XLP Operating Manual

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What is XLP?

XLP stands for “Extreme Learning Process,” a methodology that enables **communities of learners** to design and conduct collaborative learning activities. Our aim is to become a **crowd learning** “operating system” that facilitates collective learning in this increasingly large macro ecosystem. This enables the flexible recombination of collaborative micro-ecosystems of learners, and will incorporate both digital and offline (or “real world”) elements.

Communities of Learners

Communities come in all shapes and sizes. They may be:

- Large or small
- Physically together, near each other, or spread around the world
- Of similar ethnic, cultural, educational, professional, and religious backgrounds, or vastly different backgrounds
- Similar or different skill sets, skill levels, interests, and life experiences
- Relatively homogeneous, or highly diverse
- Stay together for many years, or come together to design and conduct a single learning activity

Crowd Learning

Whatever the form, XLP helps communities build collaborative learning activities that engage individuals and the community as a whole. Each community designs and operates its own learning ecosystem that serves the individual and collective aims of the creators and participants.

These micro-learning ecosystems come together to learn something specific, often for a specific duration. Multiple ecosystems can interact, and may later flow together to form macro-learning ecosystems, just as amoebas divide and recombine in different ways. As the macro-learning system becomes larger, it increasingly approximates the real world, and participating individuals, institutions, systems and societies can iterate upon increasingly optimal solutions.

Evaluation and Assessment

Using secure tools like the Blockchain, learner activity can be tracked at each level, assessing how individuals contribute to a micro-learning ecosystem, and how a micro-learning ecosystem contributes in turn to the macro- level.This allows individuals and teams to receive personalized feedback on their performance and iteratively improve over time.

This in turn applies to grading and certification, with both micro-credentials and full degrees stored on the Blockchain. Access rights can be granted to other universities or employers to show tamper-proof evidence of achievement.

Containers of Knowledge

When we think of managing knowledge, it helps to use metaphors. XLP's metaphor is *containers of knowledge*. We categorize knowledge into five layers, each of which represents a kind of digital asset, and these data assets can all be managed from within our online Remix system.

Content Type	Workflow Unit	Supporting Tools
File	Individual Activity	MediaWiki, Text Editor
Directory	Collaboration Efforts	Git, GitLab, GitHub
Micro Service	Computational Service	Docker/RTK/...
Configuration and Deployment	Development & Operations (DevOps)	Kubernetes/Trello/ WeSlack
Physical Environment	Context Specific Services	Maker Space Schools

Outcomes

For Students

Real World Decisions

XLP engages students by forcing them to make financial, legal, cultural and technical decisions, so they can achieve goals set by the student groups themselves.

Pragmatism

XLP is pragmatic. The XLP -method induces realistic human dynamics, utilizes modern technologies, encourages students to create social norms, and establishes executable regulations based on the design principles of the fast evolving Internet.

Realizing Potential

XLP drives students to realize their untapped potentials and emerging powers of collaboration through having them stretch the educational envelop by shifting focus from teaching (top-down) to learning (bottom up).

For Teachers

Evolutionary Process

XLP encourages an evolutionary process, which creates a digitally enabled learning context that delivers rich social-interactions and leaves no-one behind.

Curating and Evaluating

By placing students in control of learning, XLP redefines teachers' roles as curators of learning resources and as evaluators of students' learning-potentials.

Network Enabling

XLP provides network-enabled learning data management technology that enables stakeholders to record, analyze and identify learning trajectories to define new directions for progress.

Impact

Since June 2012, XLP-based orientation programs and semester-long courses have been conducted at:

Tsinghua University in Beijing

National Taiwan University of Science and Technology

Singapore University of Technology and Design

Taylors' University in Malaysia

Eurasia University in Xi'An

Tianjin Vocational College of Mechanics and Electricity

Courses have also been conducted at many leading high schools in China. Due to XLP's experimental success, China's Ministry of Education has invited the founder of XLP to serve on the Design Committee of National Curriculum Standards on Technology Education. The goal is to use XLP as a learning architecture and a learning activity design methodology for over 300 million registered students in the Chinese education system.

XLP is scalable and applicable to a broad range of students. A teacher from Tianjin Vocational College of Mechanics and Electricity stated his observation:

> "In the past, I can only judge students' quality by their test scores. However, after seeing the students with low test scores can sometimes be the most productive contributors in XLP-enabled learning process, I realized XLP presents many opportunities for students to demonstrate their natural talents."

Mr. Wang Hong Yu, the General Manager of China's Open Course Resource Center, stated how XLP might affect his business:

> "With shock and awe, I personally witnessed the transformative effect of a few XLP events on students. I realized that a radical transformation in education has already taken place here in China. The traditional textbook-oriented industry could no longer be lasting. We have to re-position ourselves in the future ecology of education."

Why XLP? Why Now?

Computing Power

The processing power of computers doubles about every 18 months, while data storage and bandwidth are rocketing and costs are falling. This influences every aspect of our lives, and the opportunities to learn in new and different ways are expanding exponentially.

Big Data

Every second, gigabytes of data are being collected, and no one – or even any organization – will ever be able to access or process all of this data. Micro-learning communities can come together to deal with subsets of this data and solve real world problems.

This big data makes what and how humans learn more important. As data collection and processing increasingly lets machines connect and aid human decisions, (hence creating value,) human ingenuity, creativity and intuition are becoming increasingly important. More and more, the only things that people *should* do are the things that only people *can* do – and this, of course, places a premium on humans' ability to learn.

Open Source

Open-source gives anyone the right to use, change, or share a given technology, thus dramatically reducing the cost of using, copying, modifying, and redistributing software (and indeed, hardware). This means anyone can be a creator and build upon the shoulders of giants.

Mobile Devices

Developments in mobile communications and the ubiquity of digital electronic devices mean that more people can connect to the Internet – and each other – anytime, anywhere. This means newer, richer opportunities to learn from and with others, no matter where they are.

Containers and Clouds

Big data needs big computing power – too much for any one institution. With cloud providers like AliCloud or Amazon Web Services, anyone can run virtual machines to perform big computng tasks, and with the power of container platforms (Docker, Kubernetes) they can scale and replicate with ease.

Globalization

The problems of today's world require diverse communities to offer new insights. These problems are too big for just one individual or institution, but affordable internet access is enabling people all over the world to collaborate in micro-learning communities to solve these problems. Learning and working together globally across boundaries of space and time – across *all* boundaries – is

mankind’s greatest hope for making progress, and XLP enables this crowd learning and collaborative effort to improve the state of the world.

XLP pushes for the emergence of the world as we believe it should be – egalitarian and equitable, a world in which everyone has a fair chance to have their voice heard, and a fair opportunity to contribute to the progress of the world and humanity.

