



-----Mandatory Information to  
fill-----

Group ID: 302

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-----Write your remarks (if any) that you want should  
get consider at the time of evaluation-----

Remarks: ##Add here

## Scenario

A pharmaceutical company is conducting clinical trials to evaluate the effectiveness of three antiretroviral drug combinations for treating HIV-positive patients. Due to the ethical and cost constraints of clinical trials, it is critical to identify the most effective treatment regimen using the least number of patients. Each treatment (or “arm”) can lead to different outcomes depending on patient responses. The effectiveness of each treatment is evaluated using a reward function derived from the improvement in patients’ immune system markers and survival status.

## Problem Definition

You are provided with a clinical dataset where each record corresponds to a patient, including the treatment they received and the resulting health outcomes. Your task is to simulate a clinical trial environment using various MAB strategies to sequentially recommend treatments and observe outcomes. The objective is to maximize the overall success rate across trials by identifying and favouring the most effective treatment.

# Dataset

You will be provided a dataset containing the following fields:

- **Age (age)**: Patient's age in years at baseline.
- **Weight (wtkg)**: Continuous feature representing weight in kilograms at baseline.
- **Gender (gender)**: Binary indicator of gender (0 = Female, 1 = Male).
- **CD4 Counts (cd40, cd420)**: Integer values representing CD4 counts at baseline and 20+/-5 weeks.
- **Treatment Indicator (trt)**: Categorical feature indicating the type of treatment received (0 = ZDV only, 1 = ZDV + ddl, 2 = ZDV + Zai, 3 = ddl only).
- **Censoring Indicator (label)**: Binary indicator (1 = failure, 0 = censoring) denoting patient status.

**Link for accessing dataset:** [https://drive.google.com/file/d/1LYflrJ4VEEGeyOsSt\\_qoLk7FaAv5Jfx-/view?usp=sharing](https://drive.google.com/file/d/1LYflrJ4VEEGeyOsSt_qoLk7FaAv5Jfx-/view?usp=sharing)

## Environment Setup

**Arms (Actions):** The treatment types (trt)

- Arm 0: ZDV only
- Arm 1: ZDV + ddl
- Arm 2: ZDV + Zai
- Arm 3: ddl only

**Reward Function:**

Reward `r` is defined as:

```
r = 1, if (label == 0) and (cd420 > cd40)
```

```
r = 0, otherwise
```

This reward represents a successful treatment outcome as an increase in CD4 count and survival.

**Assumptions:**

*Number of Iterations:* Run the simulation for at least 1000 trials (iterations), with

the option to extend the number of trials depending on the convergence behavior or observed reward trends. In each iteration, simulate one patient trial using one of the bandit policies.

## Requirements and Deliverables:

Implement the Multi-Arm Bandit Problem for the given above scenario for all the below mentioned policy methods.

### Initialize constants

```
In [18]: # Constants
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import random
import math
```

## Load Dataset (0.5M)

```
In [19]: # Code for Dataset loading and print dataset statistics
#-----write your code below this line-----

# Load dataset into a DataFrame
# This dataset includes patient characteristics and treatment outcomes
df = pd.read_csv("Clinical_Trial.csv")
df.head() # Display the first few rows to verify the data
```

```
Out[19]:
```

	age	wtkg	gender	cd40	cd420	trt	label
0	48	89.8128	0	422	477	2	0
1	61	49.4424	0	162	218	3	1
2	45	88.4520	1	326	274	3	0
3	47	85.2768	1	287	394	3	0
4	43	66.6792	1	504	353	0	0

## Design a Clinical Trial Environment (0.5M)

```
In [20]: # Code for environment setup along with reward function
#-----write your code below this line-----
```

```

# Define the ClinicalTrialEnvironment class which will act as our simulation e
class ClinicalTrialEnvironment:
    def __init__(self, data):
        """
        Initialize the environment with the dataset.
        Also, compute the binary reward as per the given reward function.
        """
        self.data = data.copy()
        self.data['reward'] = np.where((self.data['label'] == 0) & (self.data[

    def sample(self, arm):
        """
        Randomly sample a patient from the dataset for the specified treatment
        and return the corresponding reward.
        """
        sample = self.data[self.data['trt'] == arm].sample(1)
        reward = int(sample['reward'].values[0])
        return reward

    def get_data(self):
        """Returns the internal dataframe with rewards included."""
        return self.data

# Create an instance of the environment
env = ClinicalTrialEnvironment(df)

```

## Using Random Policy (0.5M)

Implement a random policy for treatment selection and print each 100th iteration.  
(Mandatory)

```

In [21]: # run the environment with an agent that is guided by a random policy
#-----write your code below this line-----

n_iterations = 1000 # Total number of simulations
random_rewards = [] # To store rewards obtained in each iteration
random_selections = [] # To store selected treatment arms

# Simulate trials using random arm selection
for i in range(n_iterations):
    arm = random.choice([0, 1, 2, 3]) # Randomly pick a treatment
    reward = env.sample(arm) # Get reward for this treatment
    random_rewards.append(reward)
    random_selections.append(arm)
    print(f"Iteration {i+1}: Treatment {arm}, Reward: {reward}")

# Compute cumulative reward over iterations
random_cumulative = np.cumsum(random_rewards)

```

Iteration 1: Treatment 0, Reward: 0  
Iteration 2: Treatment 2, Reward: 0  
Iteration 3: Treatment 3, Reward: 1  
Iteration 4: Treatment 3, Reward: 1  
Iteration 5: Treatment 2, Reward: 0  
Iteration 6: Treatment 2, Reward: 0  
Iteration 7: Treatment 1, Reward: 1  
Iteration 8: Treatment 2, Reward: 1  
Iteration 9: Treatment 1, Reward: 1  
Iteration 10: Treatment 0, Reward: 0  
Iteration 11: Treatment 1, Reward: 1  
Iteration 12: Treatment 2, Reward: 0  
Iteration 13: Treatment 2, Reward: 0  
Iteration 14: Treatment 2, Reward: 1  
Iteration 15: Treatment 3, Reward: 1  
Iteration 16: Treatment 0, Reward: 0  
Iteration 17: Treatment 0, Reward: 0  
Iteration 18: Treatment 2, Reward: 0  
Iteration 19: Treatment 0, Reward: 0  
Iteration 20: Treatment 0, Reward: 1  
Iteration 21: Treatment 2, Reward: 0  
Iteration 22: Treatment 3, Reward: 0  
Iteration 23: Treatment 3, Reward: 0  
Iteration 24: Treatment 3, Reward: 0  
Iteration 25: Treatment 1, Reward: 1  
Iteration 26: Treatment 1, Reward: 0  
Iteration 27: Treatment 0, Reward: 0  
Iteration 28: Treatment 3, Reward: 0  
Iteration 29: Treatment 1, Reward: 0  
Iteration 30: Treatment 1, Reward: 1  
Iteration 31: Treatment 0, Reward: 1  
Iteration 32: Treatment 3, Reward: 0  
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Iteration 467: Treatment 2, Reward: 0  
Iteration 468: Treatment 3, Reward: 1  
Iteration 469: Treatment 0, Reward: 0  
Iteration 470: Treatment 0, Reward: 0  
Iteration 471: Treatment 3, Reward: 0  
Iteration 472: Treatment 0, Reward: 1  
Iteration 473: Treatment 2, Reward: 0  
Iteration 474: Treatment 2, Reward: 1  
Iteration 475: Treatment 1, Reward: 0  
Iteration 476: Treatment 0, Reward: 0  
Iteration 477: Treatment 2, Reward: 0  
Iteration 478: Treatment 2, Reward: 1  
Iteration 479: Treatment 1, Reward: 1  
Iteration 480: Treatment 0, Reward: 0  
Iteration 481: Treatment 1, Reward: 1  
Iteration 482: Treatment 2, Reward: 0  
Iteration 483: Treatment 2, Reward: 1  
Iteration 484: Treatment 1, Reward: 1  
Iteration 485: Treatment 2, Reward: 1  
Iteration 486: Treatment 3, Reward: 0

Iteration 487: Treatment 3, Reward: 1  
Iteration 488: Treatment 0, Reward: 0  
Iteration 489: Treatment 2, Reward: 1  
Iteration 490: Treatment 0, Reward: 0  
Iteration 491: Treatment 0, Reward: 1  
Iteration 492: Treatment 3, Reward: 0  
Iteration 493: Treatment 2, Reward: 0  
Iteration 494: Treatment 2, Reward: 1  
Iteration 495: Treatment 0, Reward: 0  
Iteration 496: Treatment 2, Reward: 0  
Iteration 497: Treatment 2, Reward: 0  
Iteration 498: Treatment 3, Reward: 1  
Iteration 499: Treatment 0, Reward: 1  
Iteration 500: Treatment 2, Reward: 0  
Iteration 501: Treatment 1, Reward: 0  
Iteration 502: Treatment 1, Reward: 1  
Iteration 503: Treatment 1, Reward: 0  
Iteration 504: Treatment 0, Reward: 0  
Iteration 505: Treatment 2, Reward: 0  
Iteration 506: Treatment 3, Reward: 1  
Iteration 507: Treatment 3, Reward: 1  
Iteration 508: Treatment 0, Reward: 0  
Iteration 509: Treatment 2, Reward: 1  
Iteration 510: Treatment 1, Reward: 1  
Iteration 511: Treatment 0, Reward: 0  
Iteration 512: Treatment 2, Reward: 1  
Iteration 513: Treatment 2, Reward: 1  
Iteration 514: Treatment 1, Reward: 0  
Iteration 515: Treatment 1, Reward: 0  
Iteration 516: Treatment 2, Reward: 0  
Iteration 517: Treatment 1, Reward: 0  
Iteration 518: Treatment 3, Reward: 1  
Iteration 519: Treatment 2, Reward: 1  
Iteration 520: Treatment 3, Reward: 0  
Iteration 521: Treatment 0, Reward: 0  
Iteration 522: Treatment 2, Reward: 1  
Iteration 523: Treatment 2, Reward: 1  
Iteration 524: Treatment 0, Reward: 0  
Iteration 525: Treatment 1, Reward: 1  
Iteration 526: Treatment 3, Reward: 0  
Iteration 527: Treatment 3, Reward: 0  
Iteration 528: Treatment 1, Reward: 0  
Iteration 529: Treatment 2, Reward: 1  
Iteration 530: Treatment 2, Reward: 0  
Iteration 531: Treatment 1, Reward: 1  
Iteration 532: Treatment 3, Reward: 1  
Iteration 533: Treatment 3, Reward: 1  
Iteration 534: Treatment 1, Reward: 1  
Iteration 535: Treatment 3, Reward: 0  
Iteration 536: Treatment 0, Reward: 0  
Iteration 537: Treatment 1, Reward: 1  
Iteration 538: Treatment 3, Reward: 1  
Iteration 539: Treatment 0, Reward: 0  
Iteration 540: Treatment 2, Reward: 0

Iteration 541: Treatment 2, Reward: 0  
Iteration 542: Treatment 1, Reward: 1  
Iteration 543: Treatment 0, Reward: 1  
Iteration 544: Treatment 0, Reward: 1  
Iteration 545: Treatment 3, Reward: 0  
Iteration 546: Treatment 0, Reward: 0  
Iteration 547: Treatment 1, Reward: 0  
Iteration 548: Treatment 3, Reward: 0  
Iteration 549: Treatment 2, Reward: 0  
Iteration 550: Treatment 0, Reward: 1  
Iteration 551: Treatment 3, Reward: 0  
Iteration 552: Treatment 2, Reward: 1  
Iteration 553: Treatment 2, Reward: 1  
Iteration 554: Treatment 3, Reward: 0  
Iteration 555: Treatment 2, Reward: 1  
Iteration 556: Treatment 2, Reward: 1  
Iteration 557: Treatment 1, Reward: 0  
Iteration 558: Treatment 1, Reward: 0  
Iteration 559: Treatment 0, Reward: 1  
Iteration 560: Treatment 0, Reward: 0  
Iteration 561: Treatment 0, Reward: 0  
Iteration 562: Treatment 1, Reward: 1  
Iteration 563: Treatment 2, Reward: 0  
Iteration 564: Treatment 3, Reward: 1  
Iteration 565: Treatment 1, Reward: 0  
Iteration 566: Treatment 0, Reward: 0  
Iteration 567: Treatment 1, Reward: 1  
Iteration 568: Treatment 0, Reward: 1  
Iteration 569: Treatment 3, Reward: 1  
Iteration 570: Treatment 0, Reward: 0  
Iteration 571: Treatment 0, Reward: 0  
Iteration 572: Treatment 3, Reward: 0  
Iteration 573: Treatment 2, Reward: 1  
Iteration 574: Treatment 2, Reward: 1  
Iteration 575: Treatment 1, Reward: 0  
Iteration 576: Treatment 1, Reward: 1  
Iteration 577: Treatment 0, Reward: 1  
Iteration 578: Treatment 2, Reward: 1  
Iteration 579: Treatment 1, Reward: 0  
Iteration 580: Treatment 2, Reward: 1  
Iteration 581: Treatment 0, Reward: 0  
Iteration 582: Treatment 0, Reward: 0  
Iteration 583: Treatment 1, Reward: 1  
Iteration 584: Treatment 1, Reward: 0  
Iteration 585: Treatment 1, Reward: 1  
Iteration 586: Treatment 2, Reward: 1  
Iteration 587: Treatment 3, Reward: 0  
Iteration 588: Treatment 1, Reward: 0  
Iteration 589: Treatment 1, Reward: 1  
Iteration 590: Treatment 2, Reward: 1  
Iteration 591: Treatment 2, Reward: 0  
Iteration 592: Treatment 2, Reward: 0  
Iteration 593: Treatment 2, Reward: 1  
Iteration 594: Treatment 2, Reward: 1

Iteration 595: Treatment 2, Reward: 1  
Iteration 596: Treatment 0, Reward: 1  
Iteration 597: Treatment 2, Reward: 1  
Iteration 598: Treatment 2, Reward: 0  
Iteration 599: Treatment 3, Reward: 0  
Iteration 600: Treatment 0, Reward: 0  
Iteration 601: Treatment 3, Reward: 1  
Iteration 602: Treatment 3, Reward: 1  
Iteration 603: Treatment 2, Reward: 1  
Iteration 604: Treatment 0, Reward: 0  
Iteration 605: Treatment 1, Reward: 1  
Iteration 606: Treatment 0, Reward: 0  
Iteration 607: Treatment 1, Reward: 1  
Iteration 608: Treatment 3, Reward: 1  
Iteration 609: Treatment 0, Reward: 0  
Iteration 610: Treatment 3, Reward: 0  
Iteration 611: Treatment 0, Reward: 0  
Iteration 612: Treatment 3, Reward: 1  
Iteration 613: Treatment 0, Reward: 1  
Iteration 614: Treatment 2, Reward: 0  
Iteration 615: Treatment 2, Reward: 0  
Iteration 616: Treatment 3, Reward: 1  
Iteration 617: Treatment 2, Reward: 1  
Iteration 618: Treatment 1, Reward: 0  
Iteration 619: Treatment 3, Reward: 0  
Iteration 620: Treatment 2, Reward: 0  
Iteration 621: Treatment 0, Reward: 0  
Iteration 622: Treatment 0, Reward: 1  
Iteration 623: Treatment 1, Reward: 1  
Iteration 624: Treatment 1, Reward: 1  
Iteration 625: Treatment 1, Reward: 1  
Iteration 626: Treatment 3, Reward: 1  
Iteration 627: Treatment 3, Reward: 1  
Iteration 628: Treatment 2, Reward: 1  
Iteration 629: Treatment 3, Reward: 1  
Iteration 630: Treatment 2, Reward: 1  
Iteration 631: Treatment 1, Reward: 0  
Iteration 632: Treatment 3, Reward: 0  
Iteration 633: Treatment 1, Reward: 1  
Iteration 634: Treatment 1, Reward: 1  
Iteration 635: Treatment 0, Reward: 0  
Iteration 636: Treatment 2, Reward: 1  
Iteration 637: Treatment 2, Reward: 0  
Iteration 638: Treatment 1, Reward: 1  
Iteration 639: Treatment 1, Reward: 1  
Iteration 640: Treatment 1, Reward: 1  
Iteration 641: Treatment 3, Reward: 0  
Iteration 642: Treatment 3, Reward: 1  
Iteration 643: Treatment 2, Reward: 0  
Iteration 644: Treatment 2, Reward: 1  
Iteration 645: Treatment 3, Reward: 1  
Iteration 646: Treatment 0, Reward: 1  
Iteration 647: Treatment 2, Reward: 1  
Iteration 648: Treatment 1, Reward: 0



Iteration 649: Treatment 3, Reward: 1  
Iteration 650: Treatment 2, Reward: 1  
Iteration 651: Treatment 1, Reward: 0  
Iteration 652: Treatment 2, Reward: 0  
Iteration 653: Treatment 1, Reward: 0  
Iteration 654: Treatment 1, Reward: 0  
Iteration 655: Treatment 2, Reward: 1  
Iteration 656: Treatment 3, Reward: 0  
Iteration 657: Treatment 2, Reward: 0  
Iteration 658: Treatment 3, Reward: 1  
Iteration 659: Treatment 2, Reward: 0  
Iteration 660: Treatment 2, Reward: 0  
Iteration 661: Treatment 3, Reward: 1  
Iteration 662: Treatment 3, Reward: 0  
Iteration 663: Treatment 3, Reward: 1  
Iteration 664: Treatment 0, Reward: 0  
Iteration 665: Treatment 0, Reward: 0  
Iteration 666: Treatment 2, Reward: 0  
Iteration 667: Treatment 0, Reward: 0  
Iteration 668: Treatment 0, Reward: 0  
Iteration 669: Treatment 2, Reward: 0  
Iteration 670: Treatment 2, Reward: 0  
Iteration 671: Treatment 0, Reward: 1  
Iteration 672: Treatment 2, Reward: 1  
Iteration 673: Treatment 1, Reward: 1  
Iteration 674: Treatment 0, Reward: 1  
Iteration 675: Treatment 3, Reward: 1  
Iteration 676: Treatment 0, Reward: 0  
Iteration 677: Treatment 2, Reward: 1  
Iteration 678: Treatment 0, Reward: 0  
Iteration 679: Treatment 3, Reward: 1  
Iteration 680: Treatment 2, Reward: 1  
Iteration 681: Treatment 0, Reward: 0  
Iteration 682: Treatment 1, Reward: 0  
Iteration 683: Treatment 2, Reward: 1  
Iteration 684: Treatment 0, Reward: 1  
Iteration 685: Treatment 2, Reward: 1  
Iteration 686: Treatment 2, Reward: 1  
Iteration 687: Treatment 1, Reward: 1  
Iteration 688: Treatment 3, Reward: 0  
Iteration 689: Treatment 2, Reward: 1  
Iteration 690: Treatment 1, Reward: 0  
Iteration 691: Treatment 0, Reward: 1  
Iteration 692: Treatment 0, Reward: 0  
Iteration 693: Treatment 3, Reward: 1  
Iteration 694: Treatment 0, Reward: 0  
Iteration 695: Treatment 1, Reward: 0  
Iteration 696: Treatment 2, Reward: 0  
Iteration 697: Treatment 0, Reward: 0  
Iteration 698: Treatment 2, Reward: 1  
Iteration 699: Treatment 1, Reward: 1  
Iteration 700: Treatment 3, Reward: 1  
Iteration 701: Treatment 1, Reward: 0  
Iteration 702: Treatment 2, Reward: 1

