SEMINAR PRESENTATION

PRESENTED BY

ASIF NAVAS

ROLL NO : 7

SCHOOL OF COMPUTER SCIENCES

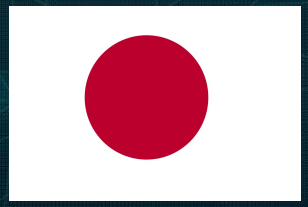
MAHATMA GANDHI UNIVERSITY

HISTORY

SECOND WORLD WAR

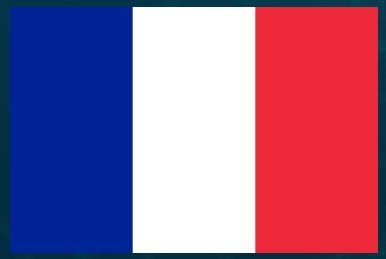
Germany

Italy



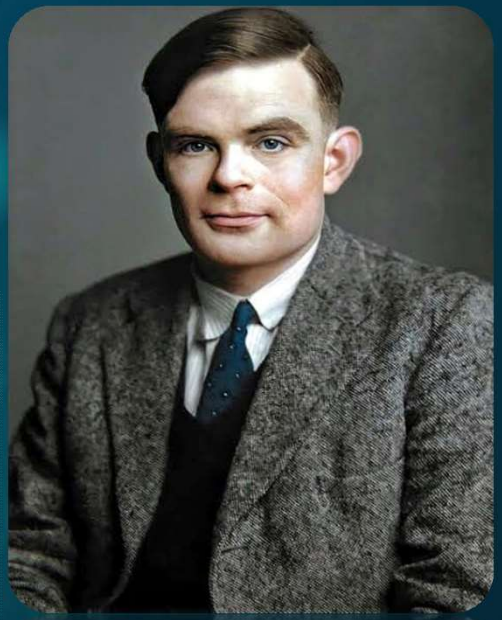
Japan

Britain



France

ENIGMA



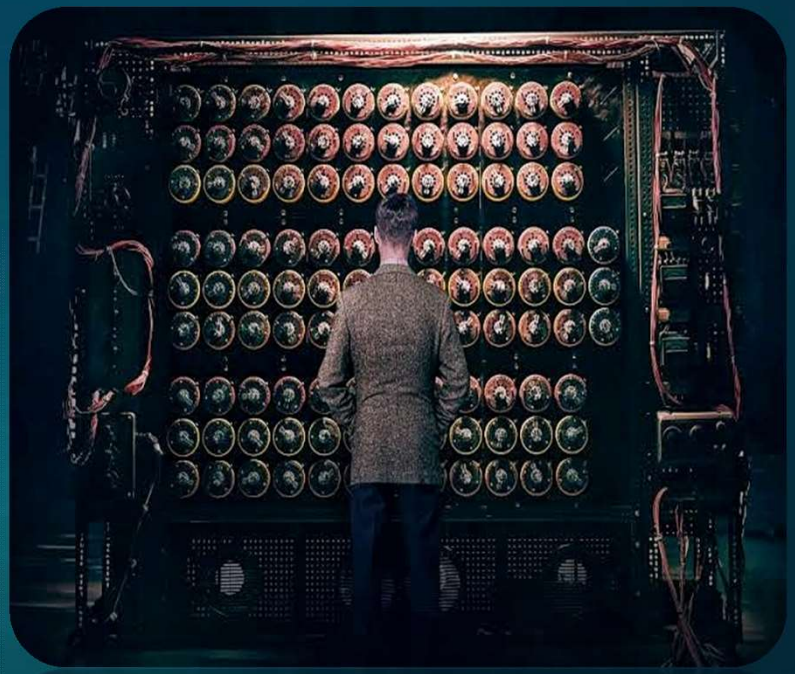
ALLEN TURNING

ALLEN TURNING'S CONCEPTS

"Do machines can Think like a human"

"How a machine can Think like a human"

"Why machines can't think Like a Human"



BOMBE

THE IMITATION GAME

ARTIFICIAL INTELLIGENCE

What Is An Artificial Intelligence….?

