Testimony before the House Science Subcommittee on Investigations and Oversight and Subcommittee on Research and Technology
Securing the Digital Commons: Open-Source Software Cybersecurity
May 11, 2022
Dr. Andrew Lohn

Chairman Foster, Chairwoman Stevens, Ranking Member Obernolte, Ranking Member Feenstra, and members of the Subcommittees, thank you for the opportunity to testify before you today. I am Andrew Lohn, Senior Fellow in the CyberAI Project of the Center for Security and Emerging Technology at Georgetown University. It is an honor to be here. During the next few minutes, I would like to discuss risks related to the artificial intelligence supply chain.

A Culture of Sharing

The AI community has been particularly open to sharing. For example, it cost $500,000 and two and a half years to build the famous ImageNet dataset, but the professor who built it released it to everyone. Then Google and Facebook both released their powerful AI engines. Now thousands of the most powerful AI models are a quick download away. It is truly incredible given that these models often range from thousands to millions of dollars to build – and that's in computing cost alone, without even considering the expertise to design them.

The AI Supply Chain

These datasets, models, and AI programming resources are the building blocks of today's AI systems. In the same way that few bakers today grow their own grain and raise their own hens, most AI developers simply combine ready-made components and tweak them for their new applications. Sometimes the whole process only needs a few lines of code and surprisingly little expertise. This approach allowed Google Translate to improve performance in 2016 while trimming from 500,000 lines of code down to just 500.

Sharing has driven both scientific and economic progress, but it has also created an alluring target for attackers.

Supply Chain Vulnerability

For one, an attacker can subvert an AI system by altering the data. That could happen, for instance, by a nefarious online worker while they label the datasets or by a hacker who sneaks into the victim's networks. Alternatively, if the attacker provides a fully trained model, then it can be very hard to find their manipulations.

There is no good way to know if a downloaded model has a backdoor, and it turns out that those backdoors can survive even after the system has been adapted for a new task. A poisoned computer vision system might mistakenly identify objects, or a poisoned language model might not detect terrorist messages or disinformation campaigns that use the attacker's secret code-words.

The programming resources for building AI systems are also vulnerable. Such systems can have thousands of contributors from around the globe writing millions of lines of code. Some of that code has been exploitable in the past. And some of it prioritizes speed or efficiency over security. For example, vision systems need images at a specific size, but the code to resize images allows attackers to swap out one image for another.

And lastly, these resources are only as secure as the organization or system that provides them. Today, the vast majority are hosted in the United States or its allies, but China is making a push to create state-of-the-art resources and the network infrastructure to provide them. If adversaries make the most capable models – or if they simply host them for download – then developers in the United States would face an unwelcome choice between capability and security.

Recommendations

There are a few things Congress can do now to help maximize the benefits of this sharing culture while limiting the security risks that come with it. One step is supporting efforts to provide trusted versions of these AI resources, such as through NIST or the National AI Research Resource. Funding is also needed to do the basic hygiene, cleanup, and audits that are important for security, but that attract few volunteers.

Congress should consider requesting that organizations across the U.S. government create a prioritized list of AI systems and the resources used to build them. This list may be easier to create and maintain if these organizations are incentivized to collect a software bill of materials that lists the components in the software that the government buys or builds.

And lastly, many of these AI systems are new, and so are the attacks on them. The government would benefit from augmenting their red and blue teams of defensive hackers and security specialists with AI expertise to help them discover security holes in our most important systems while also thinking of new, creative ways to subvert them before our adversaries do.

Thank you for the opportunity to testify today, and I look forward to your questions.

Andrew J. **Lohn**

PROFILE

Technical researcher at the core who has been able to step back and apply those skills and understanding to broad and complicated issues.

EDUCATION

Ph.D. - Electrical Engineering (2007-2012)
University of California Santa Cruz, CA USA

B.Eng. - Engineering Physics (2001-2006)
McMaster University, Hamilton, ON Canada

RESEARCH EXPERIENCE

CSET at Georgetown University – *Senior Fellow* - (2020-Present)
• Answer pressing policy problems at the three-way intersection of cybersecurity, artificial intelligence, and national security.
• Help develop future policy makers and advisors who have strong technical and methodological foundations along with broad policy perspectives.

