Critical Thinking and Argumentation

Javier Larrosa

UPC Barcelona Tech

.

Introduction

- We all have **opinions** about different issues...
  - *Education* should be free.
  - *Catalonia* should be independent.
  - Cars using *fossil fuel* should be banned
  - There should be *patents* on algorithms
  - *Linux* is better than *Windows*
  - The *blockchain* technology will replace physical money shortly
  - *Walking Dead* is a great series

fact

Normally we do not think much about how did we get these opinions

Introduction

Critical Thinking

is about being **the owner of our opinions**. Having **our own understanding** of the world.

Our opinions must go through a **conscious critical filter**, before being accepted.

Critical Thinking

- It is arguably one of the most **noble goals** we may achieve as human beings (ultimate freedom).
- It may cause **discomfort** because we are social animals and **we look for acceptance in our "tribe"** (and follow our leaders)
  - **Politics**: left-wing vs right-wing
  - **Catalan politics**: independentists vs constitutionalists
  - **AI**: neats vs scruffies
  - **Statistics**: bayesian vs frequentists
- It is **tiring** because **it is not in our nature**, and because it forces us to reconsider our previous believes all the time
- It is not realistic to fully know the reasons of each one of our beliefs
- It is less tiring if we **train** our brain

Habits of Critical Thinking

- **Metacognition**: being aware of our thinking
- **Disposition**:
  - Inquisitiviness (desire to learn)
  - Curiosity (desire to broad the scope of your knowledge)
  - Humbleness (when finding contradiction to our believes)
  - Self confidence (making judgements, challenging others,...)
  - Open-mindness (being aware of one's biases, empathy,...)

Critical Thinking Attitude

Judea Pearl @yudapearl · 13 feb.

I plan to stick around for another 2-3 decades, so just tweet if you want to dissolve any disagreement. Lucky for us, modern #causalinference leaves no room for lingering disagreements, they can now be examined under the microscope
and breed poetry. #Bookofwhy #epitwitter

Ellie Murray @EpiEllie

En respuesta a @yudapearl

It's been great chatting with you this past year. I've learned tons even (especially?) when we disagree...

...which I'm gonna about the fun of mixing foods,...

Traducir Tweet

2 32

Habits of Critical Thinking

Example

Your friend John, a technology geek, tells you how good is his new iphone X and how happy he is having it

- Do you think your friend is being honest?
  - he may not like to look as a fool after expending his money
  - may be part of his joy is from bragging
- What does the phone has that predecessors did not?
  - try to get specific information
  - how important is it?

Critical Thinking in our everyday life

- Critical Thinking relates with **creativity** and **sound reasoning**.
- It enables a person to investigate a situation, problem, question, or phenomenon to arrive at a viable hypothesis, conclusion, or solution
  - It makes you and **independent thinker**, **problem solver**, **innovator**
  - It may be a vital skill in today society (may be more than a responsible and hard worker)
- There are some jobs where **sound reasoning** is very important: **judges** (people vs. Collins), **doctors**, **scientists**

How Data Influences Opinions

Fact:

- In 1992, Stella Liebeck spilled coffee in her lap and burnt it
- She sued McDonalds for $2.9 million dollars (and she finally got approx $800000)

Opinion:

- Of course coffee is hot! if you spill it on yourself, you will get burnt
- Stella "Beat the system"

(Ridiculous) Consequence:

- Now most plastic lids warn "Coffee is Hot"

.

