

AILEC3 - Artificial Intelligence for Lower Energy Consumption in Fog-Edge Computing

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I. PRELIMINAR RESEARCH

A. Riassunto e Considerazioni Finali

Partendo dal 2022 si hanno un paio di survey che elencano una serie di algoritmi che affrontano l'ambito della distribuzione dei task nel fog/edge computing in vista di un risparmio energetico e/o di un'ottimizzazione degli overhead di calcolo sui server. Gli algoritmi genetici sono praticamente sempre presi in considerazione e, tra questi, vi sono due Elitism-based Genetic Algorithms che paiono dare risultati interessanti. L'unica cosa da fare ora è focalizzarsi su una cerchia ristretta di paper e iniziare ad implementare.

Il materiale raccolto è molto più rarefatto rispetto a quello riguardante il Cloud Computing ma c'era da aspettarselo vista la relativa novità dell'ambito considerato. Prima del 2019, oltretutto, viene data più rilevanza a "come" organizzare lo scheduling dei task nel fog/edge computing più che alla sua efficienza energetica. Tale ambito guadagna rilevanza proprio nel 2019 e aumenta esponenzialmente nel 2021/2022, tant'è che la maggior parte dei paper sono proprio di questi anni. Purtroppo per forza di cose ho dovuto troncare la raccolta perché, nonostante negli anni precedenti al 2019 ci sia poco materiale, soprattutto nel 2021 e nel 2022 è stata fatta tantissima ricerca. Non ho commentato ciascun singolo paper, di tre o quattro ho citato solo il titolo per non appesantire troppo.

B. *aTask scheduling approaches in fog computing: A survey*

[8] The advent of the Internet of Things brings a wave of research, technology, and computing. The Internet of Things has brought a concept called the fog computing, which has launched many discussions in the scientific community. In a fog environment, a requested service decomposed into a set of tasks and applied with an optimal approach to schedule these tasks across the fog devices to serve the user requirements is an important challenge. In spite of the task scheduling approaches being a necessity in fog computing, to the best of our knowledge, there is no comprehensive survey in the field of task scheduling approaches in fog computing. This paper provides a survey to analyze the current research studies in task scheduling approaches in fog computing from 2015 to 2018. Moreover, this paper classifies the task scheduling approaches in two fields: static and dynamic. This study tries to discuss the advantages and disadvantages of each study to solve their weaknesses. Providing a survey of the task scheduling approaches in the fog computing, planning a technical taxonomy for the task scheduling approaches, and highlighting the future open issues in the recent topics are the contributions of this study.

This paper surveyed all recent articles of task scheduling approaches in fog computing in 2015-2018. Moreover, this paper reviewed the selected mechanisms and investigated their algorithms and results in terms of tasks scheduling algorithms, evaluated factors, simulation environments, and task scheduling categories. In this paper, we classified the task scheduling approaches as static and dynamic approaches. The static approach includes heuristic and metaheuristic algorithms, and the dynamic approach contains real-time and heuristic methods. As a result, the static approach and heuristic algorithms are more popular in task scheduling mechanism in fog computing. The static task scheduling algorithms are the most popular algorithms by 76% usage. Heuristic-based algorithms are the most common task scheduling algorithms by 43% usage. The execution time factor is the most important factor and has 36% usage. In the future work, some scheduling approaches such as hybrid scheduling, energy-aware scheduling, and reliability-based scheduling in the fog computing can be considered for SLR-based analysis and review. In addition, resource provisioning

approaches can be considered as SLR in fog computing.

Una survey interessante che pone al lettore una vasta gamma di algoritmi di scheduling utili nel fog computing. Certamente utilizzabile per vedere in che direzione andare.

C. Sustainable task offloading decision using genetic algorithm in sensor mobile edge computing

[7] Propelling energy-constrained sensor tasks to edge servers in Sensor Mobile Edge Computing (SMEC) subjugates Mobile Devices' (MDs) resource limitation menace. Most of the existing studies focused only on the offloading issues. However, a task may hinge on some allied tasks executed in the prior edge server in the trajectory of MDs. Task execution accomplishes by the assemblage of dependent data.

