Complexity Toolkit

2017

The Complexity Toolkit is a combination of the resources assembled for the class for the Activity Facilitations.

Disciplines

- Medicine and Law
  - with Oliver, Zoe, Damon, Francisco
- Computer Science, Culture & Language, Marketing, Engineering
  - with Jieming, Arindam, Siqi, Lydia

Tools

- Visualisation, Estimation, Mathematical Modelling, and GIS
  - with Matt, Alex B, Dev, and Daya
- Narrative, Discourse, Sociology, Artificial Intelligence, Statistics, and Big Data
  - with Jie, Shankar, Simon

Insights

- Country, Culture, Truth, Justice, History, Identity
  - with Maasa, Liam, Brigid, Alexandra
- Ignorance, Spectrums, Chaos and Uncertainty
  - with Jess, Georgina, Sylvia, Carly

Approaches

- Design Thinking, Behavioural Economics, Game Theory, Group Dynamics
  - with Eliza, Migara, Yaya
- Appropriate Technology, Strengths-Based Approach & Sustainable Design
  - with Tudor, Tom, Manik, Christie

Attachments can be found on the Wattle Wiki activity.
Disciplinary perspectives on Complexity

The research schools and disciplines at ANU:

• C Advanced Microscopy
• C History & Language
• C Public Awareness of Science
• CHELT
• China in the World
• Coral Bell School
• Crawford School
• Fenner School
• JCSMR
• Law School
• Marketing
• Mathematics SI
• Medical School
• National Computational Infrastructure
• NC Indigenous Studies
• Regulation & Global Governance
• RS Accounting
• RS Astronomy & Astrophysics
• RS Biology
• RS Chemistry
• RS Computer Science
• RS Earth Science
• RS Economics
• RS Engineering
• RS Finance, Actuarial, Statistics
• RS Humanities and the Arts
• RS Management
• RS Physics and Engineering
• RS Population Health
• RS Psychology
• RS Social Sciences
• Tjabal Centre
Disciplines: Medicine and Law
with Oliver, Zoe, Damon, Francisco

Key Ideas

Our task was to research two disciplines: medical research and the law. Medicine is a distinct discipline: a field of research dedicated to increasing our understanding of the human body with the goals of alleviating sickness and disease and improving quality of life. Law, however, is inherently interdisciplinary in that laws must necessarily apply to wide range of disciplines. There is law governing medical research, aviation, information technology, expressions of creativity, and the seabed.

Our first main consideration was communication between disciplines. It is the reason we played the warm up game today. Disciplines inevitably have to interact and, given the specialised vocabularies that exist within disciplines, difficulties will arise when interdisciplinary communication is attempted. One approach is to employ language from another field to communicate the message. For example, in Bob Costanza’s lecture, he spoke of defining the value of the environment in economic terms. That is, the Great Barrier Reef contributes $5.4 billion to the Queensland economy every year. This is effectively communicating the worth of the environment in language that economists will understand so as to communicate a message: the environment is valuable. Similarly, in our meeting with Thomas Faunce, he discussed the granting of a legal status to environmental entities. The Whanganui River in New Zealand, for example, was recently declared a legal entity. Aside from granting the river legal protection, this act communicates to corporate interests and lawmakers that the river is valuable and should be preserved. While Bob was somewhat derisive of placing economic valuations on the environment, we are of the opinion that doing so is actually a powerful way of communicating between disciplines.

In our meeting with Simon Rice, he discussed the two ways in which the law will approach an issue:

1. Regulatory approach
2. Human rights approach

Lawyers consider the medical field to be an area of regulation. As such, there is tension between the legal and medical communities. Susan asked us if we had heard the joke about lawyers and rats, saying that the reason medical researchers experiment with lawyers is because there are some things rats will not do. Susan also said that there is a disconnect between the intention and the effect of legal regulation on the medical industry. Rather than not breaching legal regulations due to safety considerations—i.e. their intended purpose, medical researchers avoid doing so for fear of being sued. Additionally, the medical community often perceives the law as standing in the way of what is achievable.