Iteration 703: Treatment 3, Reward: 1  
Iteration 704: Treatment 1, Reward: 0  
Iteration 705: Treatment 0, Reward: 0  
Iteration 706: Treatment 3, Reward: 0  
Iteration 707: Treatment 2, Reward: 1  
Iteration 708: Treatment 3, Reward: 1  
Iteration 709: Treatment 3, Reward: 0  
Iteration 710: Treatment 3, Reward: 0  
Iteration 711: Treatment 3, Reward: 0  
Iteration 712: Treatment 3, Reward: 0  
Iteration 713: Treatment 1, Reward: 1  
Iteration 714: Treatment 0, Reward: 0  
Iteration 715: Treatment 2, Reward: 0  
Iteration 716: Treatment 3, Reward: 1  
Iteration 717: Treatment 2, Reward: 1  
Iteration 718: Treatment 2, Reward: 0  
Iteration 719: Treatment 2, Reward: 0  
Iteration 720: Treatment 1, Reward: 1  
Iteration 721: Treatment 3, Reward: 1  
Iteration 722: Treatment 3, Reward: 1  
Iteration 723: Treatment 1, Reward: 1  
Iteration 724: Treatment 3, Reward: 1  
Iteration 725: Treatment 0, Reward: 0  
Iteration 726: Treatment 3, Reward: 0  
Iteration 727: Treatment 0, Reward: 0  
Iteration 728: Treatment 3, Reward: 1  
Iteration 729: Treatment 2, Reward: 0  
Iteration 730: Treatment 0, Reward: 1  
Iteration 731: Treatment 1, Reward: 0  
Iteration 732: Treatment 0, Reward: 0  
Iteration 733: Treatment 1, Reward: 0  
Iteration 734: Treatment 2, Reward: 0  
Iteration 735: Treatment 3, Reward: 1  
Iteration 736: Treatment 0, Reward: 1  
Iteration 737: Treatment 1, Reward: 1  
Iteration 738: Treatment 1, Reward: 0  
Iteration 739: Treatment 2, Reward: 1  
Iteration 740: Treatment 3, Reward: 0  
Iteration 741: Treatment 2, Reward: 1  
Iteration 742: Treatment 0, Reward: 0  
Iteration 743: Treatment 0, Reward: 0  
Iteration 744: Treatment 2, Reward: 1  
Iteration 745: Treatment 0, Reward: 0  
Iteration 746: Treatment 2, Reward: 1  
Iteration 747: Treatment 3, Reward: 1  
Iteration 748: Treatment 1, Reward: 1  
Iteration 749: Treatment 2, Reward: 0  
Iteration 750: Treatment 0, Reward: 1  
Iteration 751: Treatment 3, Reward: 0  
Iteration 752: Treatment 0, Reward: 0  
Iteration 753: Treatment 0, Reward: 0  
Iteration 754: Treatment 0, Reward: 0  
Iteration 755: Treatment 3, Reward: 0  
Iteration 756: Treatment 1, Reward: 0

Iteration 757: Treatment 1, Reward: 0  
Iteration 758: Treatment 1, Reward: 1  
Iteration 759: Treatment 3, Reward: 0  
Iteration 760: Treatment 2, Reward: 0  
Iteration 761: Treatment 1, Reward: 1  
Iteration 762: Treatment 0, Reward: 0  
Iteration 763: Treatment 1, Reward: 1  
Iteration 764: Treatment 3, Reward: 0  
Iteration 765: Treatment 0, Reward: 1  
Iteration 766: Treatment 1, Reward: 0  
Iteration 767: Treatment 2, Reward: 0  
Iteration 768: Treatment 1, Reward: 0  
Iteration 769: Treatment 3, Reward: 0  
Iteration 770: Treatment 1, Reward: 1  
Iteration 771: Treatment 0, Reward: 0  
Iteration 772: Treatment 0, Reward: 0  
Iteration 773: Treatment 3, Reward: 1  
Iteration 774: Treatment 0, Reward: 0  
Iteration 775: Treatment 0, Reward: 0  
Iteration 776: Treatment 3, Reward: 0  
Iteration 777: Treatment 2, Reward: 1  
Iteration 778: Treatment 2, Reward: 1  
Iteration 779: Treatment 2, Reward: 1  
Iteration 780: Treatment 2, Reward: 0  
Iteration 781: Treatment 3, Reward: 0  
Iteration 782: Treatment 2, Reward: 1  
Iteration 783: Treatment 3, Reward: 1  
Iteration 784: Treatment 0, Reward: 0  
Iteration 785: Treatment 1, Reward: 0  
Iteration 786: Treatment 2, Reward: 0  
Iteration 787: Treatment 3, Reward: 1  
Iteration 788: Treatment 3, Reward: 0  
Iteration 789: Treatment 0, Reward: 0  
Iteration 790: Treatment 1, Reward: 1  
Iteration 791: Treatment 1, Reward: 1  
Iteration 792: Treatment 0, Reward: 0  
Iteration 793: Treatment 3, Reward: 1  
Iteration 794: Treatment 1, Reward: 1  
Iteration 795: Treatment 2, Reward: 1  
Iteration 796: Treatment 1, Reward: 1  
Iteration 797: Treatment 1, Reward: 1  
Iteration 798: Treatment 1, Reward: 1  
Iteration 799: Treatment 1, Reward: 1  
Iteration 800: Treatment 3, Reward: 1  
Iteration 801: Treatment 0, Reward: 0  
Iteration 802: Treatment 3, Reward: 1  
Iteration 803: Treatment 2, Reward: 1  
Iteration 804: Treatment 1, Reward: 1  
Iteration 805: Treatment 1, Reward: 1  
Iteration 806: Treatment 3, Reward: 1  
Iteration 807: Treatment 2, Reward: 1  
Iteration 808: Treatment 2, Reward: 1  
Iteration 809: Treatment 0, Reward: 0  
Iteration 810: Treatment 2, Reward: 0

Iteration 811: Treatment 0, Reward: 0  
Iteration 812: Treatment 3, Reward: 0  
Iteration 813: Treatment 0, Reward: 0  
Iteration 814: Treatment 3, Reward: 1  
Iteration 815: Treatment 3, Reward: 0  
Iteration 816: Treatment 1, Reward: 1  
Iteration 817: Treatment 1, Reward: 0  
Iteration 818: Treatment 1, Reward: 1  
Iteration 819: Treatment 1, Reward: 1  
Iteration 820: Treatment 2, Reward: 0  
Iteration 821: Treatment 3, Reward: 1  
Iteration 822: Treatment 1, Reward: 1  
Iteration 823: Treatment 3, Reward: 0  
Iteration 824: Treatment 1, Reward: 1  
Iteration 825: Treatment 0, Reward: 0  
Iteration 826: Treatment 3, Reward: 1  
Iteration 827: Treatment 3, Reward: 0  
Iteration 828: Treatment 3, Reward: 0  
Iteration 829: Treatment 3, Reward: 0  
Iteration 830: Treatment 0, Reward: 0  
Iteration 831: Treatment 1, Reward: 1  
Iteration 832: Treatment 3, Reward: 0  
Iteration 833: Treatment 0, Reward: 0  
Iteration 834: Treatment 1, Reward: 1  
Iteration 835: Treatment 2, Reward: 1  
Iteration 836: Treatment 3, Reward: 1  
Iteration 837: Treatment 3, Reward: 1  
Iteration 838: Treatment 3, Reward: 1  
Iteration 839: Treatment 1, Reward: 1  
Iteration 840: Treatment 0, Reward: 1  
Iteration 841: Treatment 1, Reward: 0  
Iteration 842: Treatment 0, Reward: 0  
Iteration 843: Treatment 0, Reward: 0  
Iteration 844: Treatment 1, Reward: 0  
Iteration 845: Treatment 1, Reward: 1  
Iteration 846: Treatment 3, Reward: 1  
Iteration 847: Treatment 0, Reward: 0  
Iteration 848: Treatment 2, Reward: 0  
Iteration 849: Treatment 1, Reward: 0  
Iteration 850: Treatment 2, Reward: 1  
Iteration 851: Treatment 2, Reward: 1  
Iteration 852: Treatment 2, Reward: 0  
Iteration 853: Treatment 3, Reward: 0  
Iteration 854: Treatment 3, Reward: 0  
Iteration 855: Treatment 1, Reward: 1  
Iteration 856: Treatment 2, Reward: 0  
Iteration 857: Treatment 2, Reward: 0  
Iteration 858: Treatment 2, Reward: 0  
Iteration 859: Treatment 2, Reward: 0  
Iteration 860: Treatment 3, Reward: 1  
Iteration 861: Treatment 1, Reward: 1  
Iteration 862: Treatment 1, Reward: 0  
Iteration 863: Treatment 2, Reward: 0  
Iteration 864: Treatment 2, Reward: 0

Iteration 865: Treatment 0, Reward: 0  
Iteration 866: Treatment 3, Reward: 1  
Iteration 867: Treatment 0, Reward: 0  
Iteration 868: Treatment 1, Reward: 1  
Iteration 869: Treatment 1, Reward: 1  
Iteration 870: Treatment 3, Reward: 1  
Iteration 871: Treatment 3, Reward: 1  
Iteration 872: Treatment 3, Reward: 0  
Iteration 873: Treatment 1, Reward: 1  
Iteration 874: Treatment 0, Reward: 1  
Iteration 875: Treatment 3, Reward: 0  
Iteration 876: Treatment 3, Reward: 1  
Iteration 877: Treatment 1, Reward: 0  
Iteration 878: Treatment 2, Reward: 1  
Iteration 879: Treatment 3, Reward: 1  
Iteration 880: Treatment 1, Reward: 0  
Iteration 881: Treatment 2, Reward: 1  
Iteration 882: Treatment 3, Reward: 0  
Iteration 883: Treatment 0, Reward: 0  
Iteration 884: Treatment 1, Reward: 1  
Iteration 885: Treatment 1, Reward: 1  
Iteration 886: Treatment 0, Reward: 0  
Iteration 887: Treatment 0, Reward: 0  
Iteration 888: Treatment 1, Reward: 1  
Iteration 889: Treatment 1, Reward: 1  
Iteration 890: Treatment 0, Reward: 0  
Iteration 891: Treatment 0, Reward: 0  
Iteration 892: Treatment 0, Reward: 0  
Iteration 893: Treatment 1, Reward: 0  
Iteration 894: Treatment 0, Reward: 0  
Iteration 895: Treatment 0, Reward: 1  
Iteration 896: Treatment 0, Reward: 0  
Iteration 897: Treatment 2, Reward: 1  
Iteration 898: Treatment 3, Reward: 1  
Iteration 899: Treatment 0, Reward: 0  
Iteration 900: Treatment 3, Reward: 0  
Iteration 901: Treatment 2, Reward: 0  
Iteration 902: Treatment 1, Reward: 1  
Iteration 903: Treatment 1, Reward: 1  
Iteration 904: Treatment 0, Reward: 1  
Iteration 905: Treatment 2, Reward: 0  
Iteration 906: Treatment 3, Reward: 0  
Iteration 907: Treatment 1, Reward: 1  
Iteration 908: Treatment 1, Reward: 1  
Iteration 909: Treatment 2, Reward: 1  
Iteration 910: Treatment 0, Reward: 1  
Iteration 911: Treatment 2, Reward: 0  
Iteration 912: Treatment 2, Reward: 0  
Iteration 913: Treatment 2, Reward: 1  
Iteration 914: Treatment 0, Reward: 0  
Iteration 915: Treatment 0, Reward: 0  
Iteration 916: Treatment 0, Reward: 0  
Iteration 917: Treatment 3, Reward: 0  
Iteration 918: Treatment 2, Reward: 1

Iteration 919: Treatment 0, Reward: 1  
Iteration 920: Treatment 0, Reward: 0  
Iteration 921: Treatment 3, Reward: 1  
Iteration 922: Treatment 3, Reward: 1  
Iteration 923: Treatment 1, Reward: 1  
Iteration 924: Treatment 2, Reward: 1  
Iteration 925: Treatment 2, Reward: 0  
Iteration 926: Treatment 3, Reward: 1  
Iteration 927: Treatment 3, Reward: 1  
Iteration 928: Treatment 2, Reward: 1  
Iteration 929: Treatment 3, Reward: 1  
Iteration 930: Treatment 2, Reward: 1  
Iteration 931: Treatment 0, Reward: 0  
Iteration 932: Treatment 0, Reward: 1  
Iteration 933: Treatment 1, Reward: 1  
Iteration 934: Treatment 1, Reward: 1  
Iteration 935: Treatment 1, Reward: 0  
Iteration 936: Treatment 1, Reward: 1  
Iteration 937: Treatment 2, Reward: 0  
Iteration 938: Treatment 3, Reward: 0  
Iteration 939: Treatment 1, Reward: 0  
Iteration 940: Treatment 3, Reward: 1  
Iteration 941: Treatment 2, Reward: 0  
Iteration 942: Treatment 2, Reward: 1  
Iteration 943: Treatment 3, Reward: 0  
Iteration 944: Treatment 1, Reward: 0  
Iteration 945: Treatment 2, Reward: 0  
Iteration 946: Treatment 1, Reward: 0  
Iteration 947: Treatment 2, Reward: 0  
Iteration 948: Treatment 3, Reward: 0  
Iteration 949: Treatment 0, Reward: 0  
Iteration 950: Treatment 2, Reward: 0  
Iteration 951: Treatment 0, Reward: 0  
Iteration 952: Treatment 0, Reward: 0  
Iteration 953: Treatment 1, Reward: 1  
Iteration 954: Treatment 0, Reward: 0  
Iteration 955: Treatment 0, Reward: 0  
Iteration 956: Treatment 1, Reward: 1  
Iteration 957: Treatment 0, Reward: 1  
Iteration 958: Treatment 1, Reward: 1  
Iteration 959: Treatment 0, Reward: 1  
Iteration 960: Treatment 2, Reward: 1  
Iteration 961: Treatment 0, Reward: 0  
Iteration 962: Treatment 3, Reward: 0  
Iteration 963: Treatment 2, Reward: 1  
Iteration 964: Treatment 0, Reward: 0  
Iteration 965: Treatment 3, Reward: 0  
Iteration 966: Treatment 1, Reward: 0  
Iteration 967: Treatment 2, Reward: 0  
Iteration 968: Treatment 3, Reward: 1  
Iteration 969: Treatment 2, Reward: 0  
Iteration 970: Treatment 0, Reward: 0  
Iteration 971: Treatment 1, Reward: 0  
Iteration 972: Treatment 1, Reward: 1

```

Iteration 973: Treatment 1, Reward: 0
Iteration 974: Treatment 3, Reward: 1
Iteration 975: Treatment 0, Reward: 0
Iteration 976: Treatment 1, Reward: 1
Iteration 977: Treatment 0, Reward: 0
Iteration 978: Treatment 3, Reward: 0
Iteration 979: Treatment 2, Reward: 0
Iteration 980: Treatment 1, Reward: 1
Iteration 981: Treatment 2, Reward: 1
Iteration 982: Treatment 3, Reward: 0
Iteration 983: Treatment 3, Reward: 0
Iteration 984: Treatment 2, Reward: 0
Iteration 985: Treatment 2, Reward: 0
Iteration 986: Treatment 1, Reward: 0
Iteration 987: Treatment 2, Reward: 1
Iteration 988: Treatment 0, Reward: 0
Iteration 989: Treatment 3, Reward: 0
Iteration 990: Treatment 2, Reward: 0
Iteration 991: Treatment 0, Reward: 1
Iteration 992: Treatment 2, Reward: 0
Iteration 993: Treatment 0, Reward: 0
Iteration 994: Treatment 1, Reward: 1
Iteration 995: Treatment 0, Reward: 0
Iteration 996: Treatment 3, Reward: 1
Iteration 997: Treatment 1, Reward: 0
Iteration 998: Treatment 2, Reward: 0
Iteration 999: Treatment 2, Reward: 0
Iteration 1000: Treatment 1, Reward: 1

```

## Using Greedy Policy (1M)

Implement the Greedy policy that always selects the treatment with the highest average reward and print each 100th iteration. (Mandatory)

```

In [22]: # run the environment with an agent that is guided by a greedy policy
#-----write your code below this line-----

greedy_rewards = []
greedy_selections = []
reward_sums = [0] * 4 # Total reward per arm
counts = [0] * 4 # Number of times each arm is selected

# Simulate trials using greedy policy
for i in range(n_iterations):
    avg_rewards = [reward_sums[a] / counts[a] if counts[a] > 0 else 0 for a in range(4)]
    arm = np.argmax(avg_rewards) # Select arm with max avg reward
    reward = env.sample(arm)
    greedy_rewards.append(reward)
    greedy_selections.append(arm)
    reward_sums[arm] += reward
    counts[arm] += 1

```

```
    print(f"Iteration {i+1}: Treatment {arm}, Reward: {reward}")  
  
# Compute cumulative rewards  
greedy_cumulative = np.cumsum(greedy_rewards)
```



Iteration 1: Treatment 0, Reward: 0  
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Iteration 585: Treatment 0, Reward: 0  
Iteration 586: Treatment 0, Reward: 1  
Iteration 587: Treatment 0, Reward: 0  
Iteration 588: Treatment 0, Reward: 0  
Iteration 589: Treatment 0, Reward: 1  
Iteration 590: Treatment 0, Reward: 1  
Iteration 591: Treatment 0, Reward: 1  
Iteration 592: Treatment 0, Reward: 0  
Iteration 593: Treatment 0, Reward: 0  
Iteration 594: Treatment 0, Reward: 0

Iteration 595: Treatment 0, Reward: 0  
Iteration 596: Treatment 0, Reward: 1  
Iteration 597: Treatment 0, Reward: 1  
Iteration 598: Treatment 0, Reward: 1  
Iteration 599: Treatment 0, Reward: 0  
Iteration 600: Treatment 0, Reward: 1  
Iteration 601: Treatment 0, Reward: 0  
Iteration 602: Treatment 0, Reward: 1  
Iteration 603: Treatment 0, Reward: 0  
Iteration 604: Treatment 0, Reward: 1  
Iteration 605: Treatment 0, Reward: 1  
Iteration 606: Treatment 0, Reward: 1  
Iteration 607: Treatment 0, Reward: 0  
Iteration 608: Treatment 0, Reward: 1  
Iteration 609: Treatment 0, Reward: 0  
Iteration 610: Treatment 0, Reward: 1  
Iteration 611: Treatment 0, Reward: 1  
Iteration 612: Treatment 0, Reward: 0  
Iteration 613: Treatment 0, Reward: 0  
Iteration 614: Treatment 0, Reward: 1  
Iteration 615: Treatment 0, Reward: 0  
Iteration 616: Treatment 0, Reward: 0  
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Iteration 618: Treatment 0, Reward: 0  
Iteration 619: Treatment 0, Reward: 0  
Iteration 620: Treatment 0, Reward: 0  
Iteration 621: Treatment 0, Reward: 0  
Iteration 622: Treatment 0, Reward: 0  
Iteration 623: Treatment 0, Reward: 0  
Iteration 624: Treatment 0, Reward: 1  
Iteration 625: Treatment 0, Reward: 1  
Iteration 626: Treatment 0, Reward: 1  
Iteration 627: Treatment 0, Reward: 1  
Iteration 628: Treatment 0, Reward: 1  
Iteration 629: Treatment 0, Reward: 0  
Iteration 630: Treatment 0, Reward: 0  
Iteration 631: Treatment 0, Reward: 0  
Iteration 632: Treatment 0, Reward: 0  
Iteration 633: Treatment 0, Reward: 1  
Iteration 634: Treatment 0, Reward: 0  
Iteration 635: Treatment 0, Reward: 0  
Iteration 636: Treatment 0, Reward: 0  
Iteration 637: Treatment 0, Reward: 0  
Iteration 638: Treatment 0, Reward: 1  
Iteration 639: Treatment 0, Reward: 0  
Iteration 640: Treatment 0, Reward: 0  
Iteration 641: Treatment 0, Reward: 0  
Iteration 642: Treatment 0, Reward: 0  
Iteration 643: Treatment 0, Reward: 0  
Iteration 644: Treatment 0, Reward: 0  
Iteration 645: Treatment 0, Reward: 1  
Iteration 646: Treatment 0, Reward: 0  
Iteration 647: Treatment 0, Reward: 1  
Iteration 648: Treatment 0, Reward: 0

