

The Heartwares of Research

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Introduction

- Why this talk ?
 - Anthony have some thinking which he want to share.
- What is the heartware of research ?
 - It refer to the attitude and mentality towards research which is more important than intelligence but which is more often overlook
- This is the opinion of a very young researcher, so take it at your own risk!
- And of course, people born in different environment will have different restriction. It is up to you to decide how to apply the discussion here.

Outline

- Why do research ?
- What are the heartwares for research ?
- How do heartwares affect research ?
 - Input
 - Digest
 - Output
 - Collaborators and the Research Community

Why do research?

- The aim and objective is most important in a war likewise in research.
 - ...一曰道，二曰天，三曰地，四曰将，五曰法。道者，令民于上同意，可与之死， ...
- The wrong reasons
 - Don't know what to do after undergrad, so do research to get my Phd/Msc
 - To get my Phd/Msc so that I can earn more money and be famous
- The right reason
 - I am interested in constantly learning and applying what I learn
 - 学而时习之，不亦说乎。有朋自远方来，不亦乐乎？人不知而不愠，不亦君子乎？

Heartwares of a good researcher...

- Interest and Curiosity
- Honesty and Integrity
- Open but Critical Mindset
- Diligent and Discipline
- Intelligence vs Patience

Interest and Curiosity (I)

- It is common knowledge that people are better at doing things that they enjoy. Example: many people can spend the whole night playing computer games and don't feel tired
- A good researcher will be interested to learn new things whether it bring about benefits or not (好学)
- Confucius use the term “好学” on only two person
 - 孔子曰：『有颜回者好学，不迁怒，不二过。不幸短命死矣，今也则亡，未闻好学者也。』
 - 孔子曰：『圣则吾不能。我学不厌而教不倦也。』

Interest and Curiosity (II)

- Putting too much emphasis on materialism and reputation is detrimental to research
 - ... 致知在格物。物格而后知至。知至而后意诚。意诚而后心正...
- Of course, we need to have money to survive, but most of us is probably not dying of hunger anyway. The question is how much is enough.
- Research is full of setbacks (papers rejected, other people publish the same idea...). But you can easily overcome these as long as you enjoy yourself

Honesty and Integrity

- If research is done based on interest and curiosity, then honest and integrity come naturally. Would it be fun to play a hacked computer game where you cheat your fellow players ?
- Likewise, what is the kick in having a paper in which you know the idea do not originally come from you ?
- Once a person's honesty and integrity is in doubt, people will always doubt the originality of his/her work.
- We have no choice on whether we are born intelligent, beautiful or handsome, but honesty is something we can also choose to follow.

Open but Critical Mindset

- One should also be open to the possibility that one is wrong
- More importantly, one should judge and analyze things themselves rather than looking at who is the one giving the opinion
- Again, this should come naturally for people who do research because of interest and curiosity.

Diligence and Discipline

- Again come naturally with interest and curiosity.

Intelligence vs Patience

- Intelligence is of course important for research but not as important as patience
- Think fast vs think deep
 - Think fast is good for examination
 - Think deep is essential for research
- A person who think fast might not necessary have the patience to think deep
- Obviously, a person who have the wrong aim in doing research will be more interested in thinking fast than thinking deep

How do heartwares affect reseach ? Input(I)

- Garbage in => garbage out. Without comprehensive knowledge, no good research can be done
- What you learn is yours, no one can take it away.
- A little knowledge is a dangerous thing, at least you should know what you don't know
 - By right, the more you know, the more you realize you don't know, the more humble you become
- Where to get information on your research ?

How do heartwares affect reseach ? Input(II)

- A good book will help too. Typically, for established research area, a book will help to summarize the old materials while research papers are used for new development
 - Amazon.com is a very rich source of information!
- Finding out established conferences and scan through their proceedings
- Finding out established researchers in the field and check out their work
- Google keyword search
- Patience and interest are needed for all these

How do heartwares affect reseach ? Input(III)

- Overcoming Yourself
- Mathematic Overdose Syndrome
 - Dizziness from mathematical symbols
 - Hot under the collar
 - Very thirsty
 - Feel like banging head against the wall
- Medicine Drinks lot's of cold water
 - breathe slowly
 - be conscious of your emotion
 - remember that what you learn is yours!