In terms of duties to their ‘clients’, doctors take a Hippocratic oath and are bound by the do no harm principle. Lawyers have no similar duty to provide access to justice. Lawyers are simply hired to represent the interest of their client, who may be paying a significant amount of money for them to do so. This has earned them the ire of other professional industries.

In terms of communication, there has been a drive recently within the legal industry to simplify the language used in legal judgements so as to make them more readable by the population. Simon Rice suggested that it was not difficult language that made legal judgements inaccessible—specific language is often required so as to allow a specific point to be made—rather it was their length.

Susan Howitt made a point of differentiating between what is complicated and what is complex. Altering genetic sequences, for example, is a complicated scientific process. However, complexity is introduced when ethical considerations are required. I.e., should genetic sequences be alterable to create designer babies.

Core Readings

These are three core readings which address the disciplinary approaches of law and medicine, as well as their interaction in the field of ethics.

1. The Significance of Disciplinary Difference by Tony Becher
2. Literature and Ethics - Thomas Faunce
3. Mason and McCall Smith’s Law and Medical Ethics by Mason, Laurie and McCall Smith pay particular attention to chapters relevant to the tutorial (chapters 7, 8, 17, 18, 19)

Further Resources

Attached are some resources relevant to the specific areas discussed in the group facilitation exercise.

- Religion, ethics, law and human rights in obstetric research by Thomas Faunce
- The new Federal Organ and Tissue Donation Legislation - Thomas Faunce
- A Right to Die? Euthanasia and the law in Australia - by Bartels and Otowski
- The Ethical Challenges of Direct to Consumer Genetic Testing - by Berge and Fryer Edwards
Disciplines: Computer Science, Culture & Language, Marketing, Engineering

Arindam Dutta, Jieming Hu, Lydia Ho, Siqi Zhang

This tutorial facilitation is aimed at exploring what each discipline is about and their respective advantages and disadvantages. We also discuss the pros and cons of working inter-disciplinary and intra-disciplinary. This toolkit is a summary of the tutorial plan and activities. Below lists further resources for those who are interested to explore.

Take Home Message: There is no ‘better way’ to resolve a complex problem. Different disciplines provide a different perspective and understanding towards analysing a complex problem. Interdisciplinary integration helps us to utilise different strengths but cause different problems as well.

For our 'Secret Plan' and other tutorial materials, refer to the file marked Tutorial Facilitation.

The only RECOMMENDED CORE READING would be: Disciplining Interdisciplinarity by Gabriele Bammer Read p3-13. This is also listed in the Interdisciplinary Work Section listed below.

If you are interested in further academic exploration, you can refer to the links and resources recommended below:

Computer Science
- For Siqi’s presentation refer to the attachment marked 'Computer Science'.

Culture and Language
- ARC Center of Excellence for the Dynamics of Language http://www.dynamicsoflanguage.edu.au/about/
- For the presentation of the interview with Dr Uta Reinoehl refer to the file marked 'Culture and Language'

Digital Humanities
- ANU Center for Digital humanities http://cdhr.anu.edu.au/
- Tim Sheratt’s Invisible Australia Project http://invisibleaustralians.org/blog/category/digital-humanities/

Engineering
- Engineer’s perspective on Global Warming.
- Think like an engineer https://www.openlearning.com/courses/thinklikeanengineer

Marketing
- https://www.numbeo.com/cost-of-living/city_price_rankings?itemId=100
- http://www.english-online.at/geography/world-population/urban-areas.html
- For Jimmy’s presentation transcript, refer to the file marked 'marketing'

Interdisciplinary Work

Scenario Problem Resources
- SDG 6: Ensure availability and sustainable management of water & sanitation.
- SDG 11: Sustainable Cities & Communities.
- ACT2020 100% Renewable Project
Tools for thinking about Complexity

Some of the tools we explored for thinking about complexity:

• Appropriate Technology
• Behavioural Economics
• Design Thinking
• Education
• Game theory
• Integrative Science
• Precautionary Principle
• Strengths-based approaches
• Sustainable Design
• Systems Thinking
Tools: Visualisation, Estimation, Mathematical Modelling, and GIS

with Matt, Alex B, Dev, and Daya

Overview

Our tutorial facilitation aims to show you the value of visualisation, critical thinking and common sense when unravelling complex problems and presenting them to the public or communicating with people trained in other disciplines.