Iteration 649: Treatment 0, Reward: 0  
Iteration 650: Treatment 0, Reward: 0  
Iteration 651: Treatment 0, Reward: 0  
Iteration 652: Treatment 0, Reward: 1  
Iteration 653: Treatment 0, Reward: 0  
Iteration 654: Treatment 0, Reward: 1  
Iteration 655: Treatment 0, Reward: 0  
Iteration 656: Treatment 0, Reward: 0  
Iteration 657: Treatment 0, Reward: 0  
Iteration 658: Treatment 0, Reward: 0  
Iteration 659: Treatment 0, Reward: 1  
Iteration 660: Treatment 0, Reward: 1  
Iteration 661: Treatment 0, Reward: 1  
Iteration 662: Treatment 0, Reward: 0  
Iteration 663: Treatment 0, Reward: 0  
Iteration 664: Treatment 0, Reward: 0  
Iteration 665: Treatment 0, Reward: 0  
Iteration 666: Treatment 0, Reward: 1  
Iteration 667: Treatment 0, Reward: 0  
Iteration 668: Treatment 0, Reward: 0  
Iteration 669: Treatment 0, Reward: 0  
Iteration 670: Treatment 0, Reward: 0  
Iteration 671: Treatment 0, Reward: 1  
Iteration 672: Treatment 0, Reward: 0  
Iteration 673: Treatment 0, Reward: 0  
Iteration 674: Treatment 0, Reward: 1  
Iteration 675: Treatment 0, Reward: 0  
Iteration 676: Treatment 0, Reward: 0  
Iteration 677: Treatment 0, Reward: 0  
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Iteration 679: Treatment 0, Reward: 0  
Iteration 680: Treatment 0, Reward: 0  
Iteration 681: Treatment 0, Reward: 0  
Iteration 682: Treatment 0, Reward: 0  
Iteration 683: Treatment 0, Reward: 0  
Iteration 684: Treatment 0, Reward: 0  
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Iteration 687: Treatment 0, Reward: 0  
Iteration 688: Treatment 0, Reward: 0  
Iteration 689: Treatment 0, Reward: 1  
Iteration 690: Treatment 0, Reward: 0  
Iteration 691: Treatment 0, Reward: 0  
Iteration 692: Treatment 0, Reward: 0  
Iteration 693: Treatment 0, Reward: 1  
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Iteration 695: Treatment 0, Reward: 0  
Iteration 696: Treatment 0, Reward: 0  
Iteration 697: Treatment 0, Reward: 1  
Iteration 698: Treatment 0, Reward: 0  
Iteration 699: Treatment 0, Reward: 0  
Iteration 700: Treatment 0, Reward: 0  
Iteration 701: Treatment 0, Reward: 1  
Iteration 702: Treatment 0, Reward: 0

Iteration 703: Treatment 0, Reward: 0  
Iteration 704: Treatment 0, Reward: 0  
Iteration 705: Treatment 0, Reward: 1  
Iteration 706: Treatment 0, Reward: 0  
Iteration 707: Treatment 0, Reward: 1  
Iteration 708: Treatment 0, Reward: 0  
Iteration 709: Treatment 0, Reward: 1  
Iteration 710: Treatment 0, Reward: 0  
Iteration 711: Treatment 0, Reward: 0  
Iteration 712: Treatment 0, Reward: 0  
Iteration 713: Treatment 0, Reward: 0  
Iteration 714: Treatment 0, Reward: 1  
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Iteration 716: Treatment 0, Reward: 1  
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Iteration 719: Treatment 0, Reward: 1  
Iteration 720: Treatment 0, Reward: 0  
Iteration 721: Treatment 0, Reward: 0  
Iteration 722: Treatment 0, Reward: 1  
Iteration 723: Treatment 0, Reward: 0  
Iteration 724: Treatment 0, Reward: 0  
Iteration 725: Treatment 0, Reward: 0  
Iteration 726: Treatment 0, Reward: 0  
Iteration 727: Treatment 0, Reward: 0  
Iteration 728: Treatment 0, Reward: 0  
Iteration 729: Treatment 0, Reward: 0  
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Iteration 731: Treatment 0, Reward: 1  
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Iteration 735: Treatment 0, Reward: 0  
Iteration 736: Treatment 0, Reward: 0  
Iteration 737: Treatment 0, Reward: 0  
Iteration 738: Treatment 0, Reward: 0  
Iteration 739: Treatment 0, Reward: 0  
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Iteration 742: Treatment 0, Reward: 1  
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Iteration 747: Treatment 0, Reward: 0  
Iteration 748: Treatment 0, Reward: 0  
Iteration 749: Treatment 0, Reward: 0  
Iteration 750: Treatment 0, Reward: 0  
Iteration 751: Treatment 0, Reward: 1  
Iteration 752: Treatment 0, Reward: 0  
Iteration 753: Treatment 0, Reward: 0  
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Iteration 760: Treatment 0, Reward: 1  
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Iteration 762: Treatment 0, Reward: 0  
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Iteration 764: Treatment 0, Reward: 1  
Iteration 765: Treatment 0, Reward: 0  
Iteration 766: Treatment 0, Reward: 0  
Iteration 767: Treatment 0, Reward: 0  
Iteration 768: Treatment 0, Reward: 1  
Iteration 769: Treatment 0, Reward: 0  
Iteration 770: Treatment 0, Reward: 1  
Iteration 771: Treatment 0, Reward: 0  
Iteration 772: Treatment 0, Reward: 1  
Iteration 773: Treatment 0, Reward: 0  
Iteration 774: Treatment 0, Reward: 1  
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Iteration 776: Treatment 0, Reward: 0  
Iteration 777: Treatment 0, Reward: 0  
Iteration 778: Treatment 0, Reward: 0  
Iteration 779: Treatment 0, Reward: 1  
Iteration 780: Treatment 0, Reward: 1  
Iteration 781: Treatment 0, Reward: 1  
Iteration 782: Treatment 0, Reward: 1  
Iteration 783: Treatment 0, Reward: 0  
Iteration 784: Treatment 0, Reward: 0  
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Iteration 786: Treatment 0, Reward: 0  
Iteration 787: Treatment 0, Reward: 0  
Iteration 788: Treatment 0, Reward: 1  
Iteration 789: Treatment 0, Reward: 0  
Iteration 790: Treatment 0, Reward: 0  
Iteration 791: Treatment 0, Reward: 0  
Iteration 792: Treatment 0, Reward: 0  
Iteration 793: Treatment 0, Reward: 0  
Iteration 794: Treatment 0, Reward: 0  
Iteration 795: Treatment 0, Reward: 0  
Iteration 796: Treatment 0, Reward: 0  
Iteration 797: Treatment 0, Reward: 0  
Iteration 798: Treatment 0, Reward: 0  
Iteration 799: Treatment 0, Reward: 0  
Iteration 800: Treatment 0, Reward: 0  
Iteration 801: Treatment 0, Reward: 0  
Iteration 802: Treatment 0, Reward: 0  
Iteration 803: Treatment 0, Reward: 0  
Iteration 804: Treatment 0, Reward: 1  
Iteration 805: Treatment 0, Reward: 0  
Iteration 806: Treatment 0, Reward: 0  
Iteration 807: Treatment 0, Reward: 0  
Iteration 808: Treatment 0, Reward: 1  
Iteration 809: Treatment 0, Reward: 1  
Iteration 810: Treatment 0, Reward: 0

Iteration 811: Treatment 0, Reward: 0  
Iteration 812: Treatment 0, Reward: 0  
Iteration 813: Treatment 0, Reward: 1  
Iteration 814: Treatment 0, Reward: 0  
Iteration 815: Treatment 0, Reward: 0  
Iteration 816: Treatment 0, Reward: 0  
Iteration 817: Treatment 0, Reward: 1  
Iteration 818: Treatment 0, Reward: 0  
Iteration 819: Treatment 0, Reward: 0  
Iteration 820: Treatment 0, Reward: 1  
Iteration 821: Treatment 0, Reward: 0  
Iteration 822: Treatment 0, Reward: 0  
Iteration 823: Treatment 0, Reward: 1  
Iteration 824: Treatment 0, Reward: 0  
Iteration 825: Treatment 0, Reward: 0  
Iteration 826: Treatment 0, Reward: 0  
Iteration 827: Treatment 0, Reward: 0  
Iteration 828: Treatment 0, Reward: 0  
Iteration 829: Treatment 0, Reward: 0  
Iteration 830: Treatment 0, Reward: 0  
Iteration 831: Treatment 0, Reward: 0  
Iteration 832: Treatment 0, Reward: 1  
Iteration 833: Treatment 0, Reward: 0  
Iteration 834: Treatment 0, Reward: 0  
Iteration 835: Treatment 0, Reward: 0  
Iteration 836: Treatment 0, Reward: 0  
Iteration 837: Treatment 0, Reward: 1  
Iteration 838: Treatment 0, Reward: 1  
Iteration 839: Treatment 0, Reward: 0  
Iteration 840: Treatment 0, Reward: 1  
Iteration 841: Treatment 0, Reward: 0  
Iteration 842: Treatment 0, Reward: 1  
Iteration 843: Treatment 0, Reward: 0  
Iteration 844: Treatment 0, Reward: 1  
Iteration 845: Treatment 0, Reward: 1  
Iteration 846: Treatment 0, Reward: 0  
Iteration 847: Treatment 0, Reward: 0  
Iteration 848: Treatment 0, Reward: 0  
Iteration 849: Treatment 0, Reward: 0  
Iteration 850: Treatment 0, Reward: 1  
Iteration 851: Treatment 0, Reward: 1  
Iteration 852: Treatment 0, Reward: 0  
Iteration 853: Treatment 0, Reward: 0  
Iteration 854: Treatment 0, Reward: 1  
Iteration 855: Treatment 0, Reward: 0  
Iteration 856: Treatment 0, Reward: 0  
Iteration 857: Treatment 0, Reward: 1  
Iteration 858: Treatment 0, Reward: 0  
Iteration 859: Treatment 0, Reward: 0  
Iteration 860: Treatment 0, Reward: 0  
Iteration 861: Treatment 0, Reward: 0  
Iteration 862: Treatment 0, Reward: 1  
Iteration 863: Treatment 0, Reward: 0  
Iteration 864: Treatment 0, Reward: 0



Iteration 865: Treatment 0, Reward: 0  
Iteration 866: Treatment 0, Reward: 0  
Iteration 867: Treatment 0, Reward: 0  
Iteration 868: Treatment 0, Reward: 1  
Iteration 869: Treatment 0, Reward: 0  
Iteration 870: Treatment 0, Reward: 0  
Iteration 871: Treatment 0, Reward: 0  
Iteration 872: Treatment 0, Reward: 0  
Iteration 873: Treatment 0, Reward: 0  
Iteration 874: Treatment 0, Reward: 0  
Iteration 875: Treatment 0, Reward: 1  
Iteration 876: Treatment 0, Reward: 1  
Iteration 877: Treatment 0, Reward: 0  
Iteration 878: Treatment 0, Reward: 0  
Iteration 879: Treatment 0, Reward: 0  
Iteration 880: Treatment 0, Reward: 0  
Iteration 881: Treatment 0, Reward: 0  
Iteration 882: Treatment 0, Reward: 1  
Iteration 883: Treatment 0, Reward: 0  
Iteration 884: Treatment 0, Reward: 0  
Iteration 885: Treatment 0, Reward: 1  
Iteration 886: Treatment 0, Reward: 0  
Iteration 887: Treatment 0, Reward: 1  
Iteration 888: Treatment 0, Reward: 0  
Iteration 889: Treatment 0, Reward: 0  
Iteration 890: Treatment 0, Reward: 0  
Iteration 891: Treatment 0, Reward: 1  
Iteration 892: Treatment 0, Reward: 0  
Iteration 893: Treatment 0, Reward: 0  
Iteration 894: Treatment 0, Reward: 0  
Iteration 895: Treatment 0, Reward: 1  
Iteration 896: Treatment 0, Reward: 1  
Iteration 897: Treatment 0, Reward: 1  
Iteration 898: Treatment 0, Reward: 0  
Iteration 899: Treatment 0, Reward: 1  
Iteration 900: Treatment 0, Reward: 0  
Iteration 901: Treatment 0, Reward: 1  
Iteration 902: Treatment 0, Reward: 0  
Iteration 903: Treatment 0, Reward: 0  
Iteration 904: Treatment 0, Reward: 0  
Iteration 905: Treatment 0, Reward: 0  
Iteration 906: Treatment 0, Reward: 0  
Iteration 907: Treatment 0, Reward: 0  
Iteration 908: Treatment 0, Reward: 1  
Iteration 909: Treatment 0, Reward: 0  
Iteration 910: Treatment 0, Reward: 0  
Iteration 911: Treatment 0, Reward: 0  
Iteration 912: Treatment 0, Reward: 1  
Iteration 913: Treatment 0, Reward: 0  
Iteration 914: Treatment 0, Reward: 0  
Iteration 915: Treatment 0, Reward: 1  
Iteration 916: Treatment 0, Reward: 1  
Iteration 917: Treatment 0, Reward: 0  
Iteration 918: Treatment 0, Reward: 0

Iteration 919: Treatment 0, Reward: 1  
Iteration 920: Treatment 0, Reward: 0  
Iteration 921: Treatment 0, Reward: 1  
Iteration 922: Treatment 0, Reward: 1  
Iteration 923: Treatment 0, Reward: 0  
Iteration 924: Treatment 0, Reward: 0  
Iteration 925: Treatment 0, Reward: 0  
Iteration 926: Treatment 0, Reward: 0  
Iteration 927: Treatment 0, Reward: 1  
Iteration 928: Treatment 0, Reward: 0  
Iteration 929: Treatment 0, Reward: 0  
Iteration 930: Treatment 0, Reward: 1  
Iteration 931: Treatment 0, Reward: 0  
Iteration 932: Treatment 0, Reward: 0  
Iteration 933: Treatment 0, Reward: 1  
Iteration 934: Treatment 0, Reward: 0  
Iteration 935: Treatment 0, Reward: 0  
Iteration 936: Treatment 0, Reward: 0  
Iteration 937: Treatment 0, Reward: 0  
Iteration 938: Treatment 0, Reward: 1  
Iteration 939: Treatment 0, Reward: 0  
Iteration 940: Treatment 0, Reward: 0  
Iteration 941: Treatment 0, Reward: 0  
Iteration 942: Treatment 0, Reward: 1  
Iteration 943: Treatment 0, Reward: 0  
Iteration 944: Treatment 0, Reward: 1  
Iteration 945: Treatment 0, Reward: 1  
Iteration 946: Treatment 0, Reward: 0  
Iteration 947: Treatment 0, Reward: 1  
Iteration 948: Treatment 0, Reward: 0  
Iteration 949: Treatment 0, Reward: 0  
Iteration 950: Treatment 0, Reward: 0  
Iteration 951: Treatment 0, Reward: 0  
Iteration 952: Treatment 0, Reward: 1  
Iteration 953: Treatment 0, Reward: 0  
Iteration 954: Treatment 0, Reward: 0  
Iteration 955: Treatment 0, Reward: 0  
Iteration 956: Treatment 0, Reward: 0  
Iteration 957: Treatment 0, Reward: 1  
Iteration 958: Treatment 0, Reward: 0  
Iteration 959: Treatment 0, Reward: 1  
Iteration 960: Treatment 0, Reward: 0  
Iteration 961: Treatment 0, Reward: 0  
Iteration 962: Treatment 0, Reward: 1  
Iteration 963: Treatment 0, Reward: 1  
Iteration 964: Treatment 0, Reward: 0  
Iteration 965: Treatment 0, Reward: 0  
Iteration 966: Treatment 0, Reward: 0  
Iteration 967: Treatment 0, Reward: 1  
Iteration 968: Treatment 0, Reward: 0  
Iteration 969: Treatment 0, Reward: 1  
Iteration 970: Treatment 0, Reward: 0  
Iteration 971: Treatment 0, Reward: 0  
Iteration 972: Treatment 0, Reward: 1

```

Iteration 973: Treatment 0, Reward: 1
Iteration 974: Treatment 0, Reward: 1
Iteration 975: Treatment 0, Reward: 0
Iteration 976: Treatment 0, Reward: 0
Iteration 977: Treatment 0, Reward: 1
Iteration 978: Treatment 0, Reward: 1
Iteration 979: Treatment 0, Reward: 0
Iteration 980: Treatment 0, Reward: 1
Iteration 981: Treatment 0, Reward: 1
Iteration 982: Treatment 0, Reward: 0
Iteration 983: Treatment 0, Reward: 0
Iteration 984: Treatment 0, Reward: 0
Iteration 985: Treatment 0, Reward: 0
Iteration 986: Treatment 0, Reward: 0
Iteration 987: Treatment 0, Reward: 0
Iteration 988: Treatment 0, Reward: 0
Iteration 989: Treatment 0, Reward: 0
Iteration 990: Treatment 0, Reward: 0
Iteration 991: Treatment 0, Reward: 0
Iteration 992: Treatment 0, Reward: 0
Iteration 993: Treatment 0, Reward: 0
Iteration 994: Treatment 0, Reward: 0
Iteration 995: Treatment 0, Reward: 0
Iteration 996: Treatment 0, Reward: 1
Iteration 997: Treatment 0, Reward: 0
Iteration 998: Treatment 0, Reward: 0
Iteration 999: Treatment 0, Reward: 0
Iteration 1000: Treatment 0, Reward: 0

```

## Using Epsilon-Greedy Policy (1.5M)

Implement the  $\epsilon$ -Greedy policy with  $\epsilon = 0.1, 0.2, 0.5$ . Report iteration-wise selections and rewards. Determine which  $\epsilon$  yields the best result. (Mandatory)

In [23]: *# run the environment with an agent that is guided by a epsilon-greedy policy*  
*#-----write your code below this line-----*

```

# Function to run  $\epsilon$ -greedy simulation
def run_epsilon_greedy(env, epsilon):
    rewards, selections = [], []
    reward_sums = [0] * 4
    counts = [0] * 4

    for i in range(n_iterations):
        if random.random() < epsilon:
            arm = random.choice([0, 1, 2, 3]) # Explore
        else:
            avg_rewards = [reward_sums[a] / counts[a] if counts[a] > 0 else 0
            arm = np.argmax(avg_rewards) # Exploit

        reward = env.sample(arm)

```

```

        rewards.append(reward)
        selections.append(arm)
        reward_sums[arm] += reward
        counts[arm] += 1
        print(f"ε={epsilon} | Iteration {i+1}: Treatment {arm}, Reward: {reward}")

    return rewards, selections

# Run simulations for different epsilon values
eg_rewards_10, _ = run_epsilon_greedy(env, 0.1)
eg_rewards_20, _ = run_epsilon_greedy(env, 0.2)
eg_rewards_50, _ = run_epsilon_greedy(env, 0.5)

# Compute cumulative rewards for each
eg_cumulative_10 = np.cumsum(eg_rewards_10)
eg_cumulative_20 = np.cumsum(eg_rewards_20)
eg_cumulative_50 = np.cumsum(eg_rewards_50)

```

[illegible]

[illegible]

[illegible]

[illegible]



[illegible]

[illegible]

[illegible]

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[illegible]



