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Using Blockchain to Streamline the College Application Process

Commercialization Plan

Elevator Pitch: Imagine a student just starting the college process, completely unfamiliar with the system, potentially missing out on certain colleges because they might not be aware of them or falsely believe they lack the qualifications. Or imagine an admissions officer reviewing a list of awards, unsure if the awards are truthful. Blockchain could solve these problems by creating one, unified network with data that is easy to validate and also connect students to relevant colleges through smart contracts.

Executive Summary

The goal of this project is to bring authenticity, integrity, and equity to the college admissions process. Lower-income groups are underrepresented at colleges as they may not have the resources to find a suitable college or have apprehensions about applying. Moreover, their access to attaining admissions can be further limited by the lack of verified information about their awards, informal service, and other accomplishments.

Blockchain is a possible solution to this problem. Because blockchain is tamper-resistant and requires signatures for each piece of data, admissions officers can trust data uploaded to the blockchain. In the current scenario, an admissions officer would have to take the time-consuming and impractical process of emailing or calling every organization (sometimes ones that are informal or esoteric) to verify information.

Additionally, blockchains support smart contracts, bits of code that perform tasks with data. They can do simple tasks, such as sorting students by test score or give extra credit points if a student submits an assignment. Moreover, because the blockchain stores all data relevant to the college application process (grades, activities, awards, etc.), smart contracts can accurately make recommendations, helping students and their counselors identify better college matches. Accordingly, students would feel more enthusiasm and less stress, leading to improved attempts at applying and accessing a college.

If successfully adopted, this application will make the college application process not only simpler for students and high schools, but more importantly, it will help students maximize their potential and future upward mobility.

Problem Summary and Proposed Solution

Attaining higher education remains one of the most important drivers of social mobility in this country. However, the process isn't perfect. Students are often completely new to college applications; unless they have an older sibling, knowledgeable parent, or supportive counselor, they often lack the resources to properly enact a full college search, much less

navigate every admissions hurdle. In fact, those in the bottom 20th percentile for income are 77 times less likely to attend an Ivy League school than those in the top 1%, no doubt because of a dearth in guidance (Chetty 2017). From the alternate perspective of the college, verification of student data can be a time-consuming task. While grades and test scores are easily verified, extracurriculars and awards are harder to properly validate.

Blockchain can help solve these issues. Every activity or award (formal or informal) can be uploaded and signed by a verified organization, which will give college admissions officers a more accurate view of a student's accomplishments, interests, and life. Moreover, the blockchain stores a historic and holistic record of a student's activities and interests, which can be utilized with a smart contract to deliver targeted college recommendations. The blockchain will also support high school counselors by making it easier to send documents to colleges, and the same smart contracts that help students can aid counselors in making college recommendations.

Summary of the STEM Concepts and Principles Underlying the Overall Plan

Blockchain is a data storage technology in which pieces of data are put into blocks. Each block has its own unique identifier known as a hash code, as well as the identifiers for the blocks created before and after it. This hash code is calculated based on all the data in the block, so if any piece of information inside is modified, the hash code will change. Therefore, the block after will point towards an invalid hash code, and the chain will be broken, making it easy to detect manipulation of data. However, it is possible for a computer to modify the data of a block and then "fix" the next block by changing its previous pointer to the new hash code. In this case, the hash code of next block will be changed, and the process has to be repeated for all future blocks. To combat this, every member in the network has a copy of the blockchain, so modified chains can be detected by comparing them to other copies. This ensures that the blockchain is essentially immutable, because a hacker would not only have to modify his own blockchain, but also the ones on many different computers. In regard to the college application process, this means that data, once on the blockchain, cannot be modified. Additionally, each

piece of data is “signed” by the user that uploaded it, which means that it’s easy to determine if certain pieces of data are valid (e.g. a college admissions officer can see that it was a student’s high school uploaded the transcript, not someone else).

The blockchain used in question is a private, managed blockchain, which adds a few more features. In a traditional application (e.g. bitcoin), every piece of data is visible to everyone, but this would be a breach of privacy. Instead, each piece of data is encrypted, and a permissions system limits the read and write capabilities of certain users. This means, for example, a teacher is able to restrict the visibility of a student’s grades to just that student. A private, managed blockchain also requires an administrator role that manages adding users to the blockchain, since this blockchain is restricted to those involved in the college application process.

Smart contracts are another important aspect. They are scripts that can be stored on the blockchain and can be used to automate tasks. For example, a very simple smart contract could be deployed by a college admissions office to filter out students by test score or for a teacher to automatically add bonus points if an extra credit project is submitted. However, they could also be much more complex. Because this blockchain stores all the data relevant to the college application process, a smart contract could use this data to recommend colleges to students they might not know about and potentially improve its own model by detecting trends. In sum, smart contracts can make the college process easier for everyone and also offer more opportunities to students.

