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COMPUTATIONAL AND DATA SCIENCES

THE OFFICIAL NEWSLETTER OF IISc BANGALORE, CDS DEPARTMENT

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The Department of Computational and Data Science presents the fifth issue of the first volume of the Newsletter series! Through this newsletter, we hope to give you a glimpse into our little world- what we do, where our interests lie and what we hope to achieve. The Department of Computational and Data Sciences (CDS) is an interdisciplinary engineering department covering the broad research areas of computational science and engineering, and scalable computer & data systems.

Our journey began in 1970, when the Computer Centre of the institute was established as a central computing facility. In 1990, it became Supercomputer Education and Research Centre (SERC), providing computing facility to the faculty and students of the Institute. A master's degree programme M.Tech in Computational Science, one of the first of its kind in India, was started by SERC in 1999. Therefore about 16 years later, CDS was formed in December 2015 from the academic wing of SERC.

From the Chair's Desk

It is our pleasure to share the activities of the department through this newsletter. The goal of this publication is to highlight our research activities, achievements of faculty, students and project staff and new initiatives.

The main motive of this news digest is to reach out to the world outside the campus including student , faculty, corporate and any individual who is interested in computational and data sciences. Ultimately, we hope to build a highly connected, a truly inter-disciplinary society and, of course, help us to network.

Faculty Interview

- with Dr. Yogesh Simmhan

Dr. Yogesh Simmhan
Assistant Professor

Q1: Could you share your academic journey with us?

I started off doing my undergraduate in Chennai, India in a private college over there and then went on to do, initially, my Masters at the Indiana University, Bloomington in the US. In the first semester, I felt that I wasn't being challenged enough by just the regular coursework in my Masters. I had the chance to join as a research assistant in the Extreme lab and I found the systems research work there much more interesting! I decided that I want to do this for much longer than my Masters and converted it to PhD after my first year.

That was a time when Grid computing was getting popular as a distributed system. I started working on that. I started looking into provenance, which is - how these various distributed applications execute, and how to capture their runtime dependencies. And that sort of formed my thesis, on how do you track provenance for workflows and how to use it.

Q2. You started the DREAM:lab at IISc. So tell us about how you envisioned it and also briefly share the research philosophy what you practice.

In fact, DREAM:Lab started 6 years back – we will be celebrating the 6th year anniversary this November. One of the nice things about being a faculty, especially at IISc, is that you get to do independent research. I tell my students that, the way research works, at least Systems Research works, is that it's like a "startup". Which means, you can come up with really good ideas; and you can work on that if you think they will have a good research impact or, maybe even some social impact; and one of the nice things is that it's a startup with a monthly salary! They don't have to go to venture capitalists for funding. You do have to go to R&D agencies to get funding, get grants from industry etc.

The nice thing about being a faculty, especially at IISc, is that you have resources at your disposal. The human capital is probably the most valuable resource that we have, followed by all the ecosystem around the lab spaces, the computing infrastructure, and so on. Adding to it, we also do not have a lot of teaching commitments. Even the faculty in US do not have such a luxury. The funding is way more competitive there and you have a lot more teaching load.

So the opportunity to build the DREAM:Lab was like a culmination because until you become a faculty – you could be a postdoc, you could be a scientist or you could be in the industry – you always report to someone. Even the CEO of a company reports to the board of directors. Being in academia as a faculty, is probably one of the few roles in the whole world, where you don't report to someone on a daily or even a yearly basis. Hence, setting up a lab is almost like setting up a company or like raising a kid! It gives you a lot of responsibility and also gives you a lot of freedom.

When I started setting up the DREAM:Lab, it was about two things: one, the *physical infrastructure* - everything from the name of the lab to the websites to the space and all those things. Second but more important is also about the *idea*. What are the ideas that we'd like to work on? The idea of the lab has to have a long-term vision - we don't want to keep changing the name of our lab (which is like a brand) or our vision every few years! It has to stand the test of time. But at the same time, we should have short term ideas that we can capitalize on and go on to the next big thing. And the third part is, how do you get the right set of students? And that's always probably the most challenging thing, even globally. Because systems research is not just about coming up with intelligent ideas, or just being good in reading papers. One should have analytical skills, programming skills and experimental skills. So, finding the right set of people who have this aptitude, and who are self-motivated to work on these things is the most challenging.

Regarding my research philosophy, I always think of myself as an engineer more than a scientist. Because at the end of the day, I always believe that we are all good problem solvers. Research is more about *what* is the problem that you solve and *how* you solve the problem. The actual solution to the problem is more like engineering. So, one of the key things is to come up with interesting problems to solve. And a lot of them come from experience.