This study imparts the dynamic selection of edge cloud for offloading tasks and checks the task's dependencies in a multiuser, multichannel environment. The proposed dynamic edge server selection for the inter-edge dependent task scheme piles up data from multiple allied edge nodes to finish the execution. This paper employs a Genetic Algorithm (GA) based optimization technique in the SMEC environment (GAME) to discern the optimal solution. The performance of our proposal is analyzed and compared with the other offloading policies exerting standard datasets. The result of this study manifests with the depletion of energy consumption and computational delay within the allowable range of transmission latency, despite appraising multiple task dependencies. In this study, we propose the GAME scheme, a sustainable energy-efficient dynamic edge server selection process that considers the dependencies of tasks to other edge servers and other wireless devices. Executing edge server selection at the run time makes the process dynamic, moreover applying the heuristic searching algorithm, we obtain the optimal solution in a stipulated amount of time. It optimizes the energy requirement at its best after scheduling each task to its best possible edge resource. The algorithm invests its best effort to adjust with the edge server assignment for the tasks that cannot be executed locally to avoid the costliest cloud assignment process.

We have compared our study with other state-of-art techniques (Zhao et al., 2019, Mazouzi et al., 2019), and we have seen that our proposal exhibits better performance. For task dependency computation, the proposed model does not consider the centralized cloud server. It can be outstretched by considering the dependent data from the costly cloud server too. This model will attract researchers in the domain of distributed task execution. It will enhance the future scope of the work by considering the microservice task execution and sequencing in the MEC network. Furthermore, the proposed model can also be emphasized by incorporating the security features of the task executing MDs.

Nuovo stato dell'arte (dichiarato) egstire meglio la selezione degli edge server nell'edge mobile computing.

Potrebbe essere il punto di partenza per la mia implementazione.

D. Bi-objective optimization of application placement in fog computing environments

[4] Fog computing has been recently introduced to complement the cloud computing paradigm and offer application services at the edge of the network. The heterogeneity of fog computational nodes makes application placement in fog infrastructures a challenging task that requires proper management in order to satisfy application requirements. This paper proposes a bi-objective application placement algorithm for fog computing environments. The proposed algorithm seeks to optimally place application modules on the underlying fog devices considering applications criticality levels and security requirements. The placement problem has been formulated as a bi-objective knapsack problem and solved using the non-dominated sorting genetic algorithm II (NSGA-II). It has been implemented using a specialized fog computing simulation tool and compared against existing placement algorithms. Simulation results demonstrate the ability of the proposed algorithm to optimize application placement in fog computing environments in terms of application performance, power efficiency and security satisfaction rates.

This paper has proposed a bi-objective application placement algorithm that aims at optimizing the placement of IoT applications on a tree-like fog infrastructure. IoT applications consist of a set of interconnected modules that follow a distributed data flow model. Each application is characterized by a criticality level and a set of security requirements. Unlike previous research efforts, this paper has considered application's criticality and security requirements as simultaneous optimization variables. The proposed algorithm has been implemented on a specialized fog computing simulation tool. Its performance has been thoroughly analyzed and compared to existing algorithms.

Simulation scenarios have covered various infrastructure configurations, application security requirements and infrastructure security capabilities. Simulation results have proved the ability of the proposed algorithm to capture the preference given to each objective and optimally place application modules on the underlying physical infrastructure and surpass other existing placement algorithms considering several figures of merit such as application response time and security satisfaction rate. As a future work, the proposed algorithm will be extended to handle other factors such as trust considerations in fog environments, cost optimization in fog environments - where multiple service providers may exist, and energy dissipation of fog nodes. In addition, the proposed algorithm will be tested on real-time testbeds and extended to handle dynamic changes of user preferences and application criticality levels.

Molto più interessante del paper precedente e più orientato all'obiettivo che si vorrebbe considerare in questa tesi.

E. A genetic-based approach for service placement in fog computing

[12] The combination of cloud computing with the Internet of Things has made fundamental changes in areas from industry, healthcare, traffic, and transportation to home appliances and even personal lives. Billions of devices and users are connected through these platforms disseminating enormous amounts of data leading to performance degradation, which has generated a demand for prior application placement planning. This paper focuses on the minimization of application delay and network usage by proposing a genetic-based service placement algorithm in fog-cloud environments. Throughout this work, a penalty-based approach to target both the delay and the number of time-consuming cloud placements is introduced, which explores the solution pool as a function of generations. This helps in exploring a wider space at the beginning and gradually intensifying the effect of penalty in the next generations. In a separate phase, the proximity of the applications to the users is taken into account as well. This is done through the chromosome selection process by using a priority value that identifies the proximity of dependent modules. The results of simulations demonstrate that the proposed algorithm achieved improvements regarding delay, network usage, energy consumption, and cost.

