Report for BoF189: HPC Outreach: Promoting Supercomputing to the Next Generation

Pre-BoF actions

A number of actions were performed before the BoF in order to prepare for and advertise the session. A Q&A article was written and published by HPCWire which discussed the main aims of the BoF, why outreach is important and how the BoF would assist people getting more involved in public engagement and running their own sessions. This was published as a Q&A (https://www.hpcwire.com/2016/11/09/bof-boost-supercomputing-outreach-skills/)
A webpage was developed https://www.epcc.ed.ac.uk/discover-and-learn/sc16-outreach-bof which summarised the BoF objectives, gave viewers an idea of the content and also a place of focus for getting in contact with the organisers after SC. This was published in the HPCWire Q&A, advertised through EPCC's contacts (EPCC blog & twitter) and also advertised on the PRACE website and twitter too.
Throughout SC outreach activities (specifically Wee Archie the mini supercomputer made out of Raspberry PIs) were run at the EPCC booth as advertisements for the BoF, along with representatives telling people who were interested & interacted with this demo about the BoF.

BoF aims

As per the proposal the goals of this BoF were:

- Sharing success stories to better understand how we the community currently undertake public engagement and new techniques and processes for improving activities. For instance, what changes can people make to ensure longer term impact? How do you design HPC projects so outreach is a first class design criterion?
- Sharing ideas on how the community can encourage diversity with public engagement. What modifications can be made to ideas or existing activities to ensure that they are inclusive to all?
- Providing an opportunity for members of the HPC outreach community to meet face-to-face and collaborate.

BoF structure

The BoF was split into four distinct sections, the first three sections were oriented around a specific topic, with a 10 minute talk from one of the organisers then followed by audience discussion. For each of these three sections we had some sample questions to motivate discussion and interaction from the audience. Each of these was intended to last 20-25 minutes depending upon audience engagement. The fourth session was a demo session with five different demos set up in the room which people could play and interact with.
The online Q&A system was used and some people did take advantage of this along with audience participation in person. The online system worked well.

Session 1: Outreach targeted at K12

This session was led by Nick Brown who introduced the BoF as a whole, he talked about the Big Bang Fair which was held in the UK and attended by EPCC with 75,000 school children

attending over 5 days. Examples of demos appealing to this group were introduced, along with some general principles for targeting the age group and some lessons learnt. The last slide contained a number of questions designed to drive audience participation. Realistically you might not drive this group of people to HPC directly, but by doing outreach to them you can often enthuse them about science in general and spark their interest in this more general area.

Audience discussions were held that covered a variety of different topics, such as the different experiences of outreach to this group and the sharing of experiences from others in the audience. Exactly how we go about doing outreach to these groups was discussed and a number of areas identified by the audience that the presenters had not thought of (such as scout sessions, which the contributor believed can help reach a more diverse set of people.)

There was also a question about designing activities so that they are accessible to those with disabilities, there was no clear one fits all approach identified here as it depends on the activity itself but we agreed that the majority of HPC public engagement activities can be designed with accessibility in mind.

Session 2: Outreach targeted at university students & general public

This session was led by Scott Callaghan who gave a short introductory talk about his own outreach efforts targeted towards this group of people, some suggestions that he has found useful when working in this area and some questions to promote discussion. Karina from PRACE also gave a lightning two minute talk about their activities, specifically the Summer of HPC programme. By targeting university students one can sometimes directly recruit them into the HPC community, for instance there are numerous examples of participants in the PRACE summer of HPC then continuing and working in HPC and/or completing further study with an HPC focus. The angle taken appealing to the general public was less of a direct recruiting one but more informing them where public money is being spent, why, and what kinds of science it enables.

One of the members of the audience works closely with older people, attracting this group of people to HPC and science in general. There was some discussion about whether the ideas we were focussing on could easily be applied to this group of people who were a primary target of bringing into the community. We all believed so, although this group could sometimes be less confident so it does impact our approach to how we engage with them successfully.

An undergraduate from a liberal arts institution spoke a bit about her experience with HPC outreach. She made the point that although liberal arts institutions are often not a priority in outreach efforts, they are warmly receptive to them and at her institution, the majority of the computer science department will show up for visiting speakers. The audience agreed that this was an excellent point to keep in mind and that we should remember to include such institutions when planning outreach.