Looking at our lab title - The Distributed Research on Emerging Applications and Machines (DREAM), I see our lab sitting between the *physical computing infrastructure* - commodity clusters, clouds, containers, accelerators, edge devices etc. and *the applications*, things that make use of the computing hardware to accomplish things. Both of these layers are going to keep changing over time. From a systems researcher perspective, we actually don't have control over either of these. The industry is going to come out with the hardware it thinks is going to sell well, whether it is GPUs yesterday, TPUs today, or quantum computing tomorrow. So, we have to keep up with where the industry is going. At the same time, the applications keep evolving. AI and ML was nowhere in the picture 10 years back. But now that's all everyone talks about! So the question is, *what role can we play?* We are almost like the enablers, helping these new and emerging applications make use of the emerging hardware. Which actually makes it very exciting from my perspective, because things are always going to keep changing. But it also means that we need to invest time to understand both the applications and the underlying computing infrastructure, and help it scale.

I tell my students that - now is the time to read the papers that you want to read. As faculty, we often don't get the luxury to spend a lot of time reading papers we like but are part of program committees or editorial boards where we are assigned papers to review. One of its nice things is that you get to read papers that others haven't been published yet. Hence you get a pulse for where the research area is going, just by reading those five papers, even though many of them might be rejected. You get a feel for where the community is headed. So that too helps come up with new problems and gives you a good research direction.

Q3. Where do you see this field 10 years down the line?

That's a tough question.

Maybe I'll give you an example from both the computing side of things and the application side of things. One area is *edge computing*; people are already doing edge computing, but more as a single-point computer. But we are betting that all these computing devices are going to be able to collaborate with each other. So you might have a smartphone right now, but down the line, it might be talking to other devices elsewhere, and all working together to achieve things as part of a single computing fabric. And one of the enablers over there is also going to be 5G. From a computing fabric perspective, you have all the ingredients like computing, network, low power devices. Part of that could also be things like TPUs. A couple of years from now, every android phone might have carrier TPU.

The other thing is from the application side of things. AI and ML, I think, are going to become almost taken for granted in the next 5 or 10 years. They are going to be so intrinsic to things that you don't call it a special application! One of the interesting application areas, will be *autonomous vehicles and drones.*

That's something that IISc is investing a lot of resources into as well. In fact, we have a Center of Excellence on autonomous vehicles coming up. Drones pose the next level of interesting problems out there and are going to be much more feasible in India as compared to self-driving cars. Which means, that's going to give rise to a lot of interesting applications. It could be everything from a graph analytics perspective and from a scheduling perspective. *How do you do routing of drones, thousands of drones flying around? How do you make sure that they go around without hitting each other? Or how to do logistics planning?* Drone itself may become like an API or an SDK: you may come up with a nice idea and will program drones collectively to do that. In the next five years or so, it'll start getting mature. And hopefully some of the research that we do will help get it flying sooner.

Q4. Your area of research has nice applications in industry. So what motivated you to choose Academia over Industry?

I've spent time both in academia and industry. I was in grad school and then I spent three years as a postdoc at Microsoft Research and then back to academia at USC as a research faculty and now as a tenure-track faculty here at IISc.

Academia gives you much more freedom and the resources to pursue the kind of problems that you want to pursue. Of course, It can't be implausible things. We have to be grounded to the computing hardware and the realistic applications. But at the same time, you can take bets that Industry can't take. You essentially have the luxury to plan things for a longer term. I can work on a problem that I feel is meaningful and interesting today. It also lets you be driven by your own interests, or the interests of the students, and not by someone telling you ought to do it. So it's the freedom that you have, and that's wonderful.

The other thing is that you get to own it and nurture it for a long time. I believe that the first time you solve or build something, whether it's software or a system or an idea,it is going to be very bad. The second time you learn from your mistakes, but you end up over engineering it! The third time, you actually get it right. Which means that I don't mind redoing the same thing several times until we have something that's good. So even an hour I invest in the lab is something that's going to be there – with me, with my students, and with the Department – for a long time. That longevity is really motivating!

Oftentimes research students who pass out of IISc and join industries get bored after a while because such jobs are not intellectually very stimulating while the pay is good. The academic pay is fairly decent in India though not comparable to the industry – the fact is that globally, academic pay is not comparable to industry. So that's not a big complaint factor. You have adequate financial support but a lot of intellectual freedom.

Q5. This is a fast evolving field. How do you look at it - do you try to keep up-to-date or think ahead of others?

Being in applied systems research, we definitely need to try and think ahead of where the industry is going – especially large companies like Microsoft, Google and Amazon. These three, along with others like Facebook and Twitter, have arguably advanced the practice of distributed computing much more than academia has been able to in the last two decades. There are some types of systems research that you can do much better in industry, in some of these big companies, than in academia. So that means that you have to be careful about the problems that you pick. You really don't want to chose a problem today Google's going to solve it better tomorrow, because they have better engineers, larger data sets, large scale systems and so on. You really want to stay ahead by having a sense of where the hardware and applications are going. If we think the idea is plausible, we invest our time and that of our students.

You also need to be aware of where the other researchers in the world are going as well. Many systems problems transcend geographies, which anyone in the world could be working on. Here, you are competing globally on *how* to solve the problem. And then there are another set of problems that are unique to India, given its immense scale and diversity. Such problems give us an advantage since we compete on *what* novel problem to solve, rather than the *how*.