Without applying critical thinking, visualisation is simply eye-candy that distracts from the problem and reinforces erroneous thinking. When critical thinking and common sense are applied, visualisations will provide people with a shared idea of what the problem is across disciplinary and cultural boundaries.

When you exercise common sense, you are often estimating the scope, size, or answer to a problem. Because common sense is mostly just estimation, this means it is a skill you can improve. For instance, most people can estimate the distance they walk throughout their degree at university, but with some extra mental tools it is possible to estimate the weight of anything from the weight of the empire state building to the value of a field of study.

We base our facilitation on visualisation, Graphic Information Systems (GIS) including geo mapping, estimation and mathematical modelling. We attempt to make it understandable and engaging in ways so that you create links between these different concepts by using examples from the real world and from your daily life too 😊. Our tutorial facilitation is based around the fact that different tools can come together to narrate a very complex idea or a theme which is full of different sets of data in a simple way.

Take-home message: A problem itself doesn’t have to be complex. However, tools can assist on understanding the complexity.

Visualisation

Visualisation is the presentation of objects, data, information to gain insights into the data.

Interview with Julie Brooke — “Imagine it to visualise it”

Julie Brooke’s personal website & portfolio

While visualisation is often pigeon-holed into a form of presentation, visualization is great for problem solving.

Good visualisation engages with, and communicates, problems effectively without dumbing down the content. The complexity surrounding hyperbolic planes and how an artist sees these objects are very different to a mathematician or a scientist. The basic idea is to let your imagination flow and lend a different perspective to explain a complex idea or process that exists around us.

The take home message of this section is "Imagine it to visualize it". As an artist, Julie attempts to use every material and tool at her disposal to faithfully explore the visualisations that she has developed over the years to understand certain topics. Developing these internal visualisations is something we all do. For the data scientist or academic visualisations simply help to present data in X-Y graphs and charts. Julie believes that visualisations have the potential to be much much more, and to reflect our rich inner visualisations more closely. Of course, this may involve more than an excel spreadsheet. Julie makes use of any materials at her disposal. This is often paint, but includes wire, plastic, and other odds and ends.

Visualisation also slows down thinking. The idea of "Thinking fast and slow" was coined by Daniel Kahneman in his 2011 book.

However in some cases, a visualisation needs to be comprehended fast. Road signs are an excellent example of clear design. Their meaning is never ambiguous, and in the case of the “STOP” sign, it invokes no imagination, conveying it’s message immediately. It’s useful to understand both types of visualisation, but tools that encourage slow thinking are often far more useful in exploring complex problems and helping the public to do the same.

Estimation and Mathematical modelling

Estimation and mathematical modelling both give us numbers. Estimation is a good place to start — a gateway drug — while solid mathematical modelling should underlie any significant findings or original research in many fields.
Interview with Dr. Joanna Sikora

Our interview with Dr. Joanna Sikora provided an invaluable insight into how she used quantitative methods to evaluate complex aspects of her study into gender inequalities. We used her paper on gender ambition in indigenous youth in our tutorial to illustrate these insights. The methodology, results and discussion in this paper are all particularly interesting. The results are simply pure data. This does not immediately portray meaning. However, Joanna then takes this data and discusses it, giving it meaning in relation to the issue, involving many complex social influences. Another interesting example of her work is shared as well. We highly recommend a cursory read of both these papers if you want to further appreciate the powerful capabilities of quantitative methodologies in a social science (complex environment) context.

Interview with Dr. John Debs

“I used to be curious. Now I am fearlessly curious. I feel ready to attack any problem that comes at me, and at least get a feel for why things happen… roughly.” —An anonymous student

TED Talk (Youtube): “A clever way to estimate enormous numbers” —Michael Mitchell

This Ted Talk succinctly encapsulates the roughness and usefulness of the estimation philosophies shared by Dr. John Debs. He regarded estimation as a skill that everyone has, and that everyone should practice and improve.

Street Fighting Mathematics is a book he recommended advocating for mathematical techniques that support understanding and intuition. This is a valuable use of mathematics that is often ignored or even punished in modern maths classrooms which require absurdly precise answers. A link to this book is provided. The following quote illustrates the lifestyle and capabilities of a good estimator.