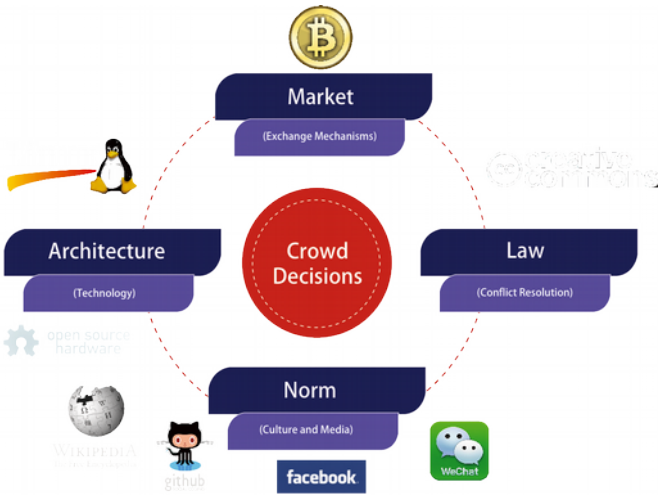
Summary

These enable and necessitate new modes of learning than those that have existed in the past. Learning is increasingly collaborative, personalized, self-directed, active, engaging, and global. XLP has enabled micro ecosystems of learners to form, disband, and learn collectively more easily and inexpensively as they ever have before. The ubiquitous interconnectedness of data, people, things, and processes, the opportunities for collaborative crowd learning – and new modes of crowd learning – will increase exponentially. These technology trends will enable learning to be measured in a way that it never has been before, and will redefine what the outcomes of learning should be. XLP capitalizes on these trends and enables new learning environments and opportunities. XLP is enabled by these trends – and at the same time is necessitated by them. What humans learn, and the way they learn, must and will be transformed. We envision XLP becoming the learning operating system of the Internet of Everything.

How XLP Works

Philosophy: Four Forces

Lawrence Lessig's *Code Version 2.0* states that a number of forces regulate the behavior of individuals in a society or community"[i]:



Since XLP is a methodology for crowd learning, or a crowd learning operating system, these four forces also (by definition) regulate the behavior of individuals in each micro learning ecosystem, and ultimately increasingly large macro learning ecosystems.

Law: The Rules a Community Recognizes

- Imposes constraints on the behavior of members by explicitly threatening punishment or sanctions that the community as an entity will enforce

Social Norms: How a Community Expects You to Behave

- Similar to the law in that they constrain behavior of community members
- Unlike the law, community members impose social norms on each other informally
- Whereas the law, and (prospective) punishment for breaking the law, is explicit, social norms are often understood by all, or most, community members without being explicitly stated or mandated

Market: How Much Do You Pay?

- Enables buyers and sellers of goods, services, information, labor, and capital to exchange these things
- Determines how the forces of the supply and demand determine respective prices of these things

- Regulates behavior of community members by establishing prices of goods, services, and other things exchanged by these members

Architecture: The Way the World Is

"The way the world is, or the ways specific aspects of it are."

- The way a product (not a service) has been designed and created, manufactured, or built
- Regulates community members by imposing physical or technical/technological constraints
- Special due to "agency" - does not require direct human intervention to operate (whereas other forces require police force, community members, merchants, etc), so it is "self-executing"

While each of these regulating forces is separate and distinct, all four influence each other as they regulate the behavior of community members.

Example: Smoking

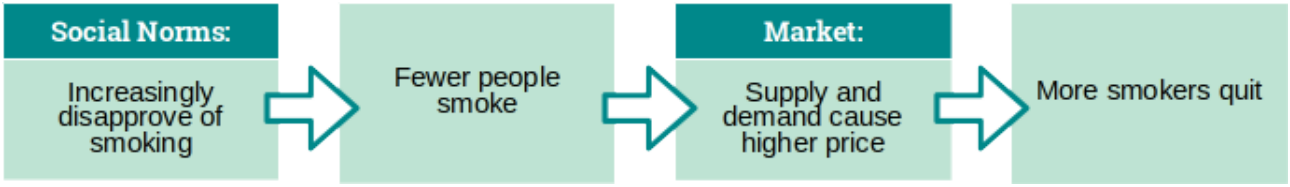
In Code version 2.0, Lessig uses the regulation of smoking to illustrate the operation and interdependence of these four forces. If you want to smoke, Lessig asks, what constraints do you face?

Law	Federal, state, and local laws laws regulate: • Minimum age and ID requirements • Where you are permitted to smoke • Tax on purchase of cigarettes (aiming to reduce smoking incidence)
Social Norms	Social norms can constrain behavior even more than laws: • Smoking in the house of a non-smoking friend • Smoking near children in restaurants
Market	• The higher the price of cigarettes, the less likely you are to smoke • Higher insurance premiums for smokers
Architecture	The way cigarettes are designed and manufactured.: • Filterless cigarettes are more dangerous, so more pressure to reduce smoking. Ultralights may tempt you to smoke more (thus costing more in terms of money and social norms)

How do the Four Forces Interact?

The four mechanisms are interdependent; they interact, and influence each other as they regulate the behavior of individuals in the community. A change in one force may influence another.[ii]. Using the example of smoking:

Social norms → Market



Market → Law/Social norms

If cigarette manufacturers lower the prices dramatically to entice more people to begin smoking, then the increased incidence of smoking in public places that had previously permitted smoking might prompt lawmakers restrict or ban smoking in these places. Even if they did not, the increasing anger of non-smokers might prompt the evolution of new social norms, or increased enforcement of existing social norms, that discouraged people from smoking in these places.

Architecture → Market

If cigarette manufacturers were to sell a new kind of cigarette (assuming that they could legally do so) – and if many people wanted the new kind of cigarette, then the the market would enable manufacturers to raise the price of this new kind of cigarette. This would increase the constraint of the market on the behavior of smokers. On the other hand, if the new cigarettes were not popular , then the market might compel cigarette manufacturers to lower its price to sell more.

If non-smokers hated the smell of the new cigarette, they might dictate and enforce new social norms that discouraged smokers from smoking it.

Architecture → Law

Lawmakers might ban the new kind of cigarette if they determined that is posed health hazards that other cigarettes did not. Of course, such a change in the law would in turn influence architecture by legally restricting the design of cigarettes.

Thus, the four mechanisms that regulate the behavior of individuals in a community – the law, social norms, the market, and architecture – are interdependent; they interact, and influence each other as they regulate the behavior of individuals in the community.

How do the four forces relate to XLP?

XLP provides digital and physical infrastructure for learners to practice their four basic rights, which correlate with the Four Modalities/Forces

Since XLP is a methodology for crowdlearning (or a crowdlearning operating system) the behavior of individuals in each micro (or macro) learning ecosystem must be regulated by the four forces:

Law	In XLP's constitutional framework, the law is constituted by our digital recording infrastructure (legal evidence collection mechanism), which allows the filing of complaints, patent filing, and law enforcement.
Social Norms	One of the most important forces shaping social norms in the crowd learning environment of XLP is the notion that all learning outcomes must be demonstrable. One of the most important end products is publishing the crowdlearning results online using a digital publishing system.
Market	XLP's transaction validation system records and validates transactions executed in the crowd learning environment.
Architecture	The technology architecture of XLP is one of the most important forces that regulate the behavior of individuals in the crowd learning environment of XLP. The architecture mechanism is the only one of the four mechanisms that, once created or enabled, does not require direct human intervention to operate. It functions alone and directly; that is, it is "self-executing." The architecture in XLP's crowdlearning environment is a combination of hardware and software. A later section in this manual will describe it in detail.

XLP and The Real World

The four interdependent forces – the law, social norms, the market, and architecture - regulate individuals in XLP's crowdlearning environment, as they do in any community.