How do heartwares affect reseach ? Input(IV)

- Updating yourself
- Keeping track of accepted papers in latest conferences
- Keeping track of established researcher website
 - <http://www.aignes.com/features.htm>
 - http://dmoz.org/Computers/Software/Internet/Site_Management/Monitoring/
- Random Web search

How do heartwares affect reseach ?(Digest)

- While one can proceed to read a lot of material, now does not necessarily be able to digest the material.
- How do one know whether the material learned had been digested ?
- Answer: Being able to form a logical framework connecting the materials that you read.

Example of a Framework

Techniques

- Association rules discovery
- Sequential Pattern Discovery
- Cluster analysis
- Outlier Detection
- Classifier Building
- Data Cube/Data Warehouse Construction
- Visualization ...

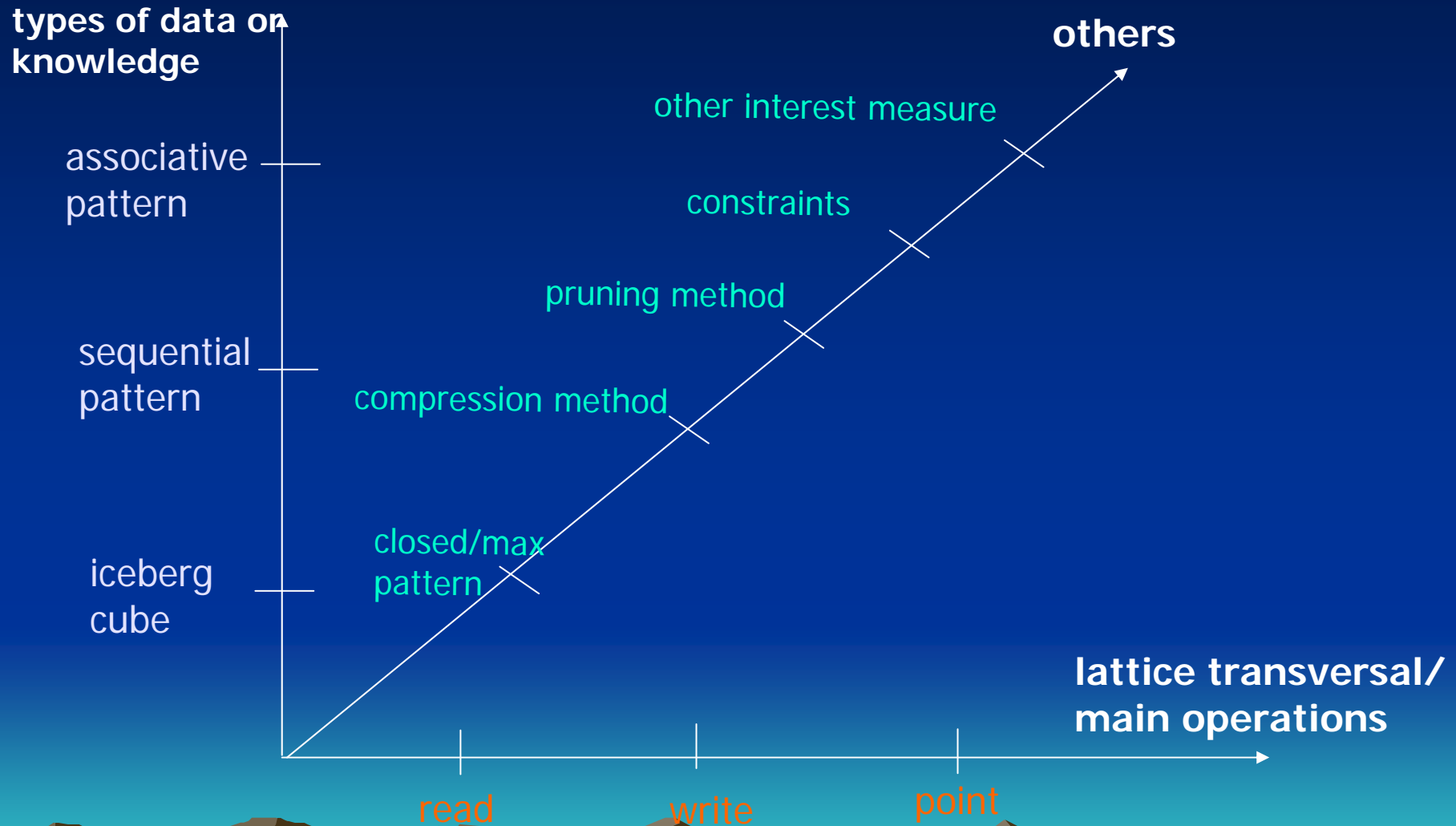
Applications

- Customer Relationship Management (CRM)
- Web pages Searches and Analysis
- Network Security
- Geographical Data Analysis
- Genomic Database ...

