MIT CSAIL Alliances | David Karger Podcast Export 1

Welcome to MIT's Computer Science and Artificial Intelligence Lab's *Alliances* podcast series. My name is Steve Lewis, I am the Assistant Director of Global Strategic Alliances for CSAIL at MIT. In this podcast series, I will interview principal researchers at CSAIL to discover what they're working on and how it will impact society.

David Karger is a professor of computer science at MIT. Karger splits his research between algorithms and information retrieval. His work in algorithms has focused on applications of randomization to optimization problems. More recently, he has been researching retrieval systems that personalized themselves to best fit the individual's user's needs and behaviors.

Professor Karger also leads CSAIL's Haystack Group, which researches many facets of information management, including capture, organization, retrieval, sharing, and visualization. All right, David, thank you for your time today. Why is it important for you to develop tools to make programming easier? What are some of the difficulties that non-programmers face when dealing with data?

Well, the general problem that dragged me into human-computer interaction was this sense that often it's our applications themselves that are the difficulties that non-programmers face when dealing with data. Many, many people today fall into this category of what are called knowledge workers. They do work that involves manipulating certain kinds of information. And even people who are not knowledge workers may manipulate information for their own benefit or for pleasure.

And the problem is that the tools that are created are often not suited to the information that particular people want to manipulate. My general thesis is that people understand the information that they're working with quite well, and then they're forced to use tools that are not really ideally suited to working with that information.

An example of this that I've drawn on for a long time is that one of my hobbies is folk dancing, and I frequently go to various folk dancing sessions. And there's a DJ there whose job is to play music. And so all of them have some sort of sophisticated app for managing all of the music that they're playing during the session.

And the problem is that your typical music-playing app, like Spotify or Apple Music or whatever, it's designed for playing music and not for DJing a folk dance session. And so for example, the kinds of information that are associated with each piece of music are not the information that DJ needs. The DJ at the folk dance session needs to know, is this a circle dance or a partner dance? Is it fast or slow? Who choreographed the dance for this particular piece of music? And this is all missing from the standard music-playing software.

So a person who wants to use standard music playing software to DJ their folk dance session has to jerry-rig it in some way. A lot of times, people will make very innovative uses of the comment field in a tool. They put whatever information the tool did not actually make room for.

The problem is that you usually can't sort on the comment field or filter on the comment field. An application will often provide you with these sort of sophisticated mechanisms for saying, I only want the red stuff or I want only want the stuff that's more than 20 years old and so on. And you can't do that with the comment field because it's too generic.

So really, I look at people like this and say, they need a slightly different kind of application. Not a completely different application, but one that's just a sort of mutation of an application that's out there. But that historically would mean they need to become programmers, and they need to dive into the software and modify the software to become a somewhat different application to work with the data that they care about. And we don't want everybody to have to become a programmer.

So what I've been working on for several decades is figuring out ways to describe applications in simpler ways than using programming languages so that people who are not programmers can change those descriptions in order to change the application into something that is specifically suited for what they want to do.

That's fascinating. And this leads me to my next question, is, what are Mavo and Shapir and how do they assist people?

Yeah. So Mavo and Shapir are our latest projects in this line of effort where we ask, what's a simpler way to describe the application or the computation that you want? And then, once you have a simpler description, what is a good tool that would allow a non-programmer to create their own descriptions or modify existing descriptions to create the applications that they want?

And so Mavo takes the perspective that a lot of applications-- a lot of simple applications, you really can think of about them as just sort of documents. Documents with content that can be modified in specific ways. Or many of you have probably worked with various kinds of forms on the web.

So you can go to a web form where you fill in your contact information and that includes your name and your address. And there are these nice little widgets that exist on web pages for entering that specific kind of information. That actually-- that kind of entry of a contact information, that's associated with the contact manager.

What's a contact manager? Well, it's just a collection of these contact records where each of these records has a name and an address and a phone number and maybe some other information. And the question is, why should you need a programmer to create a simple contact managing application If. It's just this list of records?

What you need is a way to say, this is the kind of information that I want in each of the records, and I want to be able to add and remove them, and I want to be able to filter them on such and such property and so forth. And actually, a lot of this functionality, if you think about it, can be achieved by a spreadsheet, and there are many people who will, say, use a spreadsheet as their contact manager. They'll have one column for the name and one column for the address and one column for the phone number, so on and so forth.

