Promo statement

Proxy aims to make learning robots that help people with everyday tasks. I lead the Proxy simulation project from its inception as the first IC, to now leading a team of 16 engineers on what has become our secret sauce to **scale up and transform the whole Proxy development across the entire workflow** - ML model training, new service development, design of future HW. My work enabled Proxy to deliver the critical robot learning milestones, and allowed us to deliver the first paid service: Sorty.

Achievement 1 - Grew simulation efforts from an idea to a cornerstone that accelerates Proxy's robot learning, development, and deployment **(Impact).**

- Proved that simulation not only accelerates Reinforcement Learning, but also scales up and accelerates the whole Proxy development across the entire workflow with 8 major user profiles. Simulation provides reliable, automatic tests at-scale (1115 tests), reduces data collection time for perception training by 30,000x, and enables fast service iteration and development.
- In 2019, Proxy's strategy for solving learning robots is to learn from data and the end-to-end experiment was Proxy's first critical milestone to demonstrate this approach. Simulation enabled Proxy to deliver this milestone by accelerating the data collection and learning by 3x, and improving the overall robot performance. This got X leadership to buy into our data-driven acceleration strategy and enabled Proxy to move to the next phase.
- In 2020, simulation enabled us to successfully land Sorty as Proxy's first paid service. Massive simulation runs were used for ML (55M/quarter), integration testing and benchmarking (176K/quarter), which would have cost hundreds of millions of dollars to produce on real robots. The sorting performance reached 90% with sim, compared to 45% without, which would not be a viable service.
- In 2021, skills learning is the main milestone for Proxy and for graduation, which wouldn't be achieved without sim. For door opening using LfD, using sim data and sim2real for both RGB and depth, the door opening achieved >85% success on >40 meeting rooms at both Rails and PR55, without sim the robot completely failed.
- During COVID without robot access, I repositioned simulation to unblock Proxy and to reimagine the development paradigm using sim. This ensured development milestones with no change and no regression, as well as enabled long-term collaborations with other Alphabet teams.

Achievement 2 - Contributed my technical expertise in simulation, robotics and ML across Alphabet and research communities **(Complexity, Difficulty, & Knowledge).**

- Robot learning requires an extraordinary amount of data. In order to make the deployment of learning practical and to solve for scalable and general-purpose learning robots, I led the team to solve sim-to-real, which is an open problem in the robotics community. I proposed the framework, and drove technical innovations, which became one of Proxy's technical pillars. Sim-to-real makes it possible to learn at scale.
- Led the technical development to build a high fidelity, capability, and performance sim at scale, and delivered major technical progress yearly.
- Recognized as an expert in the Robotics and ML communities with publications and invited talks at top-tier conferences.

Achievement 3 - Designed and grew a cross-geo simulation team with strategic vision and direction to continuously scale-up and move fast (**Leadership**).

- Created a 10 year vision and strategy, proposed investment areas, designed three cross-geo function teams, grew 3 TLs and promoted 7 FTEs.
- Pushed a holistic planning process to support diverse use cases, and an efficient execution and communication process to solve cross-geo challenges. Set and shared examples for efficient operation towards Proxy's graduation, such as user focused planning and on-call rotation.

Achievement 4 - Initiated and led strategic collaborations across Alphabet and member of Proxy Software Leads team with impact at Proxy and beyond **(Scope & Influence).**

- One of the main drivers behind Proxy's collaboration with Brain and DeepMind. Brain robotics now heavily depends on Proxy's simulation, as part of their development strategy.
- Facilitated collaboration with Project Mineral, who used our simulation and landed the plant identification model in production.
- Outside of Alphabet, developed strategic alliances with Nvidia to allow Proxy to leverage their latest work in simulation and compute.
- As a Proxy software lead and a member of the Proxy extended leadership team, I worked with other leads to set Proxy software directions, planned software OKRs and headcount, and proposed software processes.
- Be a good citizen by mentoring Googlers and supporting hiring beyond my team.

The following are the details for each achievement:

Scaled simulation to a technical cornerstone, and accelerated Proxy robot learning, development, and deployment

Built a world-class robot simulator to make Proxy's breakthrough technologies only possible through the scale of simulation