If you are interested in practicing estimation problems similar to those covered in the tutorial Google Search this phrase: “Google interview questions”. Practice your estimation skills!

Some practice questions:

• How much should you charge to wash all the windows in Seattle?
• How many piano tuners are there in Sydney?
• What's the power output of a human?
• What's the maximum power output of a human?

Graphic Information Systems (GIS)

Graphic Information Systems (GIS) are Computer software based on maps that helps to visualise data, explain trends and manipulate data. Our focus is on geo mapping. Note that GIS does not require you to travel to your study site, it can be used in almost every area, hydrologists, policy makers, engineers, architects. It builds a shared understanding to communicate with different departments, stakeholders, disciplines. It can help to estimate what would be likely to happen in geographic space, so then actions can be taken. All these by using visual representations: maps.

Interview with Dr. Bruce Doran

Bruce Doran is a lecturer in GIS who emphasizes critical thinking in the field. Most often, GIS are maps. While these maps can include a whole lot of different information, arranging dense information for a broad audience is often difficult, but critical in consultancy projects. Bruce encourages students to be creative and explore on new ideas. He considers these skills for the real world. While university provides students with the tools to jump into their careers, it is up to students to take their own ideas further.

To discover where good ideas come from: "WHERE GOOD IDEAS COME FROM" —Steven Johnson

Core Resources

Visualization

• Julie Brooke's website contains some cutting edge work on visualization
• Thinking spaces - A practice led enquiry into Representations of Memory and Thought
• A fascinating paper on axis.
• The following books by Edward Tufte:
  • Envisioning Information (1990)
  • Visual Explanations (1986)
  • The Visual Display of Quantitative Information (1983)
  • Beautiful Evidence (2006)

Estimation

• How gendered is ambition? Educational and occupational plans of Indigenous youth in Australia

Critical Thinking

• Critical thinking or "case-based" approach
• WHERE GOOD IDEAS COME FROM by Steven Johnson.

GIS

• ESRI- GIS Mapping software
• 3D imagery on Peaks and Valleys
• Six maps that will make you rethink the world
• Wind map of the globe
Tools: Narrative, Discourse, Sociology, Artificial Intelligence, Statistics, and Big Data

with Jie, Shankar, Simon

Background

Recent years, global issues such as national security, global warming, qualified education have increasingly posed grave threats to the public. In order to address these thorny problems, it is necessary to gain some empirical knowledge so that we can understand the inner mechanism of these issues better. The tutorial mainly focus on the discussion of six tools, which are AI, statistics, big data, sociology, narrative, and discourse.

Tools Integration

How these tools work together? Narrative and discourse are the outcome of some sociologists’ investigation and will be used to reveal social status and awake public awareness. AI, big data, and statistics have provided another explanation from science’s perspective to demonstrate sociology precisely. Engineers or scientists can reshape a better, closely-knit community after fully perceiving the society according to the information we have gathered.

A Big Problem

It sounds a good plan. The problem is that when we start to use these tools to address the real complex issues, we need to understand the potential consequence of using them unwisely. Gain a good understanding of the way that how we use them and solve the problem is much easier than how we become cautious towards these tools. Take narrative and discourse as an example, it is easy to influence the public because these tools usually supported by some authentic statistics result, but when the data provided is out of fact or too small, the public will be misled, and will eventually have a bad impact on the society.

Think these questions

Q1: What complex problems do you want to unravel?
Q2: What are the advantages and disadvantages of all these tools?
Q3: How will you use these tools?
Q4: Are you afraid of or excited of AI?

Need More Resources?

