

Visualization 2014 – Lecture 2: Why Visualization and the Pipeline

Mario Romero – 2014/03/27



User interacting with KTH AGI13 SolarSense at GAMEX. Image: Fredrik Lilkaer

Prelude Video



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Anders Ynnerman:

Visualizing the medical data explosion

TEDxGöteborg 2010 · 16:36 · Filmed Nov 2010

Subtitles available in 21 languages

 [View interactive transcript](#)



Outline

1. Quick tour of KTH Social and Facebook and SURVEYS
2. Who are you?
3. My students, my heroes!
4. The C-Awards
5. Project 1 due next Tuesday, April 1, 08:00
6. Readings for next class
7. Why Visualization?
8. The Visualization Pipeline
9. Discussing readings grounded in Uniview

Who are you?

- Write First name on sheet of paper and fold it in front of you
- In 30 seconds
 - Say your name
 - Degree and Major
 - Expected Learning Outcomes from VIS14

My Students, My Heroes!



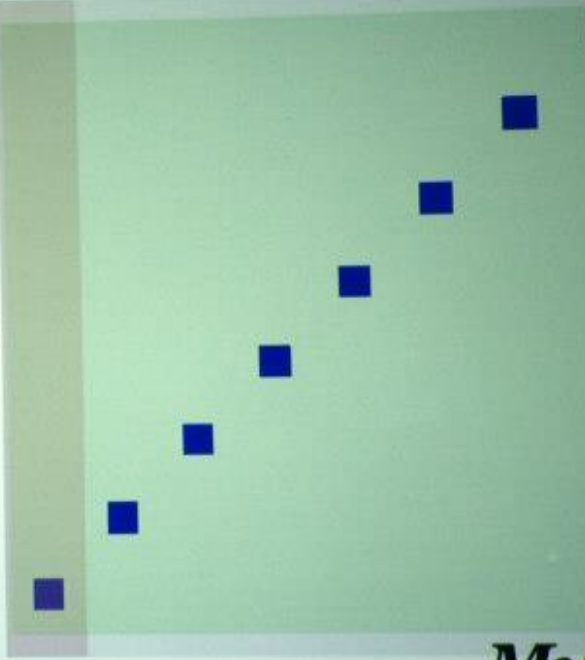
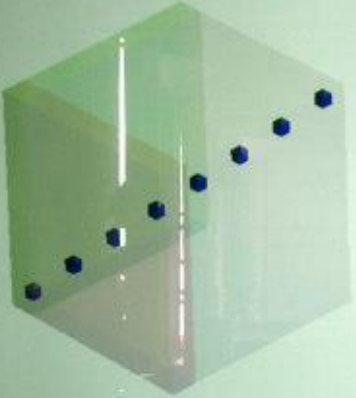


MusiCube

musicube.se



Settings



CONTROLS
Rotate W, A, S, D, Q, E
Draw Mouse
Change slice Scroll
Play / pause Space bar
Randomize / clear R / C


Mu

4 APRIL



C Awards

👍 like You like this.



"...BETYDDE NOG
MYCKET ATT JAG
VUNNIT BÄSTA
VISUALISERING I C
AWARDS..."





SHOWROOM

SE DE NOMINERADE BIDRAGEN UNDER RESTEN AV VECKAN. SÄLLA BJORÅR I ÅRETS TÄVLING UNDER PUBLIKENS VAL. GLÖM INTE ATT MISSA ALLA VÄRN. VISAS BÄST I GOOGLE

Please Vote!!!

- ALLA BIDRAG / PUBLIKENS VAL
- BÄSTA AFFÄRSMÖJLIGHET
- BÄSTA INTERAKTIONSDSIGN
- BÄSTA VISUELLA EFFEKT I FILM & RÖRLIG BILD
- KREATIV TEKNISK TILLÄMPNING
- NÄSTA PUBLIKMAGNET
- TEKNISK EXCELLENS

The grid contains the following images:

- Top-left: A glowing blue tree-like structure against a dark background.
- Top-middle: The Obscurus logo, which features a stylized eye with a question mark inside.
- Top-right: A screenshot of a news article with a world map and a line graph.
- Second row, left: A person with a glowing orange robot head.
- Second row, middle: A man and a woman standing in a misty outdoor setting.
- Second row, right: A 3D isometric map of a city with various buildings and roads.
- Third row, left: A man and a woman looking at a laptop screen.
- Third row, middle: A young man with glasses looking directly at the camera.
- Third row, right: A green background with the WALLYFYfy logo and the text 'THE CREATIVE DESIGN GENERATION'.
- Fourth row, left: A man holding a sign that says 'I ♥ HJO' in a narrow alleyway.
- Fourth row, middle: A hand drawing a series of connected circles on a whiteboard.
- Fourth row, right: A person using a tablet computer.

Bottom-right panel: A poster with the text 'DÖDSSYNDERNA LOVAR HELVETE ÅT SYNDERNA. STRAFFET? FÖRDOMELSE. EVIG'.



ENS VAL

bidrag har chans att vinna i specialkategorin Publikens val. Inför galan kommer det att
rit här på cawards.se. Publikens val är en utmärkelse där man förutom ära och berömm
liseringscenter C.

ÄR!

C-Awards

- You are invited!
- Next Wednesday, April 2
- You pay your train ticket and food
- Participation is free
- Please, RSVP in Facebook wall
- More details soon

Project 1

1. Visit [Visit](#)
2. Read what it is.
3. Download executable.
4. Read the manuals.
5. Explore a data set of your choice.
6. Create an Analytic Trail with up to 5 images and 100 words.
7. Deliver PDF with the trail to marior@kth.se next Tuesday, April 1, 2014. Put “**VIS14 – P1**” on the subject line of the email.

Questions?

- What is an Analytic Trail?
 - Tell the story
 - Start with the raw data
 - How did it look at first?
 - How did you modify it through the visualization?
 - How did you understand something new?
 - Conclusions?

Readings for Next Tuesday

- **Introduction to Scientific Visualization, Chapter 2**
 - Helen Wright
 - [LINK](#)
 - Write 100-word reflection on how you will use this reading in project 1.
- **Scientific Storytelling Using Visualization**
 - [Kwan-Liu Ma](#) ; [Liao, I.](#) ; [Frazier, J.](#) ; [Hauser, H.](#) ; [Kostis, H.-N.](#)
 - [LINK](#) (download PDF within KTH network or from KTH Library)
 - Write 100-word reflection on how you will use this reading in project 1.
- Send a PDF with both reflections to marior@kth.se by next Monday 31/3 at 23:59.

WHY VISUALIZATION?



The trouble with data

<https://www.emc.com/infographics/digital-universe-business-infographic.htm>



Challenge

Visually transform data into scientific insight.

