MONOLITHIC ARCHITECTURE (ARCHITECTURE DESIGN) pdf

1: Moving from a Monolithic to a Microservices Architecture

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Microservices vs Monolithic Architecture Microservices vs Monolithic Architecture Microservices are an important software trend and one that can have profound implications not just on the enterprise IT function, but the digital transformation of the entire business. Microservices vs monolithic architecture represents a fundamental shift in how IT approaches software development, and one which has been successfully adopted by organizations like Netflix, Google, Amazon, and others. A monolithic application is built as a single unit. Enterprise Applications are built in three parts: This server-side application will handle HTTP requests, execute some domain-specific logic, retrieve and update data from the database, and populate the HTML views to be sent to the browser. It is a monolith â€" a single logical executable. To make any alterations to the system, a developer must build and deploy an updated version of the server-side application. By contrast, microservice capabilities are expressed formally with business-oriented APIs. They encapsulate a core business capability, and as such are valuable assets to the business. The implementation of the service, which may involve integrations with systems of record, is completely hidden as the interface is defined purely in business terms. The positioning of services as valuable assets to the business implicitly promotes them as adaptable for use in multiple contexts. The same service can be reused in more than one business process or over different business channels or digital touchpoints, depending on need. Dependencies between services and their consumer are minimized by applying the principle of loose coupling. By standardizing on contracts expressed through business-oriented APIs, consumers are not impacted by changes in the implementation of the service. This allows service owners to change the implementation and modify the systems of record or service compositions which may lie behind the interface and replace them without any downstream impact. Software development processes with microservices vs monolithic architecture Traditional software development processes waterfall, agile, etc usually result in relatively large teams working on a single, monolithic deployment artifact. There are, however, some lurking issues traditional approaches: Limited reuse is realized across monolithic applications. Scaling monolithic applications can often be a challenge. By definition monolithic applications are implemented using a single development stack ie, JEE or. The monolith is instead disassembled into a set of independent services that are developed, deployed and maintained separately. This has the following advantages: Services are encouraged to be small, ideally built by a handful of developers. Services exist as independent deployment artifacts and can be scaled independently of other services. Developing services discretely allows developers to use the appropriate development framework for the task at hand. The tradeoffs of microservices architecture vs monolithic architecture The tradeoff of this flexibility is complexity. Managing a multitude of distributed services at scale is difficult for the following reasons: Project teams need to easily discover services as potential reuse candidates. These services should provide documentation, test consoles, etc so re-using is significantly easier than building from scratch. Interdependencies between services need to be closely monitored. Downtime of services, service outages, service upgrades, etc can all have cascading downstream effects and such impact should be proactively analyzed. A lack of DevOps-style team coordination and automation will mean that your microservices initiative will bring more pain than benefits. Benefits of microservices vs monolithic architecture The business benefits of a microservices vs a monolithic architecture are significant. When deployed properly, a microservices based architecture can bring significant value to the business. That value can be expressed in both technical debt being avoided and a substantial increase in efficiency. For example, technical debt from a monolithic code base is a measurable reality in traditional DevOps. With monolithic code, even segregated components share the same memory, as well as sharing access to the program itself. While that may make it a little easier to code interfaces and implement applications, it ultimately takes away the flexibility that should be a part the agile development process. For example, chores such as bug resolution, interface modifications, adding capabilities, and other changes to applications, impacts the application as a whole, introducing

downtime, as well as creating an environment where inefficiencies can unintentionally be introduced. Simply put, monolithic code bases are more time consuming to work with, are less adaptable and ultimately, more expensive to maintain, which in turn increase technical debt. Reducing technical debt is an important benefit offered by microservices; however, measurable savings do not end with just technical debt. Microservices offers other benefits to the business which can reduce costs and impact the bottom line. By breaking down functionality to the most basic level and then abstracting the related services, DevOps can focus on only updating the relevant pieces of an application. This removes the painful process of integration normally associated with monolithic applications. Microservices speed development, turning it into a process that can be accomplished in weeks and not months. Leveraging a microservices based architecture can result in a far more efficient use of code and underlying infrastructure. By dispersing functionality across multiple services eliminates an applications susceptibility to a single point of failure. Resulting in applications which can perform better, experience less downtime and can scale on demand. User retention and engagement increases with continuous improvements offered by microservices. Take a look at more resources on best practices for implementing microservices in your organization.

