Pedagogy Sciensation'18 Questionnaire

3rd edition – Abstraction, Education and Pedagogy

General Instructions

- Participants can send in their research write-ups in teams of three
- There are two parts- Analysis and Synthesis
- The Analysis part gives the required subject background.
- Participants would have to submit both Synthesis themes, would present only one in the competition, the team which secures more points in analysis round gets the first preference to pick a particular Synthesis theme.
- The team which would have submitted the best research shall present during the event.
- Interesting wrong answers are valued more than correct answers, at Sciensation!
- If you disagree with any implicit assumptions in the question, please state your point of view explicitly. You'd receive extra credit.

Selection Criterion

- Examples- Can the participant provide intuitive examples to justify the logic?
- Eloquence- Were the arguments explained carefully?
- Rigor- The arguments/assertions need to be justified.
- Robustness- Can the argument break down easily? How general is it?
- Elegance- Were the arguments beautifully constructed?

Scoreboard

	Examples	Eloquence	Rigor	Robustness	Elegance
Analysis: P1	/5	/5	/5	/5	/5
Analysis: P2	/5	/5	/5	/5	/5
Analysis: P3	/5	/5	/5	/5	/5

	Examples	Eloquence	Rigor	Robustness	Elegance
First Theme	/5	/5	/5	/5	/5
Second Theme	/5	/5	/5	/5	/5

Total (Analysis + Synthesis):

Analysis1: Theories

Q1: Why do we observe things around us? Why compare observations? Why compare the earth with a ball? Why did Henry Ford compare car with a horse (if he listened to his customers, they'd ask for a faster horse)? Why did Steve Jobs call computers as bicycles of the mind (Humans are tool builders, they build tools to amplify innate human capabilities and computers)? Are we using bicycles to understand computers or computers to understand bicycles? Does this make knowledge more compact?

Q2: How do we understand the stars, how about the animals, global economy and what about the human mind? A lot of things? How is this much of knowledge and wisdom captured within a few pages? How do we get general rules to describe these phenomenon? Is it a coincidence that the same rules apply everywhere? If we didn't have general rules, would it be possible to have such a small set of rules which describe a wide variety of phenomenon? How does this change the way we go about exploring the world around us? Does it give us more confidence? Does it make our exploration easier?

Q3: Why do we come up with explanations? Why did you get a fever? Why do CEOs wear white shirts? Why don't we depend on observations alone, why explain these observations? How are explanations useful? How would you compare "all advertisements containing a lot of yellow were successful, so your poster should have more of yellow" with "kids like brighter colors and yellow is a relatively (to red) cooler bright color, so your advertisement can have more of yellow"? Why do we look for general rules?

Q4: Textbooks describe theories, but why study them? Legendary economist C.K.Prahlad's theory "Fortune at the Bottom of the Pyramid" explains that companies can make money by selling to the people with low purchasing power. How does this theory help? Does it change the way we look at business or the way we look at education in general? Charles Darwin's theory explains that evolutionary recurring situations have brought out a few characteristics- like fear (to prevent danger) or hunger (to make us eat). How does his theory help? Would we not be eating food if we didn't know about Darwin? Does Darwin's theory help us in understanding the current design of human body (people who had too much of hunger didn't get enough food and those with too little hunger didn't get enough energy)?

Q5: Few technologists believe that mobile apps have to be designed only after pen paper testing, to understand the nature of problems to be solved. For instance, Uber should start coding only after it understands how a customer books a cab and how a taxi driver goes about picking a ride. Why work out features from experience and not the other way round? Computer Scientists classify programs basis the number of steps (Big O notation), how is it useful? Would it help a coder in judging the code, would the programmer know about the possible speed even before coding, by seeing patterns/markers?

QFD: Come up with five very different observations and connect them into a theory and critique it!

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Analysis2: How do we look at theories?

Q1: Would you prefer practical learning or theoretical learning? Would you prefer to learn how to write a code or would you prefer reading different computer scientists explanations of what makes a code beautiful? Is it possible to research computer science without knowing how to code? How do we have so many accomplished computer scientists who proudly claim that they can't code?

Q2: Is our college education related to the kind of work which one does at the workplace? Is school education contributing to employability of students? How do we make sure that students learn something which helps them in getting a job? But wouldn't technology change by the time students complete their education? Would we be able to predict the future and teach accordingly? Would that put students in a disadvantaged position? Would it matter? If everybody doesn't know about the future technologies, would it disadvantage a particular student? So if no school or college can teach this, should a student teach himself? Then what should a school or college teach? Technologies can change with time, but do ideas or does the process of learning change with time?