A noteworthy feature of XLP is how each force within a specific micro or macro learning ecosystem interacts with the same force in the "real world." For example, much of XLP's **legal framework** and that of the real world: It is difficult to divorce the two, given that the real world's legal frameworks and mechanisms have evolved over centuries, and to greatly regulate the individuals in a community effectively and efficiently. Patents filed in the crowd learning environment of XLP might very well also be filed in the real world, for example.

Similarly, given that one of the most important end products of an XLP project or activity is the publishing of the crowdlearning results, it is natural that these results are published are published via a real world means like social media, other online media, or traditional media that is accepted by **social norms**.

In the **market**, a product or service might attract investment in the environment of XLP – and might also attract real world investment. Intellectual property in XLP's environment might be bought and sold in the real world too.

In addition, XLP's **architecture** is its roots in using the public commons of universities, and specifically the physical campuses and other resources that enable the crowd learning environment to emulate the the real world to a certain large degree. This is an important reason that XLP enables learning on a large and public scale.

XLP informs students about their rights to learn, to resolve conflicts and to defend their rights during the evolution of the learning program (litigation). Students can also exchange their assets, especially digitally transferable and electronically exchangeable assets with other participants. In an XLP-based activity, they are required to present and record their opinions and ideas in public via digital means (such as blog posts and wiki-based websites).

XLP utilizes open sourced, multi-platform digital content distribution systems, such as Git, to replicate and digitally track any digitally recordable content, from source code, design plans (technology), conflict resolution records (law), asset exchange records (market), and students' learning reflections on blog entries (media). The schools that adopt XLP must also provide the physical learning environment to allow in-person interactive learning activities.

Curriculum

Micro, Meso, Macro

The XLP curriculum has three tiers:

Macroscopic in Nature

Globally search and compile relevant information, and creatively tell a compelling story using trustworthy data sources and presentation techniques.

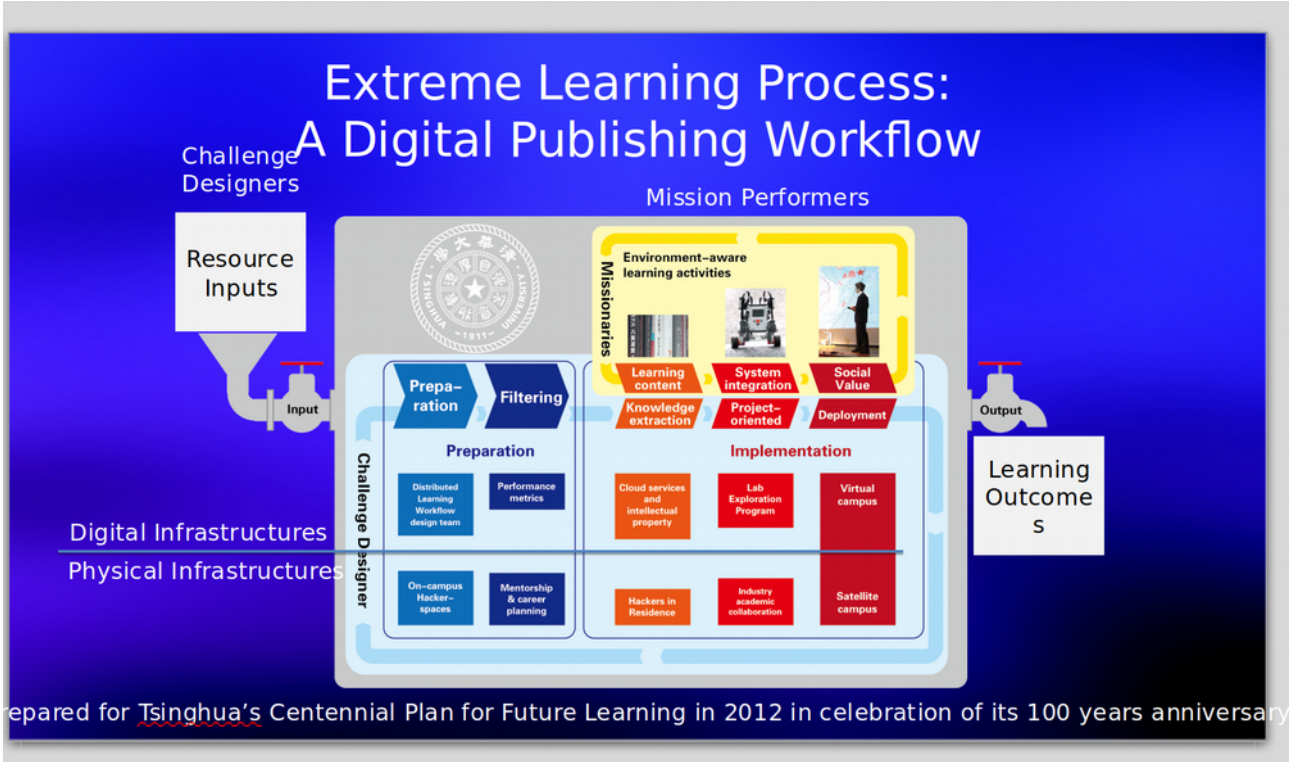
Mesoscopic in Sorting Order

Apply optimization technologies and understand the principles of optimal limits, so that students and teams can apply optimization to all their learning activities.

Microscopic in Contexts

Guide students to be acquainted with domain-specific vocabulary and rules, so that they can leverage existing body of knowledge in an organized manner.

Digital Publishing Workflow



A learning environment comprises both the virtual world and the physical world:

Physical

- On-campus hackerspaces
- Mentorship and career planning
- Hackers in residence
- Industry/academic cooperation
- Satellite campus

Virtual

- Distributed learning workflow design team
- Performance metrics
- Cloud services and intellectual property
- Lab Exploration Program
- Virtual campus

Each learning activity may have several inputs – human resources, capital, and mission statements, for example, and outputs like the experience of the MD's and ME's; the statistical data that comes out of the XLP event; and physical products or other inventions derived from the intellectual efforts of the event participants.

Digital Publishing Workflow Operating System

The three tiers are built on top of our Remix platform, which provides a foundation of industry-standard tools to help XLP students achieve the goals of their curriculum.

Participants

XLP assigns three roles to force interdisciplinary collaboration, which are regulated by the four forces:

Sponsor

School/department that provides resources for XLP program

Mission Designer

Design and test learning missions in accordance with the goals sponsors
Create tailored learning “games” to fit resources and requirements