A discussion was held about metrics for success: very often outreach is performed as an add on activity and it can be difficult to get funding because the impacts can be indirect. The

point was raised that often we use “number of people interacted with” as a way of assessing an event, however this doesn’t quantify the impact that the event has actually had on the participants. Whilst there were some anecdotal success stories (such as a student who attended an EPCC outreach event then undertaking an MSc in HPC) it was agreed that this can be very difficult indeed with the impact not being realised until quite some time after the event. The audience and presenters agreed that whilst “number of people interacted with” was not ideal it was realistically the best we had.

Session 3: Diversity

This session was led by Lorna Rivera who introduced the challenges around diversity relating to outreach and gave a short concrete example of how a public engagement activity targeted at students (a summer school) had very dramatically increased their success in attracting a diverse set of successful attendees by slightly modifying and rephrasing the application form to take into account the differences in technical confidence between the genders. Kelly Gaither from TACC then gave a powerful example case study of encouraging diversity in university student programs and XSEDE’s efforts around this area.

Demos session

Five outreach demos were set up in the room that people could actually play with and use in their own outreach. We had a flier (attached) provided with further information about each demo and where about in SC (often a specific booth) that someone could discuss the demo in more detail after the BoF. There were also a number of example leaflets that have been produced to accompany the demos and are given to the public after they have interacted with the demo for them then to continue this later on at home. This tied into some of the discussions in session one where we talked about how to continue the outreach activity after and event has completed and ensure a longer term impact. The demos exhibited were:

- Wee Archie running a design your own wing CFD demo: Wee Archie is a mini supercomputer made from Raspberry PIs. It provides 64 compute cores and this demo allowed participants to design their own wing and then run the CFD computation on Wee Archie before it illustrated the facets of the wing along with lift and drag of their design.
- Wee Archlette running dinosaur racing: This is a mini version of Wee Archie (16 cores) and was running a design your own dinosaur demo, where participants select a base dinosaur model and then configure it. This is then simulated and multiple different dinosaurs can be raced against each other.
- Ball sorting: Sorting coloured balls into the appropriate boxes. This demo illustrates the difference between working on a task in serial and then the likely parallel speed up that will occur when multiple people (or processes in HPC) work together.
- PRACE shooting stars: An app for designing your own solar system by placing planets into orbit around a sun, but having to be careful that you don’t set a planet off on an orbit that will result in a collision!
- Design your own supercomputer webapp: A web game where participants can design their own supercomputer and within a specific monetary & power budget select all the component parts (CPU, memory, accelerators etc.) They are aiming to see how many different jobs and FLOPs they can run in 90 seconds.

The demos section overran a little (it was the end of the day so not a major issue), and a number of different contacts for people were exchanged in order for these activities to be shared after SC.

Feedback and further steps

We received one review that awarded the BoF as 5/5 overall and said that they enjoyed learning about new material, that the speakers were very engaging, the demos were great and that we should try to build on this for SC17. Going forward we are in contact with a number of people since the BoF about helping them replicate some of the demos for their own outreach work. A whitepaper will be published which detailed the BoF and findings in more detail.

Attachments

Also attached to this report are the three main presentations per session given by the organisers and the BoF handout provided to attendees.

HPC Outreach

SC16
Salt Lake City, Utah | hpc matters.