Some countries (like Norway) do not allow lawyers to work on percentage

How Data Influences Opinions

- Stella Liebeck: 79 years old, cashier ($5000/year)
- Early morning, after rushing to take her son to airport
- Buys breakfast, pulls the car into a parking space to add sugar and cream. Holds coffee between legs.
- Spills coffee (85 degrees hot)
- second and third degree burns on buttocks, thighs and labia (extremely painful)
- 7 days in hospital + 3 weeks of recovery
- her weight droped 10Kg

How Data Influences Opinions

- First reaction: letter to McDonalds requesting lower temperature and $2000 (actual cost). McDonalds offered $800
- Investigation:
  - McDonalds had 700 previous burn complaints
  - Beverages over 55 Degrees are not drinkable
- Subsequent reaction: Sue McDonalds (negligence causing major injuries), $2.9 millions

Critical Thinking

- Back-ground context is important
- Different (conflicting) points of view may be reasonable
- In this example: Doctors, Lawyers, Politicians, Media,...
- What does it have to do with Research?
  - We have all the time conflicting reviews
  - Take them with open mind

Critical Thinking

Critical Thinking = Claim + Argumentation

Claim

Opinion, hypothesis, conclusion, solution that must be arguable (falsifiable)

Accepting a claim requires an argumentation

Argumentation

Support for the claim

Example

- Fact (?) that triggers our thinking: The percentage of shortsighted population is dramatically increasing
- Claim 1: it may be because kids spend many hours looking at screens (tv, computers, cell phones,...)
- Argum 1: (medical)
- Claim 2: may be they should spend one hour per day outdoors
- Argum 2: (medical)

Claims

An opinion, hypothesis, belief that comes from our thinking

- It has to be **arguable** (falsifiable)
- It has to be **precise** (makes falsification easier)

Operative Systems

- Not a claim: all my friends say Linux is better than Windows
- Claim: Linux is better than Windows
- A better claim: Linux does a better memory management than Windows

Claims?

1. I believe in God
2. God Exists
3. I can tell the future (fortune teller)

Argumentation

- **Argumentation**:
  - **Premises**:
    - Evidence (observable facts)
    - Assumptions (beliefs generally accepted as true)
  - **Reasoning**: link between evidence, assumptions and claim

- Argumentation can be **internal** (a thought process to convince ourselves) or **external** (a public exposition to convince the others)
- Ideally, arguments should be **irrefutable**. But this is not realistic in many contexts

Example

Illegal Music Downloading

Illegal file sharing is one of the largest uses of Internet (900 million illegal files available). It should be heavily punished because it is completely destroying the music industry and that hurts all of us who want to enjoy quality music. People no longer buy music; they rip it off. Artists can no longer make a living, music stores have gone bankrupt.

- claim:
- argumentations:
  - evidence
  - assumptions
  - reasoning (argument chains)