One thing I tell my students is to attend *keynotes* at conferences. They're given by top notch researchers and are typically visionary in nature. So, you're asking some of the best brains in the area to look ahead and predict what's going to happen in five years. They may set out 10 things and maybe 2 of them may really happen. But it'll at least offer you a bag of ideas to think about.

Q6. what motivates you to work so hard? And how do you plan to maintain work-life balance?

There are several parts to what motivates me to work. One is the sheer joy of doing research and publishing papers. It's a bit like sports. A sport in itself might be a pointless exercise, but you enjoy doing that, right? I almost feel like doing research and publishing a paper is a bit of a competition. Your ideas are competing against some of the top researchers in the world and you have to meet certain benchmarks to beat them and get accepted in a top conference or a journal.

The other thing is building systems and seeing them work! Theory people may get happiness from proving a theorem. I feel that, if you build a system that works efficiently, scales, and beats other competent systems, it gives you a thrill!

Lastly, it's also about working with the students, working as a team to achieve something. And this is again like the sports analogy, especially team sports like cricket and football. Each player brings his or her skills to the table, and the team win only when all contribute together to achieve the common purpose.

It's intrinsic human nature to compete. While advancing the cause of science and engineering is surely a factor, the drive for many academics is as much the chase as the outcome.

It is possible to have a good work-life balance in academia, but you have to put thought into it.

Academia gives you flexibility of when to work and where to work from. But the tenure track also expects a lot over the first 5 years as career advancement depends on this – it's not simple to just switch institutions in academia given the time we invest in building our lab. If we are not thoughtful, we can swing one way or the other.

This can be particularly challenging for women faculty early in their career.

Being arecent parent, I know first hand the demands of raising a kid and, unfortunately, the structure of our society implicitly imposes a larger burden on the mother. Combined with the implicit (and explicit) biases that we are surrounded by, much more needs to be done to encourage more women doctoral graduates and postdocs to become faculty and fix the abysmal gender diversity at the Institute.

Q7. What do you think is the research scenario in general, in India and in specific, at IISc and do you have some pointers to improvise it?

The systems research scenario in India is inadequate. But it is improving. In the last six years I've been here, I've seen several of good quality faculty being hired into places like IISc and IITs. So things broadly are improving.

But is it improving fast enough? I don't think so. For a country of our size and the number of educated people, we are starting off way behind and the percentage of research that gets done is miniscule. In fact, I would argue that any single top university in the US publishes more good quality papers in a year than all of India combined! There are few institutions in India that are systemically set up to do high quality research – IISc is a unique environment within this ecosystem. But we need a hundred more IIScs for a country of our size. We need to be able to attract good talent, both faculty as well as students who stay behind and not get shipped off to other countries, to make this happen. Things are better now than 20 years back and continuing to improve. But we are not yet a competitive destination.

Q8.On a lighter note, what are your interests and hobbies outside research.

I have to probably talk in the past tense(!) because there's not enough time for that. I love reading books and used to be active with various non-profit and student groups.

I do enjoy running -- it's something you can do anytime and don't need equipment.

One thing we do in our group each year is play Ultimate Frisbee. We have an annual game and nowadays we have enough people for two teams within our own lab. I play in every game and that's almost a push each year to start getting fitter!

I do find time read the news actively and follow current affairs – both in India and the US. The other thing I do is listen to podcasts on geo-politics, science and business.

Q9. Important question for all of us. What is your advice for we students? what are some of the essential qualities in a research student to succeed?

The biggest thing I would like students to have is *motivation*. That's also the most challenging trait. Being self-motivated is critical for a researcher. Part of the motivation comes from the kind of problem that you're solving, how much progress you're making, and how exciting or interesting it is. Part of it comes from seeing others in the lab work hard on interesting problems. There's no single way, but it has to come from within. I expect the student to *pull* rather than the advisor to *push*. I believe an advisor has limited role to play in motivation. Maybe it's a lazy philosophy, but if a student is highly motivated, then they're going to want to work hard and accomplish things, making the advisor's role easy. If the student is not motivated, then too the advisor's role is easy as they're not going to do anything and there's nothing much you can do to make them accomplish anything!

The second key trait is *working hard*. As I tell my students, you don't have to be the smartest kid in the room, but make sure you're the hardest working. Like Edison said Innovation is just 1% inspiration and 99% perspiration.

The third is to work well *as a team*. For systems research, especially, it's rarely individual-driven work. It requires several people to come together to build larger meaningful systems or run detailed experiments. One student may take the intellectual lead, but making the whole system happen and a paper published require many to come together. Sometimes, this is easier said than done and personalities come in the way.

One last thing is to have a *life outside work*. Doing a PhD can be fairly stressful, and here again, this can be more challenging for female students. All work and no play is not the way to go. I always want my students to have one hobby that they really enjoy doing outside of work. It could be arts, music, dancing, playing instruments. It could be sports. But make sure that's something that you can run away from work and run towards, and enjoy doing. And have good friends as well. Most students are staying in hostels are away from the family. So you need safety nets: social and emotional, to help you through the tough times, which are inevitable.