Human Vision

- Highest bandwidth
- Fast, parallel
- Pattern Recognition
- Pre-attentive
- Extends memory and cognitive capacity
- People think visually
- Brain: 30% vision, 8% touch, 3% hearing

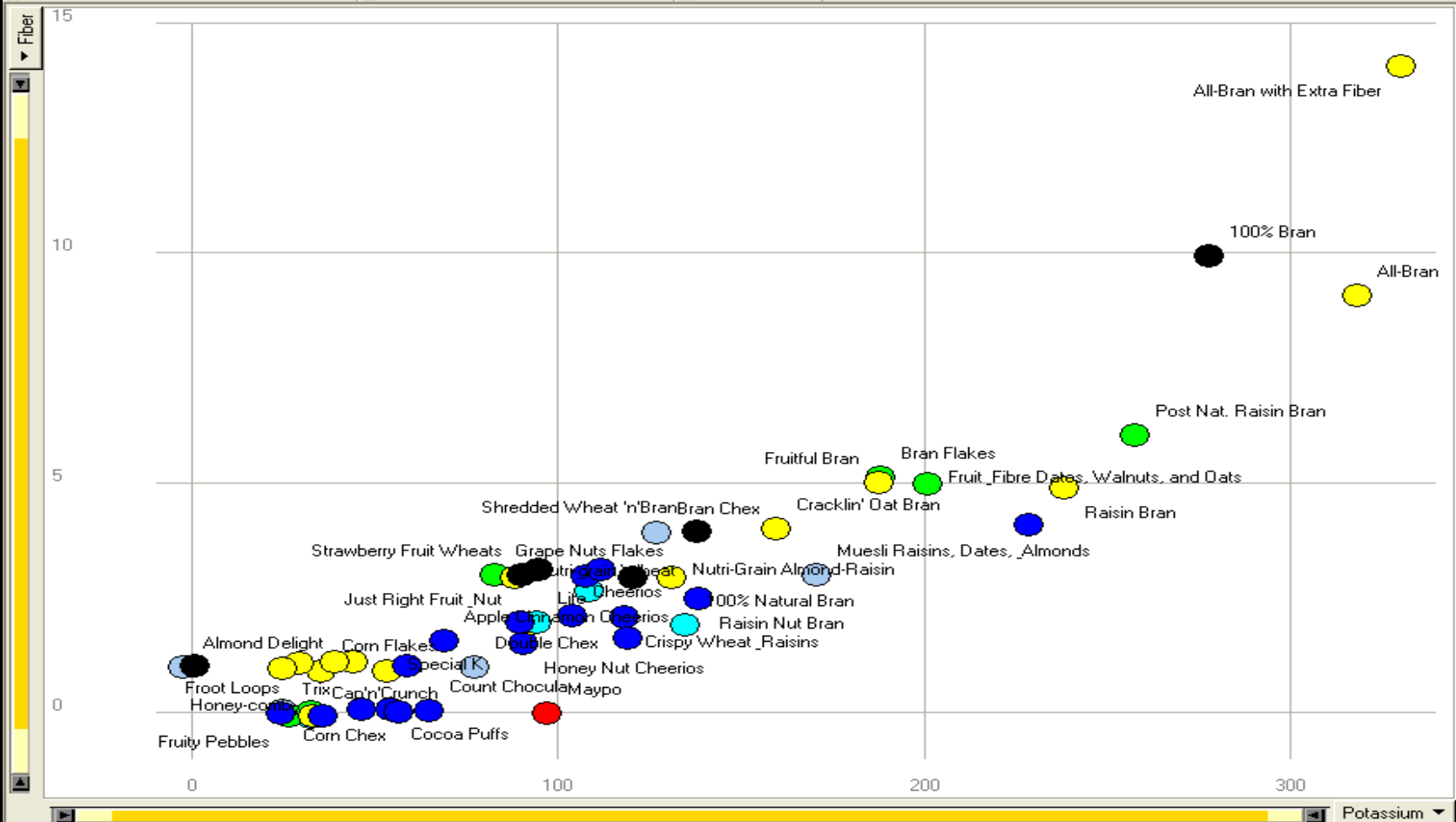
Example

- Which cereals have the most and least potassium?
- Is there a relationship between potassium and fiber?

Cereal Data

	A	B	C	D
1	Cereal	Manufacturer	Fiber	Potassium
2	100% Bran	N	10	280
3	100% Natural Bran	Q	2	135
4	All-Bran	K	9	320
5	All-Bran with Extra Fiber	K	14	330
6	Almond Delight	R	1	0
7	Apple Cinnamon Cheerios	G	1.5	70
8	Bran Chex	R	4	125
9	Bran Flakes	P	5	190
10	Cap'n'Crunch	Q	0	35
11	Cheerios	G	2	105
12	Cocoa Puffs	G	0	55
13	Corn Chex	R	0	25
14	Corn Flakes	K	1	35
15	Count Chocula	G	0	65
16	Cracklin' Oat Bran	K	4	160
17	Cream of Wheat (Quick)	N	1	0
18	Crispy Wheat & Raisins	G	2	120
19	Double Chex	R	1	80
20	Froot Loops	K	1	30
21	Frosted Flakes	K	1	25
22	Fruit & Fibre Dates, Wal	P	5	200
23	Fruitful Bran	K	5	190
24	Fruity Pebbles	P	0	25
25	Golden Grahams	G	0	45
26	Grape Nuts Flakes	P	3	85
27	Honey Nut Cheerios	G	1.5	90

28	Honey-comb	P	0	35
29	Just Right Fruit & Nut	K	2	95
30	Life	Q	2	95
31	Lucky Charms	G	0	55
32	Maypo	A	0	95
33	Muesli Raisins, Dates, &	R	3	170
34	Multi-Grain Cheerios	G	2	90
35	Nutri-Grain Almond-Rais	K	3	130
36	Nutri-grain Wheat	K	3	90
37	Oatmeal Raisin Crisp	G	1.5	120
38	Post Nat. Raisin Bran	P	6	260
39	Product 19	K	1	45
40	Quaker Oatmeal	Q	2.7	110
41	Raisin Bran	K	5	240
42	Raisin Nut Bran	G	2.5	140
43	Rice Krispies	K	0	35
44	Shredded Wheat	N	3	95
45	Shredded Wheat 'n'Bran	N	4	140
46	Shredded Wheat spoon	N	3	120
47	Smacks	K	1	40
48	Special K	K	1	55
49	Strawberry Fruit Wheats	N	3	90
50	Total Corn Flakes	G	0	35
51	Total Raisin Bran	G	4	230
52	Total Whole Grain	G	3	110
53	Trix	G	0	25
54	Wheaties	G	3	110
55	Wheaties Honey Gold	G	1	60



Cereal (All)

Manufacturer

- A
- G
- K
- N
- P
- Q
- R

Fiber 0 14

Pot... 0 330

Thought

- What if I read the data to you?

