



The Crypta Academic Aid Fund

MHCI Capstone 2019: The Crypto Crew

The AAF is the financial backbone system for Crypta, an CMU-exclusive cryptocurrency that protects students' personal data.

This paper helps distill the *purpose* of the AAF, some of its *key mechanisms*, and *future challenges & possibilities*.

Key Terms:

- **Academic Aid Fund (AAF):** The pool of money made up of 1) research grant money and 2) donations from alumni, organizations, etc. Students trade their Crypta for an allotted portion of money in the AAF to use towards their student loans or to cash out. The AAF lives within the CMU HUB.
- **Crypta:** The CMU cryptocurrency (virtual coin). The CMU HUB retains a reserve of Crypta.
- **cBase:** Research project platform
 - Researchers can post their research and request specific student data, rewarding students with Crypta for participation.
 - Participants can sign up for research, decline or grant access to specific data points to be involved in research and receive Crypta as compensation.
- **Printing:** Creation of new Crypta by the HUB
- **Inactive Crypta:** Crypta that is not backed by grant dollars and is not being circulated in the market.

Executive Summary

The Crypto Crew is proposing a research grant & donation-funded, cryptocurrency-based agglomerated collective of monetary reserves called the Academic Aid Fund (AAF). The AAF will provide as an incentive for students to participate in research and spend Crypta. The AAF, in effect, will cycle a fully digital currency on campus. Our mission is to give students a secure process to transfer their personal data and be rewarded with a secure form of currency, in a way that supports the continuous flow of new ideas, experiments, startups, collaborations and inventions. The AAF & Crypta make up a system that is fully reinforced from top to bottom both in value and in how individuals can earn Crypta. The fund would be open to any student on campus and would be earned through doing research studies, thus contributing to a major community on the CMU campus.



Purpose of the Fund

CMU has always been committed to making the student experience as accessible and manageable as possible. Additionally, CMU has always been at the technological forefront in innovative solutions for the world's most nebulous problems, including within the realm of digital currency. This fund attempts to do both:

- 1) Establish a **novel, functioning cryptocurrency system** that is useful in **student's day-to-day lives**
- 2) Give students **a channel through which to earn money** towards paying off their education as they are completing it. It is a fund that is accessible to the students of Carnegie Mellon University throughout their four or more years on campus.

Market Analysis

Up until now, there has not been a cryptocurrency that is designed for everyday use. It is a chicken-and-egg problem, mostly between perceived value and circulation. If a currency doesn't have any perceived value, people will not use it, and it won't circulate. Likewise, if a currency isn't circulating, people will perceive that it probably doesn't have any value. As such, cryptocurrencies such as Bitcoin rely solely on speculation as a mechanism for maintaining value, much like an investment. However, cryptocurrencies are even further removed from a currency-like value, as major cryptocurrencies are not reliably backed by any base source of money (such as trusted government debt with the US Dollar). This further hinders the already-sluggish adoption of cryptocurrencies as a daily fiat currency that can purchase goods and services.

The AAF proposes a way in which Crypta can differentiate itself from previous cryptocurrency. Crypta relies on two fundamental functions:

- 1) It is backed by a stable pool of money dictating that the exchange rate of Crypta never falls below 1 to 1.
- 2) Crypta exists as a trackable medium to earn money, and is not money itself.

Because Crypta can be utilized to earn a portion of the AAF money, Crypta exists as a *de facto* medium to exchange money, while never competing with actual currency. Likewise, the AAF structure never allows Crypta to drop below a 1-to-1 Crypta to dollar rate. The highly trackable and secure nature of cryptocurrency means that Crypta functions to yield important information on how money is being earned and spent, without revealing sensitive data on who is using the Crypta or how much is being transacted.