About MALL Lab

Machine And Language Learning (MALL) Lab is led by Dr. Partha Talukdar and has researchers and students from the Department of Computational and Data Sciences (CDS) and the Department of Computer Science and Automation (CSA).

Research in the lab is motivated by the thesis: **background world knowledge is key to intelligent decision making**. Humans regularly use background knowledge in decision making. If a person wants to visit the Indian Institute of Science, he/she uses the knowledge that it is located in Bangalore which is in turn located in Karnataka to plan his/her visit. However, access to such background knowledge is very limited to a machine learning algorithm. Hence, the research at MALL Lab is focused on bridging this knowledge bottleneck and in making broad-coverage world knowledge available to machines (and humans) at the right granularity and at the right time.

Also, external knowledge is abundantly available in raw form as Web Pages, tweets, etc. hence one of the key research goals is to extract, organize, and make readily available the knowledge trapped inside such unstructured text data on a large scale. Researchers in the lab are actively conducting research in the field of machine learning and natural language processing to achieve these goals. Furthermore, MALL Lab also conducts research in multi-modal machine learning and Knowledge aware Visual Question Answering.

The lab firmly believes in the idea of reproducible and publishable research. Students of the lab have actively published their work in top tier conferences and have also received many accolades for their work.

M.Tech students from the lab have been awarded fellowships from Cargill, Target, Tesco, IBM and have also received the Motorola gold medal award for the best student in M.Tech coursework. PhD students from MALL Lab have secured highly competitive research internships at Facebook Lab in London and Google Research Lab in New York.

Also, recently MALL Lab has its first Ph.D. graduate (Dr. Madhav Nimishakavi) who has joined Facebook London as a ML engineer. Graduates from the lab have gone to work in industries such as Amazon, American Express, Samsung Research, Minds.AI, Target, etc. and some have even opted for Ph.D. and PostDoc positions in universities such as CMU, UMass Amherst, IIT Delhi etc.

The lab is equipped with high performance computing hardware to support cutting edge research. MALL Lab actively collaborates with the Read the Web (NELL) and the Brain Research Group at CMU.

Mall Lab welcomes highly motivated PhD, M.Tech. Research and M.Tech. Course students with demonstrated programming experience to work on challenging state-of-the-art topics in Machine Learning and Natural Language Processing. There are opportunities for research assistants and project staffs to collaborate with students on research projects. Limited summer internships for undergraduates are also available for pursuing research

For more details visit: https://malllabiisc.github.io/

NEWS @ CDS

Student Achievements

Anubhav Guleria has won Best Student Paper Award at IEEE-CCEM

Anubhav Guleria, M.Tech Research Student from Cloud Systems Lab under Dr. J Lakshmi, has won won the IEEE Technical Committee on Services Computing(TCSVC) Best Student Paper Award at IEEE-CCEM (Cloud Computing for Emerging Markets), 2019. The work is titled “EMF : Disaggregated GPUs in Datacenters for Efficiency, Modularity and Flexibility”. The award carries certification and US $300.00 given by TCSVC.

Sawan & Sharmistha's paper received an Outstanding Paper Award @ the ACL, 2019

The paper titled “Zero-Shot Word Sense Disambiguation using Sense Definition embeddings” by Sawan Kumar, Sharmistha Jat, Karan Saxena, and Partha Talukdar from MALL lab received an Outstanding Paper Award (one out of five) at the Annual Meeting of the Association for Computational Linguistics (ACL), 2019

Swapnil Gandhi has won Bronze Medal at ACM SOSP SRC.

Swapnil Gandhi, M.Tech Research Student from DREAM Lab under Dr. Yogesh Simmhan, has won the Bronze Medal at ACM SOSP Student Research Competition (SRC), 2019 in the graduate student category for his poster titled “Wave: A Substrate for Distributed Graph Processing on Commodity Clusters”.

Upcoming Events

IISc-HMS Worshop on “Diploid assemblies and phenotype interpretation on cloud”. 20 Dec -- 21 Dec, 2019

The workshop will be run at the Department of Computational and Data Sciences, Indian Institute of Sciences, co-hosted by Harvard Medical School (HMS). Topics include, (i) building haplotype-resolved graphs from various regions in human genomes, (ii)including medically relevant ones such as MHC/KIR, (iii)Haplotype-resolved Structural Variant (SV) calling, Interpreting missense mutation, (iv)Using protein structure and dynamics to interpret phenotype change on mutation

http://cds.iisc.ac.in/calendar/iisc-hms-worshop-on-diploid-assemblies-and-phenotype-interpretation-on-cloud/

Winter School on Hybrid Cloud 9 Jan -- 14 Jan, 2020

This school will cover topics in the area of hybrid cloud, ranging from the basics of cloud as a distributed system and as a service, to more advanced topics around virtualization, container platforms and application development for hybrid cloud. Students will obtain a deep understanding of the theoretical foundations and get hands-on experience through multiple practices and tutorials.

https://india.acm.org/education/hybrid-cloud-winter-2019-20

Conference Trip Reports

Researchers at CDS proactively contribute to the research community by publishing their work in top tier conferences and journals. We bring to you the experiences of our students who have been to these conferences to present their work.

