Transcript of Season 1, Episode 1

Jeff Hittinger: Leading By Example

SPEAKERS
Sarah Webb, Jeff Hittinger

Sarah Webb 00:00
Hello, I'm your host Sarah Webb and this is Science in Parallel, a new podcast about people in projects in computational science. In this season, we'll discuss how computers are helping scientists work on climate change and alternative energy and study quantum control, 2-D materials and hot, dense electrons. The common theme is the Department of Energy Computational Science Graduate Fellowship program or C-S-G-F, for short. All our guests are fellows or alumni of the program, which is celebrating its 30th anniversary this year.

Sarah Webb 00:36
To kick off the podcast, and this season, I'll be speaking with Jeff Hittinger. Jeff is the director for the Center for Applied Computing called CASC at Lawrence Livermore National Laboratory. Jeff has a long history with the CSGF. He was a fellowship recipient from 1996 to 2000, while completing his Ph.D. at the University of Michigan, and he remains active in shaping the fellowship today. We'll be talking about scientist chimeras, definitions of scientific success and how to build a good science analogy.

Sarah Webb 01:11
Welcome, Jeff. It's great to have you.

Jeff Hittinger 01:12
Thank you. It's great to be here.

Sarah Webb 01:14
So where I'd like to start actually is for you to talk to me a bit about your current work at Livermore. What are you working on? What are your key responsibilities?

Jeff Hittinger 01:24
My key responsibility right now as the director for CASC is I've got on the order of 150, mostly Ph.D. researchers in computational mathematics, computer science, data science, computational physics, and just trying to keep that organization doing all that it does. So it, it acts as a bridge organization. So we work directly with many of the programs at the laboratory, helping them make the best use of the computational resources that we have. We do a lot of fundamental research. And through that we interact a lot with the outside world, a lot with academia, with industry partners. So we kind of stand at that intersection, that crossroads between what's going on inside the lab, what's going on outside and try to bring in the best from the outside, develop our own capabilities, and address the needs that the

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programs have at the laboratory. In my spare time, when I still get to do some technical work, my background is in computational fluid dynamics originally. So more broadly discretization methods for partial differential equations. Ever since I came to the lab 20 years ago, I have worked on the simulation of plasmas.

Sarah Webb 02:42
Plasmas are gases that are made up of charged atoms or molecules.

Jeff Hittinger 02:48
Mostly continuum models of plasmas. So I cut my teeth early on, on doing laser plasma interaction. one of the big experimental facilities at Livermore; well, Livermore has always been a leader in the science and development of laser technology. We currently have the National Ignition Facility, which is the biggest, most powerful laser on Earth. Interesting things happen when you shoot lasers into plasmas.

Jeff Hittinger 03:14
Since then, I've worked on those sorts of problems and inertial confinement fusion, I've worked on magnetic confinement fusion problems. Most recently, I led a project on variable precision computing, which was reevaluating the foundational way that we represent numbers in the computer, trying to find ways to reduce the amount of data that we're storing and moving around since that's become the big bottleneck in high performance computing these days. So we're developing some pretty clever ways of working with compressed data types. And fundamentally having compressed data types on the computer that locally decompress only when you need to operate on them, which potentially can have really big savings for things like GPUs and other memory bound applications.

Sarah Webb 04:03
GPUs are graphics processing units, often used in high performance computers to boost processing speed.

Jeff Hittinger 04:10
I had the pleasure of leading a really talented team of researchers, they're working on that, who ran the gamut from people working on fundamental compiler technologies to application scientists and computer scientists and applied mathematicians, on all these various problems, and trying to build the foundation for it. So we did a lot of mathematical analysis to justify the methods. We worry a lot that any of the approximations we make, still guarantee that we get the right answer. So we put a large emphasis on that.

Sarah Webb 04:41
So I want to take a step back. Can you tell me a little bit about how you first got interested in science and math and were there key people or key experiences that you know, sort of seeded, the Jeff that came later?

Jeff Hittinger 04:56
Oh, yeah, sure. Of course, there were things that come to mind. My uncle and his wife are both lieutenant colonels in the Air Force and lived in the D.C. area. So we would always visit them every

summer. And I think early on, I was exposed to the Smithsonian Institute and the Air and Space Museum and the Natural History Museum. I mean, ever since I was I don't know, four and went to my dad and told him I wanted to be a paleontologist when I grew up, you know, I, I've kind of tended in that direction. Certainly those were formative years that I got to see all kinds of technology.