Principles

- **Database Technology:**
 - Indexing, Compression, Data Structure
- **AI/ Machine Learning**
- **Statistics**
- **Information Theory**
- **Theoretical CS :**
 - Approximate, Random, Online Algorithms
- **Mathematical Programming**
- **Computational Geometry ...**

A Multidimensional View of Frequent Pattern Discovery



How to form a framework?

- Reading a good survey paper. But this implies not forming the framework yourself => may not have digest
- A framework can typically be formed by
 - compare and contrast materials
 - identifying dimensions to compare and contrast (PCA)
- How to identify the dimensions ?
 - most papers will highlight their contributions and argue that certain issues are important
 - most papers will criticize some related work
 - scrutinize yourself! be critical

Typical Performance Measurement for Comparing Techniques

- Space
- Speed
 - CPU Cost
 - I/O Cost
- Accuracy
- Generality

Component Based Comparison

- Break down things based on the role they played
- Example: In data mining, we need to look at
 - models
 - scoring functions
 - search techniques
 - database techniques

Importance of a Framework

- Having form a framework help you to identify research area which has not been looked into
- It also give you a clear understanding on how to position you work
- Identifying a solution to new problem is easy because you know which part of the framework must be changed

How do heartwares affect reseach? Output(I)

- No matter how good your research is, it is of no use if you can't communicate you idea to other researchers
- Packaging is important too when it come to research
- Two way of output
 - writing
 - talking/presentation
- For a start though, there should be pride in what you want to output and genuine sincerity in wanting to let your reader and audience understand your work

How to learn to write ?

- Improving your English
 - read/listen more example news/newspaper
 - if you are still reading/writing in your mother tongue more than 50% of your time, then your English will hardly improve
- Reading papers
 - instead of focusing on understanding the technical details, focus on analyzing the organization
 - after reading the paper, try to rewrite it. start with rewriting some of the paragraphs/sentences(try at least 5 ways!)
 - memorize some of the well written paragraphs or sentences if necessary

First Draft

- Have an overall outline and fill in as much as possible ignoring grammar etc.
- If possible, list out the notations that is needed in a table form first
- List out whatever you think is important in your mind first
- Can leave out introduction, discussion and conclusion first

Typical Organization

- Introduction
 - Motivation
 - Contribution
 - Organization
- Preliminary
 - Definition/Notation
- Solution
- Experiments
 - Explain datasets, default parameters, measurement, competing solution
 - Varies parameters & show experiments
- Discussion
 - generality of solutions/future improvement
- Conclusion

Refinement

- Involve the following:
 - Reorganization to improve the flow of thoughts for reader. Can reader understand this part without knowing something else that is not mentioned earlier? too much repeats ? same words in the same sentences ?
 - Add in running examples to illustrate definition/algorithms/lemma/theorem. can be helpful for complex stuff!
- With collaborators
 - Should add in comments to highlight the changes
 - more often than not, discussion is done through the writing of papers
 - latex can be helpful in this case

Proof Reading

- At least two rounds
- Read to correct grammars/spelling etc
- Pretend that you are the readers and try to follow the technical details. Try hard to misinterpret what you have read and assume you got no prior knowledge

Presentation

- Organization of a presentation can typically follow that for a paper
- Try to give audiences a mental map of where they are
- When in conference, presentation is usually short and the aim is to attract people to read your papers! Technical details can be done by hand-waving.

Collaborators and the Research Community

- Collaborators are people who share common research passion. Collaboration should be done with mutual respect and sincerity. Go into a collaboration thinking of how you can contribute rather than what you can get
- Likewise, the research community is a group of people who come together to learn from each other on some common topics. Respect them and their work and you will be respected too. Example: people who cheat their fellow players in multiplayer game are always frowned upon.

Conclusion

Research

Heartware

- 博学，审问，慎思，明辨，笃行
- The speaker is not important. The content is.