# Kelly Kostopoulou

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EDUCATION		
Columbia University, New York, USA		
<ul> <li>PhD in Computer Science <sup>C</sup></li> <li>Current GPA: 4.22/4.00, Advisor: Asaf Cidon</li> </ul>	Sep 2020 - Present	
National & Kapodistrian University of Athens (NKUA), Athens, Greece		
<ul> <li>MSc in Data Science &amp; Information Technologies C</li> <li>GPA: 9.7/10 (first among graduate class of 10 students)</li> <li>Specialization: Big Data and Artificial Intelligence</li> <li>Thesis: Sparse Communication for Deep Learning</li> </ul>	Sep 2018 - Sep 2020	
<ul> <li>BSc in Informatics &amp; Telecommunications GPA: 9.01/10 (first among graduate class of 79 students)</li> <li>Specialization: Data and Knowledge Management   Software</li> </ul>	Oct 2012 - Sep 2018	

• Thesis: Recursive Function Definitions in Static Dataflow Graphs & their Implementation in TensorFlow

## HONORS & AWARDS

2024 Avanessians Fellowship	Jan 2024
Gerondelis Foundation Scholarship	May 2023
Bodossakis Foundation Scholarship	Sep 2022
Onassis Foundation Scholarship	Sep $2022$
Valedictorian, MSc, Dept. of Informatics and Telecommunications, NKUA	Jan 2021
Valedictorian, BSc, Dept. of Informatics and Telecommunications, NKUA	Mar 2019
Scholarship of Excellence, MSc of Data Science & Information Technologies, NKUA	Oct 2018

#### **EXPERIENCE & RESEARCH**

Gray Systems Lab, Microsoft Research, Redmond, Washington C Research Intern	Jun 2024 - Aug 2024
$\cdot$ I developed a classifier for identifying workloads executed on cloud servers based on	their telemetry.
Visiting Student Research Program, KAUST, Saudi Arabia	Jan 2020 - Jun 2020
$\cdot$ I developed a compressed communication mechanism for distributed deep learning u	using bloom-filters.
National Center of Scientific Research - Demokritos, Athens, Greece $\square$ Research Software Engineer, Research Assistant	Sep 2018 - Dec 2019
$\cdot$ I participated in the implementation of the National Network of Precision Medicine and Treatment where I created a cloud-based platform for the distributed execution of	e for Cancer Prevention of reproducible scientific

workflows, developed bioinformatic pipelines and created a web application for user interaction.  $\mathbf{Q}$ 

**Dab Ltd**, Athens, Greece *IT Consultant* 

Sep 2016 - Sep 2018

## PUBLICATIONS

- Pierre Tholoniat\*, Kelly Kostopoulou\*, Peter McNeely, Prabhpreet Singh Sodhi, Anirudh Varanasi, Benjamin Case, Asaf Cidon, Roxana Geambasu, Mathias Lecuyer. "Cookie Monster: Efficient On-device Budgeting for Differentially-Private Ad-Measurement Systems", SOSP '24 (\*equal contribution)
- · Kelly Kostopoulou<sup>\*</sup>, Pierre Tholoniat<sup>\*</sup>, Asaf Cidon, Roxana Geambasu, Mathias Lecuyer. "Turbo: Effective caching in Differentially-Private Databases", SOSP '23 (\*equal contribution)
- Pierre Tholoniat\*, Kelly Kostopoulou\*, Asaf Cidon, Mosharaf Crowdhury, Roxana Geambasu, Mathias Lecuyer, Junfeng Yang. "Efficiently Packing Privacy Budget with DPack", EuroSys '25 (\*equal contribution)
- · Hang Xu, Kelly Kostopoulou, Aritra Dutta, Xin Li, Alexandros Ntoulas, Panos Kalnis, 'DeepReduce: A Sparse-tensor Communication Framework for Federated Deep Learning", NeurIPS '21

#### ADDITIONAL INFORMATION

Technical skills: Python, C/C++, SQL, TensorFlow, Docker, Kubernetes, Git Languages: **English** (proficient), **French** (basic), **Greek** (native)

### **RESEARCH PORTFOLIO**

Cookie Monster: Efficient On-device Budgeting for Differentially-Private Ad-Measurement Systems 🗘

Cookie Monster is an on-device budgeting component that can be integrated into differentially private admeasurement systems. Powered by a robust theoretical framework known as Individual Differential Privacy (IDP), a variant of traditional differential privacy, Cookie Monster allows advertisers to conserve significantly more privacy budget compared to existing alternatives.

