Group #5: Community of Interest on the Future of Scientific Methodologies

|  |  |
| --- | --- |
| Date | November 2, 2020 |

|  |  |
| --- | --- |
| Participants | |
| Elizabeth Worcester | Daniel Ratner |
| Patricia Lee | Patricia Lee |
| Josh Levine | Brandi Brown |
| Bruce | \*fac- Nami Ishihara |
| Kjiersten | James Ahrens |

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1 Day One - November 2, 2020

1.1 Breakout 1 - Define the Scope of the Problem.

**The following participants have not been active:**  
\*fac- Nami Ishihara, Patricia Lee

**Question or instruction for the discussion:**  
Breakout 1 - Define the Scope of the Problem.  
The purpose of this session is to lay the foundation for the next 5 sessions. That is, each breakout group will define a key piece of technology, a new device, or methodology that would have an impact on how the labs/scientists operate. The details should include answers to the questions below.



**Sticky points:**

 Top Takeaways (5 points per participant)

* What is the problem, issue, technology, device, methodology?
  + (2) Specialization in training vs. interdisciplinarity (#1)
    - What do mean Josh? (#3)
    - Does the next generation of scientists need to be experts in just one thing (e.g. physics) or do they also need to have explicit training in AI? (#5)
  + Human - AI interaction - how do humans evaluate input from AI ("systematics") (#4)
  + Topic: What basic skills will all AI scientists need to teach and learn from AI collaborators as well as human collaborators? (#6)
    - (1) Lets assume that AI is providing scientific suggestions and directions. (#11)
      * Explainable AI is key (#12)
        + I think given the thirty year time frame - we should postulate a AI collaborator is an "intelligent" actor that offers suggestions of research with evidence to backup lines of inquiry (#13)

If this is the case then I think it's important to understand how one evaluates the intelligence of the AI collaborator - in human-human interactions we weight people's suggestions based on our knowledge of their expertise, track record, etc (eg people might be more interested in my opinions on neutrinos than on biology) - how do we interact with the AI in a way that allows us to evaluate our "impressions" of them? (#14)

* + - Perhaps we need to define what an "AI Collaborator" is? (#10)
  + Not all collaborators can have a complete skill set - what are things that everyone needs to understand to work together? What things are individual skill sets that is not required of everyone? How to bring groups with different skill sets together? (#2)
    - Common understanding of language/jargon, what is possible with AI, etc can facilitate working together (#8)
  + Are there vehicles in place to facilitate the needed integrated skill set. (#9)
  + p value problem - need to understand statistics (#17)
  + if we don't know what it is doing than we don't know if you are getting it wrong (#18)
  + human interpretation of complex machinery can and is wrong (#19)
  + (1) Where training occurs -- is the expectation that scientists learn everything when they complete their degree or is their training on-the-job? (#7)
  + (1) How much of the interaction will become intuitive (eg babies seem to instinctively know how to use smart phones) so that "training" happens naturally just by using it? Can we develop interfaces that makes the communication more intuitive? (#25)
  + (1) Knowledge drain from industry -- folks who are AI trained often get snagged (#29)
    - Probably not possible to compete financially. Can we compete in quality of life by being more flexible than most labs have been in the past with work arrangements, etc? (#30)
  + (2) What is impact of AI on diversity in workforce? (#33)
    - How does recruiting from diverse groups cross-cut workforce development (#34)
* Who would develop it (basic research to advanced deployment)?
  + federal government level decision making (#15)
  + University/Laboratory teams develop with federal deployment due to difficulty in implementation across contracts. (#16)
  + Application specific vs general? If there's a common development, does that cover the needs of particular research topics? Or are there domain specific needs such that some level of development needs to to occur at the scientific field or collaboration level? (#22)
  + Who at a university is making choices that help students become better trained to be a lab (e.g. curriculum choices). (#23)
    - Or is most workforce development through summer internships? (#24)
  + Should it be a program, or should it be a way of life / culture shift? (#26)
  + who are the collaborators? (#27)
    - universities (#28)
* Who would use it and what skills would they need to use it effectively?
  + (1) Statistics training in general is needed (at least right now) (#20)
    - In the future it depends on our ability to interpret what an AI collaborator gives us. These days, the interpretation can be difficult (in part because they are black boxes, and in part because they give complex answers) (#21)
  + (2) Difference between "producer" vs. "consumer" training in AI. Do we need more training in how to "make" the next AI systems or just how to "use" them? (#31)
* When would it be expected to be in production use (N years in the future)?
  + We are already doing this (AI-human collaboration) at some level - though we imagine it being much more sophisticated in this exercise. Will it be an adiabatic change? Or is there some major change we anticipate? (#32)
  + 5-10 years to create workforce change in programmatic efforts. (#35)
    - including adopting the technology (#37)
  + long-term change: cultural (#36)
  + I am wondering about the linkage between the flexibly and dynamicism within the human force, "gig-economy", and reduced culture barriers to inclusion of AI (#40)
* Where, and how widely, would it be deployed?
  + Laboratories (#38)
  + Universities (#39)
  + Only in scientific research or is this permeating culture (eg smart phones) (#41)
* What is the setup time and/or process for using it?