- **Impact 1: Reduce data collection cost and time.** Data collection is a common bottleneck across Reinforcement learning (RL), Perception training, and Learning from Demonstration (LfD), given each robot costs ~$100k and human labeling effort.
    - **Reinforcement learning (RL):** 55M sim ran on borg in one quarter enabled RL to work, which would have cost hundreds of millions of dollars to produce on real robots. This helped to land our first paid service - Sorty.
    - **Perception training:** I proposed using synthetic data for perception training as a new development strategy, resulting in 12 sim-based perception projects. It reduced time to produce per-labeled data from 18 mins through human-labeling to 36 ms in sim.
    - By combining RL and perception, sim enabled Proxy's first strategic milestone – data-driven acceleration – to land.
- **Impact 2: Ensure testing robustness.** Automatic running tests at large-scale on real robots is impossible without requiring human supervision, and brings safety concerns.
    - **Testing**: Simulation provides reliable, automatic tests at scale. 1115 unit/integration tests run in sim to guard SW health. 176k Sorty benchmark tests in one quarter prevented Sorty regression without real robot access during WFH.
- **Impact 3: Enable faster iteration and prototyping.** Service development and robot hardware design traditionally require a physical mock, making design and evaluation iteration slow and difficult.
    - **Service development**: Proposed and presented simulation-based service development workflow. Simulation became an integral part of Sparkle development: 1) Get the quality metrics and test the service scalability in different environments for Table wiping, 2) speed up robot cart design iteration for Dish drop, and 3) enable the new Proxy development workflow - app driven learning for Sorty trash bin flush.
    - **Robot hardware design**: Proposed simulation-based hardware design and validation framework. The nextgen of Proxy robot design heavily relies on simulation. The end-of-arm-perception system was prototyped

and validated in sim before hardware manufacturing. 15 designs were prototyped and tested in sim within two weeks, which would take months and was impractical to iterate in the real world.

During COVID without robot access, I repositioned simulation to allow Proxy to reimagine the development paradigm using sim, which ensured development milestones with no regression, as well as enabled long-term collaborations with other Alphabet teams

- Simulation allowed Proxy's continuous development and prevented a potential huge setback during COVID.
    - 108M sim run for training and testing in 2020.
    - Sorty benchmarking in sim—equaling 65k hrs of sorting in one quarter—guarded against robot regression, allowed continued RL development, and smoothly transitioned back to real robots.
- Simulation allowed Proxy and collaborators to reimagine development workflow using sim, and enabled new initiatives and long-term collaborations.
    - Pivoted LfD development from real robots to learning in sim. I led this initiative and quickly delivered multiple new features. This not only resumed the LfD data collection within 1 week of WFH, but also transformed the workflow moving forward.
    - Established new collaborations with Brain Mobility Team on navigation, with Reach Team on teleoperation, and DeepMind on skills learning.
- Quickly set up a WFH support process and a virtual techstop (138 people joined and 536 threads), which enabled supporting doubled weekly active users and increased sim runs (4.5k -> 16k) over the first 3 months of WFH.
- The simulation team was recognized as the Proxy MVP team in Q2 2020 for our contribution to COVID WFH support.

Contributed my expertise as an authority in simulation, robotics and ML across Alphabet and research communities, by solving technical challenges with innovative designs

Drove sim-to-real innovations to solve scalable and general-purpose robot learning problems.

- Learning techniques are notoriously data hungry. In order to make the deployment of learning practical, I led the team to solve sim-to-real, which is an open problem in the robotics community.
    - Proposed and presented the high-level framework on how to solve sim-to-real to astroteller@. I advised high-level sim-to-real technical directions, such as RetinaGAN, deformable body simulation, robot system identification and modeling robot compliance for Sorty.
    - Among all the sim-to-real projects, RetinaGAN is a technical breakthrough in collaboration with Brain. I proposed the idea with kanishkarao@ and danielho@, and implemented the data and training pipelines. RetinaGAN is now used across Proxy (e.g. Sorty, Sparkle, LfD door opening) and Brain, enabled critical milestones to land. It has increased skill-learning data-efficiency 13x, reducing real-world data collection requirements from months to days.

Proposed designs to solve large-scope and complex problems in simulation.

- Simulation is a large system with many complex domains: physics, graphics, visualization, sim-to-real, framework, and infrastructure.
- Data collection for perception training is a bottleneck.
    - Designed and implemented the data generation pipeline under a unified framework, which is a complex system across simulation and perception pipelines with model training and evaluation.
    - The data generation pipeline generates 125k-1M labeled data across 9 tasks nightly, which would take more than a year from crowd-compute in the real world.
    - Simulation needs a scalable and reliable framework to support running 55M sim instances on borg quarterly.
- Initiated simulation framework redesign, which led to Simian. 1) Simian saved 278k GCU (40% fewer than before) in just the first month. 2) Provides a generic interface to connect to any robot control stack. Project Mineral and Giza used Simian to simulate their robots.
    - Easy scene creation is an open problem and is required for all sim use cases.
    - Proposed the real-to-sim idea, which is a novel way to automate scene creation and close the sim and real loop.

Recognized as an expert in the Robotics and Machine Learning communities with publications and invited talks at top-tier conferences

- Invited talk at RSS 2019 on “Learning to grasp using simulation and deep learning”.