RAND Corporation – *Information Scientist* - (2014-2020)
• Apply current methods to high-impact policy problems. Example methods: Reinforcement Learning, written equations, gaming, etc
• Lead teams of highly experienced researchers tackling complex problems. Example topics: AI risk, cyberwarfare, and drone delivery.
• Manage client relations with high-ranking executives in government

Pardee RAND Graduate School – *Professor of Public Policy* - (2018-2020)
• Design and teach course on offensive cybersecurity
• Mentor public policy graduate students, especially those with technical backgrounds or interests

Sandia National Laboratories - *Postdoctoral Researcher* - (2012-2014)
• Discovered and developed new device behavior then used it to design neural hardware for new computing architectures.
• Derived an equation describing the operation of next generation computing devices (RRAM) and used it to increase storage capacity per device by at least an order of magnitude.
• Our team went from TRL 0 (no working devices) to TRL 4 (wafer-scale, CMOS-compatible, device specs met) in one year, accelerating product timelines.

Hot Power, Inc. - *Chief Technology Officer* - (2011-2013)

• Led technology development and business planning for a nanotechnology-based energy company to convert heat to electricity.

NASA Ames Research Center - *Graduate Researcher* - (2009-2012)
• Built a nanotechnology lab from building permits to leading research facility.
• Attracted the interest of venture capitalists and government.

Hewlett-Packard Labs - *Visiting Researcher* - (2009-2012)
• Designed, simulated, and tested approaches to use light instead of electricity in computer wiring to alleviate a bottleneck in high performance computing

SELECTED AWARDS

Team Innovation Award – Project Air Force (2019).
Top 150 McMaster Engineering Alumni - 150th anniversary (2017).
RAND Spotlight Award (2015).
Sandia Certificate of Excellence (2013).
Newport Spectra Physics Research Excellence Award (2012).
APS Excellence in Graduate Research Award (2012).
Chancellor's Dissertation Fellowship (2011-2012).
National Graduate Student Award - American Vacuum Society - (2011).

COMMUNITY VOLUNTEER

IEEE Golden Reviewer Award - Electron Device Letters (2013, 2014, and 2016).
Outstanding Reviewer Award from Semiconductor Science and Technology (2017).

SELECTED TALKS

"Disinformation at Scale: Using GPT-3 Maliciously for Information Operations," Black Hat 2021.

"How Might AI Affect the Risk of Nuclear War?," Pentagon (2018) and Oxford University (2018).

"The future of urban air mobility," Uber Elevate 2018, Los Angeles, CA (2018).

"City-Scale Impacts of Drone Delivery," World Economic Forum - Future of Drones Steering Committee, San Francisco, CA (2017).

PUBLIC OPINION

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https://warontherocks.com/2020/01/what-chess-can-teach-us-about-the-future-of-ai-and-war/

Robert J. Lempert, Tim McDonald, **Andrew J. Lohn**, "A Better Way to Think About Scooters," Los Angeles Times Aug 28, 2018.
https://www.rand.org/blog/2018/08/a-better-way-to-think-about-scooters.html

Andrew J. Lohn, "What do Meltdown, Spectre and RyzenFall mean for the future of cybersecurity?" TechCrunch May 1, 2018.
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Andrew J. Lohn, Andrew Parasiliti, William Welser IV, "Should We Fear an AI Arms Race?" Defense One, Feb 08, 2016.
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http://time.com/4080577/artificial- intelligence-risks/

WORK COVERED IN

BBC, Wall Street Journal, Forbes, POLITICO, CNBC, Wired, MIT Technology Review, Foreign Policy, Defense One, South China Morning Post, etc.

BOOK CHAPTERS

Andrew J. Lohn, Patrick R. Mickel, James B. Aimone, Matthew J. Marinella, "Memristors as Synapses in Artificial Neural Networks: Biomimicry Beyond Weight Change," in *Cybersecurity Systems for Human Cognition Augmentation*, Springer (2014).

RESEARCH REPORTS

Andrew J. Lohn, Wyatt Hoffman, "Securing AI: How Traditional Vulnerability Disclosure Must Adapt," Center for Security and Emerging Technology (2022).