1.2 Breakout 2 - Implications of this Problem.

**The following participants have not been active:**  
Bruce, Kjiersten, Patricia Lee, Daniel Ratner

**Question or instruction for the discussion:**  
Breakout 2 - Implications of this Problem.  
Each group will now develop a list of issues and implications for the issue/technology/community they settled on. There are lots of implications for how a technology can be used, or further developed.



**Sticky points:**

 Top Takeaways (5 points per participant)

* What other/companion technologies, services, software/hardware must also be developed and deployed?
  + Academic outreach programs from the labs? Or perhaps more closely knit academic training programs (#4)
    - Google does something like this: https://buildyourfuture.withgoogle.com/programs/googleinresidence/ (#6)
  + Developers of AI could consider making interfaces as intuitive as possible, taking into account human behavior - to ease adoption/communication/training (#58)
* Who is/will develop this companion technology/service?
  + What are the desirable properties with an AI collaborator? (#2)
    - E.g., explainability, trust (#3)
      * evidence based analysis and explaination (#5)
    - Evaluation of collaborator with the same criteria (#7)
      * How is trust built (#8)
  + AI as intelligent versus as AI as automation (#9)
    - Treating the AI collaborator as an "oracle", e.g. a google-like search, or a siri-like QA session, or a 538-like number crunch (with a loopback on knowing when more data is needed). (#10)
      * add to trust factor between collaborators. (#18)
* What skills/knowledge does the end user require?
  + Finding a common language to discuss these concepts and speak the same language. (#11)
    - Core curriculum for science - statistics for everyone? (#12)
  + Discussion of 538 - FiveThirtyEight - statistical modeling and its explanation to general public (#13)
  + Communication problem - explain our language (#14)
    - Interdisciplinary education (#15)
  + Structure of funding organization leads to lack of interdisciplinary work (#16)
  + Workforce follows organization - hard to keep interest / career long-term (#19)
  + Common language / tools (#20)
  + Implications and consequences (#21)
    - funding source to enforce and integrate (#27)
    - job turnover rate- downfall of lack of pension (#29)
* What are the training/support requirements?
  + who is the audience/ pipeline coming into this? (#1)
  + funding in the form of grants or some other mechanism to invest in this cross disciplinary communication. (#17)
  + Interdisciplinary connection are made (#22)
    - working group whose job it is to enforce (#23)
  + Organizational entity that encourage interdisciplinary collaboration funding etc. (#24)
    - But without deflecting responsibility from other parts of agency - still has to be everyone (#26)
  + Maybe a part of each orgnaization? (#25)
  + Long term scientific career versus short gig economy (#28)
  + Everyone writes their own module is the model (#30)
  + Pushes toward toward "hardened, super well-defined interface" (#31)
  + don't treat science as business- incentivize employees to invest long-term to topic area . (#32)
  + Curricula is fixed by universities - workforce of people who can learn - Who needs to be an expert in AI? (#33)
    - might not have applicable background when going into workforce. (#34)
    - diversity as a key driver for the future workforce - need to solve this over the next thirty years (#36)
  + diverse workforce (#35)
    - flexibility- ability to come and go, part-time, etc. (#37)
      * maternity leave. (#43)
    - race/ gender diversity promoted (environmental feel) (#45)
      * website promote diversity (#48)
  + More flexible we are - the more diverse we will have - specialized location causes two-body problems (#38)
  + Multi-site - city, rural (#39)
  + Path that their life good in multiple ways (#40)
  + black in the ivory tower twitter (#41)
  + http://twitter.com/blackintheivory (#42)
  + Paternal leave policies (#44)
  + Quality of workplace really matters (#46)
  + Leadership needs to be reflective of the community you want to be in (#47)
  + Should it be a program or should it be a way of life (#49)
  + It should be a culture (#50)
  + To find a willingness to do things now (and accept will not solve complete problem) (#51)
  + If you don't the culture and something you want to do then you do not think you want to be part of it (#52)
  + Opportunity to work alongside each other - causes culture change (#53)
    - would this be where regular meetings come into play between cross disciplinaries. Another pro: bridges AI language, too. (#54)
  + Amount of training to become a laboratory employee - only Ph.D. - how many years of education are needed? (#55)
    - Lab staff at all levels (techs, admin, support, etc) may need to interact with AI, so grad-level and professional-level training probably not sufficient (#56)
  + Earlier then college - how to engage diverse workforce (#57)