[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

$\epsilon=0.1$	Iteration 973: Treatment 1, Reward: 0
$\epsilon=0.1$	Iteration 974: Treatment 1, Reward: 0
$\epsilon=0.1$	Iteration 975: Treatment 1, Reward: 0
$\epsilon=0.1$	Iteration 976: Treatment 1, Reward: 1
$\epsilon=0.1$	Iteration 977: Treatment 1, Reward: 1
$\epsilon=0.1$	Iteration 978: Treatment 1, Reward: 0
$\epsilon=0.1$	Iteration 979: Treatment 1, Reward: 0
$\epsilon=0.1$	Iteration 980: Treatment 1, Reward: 0
$\epsilon=0.1$	Iteration 981: Treatment 1, Reward: 1
$\epsilon=0.1$	Iteration 982: Treatment 1, Reward: 1
$\epsilon=0.1$	Iteration 983: Treatment 1, Reward: 1
$\epsilon=0.1$	Iteration 984: Treatment 1, Reward: 0
$\epsilon=0.1$	Iteration 985: Treatment 1, Reward: 0
$\epsilon=0.1$	Iteration 986: Treatment 1, Reward: 1
$\epsilon=0.1$	Iteration 987: Treatment 1, Reward: 0
$\epsilon=0.1$	Iteration 988: Treatment 1, Reward: 1
$\epsilon=0.1$	Iteration 989: Treatment 1, Reward: 0
$\epsilon=0.1$	Iteration 990: Treatment 1, Reward: 0
$\epsilon=0.1$	Iteration 991: Treatment 1, Reward: 1
$\epsilon=0.1$	Iteration 992: Treatment 1, Reward: 1
$\epsilon=0.1$	Iteration 993: Treatment 1, Reward: 0
$\epsilon=0.1$	Iteration 994: Treatment 0, Reward: 1
$\epsilon=0.1$	Iteration 995: Treatment 1, Reward: 1
$\epsilon=0.1$	Iteration 996: Treatment 1, Reward: 0
$\epsilon=0.1$	Iteration 997: Treatment 1, Reward: 1
$\epsilon=0.1$	Iteration 998: Treatment 1, Reward: 1
$\epsilon=0.1$	Iteration 999: Treatment 1, Reward: 1
$\epsilon=0.1$	Iteration 1000: Treatment 1, Reward: 1
$\epsilon=0.2$	Iteration 1: Treatment 0, Reward: 0
$\epsilon=0.2$	Iteration 2: Treatment 0, Reward: 0
$\epsilon=0.2$	Iteration 3: Treatment 0, Reward: 0
$\epsilon=0.2$	Iteration 4: Treatment 0, Reward: 0
$\epsilon=0.2$	Iteration 5: Treatment 2, Reward: 1
$\epsilon=0.2$	Iteration 6: Treatment 2, Reward: 1
$\epsilon=0.2$	Iteration 7: Treatment 2, Reward: 0
$\epsilon=0.2$	Iteration 8: Treatment 2, Reward: 0
$\epsilon=0.2$	Iteration 9: Treatment 2, Reward: 1
$\epsilon=0.2$	Iteration 10: Treatment 2, Reward: 0
$\epsilon=0.2$	Iteration 11: Treatment 2, Reward: 0
$\epsilon=0.2$	Iteration 12: Treatment 2, Reward: 1
$\epsilon=0.2$	Iteration 13: Treatment 2, Reward: 0
$\epsilon=0.2$	Iteration 14: Treatment 2, Reward: 0
$\epsilon=0.2$	Iteration 15: Treatment 2, Reward: 1
$\epsilon=0.2$	Iteration 16: Treatment 2, Reward: 1
$\epsilon=0.2$	Iteration 17: Treatment 2, Reward: 1
$\epsilon=0.2$	Iteration 18: Treatment 0, Reward: 0
$\epsilon=0.2$	Iteration 19: Treatment 2, Reward: 1
$\epsilon=0.2$	Iteration 20: Treatment 2, Reward: 1
$\epsilon=0.2$	Iteration 21: Treatment 2, Reward: 1
$\epsilon=0.2$	Iteration 22: Treatment 2, Reward: 0
$\epsilon=0.2$	Iteration 23: Treatment 2, Reward: 1
$\epsilon=0.2$	Iteration 24: Treatment 2, Reward: 0
$\epsilon=0.2$	Iteration 25: Treatment 2, Reward: 0
$\epsilon=0.2$	Iteration 26: Treatment 1, Reward: 1

[illegible]



[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

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[illegible]

[illegible]

[illegible]

[illegible]



[illegible]

$\epsilon=0.2$  | Iteration 999: Treatment 1, Reward: 1  
 $\epsilon=0.2$  | Iteration 1000: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 1: Treatment 0, Reward: 1  
 $\epsilon=0.5$  | Iteration 2: Treatment 0, Reward: 0  
 $\epsilon=0.5$  | Iteration 3: Treatment 0, Reward: 0  
 $\epsilon=0.5$  | Iteration 4: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 5: Treatment 3, Reward: 1  
 $\epsilon=0.5$  | Iteration 6: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 7: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 8: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 9: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 10: Treatment 3, Reward: 1  
 $\epsilon=0.5$  | Iteration 11: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 12: Treatment 0, Reward: 0  
 $\epsilon=0.5$  | Iteration 13: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 14: Treatment 3, Reward: 1  
 $\epsilon=0.5$  | Iteration 15: Treatment 3, Reward: 1  
 $\epsilon=0.5$  | Iteration 16: Treatment 3, Reward: 0  
 $\epsilon=0.5$  | Iteration 17: Treatment 2, Reward: 1  
 $\epsilon=0.5$  | Iteration 18: Treatment 2, Reward: 0  
 $\epsilon=0.5$  | Iteration 19: Treatment 3, Reward: 0  
 $\epsilon=0.5$  | Iteration 20: Treatment 3, Reward: 0  
 $\epsilon=0.5$  | Iteration 21: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 22: Treatment 2, Reward: 1  
 $\epsilon=0.5$  | Iteration 23: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 24: Treatment 0, Reward: 0  
 $\epsilon=0.5$  | Iteration 25: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 26: Treatment 0, Reward: 1  
 $\epsilon=0.5$  | Iteration 27: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 28: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 29: Treatment 2, Reward: 0  
 $\epsilon=0.5$  | Iteration 30: Treatment 3, Reward: 0  
 $\epsilon=0.5$  | Iteration 31: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 32: Treatment 3, Reward: 1  
 $\epsilon=0.5$  | Iteration 33: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 34: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 35: Treatment 2, Reward: 0  
 $\epsilon=0.5$  | Iteration 36: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 37: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 38: Treatment 2, Reward: 0  
 $\epsilon=0.5$  | Iteration 39: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 40: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 41: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 42: Treatment 0, Reward: 0  
 $\epsilon=0.5$  | Iteration 43: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 44: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 45: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 46: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 47: Treatment 3, Reward: 0  
 $\epsilon=0.5$  | Iteration 48: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 49: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 50: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 51: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 52: Treatment 1, Reward: 1

$\epsilon=0.5$  | Iteration 53: Treatment 0, Reward: 1  
 $\epsilon=0.5$  | Iteration 54: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 55: Treatment 2, Reward: 1  
 $\epsilon=0.5$  | Iteration 56: Treatment 3, Reward: 0  
 $\epsilon=0.5$  | Iteration 57: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 58: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 59: Treatment 1, Reward: 1  
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 $\epsilon=0.5$  | Iteration 61: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 62: Treatment 2, Reward: 0  
 $\epsilon=0.5$  | Iteration 63: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 64: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 65: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 66: Treatment 0, Reward: 1  
 $\epsilon=0.5$  | Iteration 67: Treatment 2, Reward: 1  
 $\epsilon=0.5$  | Iteration 68: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 69: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 70: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 71: Treatment 0, Reward: 0  
 $\epsilon=0.5$  | Iteration 72: Treatment 3, Reward: 1  
 $\epsilon=0.5$  | Iteration 73: Treatment 3, Reward: 1  
 $\epsilon=0.5$  | Iteration 74: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 75: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 76: Treatment 2, Reward: 1  
 $\epsilon=0.5$  | Iteration 77: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 78: Treatment 0, Reward: 0  
 $\epsilon=0.5$  | Iteration 79: Treatment 3, Reward: 1  
 $\epsilon=0.5$  | Iteration 80: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 81: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 82: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 83: Treatment 0, Reward: 1  
 $\epsilon=0.5$  | Iteration 84: Treatment 3, Reward: 1  
 $\epsilon=0.5$  | Iteration 85: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 86: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 87: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 88: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 89: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 90: Treatment 2, Reward: 0  
 $\epsilon=0.5$  | Iteration 91: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 92: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 93: Treatment 2, Reward: 1  
 $\epsilon=0.5$  | Iteration 94: Treatment 2, Reward: 0  
 $\epsilon=0.5$  | Iteration 95: Treatment 3, Reward: 0  
 $\epsilon=0.5$  | Iteration 96: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 97: Treatment 3, Reward: 1  
 $\epsilon=0.5$  | Iteration 98: Treatment 2, Reward: 1  
 $\epsilon=0.5$  | Iteration 99: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 100: Treatment 2, Reward: 0  
 $\epsilon=0.5$  | Iteration 101: Treatment 3, Reward: 1  
 $\epsilon=0.5$  | Iteration 102: Treatment 3, Reward: 0  
 $\epsilon=0.5$  | Iteration 103: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 104: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 105: Treatment 0, Reward: 0  
 $\epsilon=0.5$  | Iteration 106: Treatment 1, Reward: 1

$\epsilon=0.5$	Iteration 107:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 108:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 109:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 110:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 111:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 112:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 113:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 114:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 115:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 116:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 117:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 118:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 119:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 120:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 121:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 122:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 123:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 124:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 125:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 126:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 127:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 128:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 129:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 130:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 131:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 132:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 133:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 134:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 135:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 136:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 137:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 138:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 139:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 140:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 141:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 142:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 143:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 144:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 145:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 146:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 147:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 148:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 149:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 150:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 151:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 152:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 153:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 154:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 155:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 156:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 157:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 158:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 159:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 160:	Treatment 2,	Reward: 0

$\epsilon=0.5$	Iteration 161:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 162:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 163:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 164:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 165:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 166:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 167:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 168:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 169:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 170:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 171:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 172:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 173:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 174:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 175:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 176:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 177:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 178:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 179:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 180:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 181:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 182:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 183:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 184:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 185:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 186:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 187:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 188:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 189:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 190:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 191:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 192:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 193:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 194:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 195:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 196:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 197:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 198:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 199:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 200:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 201:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 202:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 203:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 204:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 205:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 206:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 207:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 208:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 209:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 210:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 211:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 212:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 213:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 214:	Treatment 1,	Reward: 0

$\epsilon=0.5$	Iteration 215:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 216:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 217:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 218:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 219:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 220:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 221:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 222:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 223:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 224:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 225:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 226:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 227:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 228:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 229:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 230:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 231:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 232:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 233:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 234:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 235:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 236:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 237:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 238:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 239:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 240:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 241:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 242:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 243:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 244:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 245:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 246:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 247:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 248:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 249:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 250:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 251:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 252:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 253:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 254:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 255:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 256:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 257:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 258:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 259:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 260:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 261:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 262:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 263:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 264:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 265:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 266:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 267:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 268:	Treatment 1,	Reward: 1

$\epsilon=0.5$  | Iteration 269: Treatment 0, Reward: 1  
 $\epsilon=0.5$  | Iteration 270: Treatment 0, Reward: 0  
 $\epsilon=0.5$  | Iteration 271: Treatment 0, Reward: 0  
 $\epsilon=0.5$  | Iteration 272: Treatment 3, Reward: 0  
 $\epsilon=0.5$  | Iteration 273: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 274: Treatment 0, Reward: 0  
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 $\epsilon=0.5$  | Iteration 276: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 277: Treatment 0, Reward: 0  
 $\epsilon=0.5$  | Iteration 278: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 279: Treatment 2, Reward: 0  
 $\epsilon=0.5$  | Iteration 280: Treatment 3, Reward: 1  
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 $\epsilon=0.5$  | Iteration 284: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 285: Treatment 3, Reward: 1  
 $\epsilon=0.5$  | Iteration 286: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 287: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 288: Treatment 0, Reward: 1  
 $\epsilon=0.5$  | Iteration 289: Treatment 0, Reward: 1  
 $\epsilon=0.5$  | Iteration 290: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 291: Treatment 2, Reward: 0  
 $\epsilon=0.5$  | Iteration 292: Treatment 1, Reward: 0  
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 $\epsilon=0.5$  | Iteration 295: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 296: Treatment 2, Reward: 1  
 $\epsilon=0.5$  | Iteration 297: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 298: Treatment 2, Reward: 0  
 $\epsilon=0.5$  | Iteration 299: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 300: Treatment 1, Reward: 1  
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 $\epsilon=0.5$  | Iteration 304: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 305: Treatment 2, Reward: 0  
 $\epsilon=0.5$  | Iteration 306: Treatment 0, Reward: 1  
 $\epsilon=0.5$  | Iteration 307: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 308: Treatment 2, Reward: 0  
 $\epsilon=0.5$  | Iteration 309: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 310: Treatment 2, Reward: 1  
 $\epsilon=0.5$  | Iteration 311: Treatment 0, Reward: 1  
 $\epsilon=0.5$  | Iteration 312: Treatment 1, Reward: 1  
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 $\epsilon=0.5$  | Iteration 314: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 315: Treatment 0, Reward: 0  
 $\epsilon=0.5$  | Iteration 316: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 317: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 318: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 319: Treatment 0, Reward: 0  
 $\epsilon=0.5$  | Iteration 320: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 321: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 322: Treatment 2, Reward: 0

$\epsilon=0.5$	Iteration 323:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 324:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 325:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 326:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 327:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 328:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 329:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 330:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 331:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 332:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 333:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 334:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 335:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 336:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 337:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 338:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 339:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 340:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 341:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 342:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 343:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 344:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 345:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 346:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 347:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 348:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 349:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 350:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 351:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 352:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 353:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 354:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 355:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 356:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 357:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 358:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 359:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 360:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 361:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 362:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 363:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 364:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 365:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 366:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 367:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 368:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 369:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 370:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 371:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 372:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 373:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 374:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 375:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 376:	Treatment 2,	Reward: 1



$\epsilon=0.5$	Iteration 377:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 378:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 379:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 380:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 381:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 382:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 383:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 384:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 385:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 386:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 387:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 388:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 389:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 390:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 391:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 392:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 393:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 394:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 395:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 396:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 397:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 398:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 399:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 400:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 401:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 402:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 403:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 404:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 405:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 406:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 407:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 408:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 409:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 410:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 411:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 412:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 413:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 414:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 415:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 416:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 417:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 418:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 419:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 420:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 421:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 422:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 423:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 424:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 425:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 426:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 427:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 428:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 429:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 430:	Treatment 1,	Reward: 0

$\epsilon=0.5$	Iteration 431:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 432:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 433:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 434:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 435:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 436:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 437:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 438:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 439:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 440:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 441:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 442:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 443:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 444:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 445:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 446:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 447:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 448:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 449:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 450:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 451:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 452:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 453:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 454:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 455:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 456:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 457:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 458:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 459:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 460:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 461:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 462:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 463:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 464:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 465:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 466:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 467:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 468:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 469:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 470:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 471:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 472:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 473:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 474:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 475:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 476:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 477:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 478:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 479:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 480:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 481:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 482:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 483:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 484:	Treatment 2,	Reward: 1

$\epsilon=0.5$	Iteration 485:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 486:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 487:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 488:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 489:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 490:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 491:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 492:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 493:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 494:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 495:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 496:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 497:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 498:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 499:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 500:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 501:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 502:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 503:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 504:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 505:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 506:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 507:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 508:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 509:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 510:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 511:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 512:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 513:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 514:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 515:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 516:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 517:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 518:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 519:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 520:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 521:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 522:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 523:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 524:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 525:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 526:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 527:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 528:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 529:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 530:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 531:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 532:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 533:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 534:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 535:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 536:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 537:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 538:	Treatment 1,	Reward: 1

[illegible]

$\epsilon=0.5$	Iteration 593:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 594:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 595:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 596:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 597:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 598:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 599:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 600:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 601:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 602:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 603:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 604:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 605:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 606:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 607:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 608:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 609:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 610:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 611:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 612:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 613:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 614:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 615:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 616:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 617:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 618:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 619:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 620:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 621:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 622:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 623:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 624:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 625:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 626:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 627:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 628:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 629:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 630:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 631:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 632:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 633:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 634:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 635:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 636:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 637:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 638:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 639:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 640:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 641:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 642:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 643:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 644:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 645:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 646:	Treatment 0,	Reward: 0

$\epsilon=0.5$	Iteration 647: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 648: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 649: Treatment 1, Reward: 0
$\epsilon=0.5$	Iteration 650: Treatment 0, Reward: 1
$\epsilon=0.5$	Iteration 651: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 652: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 653: Treatment 3, Reward: 0
$\epsilon=0.5$	Iteration 654: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 655: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 656: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 657: Treatment 1, Reward: 0
$\epsilon=0.5$	Iteration 658: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 659: Treatment 3, Reward: 1
$\epsilon=0.5$	Iteration 660: Treatment 0, Reward: 0
$\epsilon=0.5$	Iteration 661: Treatment 2, Reward: 0
$\epsilon=0.5$	Iteration 662: Treatment 0, Reward: 0
$\epsilon=0.5$	Iteration 663: Treatment 2, Reward: 1
$\epsilon=0.5$	Iteration 664: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 665: Treatment 1, Reward: 0
$\epsilon=0.5$	Iteration 666: Treatment 2, Reward: 0
$\epsilon=0.5$	Iteration 667: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 668: Treatment 1, Reward: 0
$\epsilon=0.5$	Iteration 669: Treatment 0, Reward: 0
$\epsilon=0.5$	Iteration 670: Treatment 0, Reward: 1
$\epsilon=0.5$	Iteration 671: Treatment 1, Reward: 0
$\epsilon=0.5$	Iteration 672: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 673: Treatment 1, Reward: 0
$\epsilon=0.5$	Iteration 674: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 675: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 676: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 677: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 678: Treatment 1, Reward: 0
$\epsilon=0.5$	Iteration 679: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 680: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 681: Treatment 1, Reward: 0
$\epsilon=0.5$	Iteration 682: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 683: Treatment 2, Reward: 0
$\epsilon=0.5$	Iteration 684: Treatment 0, Reward: 0
$\epsilon=0.5$	Iteration 685: Treatment 1, Reward: 0
$\epsilon=0.5$	Iteration 686: Treatment 1, Reward: 0
$\epsilon=0.5$	Iteration 687: Treatment 1, Reward: 0
$\epsilon=0.5$	Iteration 688: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 689: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 690: Treatment 2, Reward: 1
$\epsilon=0.5$	Iteration 691: Treatment 3, Reward: 0
$\epsilon=0.5$	Iteration 692: Treatment 3, Reward: 0
$\epsilon=0.5$	Iteration 693: Treatment 2, Reward: 1
$\epsilon=0.5$	Iteration 694: Treatment 1, Reward: 0
$\epsilon=0.5$	Iteration 695: Treatment 3, Reward: 0
$\epsilon=0.5$	Iteration 696: Treatment 1, Reward: 0
$\epsilon=0.5$	Iteration 697: Treatment 3, Reward: 1
$\epsilon=0.5$	Iteration 698: Treatment 1, Reward: 1
$\epsilon=0.5$	Iteration 699: Treatment 2, Reward: 1
$\epsilon=0.5$	Iteration 700: Treatment 0, Reward: 0

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$\epsilon=0.5$	Iteration 755:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 756:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 757:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 758:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 759:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 760:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 761:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 762:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 763:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 764:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 765:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 766:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 767:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 768:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 769:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 770:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 771:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 772:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 773:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 774:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 775:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 776:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 777:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 778:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 779:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 780:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 781:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 782:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 783:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 784:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 785:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 786:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 787:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 788:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 789:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 790:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 791:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 792:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 793:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 794:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 795:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 796:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 797:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 798:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 799:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 800:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 801:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 802:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 803:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 804:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 805:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 806:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 807:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 808:	Treatment 0,	Reward: 1



$\epsilon=0.5$  | Iteration 809: Treatment 3, Reward: 0  
 $\epsilon=0.5$  | Iteration 810: Treatment 2, Reward: 1  
 $\epsilon=0.5$  | Iteration 811: Treatment 3, Reward: 1  
 $\epsilon=0.5$  | Iteration 812: Treatment 2, Reward: 0  
 $\epsilon=0.5$  | Iteration 813: Treatment 3, Reward: 0  
 $\epsilon=0.5$  | Iteration 814: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 815: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 816: Treatment 1, Reward: 0  
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 $\epsilon=0.5$  | Iteration 818: Treatment 1, Reward: 0  
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 $\epsilon=0.5$  | Iteration 821: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 822: Treatment 0, Reward: 1  
 $\epsilon=0.5$  | Iteration 823: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 824: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 825: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 826: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 827: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 828: Treatment 2, Reward: 0  
 $\epsilon=0.5$  | Iteration 829: Treatment 1, Reward: 0  
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 $\epsilon=0.5$  | Iteration 831: Treatment 2, Reward: 0  
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 $\epsilon=0.5$  | Iteration 834: Treatment 2, Reward: 0  
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 $\epsilon=0.5$  | Iteration 836: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 837: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 838: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 839: Treatment 3, Reward: 1  
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 $\epsilon=0.5$  | Iteration 841: Treatment 3, Reward: 1  
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 $\epsilon=0.5$  | Iteration 843: Treatment 2, Reward: 1  
 $\epsilon=0.5$  | Iteration 844: Treatment 1, Reward: 0  
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 $\epsilon=0.5$  | Iteration 846: Treatment 1, Reward: 1  
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 $\epsilon=0.5$  | Iteration 848: Treatment 2, Reward: 0  
 $\epsilon=0.5$  | Iteration 849: Treatment 1, Reward: 0  
 $\epsilon=0.5$  | Iteration 850: Treatment 0, Reward: 0  
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 $\epsilon=0.5$  | Iteration 853: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 854: Treatment 0, Reward: 1  
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 $\epsilon=0.5$  | Iteration 856: Treatment 3, Reward: 1  
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 $\epsilon=0.5$  | Iteration 858: Treatment 0, Reward: 0  
 $\epsilon=0.5$  | Iteration 859: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 860: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 861: Treatment 1, Reward: 1  
 $\epsilon=0.5$  | Iteration 862: Treatment 1, Reward: 1