AAF Model

Participants

Participants sign up to participate in research. In exchange for providing data, the participants are compensated with Crypta. Automatically, students then claim a portion of the money available within the AAF with that Crypta. The AAF is not a collective pool; participants can only access funds within the research project they participate in. Until any “cashing out” takes place, students remain in possession of their Crypta, while their allotted portion of research money remains in place within the AAF. Whenever students want to receive their allotted portion of the fund, they submit their Crypta to the HUB. Students can then either “cash out”, receiving money from the AAF through the HUB, or they can apply their fund portion to their student loans, tuition, etc. As of now, cashing out will always yield at least a 1-to-1 dollar exchange rate.

Researchers

Researchers apply for IRB approval and then begin the process of applying for grants. Once funding has been received and all the proper approvals are gathered, the researchers submit the funding portioned for participant recruitment and compensation to the AAF, within the HUB. In exchange, the researchers receive the direct, \$1 = 1 Crypta exchange rate for their funding from the HUB. This Crypta is directly tied to the specific study and can only be given out to individuals who participate with that specific study. However, extraneous Crypta may roll over to the next study under the same researcher. It cannot be exchanged back into dollars.

When participants take part in a study, they lock in a certain amount of Crypta, decreasing the available amount of Crypta for the study. A researcher can run multiple studies with multiple funding amounts, and each one is associated with a specific block of Crypta. This keeps free cash or money from just floating around a lab room or being misplaced. Everything is tracked by the cryptocurrency and secured in the agglomerated, although not collective, fund held by CMU.

AAF Reserves

The AAF is made up of two pools of money; one from research grants, the other from donations. The research grant portion is designed to provide Crypta with a clear backing from the US dollar, always at a 1-for-1 exchange rate with research grant money for participants. Participants will have a “piece of the pie” associated and reserved by their Crypta within the grant money pool. Therefore, **participants will always get at least 1 dollar for every 1 Crypta they earn**. This is designed to prevent volatile fluctuations of Crypta as it gets used, valued, and devalued.

The core function of the donation pool within the AAF is to supplement the funding brought in by research grants, and provide more incentives for CMU individuals to participate in research. **Every dollar donated to the donation pool is spread evenly among the amount of Crypta earned through research**. This



is in contrast to spreading donation money among amount of participants present, because certain participant might choose to be involved in more research than others, thus earning more Crypta for themselves. Alumni and other organizations are motivated to donate to this pool to support current students in their academic ventures.

Crypta Fluctuations

For every amount of Crypta students earn, they also earn a 1-to-1 amount of research grant money plus a percentage of the donation pool. This percentage is governed by how many total dollars are in the donation pool versus how many Crypta are retained by students. This can be summed up in the equation:

$$\frac{\$d}{\#c} + \frac{\$c}{\#c}$$

Where d = total donation money, and c = total number of Crypta retained. This can be simplified to:

$$\frac{\$d}{\#c} + 1$$

From this equation, we can see that students earn 1 dollar per Crypta they earn (from research grant money), **plus** a fluctuating percentage of the donation pool. The equation necessitates that even small donations have a significant positive impact on the exchange rate above \$1 to \$1 C. So alumni can help support the welfare & well-being of students by donating even small amounts of money to the AAF.

In Summary:

By doing research and accumulating Crypta, a student is able to apply more money from the AAF to their student loans than the initial Crypta amount was originally worth. The Crypta that participants receive from engaging with research will always start at the base 1-1 rate with researcher grant money. After participating in research sessions, students have the chance to watch their Crypta grow in value, as the exchange rate is recalculated with the process of increasing donations and when people earn more Crypta. Students can also decide to “cash out” when the exchange rate is cooling off, when more Crypta is entering the system, or when they’d just like to have money for daily expenditures. The exchange rate will never drop below the direct exchange rate of the grant funding for the Crypta, so users have a guaranteed base value for their Crypta that can only increase as donations come in.

Differentiation

What’s the current state?