Jeff Hittinger 05:37
And I had a great, great fourth grade teacher, Mr. Lieberman. And I still remember projects I did in that class on radio telescopes and other such things. He was very. He very much encouraged. Me, and he clearly had a passion for science. And I think that kind of started me down that path. But yeah, I was programming computers as early age and, and math came naturally to a certain degree. So I don't know if anyone is born to be a scientist. But certainly, I don't think I surprise anyone, constantly taking things apart, and losing my dad's tools, which he still reminds me to this day when I complain about my son losing my tools. So what goes around comes around, I guess,

Sarah Webb 06:32
Exactly, exactly what goes around comes around. So when, when I was preparing for this interview, I was looking at one of your old talks that I found, and there was a, I'm going to be quoting you, you're you back at yourself. But you had a slide in one of your your one of your presentations to the CSGF, where you talked about that the the CSGF tends to create chimeras. And I wanted you to talk a little bit about that. And what that you know what that statement means to you and talk a little bit about the CSGF and your career path.

Jeff Hittinger 07:13
At the core of CSGF is a foundational belief that excellent computational science lives at the intersection of several domains. It doesn't live cleanly in an application domain and physics and engineering. It doesn't live cleanly in applied mathematics; it doesn't live cleanly in computer science. And certainly, when CSGF was founded, and computational science was still a relatively new thing, it was hard to figure out where to find it in universities. And so one of the goals of CSGF, and it was founded was to try and create this kind of interdisciplinary training. And it has done so and done so spectacularly well.

Jeff Hittinger 08:00
What's very interesting about that to me, so you, for a variety of reasons, in terms of the program of study that you have to do, where you have to take courses in a variety of different areas. The program itself, though, actually kind of selects for people who have the right aptitude, who see the benefits of that multidisciplinary training, and working in interdisciplinary teams. That's a hallmark of what goes on in the laboratories, I think, which is also why a lot, a lot of folks enjoy going to the labs who are part of the program. But it does tend to train people then who have this broader perspective. They can see the connections between certain models or certain ways of doing things in applied mathematics and how those relate to things computer science or in some physical domain.

Jeff Hittinger 08:54
Broadly, what it also then does is it creates people who don't fit cleanly into any of those departments. Which, which is an interesting thing. different disciplines have different languages, and they have

different philosophies. And one of you learn about that when you are in the CSGF program. When you get to a place like the laboratory, where in our case, for instance, we have a great deal of emphasis on multidisciplinary teams. Sometimes disciplines cannot communicate effectively with each other. Invariably, I have found that CSGF fellows and alumni end up often being the bridge person in that arrangement because they speak the languages or at least they speak enough of the language or they understand the perspective that that field has, and why they're saying what they're saying, and can help translate and bring the team together.

Jeff Hittinger 09:56
And I've definitely noticed that in my career at Livermore, that I - even if it's not a project that I'm running - I have often become that person who is helping to keep the discussions going and keeping a sense of consistency amongst what everyone thinks they're doing and make sure that everyone's actually communicating effectively. So yeah, as a CSGF alumni, you end up not being maybe genuinely a, you know, what have you, applied mathematician or computer scientist, you're something, that and more. And then the other thing that's really funny that I always get a kick out of is that no one ever knows what you are. Frequently, amongst physicists, I'm a computer scientist; amongst applied mathematicians I'm a physicist, a physicist or engineer; amongst computer scientists, I'm an applied mathematician. So it's, uh, you definitely appear differently to these different communities because you do have this broader perspective.

Sarah Webb 10:57
Cool, it just seems like it must be kind of fun to be able to kind of wear these different hats now and then.

Jeff Hittinger 11:02
Oh, sure. Sure, of course it is. Yeah. Well, and it's also fun that you can really, you can appreciate a lot more, right, or you can go to a lot more seminars, and dig deeper into what they're saying.

Sarah Webb 11:16
But I mean, you've clearly taken involvement in the fellowship, to kind of a whole new level with the fact that you've been a fellow you've been involved with the fellowship, you know, over all this time, and now you're even a PI on, you know, on the fellowship itself. So I guess I wanted to get a sense of, you know, what that level of involvement has been like for you, because that's a whole other level of involvement beyond being a fellow and alumnus part of the community, you are a leader in the community?