Jogendra Nath Kundu

(PhD student @ VAL Lab)

Presented his work at The International Conference on Computer Vision (ICCV) 2019, Seoul, Korea

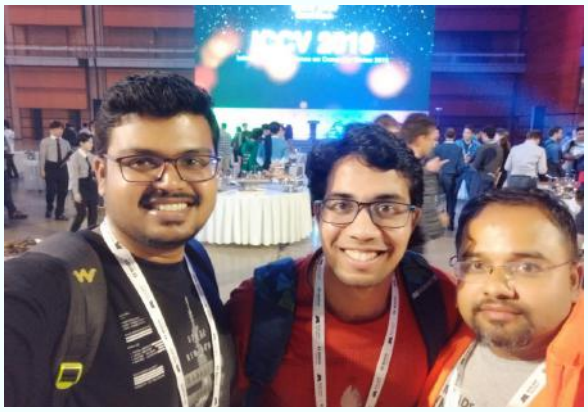
Received Google travel grant

I had two accepted papers in this conference with one selected for Oral presentation (top 4.3%) and the other as poster, both in the main conference track.

- *Jogendra Nath Kundu, Nishank L., and R. Venkatesh Babu, "UM-Adapt: Unsupervised Multi-task Adaptation using Adversarial Cross-task Distillation", In ICCV 2019. (Oral)*
- *Jogendra Nath Kundu, Maharshi G., Dakshit A., and R. Venkatesh Babu, "GAN-Tree: An Incrementally Learned Hierarchical Generative Framework for Multi-modal Data Distributions", In ICCV 2019.*

UM-Adapt: Generalization refers to the intelligence, or the ability of abstraction, that enables an algorithm/model to be effective across a range of inputs and applications. Most of the existing approaches independently address task-transferability and cross-domain adaptation, resulting in limited generalization. In this work, we have proposed a simple, yet effective unsupervised multi-task adaptation framework, that yields generic image representations with superior transferability across both tasks and domains.

GAN-Tree: In this work, we address some of the fundamental limitations of Generative adversarial networks (GAN), specifically in the case of a multi-modal diverse dataset, that requires learning of discontinuous mapping functions. In contrast to the prior bottom-up approaches, we present GAN-Tree, which follows a hierarchical divisive strategy that caters to such discontinuous multi-modal datasets.



Devoid of any assumption on the number of modes, GAN-Tree uses a novel mode-splitting algorithm to effectively split the parent node to semantically cohesive children nodes, facilitating unsupervised clustering. It was a really exciting experience for me to personally interact with researchers from around the globe, attending talks and panel discussions on various aspects of Computer Vision and its future. I was fortunate enough to interact with Prof. Jitendra Malik, Prof Andrea Vedaldi and many other well-renowned researchers regarding their current research direction and other research ideas related to my areas of interest. The most discussed topics were unsupervised learning, domain adaptation, model compression, generative networks etc.

Though it was my second visit to Seoul, I further explored this wonderful city and its culture. I enjoyed my first ice skating experience at the Lotte World. It was a nice experience to explore the local Korean market and local street food.

Siddharth Jaiswal

(M.Tech Research student @ DREAM Lab)

Presented his work at The 5th IEEE International Workshop on High-Performance Big Data and Cloud Computing (HPBDC) held in conjunction with The International Parallel & Distributed Processing Symposium (IPDPS), Rio de Janeiro, Brazil

Received TCPP student travel grant and GARP travel funds

I presented my paper titled *"A Partition-centric Distributed Algorithm for Identifying Euler Circuits in Large Graphs"* which I have coauthored with my advisor, Dr. Yogesh Simmhan. This work presents the first attempt to identify Euler Circuits(a path in a graph which starts and ends at the same vertex and visits every edge exactly once) in large distributed graphs using a partition-centric model of computation. The input Eulerian graph is first divided into partitions.

Our algorithm then executes in three phases. The first two phases are executed alternatively wherein the first phase runs local computations within each partition parallely while the second phase merges pairs of partitions based on some heuristic function. Finally, when only a single partition is left, the final phase executes which gives the traversal order of the Euler circuit. We implemented this algorithm on Apache Spark for graphs with over 500 million edges. Ours is a hierarchical algorithm that monotonically educes the state maintained at every level as well as traversing more and more of the unvisited edges in the graph.

IPDPS is one of the premier conferences in the domain of parallel and distributed computing organised on an annual basis and there were some very interesting papers this year as well. Two papers that I found relevant to my area of work were- *"CuSP: A Customizable Streaming Edge Partitioner for Distributed Graph Analytics"* and *"Incrementalization of Vertex-Centric Programs"*.