Researchers are constantly managing large sums of physical cash, often in insecure settings (folders, bookshelves, etc.). Additionally, cash is paid out to participants and the paper trail is often a physical roster document with a number of possible breakdown points, including forgetting to sign the document



and connecting payments to anonymized participants. Cash can even sometimes “disappear”, a stressful prospect for any researcher handling government-granted funds. Lastly, the process is inefficient, requiring researchers to go to their Principal Investigator (PI) to get approval and allocate the cash. Crypta would streamline this whole flow, allowing dispensation of payment from PI to researcher and researcher to participant fully online. It would be trackable and completely encrypted, ensuring that the payment goes exactly where it is supposed to go.

Market Advantages of Crypta:

1. Crypta relies on an existing flow of cash.

Crypta does not require an accrual of interest or a return on investment to maintain the pool of assets. This is a major advantage of the base asset pools being research grants and donations, two forms of payment that need not be repaid. In this way, no Crypta is lost in the system by “friction”, or any loss of value due to loans or interests.

2. Crypta has a guaranteed baseline of value.

Since the fund has a replenishing store of liquidity that comes through it via the fresh pool of grant money for participant recruitment, the fund is guaranteed to always have a stable, predictable amount of value. Investors who wish to contribute to the fund would only be able to add donations, which permits the value of crypta to only fluctuate upwards.

3. The AAF is a closed, repeatable ecosystem.

Though other cryptocurrencies are shooting for global usage, such as a digital currency that can be exchanged *ad infinitum* with other fiat currencies, we believe these characteristics are previously-established cryptocurrencies’ greatest limiting factor. This system would require a company’s business development sector to discover and secure partners within mainstream financial systems to build an ecosystem from the ground up. By current financial projections, this might take years to get off the ground, if at all, considering the US governments’ inherent skepticism and trepidation with dealing with cryptocurrency.

Thus, here is the crux of our advantage: The value of Crypta derives just as much financial credibility from a stable exchange rate (financial value) as it does giving users power over their personal data (non-financial value). Likewise, the size of the AAF uniquely positions it as a testbed to discover how a digital medium of currency functions when used by actual people, day-to-day. This will be able to inform how to tweak, translate, and scale the AAF beyond CMU.

Where Will the Fund Live?

Students will initially go through an internal CMU Crypta taskforce who will manage the exchange of Crypta for academic aid. Eventually this mechanism will be built into the blockchain so that it can be executed automatically and without delay.

In the long term, we propose that this system live within the CMU HUB. Though there are a number of different potential homes for the AAF (in particular the CMU Office of Fellowships and Scholarships), we believe the HUB is the most advantageous office at CMU to situate the AAF. This is because the HUB is the center of financial exchange between CMU and various parties on campus. The AAF is intentionally



separate from the Office of Fellowships and Scholarships because the AAF is *not* a scholarship. It is not granted on merit or comes with added prestige. It purely exists for currency exchange in the aid of students.

Gaps, Pitfalls, Risks

While we believe that the AAF, as a reserve of monetary value for Crypta, has been stress tested, it is generally impossible to predict how it will operate without physically observing working mechanisms in real time. Therefore, here are some areas of risk we have identified, along with our suggestions to tackle it.

Printing Unbacked Crypta

A question that consistently came up is whether Crypta can be printed or “mined.” Mining Crypta is *definitively prohibited* as it makes it impossible to guarantee that each Crypta is backed by a dollar amount. New Crypta can only be printed by the HUB solely when new grant dollars come in. To ensure numbers do not get misaligned (hence having Crypta that exists without backing value), there would likely need to be a technical solution in place that ensures that new grant money is always first paired with “inactive” Crypta in the Reserve, before printing any new Crypta.

Mechanism of Cashing Out

With the exchange of Crypta happening at the HUB, the most logical ‘cashing out’ method for students is to have their exchanged cash direct deposited into a bank account linked with their CMU SIO. This mechanism does not exist currently, although we envision other possibilities in the future as well, including letting the exchanged cash directly apply to tuition invoices, Plaid Cash balances, or print quotas. Additionally, in a future state, there could potentially be an option to donate Crypta towards future research, groups on campus to which an individual might be affiliated, or other initiatives.