Jeff Hittinger 11:48
Yeah, I don't, I can honestly say I didn't set out to With that in mind, things kind of snowball on you, I guess. I mean, I guess in some respects, I not only talk the talk, but I walk the walk. And I've been clearly shaped by this program, and and have internalized what I think are strengths and benefits. And I care deeply about it, I think it does a great job of expanding the horizons for computational scientists, people who are going to be engaged in applying computation to science in a way that they wouldn't ordinarily get, just by going to a program where the emphasis is going to be much more on their

research activity, their specific domain science research activity, and it would be up to the good graces of their, of their advisor, and their willingness to take on extra work to do it on their own.

Jeff Hittinger 12:55
CSGF provides the freedom to do it, in the sense that, because they bring, they have their own funding, they have the opportunity to steer their direction. It gives an excuse to do it. The program of study, which lays out the coursework that they need to do in the various different areas can be seen as a requirement. I know when I was in it, I thought as an opportunity, because I got to take more classes, I was a junkie with regard to taking classes and because I always wanted to know more about other areas. And, you know, we actually I see it as giving the fellows the freedom to tell their advisor, look, I have to go take these courses over in the math department, right? Or CS department or what have you, you know, coming to the program reviews, where you meet the other fellows who are all in different areas, different fields of science, coming from different backgrounds, seeing their technical presentations, and their posters and having those discussions, you wouldn't ordinarily have those interactions necessarily.

Jeff Hittinger 14:02
Since many of us, you know, when we go to our technical conferences we're going to now are more specialized conferences where everyone's doing the same thing. You know, I don't get to see many biologists, for instance, in the conferences that I would ordinarily go to for plasma physics. So that's really cool because you can make all these connections with people who are outside, and you can find similarities and fertilize ideas across the different fields. You know, invariably, lots of things get invented multiple times in multiple fields. And you can accelerate that whole process if you talk amongst the fields. So yeah, I mean, it's a great program and I'm thrilled to be a part of making sure that it's healthy and continues to grow and continues to adapt as computational science has continued to grow and change over the years. And it I have a hard time saying no, when Krell comes knocking and says, "Hey, we need help with this." Because I know it's for a really good cause.

Sarah Webb 15:14
So I want to ask you a slightly broader question. You know, there are many ways, obviously, to measure success in science, and particularly at different points in a career. And I guess I was sort of interested in how you measure success today, and how maybe you've measured it at other points in your scientific career?

Jeff Hittinger 15:41
Sure, I, that potentially is a loaded question. But you're correct, that my view of it has evolved over time. Certainly, I think when you first launch into your research career, it's all about papers and getting proposals funded, and, you know, giving talks and establishing yourself in a community. And I think that's a very valid measure. It certainly I think, is the most common measure of success in the scientific research community. Perhaps there's some faults there that maybe rely a little too much on publication. You see lots of papers that are, you know, more incremental than maybe they need to be, because there's too much emphasis put on numbers and not so much on quality. But that's a that's an issue for that's a bigger issue.

Jeff Hittinger 16:39
Coming to a lab, you know, I have a different perspective. And success is measured differently there. And I was fortunate to come into cask relatively early in its existence. CSGF is celebrating 30 years; CASC is celebrating 25 this year. So I've been there for 20 of those. CASC is unique, sort of at the lab in the sense that it might, as I said, straddles the programs at the laboratory and the external academic world. And so you can kind of be successful in that academic mode within my organization. You can also be completely successful by purely focusing on the programs and helping the programs meet their mission. And that's something that's a really nice thing about the laboratories is that you do have a mission: You have a mission to expand science or, in the case of the national security labs like Livermore, to expand science in support of the national security interests of the country. So there's contributing to a greater whole they're, contributing to the programs is another way to define success. And now running CASC, you know, I appreciate both ends of the spectrum and everything in between. So certainly my thoughts have evolved over that. They've, you know, again, have evolved beyond that, because now I'm in management, right? I've gone from being a rank-and-file scientist to being a group leader, and now a division leader.

Sarah Webb 18:14
Well, a part of that was actually my next question was kind of leadership and what's involved in that sort of transition and thought process there too?

Jeff Hittinger 18:23
Well, right. Yeah. So that's another, you know, we all have our different aptitudes and abilities. And, you know, I think I'm a decent scientist, I know plenty of other people who I highly respect who are, I think, much more brilliant than I am, and perhaps more innovative, and, you know, I wouldn't want them to venture off into line management and people management because it'd be a waste of their talents. I think I have a pretty good aptitude for motivating people and helping get people organized and breaking down barriers and getting people the resources they need. I think I've got a pretty good view of where things are going, or actually what probably motivates me more of trying to direct where things are going. But ultimately what led me into management and some of these roles over the years has been a desire to have a seat at the table and help impact and influence where things are going as opposed to just responding to the current.