Si trovasse qualcosa di più online sarebbe molto interessante. Non pare introdurre però nulla di nuovo rispetto ai paper precedenti.

F. Adopting elitism-based Genetic Algorithm for minimizing multi-objective problems of IoT service placement in fog computing environment

[11] Fog computing is an emerging computation technology for handling and processing the data from IoT devices. The devices such as the router, smart gateways, or micro-data centers are used as the fog nodes to host and service the IoT applications. However, the primary challenge in fog computing is to find the suitable nodes to deploy and run the IoT application services as these devices are geographically distributed and have limited computational resources. In this paper, we design the two-level resource provisioning fog framework using docker and containers and formulate the service placement problem in fog computing environment as a multiobjective optimization problem for minimizing the service time, cost, energy consumption and thus ensuring the QoS of IoT applications. We solved the said multi-objective problem using the Elitism-based Genetic Algorithm (EGA). The proposed approach is evaluated on fog computing testbed developed using docker and containers on 1.4 GHz 64-bit quad-core processor devices. The experimental results demonstrate that the proposed method outperforms other state-of-the-art service placement strategies considered for performance evaluation in terms of service cost, energy consumption, and service time.

Fog Computing is the most suitable computing architecture for delay-sensitive IoT applications to process data at the

edge of the network and provides service in real-time. In this work, we developed a docker and containers based two-level fog infrastructure to provide the resources. We then formulated the fog service placement problem as a multi-objective optimization problem to ensure the QoS of IoT applications. Further, we solved this optimization problem using the Elitism-based GA (EGA) service placement algorithm. We investigated different service placement strategies for IoT applications in the fog computing environment. We then experimented on the fog infrastructure testbed developed using the docker and containers on the cluster of 1.4 GHz 64-bit quad-core processor devices. The experimental results demonstrate that the proposed EGA performs better than the other state-of-the-art service placement algorithms considered for performance evaluation in terms of service time, energy consumption, service cost, and average CPU utilization of fog nodes. But, one of the limitations of the work is we have not considered the interdependent IoT applications to check the performance of the proposed EGA on the developed fog testbed. In future work, we address the limitations and combine evolutionary algorithms to build a hybrid approach for solving the fog service placement problem, load balancing, service migration, and handling device failures in the fog computing environment.

Molto interessante l'approccio via Elitist-based Genetic Algorithm. Sembra un ottimo candidato per essere SOTA.

G. IEGA: An improved elitism-based genetic algorithm for task scheduling problem in fog computing

[2] Modern information technology, such as the internet of things (IoT) provides a real-time experience into how a system is performing and has been used in diversified areas spanning from machines, supply chain, and logistics to smart cities. IoT captures the changes in surrounding environments based on collections of distributed sensors and then sends the data to a fog computing (FC) layer for analysis and subsequent response. The speed of decision in such a process relies on there being minimal delay, which requires efficient distribution of tasks among the fog nodes. Since the utility of FC relies on the efficiency of this task scheduling task, improvements are always being sought in the speed of response. Here, we suggest an improved elitism genetic algorithm (IEGA) for overcoming the task scheduling problem for FC to enhance the quality of services to users of IoT devices.

The improvements offered by IEGA stem from two main phases: first, the mutation rate and crossover rate are manipulated to help the algorithms in exploring most of the combinations that may form the near-optimal permutation; and a second phase mutates a number of solutions based on a certain probability to avoid becoming trapped in local minima and to find a better solution. IEGA is compared with five recent robust optimization algorithms in addition to EGA in terms of makespan, flow time, fitness function, carbon dioxide emission rate, and energy consumption. IEGA is

shown to be superior to all other algorithms in all respects.

This study presents a new model based on the IEGA for addressing TSFC in IoT applications. IEGA was improved in two ways. The first uses a high mutation rate that reduces with each iteration to explore each solution alone to complete better permutations that can achieve a better solution when recombining each permutation with another based on crossover rate; because the exploration capability tries to discover more regions than the mutation operator, so at the start, the mutation rate will start with a high value and reduce gradually with each iteration. Then, the exploitation phase, which is based on the crossover operator, will increase to combine each pair of solutions in the hope of finding a better one.