1.3 Day 1 Reflections

Participants: 1

**Brainstorm question or instruction:**  
Day 1 Reflections  
This area is for the Moderator to note key discussion points to summarize what was accomplished in Day one. Remember that day one is focused on Identifying a new technology or methodology and identifying the implications and possible consequences of it. The moderator can populate this individually at the end of the day or request input from the group here.



* 1. Topic (in workforce development): What basic skills will all AI scientists need to teach and learn from AI collaborators as well as human collaborators?   
  Goal: strategic, 30-year vision. Focus on long-term vision rather than details.   
  Day 1 recap:   
  Sesson 1:   
  • Problems/ issues:   
  o Specialized vs interdisciplinary  
  o AI collaborator as intelligent actor  
  o Common language/ jargon  
  o Need to understand statistics  
  o Where does training occur?   
  o Once degree complete? On the job training?  
  o Develop communication methods that become intuitive  
  o AI impact on diversity in workforce  
  • Who would develop:   
  o University/ laboratory teams  
  o Should it be a program or way of life?  
  • Who would use it/ what skills?   
  o Statistics training as needed  
  o Difference between producer and consumer-do we need training in how to use it or how to make the AI system?  
  • Projected target:   
  o 5-10 years to create workforce change  
  o Long-term shift: cultural  
  • Where: laboratires, universities  
  Session 2:   
  • What must be developed?   
  o Academic outreach programs from labs or academic training programs  
  o Developers of AI make it intuitive- take into account human behavior.   
  • AI collaborator: how is trust built? AI as intelligent vs automation  
  o Treat like oracle- adds to trust between collaborators   
  • End-user  
  o Communication barrier- interdisciplinary education  
  o Structure of funding   
  o Workforce follows organization   
  o Need: Common language / tools  
  • Implications/ issues:   
  o Funding source  
  o Job turnover rate  
  o Curiculuu is fixed by universities   
  o Amount of training needed before becoming an employee  
  • Need:   
  o Funding: grants; interdisciplinary communication promotion  
  o Interdisciplinary connections: working groups- job= enforce  
  o Organization entity   
  o Long-term scientific career (address job turnover rate)  
   Quality workforce  
   Cultural feel in the workplace  
  o Push toward well-defined interface  
  o Diverse workforce   
   Flexibility  
   Promote on websites  
   Paternal leave  
   Earlier than college- how to engage diverse workforce?  
  o Don’t treat science as business-incentivize employees

2 Day Two - November 5, 2020

2.1 Breakout 3 - Signposts

**The following participants have not been active:**  
Bruce, Patricia Lee, Patricia Lee

**Brainstorm question or instruction:**  
Breakout 3 - Signposts  
What we are looking for is technology or social trends that would give us clues that we are on the right track. o How would precursor technologies/services be identified? o What are the precursor technologies/services? o Is there a rank order for when specific technologies/services need to be available? o What DOE or Lab policies need to be in place now, in 5 years? o What facilities need to be in place now, in 5 years?