Jeff Hittinger 19:39
And so far, no one's complained, but I think I do. I think I'm doing a service there for the folks I represent. I see that you know that's another way to impact the scientific community, in that sort of leadership role. That isn't one necessarily of being you know, the leader in the field with the newest, best ideas, but being someone who can take in all that information and appreciate the science, and appreciate how all the pieces come together and where they're pushing us, especially in computational science, where there's lots of pressures between what can be done, what the scientists want to do, or be able to do, what the mathematics limits us to be able to do, the computer science behind where the new machines are going because we're in a really interesting transition right now in crossroads. Because the technologies that we've relied on for the last, you know, 30+ years, are reaching sort of an endpoint with what they can do. And we're seeing all kinds of new ideas sprouting up with regard to the hardware, and then that has a downstream effect on everything else and what we can do. And so to be

able to look at all that and pull it together and build a sense of where we should go, or where I think we should go, and to try and help get the community to move in that direction.

Jeff Hittinger 21:06
That that's where I find my satisfaction these days. I don't get to write much code anymore, or solve real, meaty science problems. I also, you know, I do get to, I am engaged in, in many scientific projects where I can help advise younger scientists and help mentor them, which is something else that I really enjoy. So I still stay in touch with my roots that way, by maybe not being hands-on, but giving them my insights and suggestions as to where to go.

Sarah Webb 21:37
I know one thing that you've been a part of is Livermore Ambassadors, and I wanted to ask you about science outreach and communication. I want to get your experiences, what that's been like for you. And, you know, even, you know, advice you might have for other scientists who are trying to embark on this work.

Jeff Hittinger 21:57
Yeah, well, I mean, it's a different type of communication, right? So the Ambassador series is a series of lectures. There's about a about 10 of us, I guess, from Livermore, who go to the UC campuses and give technical talks, technical seminars that are more broadly accessible to hopefully undergraduates with the goal of really getting people interested in science. It's pretty well-known that there's a, you know, challenge of diversity in the scientific fields. And one of the reasons for that is that we don't do a good job of attracting people to the scientific fields. In fact, I dare say that most undergraduates don't realize that you can have a very fulfilling career in science, right? They, they see all of the money in Silicon Valley, or other things like that. And never even considered, say, a career at a national laboratory, and don't realize that, that that's an option that exists. And so they don't go to grad school because of that. And so it, you know, we have this ever decreasing pool of potential candidates.

Jeff Hittinger 23:21
Diversity isn't just some kind of, you know, PC concept. I'm speaking, you know, as a CSGF person, which is about diversity, you know, a diversity of experience diversity of training. We think at Livermore, for instance, when we make these multidisciplinary teams, and that's a strength of what we do. We come up with better solutions because we were looking at the problems from a whole bunch of angles, right, and that's one form of diversity. But I know studies show that you're better off having more diversity. You get better solutions; you explore the solution space better. So so that's one of the reasons that we want to do it. The knack of kind of giving those kinds of talks I have found is: they have to be entertaining, of course. It's always helpful. You have to have a good hook that draws people in, and much like, much like comedy, it's always loop back to that by the end of the talk and get back to where you started.

Jeff Hittinger 24:28
I have found mostly it's about analogy, right? Trying to find what doesn't be a perfect analogy, but what's it what's the, what's a good analogy that your audience would readily relate to, that you can draw to try and connect them to what you're trying to talk about? And because you're not trying to make them

an expert, right, you're not trying to teach them about the nuance of some detail. You're trying to give them an idea right. You want to idea about what you do. They don't have to be an expert by the end of your talk.

Sarah Webb 25:03
So something that they can walk away from and say, "Oh, Jeff, does that. Right?"

Jeff Hittinger 25:09
Yeah, exactly.

Sarah Webb 25:11
So what's your favorite analogy that you've come up with for a talk like this?

Jeff Hittinger 25:16
Interestingly, there's a talk, I had to give him a work that I didn't do, which is another skill you have to develop when you become a manager is you have to be able to understand the science of the people who work for you and be able to represent it. One of the challenges of moving to the new machines: we have to rewrite our codes. So there's been a lot of work put into something called abstraction layers, and programming abstractions. So one example of this is Kokkos and RAJA. Kokkos was developed at Sandia; RAJA was developed at Livermore. They effectively do the same thing, but they were developed for different reasons.