“Forced” Cashout by Graduation

There is currently no mechanism in place that deals with graduating students’ unexchanged Crypta. In order to maintain the balance of the Crypta ecosystem within CMU, we recommend that there be an automatic cashout when students graduate, to their linked bank account in CMU SIO. In this way, the risk of unbalanced books is not exacerbated.

Other open questions to think about:

- **Is there a need to manage large donations?**
 - As mentioned previously, even small sums of money can have a significant positive impact on the exchange rate of Crypta (See Crypta Fluctuations, pp. 3). We are curious to see how this model fluctuates in real time. Potentially, there may be a need to enforce an upper cap on donations, to manage the potential volatility of the exchange rate.
- **Similarly, should the AAF have blackout periods?**



- There is a possible future where CMU might be interested in using a percentage of donation dollars in the AAF to fund other projects, and allow Crypta holders to accrue interest. In this case, there is a possibility that CMU may want to impose specific, limited blackout periods where people are not allowed to cash out, and CMU can utilize the funds for its purposes.

Roadmap Recommendations

Initial Mechanisms & Funding Request

The AAF would be run initially as an experiment via the CBDR and the Tepper School of Business, the latter of which would maintain the investment of funds, whether through department budget or via investors. For experimental purposes, halfway through both the Fall and Spring Semesters, PNC will provide a small donation (\$500 each time) to push the AAF into its fully-functioning flow state of varying exchange rates for Crypta. We predict that these two basic mechanisms would be enough to generate a first round of data points that will help us significantly understand how the system would operate in the real world. From here, we would like to explore some time benchmarks as cBase, Crypta, and AAF begin to be adopted by other researchers and students at CMU.

One Year Benchmark: Proof of Concept

In one year, we propose that a proof-of-concept be established with a discrete fund set up through the Tepper/PNC partnership, with **one lab as the testbed**. In order to initiate the launch, buy-in would be needed from the Principal Investigator of the lab and two people on the Tepper side in charge of acting as the “HUB” (one person running exchanges and one person updating the exchange rate as donations come in). An early estimate is that a baseline total fund of \$1,000 dollars should be established as the initial grant for research. This translates to 1,000 Crypta which can be distributed to roughly 100 participants, at an average study compensation rate of 10 C / completed research session. In terms of the second lever point, in the first year, we recommend two donations of \$500 - 1000 each from PNC: one will happen in the middle of the Fall Semester and one will happen in middle of the Spring Semester. This will help kickstart data collection on how the donation pool is incentivizing students to earn & use Crypta.

Three Year Benchmark: Assessing the Health of cBase, Crypta, and the AAF

At this point, we hope that the cBase infrastructure is deemed functional enough for the migration of at least 50% of the existing SONA pre-screened data into the new system. This implies that researchers beyond the scope of the first-year benchmark have begun to adopt cBase and use it regularly. A further marker of health for cBase will be the widespread utilization of the system not just by researchers within Tepper, but also in common usage within other departments at CMU. Likewise, we hope the adoption of cBase by CMU Admissions will begin to append students' personal data to the blockchain network as they matriculate.

We believe that in a healthy cryptocurrency ecosystem at CMU, Crypta will be actively employed by multiple labs on campus as the main method of payment. At the same time, more students beyond just



those that are *required* to do research are participating to earn Crypta. A marker of success here will be the widespread usage of Crypta across the student body, whether students are cashing out or retaining their Crypta as a form of investments for their student expenditures and loans.

Five Year Benchmark: Looking to the Future

As cBase becomes embedded into the lifeblood of CMU, we visualize this system as the main database used for student data on campus, owing to its advantages in security, encryption, and powerful control it hands to the individual (while not limiting value to CMU as a whole). Additionally, we predict that cBase could eventually be used on and between multiple CMU campuses, to foster the collaboration of researchers (and potentially even participants) internationally, to improve upon scientific methods, results, and conclusions on a much broader scale.