And the spreadsheet can hold the data, but it's not a great interface for interacting with the data. You would much rather use something like a web form in order to enter that information. And you would like to have a better interface for filtering and sorting and visualizing the information that is in your contact database.

And so Mavo tries to give you a way of describing what your contact manager should look like essentially by making a web page. And making a web page requires not programming, web pages are described in this language called HTML, which is much simpler than a programming language. It's more of a document description language. It says, this is the layout of the page. The title goes here and the first paragraph goes here and you want a bulleted list over here, so on and so forth.

And anybody can use a variety of editing tools to make that kind of web page. You can even do it with Microsoft Word these days, for example, you can output an HTML document.

So you've got these documents, but traditionally documents are kind of static. You write them once and you're done. So what Mavo does is combine the capabilities of the spreadsheet with the capabilities of the document. So the document, you still do something like authoring a document in order to decide how your application should look, but the document is empowered to contain data that you can add and remove using these specialized widgets that people are used to working with in forms.

So essentially, you create this HTML document and you add a little bit of annotation to certain parts of the document saying, well, this thing here that I made a picture of a contact, I actually want that to be editable data, and I want you to be able to add more of them by clicking on a button, and I want you to be able to sort them by clicking on another button and so on and so forth.

So what you finish with is something that has the data richness of a spreadsheet and the interactivity, but it has the visual appeal that you can get by authoring a document. And all of this happens without any programming. You just make an HTML document and you add a little bit of markup that says, I want certain data elements to appear and be editable in this document.

And then Mavo, which is a JavaScript library, understands all of that markup and turns your application into a live application and takes care of providing you with the editing functionality and storing the data after you edit it and retrieving it the next time you open your application. And we found that this works really well. We actually have people bring us pictures of contact managers that they would like to have. Like we just told them, when we were recruiting them for a user study, that they should make a picture of the content manager they would like to have.

And when they came with that HTML document, we told them-- we taught them about Mavo, and we gave them a few minutes to turn it into a working application and they were successful. That's all it took, was a few minutes to say, this should be data and not just a picture of an application. And they ended up with a working contact manager.

Now Shapir is another piece of this where we've been thinking about the fact that a lot of the data that people want to work with in their applications is on the web. And it's stored on various websites. So you can find videos on YouTube and you can find information about movies on IMDb and so on and so forth.

And we wanted to make it possible for people to access the data on those websites as part of the applications that they were building. So again, maybe I want to make some kind of music-playing application, but what I want to play are videos from YouTube. There's a lot of music videos on YouTube and that's how that's where I want to get the videos that I want to manage and play in my session.

So traditionally, you've got all of these websites, but people have to manually find and copy out data from those websites in order to make use of it in their own tools. Now if you're a programmer, there's an alternative, which is what is known as an API, an Application Programming Interface.

API is provided by many of these websites, which allow somebody to write a program which can contact the website and ask for data. And the data will be sent back in machine-readable form. So nobody has to manually copy it out and paste it into a spreadsheet or something in order to use it, it already comes back ready to use. The problem is that using these APIs requires you to be a programmer, to write the code that talks to the API.

So with Shapir, we've taken away the need for the programming. We've shown that many of the APIs on the web can easily be described in a very simple ontology, a very simple language where you sort of talk about, what are the functions that this API provides and what are the arguments that you need to pass in to each of these functions in order to get a response?

And even somebody who is not a programmer, we have found, can look at the manual associated with these APIs and answer those questions. And Shapir essentially provides a form that you fill out to describe one of these APIs. And once you've described that API, Shapir takes care of talking to it for you. So you can use Shapir to ask that API for data and get it back in machine-readable form without ever writing a line of code yourself.

And we've now taken Shapir and attached it to Mavo. So you can now build these Mavo applications that also make use of all of the data that's out there on the web without ever writing a single line of code.

Now are these two tools open source? Are they commercially available?

Yes, these tools are open source and are also available on the web. You can find Mavo at the website called Mavo.io. And you can find Shapir at the website called Shapir.org.

Great. Now can you outline some of the problems with the way that people interact online?