**Publication:** Pierre Tholoniat<sup>\*</sup>, Kelly Kostopoulou<sup>\*</sup>, Peter McNeely, Prabhpreet Singh Sodhi, Anirudh Varanasi, Benjamin Case, Asaf Cidon, Roxana Geambasu, Mathias Lecuyer. "Cookie Monster: Efficient Ondevice Budgeting for Differentially-Private Ad-Measurement Systems", SOSP '24 (\*equal contribution)

Turbo: Effective caching in Differentially-Private Databases  $\bigcirc$ 

Effective caching for linear query workloads over DP databases. Turbo builds upon private multiplicative weights (PMW), a DP mechanism that is powerful in theory but very ineffective in practice, and transforms it into a highly effective caching object, namely PMW-Bypass. A description of this project can be found on our paper, titled Turbo: Effective caching in Differentially-Private Databases.

**Publication:** Kelly Kostopoulou<sup>\*</sup>, Pierre Tholoniat<sup>\*</sup>, Asaf Cidon, Roxana Geambasu, Mathias Lecuyer. "Turbo: Effective caching in Differentially-Private Databases", SOSP '23 (\*equal contribution)

**Demo:** Turbo integrated with Grafana

#### DPack: Efficiently Packing Privacy Budget **Q**

DPack is a framework designed to maximize the utility of private datasets while adhering to differential privacy constraints. Differential privacy provides theoretical bounds on privacy loss when querying a dataset, with each query consuming a portion of the privacy budget. Since the privacy budget is finite, the dataset can only answer a limited number of queries while maintaining privacy guarantees. In this work, we treat privacy consumption as a scheduling resource, elevating it to the same level as traditional computing resources like CPU, memory, and network bandwidth. DPack's objective is to schedule queries in a way that maximizes either the total number of queries processed or the overall utility achieved, considering the importance of each query. To achieve this, we framed the scheduling challenge as an optimization problem and developed a tool to simulate the dynamic arrival of data and queries. The tool includes a scheduler that allocates privacy resources for query execution. To extend DPack's applicability, we integrated the scheduler with Kubernetes.

**Publication:** Pierre Tholoniat<sup>\*</sup>, Kelly Kostopoulou<sup>\*</sup>, Asaf Cidon, Mosharaf Crowdhury, Roxana Geambasu, Mathias Lecuyer, Junfeng Yang. "Efficiently Packing Privacy Budget with DPack", EuroSys '25 (\*equal contribution)

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I led this project as part of my MSc thesis at KAUST. I designed a compressed communication mechanism for distributed machine learning using Bloom filters to address the communication bottleneck caused by broadcasting and aggregating gradients in data-parallel neural network training. In such settings, each model replica generates local gradients that must be shared and aggregated across replicas for updates, leading to significant overhead. To mitigate this, I developed two TensorFlow operators for encoding and decoding the indices of sparsified gradients produced during training. The encoded gradients utilized Bloom filters, which, being lossy, introduced errors that degraded model accuracy due to inaccurate gradient reconstruction. To address this, I implemented a 'false-positive-aware' compression method that adaptively adjusted the encoded gradients by accounting for future Bloom filter errors, thereby improving accuracy.

Thesis: Kelly Kostopoulou, "Sparse Communication in Deep Learning"

**Publication:** Hang Xu, Kelly Kostopoulou, Aritra Dutta, Xin Li, Alexandros Ntoulas, Panos Kalnis, "DeepReduce: A Sparse-tensor Communication Framework for Federated Deep Learning", NeurIPS '21

Recursive Function Definitions in Static Dataflow Graphs & their Implementation in TensorFlow

I led this project as part of my BSc thesis at University of Athens. I investigated how recursive functions can be supported in dataflow systems, specifically TensorFlow. The primary challenge was to design static dataflow graphs capable of representing the logic of recursive functions without requiring dynamic expansion at runtime. Static graphs are crucial as they enable various graph optimizations, which can significantly accelerate the training of recursive neural networks, commonly used in natural language processing. To address this, I extended TensorFlow's API, introduced graph transformations to ensure the graphs remain static during execution, and enhanced TensorFlow's execution engine with a tagging mechanism to enable the correct execution of these static recursive graphs.

**Thesis:** Kelly Kostopoulou, "Recursive Function Definitions in Static Dataflow Graphs & their Implementation in TensorFlow"

Talk: 16th Programming Languages Seminar, Dec 2018, National and Technical University of Athens (NTUA)