Core Readings

• 8 main limitations of statistics explained
• Can we build AI without losing control over it?
• Criticisms of Marxism
• Magnus Lindkvist on the Pros and Cons of Big Data
• 10 Horrible Insults From Donald Trump

Further Resources

• Some explanation of the differences between discourse and narrative
• http://softschool.com/examples/literary_terms/discourse_examples/282/
• https://literarydevices.net/discourse/

The background of some study cases

Sociology

• Give me one dollar or I will vote for Trump, Oprah Winfrey, Corporate HQ, Homeless people in Australia

Discourse

• a scene from a Jane Austen movie – represents a different type of society
• indigenous – represents an ongoing social discussion
• SA transmission tower in storm – representing a political discourse

Narrative

• tobacco case, anzac, Honest history, Terminator – fictional narrative: it’s not real!, Turnbull message

Statistics

• income – mean vs median and vaccinations

Big Data and AI

• Big Data is Better Data and
• Potential development of Artificial General Intelligence (AGI)

Expanded Readings


Interview notes from all the academics we have interviewed: see attachments
Insights about Complexity

Some useful insights when thinking about complexity:

- Black Swans
- Chaos
- Country (Indigenous)
- Dimensions
- Diversity
- Emergence
- Entropy
- Equality
- Fractals
- Framing
- Identity & Culture
- Ignorance
- Myths
- Resilience
- Spectrums
- Truth & Justice
- Uncertainty & unknowns
- Wicked Problems
Insights: Country, Culture, Truth, Justice, History, Identity

with Maasa, Liam, Brigid, Alexandra

Introduction

Our group aimed to explore the insights contained in the themes of culture, truth, history, and identity. Because connections can be seen between these themes, we decided to use the wider-reaching notion of identity to demonstrate how the themes influence and help define each other. Thus, the themes were explored in the context of identity.

The tutorial looked at how identity is shaped by culture, relative differences, and memories that are loosely based on history. We aimed to establish that this notion of identity is multi-faceted and complex, often shifting between the realms of subjectivity and objectivity based on context and a wide-range of other considerations. This was achieved through discussion which showed the range and subjectivity of identity, comparative analysis which compared truth and history to memory and culture, and asking students to define their own identity which demonstrated the effect of social context on one’s notion of identity.

All of this was done in an effort to show not only that many factors and themes influence personal and group identities, but that this relationship is symbiotic. Identity itself influences individual and collective perceptions of culture, truth, and history, and insights beyond those that were addressed in the tutorial.

Key Ideas

The key ideas that supplied the theoretical background for this tutorial were as follows:

Activity 1: “You Can’t Ask That”

1. Possessing an identity can be considered objective but the lived experience of the identity provides a strong element of subjectivity in one’s mind
   → we showed this by analysing how different Indigenous people responded to the question of how they identified, focusing on the language used and the reasons for these differences

Activity 2: “Who Am I?”

2. Identity is revealed through difference. We identify ourselves through comparison, looking at ‘unmasked norms’ that manifest itself in our culture. Through this, our individualism is most strongly expressed through the differences we possess, rather than our similarities to others.

3. Identity is shaped through social context. This relates to the concept of lived experience. Although we share objective traits that are like others, our identities are more aligned to the social context in which we’ve developed.
   → by asking students to think about how they identified themselves and how this shifted with context, we demonstrated the idea of the “unmasked norm”

Activity 3: “The Anzac Myth”

4. Interpretations of history are the basis for memories. These memories can become a collective memory, which influences and creates a cultural identity. The truth in the history behind memory is static, but the memory itself is subject to change. This affects how we view our culture. Being confronted by truth that contradicts our memories can have differing reactions, the strength of which often has a relationship by how closely our identity is related to the memory.
   → By analysing a multitude of different sources, we demonstrated the way an Australian identity has been build on a memory of the Anzac legend, and provided tools to challenge its modern acceptance.

Take-away message

Identity is not simple, but rather inherently complex, influenced by many factors both collectively and through an individual’s lived experiences, including one’s context, their relation to the dominant culture, and shared ideas of history.

Core Resources

- You Can’t Ask That: Indigenous
- War, memory, and national identity in Australia - Joan Beaumont
- “What lies beneath a national legend” - Christopher Bantick in the Australian
- “Lest we Forget”: The Politics of Memory and Australian Military Intervention - Matt McDonald

Further readings for explorations

- mic.com video about being “white passing”
- SBS Viceland - Rachel Dolezal, a women with white heritage who identifies as African-American
- Asmi Wood on Law and Identity ‘Does law constitute identity?
- Helen Keane on Social Smoking and how Smokers Identify Themselves
- Article casting doubt on Atatürk’s famous ‘Johnnies and Mehments’ quotation
- Article addressing the myth that Gallipoli was a disaster purely in British hands

Resources that we’ve developed

Powerpoint of sources used in class
Insights: Ignorance, Spectrums, Chaos and Uncertainty

*with Jess, Georgina, Sylvia, Carly*

**What we asked**
- How do we solve complex problems with unknowns?
- Can we use measurement and mathematics to make predictions in infinite dimensions?
- How does ignorance affect society?

