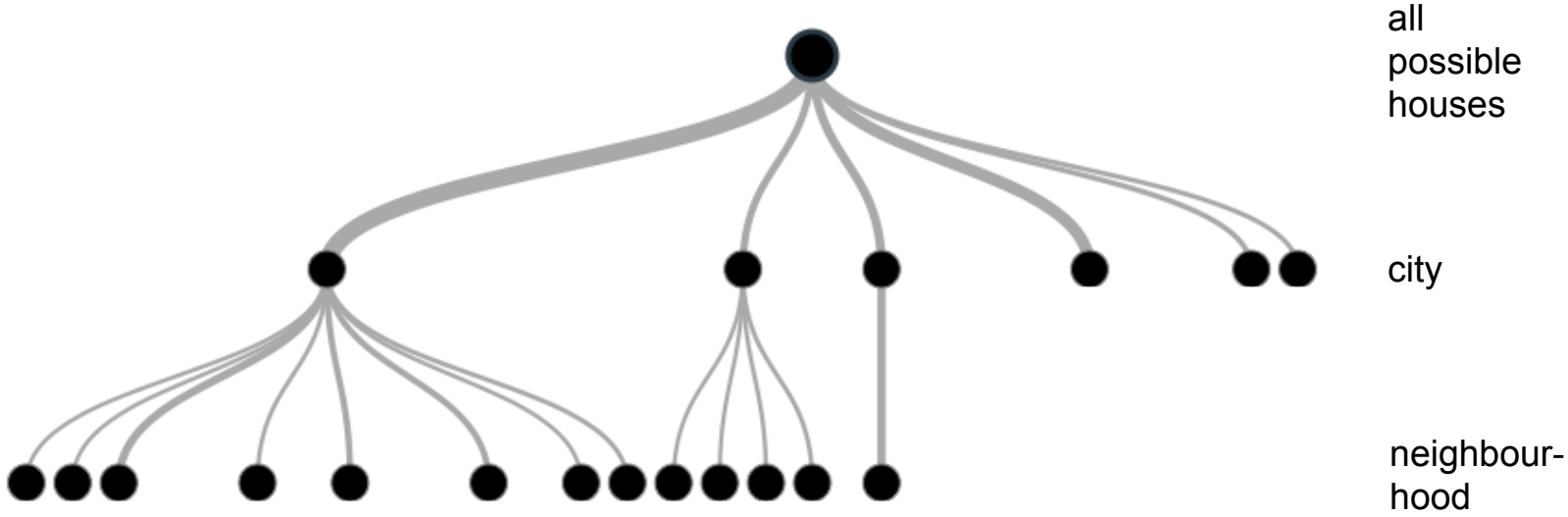


all
possible
houses

city

neighbour-
hood

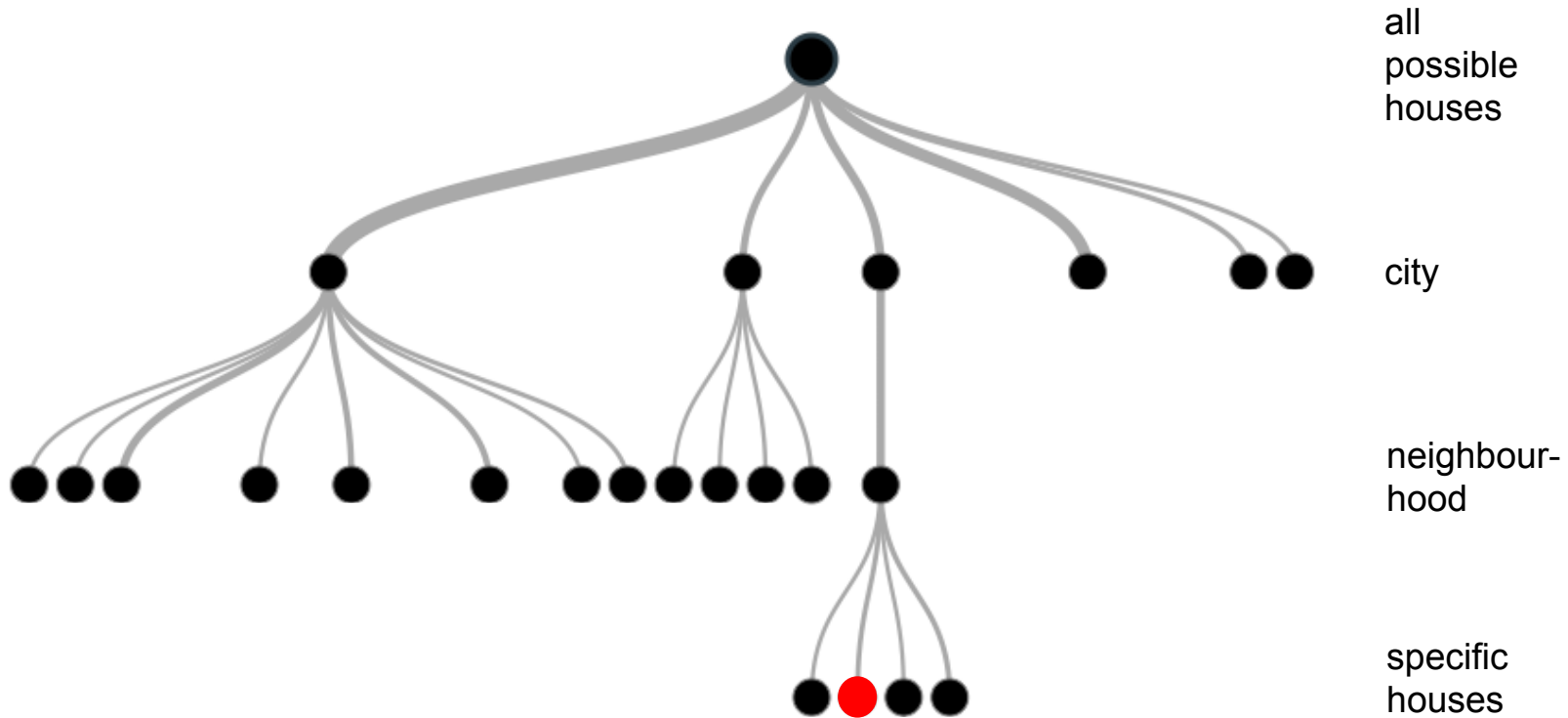


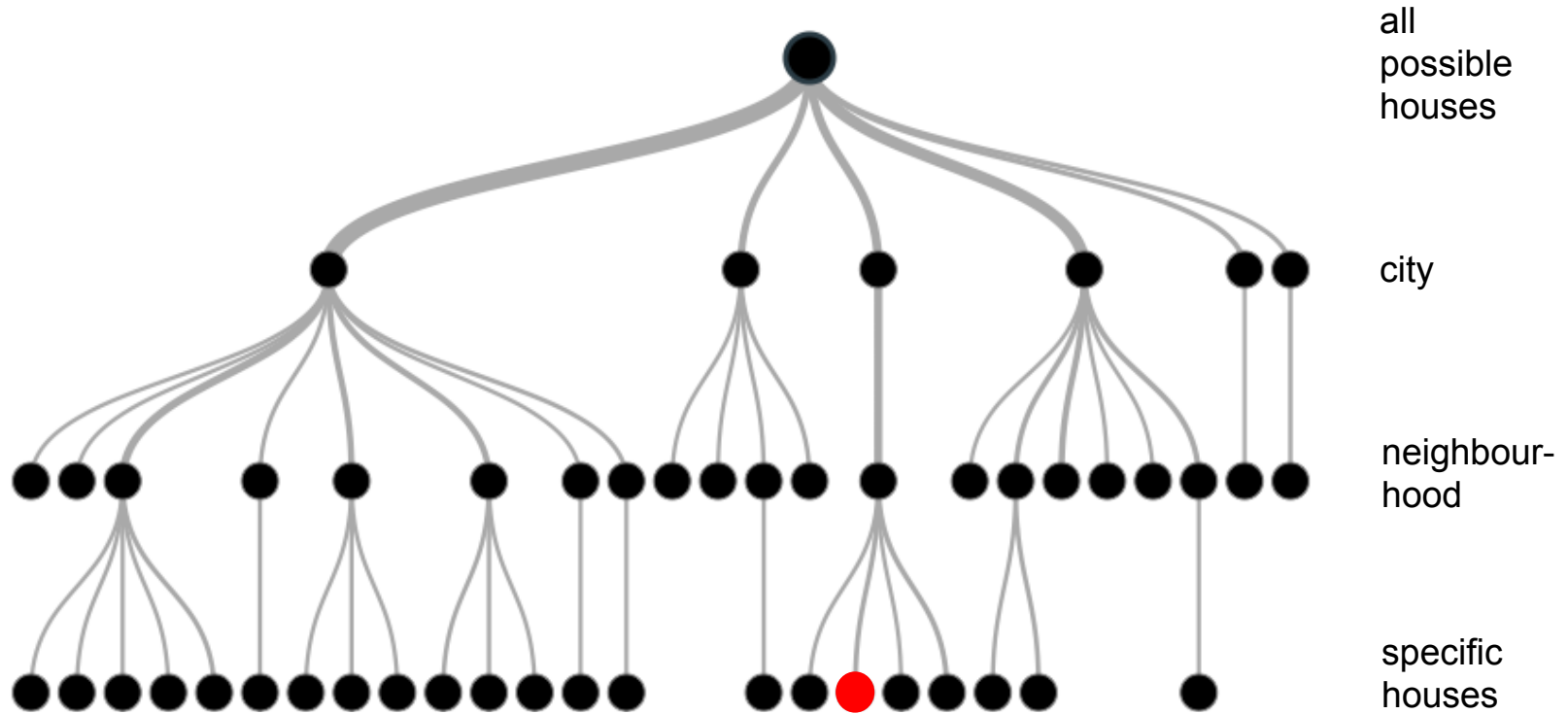


all possible houses

city

neighbourhood





Allocation of resources for search - dealing with uncertainty

- "The idea of continual refinement given a set of constraints and shortening feedback loops is very reminiscent of Agile software development methodologies" - Vincent
- "This opinion may be valuable in the past, but it has become a common information for people." - Xiaoying Gao

Example diet 1

- Breakfast
 - Cereal
 - Milk
 - Orange juice
- Lunch
 - ...
- Dinner
 - ...

Example diet 2

- Grains
 - Cereal
- Dairy
 - Milk
- Fruits
 - Orange juice

Example diet 3

- Carbohydrates
 - Cereal
- Proteins
 - Milk
- Vitamins
 - Orange juice
- ...

Example diet 4

- Breakfast
 - Soylent
- Lunch
 - Soylent
- Dinner
 - Soylent

Activity

Who (if anyone) do you think would benefit from being taught about the Science of Design?

(2-3 minutes)