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2: Monolithic architecture vs Microservices architecture | Java Foundation

The microservice architecture is an alternative pattern that addresses the limitations of the monolithic architecture. Known uses Well known internet services such as Netflix, www.enganchecubano.com and eBay initially had a monolithic architecture.

You will need to come up with a solid strategy to split your database into multiple small databases aligned with your applications. You should design your microservices architecture in such a way that each individual microservice has its own separate database with its own domain data. This will allow you to independently deploy and scale your microservices. Traditional applications have a single shared database and data is often shared between different components. We all have worked with such databases and have found the development to be simpler since the data gets stored in a single store. But there are multiple issues with this database design. Problems with Monolithic Database Design 1. The traditional design of having a Monolithic Database for multiple services creates a tight coupling and inability to deploy your service changes independently. If there are multiple services accessing the same database, any schema changes would need to be coordinated amongst all the services â€" which in real world can cause additional work and delay in deploying changes. It is difficult to scale individual services with this design, since you only have the option to scale out the entire monolithic database. Improving application performance becomes a challenge. With a single shared database, over a period of time you end up having huge tables. This makes data retrieval difficult since you have to join multiple big sized tables to fetch the required data. Most of the times you have a relational store as your monolith database. This constraints all your services to use a relational database. How to handle your data in a Microservice architecture? Each microservice should have its own database and should contain data relevant to that microservice itself. This will allow you to deploy individual services independently. Individual Teams can now own the databases for the corresponding microservice. You need to design your application based on domains which aligns with the functionality of your application. Its like following the Code First approach over Data First approach â€" hence you design your models first. This is a fundamentally different approach than the traditional mentality of first designing your database tables when starting to work on a new requirement or greenfield project. You should always try to maintain the integrity of your Business model. While designing your database, look at the application functionality and determine if it needs a relational schema or not. Keep your mind open towards a NoSQL db as well if it fits your criteria. Databases should be treated as private to each microservice. No other microservice can directly modify data stored inside database in another microservice. In the below image, the Order Service wont be able to update the Pricing Database directly, it can only access it via the microservice API. This helps you to achieve consistency across different services. Event-Driven Architecture is a common pattern to maintain data consistency across different services. Instead of waiting for an ACID transaction to complete processing and taking up system resources, you can make your application more available and performant by offloading the message to a queue. This provides loose coupling between services. Messages to the queues can be treated as Events â€" and can follow the Pub-Sub model. Publishers publishes a message and is not aware of the Consumer, who has subscribed to the event stream. Loose Coupling between components in your architecture enables to build highly scalable distributed system. Handling database changes in your journey from Monolith to Microservice is challenging. In this article, we understood the problems with Monolithic Database Design and how you can handle your data in a microservice architecture. Please let me know if you have any questions and I will be happy to discuss further. For more information about Architecture for Containerized Applications, please download the free ebook provided by Microsoft here.

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3: Breaking the Monolithic Database in your Microservices Architecture â€“ dotnetvibes

Microservices vs monolithic architecture represents a fundamental shift in how IT approaches software development, and one which has been successfully adopted by organizations like Netflix, Google, Amazon, and others.