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$\epsilon=0.5$	Iteration 869:	Treatment 0,	Reward: 0
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$\epsilon=0.5$	Iteration 881:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 882:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 883:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 884:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 885:	Treatment 3,	Reward: 1
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$\epsilon=0.5$	Iteration 890:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 891:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 892:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 893:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 894:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 895:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 896:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 897:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 898:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 899:	Treatment 3,	Reward: 0
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$\epsilon=0.5$	Iteration 902:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 903:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 904:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 905:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 906:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 907:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 908:	Treatment 0,	Reward: 0
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$\epsilon=0.5$	Iteration 910:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 911:	Treatment 0,	Reward: 1
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$\epsilon=0.5$	Iteration 913:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 914:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 915:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 916:	Treatment 1,	Reward: 1

$\epsilon=0.5$	Iteration 917:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 918:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 919:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 920:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 921:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 922:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 923:	Treatment 1,	Reward: 0
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$\epsilon=0.5$	Iteration 925:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 926:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 927:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 928:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 929:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 930:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 931:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 932:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 933:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 934:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 935:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 936:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 937:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 938:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 939:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 940:	Treatment 2,	Reward: 0
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$\epsilon=0.5$	Iteration 944:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 945:	Treatment 3,	Reward: 1
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$\epsilon=0.5$	Iteration 948:	Treatment 0,	Reward: 1
$\epsilon=0.5$	Iteration 949:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 950:	Treatment 1,	Reward: 0
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$\epsilon=0.5$	Iteration 953:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 954:	Treatment 2,	Reward: 1
$\epsilon=0.5$	Iteration 955:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 956:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 957:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 958:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 959:	Treatment 2,	Reward: 0
$\epsilon=0.5$	Iteration 960:	Treatment 1,	Reward: 1
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$\epsilon=0.5$	Iteration 962:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 963:	Treatment 1,	Reward: 1
$\epsilon=0.5$	Iteration 964:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 965:	Treatment 3,	Reward: 1
$\epsilon=0.5$	Iteration 966:	Treatment 1,	Reward: 0
$\epsilon=0.5$	Iteration 967:	Treatment 0,	Reward: 0
$\epsilon=0.5$	Iteration 968:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 969:	Treatment 3,	Reward: 0
$\epsilon=0.5$	Iteration 970:	Treatment 1,	Reward: 0

```

ε=0.5 | Iteration 971: Treatment 1, Reward: 1
ε=0.5 | Iteration 972: Treatment 3, Reward: 1
ε=0.5 | Iteration 973: Treatment 0, Reward: 1
ε=0.5 | Iteration 974: Treatment 1, Reward: 0
ε=0.5 | Iteration 975: Treatment 3, Reward: 0
ε=0.5 | Iteration 976: Treatment 1, Reward: 1
ε=0.5 | Iteration 977: Treatment 1, Reward: 1
ε=0.5 | Iteration 978: Treatment 1, Reward: 1
ε=0.5 | Iteration 979: Treatment 3, Reward: 1
ε=0.5 | Iteration 980: Treatment 2, Reward: 0
ε=0.5 | Iteration 981: Treatment 1, Reward: 0
ε=0.5 | Iteration 982: Treatment 1, Reward: 1
ε=0.5 | Iteration 983: Treatment 1, Reward: 1
ε=0.5 | Iteration 984: Treatment 3, Reward: 1
ε=0.5 | Iteration 985: Treatment 1, Reward: 1
ε=0.5 | Iteration 986: Treatment 1, Reward: 1
ε=0.5 | Iteration 987: Treatment 3, Reward: 1
ε=0.5 | Iteration 988: Treatment 0, Reward: 0
ε=0.5 | Iteration 989: Treatment 1, Reward: 1
ε=0.5 | Iteration 990: Treatment 1, Reward: 0
ε=0.5 | Iteration 991: Treatment 1, Reward: 1
ε=0.5 | Iteration 992: Treatment 1, Reward: 0
ε=0.5 | Iteration 993: Treatment 2, Reward: 0
ε=0.5 | Iteration 994: Treatment 1, Reward: 0
ε=0.5 | Iteration 995: Treatment 0, Reward: 1
ε=0.5 | Iteration 996: Treatment 1, Reward: 1
ε=0.5 | Iteration 997: Treatment 0, Reward: 1
ε=0.5 | Iteration 998: Treatment 1, Reward: 1
ε=0.5 | Iteration 999: Treatment 0, Reward: 1
ε=0.5 | Iteration 1000: Treatment 1, Reward: 0

```

## Using UCB (1M)

Implement the UCB algorithm for treatment selection and print each 100th iteration. (Mandatory)

```

In [24]: # run the environment with an agent that is guided by a UCB
#-----write your code below this line-----

ucb_rewards = []
ucb_selections = []
reward_sums = [0] * 4
counts = [0.0001] * 4 # Prevent divide-by-zero for log term

# Simulate UCB selection over trials
for i in range(n_iterations):
    ucb_values = [reward_sums[a]/counts[a] + math.sqrt(2 * math.log(i+1) / counts[a]) for a in range(4)]
    arm = np.argmax(ucb_values)
    reward = env.sample(arm)
    ucb_rewards.append(reward)
    ucb_selections.append(arm)

```

```
reward_sums[arm] += reward
counts[arm] += 1
print(f"Iteration {i+1}: Treatment {arm}, Reward: {reward}, UCB: {ucb_valu

# Compute cumulative rewards
ucb_cumulative = np.cumsum(ucb_rewards)
```

Iteration 1: Treatment 0, Reward: 0, UCB: 0.0000  
Iteration 2: Treatment 1, Reward: 1, UCB: 117.7410  
Iteration 3: Treatment 2, Reward: 1, UCB: 148.2304  
Iteration 4: Treatment 3, Reward: 0, UCB: 166.5109  
Iteration 5: Treatment 1, Reward: 1, UCB: 2.7939  
Iteration 6: Treatment 2, Reward: 1, UCB: 2.8928  
Iteration 7: Treatment 1, Reward: 0, UCB: 2.3949  
Iteration 8: Treatment 2, Reward: 1, UCB: 2.4419  
Iteration 9: Treatment 2, Reward: 0, UCB: 2.2102  
Iteration 10: Treatment 0, Reward: 0, UCB: 2.1459  
Iteration 11: Treatment 3, Reward: 1, UCB: 2.1898  
Iteration 12: Treatment 3, Reward: 0, UCB: 2.0763  
Iteration 13: Treatment 1, Reward: 0, UCB: 1.9743  
Iteration 14: Treatment 2, Reward: 0, UCB: 1.8987  
Iteration 15: Treatment 3, Reward: 0, UCB: 1.6769  
Iteration 16: Treatment 1, Reward: 1, UCB: 1.6774  
Iteration 17: Treatment 0, Reward: 1, UCB: 1.6832  
Iteration 18: Treatment 0, Reward: 1, UCB: 1.7214  
Iteration 19: Treatment 0, Reward: 1, UCB: 1.7133  
Iteration 20: Treatment 0, Reward: 0, UCB: 1.6946  
Iteration 21: Treatment 1, Reward: 0, UCB: 1.7035  
Iteration 22: Treatment 2, Reward: 1, UCB: 1.7119  
Iteration 23: Treatment 2, Reward: 0, UCB: 1.6890  
Iteration 24: Treatment 0, Reward: 0, UCB: 1.5292  
Iteration 25: Treatment 1, Reward: 1, UCB: 1.5358  
Iteration 26: Treatment 1, Reward: 1, UCB: 1.5362  
Iteration 27: Treatment 2, Reward: 0, UCB: 1.5418  
Iteration 28: Treatment 3, Reward: 1, UCB: 1.5408  
Iteration 29: Treatment 3, Reward: 1, UCB: 1.5605  
Iteration 30: Treatment 3, Reward: 0, UCB: 1.5648  
Iteration 31: Treatment 1, Reward: 1, UCB: 1.5515  
Iteration 32: Treatment 1, Reward: 0, UCB: 1.5442  
Iteration 33: Treatment 1, Reward: 1, UCB: 1.4362  
Iteration 34: Treatment 2, Reward: 1, UCB: 1.4389  
Iteration 35: Treatment 2, Reward: 1, UCB: 1.4444  
Iteration 36: Treatment 2, Reward: 1, UCB: 1.4466  
Iteration 37: Treatment 1, Reward: 1, UCB: 1.4466  
Iteration 38: Treatment 2, Reward: 0, UCB: 1.4496  
Iteration 39: Treatment 0, Reward: 1, UCB: 1.4517  
Iteration 40: Treatment 0, Reward: 0, UCB: 1.4603  
Iteration 41: Treatment 3, Reward: 1, UCB: 1.4586  
Iteration 42: Treatment 3, Reward: 0, UCB: 1.4666  
Iteration 43: Treatment 1, Reward: 0, UCB: 1.4584  
Iteration 44: Treatment 1, Reward: 0, UCB: 1.3784  
Iteration 45: Treatment 2, Reward: 0, UCB: 1.3798  
Iteration 46: Treatment 0, Reward: 0, UCB: 1.3668  
Iteration 47: Treatment 3, Reward: 1, UCB: 1.3694  
Iteration 48: Treatment 3, Reward: 0, UCB: 1.3799  
Iteration 49: Treatment 1, Reward: 1, UCB: 1.3171  
Iteration 50: Treatment 1, Reward: 1, UCB: 1.3222  
Iteration 51: Treatment 1, Reward: 0, UCB: 1.3260  
Iteration 52: Treatment 2, Reward: 0, UCB: 1.3181  
Iteration 53: Treatment 3, Reward: 1, UCB: 1.3042  
Iteration 54: Treatment 3, Reward: 0, UCB: 1.3154

Iteration 55: Treatment 0, Reward: 0, UCB: 1.2952  
Iteration 56: Treatment 1, Reward: 1, UCB: 1.2764  
Iteration 57: Treatment 1, Reward: 1, UCB: 1.2814  
Iteration 58: Treatment 1, Reward: 1, UCB: 1.2853  
Iteration 59: Treatment 1, Reward: 0, UCB: 1.2886  
Iteration 60: Treatment 2, Reward: 0, UCB: 1.2648  
Iteration 61: Treatment 3, Reward: 0, UCB: 1.2568  
Iteration 62: Treatment 1, Reward: 1, UCB: 1.2460  
Iteration 63: Treatment 1, Reward: 1, UCB: 1.2501  
Iteration 64: Treatment 1, Reward: 1, UCB: 1.2535  
Iteration 65: Treatment 1, Reward: 1, UCB: 1.2565  
Iteration 66: Treatment 1, Reward: 1, UCB: 1.2589  
Iteration 67: Treatment 1, Reward: 1, UCB: 1.2610  
Iteration 68: Treatment 1, Reward: 1, UCB: 1.2628  
Iteration 69: Treatment 1, Reward: 1, UCB: 1.2642  
Iteration 70: Treatment 1, Reward: 1, UCB: 1.2654  
Iteration 71: Treatment 1, Reward: 0, UCB: 1.2664  
Iteration 72: Treatment 0, Reward: 1, UCB: 1.2454  
Iteration 73: Treatment 0, Reward: 1, UCB: 1.2623  
Iteration 74: Treatment 0, Reward: 0, UCB: 1.2753  
Iteration 75: Treatment 1, Reward: 0, UCB: 1.2375  
Iteration 76: Treatment 2, Reward: 1, UCB: 1.2265  
Iteration 77: Treatment 2, Reward: 1, UCB: 1.2369  
Iteration 78: Treatment 2, Reward: 0, UCB: 1.2453  
Iteration 79: Treatment 0, Reward: 0, UCB: 1.2186  
Iteration 80: Treatment 3, Reward: 1, UCB: 1.2198  
Iteration 81: Treatment 3, Reward: 1, UCB: 1.2321  
Iteration 82: Treatment 3, Reward: 1, UCB: 1.2422  
Iteration 83: Treatment 3, Reward: 1, UCB: 1.2504  
Iteration 84: Treatment 3, Reward: 0, UCB: 1.2572  
Iteration 85: Treatment 1, Reward: 0, UCB: 1.2144  
Iteration 86: Treatment 3, Reward: 1, UCB: 1.2111  
Iteration 87: Treatment 3, Reward: 1, UCB: 1.2183  
Iteration 88: Treatment 3, Reward: 1, UCB: 1.2244  
Iteration 89: Treatment 3, Reward: 1, UCB: 1.2297  
Iteration 90: Treatment 3, Reward: 1, UCB: 1.2342  
Iteration 91: Treatment 3, Reward: 1, UCB: 1.2381  
Iteration 92: Treatment 3, Reward: 0, UCB: 1.2414  
Iteration 93: Treatment 2, Reward: 1, UCB: 1.2097  
Iteration 94: Treatment 2, Reward: 1, UCB: 1.2179  
Iteration 95: Treatment 2, Reward: 1, UCB: 1.2248  
Iteration 96: Treatment 2, Reward: 0, UCB: 1.2307  
Iteration 97: Treatment 3, Reward: 1, UCB: 1.2086  
Iteration 98: Treatment 3, Reward: 1, UCB: 1.2124  
Iteration 99: Treatment 3, Reward: 0, UCB: 1.2158  
Iteration 100: Treatment 1, Reward: 0, UCB: 1.1950  
Iteration 101: Treatment 2, Reward: 1, UCB: 1.1932  
Iteration 102: Treatment 2, Reward: 1, UCB: 1.1994  
Iteration 103: Treatment 2, Reward: 0, UCB: 1.2048  
Iteration 104: Treatment 0, Reward: 0, UCB: 1.1869  
Iteration 105: Treatment 3, Reward: 1, UCB: 1.1872  
Iteration 106: Treatment 3, Reward: 0, UCB: 1.1909  
Iteration 107: Treatment 2, Reward: 0, UCB: 1.1714  
Iteration 108: Treatment 1, Reward: 1, UCB: 1.1719

Iteration 109: Treatment 1, Reward: 1, UCB: 1.1749  
Iteration 110: Treatment 1, Reward: 1, UCB: 1.1777  
Iteration 111: Treatment 1, Reward: 1, UCB: 1.1802  
Iteration 112: Treatment 1, Reward: 1, UCB: 1.1825  
Iteration 113: Treatment 1, Reward: 1, UCB: 1.1847  
Iteration 114: Treatment 1, Reward: 1, UCB: 1.1866  
Iteration 115: Treatment 1, Reward: 0, UCB: 1.1884  
Iteration 116: Treatment 3, Reward: 0, UCB: 1.1667  
Iteration 117: Treatment 1, Reward: 1, UCB: 1.1667  
Iteration 118: Treatment 1, Reward: 1, UCB: 1.1687  
Iteration 119: Treatment 1, Reward: 1, UCB: 1.1706  
Iteration 120: Treatment 1, Reward: 1, UCB: 1.1724  
Iteration 121: Treatment 1, Reward: 1, UCB: 1.1740  
Iteration 122: Treatment 1, Reward: 0, UCB: 1.1755  
Iteration 123: Treatment 1, Reward: 1, UCB: 1.1561  
Iteration 124: Treatment 1, Reward: 0, UCB: 1.1578  
Iteration 125: Treatment 0, Reward: 1, UCB: 1.1519  
Iteration 126: Treatment 0, Reward: 0, UCB: 1.1661  
Iteration 127: Treatment 2, Reward: 0, UCB: 1.1489  
Iteration 128: Treatment 3, Reward: 1, UCB: 1.1444  
Iteration 129: Treatment 3, Reward: 0, UCB: 1.1488  
Iteration 130: Treatment 1, Reward: 0, UCB: 1.1412  
Iteration 131: Treatment 0, Reward: 0, UCB: 1.1249  
Iteration 132: Treatment 3, Reward: 0, UCB: 1.1242  
Iteration 133: Treatment 1, Reward: 0, UCB: 1.1242  
Iteration 134: Treatment 2, Reward: 1, UCB: 1.1208  
Iteration 135: Treatment 2, Reward: 0, UCB: 1.1276  
Iteration 136: Treatment 1, Reward: 1, UCB: 1.1078  
Iteration 137: Treatment 1, Reward: 1, UCB: 1.1101  
Iteration 138: Treatment 1, Reward: 1, UCB: 1.1124  
Iteration 139: Treatment 1, Reward: 1, UCB: 1.1145  
Iteration 140: Treatment 1, Reward: 0, UCB: 1.1165  
Iteration 141: Treatment 3, Reward: 0, UCB: 1.1032  
Iteration 142: Treatment 2, Reward: 1, UCB: 1.1019  
Iteration 143: Treatment 2, Reward: 1, UCB: 1.1085  
Iteration 144: Treatment 2, Reward: 1, UCB: 1.1146  
Iteration 145: Treatment 2, Reward: 1, UCB: 1.1202  
Iteration 146: Treatment 2, Reward: 0, UCB: 1.1253  
Iteration 147: Treatment 1, Reward: 0, UCB: 1.1027  
Iteration 148: Treatment 2, Reward: 1, UCB: 1.1010  
Iteration 149: Treatment 2, Reward: 1, UCB: 1.1062  
Iteration 150: Treatment 2, Reward: 1, UCB: 1.1109  
Iteration 151: Treatment 2, Reward: 0, UCB: 1.1154  
Iteration 152: Treatment 0, Reward: 1, UCB: 1.0956  
Iteration 153: Treatment 0, Reward: 1, UCB: 1.1093  
Iteration 154: Treatment 0, Reward: 1, UCB: 1.1212  
Iteration 155: Treatment 0, Reward: 0, UCB: 1.1317  
Iteration 156: Treatment 0, Reward: 1, UCB: 1.0974  
Iteration 157: Treatment 0, Reward: 0, UCB: 1.1074  
Iteration 158: Treatment 2, Reward: 0, UCB: 1.0951  
Iteration 159: Treatment 1, Reward: 1, UCB: 1.0905  
Iteration 160: Treatment 1, Reward: 1, UCB: 1.0927  
Iteration 161: Treatment 1, Reward: 0, UCB: 1.0949  
Iteration 162: Treatment 3, Reward: 0, UCB: 1.0872



