Bridging From Goals to Tasks with Design Study Analysis Reports

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* Tableau Software
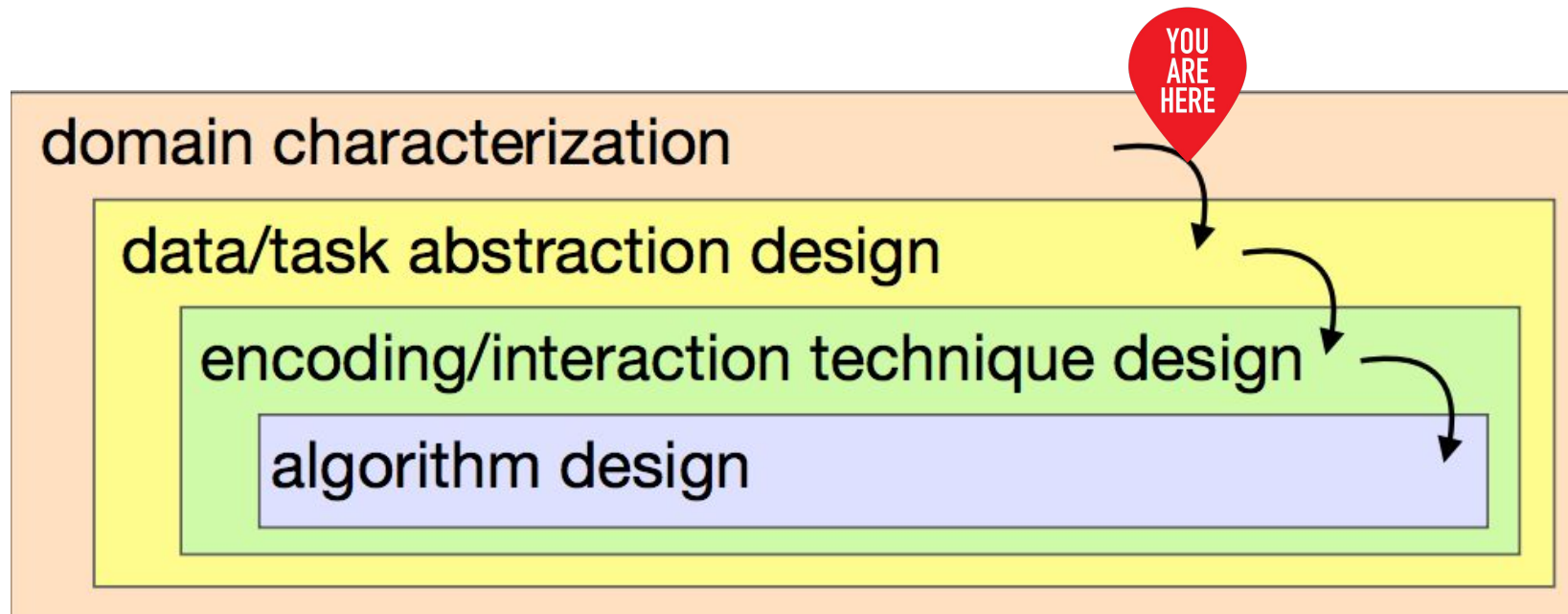[+] University of British Columbia

So I want to design a visualization, and my user says:

"As a flight reservation coordinator, I want to understand why there are so many failed purchase requests today." *

How do I design a visualization for analysis questions like this?

To design a visualization from domain questions...

Munzner, T. (2009). **A nested model for visualization design and validation**. IEEE transactions on visualization and computer graphics, 15(6).

So I want to design a visualization, and my user says:

"*As a flight reservation coordinator, I want to understand why there are so many failed purchase requests today.*"*

How do I translate domain language analysis questions to abstract tasks?

Problem: Hard to get from domain questions to tasks

not a lot of
guidance here

Task Classifications

Domain Question → Abstract Tasks → Encoding & Interaction

*"Why are there so
many failed requests
today?"*

Identify extremes
[Munzner, 2014;
Brehmer & Munzner 2013]

Analyze outliers
[Schutz et al. 2013]

Find extremum
[Amar et al. 2005]

Bridges between domain questions and task classifications

Task Classifications

Domain Question

Abstract Tasks → Encoding & Interaction

"*Why are there so many failed requests today?***"**

Identify extremes
[Munzner, 2014;
Brehmer & Munzner 2013]

Analyze outliers
[Schutz et al. 2013]

Find extremum
[Amar et al. 2005]

Bridges between domain questions and task classifications

Analysis Goals Framework

Task Classifications

Domain Question

Abstract Tasks

"*Why are there so many failed requests today?*"

WHY?

