Algoritmos e Incerteza

Prof. Marco Molinaro

www.inf.puc-rio.br/~mmolinaro

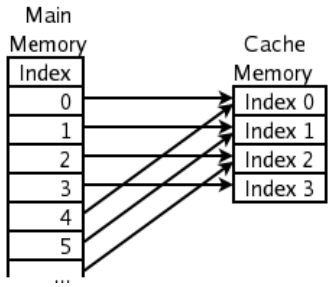
mmolinaro@inf.puc-rio.br

Motivacao

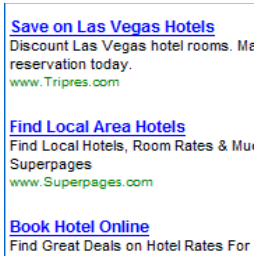
Em muitos problemas nao temos a entrada inteira, apenas informacao parcial

Motivacao

1. Processador utiliza cache para otimizar acessos futuros. Como fazer isso sem saber os acessos futuros?

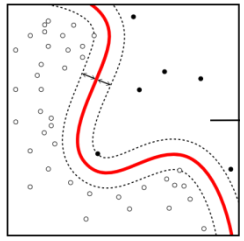


2. Como o Google otimiza globalmente sua alocação de anúncios sem saber buscas futuras?



3. Como tomar decisao com dicas de conselheiros/algoritmos/preditores sem saber a priori a qualidade das dicas?

4. Existem problemas de aprendizado de máquina mais difíceis que outros? Quantos exemplos são necessários para aprendizado?



Objetivos

Objetivo 1: Ver diferentes formas de se modelar incerteza na entrada

- Online algorithms, online learning, bandit models, PAC learning...

Objetivo 2: Desenvolver "heuristicas"/intuicao em como desenhar algoritmos tolerantes a incerteza

- Focar nos problemas/approaches mais simples, nao modelos mais realistas ou melhores resultados

Objetivo 3: Aprender ferramentas tecnicas que ajudem a pensar sobre/analisar algoritmos sob incerteza

Pre-requisitos

- Confortavel com analise de algoritmos padrao (PAA)
- Maturidade matematica
  - Vamos ter discussoes informais e dar conexoes com aplicacoes, mas o curso é baseado em demonstracoes
- Probabilidade discreta
  - Valor esperado, varianca, independencia, condicionamento, (Central Limit Theorem)

Acknowledgment

Inspired by the program *Algorithms and Uncertainty* at Simons Institute – UC Berkeley (2016.2)

Long-Term Participants (including Organizers):
Nir Ailon (Technion Israel Institute of Technology), Susanne Albers (Technische Universität München), Aris Anagnostopoulos (Sapienza University of Rome), Peter Auer (University of Leoben), Yossi Azar (Tel Aviv University), Nikhil Bansal (Technische Universiteit Eindhoven), Peter Bartlett (UC Berkeley), Eilyan Bitar (Cornell University), Avrim Blum (Carnegie Mellon University), Nicolò Cesa-Bianchi (University of Milan), Shiri Chechik (Tel Aviv University), Edith Cohen (Google Research), Artur Czumaj (University of Warwick), Amit Daniely (Google Research), Amos Fiat (Tel Aviv University), Fabrizio Grandoni (IDSIA), Anupam Gupta (Carnegie Mellon University; chair; co-chair), MohammadTaghi Hajiaghayi (University of Maryland), Longbo Huang (Tsinghua University), Sungjin Im (UC Merced), Ravi Kannan (Microsoft Research India), Anna Karlin (University of Washington), Robert Kleinberg (Cornell University), Elias Koutsoupias (University of Oxford), Ravi Kumar (Google), Stefano Leonardi (Sapienza University of Rome; co-chair), Kevin Leyton-Brown (University of British Columbia), Jian Li (Tsinghua University), Katrina Ligett (Hebrew University and Caltech), Aleksander Mądry (Massachusetts Institute of Technology), Yishay Mansour (Tel Aviv University), Ruta Mehta (University of Illinois, Urbana-Champaign), Jamie Morgenstern (University of Pennsylvania), Kamesh Munagala (Duke University), Viswanath Nagarajan (University of Michigan), Seffi Naor (Technion Israel Institute of Technology), Kameshwar Poolla (UC Berkeley), Kirk Pruhs (University of Pittsburgh), Ram Rajagopal (Stanford University), Satish Rao (UC Berkeley), Benjamin Recht (UC Berkeley), Rhonda Righter (UC Berkeley), Tim Roughgarden (Stanford University), Piotr Sankowski (University of Warsaw), C. Seshadhri (UC Santa Cruz), Jay Sethuraman (Columbia University), Cliff Stein (Columbia University), Chaitanya Swamy (University of Waterloo), Marc Uetz (University of Twente), Eli Upfal (Brown University), Marilena Vendittelli (Sapienza University of Rome), Maria Vlasiou (Eindhoven University of Technology), Jean Walrand (UC Berkeley), Gideon Weiss (University of Haifa), Adam Wierman (California Institute of Technology), Bert Zwart (CWI Amsterdam).

