



# Pattern Computer FAQ

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# FAQ

## General

**Q: Is Pattern Computer a Services company?**

**A:**

We describe ourselves as a Pattern Discovery as a Service company. By designing our code to be exposed as a web service, we have made provisions to scale quickly to a wide variety of customers. The ingestion service and pattern discovery service are well-suited to being exposed as web services. The development of contextual analysis is domain-specific, so we are prioritizing a specific set of industry verticals where we have relevant data for contextual analysis. We have been working on different methods to visualize four-dimensional and higher result sets, including various methods available to us to make the visualizations available over the web.

Our initial customer engagements are focused on more-specific partnerships with our customers as we build up the toolset, performance scaling and validation tests. As we validate fully new tools for performance, scaling, cost-optimization and other desired features (end-end security, etc.), we then move these to hosting our Pattern Discovery as a Service in our datacenter as part of the normal product development cycle.

While our technologies are designed to be exposed as web services, we recognized early on that there would be a few customers (particularly in healthcare) where we would probably be running our services within the context of our customer's datacenter or the customer's cloud service due to HIPAA (Health Insurance Portability and Accountability Act) or other privacy/ownership restrictions.

Today, our solutions can run in the Amazon Web Services (AWS) cloud, using S3, EC2 and EBS services. We have a compiled set of tools which we can transfer direct to a specific instance of a customer/partner's cloud for pattern discovery. We have plans for supporting Microsoft's Azure cloud services as well. It is worth noting that we will have two versions of our tools on AWS, one which is our highest-performance version, and a second version where we have customized our algorithmic approach to produce the best cost-effective solution. The cost-effective solution is aware of the AWS cost model, whereby we minimize the number of data access and data transfers, which in datasets of millions of objects can be a quick cost multiplier. Pattern Computer's Chief Software Architect was a co-founder of Autodesk and wrote the immediate predecessor to AutoCAD®. He is uniquely experienced in how to handle and compute large amounts of vector data in constrained memory while maintaining outstanding performance.



**Q: You have an interesting and diverse set of team members. How does that work?**

**A:**

Our team was carefully assembled to create a talented group of experts who have experience in multiple areas, such that our expert in microbiology could speak the same language as our mathematician and our expert in genetics. Similarly, our bioinformatics expert could speak with our programming experts and our expert in genetics. These individuals also have additional skills. For example, our bioinformatician has a solid background in data science and gene splicing. Our people and their diverse skills work together to build the Pattern Computer and our base set of algorithms. These are the core elements of our team today – close collaboration to build the base set of Pattern Computer algorithms.

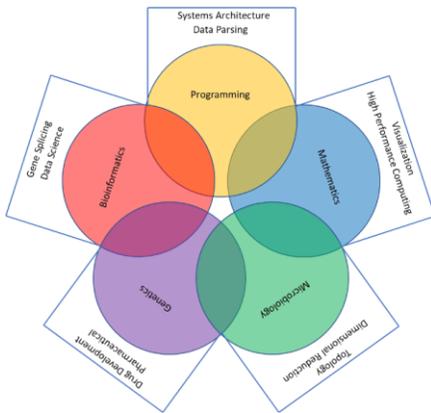


Figure 1: Formative Model

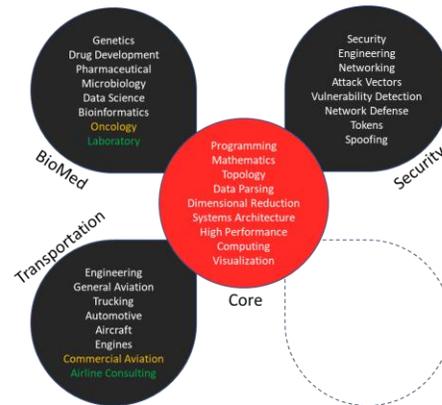


Figure 2: Operational Model

As we move from our Formative Model into an Operational Model, the vertical teams, such as BioMed, start focusing on business opportunities in their corresponding vertical space, such as BioMed. Other team members may start working with the business opportunities in the Transportation or Security space. We have the core team skills listed in white. We use outside consultants (in orange text) and partner organizations (in green text). In this manner, our core algorithms and systems architecture teams continue to enhance our capabilities, system performance and visualization abilities. All the specialist teams directly benefit from the core team’s work.