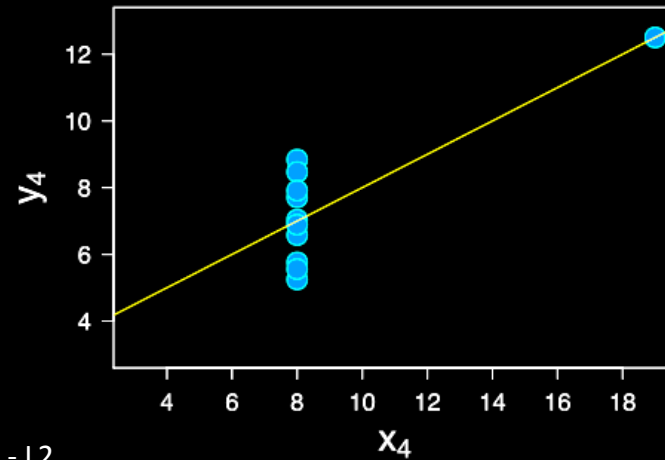
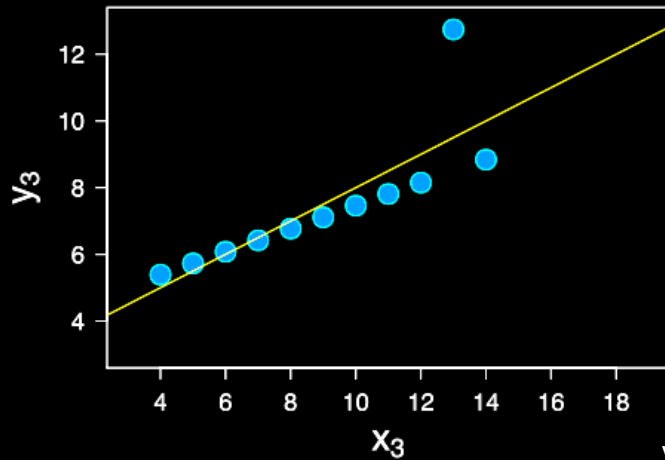
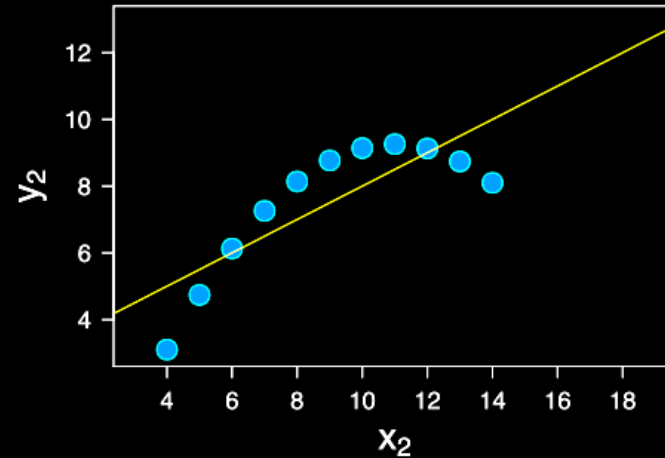
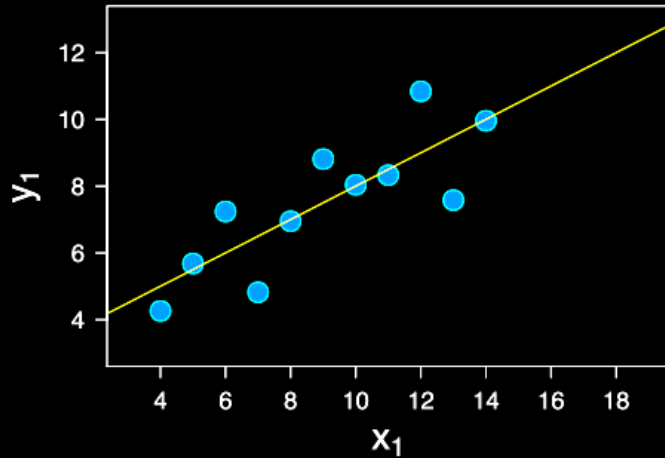
Anscombe's quartet

I		II		III		IV	
X	Y	X	Y	X	Y	X	Y
10.00	8.04	10.00	9.14	10.00	7.46	8.00	6.58
8.00	6.95	8.00	8.14	8.00	6.77	8.00	5.76
13.00	7.58	13.00	8.74	13.00	12.74	8.00	7.71
9.00	8.81	9.00	8.77	9.00	7.11	8.00	8.84
11.00	8.33	11.00	9.26	11.00	7.81	8.00	8.47
14.00	9.96	14.00	8.10	14.00	8.84	8.00	7.04
6.00	7.24	6.00	6.13	6.00	6.08	8.00	5.25
4.00	4.26	4.00	3.10	4.00	5.39	19.00	12.50
12.00	10.84	12.00	9.13	12.00	8.15	8.00	5.56
7.00	4.82	7.00	7.26	7.00	6.42	8.00	7.91
5.00	5.68	5.00	4.74	5.00	5.73	8.00	6.89

Statistics

Property	Value
Mean of x in each case	9 (exact)
Variance of x in each case	11 (exact)
Mean of y in each case	7.50 (to 2 decimal places)
Variance of y in each case	4.122 or 4.127 (to 3 decimal places)
Correlation between x and y in each case	0.816 (to 3 decimal places)
Linear regression line in each case	$y = 3.00 + 0.500x$ (to 2 and 3 decimal places, respectively)

Anscombe's quartet Visualized



Visualization

- “The use of computer-supported, interactive visual representations of data to amplify cognition.”
From [Card, Mackinlay Shneiderman '98]

Visualization

- Often thought of as process of making a graphic or an image
- Really is a cognitive process
 - Form a mental image of something
 - Internalize an understanding
- “The purpose of visualization is insight, not pictures”
- Insight: discovery, decision making, explanation

Main Idea

- Visuals help us think
 - Provide a frame of reference, a temporary storage area
- Cognition → Perception
- Pattern matching
- External cognition aid
 - Role of external world in thinking and reason

Larkin & Simon '87 Card, Mackinlay, Shneiderman '98

INFORMATION VISUALIZATION PIPELINE

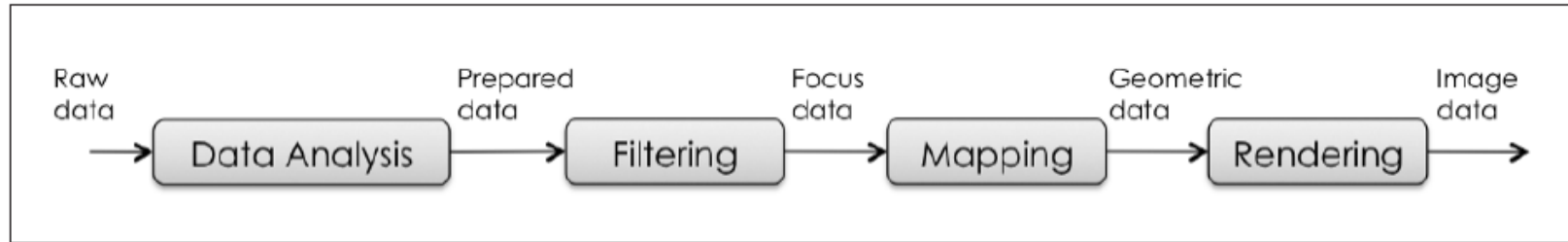


Figure 4. Visualization pipeline. Raw data is converted into image data (pixels) in four stages.