Promoting supercomputing to the next generation

Nick Brown
EPCC

Scott Callaghan
University of Southern California

Lorna Rivera
University of Illinois

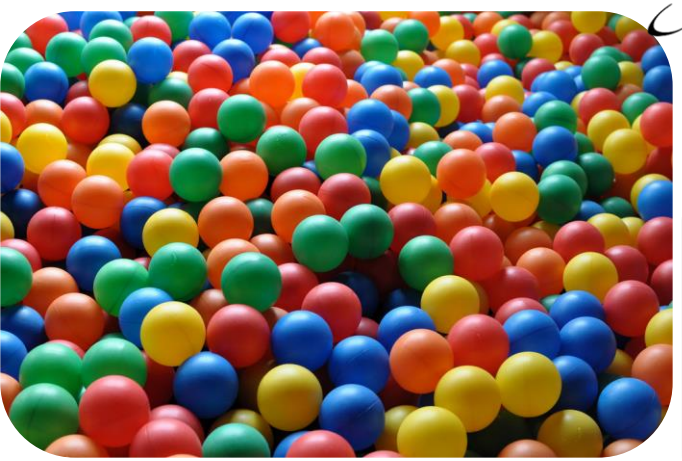
BoF Agenda

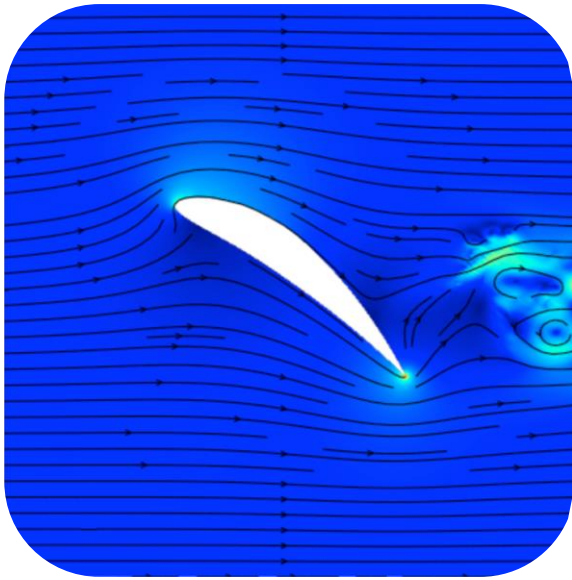
Time	Description
5:15pm	Outreach aimed towards school children (K12)
5:35pm	Outreach targeting university students and the general public
5:55pm	Diversity best practice for outreach
6:15pm	Interactive session with existing activities that can be used by participants
6:45pm	Summary and future steps & plans discussion

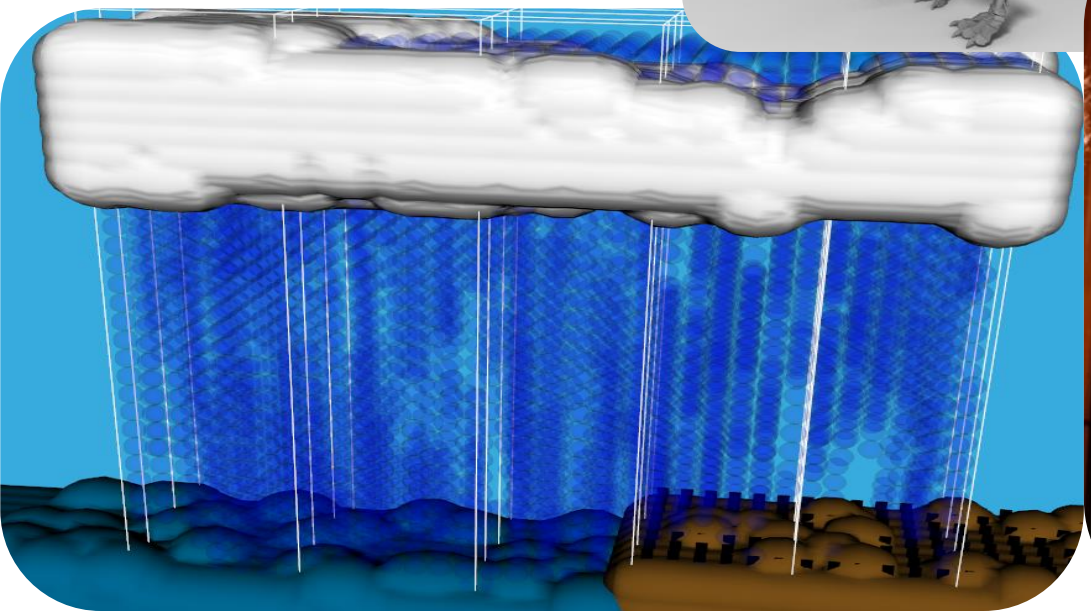
- What activities are we currently doing, what can we learn from each other's outreach efforts (success stories and challenges.)
- How can current activities be re-used for those who want to do their own outreach
- How can we best design outreach efforts
- Opportunities for collaboration by the community

archer

Challenge!