Yes. So this is turning to the other big piece of work that I've been pursuing for the past decade or so. Online discussion, online interaction has become a really part of our lives, both in work and in leisure. We all make use of Slack at work, we make use of Facebook at home, and a gazillion other online discussion platforms.

But I have found that on many of these discussion platforms, it's hard to have the discussions that you actually want to have. And what I've been exploring is an extension of the idea I've already talked about, that the reason it's hard to have the discussion you want to have may be that the platform does not hold the right data associated with the discussion.

And so my group has for many years been looking at ways to enrich online discussion platforms with other kinds of relevant information that can help structure a discussion more effectively and make that discussion more useful for whatever people want to do with it.

And can you tell me about some of the projects that you and your collaborators are working on to improve online discussions?

Absolutely. So I can start with a project that we've been running for over 10 years now called NB, which is short for Nota Bene. This is a platform that we created in order to try to improve online discussions around classes, university classes primarily. Lots of university classes have discussion boards where students can ask questions and get answers from the faculty or answers from other students. Piazza is a very popular one that's used in many university courses nowadays.

We also see on a lot of the massive open online courses that they have discussion boards associated with them, which are usually for students to talk to other students because it's impossible for faculty keep up with the volume of questions. But there are problems with these online discussion boards because they're detached from the content that the students are studying.

So you've got a textbook over here, and you're reading the textbook and you get to chapter 5, paragraph 3, and you don't understand something. And you want help understanding. OK, so you can go to your discussion platform and say, I'm confused about chapter 5, paragraph 3, can somebody please explain it to me? And this will work great if somebody happens to see your post who has an understanding of chapter 5, paragraph 3.

But what we decided to do with NB was to actually attach the conversations to the textbook. So instead of having this separate online discussion forum, when you have a question that you want to ask about the textbook, or whatever online material that is part of the course, you simply write that question in the margins of the textbook itself.

And that means that anybody else who happens to be reading paragraph 5-- chapter 5, paragraph 3 is going to see your question right there, just after they've read the paragraph that you have a question about. So they are perfectly situated to answer your question. And they're drawn to your question because they're in the right place.

Conversely, if you're lucky, when you're confused about paragraph 5-- about chapter 5, paragraph 3, somebody may have already asked the question, and the answer may already be there in the margins so that you can just look to the margins of the content that you're confused about and hopefully find the answer right there.

So this is a technique which is now called social annotation. So it's annotation, it's happening in the margins of the document, but it's social, it's not for an individual, but for a whole group of people to collectively annotate. And there are various groups that have studied this from the perspective of annotation, but we really came at it from the perspective of improving online discussion by adding this additional piece of geographic information with each discussion post. Instead of having them floating in some mysterious space, they're attached to specific content.

And so we deployed NB 10 years ago, and at this point we've got several million comments in the system from, I think, about 60,000 students overall who've used it in courses ranging from philosophy to physics and everything in between. And we've gotten a lot of positive feedback about the way that this can wake up the course content and make it alive so that students can actually be engaging with it and talking about what they're reading in the place where they're reading it.

So just this one bit of extra information about where is the discussion completely changes the way that you navigate that discussion. It also provides fantastic feedback to the faculty who can see, oh my God, this section of the textbook is just dripping with questions. Maybe I should spend some extra time on that in the next lecture.

So you once you have a location for all this content, you can visualize it and just understand much better what is engaging the students and what are they not paying attention to? So we've been doing a lot of work on that over the past 10 years with many collaborators to try to carry that idea forward.

It sounds like a great tool. It also begs the question, who's the moderator of the answers? Who determines if the answers are accurate or not?

Yes. So that's actually something that we've been playing with recently where-- one of the nice things, actually, about the classroom is that it is, by nature, a moderated discussion environment. One of the problems that you have in the wild internet is that it's full of trolls saying nasty things.

But this isn't a classroom setting. We allow the students to post anonymously because they're often very shy, but they're not anonymous to the faculty. And so this keeps the quality of the discussion from decaying. There still is the question-- we want students proposing wrong ideas.

And there's work in the education literature that actually shows that having conversations with your peers about confusing things is the very best way to learn. It's better than being lectured to. It's better than doing exercises. The interactivity where you're explaining and arguing to other people is really the best way to learn. And so we want to encourage that, and that means that wrong things will be posted.