The second addition changes a small number of the dimensions in each solution to retain the diversity in the population in addition to avoiding local minima. IEGA is compared with five robust recent optimization algorithms as well as EGA in terms of make-span, energy consumption, flow time, fitness function, and CDER. IEGA is shown to be superior in comparison with all the other algorithms under make-span, energy consumption, fitness function, and CDER.

However, for flow time, the proposed approach outperforms the others for tasks sizes higher than 700, which shows the superiority of the proposed with the large-scale problem. In the future, IEGA will be used to address dependent task scheduling in the fog system.

La versione migliorata dell'algoritmo precedente. Potrei forse puntare su questo come baseline? Devo studiare meglio le caratteristiche dell'algoritmo.

H. Intelligent workload allocation in IoT-Fog-Cloud architecture towards mobile edge computing

[1] Because of the tremendous growth in the number of smart vehicular devices and 5G mobile technologies, the Internet of Things (IoT) has experienced rapid expansion. This has led to a considerable increase in the volume of sensory data produced from, but not limited to, monitoring devices, traffic congestion in cities, safety, and pollution control. Cloud computing can deal with the corresponding workload by providing virtually unlimited computational resources. But, given the importance of the quality of service and security in delay-sensitive requests, other solutions like fog computing have also been introduced to speed up processing and management of sensory data in real scenarios like smart grid and IoT. Processing workloads at the network edge reduces the delay in mobile edge computing, but it highly increases the consuming power. Therefore, there is an urgent need for the improvement of the energy model of fog devices at the network edge. This paper is an attempt to modify this model using the green energy concept and reduce both delay and power consumption in multi-sensorial frameworks in secure IoT systems. In the proposed method, a Genetic Algorithm (GA) is used for handling a large number of requests and the corresponding quality and security limitations. Simulation results show that the proposed method can simultaneously

reduce the delay and the power consumption of edge devices compared to a baseline strategy.

The transmission of large volumes of data from sensors to the cloud imposes long delays on the workloads in the 5G empowered IoT. In the meanwhile, processing these workloads at the mobile network edge will significantly increase power consumption. Therefore, workload allocation with an emphasis on delay to provide QoS as well as on energy consumption has become an important issue. Fog devices have relatively small delays, but their high power-consumption at the network edge leads to less workload being allocated to them. In previous studies, workload allocation has been addressed without modifying the energy model of fog devices, which led to an increased delay for the end-user. In this study, we attempted to compromise between power consumption and delay in fog devices through the modification of the energy model of these devices using the NSGA II algorithm. The simulation results suggest that this modification not only reduces the power consumption of fog devices but also significantly decreases the delay in the processing of packets on the IoT. In comparison with the FEMTO method, the NSGA II algorithm resulted in a more significant reduction in both power consumption and delay for different workloads. In the two scenarios simulated using a genetic algorithm, the IoT requests were sent to the controller with full and half capacity. In both scenarios, power consumption, and delay were improved. Therefore, this model could be used in networks where green energy is not available to the processing resources. In these circumstances, solar or wind energy or any other renewable energies can be utilized as a complementary power supply to reduce the power consumption of fog devices. Deep learning methods, including deep neural networks, have proven to be powerful methods in many complicated multi-objective optimization problems [53,54]. Adapting these methods to the multi-objective workload allocation in secure MEC will be our future study.

Introduzione di due algoritmi da prendere in forte considerazione, ovvero NSGA2 e FEMTO. È forse uno dei pochi paper che nominano il risparmio energetico.

I. A new energy-aware tasks scheduling approach in fog computing using hybrid meta-heuristic algorithm

[9]

J. A Probability Preferred Priori Offloading Mechanism in Mobile Edge Computing

[14] Mobile edge computing (MEC) can provide computation and storage capabilities via edge servers which are closer to user devices (UDs). The MEC offloading system can be viewed as a system where each UD is covered by single or multiple edge servers. Existing works prefer a posterior design when task offloads, which can lead to increased workloads. To investigate the task offloading of

edge computing in multi-coverage scenario and to reduce the workload during task offloading, a probability preferred priori offloading mechanism with joint optimization of offloading proportion and transmission power is presented in this paper. We first set up an expectation value which is determined by the offloading probability of heterogeneous edge servers, and then we form a utility function to balance the delay performance and energy consumption. Next, a distributed PRiori Offloading Mechanism with joint Offloading proportion and Transmission (PROMOT) power algorithm based on Genetic Algorithm (GA) is proposed to maximize the utility of UD. Finally, simulation results verify the superiority of our proposed scheme as compared with other popular methods.