**Q: What makes Pattern Computer so unique?**

**A:**

Our ability to discover new patterns in high dimensional, complex data sets is what sets Pattern Computer apart. A simple example: if you wanted to identify the most significant 4-way gene relationships in a breast cancer related to survivability and you had 80 servers with 32 threads running



at 3.4 GHz, how long would it take? For simplification, let's say each computation was 2 ADDs, a CMP (compare) and a STO (store), and each completed in one clock cycle. It would take 10 years. In comparison, Pattern Computer's runs on against breast and other cancer data sets are often completed in hours or days.

Pattern Computer's intense focus in finding the patterns in complex, high dimensional datasets requires a set of mathematicians, researchers, developers, and subject matter experts who understand their neighboring areas. This is critical to our rapid advances.

**Q: Does the dataset have to be all one type of data? Such as gene expression-only data?**

**A:**

No. Some of our algorithms prefer consistent data types, while others can work with heterogeneous data types. We can handle categorical, continuous and/or mixed data. With the imaging engine, we can train our imaging recognition algorithms to recognize new images. We are currently working on mixed-input recognition capabilities.

**Q: Is Pattern Computer a Machine Learning company, or an Artificial Intelligence company?**

**A:**

Pattern Computer is a machine learning company in the sense that we use advanced mathematical algorithms to discover patterns and learn the nature of the relationships in the data. We also use neural networks in some of our algorithms, but very significantly, not in all our algorithms. The algorithms which perform high-dimensional data reduction while maintaining the nature of the relationships between data elements is not using traditional machine learning.

Are we an Artificial Intelligence (AI) company? AI is another term which has been used somewhat interchangeably with Machine Learning. We consider AI to involve a more complex process than pure machine learning in that AI needs to understand the nature and context of the request or question being asked to the system. For example, contextual information is understanding the question being asked in the context of prior questions, the situation/environment, or specific information about the person asking the question. At this point, we don't specifically think of ourselves as an AI company, but we are developing a contextual analysis engine within our BioMed group to handle and offload the questions about specific genes in the context of cancer (gene aliases, publications, drugs, therapies, clinical trials, etc.) This work will continue to gain new capabilities and over time will start having characteristics of an AI system.

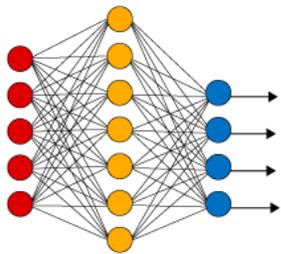


Q: Is Pattern Computer a Deep Learning company?

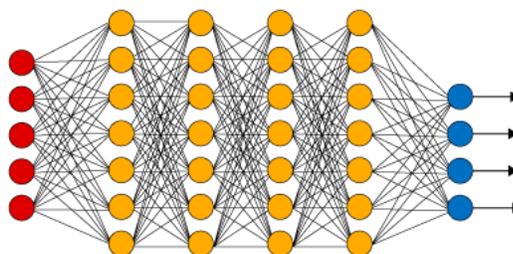
A:

Deep Learning is a somewhat vague and abused term. It came out of the neural network architectures whereby some of the neural networks have a different number of nodes and hidden layers. The term “deep” often refers to many hidden layers in the neural network, but it’s still a neural network – just a bit more complexity in the decision stages.

Simple Neural Network



Deep Learning Neural Network



● Input Layer    ● Hidden Layer    ● Output Layer

<https://becominghuman.ai/deep-learning-made-easy-with-deep-cognition-403fbe445351>

Then the question becomes, how is our use of neural networks different from what is out there today?

A neural network is a set of weighted decisions based upon the inputs given to that layer of nodes by the nodes in the preceding layer. In the case of neural networks with backwards propagation, there are hints also given to the weights base on corrections coming from the nodes to the right. We don’t need to go deep into this, but the structure is such that a neural network then needs to create the weights for each node to build (or ‘train’) a model. Depending on the nature and complexity of the task, a neural network needs to see tens of thousands of examples, even in the hundreds of thousands of examples based upon the complexity of the network and the number of output classes.