Andrew J. Lohn, Micah Musser, "AI and Compute: How Much Longer Can Computing Power Drive Artificial Intelligence Progress," Center for Security and Emerging Technology (2022).

Ben Buchanan, **Andrew J. Lohn**, Micah Musser, Katerina Sedova "Truth, Lies, and Automation: How Language Models Could Change Disinformation," Center for Security and Emerging Technology (2021).

Andrew J. Lohn, "Poison in the Well: Securing the Shared Resources of Machine Learning," Center for Security and Emerging Technology (2021).

Andrew J. Lohn, "Hacking AI: A Primer for Policymakers on Machine Learning Cybersecurity," Center for Security and Emerging Technology (2020).

Andrew J. Lohn, Jair Aguirre, Mark Ashby, Benjamin Boudreaux, Jonathan Fujiwara, Gavin Hartnett, Daniel Ish, John Speed Meyers, Caolionn O'Connell, Li Ang Zhang, "Attacking Machine Learning in War," RR-4386-AF, (2020).

Forrest E Morgan, Benjamin Boudreaux, **Andrew J. Lohn**, Mark Ashby, Christian Curriden, Kelly Klima, Derek Grossman, "Military Applications of Artificial Intelligence: Ethical Concerns in an Uncertain World," RR-3139-AF (2020).

Li Ang Zhang, Jia Xu, Dara Gold, Jeff Hagen, Ajay K. Kochhar, **Andrew J. Lohn**, Osonda A. Osoba, "Air Dominance Through Machine Learning – A Preliminary Exploration of AI-Assisted Mission Planning," RR-4311-RC (2020).

Zachary Haldeman, Jair Aguirre, Jonathan Fujiwara, **Andrew Lohn**, Igor Mikolic- Torreira, "Effects Estimation for Cyberspace Operations," RR-3090-OSD, (2019).

Andrew J. Lohn, Quentin E. Hodson, "Quick Look: State Election Security Needs: An Analysis of the 2018 Help America Vote Act State Plans," PR-4347-DHS (2019).

Andrew Lohn, Akhil Shah, Jair Aguirre, Igor Mikolic-Torreira, "Uncertainty Analysis for Offensive Cyberspace Operations Effects Estimations," PR-3716-AF/1, (2019).

Andrew Lohn, Joshua Baron, Akhil Shah, Lillian Ablon, Irina Danescu, Lara Schmidt, "Uncertainty Analysis for Offensive Cyberspace Operations Effects Estimations," PR-3716-AF/1, (2019).

Andrew Lohn, Akhil Shah, Jair Aguirre, Dara Gold, "Uncertainty Analysis for Offensive Cyberspace Operations Effects Estimations," RR-2381-AF, (2019).

Edward Geist, **Andrew J. Lohn**, "Will Artificial Intelligence Increase the Risk of Nuclear War," PE-296-RC (2018).

Andrew J. Lohn, et al., "Providing Cyber Mission Assurance for Weapon Systems: An F-16 Case Study," RR-2838-AF (2019).

Caolionn O'Connell, et al., "Assessing Cybersecurity Risk to the Civil Engineering Infrastructure: A Methodology for Implementation at Air Force Bases," RR-2354-AF (2018).

Caolionn O'Connell, et al., "Cybersecurity of USAF Civil Engineering Control Systems: Buckley Air Force Base Case Study," (2017).

Andrew J. Lohn, Lara Schmidt, Caolionn O'Connell, Joshua Baron, "Results of a Wargame to Improve the Utility and Efficiency of Operational Test for Cyber Weapons," RR-1897-OSD, (2017).

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Lara Schmidt, et. al. “Effects Estimation for Offensive Cyber: Is it Time for a Cyber JMEM?” (2016).

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Jennie W. Wenger, et. al. “The Value of Experience in the Enlisted Force” (2016).

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Nobuhiko P. Kobayashi and **Andrew J. Lohn**. Nanowire Composite for Thermoelectrics. WO 2,013,043,926 (Sept 20, 2012).

Patrick R. Mickel, Conrad D. James, Matthew J. Marinella, **Andrew J. Lohn**, "Method for Measuring and Modifying Memristor Switching Characteristics," Provisional App. No. 61/894,816 (Oct. 23, 2013).