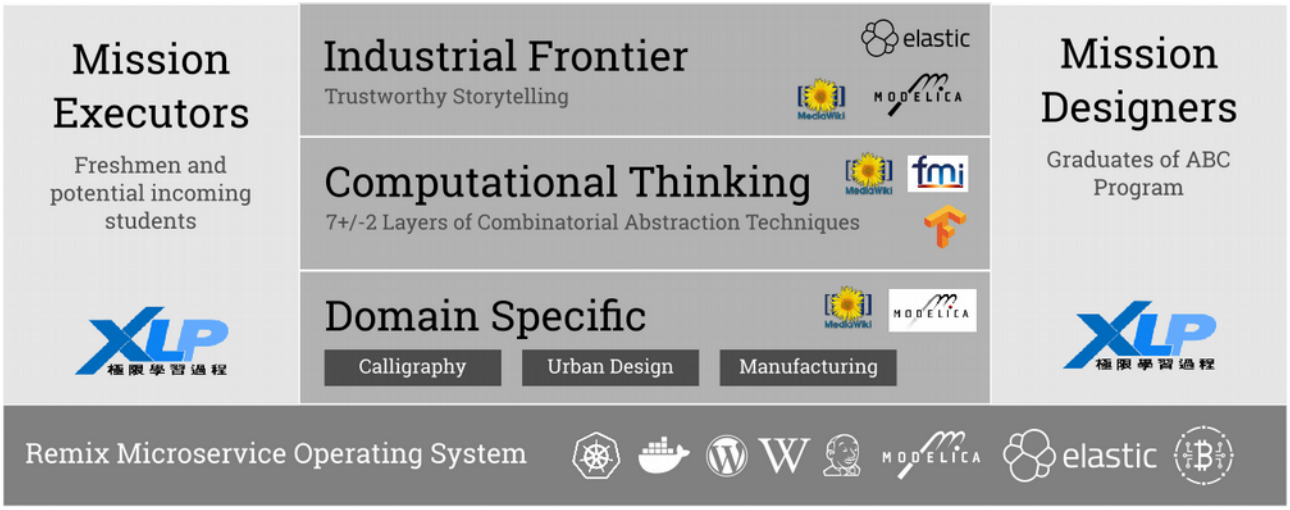
Mission Executor

Play the “games” and later becomes Mission Designers
The process of designing and testing the learning missions challenge MD’s and push them to learn, first by forcing them to come up with challenging problems to solve and then solving these problems, and then by figuring out how to guide other people to execute the mission at a higher level of complexity or at a faster speed. This process enables a rich learning context for the MD’s; of course they also learn by observing and interacting with the ME’s during the learning activity.

MD’s are generally divided into four or five groups that reflect the four forces that regulate the behavior of individuals in a community – a law court and perhaps a patent office to regulate the legal interactions between ME’s; a media department to reflect the social norms of the ME’s through social media, other digital media, and traditional media; market regulators to regulate the operation of the market; and a technology support team that provides technological resources and

technical support to enable the ME's to execute their missions using the technology required to do so.

The MD's and ME's learn individually and collectively. The community of sponsors, MD's, and ME's is a microcosm of a larger context – for example, a university, a society, or a nation.



XLP provides the tools to create and evolve a dynamic syllabus-like structure from the raw materials offered by the challenge designers. Mission Executors play the "games" designed and orchestrated by Challenge Designers. Game scores are categorized according to the "four forces" mentioned earlier. Mission Executors provide either digital or face-to-face feedback to "Challenge Designers", during and after the learning games.

XLP forces every learning team to be a focused goal-oriented microscopic society in a digital publishing / learning workflow environment. Each learning program is divided into four stages:

1. Early Success	Provides resources and knowledge that enables students to kickoff their learning journey with excitement.
2. Fail Early, Fail Safe	Insures student learning assignments are challenging enough, so students can observe their short-comings and correct their course of actions in the early stage of the “game”.
3. Convergence	Guide students to re-combine their team structures to create a synergistic product/service with other teams.
4. Demonstration	Every learning program should end with a ceremonial event that allows students to summarize their learning experience and present it to other people who might be future participants of XLP.

Learning Activities

Digital Identity

Every entity in an XLP micro or macro learning ecosystem has a verifiable digital identity, the basic building block of the digital world. Entities include individuals and organizations, as well as physical resources and technical services. Digital identities (like email addresses) enable the tracking of every entity’s contribution to the crowdlearning process.

Constitutional Framework

Constitution Reading Session: Before an XLP activity, each prospective participant participates in a constitution reading session to learn the framework of the activity. The constitution details the responsibilities of each participant in the XLP activity, in addition to services provided by the sponsor of the activity. Participants digitally sign an acknowledgment stating that they understand the details of the constitution and their responsibilities, and an agreement stating that they agree to abide by the constitutional framework during the XLP activity.

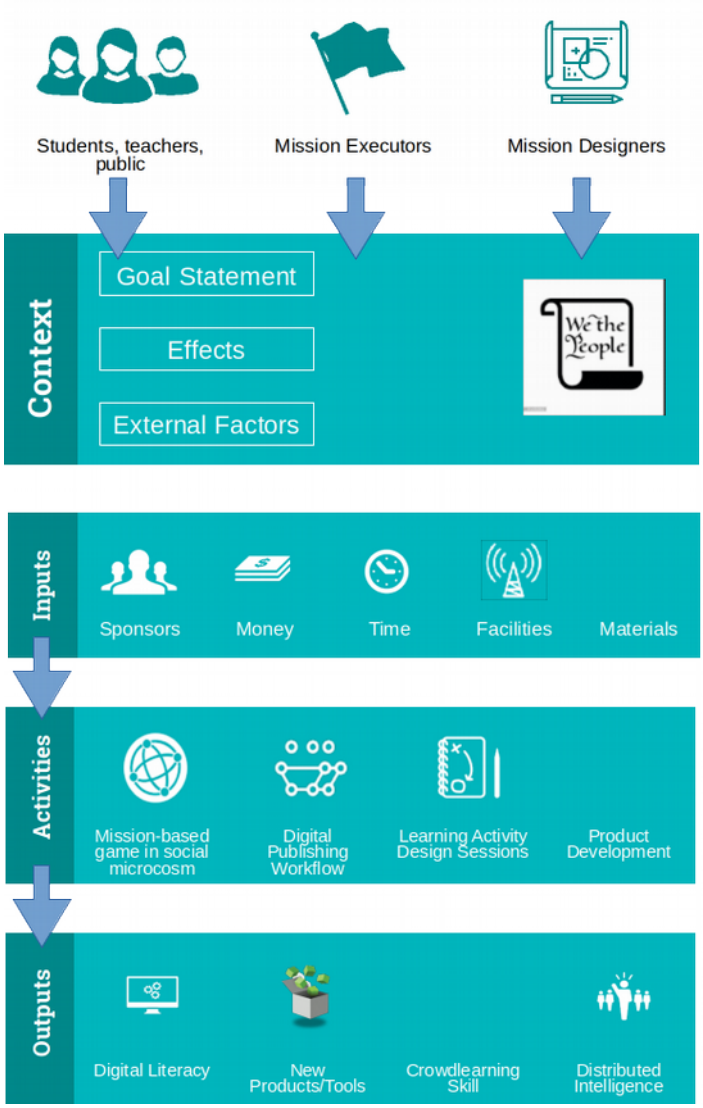
Constitution Revision Process: Given that a constitutional agreement is a framework for public collaboration, it should be a dynamic document and explicitly detail a procedure to refine it to fit the evolving context, and be tracked via a version control mechanism.

Digital Publishing Workflow

After receiving their digital identity and reading the constitution, participants take part in the digital publishing, or digital deployment, workflow. This becomes each participating entity’s experience for the XLP activity in which they participate for the rest of their life. In this experience, participants use their digital identity to contribute to developing, acquiring, using, sharing, and publishing digital and physical assets. In today’s digital society, this digital publishing workflow is an ongoing process for each entity that participates in XLP.