Identify extremes

Analysis Goal
Abstracted question

Typical
Analysis Steps
to achieve goal
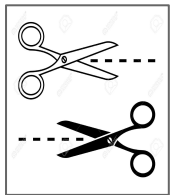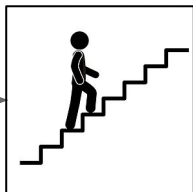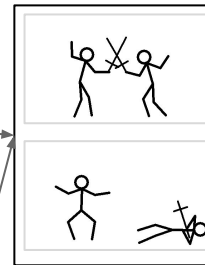
Pros & Cons of open-coding design-study papers

Design-study papers are digested analysis reports, not raw behaviour logs

Pros: Capitalize on previous thinking about abstractions from multiple authors across multiple domains

Cons: Steps extracted are not actual analysis sequences
- Only proof of existence
- Incomplete (e.g., floundering typically not reported)
- Ordering in analysis reports not not reliable

Coded InfoVis design-study papers from 2009-2015

Pre-2009 InfoVis papers did not contain analysis reports we need; InfoVis has the most design-study papers

Proposed framework is a thinking tool, not a model of visual analysis

An analysis goals framework: 9 goals + 2 axes

Specificity / # Populations	Explore	Describe	Explain	Confirm
Single	Discover Observation	Describe Observation	Identify Main Cause	Collect Evidence
Multiple		Compare Entities	Explain Differences	Evaluate Hypothesis

Specificity / # Populations	Explore	Describe	Explain	Confirm

Increasing specificity of the analysis outcome

Specificity / # Populations	Explore	Describe	Explain	Confirm
Single	Discover Observation			

Explore the data to identify interesting trends, patterns, or anomalies

"Lots of failed requests today..."

Specificity / # Populations	Explore	Describe	Explain	Confirm
Single	Discover Observation	Describe Observation		

Explore the data to identify interesting trends, patterns, or anomalies

Describe the population with a set of attributes

"Lots of failed requests today..."

"Many are Class Z and R with error code 78..."

Specificity / # Populations	Explore	Describe	Explain	Confirm
Single	Discover Observation	Describe Observation	Identify Main Cause	

Explore the data to identify interesting trends, patterns, or anomalies

"Lots of failed requests today…"

Describe the population with a set of attributes

"Many are Class Z and R with error code 78…"

Explain an observation by finding the main contributor

"Agent DYS handled a lot of these requests…"

Specificity / # Populations	Explore	Describe	Explain	Confirm
Single	Discover Observation	Describe Observation	Identify Main Cause	Collect Evidence

Explore the data to identify interesting trends, patterns, or anomalies

"Lots of failed requests today…"

Describe the population with a set of attributes

"Many are Class Z and R with error code 78…"

Explain an observation by finding the main contributor

"Agent DYS handled a lot of these requests…"

Confirm beliefs about a population

"Wonder if Agent DYS was responsible for the spike…"

An analysis goals framework

Specificity / # Populations	Explore	Describe	Explain	Confirm
Single	Discover Observation	Describe Observation	Identify Main Cause	Collect Evidence
Multiple		Compare Entities	Explain Differences	Evaluate Hypothesis

Specificity # Populations		
Single	Single population analyses start with an observation and end with a definition for a subpopulation with that observation	*"Lots of failed requests today…"* *"Failed requests with Airline A80 and flight number 4360 are all of Class Z and R, with error code 78…"*
Multiple	Multiple population analyses start with population definitions and end with similarities and/or differences between populations	*"Failed requests and successful requests…"* *"Both types involved Agent DYS…"* *"Agent Z7F handled more failed requests…"*

An analysis goals framework

	Explore	Describe	Explain	Confirm
Specificity / # Populations				
Single	Discover Observation	Describe Observation	Identify Main Cause	Collect Evidence
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How to use the framework?

Analysis Goals Framework

Domain Question

Abstract Tasks

"*Why are there so many failed requests today?*"

Identify extremes

Analysis Goal
Identify Main Cause

An analysis goals framework

Specificity / # Populations	Explore	Describe	Explain	Confirm
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An analysis goals framework