Outreach for school children (K12)

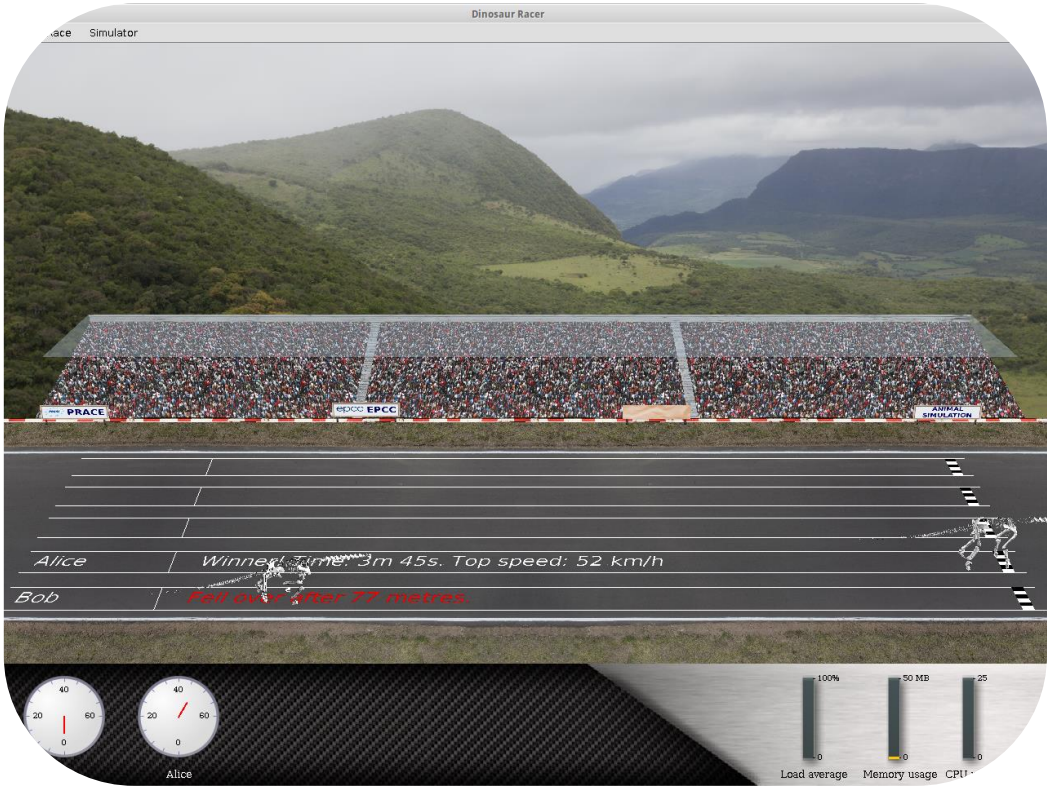
- **Big Bang Fair:** 75,000 attendees over 5 days
- Aged 7 to 18
- 4 staff over 5 days
- 3 demos