Commercialization Assessment of the Overall Plan

Problem, pain point or market opportunity:

It’s hard for students without many resources to find the right college for them. Additionally, it’s hard for colleges to verify activities and awards that students may submit.

Proposed solution:

A unified blockchain system would create a verifiable record of everything college application related for colleges, guaranteeing accuracy and honesty in the process. Moreover, smart contracts would make the process much easier for everyone and have the potential of finding better fits for students and colleges.

Target customers and intended users:

Customers will likely be high schools, colleges, and external organizations (e.g. College Board, local food bank). Students, teachers, and admissions counselors are intended to use the application, but targeting will be done through high schools and colleges.

Competitors:

Competitors include the Common App, Coalition for College, the Universal College Application, and other college application forms (e.g. UC application, MIT application).

Customer value proposition & competitive advantage:

For high schools and their college counselors, this system will not only streamline the college admissions process (smart contracts can automate tasks and instead of sending documents, high school counselors can simply make data visible to the requesting college), but it will also guarantee that students can get a better college fit through recommendations that complement their counselor recommendations. Moreover, each student will have a record of their high school career, empowering them to take a more active role in the college search and admissions process.

For colleges, smart contracts can do simple tasks such as filter or rank students by numerical measures. And since the recommendations from smart contracts can encourage more suitable students to apply to a particular college, the admissions committee can create a

better incoming class. Additionally, blockchain data can help an admissions officer easily verify certain pieces of data, such as awards, by simply checking who uploaded the data, something that isn't possible in the current system.

For external organizations associated with awards and extracurriculars, this system saves them the work of responding to verification requests. Instead of sending signed letters or answering phone calls or emails about work, each external organization simply needs to upload a piece of data detailing and verifying what a student has done.

Principal revenue streams expected:

Revenue streams will include fees from colleges, high schools, and external organizations to use the system.

Principal startup and operating costs expected to be incurred:

Costs will include system maintenance workers to ensure the system runs smoothly, administrators who will be in charge of adding high schools, colleges, etc. to the blockchain, and potentially server costs for storing a copy of the blockchain. One blockchain developer (which will likely be enough for the first year) will cost roughly $150,000 and perform tasks such as fixing bugs and adding new organizations (*What Is The Average Blockchain Developer Salary in 2020?*, 2020). AWS server space for storing the blockchain will cost $282 per terabyte per year, which is a reasonable estimate for the first year, since the data will be mostly text (Ramachandran, 2020).

Science and Technology Proof of Concept

Blockchain technology, specifically the private, managed variant, has already been applied to many use cases. One such example is a supply chain, where a private blockchain can keep an immutable record of a product through every step of its process and ensure its quality

through smart contracts (Sissman, 2018). Another use case is identifying the root cause of battery accidents in EV cars (Ding, 2018). Much like with the supply chain solution, blockchain can create an immutable, traceable record that can track battery health over time (Ding 2018).

Much like with the papers described above, the goal for this project was to create a testable, blockchain prototype. This was accomplished using the Hyperledger Fabric (a framework for private, managed blockchains) on Amazon Web Services (a server hosting site that allows for scalable storage and processing power). The prototype tackled five basic use cases for the blockchain: a teacher submitting a grade, College Board submitting an SAT score, a student submitting an application to a college, a college filtering out students by grades, and an external organization submitting an award. Snippets of code from the second use case are shown below:

```
type Asset struct {
     ID                  string    `json:"ID"`
     OrgID               string    `json:"OrgID"`
     StudentID           string    `json:"StudentID"`
     CumulativeScore     int       `json:"CumulativeScore"`
     MathScore           int       `json:"MathScore"`
     EBRWScore           int       `json:"EBRWScore"`
     EssayScore          int       `json:"EssayScore"`
     StudentRead         bool      `json:"StudentRead"`

}
```

Figure 1: Struct containing data relevant to a student's SAT score

```
func (s *SmartContract) ReadAsset
...
```

```
if asset.OrgID == userid || (asset.StudentID == userid &&
asset.StudentRead) {
          return &asset, nil
}
return nil, fmt.Errorf("insufficient permissions")
```

Figure 2: Read method that checks for adequate permissions before returning data

Further work should be done in terms of stress testing. With such a large system, it is inevitable that the amount of storage space taken up by the blockchain exceeds a reasonable amount, and users may not be able to store a full copy of the chain on their computers. One possible solution is to store fragments of the chain on each computer, and if a computer needs data outside of those fragments, it will be able to query other computers for that data. Additionally, Hyperledger Fabric doesn't support the ideal, assignable role system, so more work needs to be done to either find a new framework or create a better workaround.

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