Carnegie Mellon University
Computer Science Department

# OPTIMIZED, UNIVERSAL RESOURCE-SHARING TEMPLATE USING BLOCKCHAIN

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## Research Goal

We investigate the "Cap and Trade" scheme as a potentially universal strategy to share resources among users fairly and optimally.

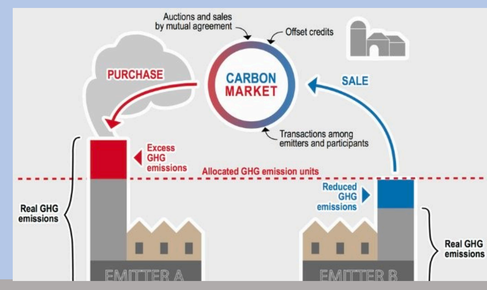
In order to gauge the feasibility and user behavior in C&T, the research first constructs a pilot test experiment to study the effectiveness of C&T. The domain chosen is the on-campus online OHQ.

This Independent Study is an effort to test the relative merit of a C&T scheme applied to the online OHQ.

## What is Cap n Trade (C&T)?

A system for controlling atmospheric pollution by which an upper limit is set on the amount a given organization may produce but which allows further capacity to be bought from other organizations that have not used their full allowance.

This research proposes that C&T has several applications beyond the classical economic strategy of controlling pollution emissions




## Applications

Effective resource sharing has the added advantages of time-saving, decongestion - meriting many applications of this research:

- Road traffic decongestion
- Need-sensitive queueing
- Internet traffic regulation
- Mobile network regulation
- Quota management
- Fair share and usage control

## Why Blockchain?

For a general use case, blockchain is an ideal platform technology with the following merits:

- Distributed
- Wide scalability
- People owned
- Voluminous transactions
- Security
- Anonymity
- Fault-tolerance

## Experiment

We pilot test three models – **FIFO**, **AMORT** and **C&T** and compute the fairness coefficient, $\Phi_{fair}$, for each.

Each model is encoded as a tuple of research defined metrics*. $\Phi_{fair}$ is a weighted linear combination of model metrics as below

$$\Phi_{fair}(model = < p_1, p_2, \dots, p_n >) = \Sigma_{i=1}^{n} w_i p_i$$

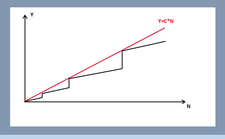
*Note that the model defining metrics are omitted from this poster for brevity

### FIFO Model

This is current system in place. At office hours, a TA opens the virtual queue. Students are put into the queue in a first come, first serve basis. Given the rapid sign on at the start of OH, this is mostly a random FIFO assignment.


### AMORT Model

In this system each student receives X amount of tokens per class at the start of the semester. At office hours, a TA opens the virtual queue. Students can quickly place their bids (in terms of # of tokens). Students are now placed into the queue based on their bids.



### C&T Model

This is the AMORT model with the addition of students being able to trade unused tokens amongst each other in return for student contribution points. A student contributor leaderboard acts as incentive for people to trade away unused tokens. Users can also trade within the queue to be promoted up the queue in exchange for tokens given to someone being demoted down.

## Hypothesis

$$\Phi_{fair}(C\&T) > \Phi_{fair}(AMORT) > \Phi_{fair}(FIFO)$$

## Accomplishments and Future Work

- Proposed an original research project and was endorsed by advising professors.
- Onboarded a team of highly motivated freshmen to continue the project.
- Formalized the FIFO, AMORT and C&T models for OHQ.
- Partnered with OHQ team to fork code and set up research code base.

Current Progress

- Implement AMORT and C&T models in code next semester.
- Expand pilot test to Print Quota, Wi-Fi bandwidth usage etc.

Future work

## References and Acknowledgements

1. "A comparative analysis between traditional and blockchain driven 'tradable road permit scheme markets' to examine improvements in market transaction costs, credit supply and trade, equilibrium prices, anti-fraud and public participation" - Akshat Prakash, Yuneil Yeo

2. "BeepBoop": first prototype of blockchain based traffic alleviation app on Hyperledger composer – Jeffrey Chen, Serano Tannason Ng, Akshat Prakash