James E. Stevens, **Andrew J. Lohn**, Patrick R. Mickel, Matthew J. Marinella, "Systems and methods to maintain optimum stoichiometry for reactively sputtered films," Provisional App. No. 61/971,301 (Jun. 21, 2013).

James B. Aimone, **Andrew J. Lohn**, Patrick R. Mickel, Erik P. Debenedictis, "Memristor circuit implementation of neurogenesis in neural networks," TA SD# 12953

Andrew J. Lohn, Patrick R. Mickel, Matthew J. Marinella, "Electrode Design for High Retention Resistive Switching," TA SD# 12945 (Nov. 25, 2013).

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27) **Andrew J. Lohn**, Noel Dawson, Robert Cormia, David Fryauf, Junce Zhang, Kate J. Norris, Nobuhiko P. Kobayashi, "Study on indium phosphide nanowires grown by metal organic chemical vapor deposition and coated with aluminum oxides deposited by atomic layer deposition", SPIE NanoScience + Engineering, 84670U-6 (2012).

26) Jin-Woo Han, **Andrew J. Lohn**, Meyya Meyyappan, Nobuhiko P. Kobayashi, "Contact metal effects in indium phosphide nanowire transistor", SPIE Nanoscience + Engineering 84670Z-6 (2012).

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24) Kate J. Norris, **Andrew J. Lohn**, Elane Coleman, Gary S. Tompa, Nobuhiko P. Kobayashi, "Modeling and Characterization of Silicon Nanowire Networks for Thermoelectric Conversion", MRS Proceedings 1456 p.1 (2012).

23) Kate J. Norris, Vernon Wong, Takehiro Onishi, **Andrew J. Lohn**, Elane Coleman, Gary S. Tompa, Nobuhiko P. Kobayashi, "Reflection Absorption Infrared Spectroscopy Analysis of the Evolution of ErSb on InSb", Surface Science (2012).

22) **Andrew J. Lohn**, Kate Norris, Robert D. Cormia, Elane Coleman, Gary S. Tompa, Nobuhiko P. Kobayashi, "Effect of Doping on Nanowire Morphology During Plasma-Assisted Chemical Vapor Deposition", MRS Proceedings 1439 p.1 (2012).

21) **Andrew J. Lohn**, Nobuhiko P. Kobayashi, "AC Surface Photovoltage of Indium Phosphide Nanowire Networks", Applied Physics A, **107** pp 647-651 (2012).

20) Kate J. Norris, **Andrew J. Lohn**, Elane Coleman, Vernon Wong, Ali Shakouri, Gary S. Tompa, Nobuhiko P. Kobayashi, "MOCVD growth of erbium monoantimonide thin film and nanocomposites for thermoelectrics" – Journal of Electronic Materials p.1 (2012).

19) **Andrew J. Lohn**, Elane Coleman, Gary S. Tompa, Nobuhiko P. Kobayashi, "Assessment on thermoelectric power factor in silicon semiconductor nanowire networks", Physica Status Solidi A **209** pp. 171-175 2012.

18) Takehiro Onishi, **Andrew J. Lohn**, Elane Coleman, Gary S. Tompa, Nobuhiko P. Kobayashi, "Reflection Absorption Infrared Spectroscopy Study on the Spontaneous Formation of Erbium Monoantimonide Nanoparticles on Indium Antimonide Surfaces", MRS Proceedings 1351 p.1 (2011).

17) **Andrew J. Lohn**, Timothy J. Longson, Nobuhiko P. Kobayashi, "Indium phosphide nanowires integrated directly on carbon fiber", Proc. SPIE 81060X (2011).

16) Takehiro Onishi, Kate J. Norris, **Andrew J. Lohn**, Vernon Wong, Nitish Padgaonkar, Elane Coleman, Gary S. Tompa, Nobuhiko P. Kobayashi, "Nanocomposites for thermoelectric power generation: rare-earth metal monoantimonide nanostructures embedded in InGaSb and InSbAs ternary alloys", Proc. SPIE 81060Q (2011).

15) Jin-Woo Han, **Andrew J. Lohn**, Nobuhiko P. Kobayashi, Meyya Meyyappan, "Copper oxide thin film and nanowire for e-textile applications", Proc. SPIE 810608 (2011).

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