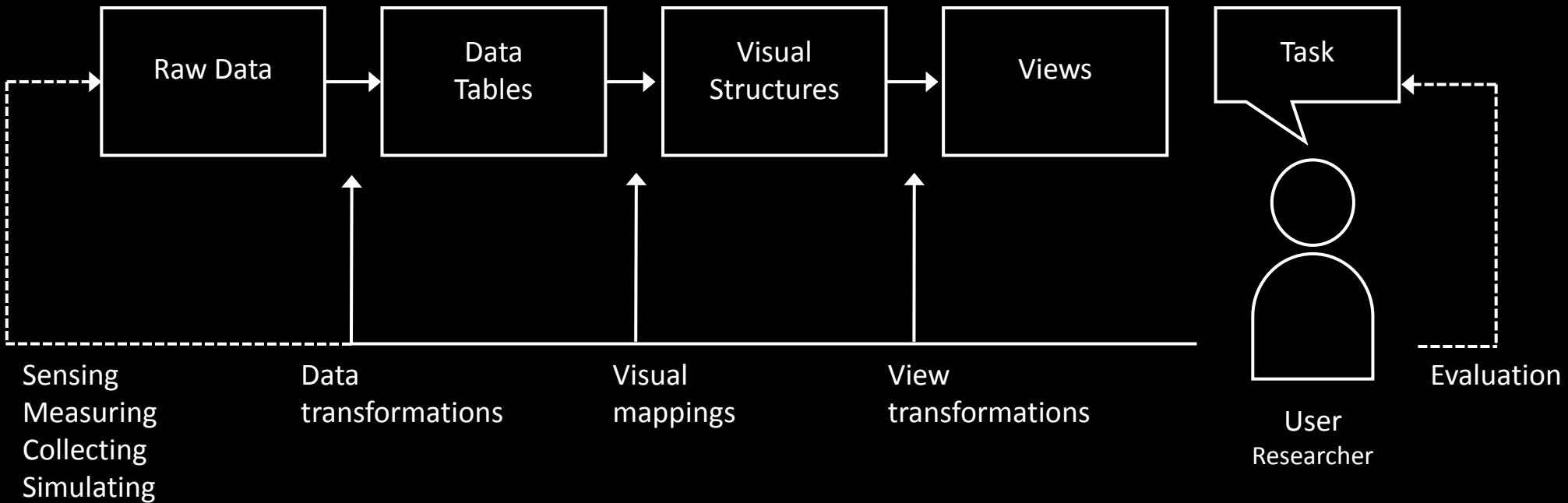
3. Visualization Pipeline

The visualization process is often described as a pipeline that contains four major stages. The pipeline converts *raw data* into *image data* (pixels) in four stages, (see *Figure 4*).

Visualization Pipeline

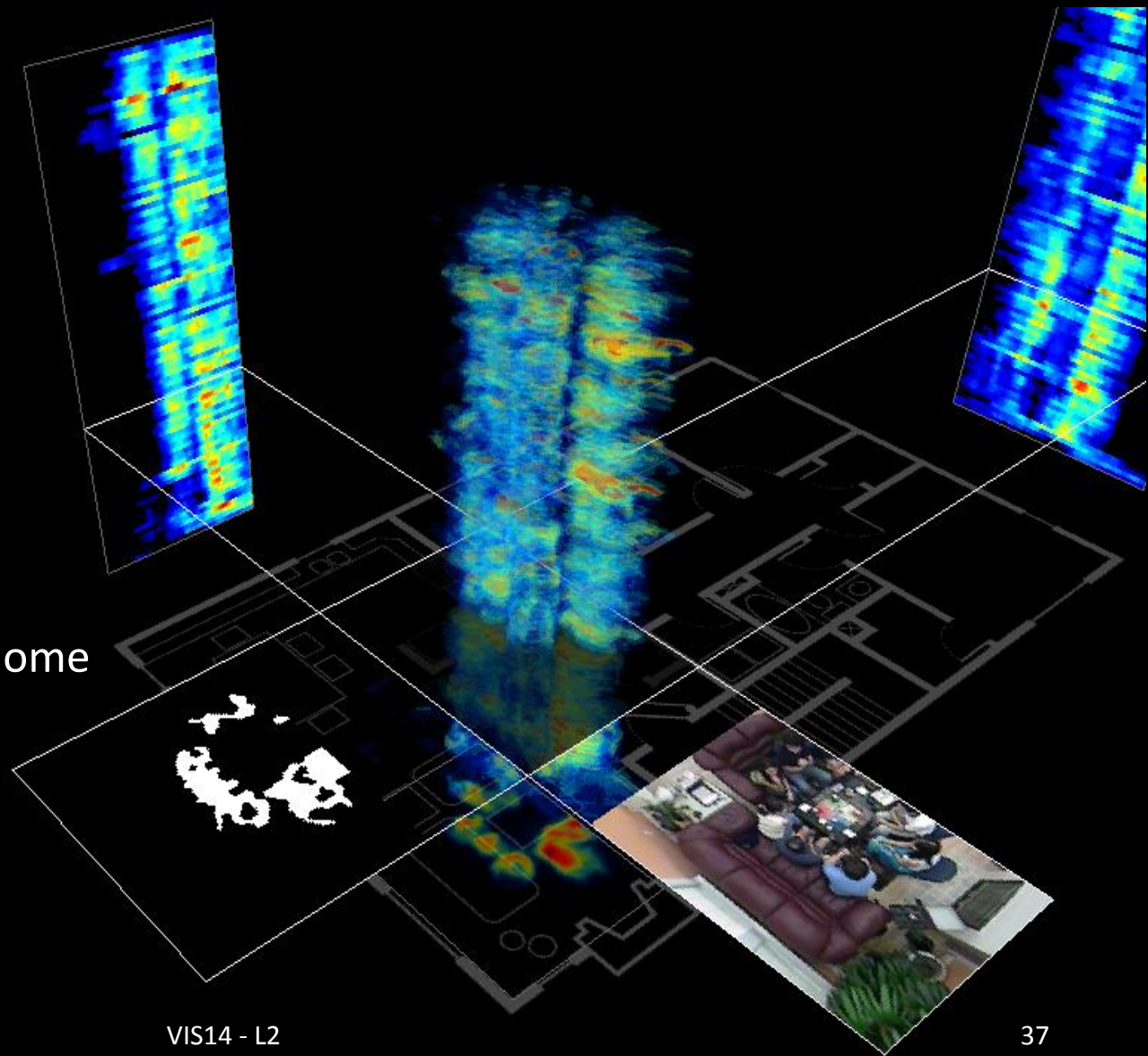
expanded from **Readings in Information Visualization: Using Vision to Think**