Therefore, first the neural network must be trained to build a model, then the model is validated with a held-out set of data. If the model meets or exceeds the intended accuracy, then the neural network may be used to predict the output based upon a given input. For example, a neural network, trained and validated on a very large set of pictures of dogs, cats and fish can then be given a picture of a fish that it has never seen before, and respond that it is a “fish”. Alexa does the same thing, recognizing words from an extensive training on series of phonemes.

Do we use neural networks? Yes. We know how to use neural networks, and there are certain algorithms which use neural networks as part of their methodology, such as Sonar. Sonar uses neural



networks in novel way to accomplish its unsupervised learned techniques, and a patent has been filed on that novel work.

Is Pattern Computer limited to neural networks? No. Our Lennard Island algorithm performs high dimensional reduction, pattern discovery, ranking (and more). The Lennard Island algorithms use a different series of techniques to discover patterns – and does not use a neural network (deep learning). The key difference is that neural networks are first trained, and then can be used to *predict* or *classify* information. Lennard Island performs pattern *discovery* and understands the relationship between the elements within the pattern. Further details on Lennard Island are explained in our Pattern Computer Technical Overview document.

**Q: How does your team develop your algorithms?**

**A:**

We have a team of PhDs in the areas of mathematics, engineering, and microbiology – they all have a strong background in mathematics. Much of our algorithm development is conceptualized first by the nature of problems we want to solve. Once we have prioritized the list of problems, then members of the Pattern Computer team meet with our think tank consultants to start formulating the approach. Given the different backgrounds of our members, we may have three to five different approaches, each may have some limitations on the scope of the solution set. We consider each approach and the nature and scope of the limitations – are they real limits, or just guidelines? Can we do transformations of the dataset without compromising the integrity of the data to overcome the limitations? Having experts in the different fields allows us to quickly discuss and compare different approaches. Given multiple paths that may work, we look for the more simplified approach, provided that the computational loads are roughly the same. We work out the algorithmic approach, note any exceptions or limitations related to the nature of the input data, and then move that work toward a Proof of Concept stage. Once that work had been validated, then we move on to coding the algorithm in C++ and adding it to our set of tools.

We do make special notations around novel ideas and concepts for later review by our IP team.

**Q: Do you have (much) IP?**

**A:**

Yes, we are quite pleased and proud of the amount of IP that we have generated as a company in such a short period. We conduct regular company-wide inventories of our inventions, documenting what we believe to be material, novel inventions across multiple technical areas. We are protecting these inventions according to an Internal IP strategy using both trade secret and patent protection. To date, we have filed patent applications in several core areas of differentiated innovation for us and will



continue to do so. We have also received final approval of US trademark registrations for the PATTERN COMPUTER name as well as our corporate logo by the US Patent and Trademark Office

## Business

**Q: You mentioned a partner model with a top global consulting firm. What does the Partner model look like?**

**A:**

We are still developing the Partner model in conjunction with this firm. Pattern Computer can find the patterns in complex, high-dimensional datasets, but we are not necessarily subject matter experts in those industries. We have in-house experts in biomed, but there are many, many industries where a partner organization will have many years of experience in understanding the story behind the discovered patterns. They will be able to identify which additional data sources/datasets should be brought to bear for their specific company (and perhaps data sources to which only the partner has access) to be able to specifically map how the discovered pattern reveals itself in the partner's business. In many ways, the partner takes over the role of the Contextual Analysis engine – interpreting the meaning of the discovered pattern for their company. We are currently discussing which APIs would be valuable for a partner. Beyond the provided source data sets (where we can map the patterns back to the actual rows of source data, we are considering creating APIs where partners can pull in external public data as well as private data to which only they have access). That would allow the Partner to map our patterns onto the source data overlaid/integrated with their customer data to reveal the specific story as it relates to the Partner's customer. This is an active area of investigation which we are working on, currently focused on the US Flight Operations dataset.