Example

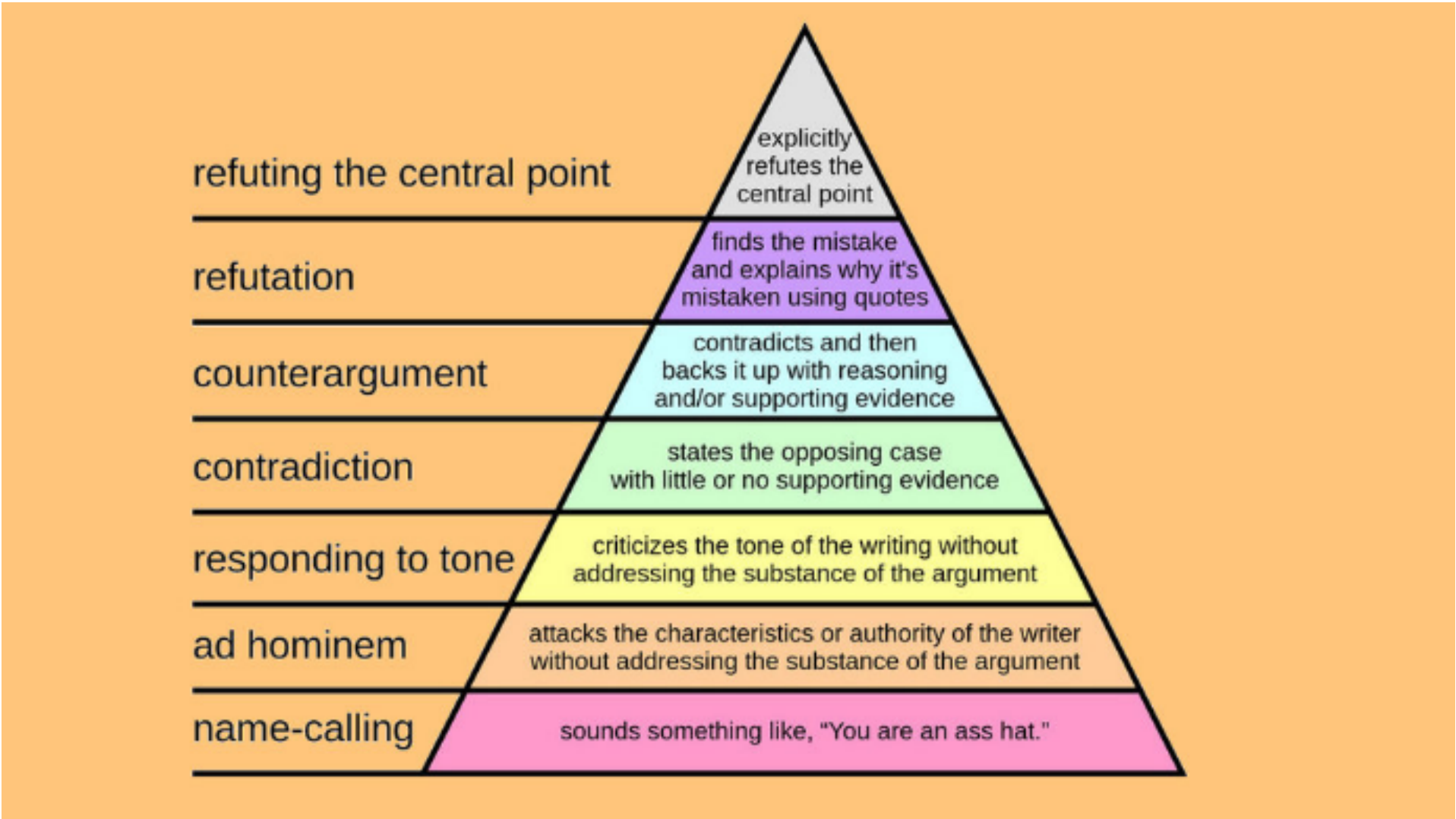
Illegal Music Downloading

Claim: We should punish illegal music downloading in order to enjoy good quality music

Argumentation:

- Evidence: Illegal file sharing is an issue
- Assumption: Illegal file sharing is bad
- Reasoning: If we punish illegal music downloading, then people will not do it anymore. This will increase the music sales, so musicians will make money and will have the resources to compose good music. Therefore, we will be able to enjoy good quality music.

How to disagree well (P. Graham)



Critical Thinking and Argumentation in Science (Social Context)

- **Knowledge increases** through Critical Thinking and Argumentation
  - Introspective work of scientists
  - Incorporation of new ideas into knowledge corpus
- Argumentation is not to be seen with a negative connotation, but as the final challenge of our CT
- CT and Arg in a **social context** is a global process. Claims, once fully accepted by the group, may become evidence in future argumentations (or they may be revised and discarded)

Example

1. You can solve a problem with a computer, if you can write an algorithm that solves it.
2. Can computers solve all problems for which algorithms exists?
3. Time exponential algorithms are not practical
4. The Simplex algorithm is time exponential and still practical
5. Worst-case complexity does not capture the full picture of time complexity

Evaluating an Argumentation

Identify the context

- Argument Spheres
- Argument Fields

Argument Spheres

Determine what is a valid claim, evidence and reasoning

- **Personal**: Actors are members of relationship, arguments are evaluated by group standards
  - low requirements for claim acceptance
  - little social impact
- **Technical**: Actors are specialized members of the field, arguments are evaluated by field standards
  - high requirements for claim acceptance
  - *little* (?) social impact (due to jergon)
- **Public**: Actors are journalists, politicians, social media influencers,..., arguments are evaluated by general public
  - medium requirements for claim acceptance
  - high social impact