Iteration 163: Treatment 1, Reward: 0, UCB: 1.0808  
Iteration 164: Treatment 0, Reward: 0, UCB: 1.0787  
Iteration 165: Treatment 2, Reward: 1, UCB: 1.0758  
Iteration 166: Treatment 2, Reward: 0, UCB: 1.0806  
Iteration 167: Treatment 1, Reward: 1, UCB: 1.0676  
Iteration 168: Treatment 1, Reward: 1, UCB: 1.0700  
Iteration 169: Treatment 1, Reward: 1, UCB: 1.0723  
Iteration 170: Treatment 1, Reward: 0, UCB: 1.0744  
Iteration 171: Treatment 3, Reward: 0, UCB: 1.0677  
Iteration 172: Treatment 2, Reward: 1, UCB: 1.0621  
Iteration 173: Treatment 2, Reward: 0, UCB: 1.0668  
Iteration 174: Treatment 1, Reward: 1, UCB: 1.0621  
Iteration 175: Treatment 1, Reward: 1, UCB: 1.0643  
Iteration 176: Treatment 1, Reward: 1, UCB: 1.0664  
Iteration 177: Treatment 1, Reward: 0, UCB: 1.0685  
Iteration 178: Treatment 1, Reward: 1, UCB: 1.0562  
Iteration 179: Treatment 1, Reward: 0, UCB: 1.0583  
Iteration 180: Treatment 0, Reward: 1, UCB: 1.0551  
Iteration 181: Treatment 0, Reward: 0, UCB: 1.0650  
Iteration 182: Treatment 2, Reward: 0, UCB: 1.0501  
Iteration 183: Treatment 3, Reward: 0, UCB: 1.0499  
Iteration 184: Treatment 1, Reward: 1, UCB: 1.0473  
Iteration 185: Treatment 1, Reward: 0, UCB: 1.0494  
Iteration 186: Treatment 0, Reward: 0, UCB: 1.0395  
Iteration 187: Treatment 1, Reward: 0, UCB: 1.0382  
Iteration 188: Treatment 2, Reward: 0, UCB: 1.0333  
Iteration 189: Treatment 3, Reward: 1, UCB: 1.0313  
Iteration 190: Treatment 3, Reward: 0, UCB: 1.0372  
Iteration 191: Treatment 1, Reward: 0, UCB: 1.0276  
Iteration 192: Treatment 3, Reward: 1, UCB: 1.0186  
Iteration 193: Treatment 3, Reward: 1, UCB: 1.0244  
Iteration 194: Treatment 3, Reward: 0, UCB: 1.0299  
Iteration 195: Treatment 2, Reward: 0, UCB: 1.0174  
Iteration 196: Treatment 1, Reward: 0, UCB: 1.0174  
Iteration 197: Treatment 0, Reward: 0, UCB: 1.0174  
Iteration 198: Treatment 3, Reward: 1, UCB: 1.0130  
Iteration 199: Treatment 3, Reward: 1, UCB: 1.0184  
Iteration 200: Treatment 3, Reward: 1, UCB: 1.0234  
Iteration 201: Treatment 3, Reward: 1, UCB: 1.0282  
Iteration 202: Treatment 3, Reward: 1, UCB: 1.0328  
Iteration 203: Treatment 3, Reward: 1, UCB: 1.0371  
Iteration 204: Treatment 3, Reward: 0, UCB: 1.0412  
Iteration 205: Treatment 3, Reward: 0, UCB: 1.0255  
Iteration 206: Treatment 3, Reward: 0, UCB: 1.0104  
Iteration 207: Treatment 1, Reward: 1, UCB: 1.0085  
Iteration 208: Treatment 1, Reward: 1, UCB: 1.0110  
Iteration 209: Treatment 1, Reward: 1, UCB: 1.0133  
Iteration 210: Treatment 1, Reward: 1, UCB: 1.0156  
Iteration 211: Treatment 1, Reward: 1, UCB: 1.0178  
Iteration 212: Treatment 1, Reward: 0, UCB: 1.0200  
Iteration 213: Treatment 1, Reward: 1, UCB: 1.0100  
Iteration 214: Treatment 1, Reward: 0, UCB: 1.0122  
Iteration 215: Treatment 2, Reward: 1, UCB: 1.0050  
Iteration 216: Treatment 2, Reward: 0, UCB: 1.0102

Iteration 217: Treatment 1, Reward: 1, UCB: 1.0028  
Iteration 218: Treatment 1, Reward: 0, UCB: 1.0050  
Iteration 219: Treatment 0, Reward: 0, UCB: 0.9994  
Iteration 220: Treatment 3, Reward: 1, UCB: 0.9983  
Iteration 221: Treatment 3, Reward: 0, UCB: 1.0027  
Iteration 222: Treatment 1, Reward: 1, UCB: 0.9961  
Iteration 223: Treatment 1, Reward: 1, UCB: 0.9983  
Iteration 224: Treatment 1, Reward: 0, UCB: 1.0004  
Iteration 225: Treatment 2, Reward: 0, UCB: 0.9959  
Iteration 226: Treatment 1, Reward: 1, UCB: 0.9915  
Iteration 227: Treatment 1, Reward: 0, UCB: 0.9936  
Iteration 228: Treatment 3, Reward: 0, UCB: 0.9898  
Iteration 229: Treatment 1, Reward: 1, UCB: 0.9850  
Iteration 230: Treatment 1, Reward: 0, UCB: 0.9871  
Iteration 231: Treatment 2, Reward: 1, UCB: 0.9815  
Iteration 232: Treatment 2, Reward: 0, UCB: 0.9868  
Iteration 233: Treatment 0, Reward: 0, UCB: 0.9801  
Iteration 234: Treatment 1, Reward: 0, UCB: 0.9790  
Iteration 235: Treatment 3, Reward: 1, UCB: 0.9773  
Iteration 236: Treatment 3, Reward: 1, UCB: 0.9817  
Iteration 237: Treatment 3, Reward: 1, UCB: 0.9860  
Iteration 238: Treatment 3, Reward: 0, UCB: 0.9900  
Iteration 239: Treatment 3, Reward: 0, UCB: 0.9773  
Iteration 240: Treatment 2, Reward: 1, UCB: 0.9734  
Iteration 241: Treatment 2, Reward: 0, UCB: 0.9785  
Iteration 242: Treatment 1, Reward: 0, UCB: 0.9715  
Iteration 243: Treatment 3, Reward: 1, UCB: 0.9654  
Iteration 244: Treatment 3, Reward: 1, UCB: 0.9695  
Iteration 245: Treatment 3, Reward: 1, UCB: 0.9735  
Iteration 246: Treatment 3, Reward: 0, UCB: 0.9773  
Iteration 247: Treatment 3, Reward: 1, UCB: 0.9656  
Iteration 248: Treatment 3, Reward: 1, UCB: 0.9694  
Iteration 249: Treatment 3, Reward: 0, UCB: 0.9730  
Iteration 250: Treatment 2, Reward: 0, UCB: 0.9659  
Iteration 251: Treatment 1, Reward: 1, UCB: 0.9643  
Iteration 252: Treatment 1, Reward: 1, UCB: 0.9665  
Iteration 253: Treatment 1, Reward: 1, UCB: 0.9687  
Iteration 254: Treatment 1, Reward: 0, UCB: 0.9708  
Iteration 255: Treatment 0, Reward: 1, UCB: 0.9635  
Iteration 256: Treatment 0, Reward: 0, UCB: 0.9737  
Iteration 257: Treatment 1, Reward: 0, UCB: 0.9631  
Iteration 258: Treatment 3, Reward: 0, UCB: 0.9630  
Iteration 259: Treatment 1, Reward: 0, UCB: 0.9555  
Iteration 260: Treatment 0, Reward: 0, UCB: 0.9543  
Iteration 261: Treatment 2, Reward: 0, UCB: 0.9540  
Iteration 262: Treatment 3, Reward: 0, UCB: 0.9525  
Iteration 263: Treatment 1, Reward: 0, UCB: 0.9482  
Iteration 264: Treatment 3, Reward: 0, UCB: 0.9420  
Iteration 265: Treatment 2, Reward: 0, UCB: 0.9414  
Iteration 266: Treatment 1, Reward: 1, UCB: 0.9409  
Iteration 267: Treatment 1, Reward: 1, UCB: 0.9432  
Iteration 268: Treatment 1, Reward: 1, UCB: 0.9454  
Iteration 269: Treatment 1, Reward: 1, UCB: 0.9475  
Iteration 270: Treatment 1, Reward: 1, UCB: 0.9497

Iteration 271: Treatment 1, Reward: 1, UCB: 0.9517  
Iteration 272: Treatment 1, Reward: 0, UCB: 0.9537  
Iteration 273: Treatment 1, Reward: 0, UCB: 0.9466  
Iteration 274: Treatment 1, Reward: 1, UCB: 0.9396  
Iteration 275: Treatment 1, Reward: 0, UCB: 0.9417  
Iteration 276: Treatment 0, Reward: 1, UCB: 0.9381  
Iteration 277: Treatment 0, Reward: 0, UCB: 0.9479  
Iteration 278: Treatment 1, Reward: 1, UCB: 0.9351  
Iteration 279: Treatment 1, Reward: 1, UCB: 0.9371  
Iteration 280: Treatment 1, Reward: 1, UCB: 0.9391  
Iteration 281: Treatment 1, Reward: 0, UCB: 0.9411  
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Iteration 283: Treatment 1, Reward: 1, UCB: 0.9364  
Iteration 284: Treatment 1, Reward: 1, UCB: 0.9384  
Iteration 285: Treatment 1, Reward: 0, UCB: 0.9403  
Iteration 286: Treatment 3, Reward: 1, UCB: 0.9344  
Iteration 287: Treatment 3, Reward: 0, UCB: 0.9382  
Iteration 288: Treatment 1, Reward: 1, UCB: 0.9340  
Iteration 289: Treatment 1, Reward: 0, UCB: 0.9359  
Iteration 290: Treatment 2, Reward: 1, UCB: 0.9321  
Iteration 291: Treatment 2, Reward: 0, UCB: 0.9374  
Iteration 292: Treatment 0, Reward: 0, UCB: 0.9323  
Iteration 293: Treatment 1, Reward: 0, UCB: 0.9299  
Iteration 294: Treatment 3, Reward: 1, UCB: 0.9289  
Iteration 295: Treatment 3, Reward: 1, UCB: 0.9326  
Iteration 296: Treatment 3, Reward: 1, UCB: 0.9362  
Iteration 297: Treatment 3, Reward: 0, UCB: 0.9397  
Iteration 298: Treatment 3, Reward: 0, UCB: 0.9301  
Iteration 299: Treatment 2, Reward: 1, UCB: 0.9261  
Iteration 300: Treatment 2, Reward: 1, UCB: 0.9312  
Iteration 301: Treatment 2, Reward: 1, UCB: 0.9362  
Iteration 302: Treatment 2, Reward: 0, UCB: 0.9409  
Iteration 303: Treatment 2, Reward: 1, UCB: 0.9293  
Iteration 304: Treatment 2, Reward: 0, UCB: 0.9340  
Iteration 305: Treatment 1, Reward: 1, UCB: 0.9247  
Iteration 306: Treatment 1, Reward: 0, UCB: 0.9266  
Iteration 307: Treatment 2, Reward: 1, UCB: 0.9230  
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Iteration 309: Treatment 3, Reward: 1, UCB: 0.9219  
Iteration 310: Treatment 3, Reward: 1, UCB: 0.9254  
Iteration 311: Treatment 3, Reward: 1, UCB: 0.9288  
Iteration 312: Treatment 3, Reward: 1, UCB: 0.9321  
Iteration 313: Treatment 3, Reward: 1, UCB: 0.9353  
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Iteration 315: Treatment 3, Reward: 0, UCB: 0.9296  
Iteration 316: Treatment 1, Reward: 1, UCB: 0.9213  
Iteration 317: Treatment 1, Reward: 1, UCB: 0.9232  
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Iteration 319: Treatment 1, Reward: 1, UCB: 0.9269  
Iteration 320: Treatment 1, Reward: 0, UCB: 0.9287  
Iteration 321: Treatment 1, Reward: 1, UCB: 0.9228  
Iteration 322: Treatment 1, Reward: 1, UCB: 0.9246  
Iteration 323: Treatment 1, Reward: 1, UCB: 0.9263  
Iteration 324: Treatment 1, Reward: 1, UCB: 0.9281

Iteration 325: Treatment 1, Reward: 1, UCB: 0.9298  
Iteration 326: Treatment 1, Reward: 1, UCB: 0.9314  
Iteration 327: Treatment 1, Reward: 1, UCB: 0.9331  
Iteration 328: Treatment 1, Reward: 1, UCB: 0.9347  
Iteration 329: Treatment 1, Reward: 1, UCB: 0.9363  
Iteration 330: Treatment 1, Reward: 1, UCB: 0.9378  
Iteration 331: Treatment 1, Reward: 0, UCB: 0.9394  
Iteration 332: Treatment 1, Reward: 1, UCB: 0.9338  
Iteration 333: Treatment 1, Reward: 1, UCB: 0.9354  
Iteration 334: Treatment 1, Reward: 1, UCB: 0.9369  
Iteration 335: Treatment 1, Reward: 1, UCB: 0.9384  
Iteration 336: Treatment 1, Reward: 1, UCB: 0.9398  
Iteration 337: Treatment 1, Reward: 0, UCB: 0.9413  
Iteration 338: Treatment 1, Reward: 1, UCB: 0.9359  
Iteration 339: Treatment 1, Reward: 0, UCB: 0.9374  
Iteration 340: Treatment 1, Reward: 1, UCB: 0.9321  
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Iteration 343: Treatment 1, Reward: 1, UCB: 0.9364  
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Iteration 346: Treatment 1, Reward: 0, UCB: 0.9340  
Iteration 347: Treatment 1, Reward: 1, UCB: 0.9290  
Iteration 348: Treatment 1, Reward: 0, UCB: 0.9304  
Iteration 349: Treatment 1, Reward: 1, UCB: 0.9255  
Iteration 350: Treatment 1, Reward: 0, UCB: 0.9268  
Iteration 351: Treatment 3, Reward: 0, UCB: 0.9243  
Iteration 352: Treatment 0, Reward: 0, UCB: 0.9239  
Iteration 353: Treatment 1, Reward: 1, UCB: 0.9221  
Iteration 354: Treatment 1, Reward: 1, UCB: 0.9235  
Iteration 355: Treatment 1, Reward: 1, UCB: 0.9249  
Iteration 356: Treatment 1, Reward: 0, UCB: 0.9262  
Iteration 357: Treatment 2, Reward: 1, UCB: 0.9220  
Iteration 358: Treatment 2, Reward: 1, UCB: 0.9264  
Iteration 359: Treatment 2, Reward: 1, UCB: 0.9307  
Iteration 360: Treatment 2, Reward: 0, UCB: 0.9348  
Iteration 361: Treatment 2, Reward: 1, UCB: 0.9245  
Iteration 362: Treatment 2, Reward: 0, UCB: 0.9285  
Iteration 363: Treatment 1, Reward: 1, UCB: 0.9218  
Iteration 364: Treatment 1, Reward: 0, UCB: 0.9232  
Iteration 365: Treatment 2, Reward: 1, UCB: 0.9187  
Iteration 366: Treatment 2, Reward: 0, UCB: 0.9227  
Iteration 367: Treatment 1, Reward: 0, UCB: 0.9186  
Iteration 368: Treatment 3, Reward: 1, UCB: 0.9172  
Iteration 369: Treatment 3, Reward: 1, UCB: 0.9203  
Iteration 370: Treatment 3, Reward: 1, UCB: 0.9234  
Iteration 371: Treatment 3, Reward: 0, UCB: 0.9264  
Iteration 372: Treatment 3, Reward: 1, UCB: 0.9182  
Iteration 373: Treatment 3, Reward: 0, UCB: 0.9212  
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Iteration 375: Treatment 1, Reward: 1, UCB: 0.9157  
Iteration 376: Treatment 1, Reward: 0, UCB: 0.9171  
Iteration 377: Treatment 2, Reward: 1, UCB: 0.9139  
Iteration 378: Treatment 2, Reward: 1, UCB: 0.9178

Iteration 379: Treatment 2, Reward: 1, UCB: 0.9216  
Iteration 380: Treatment 2, Reward: 0, UCB: 0.9253  
Iteration 381: Treatment 2, Reward: 1, UCB: 0.9160  
Iteration 382: Treatment 2, Reward: 0, UCB: 0.9196  
Iteration 383: Treatment 3, Reward: 0, UCB: 0.9139  
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Iteration 385: Treatment 0, Reward: 0, UCB: 0.9115  
Iteration 386: Treatment 2, Reward: 1, UCB: 0.9109  
Iteration 387: Treatment 2, Reward: 0, UCB: 0.9144  
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Iteration 397: Treatment 3, Reward: 1, UCB: 0.9159  
Iteration 398: Treatment 3, Reward: 0, UCB: 0.9186  
Iteration 399: Treatment 3, Reward: 1, UCB: 0.9113  
Iteration 400: Treatment 3, Reward: 0, UCB: 0.9139  
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Iteration 402: Treatment 2, Reward: 0, UCB: 0.9068  
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Iteration 410: Treatment 0, Reward: 0, UCB: 0.8985  
Iteration 411: Treatment 3, Reward: 1, UCB: 0.8962  
Iteration 412: Treatment 3, Reward: 1, UCB: 0.8987  
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Iteration 419: Treatment 3, Reward: 0, UCB: 0.8909  
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Iteration 421: Treatment 3, Reward: 0, UCB: 0.8846  
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Iteration 423: Treatment 0, Reward: 1, UCB: 0.8938  
Iteration 424: Treatment 0, Reward: 0, UCB: 0.9025  
Iteration 425: Treatment 0, Reward: 1, UCB: 0.8881  
Iteration 426: Treatment 0, Reward: 1, UCB: 0.8965  
Iteration 427: Treatment 0, Reward: 0, UCB: 0.9045  
Iteration 428: Treatment 0, Reward: 1, UCB: 0.8908  
Iteration 429: Treatment 0, Reward: 0, UCB: 0.8984  
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Iteration 431: Treatment 2, Reward: 1, UCB: 0.8837  
Iteration 432: Treatment 2, Reward: 0, UCB: 0.8873

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Iteration 434: Treatment 2, Reward: 0, UCB: 0.8794  
Iteration 435: Treatment 1, Reward: 0, UCB: 0.8793  
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Iteration 437: Treatment 1, Reward: 1, UCB: 0.8753  
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Iteration 440: Treatment 1, Reward: 0, UCB: 0.8795  
Iteration 441: Treatment 1, Reward: 1, UCB: 0.8755  
Iteration 442: Treatment 1, Reward: 0, UCB: 0.8769  
Iteration 443: Treatment 0, Reward: 0, UCB: 0.8737  
Iteration 444: Treatment 3, Reward: 1, UCB: 0.8734  
Iteration 445: Treatment 3, Reward: 0, UCB: 0.8760  
Iteration 446: Treatment 1, Reward: 0, UCB: 0.8731  
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Iteration 453: Treatment 3, Reward: 0, UCB: 0.8799  
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Iteration 456: Treatment 3, Reward: 0, UCB: 0.8707  
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Iteration 458: Treatment 2, Reward: 0, UCB: 0.8690  
Iteration 459: Treatment 1, Reward: 0, UCB: 0.8659  
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Iteration 462: Treatment 1, Reward: 0, UCB: 0.8622  
Iteration 463: Treatment 2, Reward: 1, UCB: 0.8618  
Iteration 464: Treatment 2, Reward: 1, UCB: 0.8653  
Iteration 465: Treatment 2, Reward: 1, UCB: 0.8688  
Iteration 466: Treatment 2, Reward: 0, UCB: 0.8722  
Iteration 467: Treatment 2, Reward: 0, UCB: 0.8650  
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Iteration 470: Treatment 3, Reward: 1, UCB: 0.8647  
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Iteration 480: Treatment 3, Reward: 0, UCB: 0.8580  
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Iteration 484: Treatment 2, Reward: 1, UCB: 0.8552  
Iteration 485: Treatment 2, Reward: 1, UCB: 0.8585  
Iteration 486: Treatment 2, Reward: 0, UCB: 0.8617