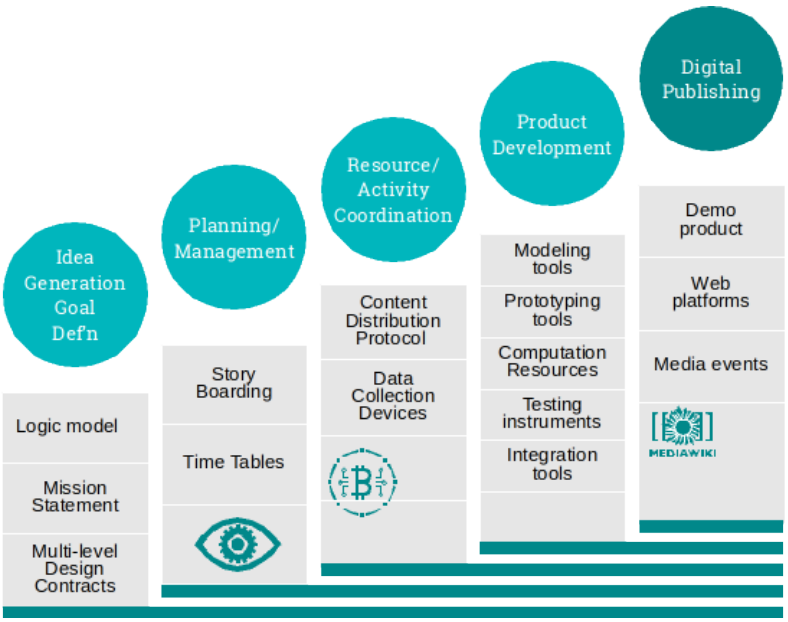
Design Contract

As part of the workflow, students work together to create a one-page design contract, taking into account activity context, inputs, activities, and outcomes:



Quality and Quantity through Digital Tools

Students assure quality by working together via **Remix**, XLP's online collaborative learning platform. This suite of tools enables collaboration, content distribution, data collection, and data modelling:



Stages of a Learning Activity

1. Orientation Program	Usually involves **digital identity**, **constitution reading session**, agreement reading/signing and quick overview teaching students how to use **digital publishing** tools in general. Students also gain experience dealing and playing with many other people on the fly, encountering the courtroom, participating in market transactions, participating in media, publishing – how the four forces interact with XLP activities.
2. Lab/Knowledge Exploration	"Taster" classes allowing students to visit many laboratories and researchers in a big campus (e.g. Tsinghua University's laboratory exploration program that makes available more than 100 laboratories and gets students on campus to see each other's research results. This gives a broader context of available technology and research results.
3. Professional/ Career/Strategy	Students write a personal career plan document and an industry analysis report created by a group of students using the digital publishing workflow mentioned previously. They can use this to collect information and present what they really want to do over time for themselves individually and for the group to propose possible products.
4. System Design/	Uses the previous three classes as an information source to identify

Development	talented individuals and highly functioning teams so that they can pick teams and individuals to create product creation organization or product team, so they can start developing a product. This course might be at least three months, sometimes 1-2 years. Then that would go into their graduate thesis or into a real product in the marketplace.
5. Public Events/ Presentations	The fifth stage is constantly offering **public events to present learning results** to the general public through major media and in public forums (like hackathons and international competitions) so that we can broadcast learning results to the public / people outside the university or hackerspace.

The above articulates how XLP works in a university environment, but there's also a sixth stage:

6. Material Creation	We realize that XLP can also be used as a **mechanism for teachers to use the same 4 forces to create syllabi and even detailed teaching material in an intensive workshop.** So we will also apply the same technique to generate and compile interesting learning material across multiple campuses, and this we intend to do as a "training the trainer" curriculum, and enable students, and, specifically, professional instructors of any discipline to participate in the creation of static or interactive learning material. On the other hand, XLP by itself is also a learning material publishing and compilation process.

Learning Outcomes

Proposal or Report Form	Discusses the conclusion of a certain research study, or the conclusion of certain industry analysis (“research study,” “business proposal,” or “industry analysis report”)
Budget	Including both a planning schedule (i.e., a resource and human resource budget and timetable, in addition to a financial budget)
Short Movie	Usually a compilation of interesting video footage of the activity seen and ideally properly annotated with words and non-proprietary music
Prototype Product	A book, a pamphlet, a brochure, or even a physical product
Team	One of the most important aspects and products of any XLP event is the friendship developed between students. Ideally the students can create a social network, or a WeChat group or some kind of cohesive team membership so they can always tap into these human resources to do something more interesting in the future.
Refined XLP Manual	As everyone is using a similar or conceptually congruent mechanism to learn from each other, in theory we will be able to use the operational data as a statistical reference point to suggest how we might over time improve XLP as a general learning process – so that everything we do in this XLP-based learning methodology can always be used as case studies or as statistical data to improve the practice of XLP learning activities in the future. Obviously the most direct contributions will be sections or refinements or revisions to the XLP operating manual (i.e., this book).

XLP Technical Analysis

XLP activities are executed in a highly technical context, which takes into account the Four Forces discussed previously. These forces require:

Legal Mechanisms	For example, a dispute resolution process and patent filing process
Market Mechanisms	Facilitating exchange of goods, services, information, and capital, and establishing prices for these through supply/demand dynamics
Technical Architecture	Sophisticated technology infrastructure that allows transdisciplinary learning across space and time

XLP participants need access to technology that enables the four forces to regulate behavior, and, just as importantly, must learn its use before the XLP activity.

Through their digital identity, participants must be trained to (among other things):

- File patents
- File complaints and sue other entities
- Defend their legal rights
- Buy and sell intellectual property and financial and other commodities
- Publish the products of their learning and their learning outcomes via social (or other) media

The four forces are all present to an extent in traditional modes of learning, but their respective and collective functions in crowdlearning is relatively minimal, and not systematic. A major reason is the lack of a common digital infrastructure to track market transactions, patent applications, and refutation processes; nor has social media been used systematically to identify and measure cultural norms in a classroom and how they relate to a specific learning scenario.

Therefore, the an XLP activity context is highly technical, and requires big data and other sophisticated technologies and principles to collect, store, process, and analyze data.

From a technical perspective, XLP is:

- A crowdlearning distributed operating system that collects, stores, processes, and analyzes data and generates condensed and refined content with machine and human help.
- A learning ecology that combines organic entities with digital equipment and processes. XLP leverages open source technologies, distributed version control systems, and cryptocurrencies to track learners' individual and collective contributions to the collaborative, collective learning process and learning outcomes.

Computer cycles for collecting, storing, processing, and analyzing data are clearly different from human cycles. Thus enabling many people to simultaneously revise content, for example, requires sophisticated engineering management practices and workflow management techniques, which we generally don't find in traditional educational settings. However, this technology is becoming increasingly mature and is being leveraged by XLP to become a distributed crowdlearning operating system that provides a learning context – both for individuals and for the crowd – that is very different from that of a traditional educational setting. [iii]

Byzantine Fault Tolerance

A major potential barrier with big data generated simultaneously across a distributed network is the Byzantine Generals Problem. Leslie Lamport, Robert Shostak, and Marshall Pease discuss this in their 1982 paper, The Byzantine Generals Problem:

> Reliable computer systems must handle malfunctioning components that give conflicting information to different parts of the system. This situation can be expressed abstractly in terms of a group of generals of the Byzantine army camped with their troops around an enemy city. Communicating only by messenger, the generals must agree upon a common battle plan. However, one or more of them may be traitors who will try to confuse the others. The problem is to find an algorithm to ensure that the loyal generals will reach agreement. It is shown that, using only oral messages, this problem is solvable if and only if more than two-thirds of the generals are loyal; so a single traitor can confound two loyal generals. With unforgeable written messages, the problem is solvable for any number of generals and possible traitors.