Microservices Architecture Monolithic Architecture When developing a server-side application you can start it with a modular hexagonal or layered architecture which consists of different types of components: Database access â€" data access objects responsible for access the database. Application integration â€" integration with other services e. Despite having a logically modular architecture, the application is packaged and deployed as a monolith. Benefits of Monolithic Architecture Simple to develop. For example you can implement end-to-end testing by simply launching the application and testing the UI with Selenium. You just have to copy the packaged application to a server. Simple to scale horizontally by running multiple copies behind a load balancer. In the early stages of the project it works well and basically most of the big and successful applications which exist today were started as a monolith. Drawbacks of Monolithic Architecture This simple approach has a limitation in size and complexity. Application is too large and complex to fully understand and made changes fast and correctly. The size of the application can slow down the start-up time. You must redeploy the entire application on each update. Impact of a change is usually not very well understood which leads to do extensive manual testing. Continuous deployment is difficult. Monolithic applications can also be difficult to scale when different modules have conflicting resource requirements. Another problem with monolithic applications is reliability. Bug in any module e. Moreover, since all instances of the application are identical, that bug will impact the availability of the entire application. Monolithic applications has a barrier to adopting new technologies. Since changes in frameworks or languages will affect an entire application it is extremely expensive in both time and cost. Microservices Architecture The idea is to split your application into a set of smaller, interconnected services instead of building a single monolithic application. Each microservice is a small application that has its own hexagonal architecture consisting of business logic along with various adapters. Other microservices might implement a web UI. The Microservice architecture pattern significantly impacts the relationship between the application and the database. Instead of sharing a single database schema with other services, each service has its own database schema. On the one hand, this approach is at odds with the idea of an enterprise-wide data model. Also, it often results in duplication of some data. However, having a database schema per service is essential if you want to benefit from microservices, because it ensures loose coupling. Each of the services has its own database. Moreover, a service can use a type of database that is best suited to its needs, the so-called polyglot persistence architecture. Some APIs are also exposed to the mobile, desktop, web apps. Instead, communication is mediated by an intermediary known as an API Gateway. The Microservice architecture pattern corresponds to the Y-axis scaling of the Scale Cube model of scalability. Benefits of Microservices Architecture It tackles the problem of complexity by decomposing application into a set of manageable services which are much faster to develop, and much easier to understand and maintain. It enables each service to be developed independently by a team that is focused on that service. It reduces barrier of adopting new technologies since the developers are free to choose whatever technologies make sense for their service and not bounded to the choices made at the start of the project. Microservice architecture enables each microservice to be deployed independently. As a result, it makes continuous deployment possible for complex applications. Microservice architecture enables each service to be scaled independently. Drawbacks of Microservices Architecture Microservices architecture adding a complexity to the project just by the fact that a microservices application is a distributed system. You need to choose and implement an inter-process communication mechanism based on either messaging or RPC and write code to handle partial failure and take into account other fallacies of distributed computing. Microservices has the partitioned database architecture. Business transactions that update multiple business entities in a microservices-based application need to update multiple databases owned by different services. Using distributed transactions is usually not an option and you end up having to use an eventual consistency based approach, which is more challenging for developers. Testing a microservices application is also much

more complex then in case of monolithic web application. For a similar test for a service you would need to launch that service and any services that it depends upon or at least configure stubs for those services. It is more difficult to implement changes that span multiple services. In a monolithic application you could simply change the corresponding modules, integrate the changes, and deploy them in one go. In a Microservice architecture you need to carefully plan and coordinate the rollout of changes to each of the services. Deploying a microservices-based application is also more complex. A monolithic application is simply deployed on a set of identical servers behind a load balancer. In contrast, a microservice application typically consists of a large number of services. Each service will have multiple runtime instances. And each instance need to be configured, deployed, scaled, and monitored. In addition, you will also need to implement a service discovery mechanism. Manual approaches to operations cannot scale to this level of complexity and successful deployment a microservices application requires a high level of automation. Summary Building complex applications is inherently difficult. A Monolithic architecture better suits simple, lightweight applications. There are opinions which suggest to start from the monolith first and others which recommend not to start with monolith when your goal is a microservices architecture. But anyway it is important to understand Monolithic architecture since it is the basis for microservices architecture where each service by itself is implemented according to monolithic architecture. The Microservices architecture pattern is the better choice for complex, evolving applications. Actually the microservices approach is all about handling a complex system, but in order to do so the approach introduces its own set of complexities and implementation challenges.

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4: Software architecture patterns - O'Reilly Media

A Monolithic architecture better suits simple, lightweight applications. There are opinions which suggest to start from the monolith first and others which recommend not to start with monolith when your goal is a microservices architecture.

Learn how organizations are re-architecting their integration strategy with data-driven app integration for true digital transformation. Monolithic architecture is something that build from single piece of material, historically from rock. Monolith term normally use for object made from single large piece of material. Modules are divided as either for business features or technical features. Many companies have invested years to build enterprise application with monolithic approach. Sometime it also called multi-tier architecture because monolithic applications are divided in three or more layers or tire i. It was a time of browser evaluation. Enterprise need to serve data to different devices and form factors smart phone, tablet, handheld, etc. Smart phone become always available, always on and personal device for everyone, which demand information anytime, anywhere, on fingertip. Mobile application is nearly useless without internet connectivity and backend services. Now is a time for mobile first, every enterprises are looking forward to develop mobile application before web. With increasing demand of mobile application force to change back-end architecture. This is prime force behind migrating monolithic architecture to microservice architecture. Microservice architecture is an approach of building large enterprise application with multiple small unit called service, each service develop, deploy and test individually. Each service run individually either in single machine or different machine but they execute its own separate process. Each service may have own database or storage system or they can share common database or storage system. Microservice is all about distribute or break application in small chunks. Microservice is more than code and structure. Its culture in a way, every developer or team own some part of large application. Microservice has some shortfalls like increase lot of operations overhead, DevOps skills required, complex to manage because of distributed system, bug tracking become challenging. Extremely difficult to change technology or language or framework because everything is tightly coupled and depend up on each other. Microservice can be developed independently by small team of developers normally 2 to 5 developers. Microservice is loosely coupled, means services are independent, in terms of development and deployment both. Microservice allows easy and flexible way to integrate automatic deployment with Continuous Integration tools for e. Jenkins, Hudson, bamboo etc.. The productivity of a new team member will be quick enough. Microservice allows you to take advantage of emerging and latest technologies framework, programming language, programming practice, etc. Microservice is easy to scale based on demand. In a nutshell, monolithic vs microservice architecture is like elephant vs ant approach. What you wants to build a giant system like elephant or army of ant, small, fast and effective. Read More From DZone.

