Creating a Culture for Curiosity, Creativity, and Critical Thinking

Radia Perlman
Dell Technologies

Radia.Perlman@dell.com
Story behind this talk

• One topic I was told people would be interested in was
  • “Building careers in the infosec space, especially for groups that are not well represented today”

• I said “I could do a talk like that, but I want to also do a technical talk”
  • Which I’ll do tomorrow

• This talk is a combination of
  • Ranting about misconceptions caused by hype
  • Story of my career, and lessons learned along the way
  • Tips for creating a positive culture
Critical Thinking

• Not everything you read, or hear is true
How computer networking tends to be taught

• Memorize these standards documents, or the arcane details of some implementation that got deployed
• Nothing else ever existed
• Except possibly to make vague, nontechnical, snide comments about other stuff
My philosophy on teaching (and books)

• Look at each conceptual problem, like how to autoconfigure an address
• Talk about a bunch of approaches to that, with tradeoffs
• Then mention how various protocols (e.g., IPv4, IPv6, Appletalk, IPX, DECnet, ...) solve it
But some professors say...

• Why is there stuff in here that my students don’t “need to know”? 
Things are so confusing

• Comparing technology A vs B
  • Nobody knows both of them
  • Both A and B are moving targets
Standards Bodies...
What about “facts”? 

• What if you measure A vs B?
What about “facts”?

• What if you measure A vs B?
• What are you actually measuring?...one implementation of A vs one implementation of B
What about “facts”?  

• What if you measure A vs B?  
• What are you actually measuring?...one implementation of A vs one implementation of B  
• So don’t believe something unless you can figure out a plausible property of the two protocols that would make that true
Example of confusion and hype: Blockchain
What is blockchain?

• Started as the technology behind Bitcoin
• People made money on Bitcoin
• The more hype, the more money gets poured in
• And with hype, “blockchain” becomes powerful for attracting venture capital
• So, people assume the technology must be important
Hype

- Articles about how “blockchain” is:
  - Biggest advancement in technology since the Internet
  - “Being considered for” all sorts of problems
  - “Even the US Military is looking at blockchain technology to secure nuclear weapons"
Possible questions

• I claim these are wrong questions
  • What kinds of applications can I build on blockchain?
  • How can I apply blockchain to this problem?

• Right approach
  • What problem am I solving?
  • What are various ways of solving it
  • Compare approaches
  • If ‘blockchain’ turns out to be the best solution, OK...
Misleading statements

• Look how many applications I can build using blockchain!
  • if you assume ‘blockchain’ is a black box with API “store data” and “retrieve data”, there are lots of applications you could build
  • But these applications could as easily (and more efficiently) have used a disk, or a cloud, or a storage array
• Societal problem, e.g., e coli...solution...put supply chain history on blockchain!
  • Problems: doesn’t answer any of the hard problems, like how the farmers get the credentials to write data, how to know which lettuce came from where...
  • And simply using a database would do the same thing (more efficiently)
• Look how much faster this application is once we moved it to blockchain
  • Problem: it used to be done with hand-carrying documents up mountains to be notarized by ... all they’re saying is if only they had computers and networks they could do stuff faster
• Governments can’t regulate or outlaw cryptocurrency
  • Yes they can...maybe if you’re careful you won’t get caught
  • Just like with murder
People hear

• “Centralized” = “Bad”
• “Distributed” = “Good”
• “Distributed” means “blockchain”
• People not even sure what “distributed” means
Is centralized “bad”?

- Centralized is the most efficient
- And it’s clear who to blame
- Most applications require “adult supervision”
- So, most of the time, centralized is exactly what is needed
- For instance, when you withdraw $20 from an ATM, your own bank makes the decision, not a consortium of banks voting
- And “centralized” can still have lots of servers so the application is always up
- And good storage systems (like public clouds) store data in multiple places, geo-replicated
What does “distributed” mean?

• Store data in lots of places? (industry knew how to do that before “blockchain”)

• Have multiple instances of a server, to split load, and for resiliency? (industry knew how to do that before blockchain)

• Distributed trust...that’s interesting and subtle
Distributed Trust

• One organization can become evil (evil employee, someone evil steals their private key and impersonates them)
• A single organization might need to prove something, other than by saying “trust me”
• Does “blockchain” solve that?
  • Not really...51% attack on public blockchain, completely trust node you query, no enforcement against a node refusing to record a transaction
• Are there other ways of protecting against a malicious participant? (next slide)
Example: Credit Rating Agencies

• Current method:
  • Several totally independent organizations
  • Each with their own sources of data, and algorithms for computing a score
  • Someone checking a credit rating can go to whichever they trust, or multiple and compare
  • Plus laws that allow consumers to contest data they think is wrong