By Stuart K. Card, Jock D. Mackinlay, Ben Shneiderman, 1999

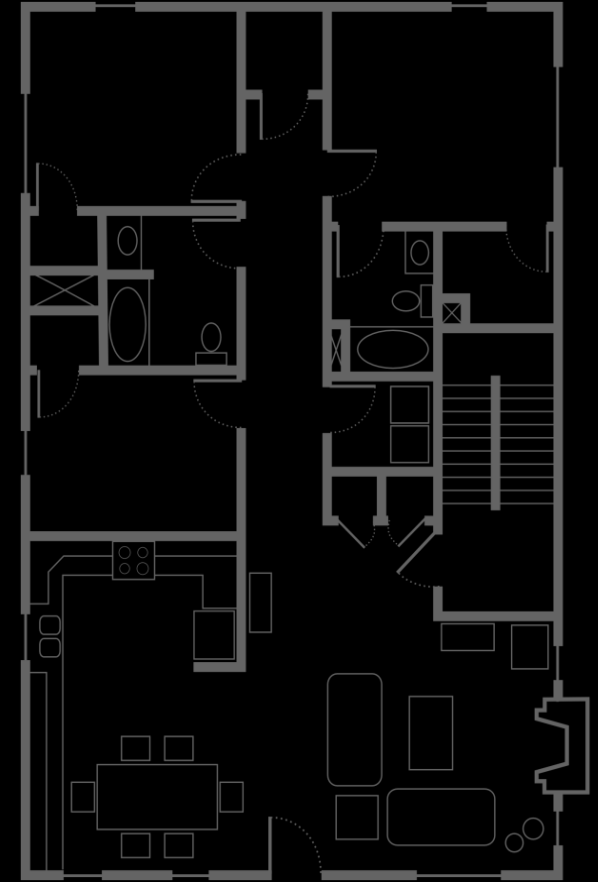


Visualizing Behavior in the Home

VIZ-A-VIS



Capturing and Visualizing Behavior





Aware Home

Compute and Aggregate Motion

10 cameras in public areas

- Image \leftrightarrow Space
- Fixed background
- High Resolution



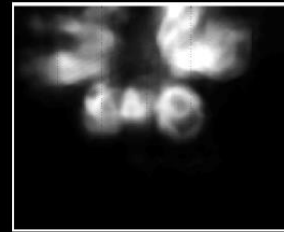
F_{t-1}