In an XLP activity, the equivalent would be the XLP operating system failing to process a massive amount of data concurrently – for example, if many participants contributed and processed information at the same time. One solution to this is unforgeable written messages[iv] – digital signatures, for example.

In the XLP operating system, the equivalent is a distributed repository allowing all participants to transparently observe all of the content that all of the other participants' have contributed in the past. This increases confidence for all participants in the trustworthiness of other participants, therefore increasing the likelihood that participants will contribute and share information content, and that this content will be compiled into a consistent result.

The XLP operating system uses existing computing science techniques that improve the ability of the system to process the concurrent publishing of massive amounts of distributed intellectual content. Bitcoin also ensures Byzantine fault tolerance – in other words, solves the Byzantine Generals Problem – by incorporating a distributed database that lets any participant to view the entire history of transaction records. This enables the processing and compiling of massive amounts of intellectual resources on an Internet scale. Open source version control software, like Git, Concurrent Versions System (CVS), and Apache Subversion (SVN), also enables sharing of human-contributed content – be it source code, novels, textual content, movies, or photographs – and enables the processing and compiling of data on a massive scale.

Remix: The XLP Operating System

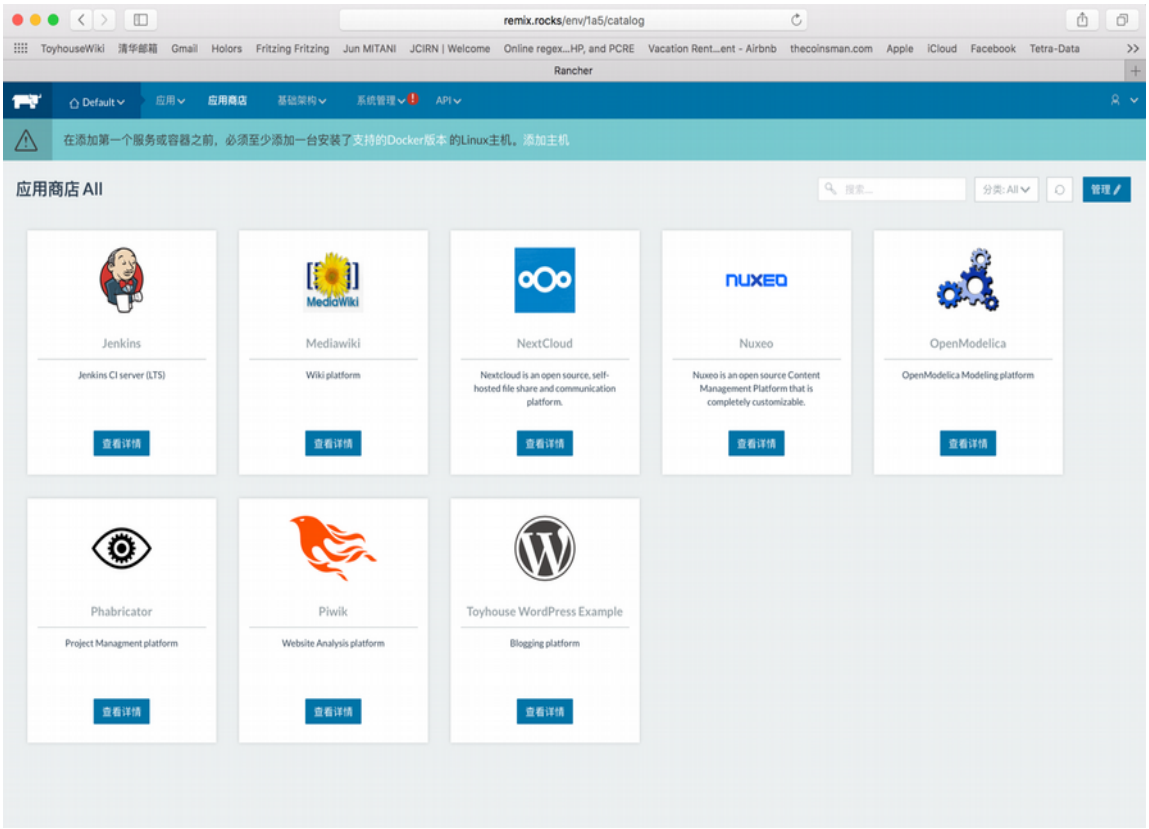
Think of the world you live in: Imagine the classroom of the future:

In a world that becomes increasingly digital, it is essential to teach the skills required to navigate through the digital environment as early as possible. A gap is opening between those who are technologically mature and others that are yet to be comfortable with handling software. The ones who are on the wrong side of this gap will eventually suffer the detrimental implications to their careers and lives. Such individuals will not be able to take part in collaborative work, thereby limiting their ability to increase their knowledge. Already, individuals and institutions lack the tools to create new digital assets or work with the existing digital information, both of which decrease their overall potential. Clearly, students need a solution to escape this situation. Imagine a classroom of the future that is modelled after the reality outside the classroom. If the reality outside the classroom is one pervaded by digital tools, so should the classroom. Remix makes sure this happens. Students will no longer study for exams but prepare for the challenges that await them in the future. It helps them work and self-manage teams with tools like Phabricator and Git, while allowing teachers to track student progress and individual contributions towards their respective projects using GitLab.

Trustworthy computing technologies such as Blockchain technology are integrated into Remix. These ensure immutability while ensuring credit is given where credit is due.

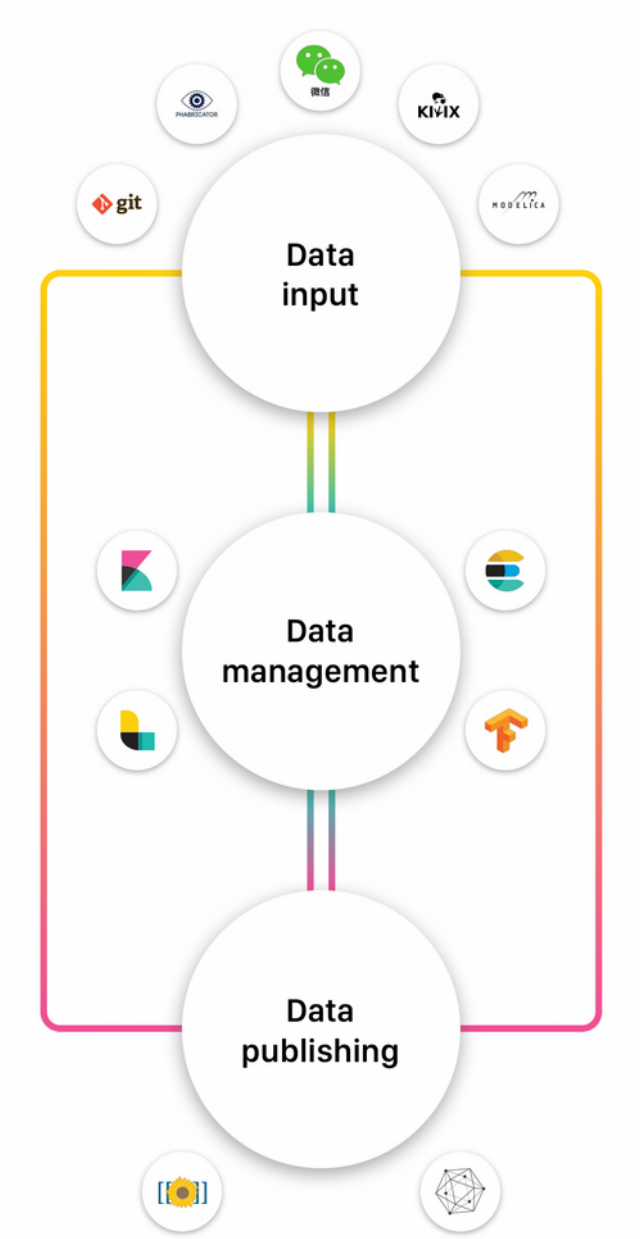
Remix Tools

The Remix platform offers a large array of powerful tools, manageable by anyone and scalable to any size.