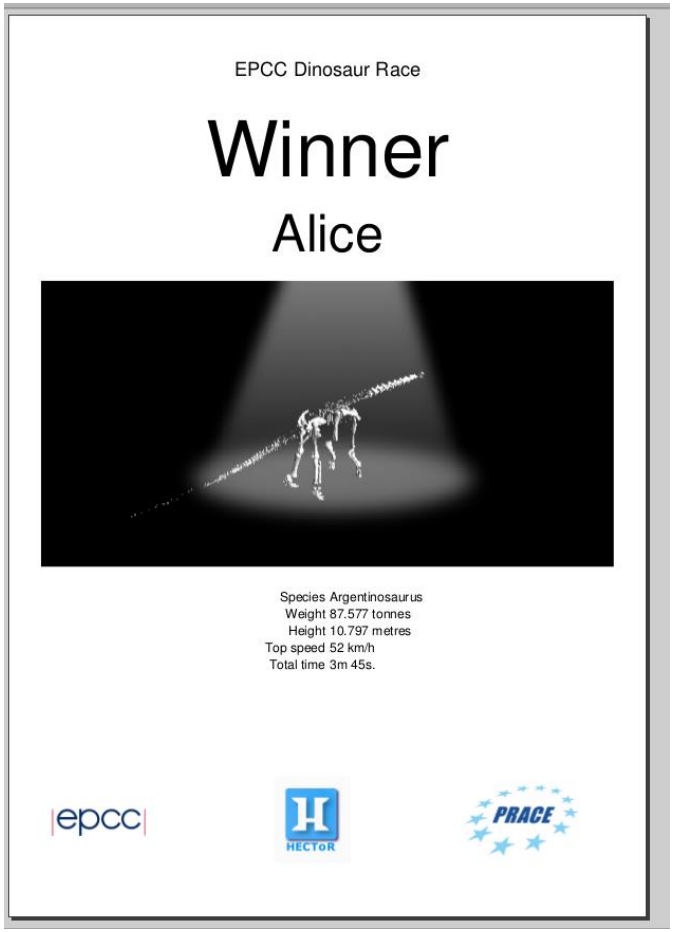
Different forms of outreach

- Public outreach events
  - Including workshops
- School visits
- People visit you
- Online outreach

Need to grab & maintain attention

- Some attraction to bring them in
- Then some gamification to keep them interested
  - Need to be careful how you do this
  - “1 minute rule”





The message

- What is the fundamental message we want to get across with this demo/activity?
- The term “school kids” covers many different ages and aptitudes
  - And their parents at some events too
  - So it needs to work on multiple levels
- Realism
- Can we make developing activities an outreach activity in itself?

Discussion points

- For activities is the “story” more important than factual accuracy?
- Should we focus on specific age ranges or groups?
- What is the cost of doing this – both in terms of staff time but also any impact to careers.
- Is it better to consolidate into one very large activity or many smaller ones?
- Can our outreach be “undone” by poor teachers etc?

What are your experiences/comments about outreach to K12?

http://qna.live/sc16/Ym9mMTg5/

Summary & future steps

- Hope you have enjoyed this BoF!
- Please leave some feedback via the SC website
- There will be a whitepaper published, to sign up for this

bit.ly/2fzpjIW

- Please feel free to see us and/or drop by our booths if you have any more questions

Outreach to University Students and General Populations

Scott Callaghan
Southern California Earthquake Center
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SC16 BoF
HPC Outreach: Promoting Supercomputing to the Next Generation
November 16, 2016

University Student Outreach

- Diverse backgrounds in math and science
- Want to communicate high-level to get students excited...
- ...but some students will also want to get under the hood
- Consider both visualizations and activities
  - Many HPC centers have videos of their systems and visualizations of science done using them
  - Don't be afraid to show images that aren't your work
  - Keep your specific audience in mind
- Many of the techniques for K-12 apply here also

Parallel Activity

- Way to illustrate parallel problem solving
  - Select a math problem which can be distributed (long multiplication, long addition, matrix multiplication, etc.)
  - Assign a subset of the problem to each student
  - Have each student work their part with pencil and paper
  - Ask each student for their answer
- Use to illustrate key HPC concepts
  - Communication: them getting the problem, you asking for their answer
  - Computation: the actual solving
  - I/O: writing down the question, writing down the answer
- Discuss impact of many students to illustrate bottlenecks

Modeling Activity

- If students and you are math/science comfortable, walk through simple problem to illustrate mathematical modeling
  - Falling object with air resistance, molecular dynamics, etc.
- Set up equations
- Discretize and solve
- Model and compare to exact solution
- Illustrate how the accuracy and runtime of your problem change based on parameters (timestep, number of objects, etc).