Q3: Many university professors do not have industry experience and they spend their entire professional life studying the nature of their discipline and various research methodologies to tackle novel problems. How can they prepare students for the industry if they have never worked? Why would companies prefer students, taught by these great professors, over experienced professionals (from normal college backgrounds)? How does research background help the professors in tackling industry problems (consulting projects)? Can the industry problems be reduced to fundamental questions? Which is harder- picking up technical skills or breaking down fundamental problems? How do theories help?

Q4: How do we look at cyber security? How do we ensure that nobody understands our emails? How do we encrypt emails? A computer scientist reduced this problem to a riddle- "you have a Kohinoor diamond, a box, a lock and a key, the diamond has to be sent to a friend. You cannot send the key or its duplicate, but you can use a courier as many times as you want, the courier is the only communication link between you and your friend, how would you send the diamond"? How is this question related to the idea of cyber security? Do you think theories help in breaking problems into riddles?

Q5: Why don't observations/facts suffice? Why does tech-creation require an abstract understanding of these facts? Why bring in experiences from other fields or old technologies into new problems? Why do most adults struggle to pick Data Science? Why are technical skills lot easier to pick up, in comparison to deep thought? Can analytical thinking be taught as a practical skill? Are technologists built up of genius or is it just a perseverant pursuit of ideas derived by critically evaluating various experiences?

QFD: How do we get kids to see ideas in our classes, rather than just content?

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Analysis3: Theorizing

Q1: Do professionals create their own theories? Why do visionary CEOs end up writing so many books? Why do they end up creating new theories? Can our existing theories help us in tackling all the situations around us? With new technological waves changing our lives so radically, would we require lots of new theories? Can a professional wait for the academia to come up with a theory or should the professional create his or her own theory? Should the professional create a robust theory to tackle the problem or should he/she use ad-hoc heuristics to tackle the problem?

Q2: A computer scientists looked at various methods used to solve problems. He observed that they can be broken into two broad categories. One kind of methods worked for almost any problem while the second kind worked for a very few problems and one couldn't predetermine where it works and where it doesn't. For example, we have the long division method to divide one number by another, this method works for any two non-zero numbers. We can club numbers to multiple them faster, for instance 16 X 25 can be written as 4 * 25 *4 which is 100 * 4 = 400 and this trick/hack cannot be used to solve all problems. Why would the computer scientist be interested in dividing methods into these two broad categories? Why divide methods into algorithms and heuristics? Do we teach algorithms or heuristics? Would most real life problems involve algorithms or heuristics? Can a heuristic be taught as a rule or as content? Can heuristic only be taught as an idea? Why don't schools/colleges teach heuristics?

Q3: Which is more exciting- telling a student that methods can be divided into algorithms and heuristics or showing how a computer scientist ended up classifying them? Which is more fun- knowing the answer or arriving at it yourself? Why are these aha moments or Eureka moments so valuable? Does a learner struggle while learning something? Even if a learner ends up understanding something, does the idea get better over a period of time? Do teachers recognize that ideas take time to stabilize in our minds? Does our examination system respect this? How do get them to internalize these ideas within the time deadline? Does life give us enough time to internalize ideas? How do we accelerate the process of internalization? Would a student internalize a concept faster if he/she arrives at it himself? Would the struggles of exploration help? Why is it important to make students to explore get their hands dirty?

Q4: Once a student internalizes a few ideas, does he/she get comfortable with the subject? Wouldn't this give more confidence to learn something else? Why do we have polymaths? Why do some people who have mastered one discipline find it much easier to venture into another discipline? Should school education then help a student in acquiring this intellectual depth and hence the much needed confidence to overcome the fear of reading several pages of theory?

Q5: Mathematicians are generally divided into two different communities- theorizers and problem-solvers. Which community is more important? Can we solve problems without having a conceptual

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understanding? Can we develop conceptual understanding without solving problems? How do we help kids in becoming theorizers, how do we nurture the ability to come up with good explanations? How do developing problem solving skills, how do we get them to learn from previous problem solving experiences? How do we get them to develop their own heuristics to solve problems?

QFD: How do we empower kids to become theorizers and problem solvers?

Synthesis1: Technology Education

Q1: What is technology? Is technology an enabler for problem solving? How do we teach kids tech enabled problem solving? How do we get them to see various use-cases of technology? How do we teach the idea of a use-case (Whatsapp can be used for texting, sending price quotations, sharing location of a meeting etc)? Why is it that very few visionaries see unique use-cases with business potential? Would this be a business skill or a technology skill or would this involve a combination?

Q2: Should coding be looked at as a mechanical activity or as a creative way of solving problems? Why do most engineering graduates look at it as a mechanical application of rules or routines? Why do most innovative companies look for creative problem solvers? Can new problems be solved by old techniques? If new problems can be solved by old techniques, wouldn't it be solved already? Would a company see value in getting their smart coders to tackle problems requiring new ideas or routine problems requiring mundane coding? Which kind of code would be more valuable in the market- one which requires mechanical and thoughtless coding or one which requires out of the box problem solving? Why would a technology company get an advantage if it produces out of the box code?