And the goal is to eventually have those discussions converge onto the right answer. And we find that often happens. The students who are right will eventually show up and give correct answers to things.

But what we've been adding to that is an ability for the staff of the course to endorse various answers and say that they're correct, and this can give confidence to the students, and it can also be a really positive-- it can really encourage students to engage more. We found in our interviews that getting a little gold star from the faculty can really excite a student and lead them to participate more and try to help out their collaborators more.

Now of course, I've been talking about this in the context of learning, but I think that the social annotation is relevant any time a group of people want to have a conversation about a document. And we had an offshoot project that look at using social annotations to discuss news articles and talk about what their biases were, for example. But there's a lot of times when there is a central piece of content that you want to have a discussion about, and I think social annotation is always relevant there.

So let's talk about that a little bit. Let's talk about misinformation online. We had interviewed David Clark recently on the subject, and I'd certainly like to hear your take on it and some of the things around TrustNet. Can you tell us a little bit about that?

Absolutely. So TrustNet is another one of these projects which began because I felt like the online discussion platforms were not actually capturing the right information to help people navigate their online discussions. And this came from a-- this emerged from a very specific experience I had many years ago where I was on Facebook and I was seeing a whole bunch of anti-vax posts-- and this was long before COVID, but this is-- anti-vax has been around for a long time.

And I was starting to see a lot of anti-vaccine posts and I didn't understand why, because they weren't even from people that I knew. But it turned out that what had happened was that a friend of mine who was in medicine had been commenting on these posts and explaining that they were wrong.

Now, Facebook has a very simplistic model of online discussions. There are posts and there are replies. And when it sees a post getting lots of replies, it says, ah, that's an engaging post, I should show that to more people. So, my friend, by commenting on these anti-vax posts and saying that they were wrong, was leading to more dissemination of these anti-vax posts. Completely the wrong outcome.

So the question I started asking was, what sort of online discussion platform would capture the additional information that's not just that my friend is saying is commenting on this, but the structured information that they're saying that this post should not be shown? That this post is wrong. And we started pursuing that in the context of misinformation generally, and we developed this tool called TrustNet.

And the idea of TrustNet is that when you post things, you also say whether you believe them to be true or whether you believe-- or when you share them. And so you mark the things that you're posting or sharing or commenting on as true or false, and you can also say why. Like you can say you're an expert on the topic or you can say that you've read a number of other sources and have information about the topic, and so on and so forth.

And so every post starts to collect from various users these annotations about whether the post is accurate or inaccurate. We also put into TrustNet another refinement of Facebook's model. Facebook has friends. But the problem is we have lots of different kinds of friends. We have the friends who we would trust with our lives, and we have the friends who have to be our friends because we're related to them or because they're our boss or something like that.

And we don't receive information the same way from them in the real world, but Facebook flattens it all down and just says, here's the feed of information from your friends. So on TrustNet, we refine this by distinguishing the notion of following somebody from the notion of trusting. So you can mark who in TrustNet that you want to follow and you get a feed just like you do on Facebook, but you can separately indicate which are the people in that feed you trust.

And once we have this information about who thinks what is true and false and who trusts who, we can start to propagate that information. And so TrustNet actually provides an interface to let people say, for example, I only want to see information that somebody I trust says is true. And all of a sudden that misinformation that's being propounded by your crazy relative just doesn't show up in your feed at all.

Now if you're in a different mood, you can say, I want to see things where the people that I trust are in disagreement with each other about whether it's true or false, because that seems like an interesting argument to get into and I want to be able to contribute my own [INAUDIBLE].

So what we're really doing with TrustNet is empowering every individual to become a fact-checker and contribute their knowledge and their understanding to all of the information that's being passed around, and I think that this could be a very powerful way to combat misinformation. We've got the professional fact-checkers, but they can't possibly keep up with the volume of information that's being disseminated.

If, on the other hand, many of the people who are sharing information are also empowered to assess information as accurate or inaccurate, now we suddenly have the manpower that we need to keep up with the volume of what's being disseminated and we have some hope of empowering individuals to choose to filter out misinformation from their own feeds.

It's fascinating. It's like crowdsourcing the truth meter.