**Q: What is your business model?**

**A:**

We are agile in assessing emerging opportunities as we continue to grow, but at this stage we are pursuing a three-pronged business and monetization model: (a) charging up-front engagement fees for our discovery platform (enterprise cloud-SaaS service fee); (b) a subscription model for recurring customer services; and (c) a success fee or revenue share model with customers for the commercialization of our discoveries.

**Q: Are you currently making money?**

**A:**

We spent our first 2.5 years in stealth mode building and testing the system, followed by six months of work in biomed to prove the system's value and credibility. While we have not yet booked revenue, we



are now, at three years of age, a year ahead of plan, and are now on-boarding commercial pilots and engagements. These currently include manufacturing improvements for a F100 aerospace company, security for a F100 insurance company, flight operations efficiency among US carriers, and the commercialization of our bio discoveries.

**Q: Can you name some of your customers?**

**A:**

A few of our engagements are subject to confidentiality restrictions, so we are not at liberty to share all updates, but we have established deep partnerships with a few leading organizations, which has been foundational to our commercial strategy. Among others, we are working with: University of California (both San Diego and Riverside); California Institute for Telecommunications & Information Technology (Calit2); Lawrence Berkeley National Lab (LBNL); Institute for Systems Biology (ISB), and more. Notably, we recently completed and announced the signing of a 10-year master partnership agreement with the Fred Hutchinson Cancer Research Center to support their work as a global leader in cancer research.

**Q: Are you a biomed company? All your updates seem to be in the areas of medical research.**

**A:**

No, we are a technology company that has developed a novel computational engine for discovering valuable insights in complex, high-dimension datasets. We chose biomed as our first domain given the enormous potential for societal impact and its incredible revenue opportunity. As we have been building out that practice area, we have started to extend our technology into new domains, including: manufacturing, aerospace, cybersecurity, and flight operations, as our platform is domain-agnostic and scales to virtually any data-rich field.

## Security

**Q: Are the Pattern Discovery Services secure?**

**A:**

The design of the Pattern Discovery services is to have the binary files encrypted at rest. We also have an explicit design to require that the executable file 'phone home' for execution permission on any other system than its home set of servers (in our datacenter). The discovery engine routines communicate directly to an encrypted log file via Transport Layer Security (TLS). At present the logging file includes the result set. Ultimately the results file will be a separate, encrypted file, accessible via TLS-based protocols. Access to the web-hosted services will require a unique 256-bit key generated by an internal Pattern Computer algorithm.



**Q. How does Pattern secure your source code?**

**A:**

We use an internal server running the GitLab software suite in a private, self-hosting mode (no code uploads to the public GitLab or GitHub environment.) Access uses X.509 certificates for authentication. All activity is monitored, logged, and audited. Our developers use this platform for storing and sharing code as we build it. Completed software is compiled and moved to our data center, located in a physically different location. Access to the data center is restricted to only those employees with a need to run the various tools within the Pattern discovery engine.

**Q. What about AWS and other cloud providers you use with your partners?**

**A:**

We currently have two AWS instances, one provided to us by a partner. Access to the S3 “bucket” (where their data is stored) is limited to a small number of Pattern employees. Our tools are in compiled executable (binary) form and are encrypted when stored at rest. Access to the AWS instance is monitored, logged, and audited.

**Q. How do you protect customer datasets, results, and analysis?**

**A:**

Our datacenter is where we run the Pattern discovery engine. All customer datasets are loaded onto servers there, and (except for one customer) are not stored “in the cloud” or in other Pattern-owned computers outside of the datacenter. Results and analysis also remain in the DC until ready to be presented to a customer. Access to the DC is tightly controlled and requires several layers of authentication. Access logs are continuously monitored and audited.

**Q. Do you provide physical security?**

**A:**

Our office suite is protected by a badge access, camera, and motion detection system that is monitored 24/7 by a third-party security company. The datacenter is likewise protected by a similar system and is monitored by a different third-party security company. Employees receive regular training and awareness briefings on physical security threats.