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5: Monolithic application - Wikipedia

Monolithic Brand Architecture example - Fedex Corporation Endorsed Brand Architecture The second type - endorsed - is characterized by marketing synergy between the product or division, and the parent.

Not easy to expand services Continuous development is difficult. It is really hard to go with Agile method. It is really hard to understand for new developers in future. In this architecture all of the services are connected to one single database. So it will make huge server load. Sometimes it will take a long time to start the web application because of the overloaded web container. Microservice architecture It is just like a desktop computer. Several units work together. I described about Microservices in my previous post. Microservice architecture makes your application as a set of loosely coupled services. There are a small set of services connecting each other as a one application. Simply it is not a one single project which is connected to one single database. Advantages of Microservices It is easy to handle errors. Because services are independent. Easy understanding curve for developers for future developments. Each services can be developed independently. One of the best option for Agile development. Application starts fast and runs smoothly. Disadvantages of Microservices Creating a microservice based application is really complex. Testing is more difficult. It should have a better communication between developers. Because several services will hit only one front end. When to use Microservices? This is totally depend on the organizational requirements. Microservices produce a pack of services and enables fast delivery with easy testable units. If your company needs to go faster than ever, it may be a reason to change system with microservices. Other reason is, if your system is still growing with adding new functionalities, it is better to use microservices. Because microservices are small components of services, You can add new components according to your requirements.

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6: kapsimalis architects' monolithic residence resembles a volcanic rock

Microservices vs Monolithic architecture. Microservices architecture is getting lot of attention these day and being used by Uber, Netflix, Linkedin and many other other companies.

Instead of a single monolithic system, functionality is carried out by a smaller set of services coordinating their operations. Microservices, as has often been stated, enables not only scalability but flexibility in the way applications are managed. But have we been unrealistic about all this? As you keep adding on and tacking on, it becomes a monolith. Her perspective is backed up by industry observer Martin Fowler , which The New Stack cites as having coined the microservices concept in the first place. But even experienced architects working in familiar domains have great difficulty getting boundaries right at the beginning. By building a monolith first, you can figure out what the right boundaries are, before a microservices design brushes a layer of treacle over them. We never talk about the middle part anymore. That middle part is really, I guess, the typical service-oriented architecture. Some software architects have referred to this model of SOA by way of arguing that microservices are, to put things more succinctly, services. But in a webinar last November, Event Store architect James Nugent pointed to a critical difference between the two concepts: The parent SOA advocates the creation of a single organizational domain model that represents the business model for all the code analogous to how a schema represents the elements of a business for a database. But the child, microservices, would eschew such a global model. That where I think people fall into that hole. At one session, Cloud Native Computing Foundation Executive Director Dan Kohn spoke out in favor of a kind of lift, shift, and adjust approach for transitioning monolithic applications into cloud inhabitants. And it often evolves faster than the second system can go and catch up. Kamdar conceded that lift-and-shift does have the advantage of expediting a project. From his perspective, decomposing such an application into stateless services running alongside a stateful session makes it impossible at best, and ridiculous at least, to continually and intentionally maintain dichotomy by design. All the business logic that this API relies on is in this monolithic Rails application. To abstract it out at that level was way more overhead, for not enough return on investment. So it made sense to keep it in the same place. It made deploying it easier; it made testing it easier. This time, we may not have that luxury. And both parties to the argument appear to have evidence, history, and experience on their side.