That's right. But it's not-- so there's an important distinction from crowdsourcing, which is that traditionally in crowdsourcing, you just aggregate what everybody says. Like moderation on Reddit. Like the more upvotes means higher rank. But we think that when you're dealing with misinformation, it's really important to incorporate trust.

I don't want the majority opinion. I want the opinion of the few people who I really trust. And so different people actually get different answers about-- will get different feeds based on who they trust. And so this is, I think, is an important refinement of crowdsourcing, to incorporate this notion of trust in it.

Now is this just an academic exercise or how is this implemented? Is this something that's a service? Is it an API or a plugin or a container for Facebook or a browser extension?

So our ambition is to someday have this running in Facebook, but Facebook doesn't like you tampering with their feeds. And they make it very difficult to do so and if you do it too much, they sue you. Or at least they come after you and try and make you stop. So we've built a research platform, TrustNet, which is sort of a Facebook-ish clone where you can subscribe to things and get a feed and also mark who you trust and so on and so forth. So it provides this experience that I've just talked about.

Recently, we've actually-- we actually haven't done the deployment yet, we haven't run the user study, but we've added to this a browser extension. And so this is just something that you install in your browser which lets you rate and get assessments on any page you visit on the internet. So you come to this page, and right away, it'll have a big red box on it saying that the people you trust say that this article is false. So it's not limited to any particular platform.

And you can, at the same time, be providing your own assessments for other people. So this is another example of extending, sort of enriching the data model of the online conversation with these ideas like trust and assessment, which empower new and hopefully better kinds of navigation of the information.

It's so important these days for sure. Let's talk about another important thing today, is online safety. So what could you tell us about a tool like Squadbox and how does that improve online safety?

Squadbox is a tool that's really quite near and dear to my heart, because it's tackling a really painful problem of people getting harassed online. And it actually shares with TrustNet this idea of democratization. If you look around now, there's a lot of debate and discussion about harassment. And one side is demanding that the platforms do something about it, and the other-- and the platform side are saying that they're trying and it's too hard.

And I agree that it is too hard for the platforms to do something about this, and I think the answer, again, is to democratize dealing with harassment. So the idea behind Squadbox is that it provides a framework that allows somebody who is suffering harassment to recruit their friends to act as moderators of incoming messages to the person who is facing harassment.

And again, this is scalable. Instead of a single platform having to moderate incoming content for every single user, every person can turn to their own friends for help.

And we had this idea, and we went out and spoke to many harassment victims and discovered that they're already doing-- so a typical behavior of somebody who is being harassed over email or on Twitter will be to give their account password to some of their trusted friends and have their friends go through their incoming messages and delete any harassment before the actual user has to experience it.

And the insight here is that harassment is often very personal, it's targeted at a single individual, and it can cause a great deal of emotional harm to that individual, but it's relatively harmless to other people. And so your friends are much better equipped to see and deal with that harassment than you are.

And so this is the tactic that people use, but it has downsides. Giving your email password to somebody else gives them a tremendous amount of power and they'll see all of the mail that you get, including from other close connections that might be very private. So with Squadbox, we created a prototype that tried to improve this experience.

Essentially, Squadbox becomes a kind of a gatekeeper for your email. So when email arrives to you, it's actually forwarded first to Squadbox. And Squadbox does a series of checks. It checks whether that mail is on a whitelist of people who you don't want to work-- who you don't want to have moderate. And that email gets sent directly back to you without any moderation.

But, any messages that are not in that whitelist get put into a queue where they can be moderated by the friends that you've recruited. And Squadbox provides a whole sort of interface for allowing the person who's facing the harassment to interact with these friends to inform them about what kind of harassment they want to have blocked and what they want to have done with it.

If a harassing message arrives, do you want to put it into a special folder where I can look at it when I'm ready? Or do you want to delete it? Or do you want to forward it to the police? There are various options that the moderators can apply. Or they can let it through. They can even like hold a particular message and have a conversation with you about whether you want to let it through.

And all of this can rely on the personal connections between you and your friends. They understand you, they know what harassment you're facing, they know what you can tolerate in terms of do you care about vulgar language, do you care about certain kinds of imagery? They really understand well and are the perfect moderators for the harrassing information.

So once again, we've taken a traditional platform, which is just email, and we've enriched it with now a new kind of workflow to improve the quality of that online discussion using a democratic approach that engages everybody in working with the information.