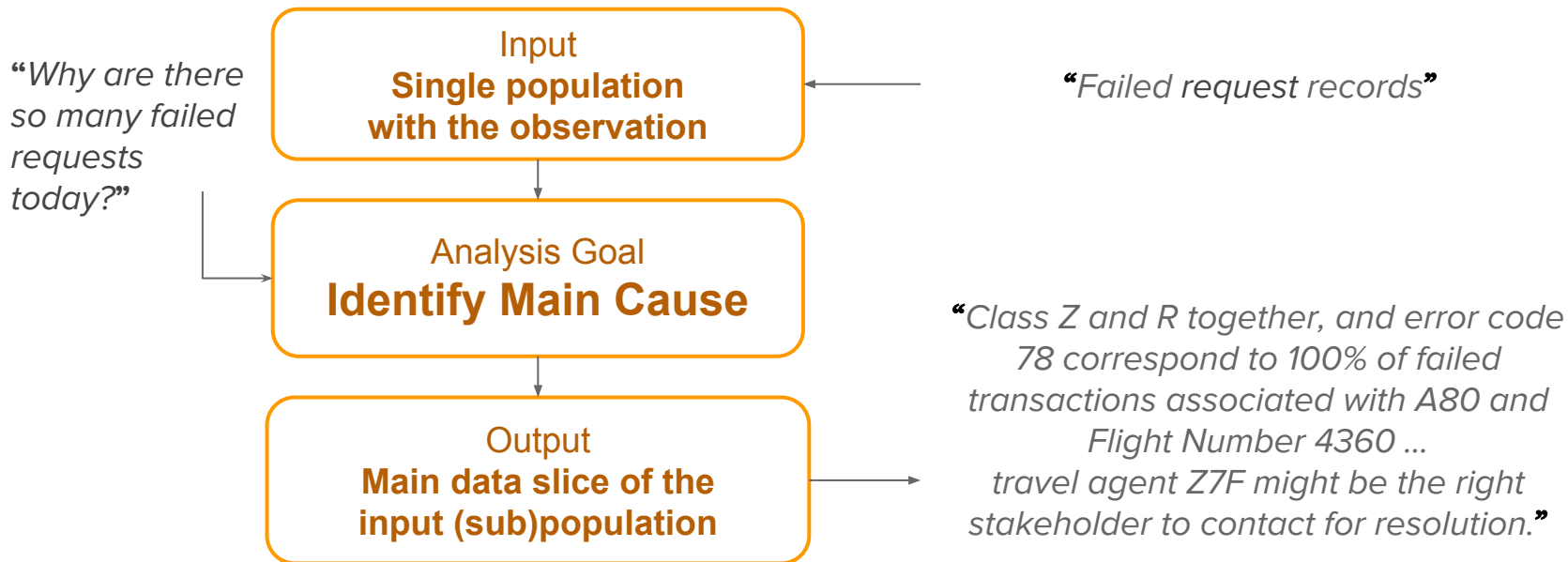|	Explore	Describe	Explain	Confirm
Specificity # Populations				
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How to use the framework?

Analysis Goals Framework

Domain Question

"*Why are there so many failed requests today?***"**

Input
Single population with the observation

"*Failed request records***"**

Analysis Goal
Identify Main Cause

Output
Main data slice of the input (sub)population

"*Class Z and R together, and error code 78 correspond to 100% of failed transactions associated with A80 and Flight Number 4360 ...***
*travel agent Z7F might be the right stakeholder to contact for resolution.***"**

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How to use the framework?

Analysis Goals Framework

Domain Question

Abstract Tasks
Identify extremes

"Why are there so many failed requests today?"

Analysis Goal
Identify Main Cause

Typical
Analysis Steps
to achieve goal

Goal breaks down to Steps

	Analysis Report	Our Framework
Input	A spike in the time trend of daily failed airline transactions	A population with an observation found at the aggregate population level
Steps	(one example loop)	(iteratively)
	Identified that Airline A80 had contributed the most failed transactions	Identify the likely dominant attribute that causes the observation
	Confirmed that the airline's contribution is worse than historical average	Confirm the identified attribute
	Filtered to focus on airline A80's failed transactions	Refine the analysis population by applying the identified dominant attribute
Output	Travel agent Z7F contributed to most of airline A80's failed transactions	The dominant attribute that explains the observation

Easy to map Steps to Tasks

| Analysis Report	Our Framework	Munzner Actions & Targets*	
Identified that airline A80 contributed the most failed transactions	Identify the likely dominant attribute that caused the observation	Analyze>Consume>Discover Search>Locate Query>Identify	Attribute>One >Distribution >Extremes
...and many more...			

*Munzner, T. (2014). **Visualization analysis and design**. CRC press.