We project that once Crypta is widely adopted by the majority of the student population, it will likely begin to retain a **value in and of itself**. This is an exciting tipping point where Crypta will begin to modulate from a secure medium to transfer dollar bills, to becoming a trusted currency on its own. We foresee students being able to spend, trade, and earn Crypta through unregulated, yet encrypted P2P transactions. Both CMU and PNC will be able to monitor these transactions on a high-level, to inform the scalability of this system as they begin to formulate applications for cBase, Crypta, and the AAF outside the sphere of CMU.

Big Picture Applications

We begin to explore this possible near future, where students who apply for undergraduate or graduate school at CMU and other institutions can control their academic data, who is able to access & transact with this data, and how benefits might be received from these transactions. Each individual owns their own secure node in the blockchain network, which includes academic data such as their GPA, classes, & positions held in extracurricular activities, as well as deeply personal information, such as addresses, bank account information, and health data.

Beyond this near future, we envision a world of companies and users where an individual's data backs the value of currency, as opposed to government debt. In this future, we would eliminate 3rd party advertisers and instead bring companies directly to users, giving users control over who sees their data. Individuals would be empowered to be in sole governance of their data, and how it is transferred and transacted as a commodity.

Parting Thoughts

The AAF is positioned to motivate and incentivize individuals to adapt to a blockchain-based platform where they own their private data. We, as the Crypto Crew, hope to utilize the AAF and Crypta to usher in a new era of decentralized internet, one where students are empowered to own their personal data, and how it is transacted. By familiarizing students with a digital currency backed by actual dollars, we hope to accomplish the eventual large-scale societal adoption of a stable, readily available & usable virtual currency like Crypta.



FAQ

Can you exchange \$ for Crypta?

No, this system rewards engagement and compensates for data; it is not an investment model for financially well off students to manipulate.

When do researchers apply for Crypta?

Researchers apply for funding from the NSF and other funding organizations. With their applications, researchers include a budget line item outlining how much of the funds they will use to recruit and compensate participants in exchange for their data. Once this application is approved and the researcher or lab is given the funds, the amount listed in their recruitment and compensation line item is transferred to the AAF. The researcher or lab account is then populated with the equivalent amount of Crypta which can then be sent out to each participant.

What happens to unused Crypta?

It rolls over to the next study the lab is doing.

Do we cap the upper value of the Crypta to \$ exchange rate?

No, it can increase or decrease naturally per the amount of Crypta and donation money.

Does there need to be confirmation that only researchers that bring funding to the AAF, get Crypta?

Yes. At the moment this model of accessing the AAF and using Crypta will be limited to researchers that are bringing funding into the grant money pool.

Do all researchers pool the funds together?

No, each researcher gets the direct exchange value of their specific funding from the grant converted into Crypta to be used as compensation for participants.

Can researchers cash in their Crypta for money?

No, only participants will be able to fulfill this exchange.

If the exchange rate is one to one, why use Crypta?



Crypta is a secure token - it is a medium to earn money with, and not exactly money in and of itself. Crypta also fluctuates positively to give you more than just a 1-to-1 exchange rate, based off of current donations entering into the AAF.

What if researchers get approved for funding and research in the middle of the semester?

They add more money to the fund and they are given Crypta to use and get participants.

If you are at your Crypta limit, can you still add more students?

No. Crypta is 1-to-1 with research dollars. If you need more students, you'll need more funding.

Does CMU mine or print new crypta every semester?

CMU will have a reserve of inactive Crypta that have no value. Once the funding arrives, the specific amount of Crypta equaling the funding amount is activated and associated with that particular research project.

What happens when funding fluctuates?

There is a direct baseline exchange rate that does not fluctuate. Money from grants will always be matched *at least* by 1 Crypta per 1 dollar to ensure compensation for participants.

How is Crypta mined or printed?

The CMU HUB can "print" Crypta **only** when new grant money comes in.

When do we calculate the exchange rate from Crypta to Dollars?

Exchange rate can fluctuate daily per donations & "cashing out" of Crypta.