Artificial intelligence (AI), is intelligence demonstrated by machines, unlike the natural intelligence displayed by humans and animals, which involves consciousness and emotionality. By using a set of programs.

Intelligent Resource Management in Future Wireless Networks Inspired by Artificial Intelligence

CONTENTS

INTRODUCTION

- The number and complexity of tasks in the network are increasing sharply, but at the same time volume of edge resources is limited.
- Major challenge in network management is the diversification of network resources .
- Many traditional resource optimization method in wireless communication network are becoming more performance-constrained and complicated in complex scenarios.
- How to provide the most efficient service for network users with limited resources is an urgent problem to be solved.

INTRODUCTION

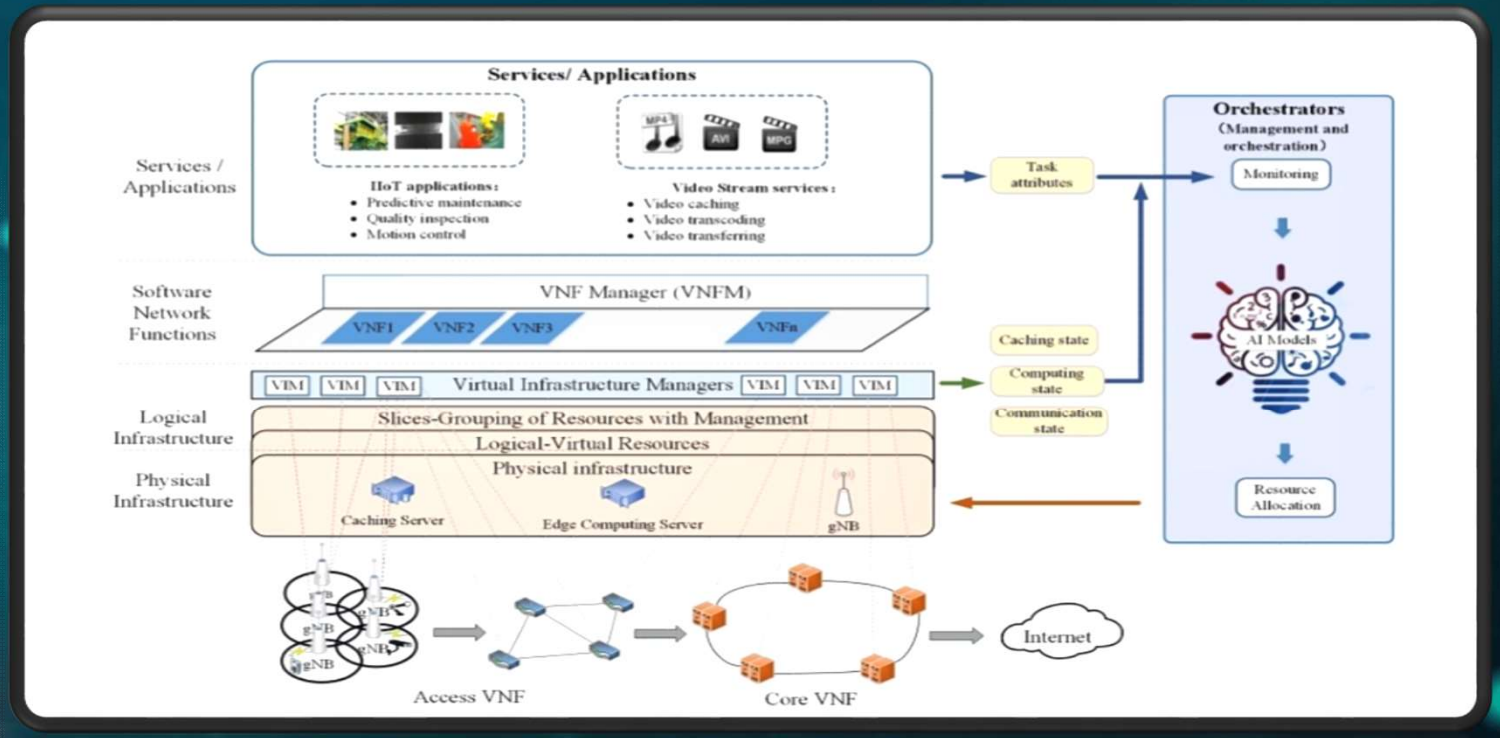
- Development of Artificial intelligence helped to solve complex decision-making problems.
- AI algorithms have been applied to joint resource allocation problems to solve complex decision-making problems.
- Various AI technologies, mainly machine learning and deep learning, can extract useful information from wireless systems, learn and make decisions from dynamic environments and are considered as possible solutions for complex and previously intractable problems in future wireless networks.