• With blockchain, presumably
  • Some consortium...who chooses the participants?
  • They’d have to argue about things, vote, etc., and it would be far less efficient
More Hype
Example proposed application

• “Could blockchain be the answer to healthcare?”
  • “Imagine this: Your entire medical record is on the blockchain. Monitoring systems and IoT devices automatically update your data, so when you go for diagnostic tests, the results are recorded without a third party”
I can’t imagine an application less suitable for blockchain

• World readable database?
• World writeable database? (who organizes credentials so you know data being written is traceable to the sensor that wrote it?)
• No organization to the data other than append-only log, mixing every human’s records and sensor readings?
• Data kept forever, in its entirety
I can’t imagine an application *less* suitable for blockchain

• And yeah, I’m sure someone will think of using encryption to get around the world-readable thing
  • But with what keys?
  • Do you use trusted third parties?
    • Then why not have them manage the database?
My advice for designs

• Start with “what problem am I solving”
• Then consider several types of solutions, and compare
• Don’t say “can we use this technology for this application”?
• What I say to engineers who are being pressured to use “blockchain”
  • Do the right technical solution
  • And then call it “blockchain”
Some stories from my past
“What do you want to be when you grow up?”

• I certainly would not have said “designing computer network protocols”
“What do you want to be when you grow up?”

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• It was just a bunch of random events that led me here
“What do you want to be when you grow up?”

• I certainly would not have said “designing computer network protocols”
• It was just a bunch of random events that led me here
• And I love how it turned out!
Lesson

• Don’t worry about finding “the thing you were born to do”
• Making decisions:
  • You’ll never have enough information to make an informed decision
  • There are two types of people:
    • Those that would be happy with either decision
    • Those that would be unhappy with either decision
School before college

- Loved logic problems
  - And writing
  - And music
  - And humor

- I certainly never took anything apart

- I knew nothing about computers
  - If I’d known more, I probably would have said “I’d be interested in anything....except computers”
Frankly...

• I think this industry could use more people that hate computers
• Engineers should actually meet some humans, then they’d stop having programs ask questions like:
  • Do you want POP or IMAP?
  • Do you want to display both the secure and insecure items?
My first computer class

• In high school, a teacher noticed there was a programming class at a nearby university
  • She could drive us there after school
  • Aren’t teachers awesome!!!
Then...my first computer class

- After years of always being the top student in any math/science class, I walk into this computer programming class...
  - Totally intimidated
    - by students saying they'd built “ham radios” when they were 7
    - And asking questions with fancy words like “input”
- I wound up learning nothing in that class
- But it made me a much better teacher
Lesson

• Most of success at learning is self-confidence
How I learned to program

• In college, took a physics class
  • TA (teaching assistant) to me:
    • I need a programmer for a project. Would you like to be my programmer?
  • Me: “I don’t know how to program”
  • TA: “I know. That’s why I’m asking you. I have no money to pay you. You’re obviously smart, and I’m sure you can learn. If you knew how to program, you’d expect to get paid.”
Why I agreed

• I had a friend who knew how to program
• In that environment, I had no trouble learning...
Continuing with grad school

• Did everything but my thesis
• My perception...
• Never found an advisor
• Then an old friend asked me if I was enjoying grad school
• I joined his group, at BBN, designing routing for ARPA packet radio network
• How I got the job at Digital
• Right place at the right time
At Digital

• Routing Protocol innovations (and specifically, IS-IS)
  • Self-stabilization
  • Scalability
  • Manageability

• Spanning tree bridging (which is what “Ethernet” is today)
Continuing with my career path

• For very weird reasons, I went back to grad school and did get a PhD (in computer science, rather than math)

• So much better the 2\textsuperscript{nd} time!
  • I’d learned “secrets”
    • When professor is droning on, ask questions!
    • Start problem sets as soon as you get them
    • If you’ve done the homework and followed the class, you’ll do fine on tests

• Despite everything I’d done, the way I actually got known....writing my book “Interconnections: Bridges, Routers, Switches, and Internetworking Protocols”

• Later co-wrote “Network Security: Private Communication in a Public World”
Now on to culture...

• How can we improve things to attract, retain, and ensure XXX type people (e.g., women, minorities, etc.) thrive?

• WRONG QUESTION!!

• Right question: “How can we improve things to attract, retain, and ensure all good people thrive.”
Culture

• It must be safe to ask questions
• Example of the opposite...
• How to answer a naïve question...
• But better yet, be a role model
Don’t reward bullies!

• Relentlessly self-promoting bullies tend to do well for themselves, in terms of recognition, titles, etc.