All the keynote talks were extremely informative and I got a chance to interact with students and professors from the top institutes all around the world working in the same domain as well as other domains in the same field. Of note was the keynote session by Ian Foster, a giant in the field of parallel processing. Pete Beckman's keynote at HPBDC on AI at the edge was also an insightful talk where he discussed significant computation on the edge devices.

Rio de Janeiro is a beautiful coastal city with some of the most beautiful beaches in the world and is home to one of the seven modern Wonders of the World. I took a day tour which included the top attractions of the city like Christ the Redeemer, Sugarloaf Mountain, Selaron steps, Santa Teresa neighborhood and the Metropolitan Cathedral. Other than that I took trips to the Botanical Garden, Museum of Tomorrow and Maracana Football stadium. It was a memorable trip with a lot of new and interesting experiences.

Neha Iyer

(M.Tech Research student @ CMG Lab)

Presented her work at The International Conference on Parallel Computing (ParCo 2019), Prague, Czech Republic.

Received GARP funding

I presented my work titled *"Parallel Smoothers in Multigrid Method for heterogeneous CPU-GPU environment"*. As modern-day supercomputers are equipped with sophisticated graphics processing units (GPUs) along with high-performance CPUs, it has become imperative to develop algorithms that can concurrently utilize the different computing resources efficiently. In this respect, we parallelize Jacobi and successive-over relaxation (SOR), which are used as smoother in the multigrid method to maximize the combined utilization of both CPUs and GPUs. We studied the performance of multigrid method in terms of total execution time by employing different hybrid parallel approaches,viz. accelerating the smoothing operation using only GPU across all multigrid levels, alternately switching between GPU and CPU based on the based on the multigrid level and our proposed novel approach of using a combination of GPU and CPU across all multigrid levels. Our experiments demonstrate a significant speedup using the hybrid parallel approaches, across different problem sizes and finite element types, as compared to the MPI the only approach.

The conference was held at Charles University. There were several keynote talks by well-known speakers from the parallel computing domain.

Speaker Erik D'Hollander delivered a talk on Empowering Parallel Computing with Field Programmable Gate Arrays(FPGAs) and motivated the extensive boom of applications based on FPGAs. The keynote talk by Thomas Lippert focussed on scalability, cost-effectiveness, and composability of large-scale supercomputers through modularity. Prof. Torsten Hoeffler from ETH Zürich delivered a talk explaining the aspects of data-centric parallel programming.The topics for conference presentations ranged from parallel architecture, GPU computing methods to power management and load-balancing methods. Symposia were held on topics such as reproducible science, which conveyed the importance of the ability to reproduce published scientific results and ECO-PAR, which focussed on energy-efficient parallel computing on FPGAs and hybrid supercomputers. In addition to the talks, there were several opportunities to interact and connect with fellow research students that allowed me to know more about the ongoing work across different global universities.

The peculiar cobbled stone streets, beautiful medieval architecture and the warmth of locals, is how I remember of Prague or Praha as it is known in Czech. Prague is known for garnet jewelry, enamel painted crockery, and traditional wooden artifacts. At one of the souvenir shops, I got a chance to enamel paint my own coffee mug. Being a vegetarian I had a very constrained diet, but I didn't miss the chance to try out Czech desserts like the trdelnik and venecek. Though Czech language was difficult to follow, I managed to pick up a word called "ahoy", which is used to greet each other. I had a great time and given a chance I would love to go back to this beautiful city.

CDS Alumni

We are proud to introduce you to our distinguished alumni who have made a mark in their respective fields. Our alumni are spread across both industry and academia where they are doing cutting edge research.

Navchetan Awasthi - Postdoc @ Harvard Medical School

Q1. Tell us about your experience at CDS

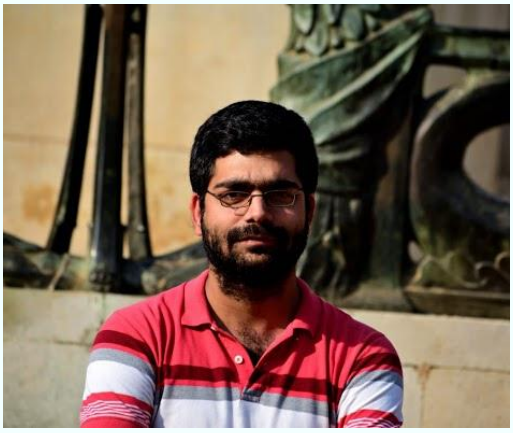
I joined the department for M.Tech in Computational Science in the year 2014. I learned a lot from the various courses offered by the different departments. The courses offered have a wide variety of options for a person of any department or stream to take the courses of their choice and acquire more knowledge in the field. During my bachelor's there was no option of auditing a course, but here with so many options of auditing courses, attending seminars, the experience was really good. It helped me a lot in understanding the concepts and doing the research in a better way. The flexibility of dropping courses, the availability of Professors for discussions and the competitive atmosphere made it a really nice experience at CDS.

Q2. What made you opt for Ph.D. after M.Tech at CDS?