F_t



$$AFD_t = |F_t - F_{t-1}| > \Theta$$

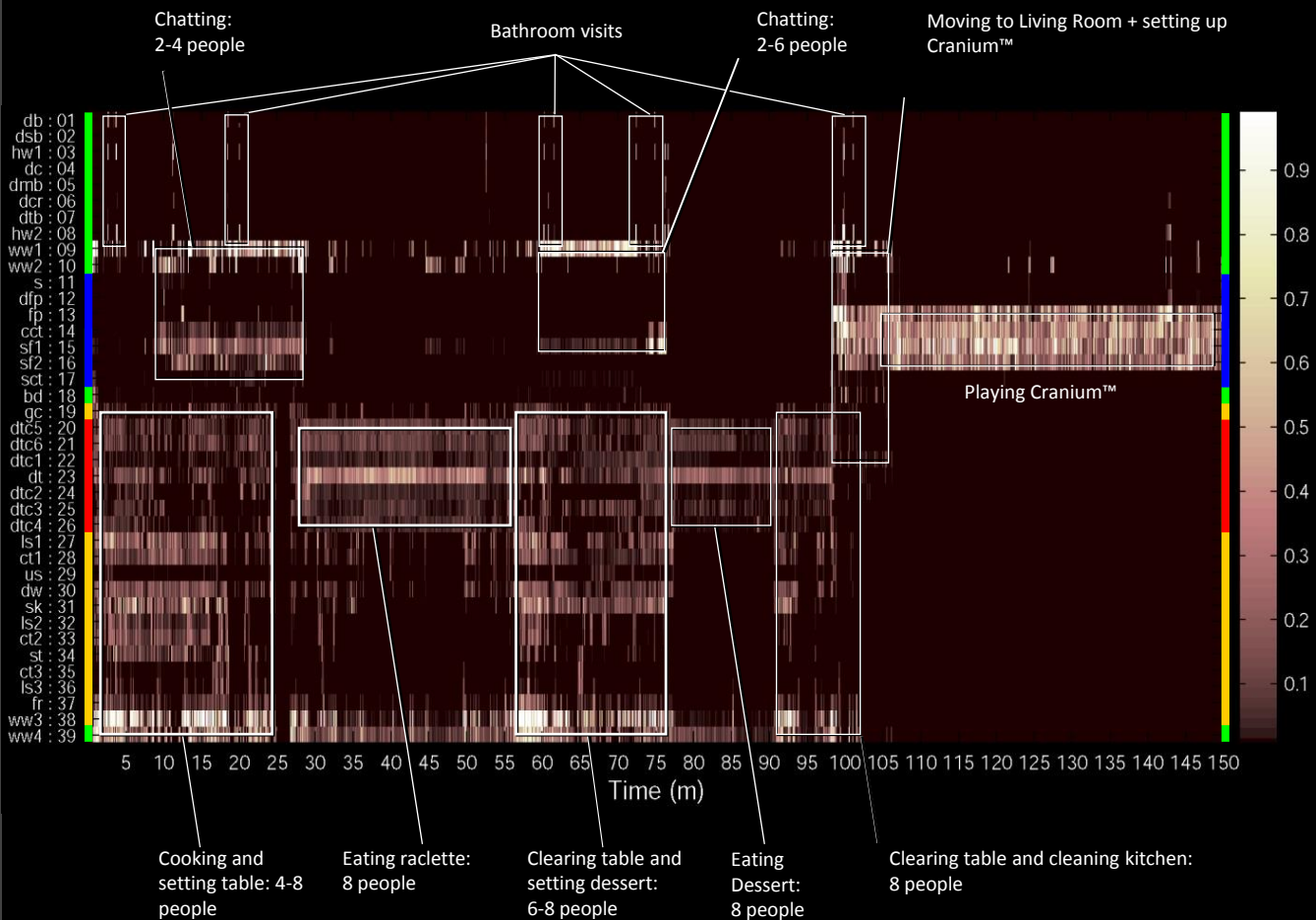


$$\sum_t AFD_t$$

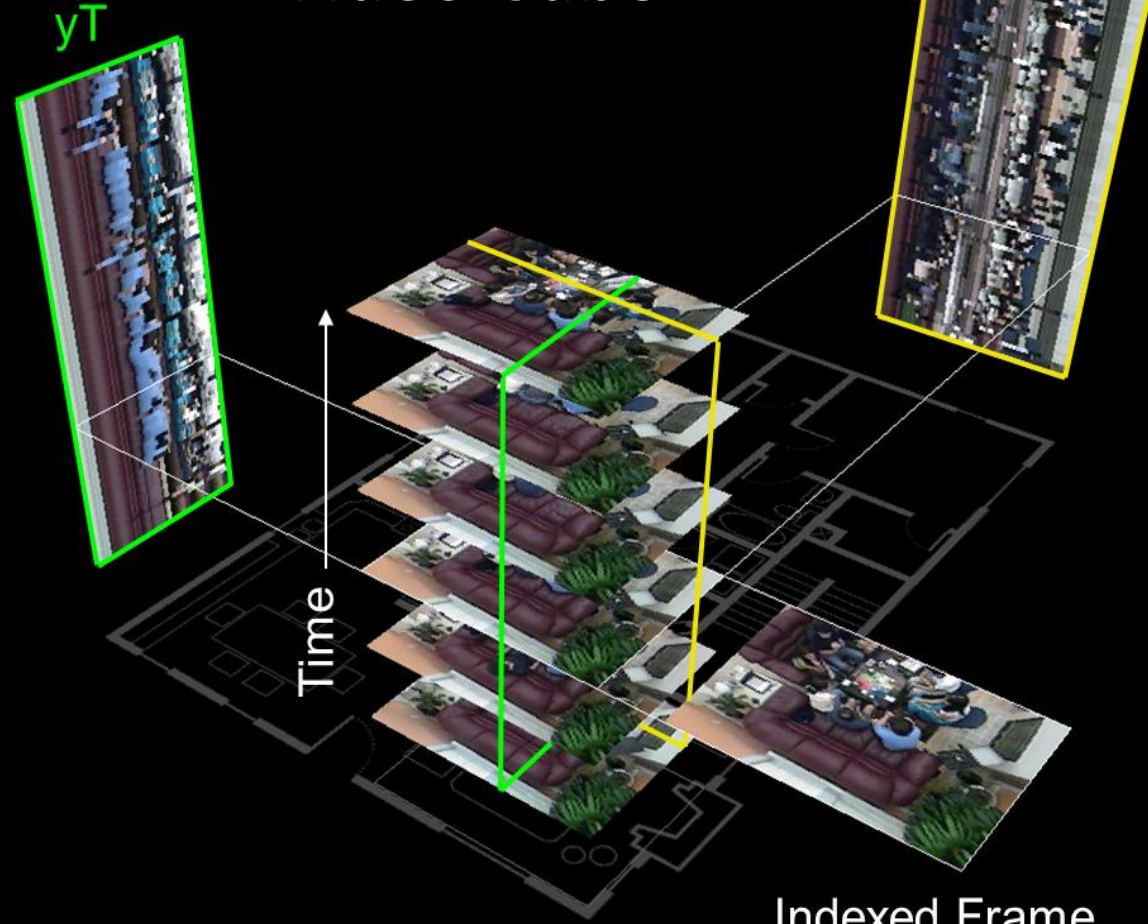


Activity Table

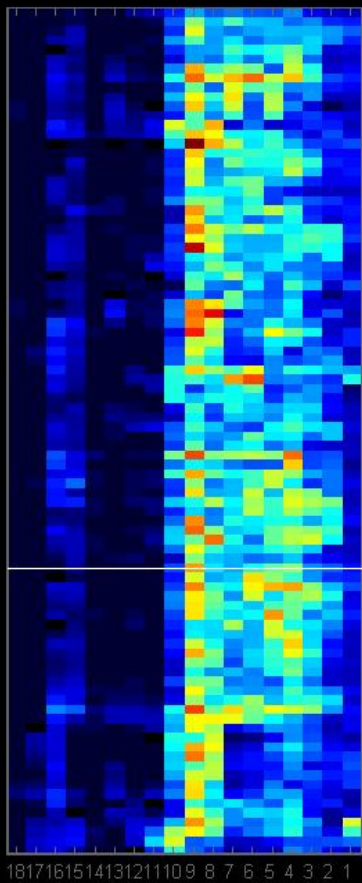
- █ Traffic Zones
- █ Living Zones
- █ Dining Zones
- █ Kitchen Zones



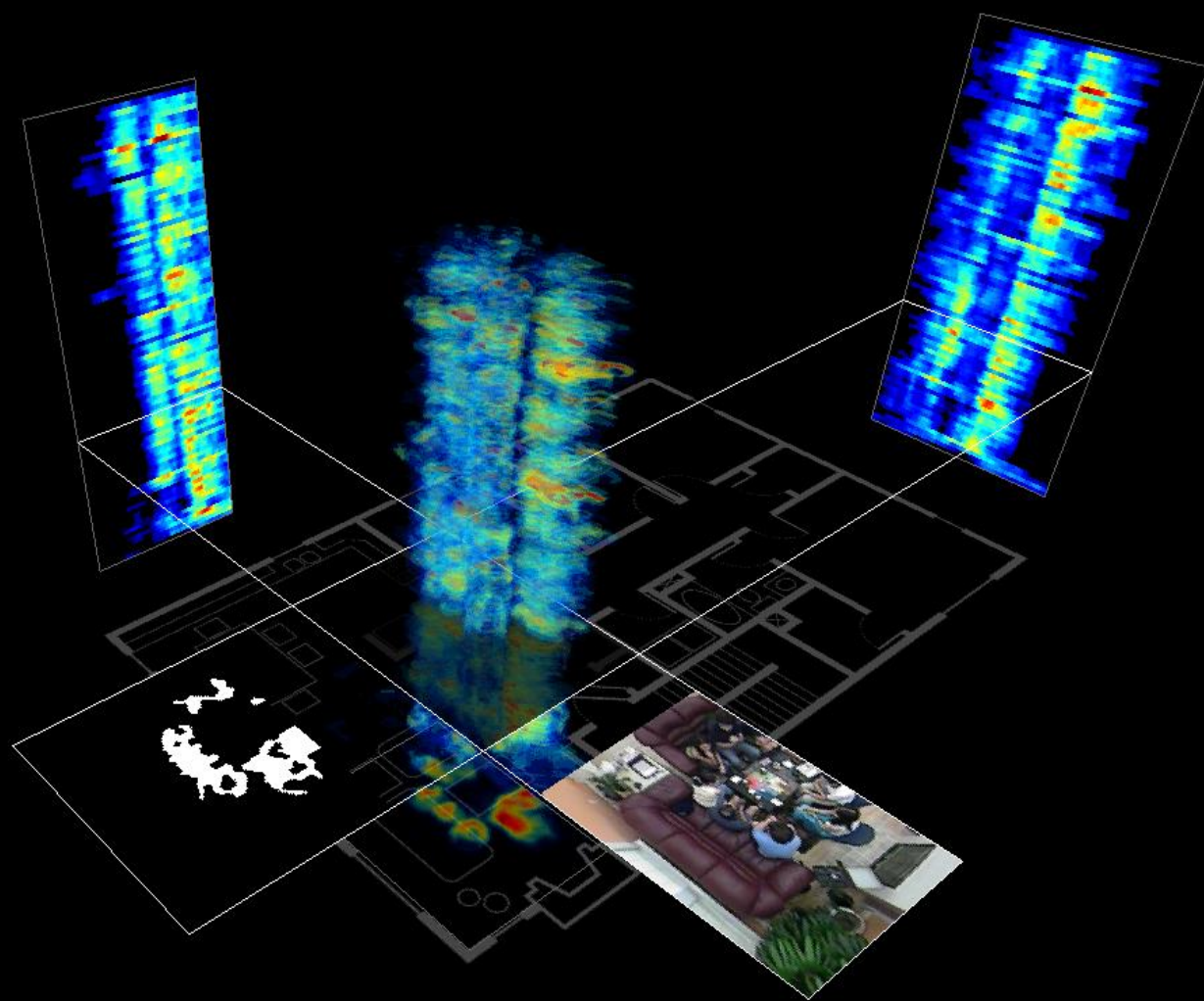
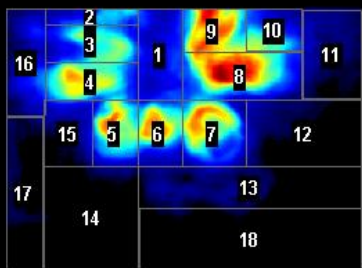
Video Cube