OBJECTIVE

The objective is to solve the complicated decision making problem and to improve the efficiency and performance of the network.

Intelligent Resource Management in Future Wireless Networks Inspired by Artificial Intelligence is a new technology for future wireless network to improve network performance, including reducing computation delay, transmission delay and bandwidth consumption. A 5G based AI-assisted intelligent wireless network architecture is given, based on the architecture, Deep Q-network (DQN) algorithm is used to figure out Joint Resource Allocation.

ARCHITECTURE OF 5G-BASED AI-ASSISTED INTELLIGENT WIRELESS NETWORK



THE SYSTEM ARCHITECTURE IS DIVIDED INTO FOUR PARTS

- **Physical Infrastructure**

It consists of caching servers, edge computing servers and gNodeB.

- **Logical Infrastructure**

The physical infrastructures are abstract into logical-virtual resources in the logical infrastructure layer.

- **Software Network Functions**

In the software network functions layer, Virtual Network Functions are software that provide some kinds of network services. And Virtual Network Function Manager is responsible for Virtual Network Function lifecycle management.

- **Orchestrators**

It is responsible for organizing infrastructures based on the tasks attribute and resource status.

AI FOR RESOURCE ALLOCATION PROBLEM

Supervised Learning & Unsupervised Learning

Reinforcement Learning

Deep Learning

Deep Reinforcement Learning

SUMMARIZED OF AI-BASED APPROACHES USED IN RESOURCE MANAGEMENT

AI categories	Characterizes	Advantages	Limitations	Application in resource management
Supervised learning(NN, SVM)	extract features from labeled data	simple and easy to deploy	sensitive to the quality of data	classification; prediction of performances
Unsupervised learning(K-Means, PCA)	learned from unlabeled data	simple and easy to deploy	sensitive to the quality of data	clustering; reducing dimensions
Reinforcement learning(Q-Learning, MDP)	learned policy from own experiences	no need of priori knowledge of data	complexity increasing with the dimension of state and action space; low convergence rate	automatic control and decision making
Deep learning(DNN)	learning from raw data	better learning performance	ininterpretable; long training time	prediction
Deep reinforcement learning(DQN)	learning policy from experiences	better performance and quick convergence	continuous state and action space; ininterpretable	automatic control and decision making; resource allocation policy

METHODOLOGY

- **Aim** : To solve the joint resource allocation problem and to improve the efficiency and performance of the network.
- To achieve the objective **DEEP Q-NETWORK (DQN) Algorithm** is used.
- DQN is a type of reinforcement learning that differs from traditional tabular RL algorithms.
- DQN requires a data set to train neural networks.
- DQN's data set comes from the interaction between the agent and the environment.
- A portion of the data generated from each interaction is stored and used to train the neural network.
- However, The order of data is Interrelated.
- In order to train neural networks, interconnections need to be removed.
- Thus, the Experience Replay mechanism is introduced.

