

COMPUTATION OFFLOADING IN MOBILE EDGE COMPUTING: AN OPTIMAL STOPPING THEORY APPROACH

Thesis Presentation

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Agenda

- Thesis Scope
- Motivation
- Research Problem
- Methods
- Performance Evaluation
- Publications



Thesis Scope

Edge computing
concept and server
deployment

- *MEC*
- *RSU and small cell deployment*

Offloading decision
and metric

- *Server (time) offloading selection*
- *Processing time at the Edge server, load*

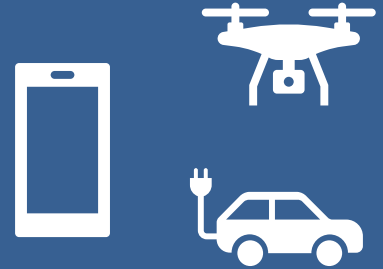
Solution

- *Optimal Stopping Theory*



Motivation

- Computational Offloading
 - Mobile nodes:
 - Smartphones - smart vehicles
 - Applications:
 - Augmented and virtual reality
 - Data offloading for analytics tasks
 - New applications constrained by limited computing resources
- The deployment of MEC servers



Motivation Example: MEC in RSU

- *Autonomous, Smart Vehicles:*

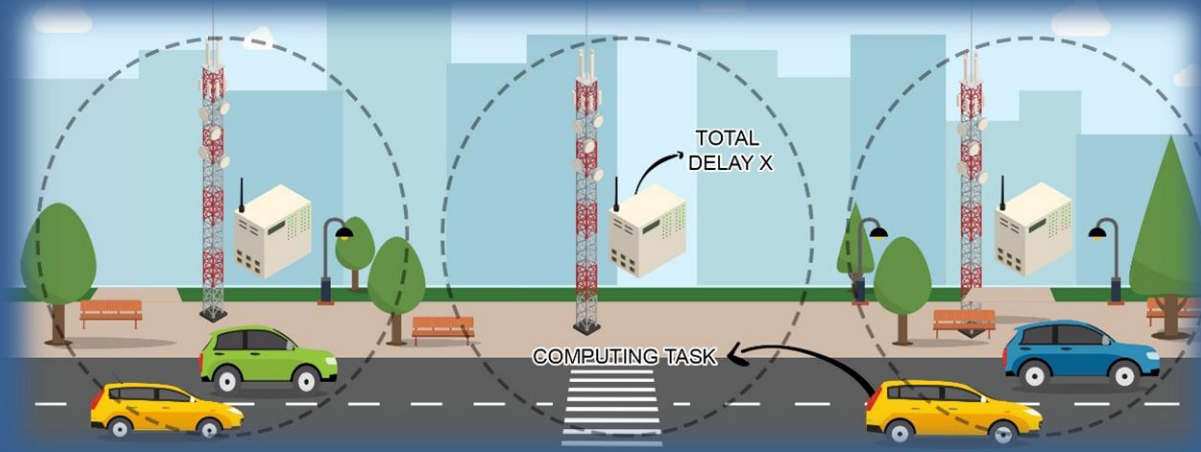


Figure 1: MEC environment. ^{1,2}

¹ K. Zhang, Y. Mao, S. Leng, Y. He, and Y. Zhang, "Mobile-edge computing for vehicular networks: A promising network paradigm with predictive off-loading," IEEE Vehicular Technology Magazine, vol. 12, no. 2, pp. 36–44, 2017.

² R. Akmal Dziauddin, D. Niyato, N. Cong Luong, M. A. M. Izhar, M. Hadhari, and S. Daud, "Computation offloading and content caching delivery in vehicular edge computing: A survey," arXiv, pp. arXiv-1912, 2019.

Research Problem



Objectives (in general):

1. Max (P_n^*)
2. Min (X)



Objectives (specificly):

Find the rules/policy to
achieve our objectives

Considerations

- Independent offloading decision
- Mobility:
 - Higher chance of meeting better resources³
- Deadline:
 - We must offload before T ⁴
- Sequential:
 - Optimality found in the optimal stopping theory



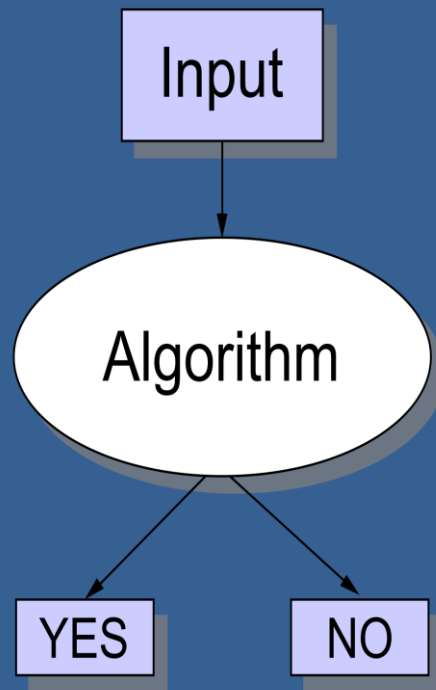
³ S. Zhou, Y. Sun, Z. Jiang, and Z. Niu, "Exploiting moving intelligence: Delay optimized computation offloading in vehicular fog networks," IEEE Communications Magazine, vol. 57, no. 5, pp. 49–55, 2019.

