# ISSUES WITH COMPUTER SCIENCE EDUCATION IN INDIA

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# CS EDUCATION

- More than a million graduates per year
- Programs: BSc/MSc, BTech/BE, MTech/ME, MCA, PhD
- More than 5000 colleges offer CS education

- Number of faculty members < 1,00,000
  - Only a small portion is PhD

- Only 2,00,000 new jobs being created in the industry
  - Largest number of unemployed of any discipline
- The bottleneck for growth is quality of graduates
  - Various surveys put number of *unemployable* between 75% and 80%

# WHY POOR QUALITY

- It is not an accident. It is by design.
- The higher education policy in India has been one of the few success stories where the policy has achieved what was desired.
  - Education policy stands on four pillars
    - Access, Equity, Cost and Service
  - Our policy has always been to focus on access, equity and cost
    - Giving a worthless piece of paper to a poor has been considered a better goal than keeping him out of higher education
      - There was no need to consider these as the only two options for the higher education policy

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# COST CONTROL

- Government has placed strict tuition controls on affiliated colleges (which teaches the bulk of CS programs)
  - The tuition that can be charged can not even pay for faculty salaries and benefits.
    - Recruit one's own unemployable graduates as faculty on minimum wages.
    - This isn't a recipe for the quality of education

# THE SYSTEM OF AFFILIATION

- India is the only major country that has retained the system of affiliation
- The faculty who teaches has no say in evaluation
  - University gets someone to design a question paper, conducts the exam, gets someone to grade it, and then the result is announced.
  - The teacher is completely demotivated
  - Students don't take classes seriously
  - Labs are almost never conducted
    - Programming skills are non-existent at the end of the program.

# THE SYSTEM OF AFFILIATION

- A single technical university in a large state
  - Several hundred colleges affiliated
  - The goal was to have uniform syllabus and uniform standards
    - Uniformity invariably means poor quality
    - Faculty is barred from indulging in any creativity
    - The colleges can not build their own niche strengths
    - Even if they manage to recruit a star faculty, he still has to teach the syllabus of the university
    - Changing anything in such a large system is very difficult
      - Curriculum is often outdated

# CURRICULUM

- Often outdated, since changes are difficult
- Education is not broad. A large number of CS courses taught.
  - In the name of making our graduates industry-ready, several softwares, technologies are taught, without enabling the student to learn key basics.
    - Will have difficulty in learning new technologies and will be outdated soon

# CURRICULUM

- A large number of courses overload the student
  - It is really not possible for an average student to handle 6+ courses in a semester.
- It is assumed in the design of curriculum that teaching will be poor
  - Prescribe a large number of courses in the hope that some teacher will teach some course well, and students will learn something.

# SHORTAGE OF FACULTY

- It is often said that we are short on faculty since there aren't enough students in PhD and MTech programs.
- But it is also because of
  - Remuneration being low (minimum wages!)
  - No respect for the profession
  - Poor research support
  - Poor working environment
  - Poor utilization of existing faculty
- Reduce the number of CS courses in the under-graduate curriculum
  - Everyone will now need lesser number of faculty members.

# RESEARCH

- The quality of research coming out of CS departments in India is abysmally poor
  - However, there are shining examples of exceptions
  - Poor quality of faculty is one of the reasons
  - Too much teaching load (shortage of faculty)
  - Very poor support from funding agencies
    - Typically, India has supported science research better
    - The overheads are too low to cover the costs which can not be paid from the sponsored projects
      - Each project that a faculty member brings, the losses of the institute goes up, and since tuition is controlled, can not cross subsidize from UG education
      - Leads to fudging of accounts and other malpractices

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# CS EDUCATION IN SCHOOLS

- The curriculum is not well thought of and does not make it interesting for students
  - It is strange that even after such a curriculum, students want to go for higher education in CS
- The textbooks are completely outdated
- Rote learning
  - Definitions of computer parts, for example
- Quality of teachers is not at a level that they can teach latest things disregarding the books

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# ENOUGH OF COMPLAINING

- Sundar Pichai and Satya Nadella are also products of the same system
  - We can be proud of them
  - *(Though neither is a CS graduate.)*

# POSITIVE NEWS

- At the broader level,
  - Number of affiliating colleges has stabilized and will hopefully reduce
  - Number of private universities and high quality government institutes are increasing
    - Most states have not yet done tuition control in private universities
    - The quality of CS departments, as a result, are much better than the average college
    - They have the flexibility to use MOOCs and leverage other technology solutions

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# RESEARCH

- Number of PhDs in CS departments is showing an upward trend across all IITs, NITs, IIITs, and other fine institutions

- While the numbers are still too small, it will certainly improve the quality of CS education in the places which can pay a proper salary

- Going forward, it will have a positive impact on Master's level courses as well

# MTECH PROGRAMS

- If the trend of increasing PhD numbers continue
  - Faculty will no longer depend on Master's students as the primary research manpower.
  - More efficient to use students for research who have long-term commitment
  - We can introduce MTech programs which have a much bigger course-based requirement and a smaller project requirement
    - More aligned with the needs of software industry
    - The program may then become a revenue-neutral one instead of loss making, and the money saved can be ploughed back into strengthening PhD programs further.
    - In case of self-financed MTech programs, the tyranny of GATE will end.

# INDUSTRY SUPPORT

- Industry has been supportive of CS education in India
- The level of support keeps going up.
  - PhD fellowships, travel support, faculty grants, adjunct faculty, infrastructure support, conference support, etc.
- Example:
  - TCS
  - Google
  - Microsoft
  - IBM
- Many companies are starting to having long-term research collaborations

# WHAT CAN BE DONE WITH BACHELOR PROGRAMS

- Not all programs need to be "engineering" programs
- Any undergraduate program needs to be broad-based
  - Engineering focused CS programs provide broad-based education through courses in Physics, Chemistry, Biology, Mathematics, Humanities, other engineering disciplines, workshops, etc.
  - The broad based education could mean that non-CS courses could be largely in liberal arts, design, management, etc.
  - A few programs are starting to get designed based on this.
    - The admission to such CS programs are not based on PCM only, but even a student who has done humanities or commerce streams in 12th class can do CS programs.

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# WHAT CAN BE DONE WITH BACHELOR PROGRAMS

- Reducing student workload (and consequently faculty workload) by reducing the number of CS courses in the curriculum

- Updating curriculum – take out outdated stuff, and make it more current

- Leverage technology

- Use newer concepts like flipped classroom model of pedagogy

# THANKS

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