Jeff Hittinger 25:59
And I use the analogy for a very pertinent one for the Bay Area of what happened after the 1989 earthquake, and the bridges that we have in the area. Right. Ultimately, what happened there is we retrofitted the Golden Gate Bridge. And you probably wouldn't notice all the seismic improvements that were done there, because we wanted to preserve the character of that bridge, right? And the Bay Bridge, on the other hand, right, we just finished building the new Bay Bridge, many, many years later. But instead of being the double decker bridge going, going from Oakland over to San Francisco, it's now you know, single story. It's a beautiful bridge, if you ever get a chance to look at it, and when they light it up, it's pretty cool. So those are two different strategies. One was start from scratch and redo it. And the other was, well, how do we keep it in place?

Jeff Hittinger 26:51
And those are the differences really, between Kokkos and RAJA. Kokkos is better at "I'm starting a code from scratch." RAJA was developed here, because we have a long history of developing scientific software that we rely on for our mission. And rewriting all those codes from scratch and doing it over and over again was not really an option. So we were looking for something that how could we make this work in retrofit, I guess, to a certain degree. But then I was able to bring it back to earthquakes because we have one of the top performing seismic simulation codes in the world, SW4. That's, that's part of the Exascale Computing Project. And it uses RAJA and gets phenomenal performance such that they've been able to do simulations, all the way to the frequencies that you would need to get to start looking at how those impact buildings,

Sarah Webb 27:49
Cool.

Jeff Hittinger 27:49
Which is groundbreaking. They hadn't been able to get to that before. And that was enabled by being able to put these, this seismic code SW4 on this new class of supercomputers, and that was enabled by using RAJA. So I got it all the way back to earthquakes. I hope it worked. But yeah, so maybe, maybe that's my favorite.

Sarah Webb 28:17
Well, that's a good one anyway. Are you up for a lightning round?

Jeff Hittinger 28:20
Sure.

Sarah Webb 28:22
What's your favorite element on the periodic table?

Jeff Hittinger 28:25
Well, livermorium, of course. When you work in a lab with its own element? Come on.

Sarah Webb 28:32
But as a physicist, do you have a favorite subatomic particle?

Jeff Hittinger 28:36
Well, quarks are kind of quarky. Right?

Sarah Webb 28:41
And what was your first computer?

Jeff Hittinger 28:43
Oh, a Trash 80.

Sarah Webb 28:48
And do you have a favorite computer?

Jeff Hittinger 28:50
Do I have a favorite computer? I don't know that I actually do. I've, I've been fortunate enough to see a whole bunch of different kinds of computers and build a whole bunch of different computers over my lifetime. I don't know. My favorite computer is usually the latest one I built.

Sarah Webb 29:09
That seems fair. I guess it's a little like asking you for your favorite child. Right? If you've built a bunch.

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Jeff Hittinger 29:15
Yeah, I can't. Yeah, I won't go there.

Sarah Webb 29:19
Exactly. So to wrap up, I want to ask you one final question. What's the key piece of advice that you like to pass on to early career computational scientists?

Jeff Hittinger 29:32
Don't say "no" just because you're scared about an area being something that you don't know anything about. It's very enriching to go into areas and learn and discover the parallels and connections to what you know, and to learn the new things which enrich how you solve problems in general. I don't like seeing people self-limit just because they're a little concerned that like, "Oh, I don't know enough about that." Jump in, you know. Yeah, certainly, when you've done the training to become a research scientist, you've demonstrated the ability to teach yourself and to learn. And you can do it. So take advantage of those opportunities. Obviously, within a limit, there's a point at which people get oversubscribed. But it's usually not a problem with the early career scientists. They're usually a little more circumspect about whether or not they can handle something. You don't know to try, and it's okay to fail. And you learn more from failure failing than you do from succeeding, honestly. I mean, that's been my experience is that the lessons I have learned the best are the ones that have come out of failure, not success. So don't worry about that. Don't limit yourself.

Sarah Webb 31:01
Cool. So, Jeff, I want to thank you for your time. And for this conversation. This was a pleasure. Thank you for being here.

Jeff Hittinger 31:10
Sure, it's been fun.

Sarah Webb 31:15
To learn more about Jeff, the Center for Applied Computing or the CSGF, please check out our show notes at scienceinparallel.org. If you like this episode, please share it with a friend or colleague and subscribe wherever you listen to podcasts.

Sarah Webb 31:34
Science in Parallel is produced by the Krell Institute and highlights computational science with a particular focus on work by fellows and alumni of the Department of Energy Computational Science Graduate Fellowship Program. Krell administers this program for the U.S. Department of Energy. Our music was written by Steve O'Reilly. This episode was produced and edited by me, Sarah Webb.