General Public Outreach

- Challenge is to adapt: may have
  - People who work close to the field
  - Young children
  - People who enjoy science but are entirely unfamiliar with HPC
- Select activities which start at a simple level but provide opportunities for detailed discussion
  - Ball sorting
  - Dinosaur racing
- Images and movies can help start discussion too

Ball Sorting Activity

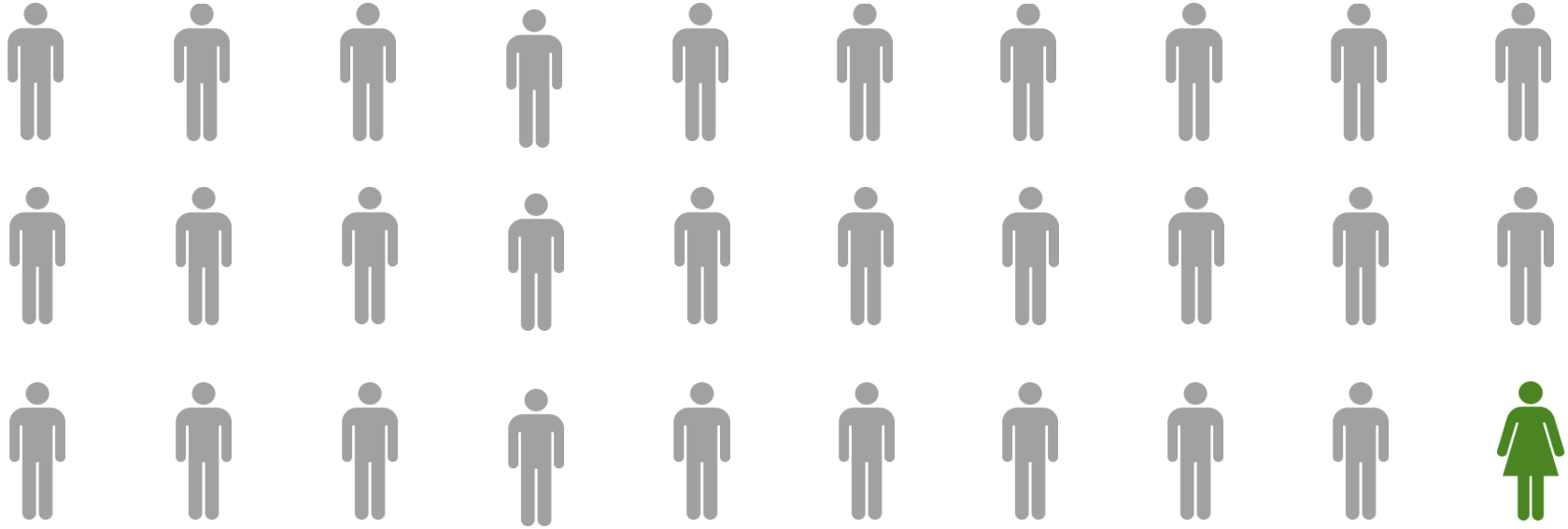
- Math-free way to communicate HPC concepts
- Time participants as they sort balls into containers by color
- Have them do it again, with help
- Explain that parallelism speeds things up
- Ask what would happen if more people participated, to illustrate contention
- Discuss changes to remove contention
- One of the demos later in the session

Resources

- HPC Centers
  - How do scientists use supercomputers? https://www.youtube.com/watch?v=45qU-rlVWe0
  - NCSA coloring books
  - Pictures of machine rooms
- Informal Science (http://informalscience.org)
  - Project, research, and evaluation resources for STEM education and outreach
- Computer Science Unplugged (http://csunplugged.org)
  - Hands-on ways to teach CS concepts without a computer
- SIGHPC Education (http://sighpceducation.acm.org/resources.html)
  - Compendium of resources for HPC education and outreach

Discussion

- Open to all related topics
- What challenges have you encountered in outreach?
- How do we convince the general public to care about HPC?
- Should outreach be done by education/training staff? Application researchers? Students?
- How do we evaluate the effectiveness of our outreach?