Q3: Kleinberg and Tardos, two professors at Cornell University, came up with an amazing book on Computer Science. They start their chapter on "Greedy Algorithms" by asking about the movie Wolf of Wall Street. They ask if greedy approaches help and how this notion could be used to design algorithms. Why are they using real life references? Is the objective to use real life examples or is the objective to transfer ideas? What is the central idea which they are trying to convey? If such professors have broken technological concepts into simple ideas, why can't students learn it by themselves? Why do very few students succeed in learning, especially when such fantastic analogies and metaphors are available?

Q4: Would it make sense to compare technology with super-powers? Sciensation calls Artificial Intelligence, Blockchain, Internet of Things, Data Science, Virtual Reality and Augmented Reality as the new Justice League. Would you see merit in this analogy? Do we show Virtual Reality as a process of writing a code and putting wires together to flash some visuals or do we show it as a superpower which can help us in completely changing our audio-visual perception, to the extent that we wouldn't be able to differentiate between illusion and reality?

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Q5: Steve Jobs said that computers basically represent freedom. Would computers give you the freedom to see what you're working on? Which is better- designing a product and seeing it at the end or being able to see it on your computer screen while you're designing it? What is better- sticking some video tapes to edit a movie or being able to see various combinations while editing it? Does this freedom empower creators? Does cloud-technology take this to a new level wherein a designer in one country can let the customer in another country see the progress of the work? Why would we want to have such a simplified notion of Technology? Would this be Technology Education or Language Education?

QFD: What is the role of various subject teachers in Technology Education?

Synthesis2: Business Education

Q1: Does a businessman require education? Why do several business families not prioritize education? Does education help a family business in building world-class products? Would education differentiate between trading and disruptive businesses? Does education help businessmen in learning from the experiences of their counterparts in other industries or geographies? Why would CEOs find the time to read so many books? What would be more useful business ideas or fundamental ideas?

Q2: Can learning from one industry be useful in a completely different industry? Can understanding supermarkets be useful in developing better mass manufacturing systems? How did American supermarkets inspire Toyota Production system? Would the processes for moving inventory be the same in both the industries? Why wasn't this "obvious similarity" not visible to the others before Toyota team found it out? How do we teach students to find such "obvious similarities" in business?

Q3: Do Science, Math, Social Studies and Languages have a role to play in Business Education? Should we teach the curriculum topics as a set of facts or should we teach them as ideas? If we teach them as ideas would it help kids in drawing inspiration and bringing in lateral connections into business? Is it surprising to see HR Management professionals draw inspiration from the animal world, while studying Organization Design? How about the concept of niche (an animal lives within a specified range of conditions and develops strength within it. Likewise Micromax has its own market-share and Apple has its own marketshare or film-makers also have their own niches) which originates in biology, but was then hijacked by the Marketing and Strategy community? Can history inspire Business Strategy? Why does Jack Trout bring in ideas from wars to teach Business Strategy (guerrilla tactics by generals like Shivaji or Chandragupta Maurya when they had lesser resources)? How is word play useful to businessmen? How can students be taught to communicate business value, like how Steve Jobs did?

Q4: How does language education work- do we teach names from phenomenon or phenomenon from names? Which comes first? Why do we give names to observations or phenomenon? Why did computer

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science professionals come up with the name bandwidth for the amount of data which can be sent in a given amount of time? Why do business professionals use the same name to suggest that one shouldn't do too many things at once and that one should focus? Why do we pick up similar names from other discipline to describe a phenomenon? Likewise why business coaches talk of organizational DNA (Mission, Vision, Values)? Why do they use a name which originates in biology? How do we go about teaching school students so that they could effortlessly bring in names/ideas from different subjects?

Q5: Are 21st century business becoming more and more complex? Is cut-throat competition changing the nature of business? Are entry barriers coming down due to technological disruption and does one still need a lot of investment to start a business? Does this require lots of new ideas to be created? Does this require an understanding of various old ideas? Would reading good business literature help? Should kids then be introduced to business news? When is the best time to start reading Harvard Business Review Case studies? Who decides what a kid is supposed to read? Few professionals repent on not knowing about these resources when they were kids, so what's the role of parents/teachers? Would an introduction to ideas/concepts help a student in breaking down jargon and thus understanding HBR case studies? Should kids read just Percy Jackson, Sydney Sheldon or should they also be introduced to Seth Godin, Jim Collins? What is the teacher's role in initiating such a reading habit?

QFD: How should our approach to teaching change so students could appreciate business ideas and create their own business strategies?

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