**What we read - Core resources**
- ‘Chaos’ by James Gleick, in The Butterfly Effect (explaining chaos theory)
- Bammer, Gabriele and Michael Smithson - *Uncertainty and risk: multidisciplinary perspectives*
- Mike Smithson - Integrating the Unknown (a documentation of years of work on unknowns)
- Joan Licata’s slides on Dimensions (for mathematical understanding)
- Video: David Christian: The history of our world in 18 minutes (TED Talk)
- Video: Michio Kaku and Morgan Freeman Explain Entropy
- J Larson, ‘Ecological stability of forests and sustainable silviculture,’ Forest Ecology and Management (on resilience and resistance)

**What we researched - additional resources**

Multidisciplinary approach:
- Bammer, Gabriele. ‘Six types of unknowns in interdisciplinary research’, Integration and Implementation Insights (I2Insights), (2016).

Note: Gabriele mentioned this blog during our interview with her. She said I2Insights is a blog that attempts to create a space where people with different disciplinary or stakeholder knowledge can come together to share their understanding and discuss complex problems.

**Complexity, chaos, and contradictions:**

**Decision-making and uncertainty:**

**Who we talked to**
- Charley Lineweaver (Chaos, dimensions and prediction)
- Gabriele Bammer (Ignorance, policy solutions)
- David Freudenberger (Resilience, cultural memory, redundancy and efficiency)
- Stephen Hyde (Wavelengths, spectrums, dimensions)
- Pierre Portal (Uncertainty, thinking fast and slow)

**What they said**

Charley Lineweaver spoke on the applicability of mathematics to the social sciences – particularly on measuring variables to make predictions. The advantages of accurate predictions could be huge – we could predict where the next civil war might break out, and take appropriate actions to prevent it. We could also use it to predict election outcomes more accurately – an exercise that could mean less people showing up to polls as they are assured that their candidate will win. Prediction at this level is difficult – we are still struggling to predict earthquakes to a precise timeframe and intensity.

We do use the measurement of finite variables in infinite dimension situations, to seemingly more mundane outcomes. Charley raised the example of dating apps: each one asks particular questions to determine something as complex as whether two people will form an attraction, many to a high degree of success.

Gabriele Bammer introduced us to the developing new discipline of Integration and Implementation Sciences. She spoke to us about the three key ingredients for tackling complex problems. The first ingredient is knowledge. In order to improve our understanding of a problem, we need access to a range of knowledge and perspectives. This insight should come from a variety of disciplines and stakeholders. The second ingredient is a better understanding and management of unknowns. Actions usually need to occur in the face of incomplete knowledge. The final element of tackling complex problems is using what we do know - our improved understanding of the problem - alongside the improved ability to deal with what we don’t know to support decision makers in government, business, and society in general. Gabriele’s insight highlighted to us the importance of accessing a range of opinions and expertise across a number of stakeholders and academic fields.
David Freudenberger shared his ideas of resilience theory and practice of socio-ecological systems. He suggested that complex socio-ecological systems appear to be unpredictable because surprises emerge, however, once we have the language and memory of a system we have a greater ability to predict such surprises. David uses the example of bushfires within Australian. If we look back and form a memory of environmental disturbances such as bushfires that occurred previously we gain a greater understanding of how a system functions. Sometimes when we are unable to predict surprises in a system, disasters occur. He uses the example of the pine plantations around the dam in Mount Stromlo which before the 2003 fires would have been impossible to change due to the vested interest in it remaining the same. However, he suggests we should see disasters within socio-ecological systems as opportunities to rethink how the current system is structured and where problems lie. After disasters, we have the space to be innovative and adaptive to form a more resilient system. So after the 2003 Canberra bushfires, the Mount Stromlo area was redesigned into a recreational park, without the fire the area would not have been able to be reimagined. David shared the ideas from social psychology that state the need to make issues personal to promote change to pro-environmental behaviour. The drought in Canberra illustrated that we do not have a sustainable water supply. Since it affected people directly the reduction in water consumption throughout Canberra was rapid and significant.