And is that extensible to social media?

In principle, it absolutely is. This is kind of the fate of all academic projects. You work on something wonderful and you produce something wonderful and then your student graduates. And so Squadbox was done by one of my master's students, Kaitlin Mahar, and a student of mine who's graduated recently, Amy Zhang.

And so I'm waiting for the next enthusiastic person to come around to carry out that extension to social media. I actually-- I envision a kind of extension as a service where Squadbox would provide an API so that any kind of social media platform could connect to it and basically pass messages over to Squadbox for moderation before they were returned to that platform to be delivered to their intended recipients.

Definitely seems like a worthwhile endeavor.

Yeah. I'd really like to carry that one forward, again, because I feel like it is a true solution. I think it would really help a lot of people. We actually-- I got an email from somebody just a couple of months ago asking a Squadbox was still working because they needed it, and I was sort of sad that I couldn't just send them over to a fully functional version of the platform, because I'd really like to do that.

Absolutely. Are there any other insights or research you're excited about you want to share with our listeners? And where can our listeners go to find out more about your research?

Sure. I'll mention a couple of other projects. We have a project called Wikum for online discussion, and that is, again, about enriching online discussions. And in the case of Wikum, it's about providing the ability to summarize online discussions. So a discussion can get so long that people arriving later have a terrible time catching up.

And so the idea behind Wikum is that besides contributing new posts to the discussion, you can also take a chunk of them and summarize them. And we use this process called recursive summarization where basically anybody who chooses to can grab a few of the posts and replace them with a summary of those posts. And that just shrank the discussion a little bit.

And so if more people grab more posts and summarize those, the discussion keeps shrinking. And eventually, you just have summaries, and you can start summarizing the summaries. And then you start summarizing the summaries of the summaries. And in the end, everything gets boiled down to a short summary of the entire long conversation.

We still provide mechanisms to let people expand the summaries to see more detail. So it essentially provides a whole navigational structure over the original conversation, but one that lets you get the gist of the conversation quickly and then dive into the parts that you want. And so in a sense it's a combination of a typical discussion forum with a wiki where everybody is working together to produce one single page that summarizes something important. We put the discussion in the wiki together and that's why we call it Wikum.

Another project that we've been working on is in helping people deal with task management, which is another collaborative activity which tends to involve a lot of conversation. So when I need somebody else to do something, that generally turns into a lot of conversation over email.

And if I'm lucky, that person is using some kind of task management software to keep track of what it is that they're supposed to do and when they're supposed to get it done. But that means that the work of coordinating the activity is split between your email or your Slack channel and the task management tool. And we're trying to figure out how to build a single tool that provides all of the discussion functionality that you would expect to talk about the task, but also the kind of scheduling and assignment functionality that you see in a typical project management tool.

One other project I'll mention which, again, is thematically related is that we're taking these ideas about empowering people to add structure into the medical domain. So in collaboration with David Sontag, I'm doing work to help doctors record information about their patients more effectively. And this is, again, about capturing more of the structure about what are the particular diseases and what are the particular treatments and medicines that they're using, what are the labs that they've taken?

And capturing this all into a more richly structured form so that other doctors are able to retrieve it more easily, and therefore, more effectively treat the patients.

Fascinating. And where could people find out a little bit more about your research?

Sure. So pretty much all of our projects can be found on our group's website at haystack.csail.mit.edu. Just about all of them are running. You can follow links to actually try out these tools. And most of them are open source as well so that you can navigate through GitHub in order to find the source code associated with these different systems.

I really enjoy finding interesting use cases and extensions of the work that we do, and so I really enjoy talking to people who sympathize with the pain points that I've been talking about, who've experienced these problems, who see them as real problems in their work or in their enterprise or in their leisure.

And I'm always happy to talk to people about the challenges that they're facing in the management of information or in dealing with large-scale online discussions and brainstorm about whether the tools that we've already created or tools that we've created in the future might be able to help.

And there's a way through the website, the Haystack website to contact you or to--

Absolutely. You can follow links to our personal pages where we all have email addresses, and absolutely you're welcome to reach out.

Great. Well David, thank you again for your time today. It's been a fascinating discussion.

Sure thing.

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