In this work, we investigated the mobile edge computing (MEC) model which UDs are covered by single or multiple edge servers. In that case, we proposed a probability preferred priori offloading mechanism with joint optimized offloading proportion and transmission power. A utility function with UD's time and energy consumption is formed, then the GA based PROMOT algorithm is used to solve the problem and the best offloading proportion and transmission power can be obtained for maximizing the UD utility. We only consider offloading task to one single edge server under the scenario that UDs are covered by single or multiple edge server(s) in this paper, and if UD is covered by multiple edge servers, we can split a task into multiple subtasks, and offloading those subtasks in a distributed way. In that case, we need to calculate the best proportion for each subtask and find a unified transmission power. A device-to-device (D2D) offloading is not considered in this paper. Thus, we can add a D2D offloading in the future work for some UDs have more enough computation capacities.

PROMOT incorpora anche il discorso probabilistico, un po' ignorato nelle altre ricerche.

K. Joint Optimization Strategy of Computation Offloading and Resource Allocation in Multi-Access Edge Computing Environment

[10]

L. Multi-Objective Computation Sharing in Energy and Delay Constrained Mobile Edge Computing Environments

[5] In a mobile edge computing (MEC) network, mobile devices, also called edge clients, offload their computations to multiple edge servers that provide additional computing resources. Since the edge servers are placed at the network edge, e.g., cell-phone towers, transmission delays between edge servers and edge clients are shorter compared to those of cloud computing. In addition, edge clients can offload their tasks to other nearby edge clients with available computing resources by exploiting the Fog Computing (FC) paradigm. A major challenge in MEC and FC networks is to assign the tasks from edge clients to edge servers, as well as to other edge clients, in such a way that their tasks are completed with minimum energy consumption and minimum processing delay. In this paper, we model task offloading in MEC as

a constrained multi-objective optimization problem (CMOP) that minimizes both the energy consumption and task processing delay of the mobile devices. To solve the CMOP, we design an evolutionary algorithm that can efficiently find a representative sample of the best trade-offs between energy consumption and task processing delay, i.e., the Pareto-optimal front. Compared to existing approaches for task offloading in MEC, we see that our approach finds offloading decisions with lower energy consumption and task processing delay.

In this work, we have considered a computation sharing problem in MEC. The considered scenario is composed by ECs and ENs, where the ECs have the ability to offload their tasks to the nearby ECs and ENs. A computation sharing system model has been developed where the goal is to jointly minimize the energy consumption and the task delay when offloading the tasks portions to different devices. A suitable MOEA has been proposed for optimizing the computation sharing problem by considering both average task delay and average EC energy consumption. The numerical results shows that through the evolutionary steps of the NSGA2 it is possible to optimize both energy and delay and achieving better results than benchmark solutions. Moreover, the proposed NSGA2-based approach result in prolonging the network lifetime by optimizing the amount to be offloaded by the ECs. Furthermore, we have analyzed the effect of number of iterations in the genetic algorithm and have observed the convergence of the Pareto fronts in different scenarios with variable number of ECs. In the end, it can be noticed that the Constrained-NSGA2 approach with a quite low time complexity can have results close to the NSGA2 approach.

M. Energy-Aware Marine Predators Algorithm for Task Scheduling in IoT-Based Fog Computing Applications

[3] To improve the quality of service (QoS) needed by several applications areas, the internet of things (IoT) tasks is offloaded into the Fog computing instead of the cloud. However, the availability of ongoing energy heads for fog computing servers is one of the constraints for IoT applications because transmitting the huge quantity of the data generated using IoT devices will produce network bandwidth overhead and slow down the responsive time of the statements analyze. In this work, an energyaware model basis on the marine predators algorithm (MPA) is proposed for tackling the task scheduling in Fog computing (TSFC) to improve the QoSs required by users. In addition to the standard MPA, we proposed the other two versions. The first version is called modified MPA (MMPA), will modify MPA to improve their exploitation capability by using the last updated positions instead of the last best one. The second one will improve MMPA by the ranking strategy-based re-initialization and mutation toward best, in addition to re-initializing, the half population randomly after a predefined number of iterations to get rid of local optima and mutated the last half toward the best so-far. Accordingly, MPA is proposed to solve the continuous one while the TSFC is considered a discrete one, so the normalization and scaling phase will be used to convert the standard MPA into a discrete

one. The three versions are proposed with some other meta-heuristic algorithms and genetic algorithms based on various performance metrics such as energy consumption, make-span, flow time, and carbon dioxide emission rate. The improved MMPA (IMMPA) could outperform all the other algorithms and the other two versions.