• Even if they were brilliant, they are toxic to those around them

• However... I’ve never met anyone like that, that was actually good technically

• Note: This is not a gender thing
Lesson

• It must be easy to learn things
Buzzwords

• For example, SDN, AI, object-oriented, hyper-converged...
• Useful for impressing people
• E.g., “our company utilizes AI-enhanced blockchain technology”
• Buzzwords don’t necessarily mean anything.
• They traumatize most engineers
• People who are sure they know the definition disagree, so...
• Be way more specific when talking, or when thinking about a problem
Cross-fertilization
Cross-fertilization

• Learning about other groups, other technology
• Getting other points of view on your technology
• How to make this happen in an industry of introverts?
Ideas

• At lunch, sit with people you don’t know
• Talk to people while you’re waiting in lines
• Maybe set aside tables specifically NOT for friends to chat with each other
• Maybe have topics chosen for such tables, or a moderator getting everyone involved and meeting each other
• Brainstorming sessions (“half-baked talks”)
Mentoring

• Strict hierarchy bothers me
• I think everyone should be mentoring everyone, when appropriate
• Pass on wisdom to next generation....
• But even better...ask them for help
Growing Leaders

• There are some people that will volunteer for leading anything, and take credit for any work the group does
• And there are those that would never think to volunteer
• Look for those, and encourage them to volunteer
• If they express nervousness, assure them others will help (and find people that will actually help them)
• Have a culture where helping others (without trying to take over, or worrying about getting the credit), is valued
Hints for problem-solving and communication

• Someone once asked me for advice on how to be a good speaker
Hints for problem-solving and communication

• Someone once asked me for advice on how to be a good speaker
• My advice
  • Given a topic you know something about
  • A level of the audience
  • An amount of time
• Come up with an appropriate talk
Suggestion

• People could be encouraged to practice this technique, e.g.,
  • Talks of various lengths (5, 10, 15, 30 minutes) on topics such as:
    • What’s a battery? What might cause it to catch fire?
    • What’s public key cryptography?
    • What is garbage collection?
    • What is agile computing?
    • What is ML?
  • Get constructive feedback
  • Then give these talks to a fairly large audience (once people are fairly good at doing this)
Problem-solving

• What problem are you solving?
• What is the best problem to solve?
• Remove all irrelevant details
• And yes…other things you have to worry about:
  • What implementation things you can leverage
  • Time to market
Now some woman-y thoughts
Why are there so few technical women?

• The more senior, the fewer there are
• It doesn’t seem to be changing
• I’m so used to being the only woman in the room I don’t even notice
• I asked some senior women who switched to the management track why they did that
  • So many things they could have said
  • Every one of them said “I wasn’t smart enough to stay on the technical track”
• Women think they wouldn’t like it
• Women think they wouldn’t be good at it
• Inner circle: networking at golf, old friends, social compatibility
• Subconscious impressions
• Perception today: women (and minorities) get special treatment
A recruitment letter I got

• “We are particularly interested in you as a female thought leader”
• My fantasy reply (I didn’t reply because I wasn’t interested in the job)
• “Thank you for your interest in me as a ‘female thought leader’. Although my credentials as a thought leader are impeccable, I must warn you I am not that qualified as a female. I cannot walk in heels, I have no clothing sense, and I’m not particularly decorative. What aspects of female are important for this job?”
Visible things that don’t actually help

• “Take your daughter to work day”
• I’m so glad they changed it to “take your children to work day”
How to feel like a group

• Sometimes diversity makes it hard...
  • Languages
  • Interests
  • Group activities
What is “diversity”

• Not just skin color and body shapes
• But different skills, different life experiences, different background
• A group should leverage each person’s strengths
Problems

• The Dilbert cartoon about “what is an engineer” is actually corrosive
• Hiring managers that can only respect someone who reminds them of a younger version of themselves
• Events that make it seem like a particular minority is getting preferential treatment creating resentment, reinforcing assumptions
School vs Life

• In school, emphasis on “must be your own work”
• In industry, the point is to get the job done
  • Great to ask for, and give help
• In academia, “novelty” is important
• In industry, build on (good) previous ideas
Fostering and Practicing Critical Thinking

• A lot of what “everyone knows” is not actually true

• Advice to professors:
  • Don’t just have students read good papers
  • Have them read horrible papers in prestigious venues
  • Have them read excellent, ground-breaking papers
    • Along with the reviews from the first 4 times the paper was rejected
Lessons

• It must be safe to ask questions
• Leaders should ask questions
• Life isn’t fair, but we can try
  • Don’t mistake bullies for geniuses
  • Don’t reward bullies
• If you believe you can’t do something, you won’t
• The most effective form of mentoring is to ask others for help
• Know what problem you’re solving before you try to solve it
Thank you!