**Sticky points:**

 Top Takeaways (5 points per participant)

* 1. Work force flexibility (incentivize long-term investment)
  + Comments
  + Within laboratory (#2)
    - part-time, work from home (#10)
  + seamlessly to move across (#3)
  + Inria has funding model do not worry about overhead - also encourage teams across laboratories - work on project for fixed duration - then to new teams (#4)
    - CNRS ideation (#6)
      * \*CNRS (#8)
  + flexibility in terms of: (#5)
  + flexibility in terms of: 1. personal life (career path)/part-time/flex-time, location, 2. best organization to be in (with a long term sceince goal) university, industry to lab, 3. funding model (#7)
    - Signpost #1 is in five years - are we still teleworking and on-site (#92)
      * is there an ability to be remote 30 years from now with scientific jobs that may not be right now? (#93)
    - SIgnpost #2 is in are we better at remote experimental science (#94)
      * Identity of scientist as "doing science" - hands on experimentation (#97)
      * Is flexibility at odds with building a community (#99)
      * You could potentially do a series of different experiments - where (like Jim is saying now) folks get together for short, intensive periods of time (#100)
        + sprint style? (#106)
      * Operator comment from below (#104)
      * Create a shared experience and bonds before the team embarks on something /phyiscality (#105)
    - signpost #3: setup experimental studies to measure success (#110)
      * test groups- remote working (#111)
  + stronger coupling of research agenda across entities (#9)
  + need for education that starts in K-12 and incorporates science culturely (#11)
  + developing high-tech workforce for the nation (#12)
  + core capability of needed by national laboratory - scientists, data stewards, software engineers, AI - thirty years from now what is the compostion of workforce (#13)
  + Daycare on site (#14)
  + give space to grow (#15)
  + idealized version of workforce - highly trained scientists, better management, incentive thought process (#16)
  + community feel- daycare, restaurant (#17)
  + campus feel - restaurant on site - day-care on site (#18)
  + community (#19)
  + time-cards versus community (#20)
  + Signposts (#40)
    - current track (#41)
    - future track (#42)
      * measurable tracking: surveys (#55)
  + Workforce dystopian vision (#44)
  + ? (#45)
  + Community welcome center (#47)
  + Fermi lab as a model - daycare, community center, bison! (#49)
  + Maybe I'm thinking about sign posts a bit differently? But I've been trying to map them onto the idea of SMART goals (specific measurable attainable relevant timely). In particularly, how could we measure "workforce flexibility", "community", etc? (#50)
  + Easier with homogeneous workforce... (#52)
  + barcelona supercomputing center (supercomputer in a decommissioned church) - as a model - museum model - integrate public as part of planning for science (#56)
  + Is it possible to measure inclusivity I'd love to see a social network graph analysis of everyone's emails what are the sources of data we can collect right now signposts can be qualitative, too (#57)
  + Interdisciplinary office in DOE - program that lets people move from lab to lab (#59)
  + cross connectivity between labs (#60)
  + structural things that are measurable - interdisplinary office (#62)
  + what does our workforce know? (#64)
  + Ah! i just wrote down something similar What are the core staff capabilities/knowledge they bring? (#65)
  + risk averse - creating a growth mind set in the labs - measures that we want to track (#68)
  + ASCR - bridge across all the other offices (#70)
  + management - good researchers are expected to become managers - balance needed (#71)
  + career path is only through management? (#73)
  + And then we don't support them! (#75)
  + Talking to experts in organizational management and leadership (#77)
  + User-centric design (#78)
  + Identity as scientist "involved in scientific experiment" (#96)
  + Is flexibility at odds with building a community? (#98)
  + flexible model- incorporates remote and sense of community at the same time. (#101)
  + For me, this is an ASCR workshop so the scope here is "what do we envision/desire the ASCR workforce to be", but I think it's in scope that we could make changes that affect the workforce of the entire lab \*or the entire DOE workforce (#102)
  + Everyone becomes an operator - (telephone analogy) with ASCR tools / AI (#103)
  + Prototype to start - interdisciplinary teams experiments - prototyping and evaluating organizational structure as part of work (#108)
  + Short term bets - agile development teams - user studies - design studies (#109)
  + https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-18-29988 (#112)