Playback Console



18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1



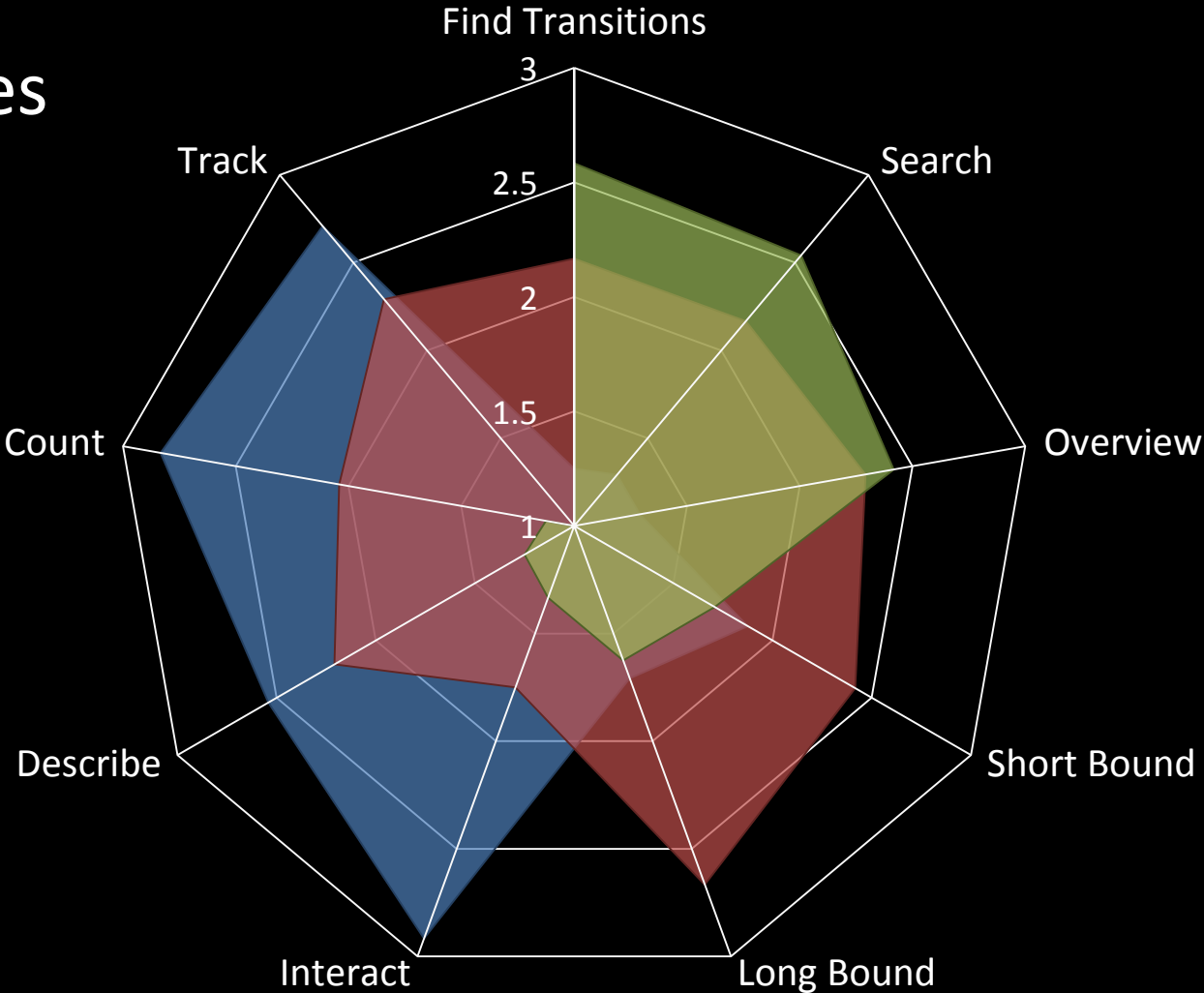
Activity Cube

Evaluating Video Visualizations of Human Behavior

Mario Romero
Alice Vialard
John Peponis
John Stasko
Gregory Abowd



User Studies

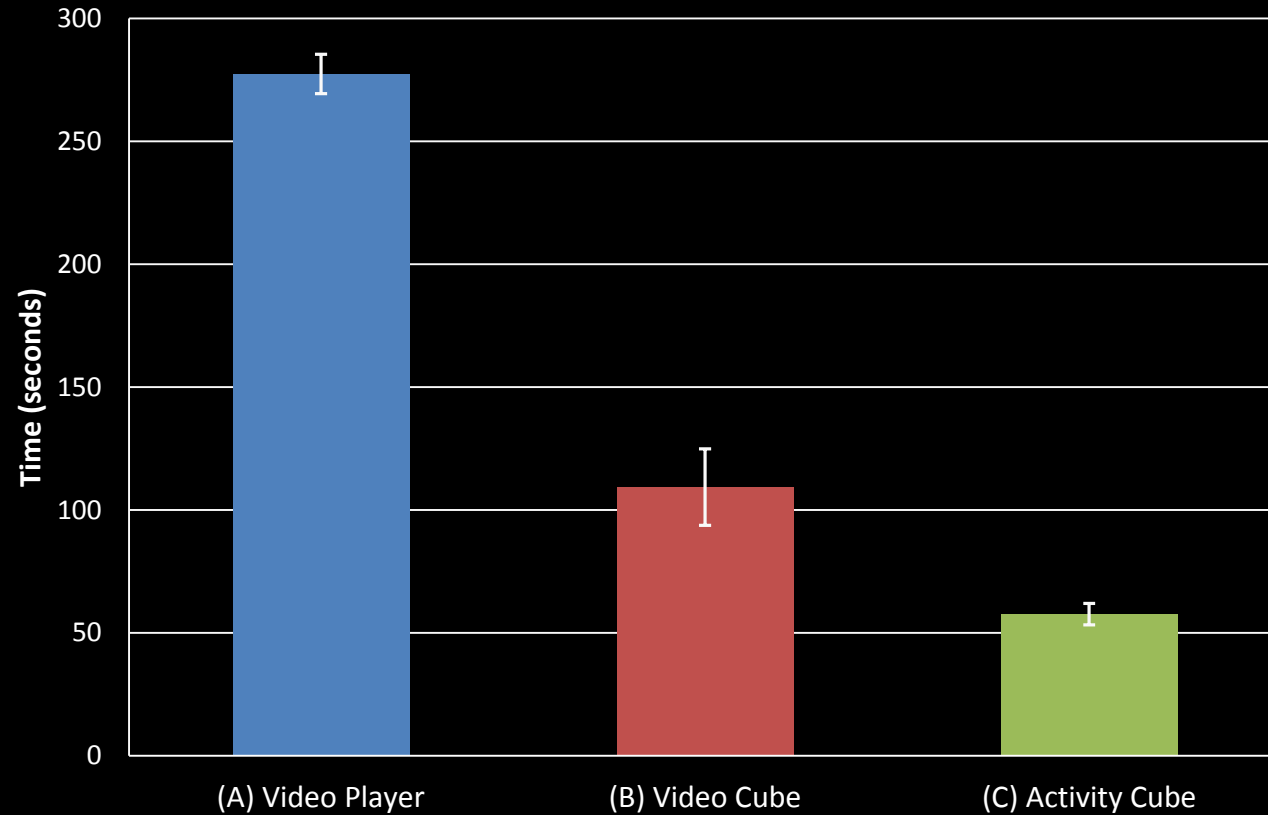


■ (A) Video Player

■ (B) Video Cube

■ (C) Activity Cube

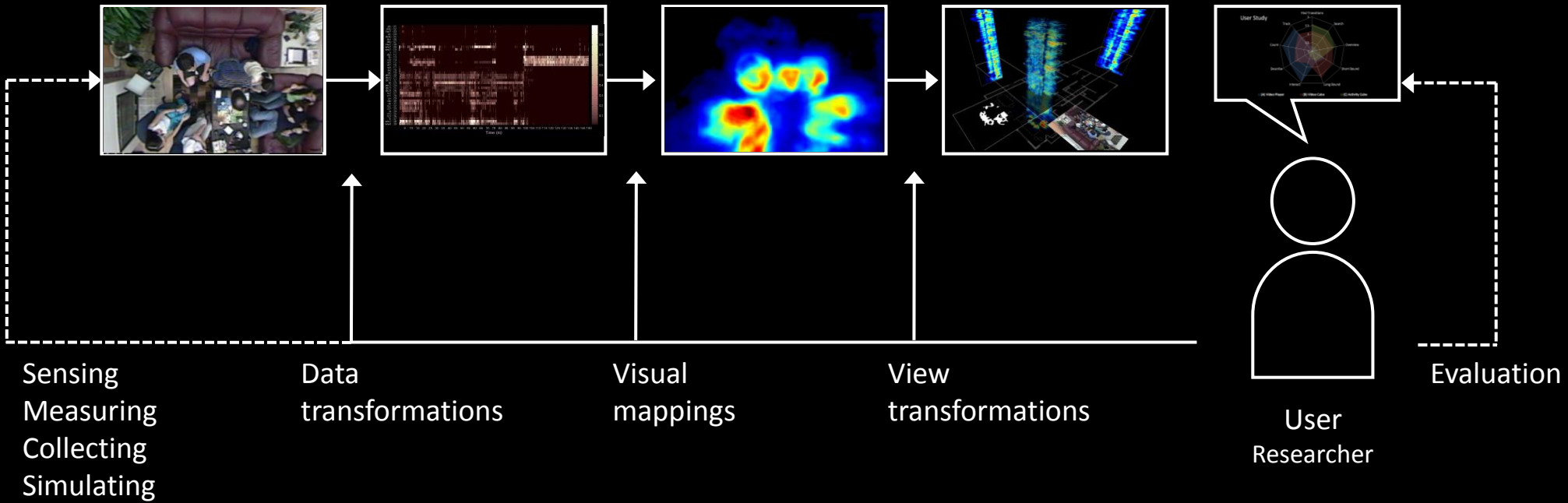
Search Time



Visualization Pipeline

expanded from **Readings in Information Visualization: Using Vision to Think**

