Anthony Williams

Batting Order

Intro to scientific visualisations via Bio
IGT Framework
Data Mining Frameworks Visual Analytics
Uncertainty and Uncertainty Pipeline
Visual Representations
Design Guidelines
Ux Examples health applications
Time Series Problem
Chart Junk
Summary
Leave the word with Edvard and Salvador
Bio

Chemist made stuff, Chemistry Literature over 200 years of literature, 5 million compounds characterised, 50 million made. Organic molecules represented as Graphs, CT. Combinatorial chemistry space is big. Cann’t make them all, Cann’t assess them all.

Morphed into Molecular Modeller, spend all day looking at 3D visualisations of chemical molecules see fit into a virtual protein. Not many chemists truly think in 3D. Minority of 3D specialists.

Consumer of algorithms, solve problem identifying low signal patterns in noisy data. Narrow down search space. Provided curated random data to enhance chemical designs. Discovery process.

“Victim” of lots of bespoke software, visual analytical solutions, that take effort time to learn, skills become obsolete 3-5 years. IT services provider for fussy users “chemists” IT illiterate, lazy digital dinosaurs.

Deeper understanding of modeling, application of software to problems solving, transfer my skills into a new domain. Broaden my outlook.

Nosey, Curious like exploring
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SKELEGEN™ Scientific Visualisation

Why use visualisations?

Advantages
- Help Define Problem / Solution
- Data Overload
  - helps separate signal from noise
  - Workload bottleneck
  - Interactive visualisations remove clutter focus attention
- Reorganise conceptual space
- “Support finding of the Wow signal”

Problems
- Illusion
- Attention
- Visual Perception, lots happening

The Power of Visualisation

“The greatest value of a picture is when it forces us to notice what we never expected to see”.

Cartesian doubt a systematic process of being skeptical about the truth of one's beliefs to distinguish between true and false claims.

Observability “insight”

“The critical test of observability is when the display suite helps practitioners notice more than what they were specifically looking for or expecting”

The design choices we make matter! We are all designers to some degree!

The Interface between Imagination, visual processing, cognition, data and computation

Trends in human reliability analysis, Rasmussen J, Ergonomics, 1985
Cognitive Amplification

Increased Resources
Reduce Search Space
Enhance Recognition Patterns
Perceptual Inference – better in pictures
Perceptual Monitoring – motion
Manipulative Medium

Illuminating the path The Research and Development Agenda for Visual Analytics, Thomas J and Cook K, 2005
GPU’s
Humans are Pattern Hunting Machines
One researcher's first reaction to the study of Uncertainty

Uncertainty leads to a disruption of my sense-making abilities that breaks my conceptual model with the consequence I am unable to explain the past or future behaviour of phenomena.

This introduces doubt into my decision making process and impairs judgment and affect my actions.

Doubt, a state between belief and disbelief, sometimes expressed as a probability or an odds ratio.
IGT Framework


“Even a dwarfs standing on the shoulders of giants can see a little further “
Data Analyst View


www.Jheer.org
The Sensemaking Process and Leverage Points for Analyst Technology as Identified Through Cognitive Task Analysis, P. Pirolli and Card S, Proceedings of International Conference on Intelligence Analysis, 2005
68 Guidelines for Charts

- Offset axis to reduce clutter
- Distinct symbols
- Has advice for error bars
- Advice on legends
- Avoid 3D difficult to estimate values
- Use common horizontal base
- [Stephens Law and Poggendorf Illusion]
- 65 references

Interactive Charts (Aka Visualisation Tools)

Edward Tufte  Stamp collection of static images over the ages

Data Ink ratio / Chart Junk

Sneiderman: overview first, zoom, filter and details on demand

Task by Data type Taxonomy
1 D, 2D, 3D, Temporal, Multi-Dimensional
Tree – hierarchies
Network – relationships,

Shneiderman B, The Eyes Have It: A task by Data Type Taxonomy for information Visualisations, Proc Visual Languages 96, 1996
Design Patterns for Visualisation Applications
Uncertainty

**Aleatoric** - Random and not reproducible

**Epistemic** - Due to incomplete knowledge
Methods to address conceptual uncertainties from inadequate representation or incomplete understanding are rare. MAPE, seek to validate model with reference data. Used to refine schema.

Uncertainty propagates through data transformation, data fusion, aggregation.

Uncertainty parameterization in the model, code implementation

Uncertainty in mapping data to visualization, Pixels, Voxels

Physiological uncertainty - MRI images different part of the brain lights up.

Observer Effect       Equipment Interference

Uncertainty MarkUp Language –Open Geospatial Consortium - capture meta data
Uncertainty Visualisation Pipeline

Riveiro M, 2007
Why is it a hard problem?

Expertise – Team expanded
Cognitive load
Simulations – Projections give Multivalues
Difficult, so simplification, use the mean
Lack of attention
Not encoded in the data
Numeracy, Graphical literacy
Make do, heuristics, realism, toss a coin.
Ignore the problem, RR
Why it matters

Overconfident or Abandonment

The most “interesting” complex problems have a “measure” of uncertainty

Climate Change Earthquakes Ecology Equipment Failure, System failure Healthcare and Disease Economic Forecasts Planning
Evaluation of artery visualizations for heart disease diagnosis, Borkin M, IEEE transactions on visualization and computer graphics, 2011, 2479
One man's Junk is another man's paper

Problem in Review

Very few domains in which uncertainty metadata is captured

Uncertainty covers many sins

More things to worry about increase cognitive burden, cognitive dissonance

No accepted method of representing uncertainty context problem dependent

Visualisations can be useful

No guidelines or documented practice to help designers

[Bounded rationality, users have limited resources going to fall back on heuristics unless you nudge them into using all the data, the data overload problem.]
Skîrk (The Scream), Edvard Munch, The National Museum, Oslo, Norway

Soft Watch at the Moment of Explosion, Salvador Dali, Salvador Dali Museum, St Petersberg, Florida, USA