Example

Deep Learning

- **Technical**: "Deep Neural Networks are Easily Fooled: High Confidence Predictions for Unrecognizable Images". In Computer Vision and Pattern Recognition (CVPR '15), IEEE, 2015.
- **Public**: "How To Tell If Machine Learning Threatens Your Job". In Forbes 2011
- **Personal**: "Doing a Ph.D on deep learning is a good option because it is cool and you will get a good job afterwards"

Argument Fields

An implicit or explicit **agreement** by a group of people about

- Object of study
- what is knowledge
- specialized language
- valid reasoning

Examples: Law, History, Math, Computer Science,...

Argumentat Chains

Formally, A and $A \Longrightarrow B_1$, $B_1 \Longrightarrow B_2$,... $B_{n-1} \Longrightarrow B_n$, therefore I claim B_n

Example

Claim: We should punish illegal music downloading in order to enjoy good quality music

Argumentation: If we punish illegal music downloading, then people will not do it anymore. This will increase the music sales, so musicians will make money and will have the resources to compose good music. Therefore, we will be able to enjoy good quality music.

Evaluating a Chain

The weakness of the claim is the weakness of the weakest step

Hedging Language

example

Most dogs are friendly and I want a friendly pet so I **should** get a dog

Used to soften a claim, evidence, reasoning,... to make the argument more defensible

In Science sometimes is needed, because absolute statements rarely hold.

However, sometimes it is a sign of

- lack of self-confidence
- lack of good-quality claims

politeness is not hedging

Phrases like *In my opinion...* or *I believe that...* are often used for politeness purposes, not hedging

Example

Homeopathy

Your friend John claims that Homeopathic products should be sold in pharmacies, because they work. He tells you that Yesterday he felt miserable, then took homeopathy and today he is much much better. You have heard of lots of people also saying that it works for them.

- how reliable is the source?
- what assumptions have been made? are they reasonable? can they be verified?
- is the reasoning solid?
- Is there an alternative conclusion to the claim?

Example

Homeopathy

Yesterday I felt miserable, I took homeopathy and today I am much much better. Therefore **it is likely that** the homeopathy worked on me. I have heard of many other people having similar experiences, so **it seems that** homeopathy can heal. Therefore, I **advocate** that homeopathic products **should be** tested with standard medical methods and, **if successful**, sold in Pharmacies.

Forms of Reasoning: Deduction

Moves from general statements to specific conclusions.

Example

There are dolphins all over the Mediterranean. Barcelona is a coastal city in the Mediterranean. Therefore, there are dolphins in the Barcelona coast.

Example

Algorithm A is better than B, if it is asymptotically faster and does not need asymptotically more memory. Quicksort is better than Bubblesort

Forms of Reasoning: Induction

Moves from specific to general (relies on statistics)

Example

From Medical databases about patients of all ages, genders, locations, etc, we can conclude that smoking **increases the risk** of lung cancer