By Stuart K. Card, Jock D. Mackinlay, Ben Shneiderman, 1999



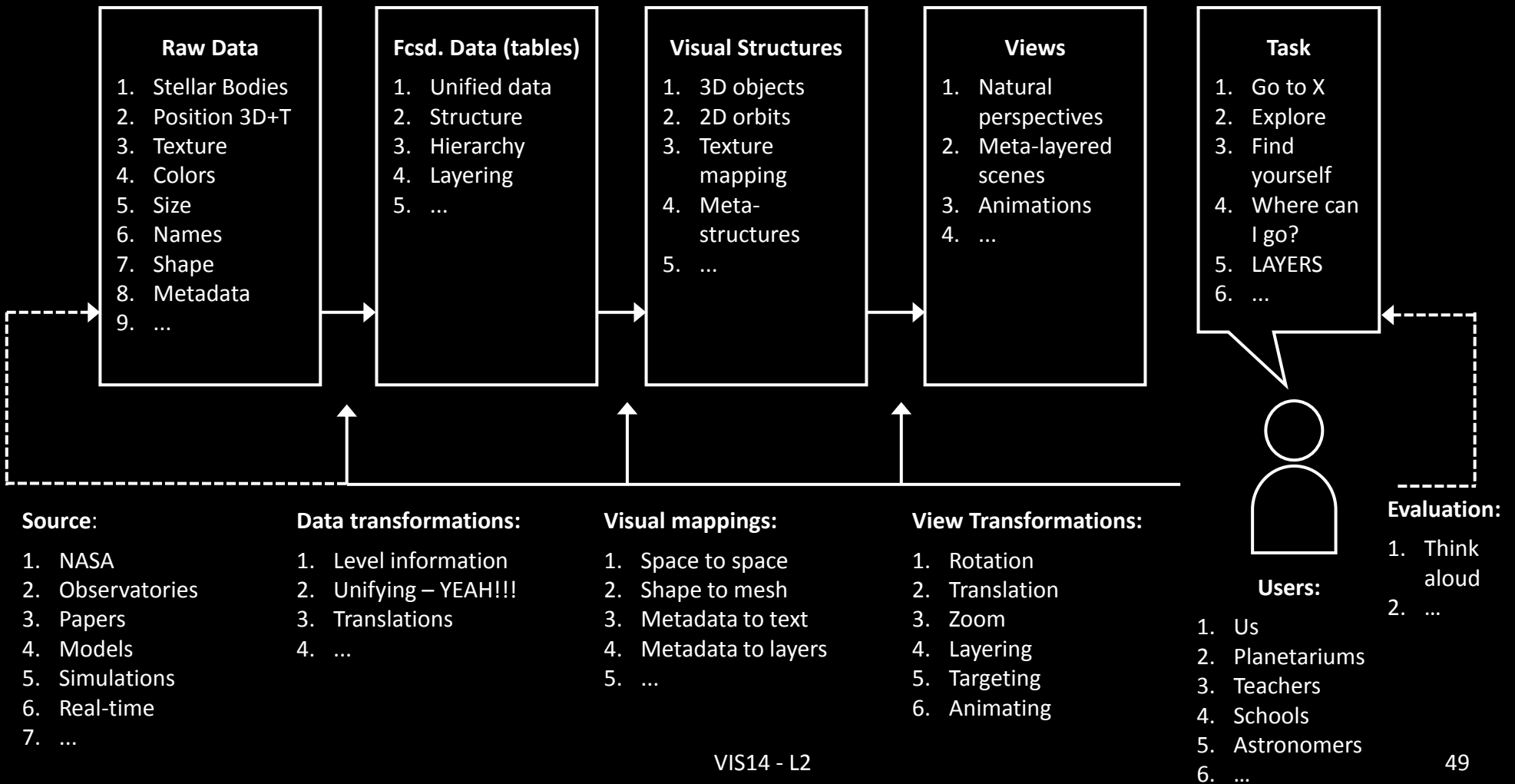
Task : Uniview Pipeline

1. Fill in the stages of the Visualization Pipeline for Uniview

Answer the following questions

1. Who is the user?
2. What are the tasks?
3. What is the data?
4. What are the data transformations?
5. What are the visual mappings?
6. What are the visual structures?
7. What are the view transformations?
8. What are the views?
9. How does the demo support the tasks?
10. How can it be improved?

Uniview Visualization Pipeline



Thank you!

marior@kth.se