These tools will be an important asset for any modern educational institution for which it can fully develop the intellectual potential of its students and staff. The platform, for the first time ever, democratizes services that were previously limited to such an extent, that only established companies were able to utilize their full potential. These services are now combined into a single application allowing any individual or institution to start their digital transformation. Without the need for continuous online connectivity, the platform can be brought to the farthest corners of the globe, where a new generation of individuals can start fulfilling their computational needs. In short, Remix can bring the tools used by established software companies into any classroom or home enabling anyone to take part in the future of the digital world.

Together, students can create new data using tools like Jupyter and OpenModelica or analyze and optimize existing information using Elasticsearch and TensorFlow. Ultimately, every individual can create or take part in a Digital Publishing Workflow – a circle going from Data Input to Data Management to Data Publishing, all from their own laptop in one single application. This is Remix.



Data Input

Data Input describes the different ways through which data may enter the Remix platform. In the Digital Publishing Workflow, Data Input lies between Data Publishing and Data Management, as previously published data can act as input for Data Management.

Generally, data may enter the system from three source types or combinations of them.
Data Creation Remix comes with micro services from which new data can be created. For instance, OpenModelica enables users to create simulations of complex systems. The data produced by these simulations can then be saved for later use. Another service, Jupyter, allows for coding, solving equations, and showing their visualisations that can then be shared in real time among different users. Again, all the data created can be saved for later use.

Online data

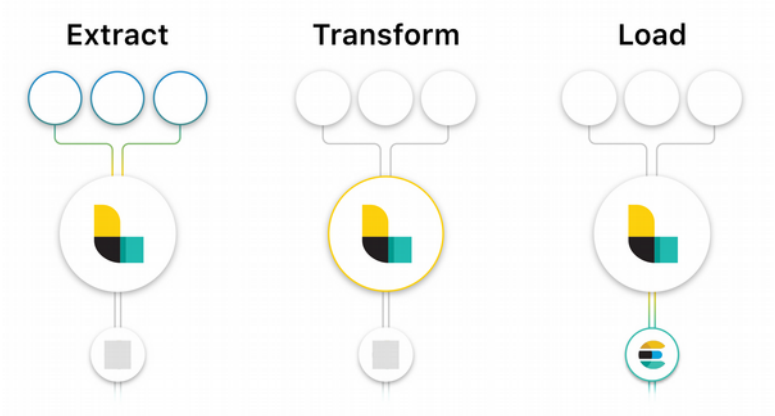
Remix also allows users to source data from the internet such as databases, wikis, or pictures. Again, different microservices are available and integrated for this purpose. Data may be used directly from the internet or downloaded first (for instance, to be brought to regions where internet access is spare or internet is slow). Kiwix, for instance, offers the entire Wikipedia, WikiVoyage, TED talks, and more for free to download on their website. This data may also be used as input for Data Creation,subsequently representing a combination of data.

Private Data

Finally, Remix enables users to use their own private data as input for Data Management and Publishing.

For this purpose, the platform comes with micro services such as Nuxeo, which is a digital asset library already used by institutions, companies, and individuals to manage their digital assets. Hence, they can tap into their existing data and use it as input for other micro services to create new data, again representing a combination. Generally, such private data may belong to an individual, an institution, or a company who can scale up their data storage as required without having to scale the other microservices thanks to the underlying system architecture.

Data Management



The data management part of Remix utilizes four different tools to perform a number of user related tasks. In the Digital Publishing Workflow, Data Management lies between Data Input and Data Publishing. The purpose of data management is to load the given information from the different data inputs, then optimize it so that it becomes searchable and produces the best results, which in turn can be visually presented to the user. This is possible through the use of the ELK stack from Elastic, consisting of Logstash, Elasticsearch, and Kibana, in combination with the machine learning capabilities of TensorFlow. These tools are combined to allow users to perform queries on wide array of data that in-turn, can be optimized based on an infinite number of characteristics. The following section will describe each tool and how they are an integral part of the of the Remix framework.Data extraction, transformation, and loading through Logstash Remix consists of a large number of data sources that each produce a large quantity of data for the system, in many different types of packages. It is therefore necessary to have a tool that can extract, transform and load the input data into the next step of the process. This is where Logstash

is used. Logstash is an open source server-side data processing pipeline based on the extract, transform, load (ETL) process.

Each of these steps have varying degrees of complexity, that will be explained in the following sections:

The first job carried out by Logstash is the extraction of data from the different defined sources. Extraction is conceptually the simplest task of the whole process but also the most important. Theoretically, data from multiple source systems will be collected and piped into the system for it later to be transformed and eventually loaded into the system. Practically however, extraction can easily become the most complex part of the process. The process needs to take data from the different sources, each with their own data organization format and ensure that the extraction happens correctly so that the data remains uncorrupted. This is where validation is used. The extraction process uses validation to confirm whether the data that was extracted has the correct values, in terms of what was expected. It works by setting up a certain set of rules and patterns from which all data can be validated. The provided data must pass the Transform Load validation steps to ensure that the subsequent steps only receive proper manageable data. If the validation step fails, then the data is either fully rejected or passed back to the source system for further analysis to identify improper records, if they exist.

The data that is extracted then moves on to the data transformation stage. The purpose of this stage is to prepare all submitted data for loading into the end target. This is done by applying a series of rules or functions to ensure that all business and technical needs are met. Logstash does this by applying up to 40 different filters to all submitted data. When filtering is completed, the information is transformed into a common format for easier, accelerated analysis. At the same time, Logstash identifies named fields to build structure from previously unstructured data. In the end of the transformation process, all data in the system will be structured and in a common format that is easily accepted by subsequent processes.

The last part of the ETL process is the load phase. The load phase takes the submitted and transformed data and loads it into the end target. There are certain requirements defined by the system that must be upheld. This pertains to the frequency of updating extracted data and which existing information should be overwritten at any given point. Logstash allows the system to load onto a number of systems, Remix does however only require that Elasticsearch receives the data.