Stephen Hyde talked to us about the multiple uses of geometry, in physics and the social sciences; about how it can be helpful to simplify multi-dimensional, or even infinite dimensional problems, into two dimensions on a curve, to condense a large problem into a smaller space.

We asked him how all this complicated geometry could possibly relate to social theory, and he answered: networks. He once ran a study to find the dimensionality of the Internet (when the internet was not as large as it is now), by creating a program that followed links to other sites and mapped the connections between them in order to determine the dimensionality of the Internet. A network’s dimensionality helps determine its speed of growth.

Lastly, we talked about small worlds theory. On the notion of six degrees of separation, Stephen thought the number was in fact lower, something like 4, between most pairs of people in the world. Network theory is particularly relevant in a social media age – it is interesting to acknowledge that this interconnectedness can exist alongside social media echo chambers and distinct pockets of society.

Pierre Portal discussed the different ways uncertainty can arise, how he believes we can deal globally with complex issues and how thinking fast and slow affects the way we respond to complex problems. He suggested that uncertainty arises through naivety, such as rolling a dice and assuming the result to be random, missing information, and through chaos, where very small amounts of missing information can result in large amounts of uncertainty. Understanding our ignorance is an important step in understanding the kind of uncertainty we are facing. Pierre also suggested three steps that could be taken to solve complex issues at a global level. Firstly, we must source knowledge from a wide spectrum of people and fields. It is no longer possible for an individual to hold all knowledge in a field, and although humanity’s knowledge is progressing we rely on experts in sub-fields to provide specialised knowledge. This leads to the second step: communication. For this knowledge to be used effectively is must be shared and combined towards a solution. Discussing ideas is also important in tackling inherent bias. The third step is promoting the idea that the complexity of a solution will match the complexity of the problem. Currently there is too much faith in the use of scientific models while forgetting to consider intrinsic complexities, therefore there needs to be wider understanding of the limits of the scientific method. The final concept we discussed with Pierre was based on ideas in the book ‘Thinking, Fast and Slow’ by Daniel Kahneman. Thinking fast is the gut feeling and intuition you immediately want to follow when making a decision. It comes from our evolutionary instinct to react without delay for thought as a means of survival. It’s a psychological reality that we trust it, but it hinders how we handle complex problems. Slow thinking has less gut feeling with less trust in conclusions, however it is more likely to develop better solutions. Pierre pointed out the importance of recognising when we are thinking fast and teaching ourselves to think slow when facing complex problems.
Our activity

1. Each participant chooses a kind of cupcake without any information (thinking fast)

2. Each participant is told limited information about the ethics of buying that cupcake. Participants must now decide not only which they will eat, but the strength of their preference in contrast to the strength of preference of other participants (e.g. if A chose cupcake 1, and B also chose cupcake 1, who has a stronger preference for it? If it is quantifiable, it is solvable).

3. Participants ignorance decreases through discussion. At the same time, they are given insights from each of the academics.

4. A final spectrum is formed, with participants ordered from the person with the strongest preference for cupcake 1 (and against 2), to the person with the strongest preference for cupcake 2 (and against 1).

5. Cupcakes are eaten while the activity and the academic insights are discussed.

Inspiration: http://www.ventureteambuilding.co.uk/spectrum-lines/

What our activity means

Our activity asks the class to:
Question how you make decisions in the face of varying degrees of uncertainty
Examine how spectrums of opinions can form on the basis of limited knowledge and/or ignorance
Reveal the value of diverse perspectives and the unique knowledge each stakeholder can bring to a complex issue
Consider how mathematical tools can be used to explain and predict social phenomena
Understand how insights (from disciplinary fields, academics, stakeholders, personal experience and morals) can be used to develop a spectrum of strategies for tackling complex problems involving uncertainty and ignorance

Our questions for you
* What did the activity mean for you?
* What would have helped eliminate ignorance quicker?
* How does this exercise apply to the real world?