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Iteration 491: Treatment 0, Reward: 1, UCB: 0.8536  
Iteration 492: Treatment 0, Reward: 0, UCB: 0.8610  
Iteration 493: Treatment 3, Reward: 0, UCB: 0.8534  
Iteration 494: Treatment 1, Reward: 0, UCB: 0.8527  
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Iteration 504: Treatment 1, Reward: 0, UCB: 0.8526  
Iteration 505: Treatment 1, Reward: 0, UCB: 0.8491  
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Iteration 510: Treatment 2, Reward: 0, UCB: 0.8430  
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Iteration 512: Treatment 1, Reward: 1, UCB: 0.8437  
Iteration 513: Treatment 1, Reward: 1, UCB: 0.8451  
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Iteration 515: Treatment 1, Reward: 1, UCB: 0.8478  
Iteration 516: Treatment 1, Reward: 0, UCB: 0.8491  
Iteration 517: Treatment 1, Reward: 1, UCB: 0.8457  
Iteration 518: Treatment 1, Reward: 0, UCB: 0.8470  
Iteration 519: Treatment 1, Reward: 0, UCB: 0.8437  
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Iteration 526: Treatment 0, Reward: 1, UCB: 0.8467  
Iteration 527: Treatment 0, Reward: 1, UCB: 0.8529  
Iteration 528: Treatment 0, Reward: 0, UCB: 0.8588  
Iteration 529: Treatment 0, Reward: 0, UCB: 0.8489  
Iteration 530: Treatment 1, Reward: 0, UCB: 0.8408  
Iteration 531: Treatment 3, Reward: 1, UCB: 0.8400  
Iteration 532: Treatment 3, Reward: 0, UCB: 0.8423  
Iteration 533: Treatment 0, Reward: 0, UCB: 0.8395  
Iteration 534: Treatment 2, Reward: 1, UCB: 0.8379  
Iteration 535: Treatment 2, Reward: 1, UCB: 0.8411  
Iteration 536: Treatment 2, Reward: 0, UCB: 0.8442  
Iteration 537: Treatment 2, Reward: 0, UCB: 0.8381  
Iteration 538: Treatment 1, Reward: 0, UCB: 0.8378  
Iteration 539: Treatment 3, Reward: 0, UCB: 0.8377  
Iteration 540: Treatment 1, Reward: 1, UCB: 0.8346

Iteration 541: Treatment 1, Reward: 0, UCB: 0.8359  
Iteration 542: Treatment 3, Reward: 0, UCB: 0.8330  
Iteration 543: Treatment 1, Reward: 1, UCB: 0.8328  
Iteration 544: Treatment 1, Reward: 1, UCB: 0.8341  
Iteration 545: Treatment 1, Reward: 1, UCB: 0.8354  
Iteration 546: Treatment 1, Reward: 1, UCB: 0.8367  
Iteration 547: Treatment 1, Reward: 1, UCB: 0.8380  
Iteration 548: Treatment 1, Reward: 1, UCB: 0.8392  
Iteration 549: Treatment 1, Reward: 1, UCB: 0.8405  
Iteration 550: Treatment 1, Reward: 1, UCB: 0.8417  
Iteration 551: Treatment 1, Reward: 0, UCB: 0.8430  
Iteration 552: Treatment 1, Reward: 1, UCB: 0.8399  
Iteration 553: Treatment 1, Reward: 1, UCB: 0.8411  
Iteration 554: Treatment 1, Reward: 1, UCB: 0.8423  
Iteration 555: Treatment 1, Reward: 1, UCB: 0.8435  
Iteration 556: Treatment 1, Reward: 1, UCB: 0.8447  
Iteration 557: Treatment 1, Reward: 1, UCB: 0.8459  
Iteration 558: Treatment 1, Reward: 1, UCB: 0.8471  
Iteration 559: Treatment 1, Reward: 1, UCB: 0.8482  
Iteration 560: Treatment 1, Reward: 0, UCB: 0.8494  
Iteration 561: Treatment 1, Reward: 0, UCB: 0.8463  
Iteration 562: Treatment 1, Reward: 0, UCB: 0.8433  
Iteration 563: Treatment 1, Reward: 1, UCB: 0.8404  
Iteration 564: Treatment 1, Reward: 1, UCB: 0.8415  
Iteration 565: Treatment 1, Reward: 1, UCB: 0.8427  
Iteration 566: Treatment 1, Reward: 0, UCB: 0.8438  
Iteration 567: Treatment 1, Reward: 0, UCB: 0.8409  
Iteration 568: Treatment 1, Reward: 1, UCB: 0.8379  
Iteration 569: Treatment 1, Reward: 1, UCB: 0.8391  
Iteration 570: Treatment 1, Reward: 0, UCB: 0.8402  
Iteration 571: Treatment 1, Reward: 0, UCB: 0.8373  
Iteration 572: Treatment 1, Reward: 0, UCB: 0.8345  
Iteration 573: Treatment 2, Reward: 0, UCB: 0.8338  
Iteration 574: Treatment 0, Reward: 0, UCB: 0.8327  
Iteration 575: Treatment 1, Reward: 0, UCB: 0.8317  
Iteration 576: Treatment 3, Reward: 1, UCB: 0.8296  
Iteration 577: Treatment 3, Reward: 1, UCB: 0.8319  
Iteration 578: Treatment 3, Reward: 0, UCB: 0.8341  
Iteration 579: Treatment 3, Reward: 0, UCB: 0.8294  
Iteration 580: Treatment 1, Reward: 0, UCB: 0.8290  
Iteration 581: Treatment 2, Reward: 1, UCB: 0.8282  
Iteration 582: Treatment 2, Reward: 1, UCB: 0.8313  
Iteration 583: Treatment 2, Reward: 0, UCB: 0.8342  
Iteration 584: Treatment 2, Reward: 1, UCB: 0.8285  
Iteration 585: Treatment 2, Reward: 0, UCB: 0.8314  
Iteration 586: Treatment 1, Reward: 1, UCB: 0.8264  
Iteration 587: Treatment 1, Reward: 1, UCB: 0.8275  
Iteration 588: Treatment 1, Reward: 1, UCB: 0.8287  
Iteration 589: Treatment 1, Reward: 0, UCB: 0.8298  
Iteration 590: Treatment 1, Reward: 1, UCB: 0.8270  
Iteration 591: Treatment 1, Reward: 0, UCB: 0.8282  
Iteration 592: Treatment 2, Reward: 0, UCB: 0.8261  
Iteration 593: Treatment 1, Reward: 1, UCB: 0.8255  
Iteration 594: Treatment 1, Reward: 1, UCB: 0.8266



Iteration 595: Treatment 1, Reward: 0, UCB: 0.8277  
Iteration 596: Treatment 3, Reward: 1, UCB: 0.8255  
Iteration 597: Treatment 3, Reward: 1, UCB: 0.8277  
Iteration 598: Treatment 3, Reward: 0, UCB: 0.8299  
Iteration 599: Treatment 3, Reward: 0, UCB: 0.8253  
Iteration 600: Treatment 1, Reward: 1, UCB: 0.8251  
Iteration 601: Treatment 1, Reward: 1, UCB: 0.8262  
Iteration 602: Treatment 1, Reward: 1, UCB: 0.8273  
Iteration 603: Treatment 1, Reward: 1, UCB: 0.8284  
Iteration 604: Treatment 1, Reward: 1, UCB: 0.8295  
Iteration 605: Treatment 1, Reward: 1, UCB: 0.8306  
Iteration 606: Treatment 1, Reward: 1, UCB: 0.8316  
Iteration 607: Treatment 1, Reward: 1, UCB: 0.8327  
Iteration 608: Treatment 1, Reward: 1, UCB: 0.8337  
Iteration 609: Treatment 1, Reward: 0, UCB: 0.8348  
Iteration 610: Treatment 1, Reward: 1, UCB: 0.8321  
Iteration 611: Treatment 1, Reward: 1, UCB: 0.8332  
Iteration 612: Treatment 1, Reward: 1, UCB: 0.8342  
Iteration 613: Treatment 1, Reward: 1, UCB: 0.8352  
Iteration 614: Treatment 1, Reward: 0, UCB: 0.8362  
Iteration 615: Treatment 1, Reward: 1, UCB: 0.8336  
Iteration 616: Treatment 1, Reward: 1, UCB: 0.8347  
Iteration 617: Treatment 1, Reward: 0, UCB: 0.8357  
Iteration 618: Treatment 1, Reward: 1, UCB: 0.8331  
Iteration 619: Treatment 1, Reward: 0, UCB: 0.8341  
Iteration 620: Treatment 1, Reward: 1, UCB: 0.8315  
Iteration 621: Treatment 1, Reward: 0, UCB: 0.8325  
Iteration 622: Treatment 1, Reward: 1, UCB: 0.8300  
Iteration 623: Treatment 1, Reward: 1, UCB: 0.8310  
Iteration 624: Treatment 1, Reward: 0, UCB: 0.8320  
Iteration 625: Treatment 1, Reward: 0, UCB: 0.8295  
Iteration 626: Treatment 1, Reward: 1, UCB: 0.8270  
Iteration 627: Treatment 1, Reward: 1, UCB: 0.8280  
Iteration 628: Treatment 1, Reward: 0, UCB: 0.8290  
Iteration 629: Treatment 0, Reward: 1, UCB: 0.8266  
Iteration 630: Treatment 0, Reward: 0, UCB: 0.8325  
Iteration 631: Treatment 1, Reward: 1, UCB: 0.8266  
Iteration 632: Treatment 1, Reward: 1, UCB: 0.8276  
Iteration 633: Treatment 1, Reward: 0, UCB: 0.8285  
Iteration 634: Treatment 1, Reward: 1, UCB: 0.8261  
Iteration 635: Treatment 1, Reward: 0, UCB: 0.8271  
Iteration 636: Treatment 1, Reward: 0, UCB: 0.8247  
Iteration 637: Treatment 0, Reward: 1, UCB: 0.8239  
Iteration 638: Treatment 0, Reward: 1, UCB: 0.8296  
Iteration 639: Treatment 0, Reward: 0, UCB: 0.8350  
Iteration 640: Treatment 0, Reward: 0, UCB: 0.8264  
Iteration 641: Treatment 2, Reward: 1, UCB: 0.8225  
Iteration 642: Treatment 2, Reward: 1, UCB: 0.8254  
Iteration 643: Treatment 2, Reward: 0, UCB: 0.8283  
Iteration 644: Treatment 2, Reward: 1, UCB: 0.8228  
Iteration 645: Treatment 2, Reward: 1, UCB: 0.8257  
Iteration 646: Treatment 2, Reward: 0, UCB: 0.8284  
Iteration 647: Treatment 2, Reward: 1, UCB: 0.8231  
Iteration 648: Treatment 2, Reward: 0, UCB: 0.8258

Iteration 649: Treatment 3, Reward: 1, UCB: 0.8227  
Iteration 650: Treatment 3, Reward: 0, UCB: 0.8248  
Iteration 651: Treatment 1, Reward: 1, UCB: 0.8226  
Iteration 652: Treatment 1, Reward: 0, UCB: 0.8236  
Iteration 653: Treatment 1, Reward: 1, UCB: 0.8212  
Iteration 654: Treatment 1, Reward: 1, UCB: 0.8222  
Iteration 655: Treatment 1, Reward: 0, UCB: 0.8231  
Iteration 656: Treatment 2, Reward: 1, UCB: 0.8209  
Iteration 657: Treatment 2, Reward: 1, UCB: 0.8236  
Iteration 658: Treatment 2, Reward: 0, UCB: 0.8262  
Iteration 659: Treatment 2, Reward: 0, UCB: 0.8211  
Iteration 660: Treatment 1, Reward: 1, UCB: 0.8209  
Iteration 661: Treatment 1, Reward: 1, UCB: 0.8218  
Iteration 662: Treatment 1, Reward: 1, UCB: 0.8228  
Iteration 663: Treatment 1, Reward: 0, UCB: 0.8237  
Iteration 664: Treatment 1, Reward: 1, UCB: 0.8214  
Iteration 665: Treatment 1, Reward: 0, UCB: 0.8223  
Iteration 666: Treatment 3, Reward: 0, UCB: 0.8209  
Iteration 667: Treatment 1, Reward: 1, UCB: 0.8200  
Iteration 668: Treatment 1, Reward: 0, UCB: 0.8210  
Iteration 669: Treatment 0, Reward: 0, UCB: 0.8194  
Iteration 670: Treatment 1, Reward: 1, UCB: 0.8187  
Iteration 671: Treatment 1, Reward: 0, UCB: 0.8196  
Iteration 672: Treatment 1, Reward: 1, UCB: 0.8174  
Iteration 673: Treatment 1, Reward: 0, UCB: 0.8183  
Iteration 674: Treatment 3, Reward: 0, UCB: 0.8168  
Iteration 675: Treatment 2, Reward: 0, UCB: 0.8166  
Iteration 676: Treatment 1, Reward: 1, UCB: 0.8161  
Iteration 677: Treatment 1, Reward: 1, UCB: 0.8170  
Iteration 678: Treatment 1, Reward: 0, UCB: 0.8179  
Iteration 679: Treatment 1, Reward: 0, UCB: 0.8157  
Iteration 680: Treatment 1, Reward: 1, UCB: 0.8135  
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Iteration 682: Treatment 1, Reward: 1, UCB: 0.8153  
Iteration 683: Treatment 1, Reward: 0, UCB: 0.8162  
Iteration 684: Treatment 1, Reward: 1, UCB: 0.8141  
Iteration 685: Treatment 1, Reward: 1, UCB: 0.8150  
Iteration 686: Treatment 1, Reward: 1, UCB: 0.8159  
Iteration 687: Treatment 1, Reward: 0, UCB: 0.8168  
Iteration 688: Treatment 1, Reward: 0, UCB: 0.8146  
Iteration 689: Treatment 3, Reward: 0, UCB: 0.8130  
Iteration 690: Treatment 1, Reward: 1, UCB: 0.8124  
Iteration 691: Treatment 1, Reward: 1, UCB: 0.8133  
Iteration 692: Treatment 1, Reward: 0, UCB: 0.8142  
Iteration 693: Treatment 0, Reward: 1, UCB: 0.8123  
Iteration 694: Treatment 0, Reward: 0, UCB: 0.8177  
Iteration 695: Treatment 2, Reward: 1, UCB: 0.8123  
Iteration 696: Treatment 2, Reward: 0, UCB: 0.8149  
Iteration 697: Treatment 1, Reward: 1, UCB: 0.8122  
Iteration 698: Treatment 1, Reward: 0, UCB: 0.8131  
Iteration 699: Treatment 1, Reward: 0, UCB: 0.8109  
Iteration 700: Treatment 2, Reward: 0, UCB: 0.8101  
Iteration 701: Treatment 0, Reward: 1, UCB: 0.8100  
Iteration 702: Treatment 0, Reward: 0, UCB: 0.8152

Iteration 703: Treatment 3, Reward: 1, UCB: 0.8091  
Iteration 704: Treatment 3, Reward: 0, UCB: 0.8113  
Iteration 705: Treatment 1, Reward: 1, UCB: 0.8089  
Iteration 706: Treatment 1, Reward: 0, UCB: 0.8098  
Iteration 707: Treatment 1, Reward: 0, UCB: 0.8077  
Iteration 708: Treatment 0, Reward: 1, UCB: 0.8076  
Iteration 709: Treatment 0, Reward: 0, UCB: 0.8127  
Iteration 710: Treatment 3, Reward: 0, UCB: 0.8073  
Iteration 711: Treatment 1, Reward: 0, UCB: 0.8057  
Iteration 712: Treatment 2, Reward: 1, UCB: 0.8056  
Iteration 713: Treatment 2, Reward: 0, UCB: 0.8083  
Iteration 714: Treatment 0, Reward: 0, UCB: 0.8053  
Iteration 715: Treatment 1, Reward: 0, UCB: 0.8037  
Iteration 716: Treatment 2, Reward: 1, UCB: 0.8036  
Iteration 717: Treatment 2, Reward: 0, UCB: 0.8062  
Iteration 718: Treatment 3, Reward: 1, UCB: 0.8033  
Iteration 719: Treatment 3, Reward: 1, UCB: 0.8055  
Iteration 720: Treatment 3, Reward: 0, UCB: 0.8076  
Iteration 721: Treatment 3, Reward: 0, UCB: 0.8035  
Iteration 722: Treatment 1, Reward: 0, UCB: 0.8018  
Iteration 723: Treatment 2, Reward: 0, UCB: 0.8016  
Iteration 724: Treatment 1, Reward: 0, UCB: 0.7998  
Iteration 725: Treatment 3, Reward: 0, UCB: 0.7996  
Iteration 726: Treatment 0, Reward: 0, UCB: 0.7984  
Iteration 727: Treatment 1, Reward: 0, UCB: 0.7978  
Iteration 728: Treatment 2, Reward: 0, UCB: 0.7971  
Iteration 729: Treatment 1, Reward: 1, UCB: 0.7958  
Iteration 730: Treatment 1, Reward: 1, UCB: 0.7967  
Iteration 731: Treatment 1, Reward: 0, UCB: 0.7975  
Iteration 732: Treatment 3, Reward: 1, UCB: 0.7958  
Iteration 733: Treatment 3, Reward: 1, UCB: 0.7979  
Iteration 734: Treatment 3, Reward: 1, UCB: 0.8000  
Iteration 735: Treatment 3, Reward: 1, UCB: 0.8021  
Iteration 736: Treatment 3, Reward: 0, UCB: 0.8041  
Iteration 737: Treatment 3, Reward: 0, UCB: 0.8002  
Iteration 738: Treatment 3, Reward: 1, UCB: 0.7964  
Iteration 739: Treatment 3, Reward: 0, UCB: 0.7984  
Iteration 740: Treatment 1, Reward: 1, UCB: 0.7957  
Iteration 741: Treatment 1, Reward: 1, UCB: 0.7966  
Iteration 742: Treatment 1, Reward: 1, UCB: 0.7975  
Iteration 743: Treatment 1, Reward: 1, UCB: 0.7984  
Iteration 744: Treatment 1, Reward: 0, UCB: 0.7992  
Iteration 745: Treatment 1, Reward: 1, UCB: 0.7973  
Iteration 746: Treatment 1, Reward: 1, UCB: 0.7981  
Iteration 747: Treatment 1, Reward: 1, UCB: 0.7990  
Iteration 748: Treatment 1, Reward: 1, UCB: 0.7999  
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Iteration 750: Treatment 1, Reward: 0, UCB: 0.8016  
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Iteration 755: Treatment 1, Reward: 0, UCB: 0.7974  
Iteration 756: Treatment 1, Reward: 0, UCB: 0.7955

Iteration 757: Treatment 3, Reward: 1, UCB: 0.7951  
Iteration 758: Treatment 3, Reward: 1, UCB: 0.7971  
Iteration 759: Treatment 3, Reward: 0, UCB: 0.7991  
Iteration 760: Treatment 3, Reward: 0, UCB: 0.7953  
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Iteration 762: Treatment 1, Reward: 1, UCB: 0.7945  
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Iteration 764: Treatment 1, Reward: 0, UCB: 0.7962  
Iteration 765: Treatment 1, Reward: 1, UCB: 0.7943  
Iteration 766: Treatment 1, Reward: 1, UCB: 0.7951  
Iteration 767: Treatment 1, Reward: 1, UCB: 0.7960  
Iteration 768: Treatment 1, Reward: 0, UCB: 0.7968  
Iteration 769: Treatment 1, Reward: 0, UCB: 0.7949  
Iteration 770: Treatment 2, Reward: 1, UCB: 0.7939  
Iteration 771: Treatment 2, Reward: 1, UCB: 0.7964  
Iteration 772: Treatment 2, Reward: 1, UCB: 0.7990  
Iteration 773: Treatment 2, Reward: 1, UCB: 0.8015  
Iteration 774: Treatment 2, Reward: 1, UCB: 0.8039  
Iteration 775: Treatment 2, Reward: 0, UCB: 0.8064  
Iteration 776: Treatment 2, Reward: 1, UCB: 0.8019  
Iteration 777: Treatment 2, Reward: 1, UCB: 0.8043  
Iteration 778: Treatment 2, Reward: 0, UCB: 0.8067  
Iteration 779: Treatment 2, Reward: 0, UCB: 0.8023  
Iteration 780: Treatment 2, Reward: 0, UCB: 0.7980  
Iteration 781: Treatment 2, Reward: 1, UCB: 0.7937  
Iteration 782: Treatment 2, Reward: 1, UCB: 0.7961  
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Iteration 784: Treatment 2, Reward: 0, UCB: 0.7942  
Iteration 785: Treatment 0, Reward: 0, UCB: 0.7935  
Iteration 786: Treatment 1, Reward: 0, UCB: 0.7934  
Iteration 787: Treatment 3, Reward: 0, UCB: 0.7923  
Iteration 788: Treatment 1, Reward: 0, UCB: 0.7915  
Iteration 789: Treatment 2, Reward: 1, UCB: 0.7902  
Iteration 790: Treatment 2, Reward: 1, UCB: 0.7925  
Iteration 791: Treatment 2, Reward: 1, UCB: 0.7947  
Iteration 792: Treatment 2, Reward: 1, UCB: 0.7970  
Iteration 793: Treatment 2, Reward: 1, UCB: 0.7992  
Iteration 794: Treatment 2, Reward: 0, UCB: 0.8014  
Iteration 795: Treatment 2, Reward: 0, UCB: 0.7973  
Iteration 796: Treatment 2, Reward: 0, UCB: 0.7933  
Iteration 797: Treatment 1, Reward: 1, UCB: 0.7898  
Iteration 798: Treatment 1, Reward: 0, UCB: 0.7906  
Iteration 799: Treatment 2, Reward: 1, UCB: 0.7894  
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Iteration 801: Treatment 2, Reward: 0, UCB: 0.7938  
Iteration 802: Treatment 2, Reward: 1, UCB: 0.7899  
Iteration 803: Treatment 2, Reward: 1, UCB: 0.7920  
Iteration 804: Treatment 2, Reward: 1, UCB: 0.7941  
Iteration 805: Treatment 2, Reward: 0, UCB: 0.7962  
Iteration 806: Treatment 2, Reward: 1, UCB: 0.7924  
Iteration 807: Treatment 2, Reward: 0, UCB: 0.7944  
Iteration 808: Treatment 2, Reward: 1, UCB: 0.7906  
Iteration 809: Treatment 2, Reward: 0, UCB: 0.7927  
Iteration 810: Treatment 3, Reward: 1, UCB: 0.7892