⁴ W. Tang, X. Zhao, W. Rafique, L. Qi, W. Dou, and Q. Ni, "An offloading method using decentralized p2p-enabled mobile edge servers in edge computing," Journal of Systems Architecture, vol. 94, pp. 1–13, 2019.



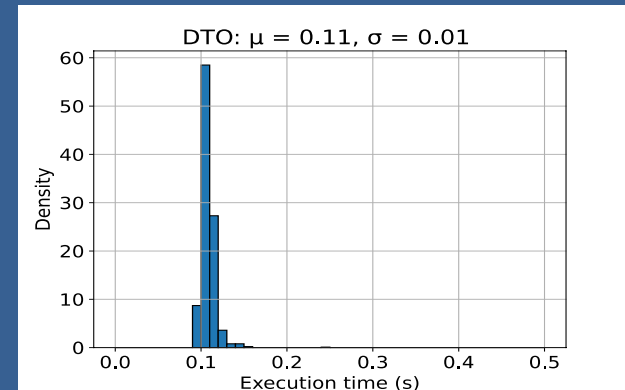
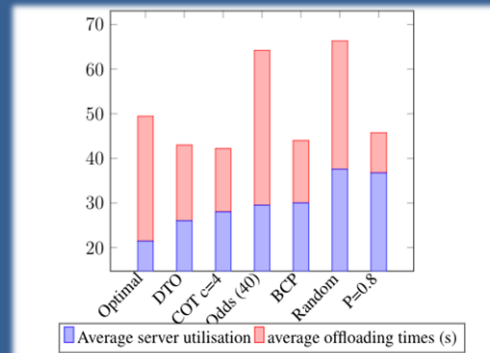
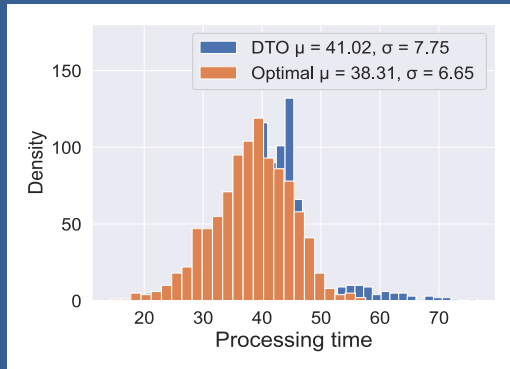
Optimal Stopping Theory

- Inputs
 - random variable X
 - probability distribution function
 - number of observations
- Processing
- Output
 - Policy/rule to be followed by the decision maker
- Why?
 - Independent decision-making
 - Low cost implementation



Performance Evaluation & Results

- Performance Evaluation:
 - Simulated random variable with different probability distributions
 - Real server utilisation
 - Task execution time



Publications

- **Ibrahim Alghamdi**, Christos Anagnostopoulos, and Dimitrios P Pezaros. "Optimized Contextual Data Offloading in Mobile Edge Computing". In: IFIP/IEEE International Symposium on Integrated Network Management (IM 2021), Bordeaux, France, 17-21 May 2021, (Accepted for Publication).
- **Ibrahim Alghamdi**, Christos Anagnostopoulos, and Dimitrios P Pezaros. "Data quality-aware task offloading in Mobile Edge Computing: An Optimal Stopping Theory approach." *Future Generation Computer Systems* (2020).
- **Ibrahim Alghamdi**, Christos Anagnostopoulos, and Dimitrios P Pezaros. "On the Optimality of Task Offloading in Mobile Edge Computing Environments," 2019 IEEE Global Communications Conference (GLOBECOM), Waikoloa, HI, USA, 2019, pp. 1-6.
- **Ibrahim Alghamdi**, Christos Anagnostopoulos, and Dimitrios P Pezaros. Delay-Tolerant Sequential Decision Making for Task Offloading in Mobile Edge Computing Environments. *Information* 2019, 10, 312.
- **Ibrahim Alghamdi**, Christos Anagnostopoulos, and Dimitrios P Pezaros. "Time-Optimized Task Offloading Decision Making in Mobile Edge Computing," 2019 Wireless Days (WD), Manchester, United Kingdom, 2019, pp. 1-8 - Recipient of the Best Paper Runner Up Paper.





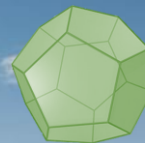
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Thank you!
Questions

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