  + https://science.osti.gov/-/media/ascr/ascac/pdf/meetings/202004/Transition\_Report\_202004-ASCAC.pdf?la=en&hash=5164916FE5158EE8919C26804B4CF7F6DDA36E9D (#113)
  + improve political structure to allow flexibility- changes require a significant amount of political approval before being implemented/ changed. (#114)
  + Significant barriers to change - risk averse management culture (#115)
  + Messaging, storytelling, data (#116)
* 21. Workforce Community
  + Comments
  + daycare, restaurant (#22)
  + timecard (#23)
  + Safety, security, liability concerns (#24)
  + labs as center - maybe just a part of your work - better job - still be a part of lab community (#25)
  + Should the lab have any software engineers (now or in the future)? (#26)
    - are the quality of software engineers within the laboratory diverse, timely, and efficient? (#29)
  + Signpost - increased diversity, quality of scientists in the US (#27)
  + Lab - not good at software engineering (#28)
  + evaluate staff and skills we are trying to entice. (#30)
  + universities- don't recommend undergrads in computer science to labs. Can make more at other companies- google. (#32)
  + Don't cut overhead funds (#34)
    - support staff (#35)
  + reduce beaucracy (#36)
  + investment into R&D - fine tuning existing products (#37)
  + funding model- leads to inefficient careers (#38)
    - not a collaborative team (#39)
  + create welcome space (#46)
  + Signposts (#48)
    - use fermi lab as a model (#51)
  + Inclusion - how can we measure inclusion? (#80)
  + include virtual and onsite community (#95)
* 31. Workforce Diversity
  + Comments
  + demographics (#53)
    - demographics both over all, and in higher profile positions (whether management, senior IC) (#74)
    - career progression (#81)
    - have it match the demographics that are reflective in the US? (#85)
      * This is a signpost! (#157)
    - focus on recruiting (#88)
  + scientists (#54)
    - how have we increased scientists in the US, not just laboratory? (#82)
  + quality management (#72)
  + Numbers that go beyond that the lab, education programs (#83)
  + I'm going to add inclusion here, too - how can we measure inclusion in addition to diversity. We want the diverse voices at the table? (#84)
  + Laboratory demographics match the US (#86)
  + Our values are embodied in the goals (#87)
  + Signnost: survey: what are causing groups to stay or leave? Is the culture changing? (#89)
  + age diversity (#138)
  + Commitment, Cultural change (#158)
  + Bimodal distribution of age in the laboratory system - Are seeing the effects - Part of that is not celebrating the diversity (#159)
    - minimal middle career people. (#160)
      * why? what made them leave? (#163)
  + Needed to document this (#161)
  + I think we're also dealing with a trend of government not being "cool" or understood - which we could combat through embracing diversity and inclusivity why did the mid-career people leave? (#162)
  + it would be really interesting to interview and talk to folks that didn't stay and, do you think that early career folks are going to stay? (#164)
  + Challenge for early career folks forced into mid career positions (#165)
  + don't have good practices enforced to promote diversity (#166)
  + Need expert advice in diversity (#167)
    - don't assume diverse people have the answers. (#169)
  + Make the assumption that diverse hires know how to fix diversity issues (#168)
  + Negative impact on career - all committees need diverse members - detrimental to career of diverse members (#170)
  + Signpost: laboratory at all levels of management match the demographics of the US (#171)
  + Signpost: investment in these processes (#172)
  + Signost: who the pool of candidates coming in are from (beyond laboratory) (#173)
  + Signpost: we understand who the pool of candidates really is - and then how successful we are with this pool (#174)
    - understand in the next couple of years, then develop understanding to draw from pool (#176)
  + Once we know this - increase the interest, number of candidates (#175)
  + Develop understanding, and then have diverse pull to draw from (#177)
  + what attracts people? (#178)
    - diverse website (#180)
    - And what retains them. (#181)
  + https://cra.org/crn/2015/09/expanding-the-pipeline-the-state-of-african-americans-in-computer-science-the-need-to-increase-representation/ (#179)
  + https://news.cornell.edu/stories/2020/05/cornells-first-black-female-cs-phd-blazed-her-own-trail (#182)
  + Pipeline issue: what role can the lab play to bridge the diverse issues? (#183)
    - fellowships geared toward diversity (summer programs?) (#184)
      * or have to include diverse people within fellowship program. (#194)
  + Study of how to improve AA representation in physics - specific recommendations https://www.aip.org/diversity-initiatives/team-up-task-force (#185)