In this paper, a new energy-aware algorithm based on a novel metaheuristic algorithm known as marine predators algorithm (MPA) is proposed for tackling the TSFC problem in IoT applications. In this paper, two versions of MPA in addition to the standard one has been proposed for tackling the TSFC. The first version is called a modification marine predators algorithm (MMPA), this version improves the standard one by using the past updated positions for generating a new one in the next generation. Regarding the second version, the MPA is improved using a Ranking strategy based reinitialization randomly and mutation two the best. A probability has been used to tradeoff between the re-initialization randomly or moving toward the best one. Because the standard MPA is proposed for tackling the continuous problem and the TSFC is considered a discrete one, so the normalization and scaling phase is using to solve this problem. Our proposed algorithm is compared with four meta-heuristic algorithms (WOA, SCA, SSA, and EOA) and the genetic algorithm to check their efficacy. Each obtained solutions is evaluated based on six performance metrics: makespan, energy consumption, costs, flow time, and carbon dioxide emission rate. The results show the superiority of IMMPA. In the future, MPA will be applied to schedule the dependent tasks in the fog system. Also, MPA could be applied for solving multidimensional knapsack problems and DNA fragment assembly problem.

Interessante l'uso di un algoritmo raro come il Marine Predators Algorithm. Buon numero di citazioni e risultati interessanti.

N. A genetic algorithm for energy efficient fog layer resource management in context-aware smart cities

[] The development of novel Information and Communication Technology (ICT) based solutions becomes essential to meet the ever increasing rate of global urbanization in order to satiate the constraint in resources. The popular smart city paradigm is characterized by ubiquitous cyber provisions for the monitoring and control of such city's critical infrastructures, encompassing healthcare, environment, transportation and utilities among others. In order to manage the numerous services keeping their Quality of Service (QoS) demands upright, it is imperative to employ context aware computing as well as fog computing simultaneously. This paper investigates the feasibility of energy minimization at the fog layer through intelligent sleep and wake-up cycles of the fog nodes which are context-aware. It proposes a virtual machine management approach for effectively allocating service requests with a minimal number of active fog nodes using a genetic algorithm (GA); and thereafter, a reinforcement learning (RL) approach is incorporated to optimize the period of fog nodes' duty cycle. Simulations are carried out using MATLAB and the

results demonstrate that the proposed scheme improves energy consumption of the fog layer by approximately 11

21% when compared to existing context sharing based algorithms.

This article proposes a VM management model at fog layer of smart cities that combines the features of a SCS algorithm and a GA optimization approach utilizing fog node resources' computation, memory and network bandwidth optimally. The proposed technique is simulated using iFogSim toolkit and adequate experiments are performed to evaluate its performance. The performance of the proposed approach is compared with existing SCS technique using the vital performance metrics namely, number of migrations and energy utilization. It is observed that the proposed hybrid SCS-GA technique outperforms the existing SCS technique by reducing overall completion time and QoS violations. This is possible by assigning the service requests to the best available VMs within fog nodes. The integrated SCS algorithm and optimized VM management model is able to reduce the number of migrations and energy utilization to a greater extent. In addition, RL based duty cycling slot prediction approach also effectively reduces the energy consumption of fog nodes. In future, the impact of incorporating learning can be studied by employing a comparative study to divulge effective schemes. Besides, an attempt to compile a real-life dataset is currently underway, which shall be employed to test the efficacy of the proposed scheme in a more credible manner.

Interessante l'approccio sonno-veglia dei nodi fog a cui si applica il Genetic Algorithm per allocare in maniera efficiente le richieste di servizio. La parte di RL per gestire la durata del ciclo di sonno nei nodi è interessante e non ho ancora trovato un approccio che la proponga. I risultati ottenuti sono molto promettenti. Peccato sia stato scritto in MATLAB ma difficilmente dovrò leggermi l'implementazione "cruda", avendo l'algoritmo mal che vada implementerò da me.

O. Task-driven resource assignment in mobile edge computing exploiting evolutionary computation

[13]

P. A Fog Computing Service Placement for Smart Cities based on Genetic Algorithms

[6]

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