Iteration 811: Treatment 3, Reward: 0, UCB: 0.7912  
Iteration 812: Treatment 1, Reward: 1, UCB: 0.7890  
Iteration 813: Treatment 1, Reward: 1, UCB: 0.7899  
Iteration 814: Treatment 1, Reward: 0, UCB: 0.7907  
Iteration 815: Treatment 2, Reward: 1, UCB: 0.7891  
Iteration 816: Treatment 2, Reward: 1, UCB: 0.7911  
Iteration 817: Treatment 2, Reward: 1, UCB: 0.7931  
Iteration 818: Treatment 2, Reward: 0, UCB: 0.7951  
Iteration 819: Treatment 2, Reward: 0, UCB: 0.7914  
Iteration 820: Treatment 1, Reward: 0, UCB: 0.7889  
Iteration 821: Treatment 2, Reward: 0, UCB: 0.7878  
Iteration 822: Treatment 3, Reward: 1, UCB: 0.7878  
Iteration 823: Treatment 3, Reward: 1, UCB: 0.7898  
Iteration 824: Treatment 3, Reward: 0, UCB: 0.7917  
Iteration 825: Treatment 3, Reward: 0, UCB: 0.7881  
Iteration 826: Treatment 0, Reward: 0, UCB: 0.7878  
Iteration 827: Treatment 1, Reward: 0, UCB: 0.7872  
Iteration 828: Treatment 1, Reward: 0, UCB: 0.7854  
Iteration 829: Treatment 3, Reward: 0, UCB: 0.7847  
Iteration 830: Treatment 2, Reward: 1, UCB: 0.7844  
Iteration 831: Treatment 2, Reward: 1, UCB: 0.7864  
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Iteration 834: Treatment 1, Reward: 1, UCB: 0.7837  
Iteration 835: Treatment 1, Reward: 0, UCB: 0.7845  
Iteration 836: Treatment 1, Reward: 1, UCB: 0.7827  
Iteration 837: Treatment 1, Reward: 1, UCB: 0.7836  
Iteration 838: Treatment 1, Reward: 1, UCB: 0.7844  
Iteration 839: Treatment 1, Reward: 0, UCB: 0.7852  
Iteration 840: Treatment 1, Reward: 1, UCB: 0.7834  
Iteration 841: Treatment 1, Reward: 1, UCB: 0.7843  
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Iteration 843: Treatment 1, Reward: 0, UCB: 0.7833  
Iteration 844: Treatment 1, Reward: 1, UCB: 0.7816  
Iteration 845: Treatment 1, Reward: 0, UCB: 0.7824  
Iteration 846: Treatment 0, Reward: 1, UCB: 0.7816  
Iteration 847: Treatment 0, Reward: 0, UCB: 0.7865  
Iteration 848: Treatment 2, Reward: 0, UCB: 0.7816  
Iteration 849: Treatment 3, Reward: 1, UCB: 0.7816  
Iteration 850: Treatment 3, Reward: 1, UCB: 0.7836  
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Iteration 852: Treatment 3, Reward: 1, UCB: 0.7874  
Iteration 853: Treatment 3, Reward: 1, UCB: 0.7892  
Iteration 854: Treatment 3, Reward: 0, UCB: 0.7911  
Iteration 855: Treatment 3, Reward: 0, UCB: 0.7876  
Iteration 856: Treatment 3, Reward: 0, UCB: 0.7842  
Iteration 857: Treatment 3, Reward: 1, UCB: 0.7809  
Iteration 858: Treatment 3, Reward: 1, UCB: 0.7827  
Iteration 859: Treatment 3, Reward: 0, UCB: 0.7845  
Iteration 860: Treatment 3, Reward: 0, UCB: 0.7812  
Iteration 861: Treatment 1, Reward: 0, UCB: 0.7809  
Iteration 862: Treatment 0, Reward: 1, UCB: 0.7802  
Iteration 863: Treatment 0, Reward: 1, UCB: 0.7850  
Iteration 864: Treatment 0, Reward: 0, UCB: 0.7897

Iteration 865: Treatment 0, Reward: 0, UCB: 0.7831  
Iteration 866: Treatment 1, Reward: 1, UCB: 0.7792  
Iteration 867: Treatment 1, Reward: 0, UCB: 0.7800  
Iteration 868: Treatment 2, Reward: 0, UCB: 0.7786  
Iteration 869: Treatment 1, Reward: 1, UCB: 0.7783  
Iteration 870: Treatment 1, Reward: 1, UCB: 0.7791  
Iteration 871: Treatment 1, Reward: 1, UCB: 0.7799  
Iteration 872: Treatment 1, Reward: 1, UCB: 0.7807  
Iteration 873: Treatment 1, Reward: 0, UCB: 0.7815  
Iteration 874: Treatment 1, Reward: 0, UCB: 0.7798  
Iteration 875: Treatment 3, Reward: 1, UCB: 0.7782  
Iteration 876: Treatment 3, Reward: 0, UCB: 0.7800  
Iteration 877: Treatment 1, Reward: 1, UCB: 0.7781  
Iteration 878: Treatment 1, Reward: 1, UCB: 0.7789  
Iteration 879: Treatment 1, Reward: 1, UCB: 0.7797  
Iteration 880: Treatment 1, Reward: 0, UCB: 0.7805  
Iteration 881: Treatment 1, Reward: 0, UCB: 0.7788  
Iteration 882: Treatment 1, Reward: 1, UCB: 0.7772  
Iteration 883: Treatment 1, Reward: 0, UCB: 0.7779  
Iteration 884: Treatment 0, Reward: 1, UCB: 0.7772  
Iteration 885: Treatment 0, Reward: 0, UCB: 0.7818  
Iteration 886: Treatment 3, Reward: 0, UCB: 0.7770  
Iteration 887: Treatment 1, Reward: 0, UCB: 0.7763  
Iteration 888: Treatment 2, Reward: 1, UCB: 0.7756  
Iteration 889: Treatment 2, Reward: 1, UCB: 0.7775  
Iteration 890: Treatment 2, Reward: 1, UCB: 0.7794  
Iteration 891: Treatment 2, Reward: 0, UCB: 0.7813  
Iteration 892: Treatment 2, Reward: 1, UCB: 0.7779  
Iteration 893: Treatment 2, Reward: 1, UCB: 0.7798  
Iteration 894: Treatment 2, Reward: 0, UCB: 0.7817  
Iteration 895: Treatment 2, Reward: 1, UCB: 0.7783  
Iteration 896: Treatment 2, Reward: 1, UCB: 0.7802  
Iteration 897: Treatment 2, Reward: 1, UCB: 0.7820  
Iteration 898: Treatment 2, Reward: 1, UCB: 0.7838  
Iteration 899: Treatment 2, Reward: 1, UCB: 0.7856  
Iteration 900: Treatment 2, Reward: 1, UCB: 0.7874  
Iteration 901: Treatment 2, Reward: 0, UCB: 0.7891  
Iteration 902: Treatment 2, Reward: 0, UCB: 0.7859  
Iteration 903: Treatment 2, Reward: 1, UCB: 0.7826  
Iteration 904: Treatment 2, Reward: 0, UCB: 0.7844  
Iteration 905: Treatment 2, Reward: 0, UCB: 0.7812  
Iteration 906: Treatment 2, Reward: 1, UCB: 0.7780  
Iteration 907: Treatment 2, Reward: 1, UCB: 0.7797  
Iteration 908: Treatment 2, Reward: 0, UCB: 0.7814  
Iteration 909: Treatment 2, Reward: 0, UCB: 0.7783  
Iteration 910: Treatment 0, Reward: 0, UCB: 0.7762  
Iteration 911: Treatment 2, Reward: 1, UCB: 0.7752  
Iteration 912: Treatment 2, Reward: 0, UCB: 0.7769  
Iteration 913: Treatment 1, Reward: 1, UCB: 0.7750  
Iteration 914: Treatment 1, Reward: 1, UCB: 0.7758  
Iteration 915: Treatment 1, Reward: 0, UCB: 0.7766  
Iteration 916: Treatment 1, Reward: 1, UCB: 0.7750  
Iteration 917: Treatment 1, Reward: 0, UCB: 0.7757  
Iteration 918: Treatment 3, Reward: 1, UCB: 0.7744

Iteration 919: Treatment 3, Reward: 1, UCB: 0.7762  
Iteration 920: Treatment 3, Reward: 0, UCB: 0.7780  
Iteration 921: Treatment 3, Reward: 0, UCB: 0.7748  
Iteration 922: Treatment 1, Reward: 1, UCB: 0.7742  
Iteration 923: Treatment 1, Reward: 1, UCB: 0.7749  
Iteration 924: Treatment 1, Reward: 1, UCB: 0.7757  
Iteration 925: Treatment 1, Reward: 1, UCB: 0.7765  
Iteration 926: Treatment 1, Reward: 0, UCB: 0.7772  
Iteration 927: Treatment 1, Reward: 1, UCB: 0.7756  
Iteration 928: Treatment 1, Reward: 1, UCB: 0.7764  
Iteration 929: Treatment 1, Reward: 1, UCB: 0.7771  
Iteration 930: Treatment 1, Reward: 1, UCB: 0.7779  
Iteration 931: Treatment 1, Reward: 1, UCB: 0.7786  
Iteration 932: Treatment 1, Reward: 0, UCB: 0.7794  
Iteration 933: Treatment 1, Reward: 1, UCB: 0.7778  
Iteration 934: Treatment 1, Reward: 0, UCB: 0.7785  
Iteration 935: Treatment 1, Reward: 0, UCB: 0.7769  
Iteration 936: Treatment 1, Reward: 0, UCB: 0.7753  
Iteration 937: Treatment 2, Reward: 1, UCB: 0.7743  
Iteration 938: Treatment 2, Reward: 0, UCB: 0.7760  
Iteration 939: Treatment 1, Reward: 0, UCB: 0.7738  
Iteration 940: Treatment 2, Reward: 0, UCB: 0.7730  
Iteration 941: Treatment 1, Reward: 0, UCB: 0.7722  
Iteration 942: Treatment 3, Reward: 0, UCB: 0.7721  
Iteration 943: Treatment 0, Reward: 1, UCB: 0.7709  
Iteration 944: Treatment 0, Reward: 0, UCB: 0.7754  
Iteration 945: Treatment 1, Reward: 1, UCB: 0.7707  
Iteration 946: Treatment 1, Reward: 0, UCB: 0.7714  
Iteration 947: Treatment 2, Reward: 1, UCB: 0.7701  
Iteration 948: Treatment 2, Reward: 1, UCB: 0.7718  
Iteration 949: Treatment 2, Reward: 0, UCB: 0.7735  
Iteration 950: Treatment 2, Reward: 1, UCB: 0.7705  
Iteration 951: Treatment 2, Reward: 1, UCB: 0.7721  
Iteration 952: Treatment 2, Reward: 0, UCB: 0.7738  
Iteration 953: Treatment 2, Reward: 0, UCB: 0.7708  
Iteration 954: Treatment 1, Reward: 1, UCB: 0.7700  
Iteration 955: Treatment 1, Reward: 1, UCB: 0.7707  
Iteration 956: Treatment 1, Reward: 1, UCB: 0.7715  
Iteration 957: Treatment 1, Reward: 0, UCB: 0.7722  
Iteration 958: Treatment 1, Reward: 1, UCB: 0.7707  
Iteration 959: Treatment 1, Reward: 0, UCB: 0.7714  
Iteration 960: Treatment 1, Reward: 1, UCB: 0.7699  
Iteration 961: Treatment 1, Reward: 1, UCB: 0.7706  
Iteration 962: Treatment 1, Reward: 0, UCB: 0.7713  
Iteration 963: Treatment 1, Reward: 1, UCB: 0.7698  
Iteration 964: Treatment 1, Reward: 0, UCB: 0.7705  
Iteration 965: Treatment 0, Reward: 0, UCB: 0.7698  
Iteration 966: Treatment 3, Reward: 0, UCB: 0.7694  
Iteration 967: Treatment 1, Reward: 0, UCB: 0.7690  
Iteration 968: Treatment 2, Reward: 1, UCB: 0.7682  
Iteration 969: Treatment 2, Reward: 1, UCB: 0.7698  
Iteration 970: Treatment 2, Reward: 0, UCB: 0.7714  
Iteration 971: Treatment 2, Reward: 1, UCB: 0.7686  
Iteration 972: Treatment 2, Reward: 1, UCB: 0.7702

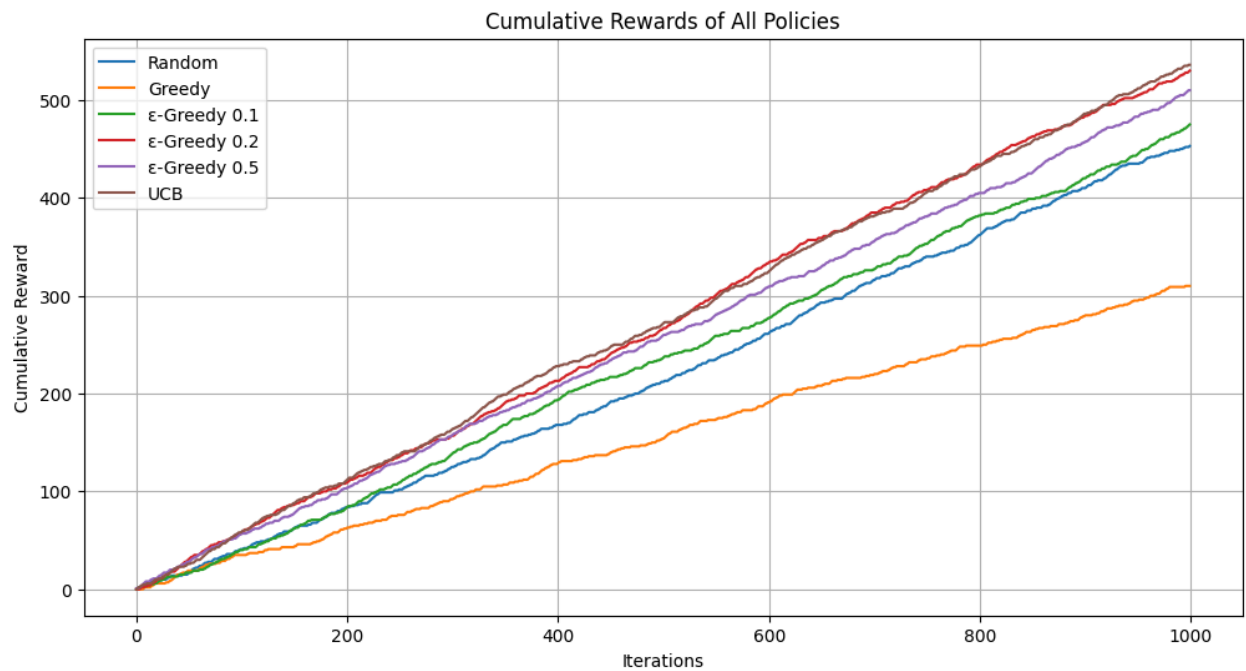
```
Iteration 973: Treatment 2, Reward: 1, UCB: 0.7717
Iteration 974: Treatment 2, Reward: 0, UCB: 0.7733
Iteration 975: Treatment 2, Reward: 0, UCB: 0.7705
Iteration 976: Treatment 2, Reward: 1, UCB: 0.7677
Iteration 977: Treatment 2, Reward: 0, UCB: 0.7692
Iteration 978: Treatment 1, Reward: 1, UCB: 0.7676
Iteration 979: Treatment 1, Reward: 0, UCB: 0.7684
Iteration 980: Treatment 1, Reward: 0, UCB: 0.7669
Iteration 981: Treatment 3, Reward: 1, UCB: 0.7666
Iteration 982: Treatment 3, Reward: 0, UCB: 0.7683
Iteration 983: Treatment 2, Reward: 0, UCB: 0.7665
Iteration 984: Treatment 1, Reward: 1, UCB: 0.7654
Iteration 985: Treatment 1, Reward: 1, UCB: 0.7661
Iteration 986: Treatment 1, Reward: 1, UCB: 0.7669
Iteration 987: Treatment 1, Reward: 0, UCB: 0.7676
Iteration 988: Treatment 1, Reward: 1, UCB: 0.7661
Iteration 989: Treatment 1, Reward: 1, UCB: 0.7668
Iteration 990: Treatment 1, Reward: 0, UCB: 0.7675
Iteration 991: Treatment 1, Reward: 0, UCB: 0.7661
Iteration 992: Treatment 3, Reward: 0, UCB: 0.7654
Iteration 993: Treatment 1, Reward: 1, UCB: 0.7646
Iteration 994: Treatment 1, Reward: 1, UCB: 0.7653
Iteration 995: Treatment 1, Reward: 1, UCB: 0.7660
Iteration 996: Treatment 1, Reward: 0, UCB: 0.7667
Iteration 997: Treatment 1, Reward: 0, UCB: 0.7653
Iteration 998: Treatment 0, Reward: 0, UCB: 0.7647
Iteration 999: Treatment 2, Reward: 1, UCB: 0.7640
Iteration 1000: Treatment 2, Reward: 0, UCB: 0.7656
```

Plot the cumulative rewards for all policies on a single graph to compare their performance. (0.5M)

In [25]: *#-----write your code below this line-----*

```
# Plot cumulative rewards across all policies
plt.figure(figsize=(12,6))
plt.plot(random_cumulative, label='Random')
plt.plot(greedy_cumulative, label='Greedy')
plt.plot(eg_cumulative_10, label='ε-Greedy 0.1')
plt.plot(eg_cumulative_20, label='ε-Greedy 0.2')
plt.plot(eg_cumulative_50, label='ε-Greedy 0.5')
plt.plot(ucb_cumulative, label='UCB')
plt.xlabel("Iterations")
plt.ylabel("Cumulative Reward")
plt.title("Cumulative Rewards of All Policies")
plt.legend()
plt.grid(True)
plt.show()
```





## Conclusion (0.5M)

write a conclusion (approximately 250 words) summarizing which treatment policy was most effective. Discuss the balance between exploration and exploitation in your simulations.

----write below this line-----

The UCB policy was the most effective in maximizing cumulative rewards over 1000 iterations. It dynamically balances exploration and exploitation by adjusting confidence intervals, thus identifying high-performing arms while occasionally exploring others.  $\epsilon$ -Greedy with  $\epsilon=0.1$  also performed well, suggesting that controlled exploration yields better long-term performance. Pure Greedy and Random strategies were less reliable as they either overexploited too early or lacked any strategic selection, respectively.