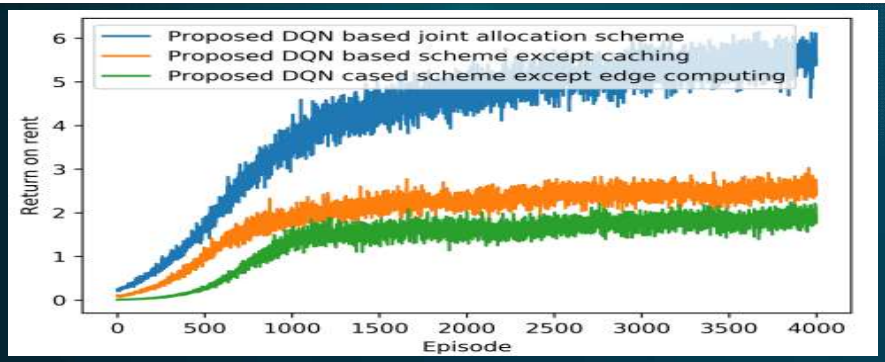
METHODOLOGY

DEEP Q-NETWORK BASED JOINT RESOURCE ALLOCATION ALGORITHM

1: Initialization:
Initialize evaluated Q-networks and target Q-networks with parameters w and w'.
2: **for** $t = 1 : T$ **do**
3: Orchestrator receives the task request $T_u^{v_i}(t)$.
4: Orchestrator senses the current environment state $S(t)$.
5: **while** $S(t)! = S_{terminal}$ **do**
6: Orchestrator selects action $a(t)$ according to $T_u^{v_i}(t)$ and $S(t)$
7: Orchestrator obtains reward $R(t)$ and next state $S(t+1)$.
8: Orchestrator stores $(S(t), a(t), R(t), S(t+1))$ in the experience replay memory.
9: Randomly sample some pieces of experiences from the experience replay memory.
10: Estimate target Q-value $Q_{target}(k)$ based on target Q-networks:
if $S(k+1) == S_{terminal}$
$Q_{target}(k) = R(k)$,
else
$Q_{target}(k) = R(k) + \gamma_q \max_{a'} Q(S(k+1), a', w')$.
11: Train evaluated Q-networks to minimize $L(w)$.
12: Every some steps, update target Q-networks.
13: $S(t) \leftarrow S(t+1)$
14: **end while**
15: **end for**

RESULTS AND ANALYSIS

- The DQN-based integrated resource allocation algorithm aims to optimize resource allocation decisions based on task attributes and resource status.
- Here, analyze the DQN based integrated resource management algorithm in two steps.
    1. The cohesiveness performance is analyzed.
    2. Analyze the performance of the algorithm to improve system reward.
- At the beginning of the simulation, we start with the State Transition Probability Metrics to show the computing, caching, and communication status.
- Here, compare the performance of four simulation schemes.
    - DQN based joint allocation scheme.
    - DQN based scheme except edge computing.
    - DQN based scheme except caching.
    - Static allocation scheme.



Shows the return on rent varies with the training episodes

To know if the algorithm works well under different task attributes.

- Dynamically change the number of CPU cycles required to see the performance changes under different schemes.
- As CPU cycles increase, the ROR under different schemes decreases.
- Furthermore, the computing server takes longer to execute the task of the required CPU cycles and the computing rate is reduced.
- Thus, the system receives lower fees from users and pays more for computing, which reduces the total rental revenue.
- The system can achieve greater benefits in handling tasks with smaller computing requirements.
- It is clear that the DQN-based joint allocation scheme achieves the highest ROR.

CONCLUSION

- By studying the environmental status and task attributes through algorithms, the Al-Algorithm-based orchestrator is able to allocate resources to different situations.
- An AI-Assisted Intelligent Wireless Network Architecture based on 5G was introduced.
- The DQN algorithm is used to solve the complex and highly complex resource allocation problem.
- The simulation results show that the newly introduced resource allocation scheme has good convergence characteristics.

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THANK YOU