Search and optimize through Elasticsearch

Search and optimize are two key attributes of any data management system. It allows a system to filter away all the unwanted data and prioritize the results based on a number of given attributes. Search and optimize are not functions that are limited to basic keyword searches, but can instead be used for a wide variety of possibilities. Everything from choosing the correct strategy in a game of chess to simulating the trajectory of a moving vehicle. In all these cases, the function utilises the available information from the different data sources in combination with machine learning intelligence to give the desired outcome To achieve this Remix uses Elasticsearch and TensorFlow. Elasticsearch is a distributed, RESTful search and analytics engine that stores data in a searchable manner. All the data that is passed through Logstash eventually ends up in

Elasticsearch. Here it is structured and analyzed to allow users to search based on their chosen parameters. The given parameters are in turn used to filter away all the unwanted results. What remains is a list of results that in one way or another are linked to the original search criteria. This list is, in turn, handed to TensorFlow.

TensorFlow is a mathematical library using deep neural networks in order to analyze data. The system takes in the data that was selected by Elasticsearch and prioritizes/orders it according to the pre-determined criteria. This gives the user a select number of results that should be suited exactly to their defined needs.

The key difference with Remix when it comes to searching and optimizing compared to other services is that results are purely based on the user. If a user specifies a certain interest or academic field that they are studying, then the optimization will be created with that parameter as a focus point. Thus, opening up for focused research where all advertising based ranking or unwanted results have been removed.

Data visualization through Kibana

In certain scenarios, the outcome of the data management process doesn't come in the form of links or lines text. In these cases, it is often required that the data goes through some sort of visualization in order to turn it into something that is manageable.

This is the job carried out by Kibana, the last tool of the data management process. Kibana is a data visualization plugin that works together with Elasticsearch to provide visualization capabilities on top of the content that has been indexed. It takes all the data that the user has asked for and gives a visualization if it is applicable. Kibana can therefore also be seen as being part of the data creation aspect of Remix which is further described in section "The Solution: Data Input".

Data Publishing

The final aspect of any standard research project concerns the publishing of results and conclusions.

For this reason, the final part of the Remix framework is data publishing. The purpose of this step is to ensure distribution of new data to a wide audience while guaranteeing rightful credit and ownership of published research and findings. To do this, the platform uses two main tools, MediaWiki and Hyperledger, in combination with the machine learning capabilities of TensorFlow. Wikimedia is a digital publishing tool created by the Wikimedia Foundation. It allows information to be published in a structured and navigation friendly way. Remix uses MediaWiki to allow institutions or individuals to create closed or open wiki spaces in which all their information and new research can be published. Each publisher then creates a distinct name for each new published article or piece of information. All the information on the given wiki space is then individually connected using the deep neural network capabilities of TensorFlow, as mentioned in the previous chapter. TensorFlow analyses each piece of information and carefully links it together with other relatable information. This, in the end, produces a wiki space which is full of research articles and other information, in combination with the existing Wikipedia data, that is fully

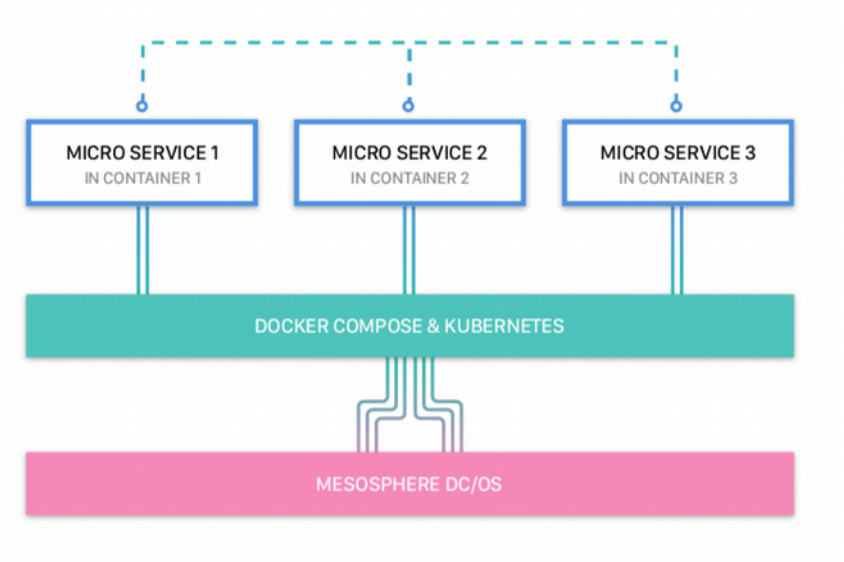
connected. Furthermore, connections and recommendations of articles can be made based on user preferences. In other words, if a user is studying biology and is doing research on the flight patterns of butterflies, then Remix will start creating more links and finding more research articles on that topic specifically. In that scenario, it might connect the flight patterns of butterflies to the evolution of airplane wing structures.[v]

Ultimately, a person can, through Remix, have access to a deeply interconnected network of research, published articles, and existing data from the internet.

To ensure that all information in the system is untampered with and that publishers are rightfully credited, Remix uses trustworthy computing technologies such as Hyperledger. Hyperledger is an open source collaborative blockchain technology that ensures transparency and immutability of all information that is created or submitted in the system. This, in turn, also insures that any information for which there may be a rightful owner, is credited as such. These tools open up for a whole new dimension of the digital publishing process that will allow institutions and individuals to contribute their knowledge to a greater audience.

Architecture

The interconnectedness of services in Remix is made possible using the Docker platform. Docker allows micro services to be run in so-called containers. These containers come with everything the micro service requires to run. Unlike virtual machines, containers do not require a guest operating system which makes them more lightweight, allowing for more or bigger applications running on a server or single computer.



Hence, a multitude of containers, that is, micro services can easily be combined in a single application. This can be done through Docker Compose. While Docker focuses on individual containers, Docker Compose engenders scripting the instalment of multiple containers that work together to create a bigger application. Micro services in Remix talk to each other to modify and move data from its creation, to its management, and publishing. At the same time, since the micro services are still housed in their respective containers, any service may be added or removed at any time without damaging other containers.

Remix also enables deploying, monitoring, and scaling micro services with Kubernetes (see appendix), a tool specifically designed for this task. Micro services can then be scaled individually and independently from each other (thanks to their containerisation), specific to the needs of the user.

Finally, the Mesosphere DC/OS (see appendix) acts as the foundation of the system and adds a layer of abstraction between Kubernetes and Docker and the underlying OS used by the user such as Linux. This operating system for data centres works specifically well with micro services and amongst other things, takes care of resource allocation and makes the system fault-tolerant. In Summary, Remix is an application that is lightweight, modular, and easy to install, use, and scale, enabling everyone to make use of the powerful micro services included. The platform achieves this using a three-part structure with the micro services being the highest layer of abstraction followed by the combination of Kubernetes and Docker and completed by the Mesosphere DC/OS.

Glossary

Digital Publishing

Docker

Elastic Search

Four Forces

Git

Gitlab

Jenkins

Jupyter

Kubernetes

Macroscopic

Mediawiki

Mesoscopic

Microscopic

Microservice

Remix

WordPress

XLP

XLP Activity

XLP Operating System

Appendices

i *Murray, Andrew D. (January 1, 2011). "Internet regulation". In David Levi-Faur. Handbook on the Politics of Regulation. Edward Elgar Publishing. pp. 272–274. ISBN 978-0-85793-611-0.*

ii Lessig

iiiLeslie Lamport, Robert Shostak, and Marshall Pease, The Byzantine Generals Problem, 1982

iv Ibid

v (see: The Structural Origins of the Modern Airplane. P Jakab) or the formation of insect flight behaviour (see: Pheromones and Flight Behaviour, T. C. Baker).