- Invited talk at IROS 2020 on "How to solve Sim2Real for robot grasping with GAN".
- Published 6 papers and acted as paper reviewer for 13 top-tier academic conferences and journals in robotics and machine learning during 2019-2021.
- Invited talk at Google Conference on 3D deep learning 2020.
- "Robotic Perception I" session chair at ICRA 2021.

Built and grew cross-geo simulation team and set strategic vision for the team to continuously scale-up and move fast

Set simulation long-term roadmap, designed the team from scratch, and created three functional teams with purpose to execute autonomously

- To scale up Proxy's development, I laid out a simulation 10-year vision and strategy and created a simulation technology roadmap with design principles, high-level architecture, technical focus for each domain, and the long-term feature roadmap for execution.
- To achieve this vision and execute on the roadmap, I defined the simulation team structure and missions to achieve team efficiency and technical clarity: Experience team to provide good user experience, Framework team to build scalable and performant infrastructure, Realism team to improve simulation fidelity.
- Designed a simulation leads team with 3 tech leads, 1 TPM, 1 PM with clear roles and responsibilities. This allows the 3 functional teams to plan and execute work efficiently and independently.
- Built a successful team: 1) awarded as the Proxy MVP team in Q2 2020. 2) received 100% positive for EDI from RadioWaves, demonstrating inclusiveness.

Established and evolved team processes to efficiently support sim use case scaling

- Cross-geo challenge: The 8-person Munich Experience team is Proxy's first team at a remote site. Access to Germany's strong robotics talent pool is a strategic advantage, however, the time difference makes team communication and collaboration difficult. I designed and implemented the team processes around planning, execution, communication, and user support to ensure team's efficiency and to overcome this challenge.
- User focus: Simulation has a uniquely diverse set of use cases and user profiles across Proxy, Brain and Deepmind, and must prioritize across a large number of feature requests. I led by example on product mindset by establishing a

user-centric planning process as well as a support process. The team got great feedback from our customers and Proxy leadership recognized this as an exemplary effort.

Initiated and led strategic collaborations inside and outside Alphabet and member of Proxy Software Leads team with impact at Proxy and beyond

Led the simulation collaborations within Alphabet and influenced their technical directions

- Initiated and advised the collaboration with Project Mineral, who used our simulation to land synthetic data in production, generating values to their customers.
- One of the main drivers behind Proxy's collaboration with Brain and DeepMind.
    - Initiated Proxy research collaboration strategy with Brain/DeepMind, with kalakris@.
    - Planned the directions and led the simulation support for many Brain projects and initiated the buganizer hotlist for asynchronous planning. The workflow of using simulation and sim-to-real technique with proven success is central to the Brain Robotics' culture and development strategy.
    - Among large collaborations, one main project to highlight is e2e Sorty. It is a three-year collaboration project between Proxy and Brain. It used simulation for massive training, and was able to achieve the critical milestone of outperforming the engineered solution using sim. The approach and the achievement was presented to Google AI and X leadership.
    - Worked with Brian robotics leads kanishkarao@ and carolinap@ to support Fractal as part of Brain's 10-year strategy and generated 120 million simulated RL rollouts for learning.
    - DeepMind leveraged Proxy sim to test their Neverending Storage infrastructure, which enabled long-term strategic collaboration with Proxy.
- As the leading effort in robot simulation in Alphabet, I shared our simulation techniques and knowledge with other Alphabet teams: Giza, Mineral, Wing, Waymo, Brain Mobility, and at Alphabots.

Developed strategic alliances beyond Alphabet

- Main POC for the Proxy-Nvidia partnership. Brought structure and clarity to the relationship and allowed Proxy to leverage their latest work on simulation, compute, etc.
    - Provided the Nvidia partnership evaluation to Proxy leadership, and influenced the collaboration agreement with Nvidia.
    - Led bi-monthly long-term collaboration strategy discussion in simulation and GPU.
    - Evaluated Nvidia simulation solutions including IsaacGym and IsaacSim.

Member of the Proxy Software Leads and Proxy's extended leadership team to make decisions and coordinate large efforts at Proxy level

- Worked with other software leads on SW quarterly OKR planning and SW headcount planning.
- Proposed and led the Proxy Software University, to facilitate knowledge sharing among Proxy developers and collaborators, with @michellecrum. 43 courses are given by 8 major teams across Proxy.
- Led sustainable engineer roadmapping for Proxy with pvodenski@, to foster good engineering practice and improve development efficiency.
- Led sim test plan during Proxy code yellow to address the software stability challenge (spot bonus).

Demonstrate citizenship by supporting career development and hiring beyond my team

- Mentored 3 Googlers and advised their career development and projects. As a TLC alumni, I shared my experiences with other X leaders.
- Besides interviewing candidates for the sim team (38 scorecards submitted and 20 interviews), I conducted 13 interviews for PMs and TPMs. Pioneered and shared the 20%er hiring process.