Example

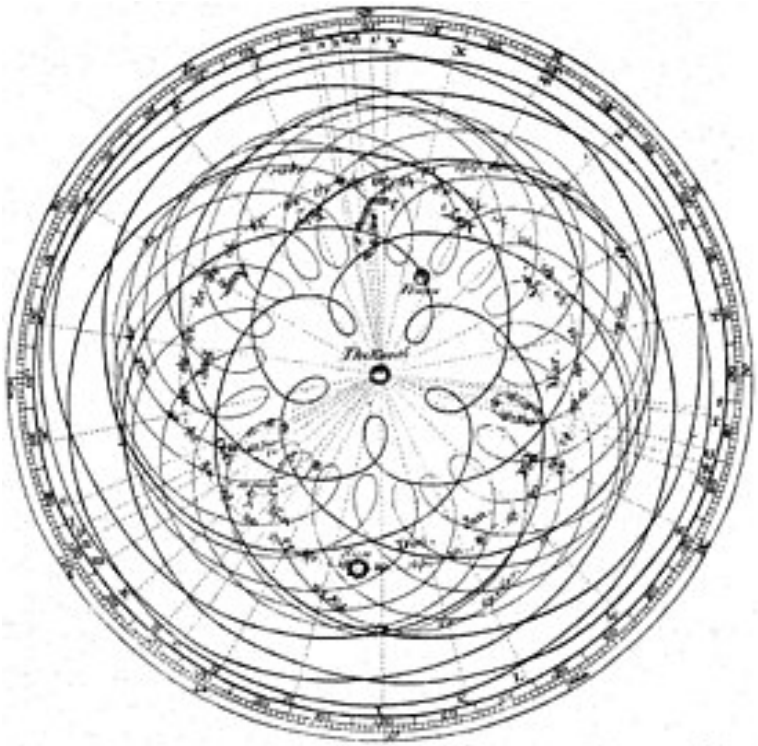
Intel Xeon E5-2679 v4 @ 2.50GHz processor **is faster** than AMD Ryzen Threadripper 1950X.
Based on performance tests reported in www.cpubenchmark.net

Forms of Reasoning: Abduction

Moves from specific to general (relies on simplest explanation)

Example

Ptolomeo's **geocentric** model vs Copernico's **heliocentric** model



Fallacies

Definition

A failure in reasoning which renders an argument invalid

We very often have mistaken believes based on unsound reasoning. It is important to know at least the most common patterns.

Fallacy: Jumping from correlation to cause

Definition

Assuming that correlation implies causation.

Example:

- "We find that books in the home have a positive payoff in improved test scores throughout the world. The relationship is strong, clear, and statistically significant in every one of the 42 nations we studied." Mariah Evans, University of Nevada-Reno.
- Therefore, buy books to make your kids less likely to fail at school

Fallacy: Hasty Generalization

Definition

Generalization from non-representative evidence

Example:

- "US Universities are way better than Spanish ones" J. Larrosa 2000.
- At this time, my only knowledge of American universities was from Conferences and a post-doc stay in California

Straw Man Fallacy

Definition

Oversimplify a claim in order to make it less defensible:

- Claim: "High quality higher education should be accessible to low-income families if we do not want to lose talent and be a competitive country"
- Counter-claim: "Free university access to all is very expensive, so taxes will have to be increased and that can hurt the Economy. Besides, many more people will chose to delay entering the working market which means even more money to build new universities and less people to pay for it."

Approaching an Argumentation Critically

When you approach an argumentation (e.g. an academic paper, a lecture, a TED talk,...) you must,

1. Deconstruct the Argumentation
2. Evaluate the Argumentation

Deconstructing the argumentation

Identify the **context**,

- argument sphera
- argument field

the **parts**,

- Claim
- Support (evidence, assumptions)

and the **reasoning** chains

Evaluating the argumentation

Then you should have a questioning stance

- Evaluate the **claim**
  - is it precise?
  - is it falsifiable?
- Evaluate the **premises**
  - evaluate the sources (reliable?)
  - evaluate the assumptions (reasonable?)
  - evaluate the facts (testable?, reproducible?)
  - look for bias
- Evaluate the **reasoning**
  - How well the premises are linked?
  - What type of reasoning is used? (deduction,...)
  - Look for fallacies
  - Check the hedging

Example

Illegal Music Downloading

Illegal file sharing is one of the largest uses of Internet (900 million illegal files available). It should be heavily punished because it is completely destroying the music industry and that hurts all of us who want to enjoy quality music. People no longer buy music; they rip it off. Artists can no longer make a living, music stores have gone bankrupt.