I was very keen on working and developing a project in my free time. I always enjoyed the flexibility which IISc provides for research. You can work at any time of the day, with high-end computing facilities which provides a very nice atmosphere for research. Also, I wanted to do more research on improving the area of medical imaging. The other reason I can say is that I feel that research is addictive, once you start doing it, you don't want to leave it. The motivation of helping someone with your research can be fulfilled only by doing some work on the unexplored topics in the field. Hence I joined for Ph.D. after M.Tech at CDS.

Q3. Congrats on getting into Harvard Med. How is your experience at Harvard till now?

Thanks. Here the research environment is very different. The setup is the same but the benefits of interaction with real doctors having experience with patients are great. Seeing your research in a product and direct application to the healthcare industry does give a lot of satisfaction. Even now the transition from computational to



clinical is still challenging. We are still working on the transition and one day hopefully we will do that to benefit a large group of people.

Q4. Could you please tell us the secret behind getting into Harvard?

I can say that my lab was pretty helpful. Whenever I went with an idea to my Prof., he was always very helpful and encouraged me to pursue my idea. Similarly, when I was applying he helped a lot in applying to various places and I got this chance to pursue the research in the field of cardiovascular signal processing. I can say the main motivation behind applying to big places is because my Prof. believes in the theory of "Why Not". So I applied and got into Harvard.

Q5. Things you wish you had known before starting your research journey?

When I started I thought everything will be straight forward, later I realized it's not. You have to be managing each and everything starting from grades to your paper revision. I should have been more organized, and keeping backups is very important when you are doing research.I think the following things one should keep in mind:

1. Keep backups of everything.
2. Make a list of every journal/conference you read.
3. Comment the codes.

Swayambhu Nath Ray

For me, IISc was the best learning experience I ever had. The way IISc balances between theory and application, alongside maintaining a very steep learning curve is something unique and was really intriguing to me. One more thing about IISc that I would like to mention is the freedom to gain knowledge. In IISc it is absolutely normal to find students taking classes from departments that are not even remotely connected to their own departments.

I was very lucky to have Dr. Partha Pratim Talukdar as my research guide in IISc, who is not only a great researcher but a wonderful mentor and a pronounced leader. Under his guidance, I was able to expand my horizon of knowledge to extents that I could never think of. Working with him is a great experience in itself which I would remember and rejoice for a long time. Publications were an outcome of strong collaboration, incredible guidance and diverse knowledge among the people of the MALL Lab

In IISc I had the opportunity to learn and experience new things every day which motivated me to give in more effort to gain further knowledge and it went on in circles. MALL Lab and all of its members were phenomenal in this respect. I also had many like-minded friends in my circle who were also motivated by the same goal of learning. This created a wonderful stage for gathering and sharing knowledge outside study hours

Currently I am working with Amazon as an Applied Scientist in the Alexa ASR team. The team focuses on improving speech recognition of Alexa using machine learning and mathematical modeling. The curriculum at IISc is made to create a strong foundation of whatever subject or domain you are specializing in. It is because of this goal of IISc, that I have strong knowledge about the basics of my domain which in turn helps me to prosper in my industry career.

Rohit Pardasani

I completed my bachelor's in Electrical Engineering from IIT Roorkee in 2008. So, when I joined CDS for M.Tech. in 2017, I was coming back to academia after spending 9 years in the industry. I never believed the transition will be so smooth as it turned out to be. All thanks to CDS which provided me with a conducive academic and research environment where I never felt out of place. The trio of state-of-the-art facilities, academic freedom, and world-class faculty makes research & study in CDS a rewarding experience. I would explicitly state the professors at CDS are outstanding when it comes to interaction with students and helping them with their problems.

I worked in the Medical Imaging Group (MIG) under the guidance of Prof. Phaneendra. Coincidentally, I received the GE Fellowship for my M.Tech. the program, so worked closely with the GE Healthcare data science team. The work comprised mainly of deriving inferences about the patient's condition from clinical time-series data. Fortunately, the results were promising, so we submitted a patent and papers on the same. Apart from that, my other projects involved the use of deep learning for medical image reconstruction and analysis.

I am presently working as a Senior Data Scientist with GE Healthcare on projects involving artificial intelligence for clinical decision support. My work comprises analysis of patient monitoring data and EMHR (Electronic Medical Health Record) followed by building machine learning/deep learning models to infer or predict patient conditions. The knowledge & skills assimilated through course work and guidance received from my mentor have been instrumental in making me ready for challenges of the industry. My work involves an understanding of both healthcare and data science. Thankfully, my learnings from CDS (& MIG) help me a lot in both the domains.

Events @ CDS

Talk by Dr. Gupta & Prof. Tambe, Google Research India

IISC ACM Chapter hosted dignitaries from Google Research India at CDS on October 23rd.

Google, at the fifth edition of its annual Google for India, event announced that it is setting up a research lab focused on artifical intelligence (AI) and its applications in India. The company's AI lab -- Google Research India -- is based in Bengaluru and it will be jointly led by Dr Manish Gupta and Prof Milind Tambe.