Bridging From Goals to Tasks…
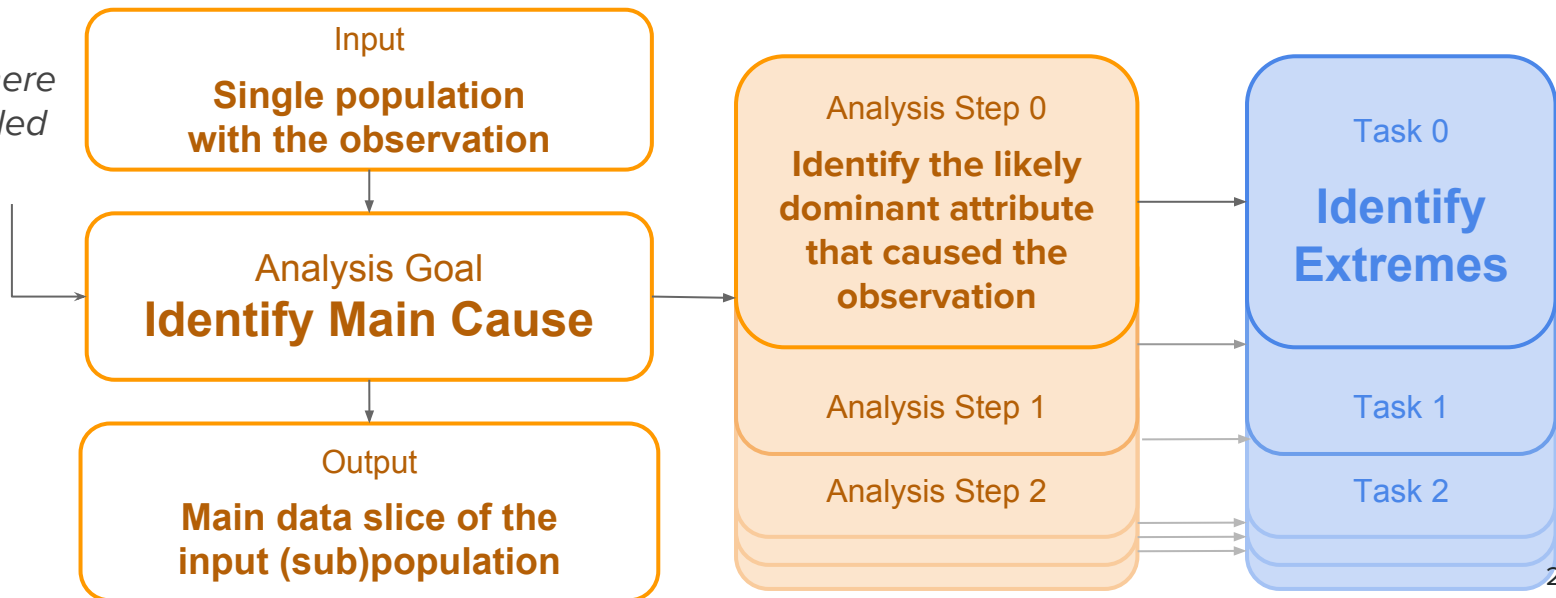
Summary: An analysis goals framework

A thinking tool to help designers map domain analysis questions, to abstract goals and steps, that can easily translate into existing tasks classifications.

Analysis goals are characterised by:
- Axes of specificity (Explore, Describe, Explain, Confirm) and the number of populations (Single, Multiple)
- Analysis inputs and outputs
- Typical analysis steps

Framework derived empirically from open coding design-study papers
- Grounded in reports of real analyses from a (relatively) diverse set of domains
- **Call for action**: Help us improve this framework by collecting more goals from other sources!!

Bridging From Goals to Tasks with Design Study Analysis Reports

http://www.cs.ubc.ca/labs/imager/tr/2017/GoalsToTasks

Bridging From Goals to Tasks with Design Study Analysis Reports

Heidi Lam, Melanie Tory and Tamara Munzner, *Member, IEEE*

Abstract—Visualization researchers and practitioners engaged in generating or evaluating designs are faced with the difficult problem of transforming the questions asked and actions taken by target users from domain-specific language and context into more abstract forms. Existing abstract task classifications aim to provide support for this endeavour by providing a carefully delineated suite of actions. Our experience is that this bottom-up approach is part of the challenge: low-level actions are difficult to interpret without a higher-level context of analysis goals and the analysis process. To bridge this gap, we propose a framework based on analysis reports derived from

http://tinyurl.com/gt27fau

Supplementary Materials of "Bridging from Goals to Tasks with Design Study Analysis Reports", InfoVis 2017

Heidi Lam, Melanie Tory, and Tamara Munzner

1 Design study papers considered

2 Summary of analysis goal assignments

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An analysis goals framework

Specificity # Populations	Explore	Describe	Explain	Confirm
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Multiple		Compare Entities	Explain Differences	Evaluate Hypothesis

http://www.cs.ubc.ca/labs/imager/tr/2017/GoalsToTasks

Specificity / # Populations	Explore	Describe	Explain	Confirm
Multiple		Compare Entities	Explain Differences	Evaluate Hypothesis

Describe two or more populations by comparing one to another

"*Wonder how the failed requests compared to the successful ones?*"

Explain the reason behind differences

"*Failed requests are more from Agent Z7F…*"

Confirm suspected similarities or differences between populations

"*Wonder if requests handled by Agent Z7F are more likely to fail?*"