Research Fellows:
Ilan Cohen (Tel Aviv University), Varun Gupta (University of Chicago), Thomas Kesselheim (Max-Planck-Institute for Informatics and Saarland University), Marco Molinaro (PUC-Rio de Janeiro; Microsoft Research Fellow), Benjamin Moseley (Washington University in St. Louis), Debmalya Panigrahi (Duke University), Xiaorui Sun (Columbia University; Google Research Fellow), Matt Weinberg (Princeton University), Qiaomin Xie (University of Illinois at Urbana-Champaign).

Visiting Graduate Students and Postdocs:
Angelos Aveklouris (Eindhoven University of Technology), Frank Ban (UC Berkeley), Chris Cameron (University of British Columbia), Niangjun Chen (California Institute of Technology), Sina Dehghani (University of Maryland), David Dinh (UC Berkeley), Alon Eden (Tel Aviv University), Talya Eden (Tel Aviv University), Soheil Ehsani (University of Maryland), Marek Eliáš (Technische Universiteit Eindhoven), Patric Fulop (University of Edinburgh), Kira Goldner (University of Washington), Guru Guruganesh (Carnegie Mellon University), Bart Kamphorst (CWI Amsterdam), Jakub Łącki (Sapienza University of Rome), Xiang Li (UC Berkeley), Raphael Louca (Cornell University), Pasin Manurangsi (UC Berkeley), Tommaso Nesti (CWI Amsterdam), Aviad Rubinstein (UC Berkeley), Tselil Schramm (UC Berkeley), Saeed Seddighin (University of Maryland), Sahil Singla (Carnegie Mellon University), Fiona Sloothaak (Eindhoven University of Technology), Seeun William Umboh (Technische Universiteit Eindhoven), Shai Vardi (Caltech), David Wajc (Carnegie Mellon University).

Acknowledgment

Inspired by the program *Algorithms and Uncertainty* at Simons Institute – UC Berkeley (2016.2)

Avaliacao

Trabalhos (40%)

- 2 trabalhos
- Em duplas
- Questoes teoricas e de implementacao (simples)

Scri

Veja instrucoes sobre o projeto na pagina e comece a pensar no seu topico **agora**

- Veja instrucoes na pagina do curso

Projeto final (40-30%)

- Apresentacao de ~40 min + documento de ~5 paginas
- Artigo, capitulo de livro, projeto de implementacao *nao trivial*
- Proposta no meio do semestre, documento ~2 paginas

Pagina do curso

Material, esclarecimentos, anuncios: pagina do curso em

http://www.inf.puc-rio.br/~mmolinaro

Antes que esqueca

Quem é o(a) *scribe* da aula de hoje?