Dr Gupta and Prof Tambe visited IISc on Wednesday, October 23 to deliver a talk about the newly formed Google Research India and their intitiatives around applying AI to tackle big problems in areas like healthcare, agriculture, and education.

Workshop : Parallel Finite element Computing using ParMooN

Prof. Sashikumaar Ganesan of CDS organized a five day workshop (14th - 18th October) on Parallel Finite elements Computing using ParMoon.

The workshop focused on providing introduction to finite element method,parallel finite element data structure and its implementation in ParMooN.

Further, the implementation of parallel geometric multigrid solver, parallel finite element solution of scaler partial differential equations and Navier Stokes Equation using ParMooN are also covered as a part of this workshop.

The workshop also hosted a theory session on Computational and experimental fluid dynamics with marine applications by Dr. V. Anantha Subramanian (Department of Ocean Engineering, IIT Madras) and a talk on Asynchronous computing for solving partial differential equations at extreme scale by Prof. Konduri Aditya (CDS, IISc)

Seminars

- Development of Raman hyperspectral imaging combined with Chemometrics for high-throughput quality and safety screening of food and pharmaceutical materials, **Dr Ritu Joshi, Chungnam (National University, Korea)**
- Real-Time Business-AI, **Jay Nanduri (Microsoft)**
- Numerical simulation of topological defects in three dimensional active nematics, **Dr. Debarghya Banerjee (Max Planck Institute)**
- Data Flow Execution Models -- a Third Opinion, **Prof. Vivek Sarkar (Georgia Institute of Technology)**

A short guide for handling mental stress in academia

- compiled by Chandrashekar M.A

When students enrol into a course or a research degree in IISc, they feel a sense of accomplishment. After all, a tiny fraction of those who apply for IISc, successfully get enrolled. During one of our initial interaction sessions with a senior Professor, he mentioned that 'Getting into IISc is tough; but getting out of IISc is tougher!'

Although attending grad school is a career shaping stage for almost all individuals and their families, this period can often be stressful for some (or many!) students because of the transitional nature of college life. Sources of stress for them can include academics, feelings of loneliness, job hunting, family, life goals, social pressure, and physiology. Stress can deplete students' levels of subjective well-being and cause lowered grades and dropped courses. (from 'Predictors of academic stress among college students' - https://doi.org/10.1002/jocc.12113)

Pressure is essential to excel, but needs to be handled well. Let's take the example of a weightlifter to understand this. To accomplish his dream of winning a medal in a major championship, he practices regularly. As the days pass, he puts on more weight-plates to the ends of his barbell, and his muscles develop gradually and thus enable his adventure. Imagine a weight lifter who, promptly and regularly, lifts same kilos of weight and doesn't stretch out of his comfort zone. . What are his odds and chances to win the championship? You know the answer!

Below let us explore and expose ourselves to the wisdom of the wise, and learn some principles to handle stressful situations in life. Among many, I will take the liberty to list what I feel are essential to learn first about.

1. **Having good friends** - we may have many 'friends'; But we all need a few close friends to share our heart - the pleasures and the pains. It's said that, "Truly great friends are hard to find, difficult to leave, and impossible to forget.". It's of foremost importance in life to have genuine friends, whose presence can act as a gentle drizzle on a scorchy noon. Remember, the onus to develop genuine friendship is on us. As a famous quote goes - "People are lonely because they build walls instead of bridges!". A small trifle can distance our hearts from long-term friends. What are we waiting for!? As the saying goes, "The best time to make friends is before you need them!"
2. **Communication** - As Peter Shepherd puts it - "Communication is the solvent of all problems and is the foundation for personal development." Many a times, when we go through tough situations, we cry in solitude. Those emotions can put us into a perpetual negative outlook towards life. It is at these times that we have to push ourselves out of the negative thought cycles and communicate with concerned people - be it friends, family or one's advisor, or even a counsellor and seek help to sort things out. It's we who should take the responsibility to communicate. As George Bernard Shaw puts it - "The single biggest problem in communication is the illusion that it has taken place!". Moreover, It's not just enough that we communicate with others. we also need to communicate with our own selves. And meditation is the means to communicate within oneself.
3. **Meditation** - It's said that 'Meditation nourishes the mind in the same way that food nourishes the body'. Just as food is essential for the upkeep of the body, one has to practice techniques to nourish one's mind and inner self. When we do meditation or breathing exercises, our goal is not to battle with the mind, but to witness the mind. To all of our surprise, an entire new world opens to us, within ourselves. To know one's own mind is nothing short of life-changing. Meditation helps us to come to peace with ourselves and learn about our inner life, which we seldom pay attention to. Once, we develop clarity within us, our life becomes as clear as the waters after the mud settles in a muddy pool. This gives us the wisdom to take meaningful and wiser decisions, and thereby overcome pressing problems. As Ajahn Brahm puts it - "Meditation is like a gym in which you develop the powerful mental muscles of calm and insight."

As wise men put it, "We can't always change what's happening around us, but we can change what happens within us." and that leads to sensible decisions that will uplift one's morale and quality of thoughts and the choices we make.

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