Further questions for us?

Let us know!
Approaches to address Complexity

Some useful approaches to address complexity:

• Appropriate Technology
• Behavioural Economics
• Design Thinking
• Education
• Game theory
• Integrative Science
• Precautionary Principle
• Strengths-based approaches
• Sustainable Design
• Systems Thinking
Approaches: Design Thinking, Behavioural Economics, Game Theory, Group Dynamics

with Eliza, Migara, Yaya

Take Home Message
Fundamentally different, but there are many ways to approach complex problems, taking into account different disciplines etc., and they are all useful in different contexts, but it is always important to remember that the most straightforward or obvious outcomes or solutions are not always what occurs or what is best.

Design Thinking
Design thinking is an approach to problem solving that puts the users needs first, finds out their needs and then focus on rapidly prototyping, testing and gathering user feedback and then feeding the data back into the design process.

Basic Steps
1. Identify problem
2. Discuss with relevant stakeholders
3. Identify possible solutions
4. Testing & Prototyping
5. Back to the drawing board!

Resources
- http://www.stanforddaily.com/what-is-design-thinking/
- https://www.youtube.com/watch?v=d5_h1VuwD6g

Behavioral Economics & Game Theory

Basic Steps
1. Identify actors
2. Identify actions
3. Identify payoffs and consequences
4. Behavioural econ: look for non-rational factors
5. Look at outcomes/Find optimum strategy

Resources
- http://www.economist.com/node/21527025

Group Dynamics

Group dynamics refers to the attitudinal and behavioural characteristics of a group. Group dynamics concern how groups form, their structure and process, and how they function.

Basic Steps
1. Identify problem
2. Identify goals and expectations
3. Look at group “makeup”
4. Assign roles or predict/explain outcomes
5. Work on problem as a group.

Resources
- Group Dynamic EBook
- The Fifth Discipline
Approaches: Appropriate Technology, Strengths-Based Approach & Sustainable Design

*with Tudor, Tom, Manik, Christie*

This tutorial facilitation focused on three approaches that can be used to navigate complex problems including - Appropriate Technology, the Strengths-Based approach and Sustainable Design. These approaches are often used to compliment one another and provide a holistic methodology to solving complex problems however their use is heavily influenced by the context of the problem. In this tutorial each approach was initially presented on its own to allow students to form a foundation understanding of the topic before combining the three approaches.

**Appropriate Technology**

is traditionally applied to solving complex problems in a community development context. The aim is to develop a deep contextual understanding and identify factors such as cultural and gender roles, social factors and norms and localised capabilities. The main principles to understand when designing a piece of appropriate technology can be found in the core reading on Appropedia.

**The Strengths-Based approach**

revolves around the idea of using the strengths of a system to improve/solve the problem in a constructive way. That is, rather than focusing on the negatives/weaknesses of a system or trying to implement revolutionary practices we should look to enhance the capabilities of a system. Essentially the strength based approach is a method to improve/solve/develop a system using already existing positive aspects of it. For the tutorial this approach was presented in vastly different context to that of Appropriate Technology and was centred around behavioural and cultural frameworks.

**Sustainable Design**

is simply an aspect of ‘good design’. This notion was brought to light through a discussion with a sustainable design academic and furniture designer, Nik Rubenis. This section of the tutorial was used to present how sustainable design is not only applicable to creating tangible products but should be invoked in all design whether its processes, policies, legislature, societal behaviours etc.

**Take-home message**

The take home messages from our facilitation was that these approaches whether they are used as a standalone or combined methodology can be applied to very diverse and intricate range of contexts. Also these approaches do not have a defined solution or output and can be used to create products, processes, behavioural frameworks, policies etc. So hopefully students will now be able to remember these approaches for when we encounter problems in our own lives and use them to come up with creative, innovative and effective solutions.

**Appropriate Technology**

- Playpump – A revolutionary design
- Playpump – Where did it all go wrong?

**Strengths Based Approach**

- The Birth Song of the Himba Tribe

**Sustainable Design**


**Case Study**

Fuel for Cooking in Developing Countries