  + Signpost: implement recommendations listed in above report. (#186)
  + "Fostering a sense of belonging..." (#187)
  + Cultural signposts (#188)
    - Survey workforce climate (#189)
  + Signpost: office of diversity dedicated to this topic. (#190)
  + Equity, inclusion (#191)
  + NSF requires improving diversity as part of all grants (#192)
    - https://bpcnet.org/ (#196)
  + we can hire a diverse workforce, but if they're not given the same opportunities or included in the conversation... then we're limiting the benefits we'd reap from having a diverse workforce (#193)
  + DEI goals as part of annual goal setting and evaluation (#195)
* 33. Interdisciplinary
  + Comments
  + there are good studies on overhead in companies ... i will try to find some of those. there are good arguments for not reducing overhead funding because that's the grease that keeps the wheels moving well Pay to generate data, but not to store or anal (#43)
  + interdisciplanary DOE office (#58)
  + cross connectedness between lab and with universities (#61)
  + common language (#66)
    - regular meetings, educational courses, training (#67)
  + POC who can communicate with cross disciplines (#69)
  + funding source to integrate. (#90)
  + integrate office of science- with interdisciplinary teams to remotely conduct experiments. (#107)
  + signpost: measure how collaborations are happening. (#148)
  + Signpost: establish interdisciplinary office (#149)
    - set aside funding to promote it. (#150)
      * -research calls specifically for interdisciplinary reserach (#151)
    - integrate into laboratory mission (#153)
    - incorporate interdisciplinary communication barriers into this. (#156)
  + Rewarded by solving the mission of the laboratory (#152)
  + Remove stovepiping of funding sources (#154)
  + Funding, authorship - cultural (#155)
* 63. What is known now and what is needed (knowledge/ training)
  + Comments
  + talk with experts (#76)
    - what is desired end goal? Is the current model reaching that goal? (#79)
  + issue: university curriculum fixed. (#91)
  + Workforce skills assessment? (identify gaps, training opportunities?) (#117)
  + Metric? (#118)
  + Metric: distribution of training (e.g. degrees) ? (#119)
  + Where is the workforce coming from? (#120)
  + how has the curriculum for the degrees changed? (#121)
  + On site and on the job training (#122)
  + Expected change in five years? (#123)
  + Crash course in CS (#124)
  + What about MOOCs? And accreditation? (#125)
  + Diversity of training? (#126)
  + Hiring of people that have skills on building teams (#127)
  + Standard - data science as a required course for education (#128)
  + Data science literacy as a metric? (#129)
  + training on focus science area jargon. (#130)
  + Give all lab employees a data science exam? ;) (#131)
  + Kahn Academy (#132)
  + Democratization of knowledge and accreditation (#133)
  + Rewards for taking online courses at the laboratory (#134)
  + Closer integration of laboratories, academic - involved in design of courses (#135)
  + Machine learning -not just for early career! (#136)
    - facilitate learning for staff of all ages. (#137)
  + Availability of training is a cultural value (#139)
  + Training in this context does not mandatory lab "rule" training (#140)
    - training has a negative connotation. (#141)
  + Signpost: Is there money devoted to this avenue? (#142)
    - what is going to education vs research? (#143)
  + Document what $ are going to education, research, overhead (#144)
  + for laboratory staff (#145)
  + Are there mentorship program? What is the success of the mentor program? (#146)
  + Mentorship - are there mentorship programs, track mentee success, open to diffferent paths (#147)

2.2 Breakout 4 - Signpost Plausibility

Participants: 0

**Brainstorm question or instruction:**  
Breakout 4 - Signpost Plausibility  
Now that we have the list of signposts, the groups need to consider how plausible they are and what DOE needs to do to either ensure they happen or the implications of them not happening. o Who is actively working on these precursors? o When would these precursor technologies/services be needed? o What active or pending research programs need to be in place now? In 5 years? 10? o What existing or planned facilities need to be in place now? In 5 years? 10? o What software services or capabilities need to be in place now? In 5 years? 10? o How successful has the community been in meeting previous goals?



**Sticky points:**

 Top Takeaways (5 points per participant)

Appendix

Live chat

**The following messages were exchanged via Live chat.**

* Nov 2, 2020, 17:47 UTC
  + Topic: what basic skills will all AI scientists need to teach and learn from AI collaborators as well as human collaborators. (Brandi Brown | Nov 2, 2020, 17:47 UTC)