Encouraging Diversity in Outreach Programs

SC16 BoF | HPC Outreach: Promoting Supercomputing to the Next Generation | November 16, 2016

Lorna Rivera, Research Faculty

CEISMC, **Georgia** Institute of **Tech**nology

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How to Encourage Diversity: The Basics

- Have open discussions on diversity
- Revamp participant recruitment & selection processes
- Invest in training of program staff
- Review internal processes and performance
- Measure progress and success towards diversity goals

Case Study:

2016 International Summer School on HPC Challenges in Computational Sciences

Ljubljana, Slovenia

Program Highlights and Challenges

- Successful program with model training & mentoring activities
- Leads to meaningful collaboration both domestically & internationally
- Issues with female recruitment & selection
- Issues with scaling the program

2015

Male applicants rated significantly higher than women

2016

No significant gender differences in applicant rankings

2015 Application Form

Mostly free text boxes describing experience

Research abstract

Discuss the research you are conducting and how HPC is being used or will be used to advance your research. Please limit your text to 400 words.

Experience with computational science and HPC

Describe your use of HPC, including familiarity with MPI, OpenMP, multicore, accelerators, coprocessors, and how you participate in software development. Please, limit your text to 400 words.

Motivation for your participation

2016 Application Form

Mostly closed-ended ratings of usage frequency

How long have you used each of the following:

Note that responding highly (i.e. 1 – 2+ years) will not necessarily improve your likeliness of acceptance.

	0-3 mos.	4-6 mos.	7-12 mos.	1 – 2 yrs.	More than 2 yrs.
MPI	◯	◯	◯	◯	◯
OpenMP	◯	◯	◯	◯	◯
CUDA/OpenCL	◯	◯	◯	◯	◯

How frequently do you use each of the following:

Note that responding highly (i.e. Weekly – Daily) will not necessarily improve your likeliness of acceptance.

	Never	Occasionally / Sometimes	Monthly	Weekly	Daily
Linux/Unix	◯	◯	◯	◯	◯

Additional Outcomes:
Rubric/Tool for Scaling Review Process & reducing selection bias

- 75% (195/258) of all applicants fell within the 5 -7 range (scale 0 – 9) using rubric
- 99% (79/80) of selected applicants scored 6 – 7 on rubric (scale 0-9)
- No gender differences were found in rubric scores

Resources:
Evaluation tools, training materials, data sets, research, etc.

- Harvard's Project Implicit, https://implicit.harvard.edu/implicit/education.html
- National Center for Women in Information Technology (NCWIT), www.ncwit.org
  - NCWIT's Critical Listening Guide: Just because you always hear it, doesn't mean it's true, https://www.ncwit.org/resources/critical-listening-guide
  - Male Advocates and Allies: Promoting Gender Diversity In Technology Workplaces, https://www.ncwit.org/resources/male-advocates-and-allies-promoting-gender-diversity-technology-workplaces
- NSF – National Science Foundation: Science and Engineering Doctorate Awards, www.nsf.gov/statistics/doctorates
- WebCASPAR and the Survey of Earned Doctorates (SED) Tabulation Engine, https://webcaspar.nsf.gov and https://ncses.norc.org/NSFTabEngine
- Women in Science and Engineering Leadership Institute (WISELI), http://wiseli.engr.wisc.edu/pubtype.php
- Women in HPC (WHPC), www.womeninhpc.org

Thanks! / Discussion

Lorna Rivera, Research Faculty | CEISMC, **Georgia** Institute of **Tech**nology
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HPC Outreach:

Promoting Supercomputing to the next generation

BoF Organisers: Nick Brown, Scott Callaghan and Lorna Rivera

Wee Archie is a suitcase-sized supercomputer, designed to let school children try their hand at computing and learn about the benefits of supercomputing.

The system has been created to be representative of the system design in massively parallel architectures. There are 18 Raspberry Pi 2's, each acting as a multi-core node providing a total of 72 cores and 144GB of RAM, a network switch, a power supply unit (PSU) and Ethernet cables. Each Raspberry Pi has an LED display that lights up when in use, providing a visual display that helps demonstrate how multiple processors work in parallel to solve complex tasks.

For more information see Booth 701 or https://www.epcc.ed.ac.uk/discover-and-learn

Sorting balls by their colour is a simple yet very fun and effective outreach demo. By inviting one participant to see how many balls they can sort in a specific time limit and then re-running the experiment with a number of people in parallel, the participants can really see how using multiple processors can speed up a problem and get more work done in a specific amount of time. Depending on how you set this up, you can even get contention when many people try to sort at the same time and this can be used to introduce concepts such as parallel speed up and the overheads of parallelism. This demo requires some plastic balls, a number of containers (for each colour of balls), a bag or box for the initially unsorted balls and some sort of timer

For more information see Scott Callaghan

Partnership for Advanced Computing in Europe (PRACE) is engaging with the young generation through various types of outreach activities. For four years the summer placement programme PRACE Summer of HPC have provided last stage undergraduates and early stage postgraduates an opportunity to get involved in real research projects in supercomputing centres in many different countries around Europe.

Students, pupils and general public at large are addressed through attendance of Science Fairs and exhibitions in Science museums which PRACE partners organize in their countries. In the last two years seven Science Fairs were attended such as the BT Young Scientist and Technology Exhibition in Dublin Ireland, Big Bang Fair in Birmingham UK or Sofia Science Festival in Bulgaria. Finland, Slovakia and Czech Republic have prepared exhibitions in Science Museum. On all these events PRACE showcases real examples of how HPC helps scientists to achieve their goals.

For more information see Booth 3000 or http://www.prace-ri.eu/daretothinktheimpossible/

archer Challenge!

The ARCHER challenge online web game challenges participants to build their own supercomputing system. Working within a monetary budget, participants select different types of hardware and see how many jobs they can run within two minutes. You get paid as jobs run, which can be used to upgrade the machine—but be careful as more nodes requires more power which must also be paid for! There are many different types of HPC job and as the game progresses many jobs require more advanced hardware in order to run.

For more information see booth 701 the game itself is at bit.ly/1KTAFSz or scan the QR code

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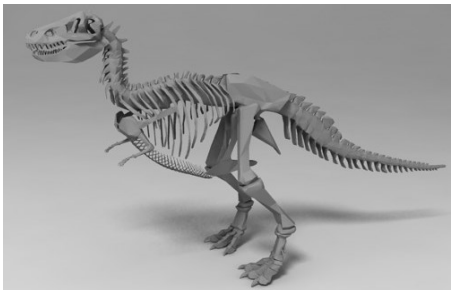
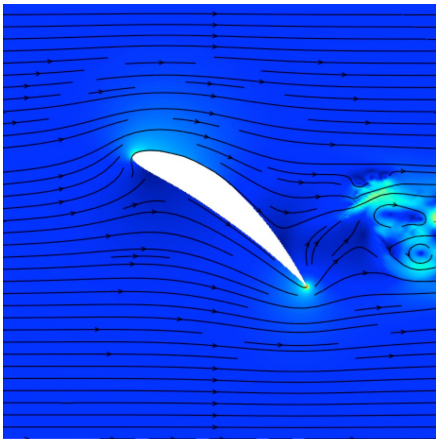
Developed by the Partnership for Advanced Computing in Europe (PRACE), Shooting Stars is a physics puzzle game where you get to control the planets of a star system. Simulate orbiting planets and gravitational forces in the searing heat of the sun. See how many planets you can keep in orbit. Test your skills in many ways, with different scenarios that give you a taste of the world of supercomputer simulation PRACE offers.

For more information see booth 3000, the game is at http://www.prace-ri.eu/daretothinktheimpossible/shootingstars/





Wee Archlet is the little brother of Wee Archie and designed to be very easily buildable by the public at home. With five Raspberry PIs held in a lego case, Wee Archlet is designed to be cheap and easy to build while still demonstrating the key concepts of parallel computing. Detailed instructions are available online for schools and groups to build the machine themselves. There is a software suite, combining the models which run on Wee Archlet with a client visualisation application for all major platforms so that the public can simply “point and click” to run demos. Demos include dinosaur racing (pictured), weather simulation, an MD demo (mouse wee!) and a CDF demo (pictured.)

For more information see Booth 701 or https://www.epcc.ed.ac.uk/discover-and-learn

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We hope you have enjoyed this BoF, interacting with the demos and the discussions. If you want to get more involved with outreach and want further information & guidance then please contact us via the BoF webpage.

An outcome of this BoF will be a whitepaper detailing the discussions, current best practice and future plans for the HPC outreach community. If you would like to receive a copy of this via email then you can sign up via the webpage.

Visit the BoF webpage

bit.ly/2fzpjIW *or*