7: Monolithic vs. Microservices Architecture â€“ Microservices Practitioner Articles

is an architectural office based in santorini greece. the rough volcanic landscape, the intense alternations of the scenery, the diversity of the materials, the former architecture and the.

This pattern is the de facto standard for most Java EE applications and therefore is widely known by most architects, designers, and developers. The layered architecture pattern closely matches the traditional IT communication and organizational structures found in most companies, making it a natural choice for most business application development efforts. Although the layered architecture pattern does not specify the number and types of layers that must exist in the pattern, most layered architectures consist of four standard layers: In some cases, the business layer and persistence layer are combined into a single business layer, particularly when the persistence logic e. Thus, smaller applications may have only three layers, whereas larger and more complex business applications may contain five or more layers. Each layer of the layered architecture pattern has a specific role and responsibility within the application. For example, a presentation layer would be responsible for handling all user interface and browser communication logic, whereas a business layer would be responsible for executing specific business rules associated with the request. Each layer in the architecture forms an abstraction around the work that needs to be done to satisfy a particular business request. Layered architecture pattern One of the powerful features of the layered architecture pattern is the separation of concerns among components. Components within a specific layer deal only with logic that pertains to that layer. For example, components in the presentation layer deal only with presentation logic, whereas components residing in the business layer deal only with business logic. This type of component classification makes it easy to build effective roles and responsibility models into your architecture, and also makes it easy to develop, test, govern, and maintain applications using this architecture pattern due to well-defined component interfaces and limited component scope. This is a very important concept in the layered architecture pattern. For example, a request originating from the presentation layer must first go through the business layer and then to the persistence layer before finally hitting the database layer. Closed layers and request access So why not allow the presentation layer direct access to either the persistence layer or database layer? After all, direct database access from the presentation layer is much faster than going through a bunch of unnecessary layers just to retrieve or save database information. If you allow the presentation layer direct access to the persistence layer, then changes made to SQL within the persistence layer would impact both the business layer and the presentation layer, thereby producing a very tightly coupled application with lots of interdependencies between components. This type of architecture then becomes very hard and expensive to change. The layers of isolation concept also means that each layer is independent of the other layers, thereby having little or no knowledge of the inner workings of other layers in the architecture. Assuming that the contracts e. While closed layers facilitate layers of isolation and therefore help isolate change within the architecture, there are times when it makes sense for certain layers to be open. For example, suppose you want to add a shared-services layer to an architecture containing common service components accessed by components within the business layer e. Creating a services layer is usually a good idea in this case because architecturally it restricts access to the shared services to the business layer and not the presentation layer. Without a separate layer, there is nothing architecturally that restricts the presentation layer from accessing these common services, making it difficult to govern this access restriction. However, this presents a problem in that the business layer is now required to go through the services layer to get to the persistence layer, which makes no sense at all. This is an age-old problem with the layered architecture, and is solved by creating open layers within the architecture. In the following example, since the services layer is open, the business layer is now allowed to bypass it and go directly to the persistence layer, which makes perfect sense. Open layers and request flow Leveraging the concept of open and closed layers helps define the relationship between architecture layers and request flows and also provides designers and developers with the necessary information to understand the various layer access restrictions within the architecture. Failure to document or properly communicate which layers in the architecture are open and closed and why usually

results in tightly coupled and brittle architectures that are very difficult to test, maintain, and deploy. The black arrows show the request flowing down to the database to retrieve the customer data, and the red arrows show the response flowing back up to the screen to display the data. In this example, the customer information consists of both customer data and order data orders placed by the customer. The customer screen is responsible for accepting the request and displaying the customer information. It does not know where the data is, how it is retrieved, or how many database tables must be queries to get the data. Once the customer screen receives a request to get customer information for a particular individual, it then forwards that request onto the customer delegate module. This module is responsible for knowing which modules in the business layer can process that request and also how to get to that module and what data it needs the contract. The customer object in the business layer is responsible for aggregating all of the information needed by the business request in this case to get customer information. These modules in turn execute SQL statements to retrieve the corresponding data and pass it back up to the customer object in the business layer. Once the customer object receives the data, it aggregates the data and passes that information back up to the customer delegate, which then passes that data to the customer screen to be presented to the user. Layered architecture example From a technology perspective, there are literally dozens of ways these modules can be implemented. For example, in the Java platform, the customer screen can be a JSF Java Server Faces screen coupled with the customer delegate as the managed bean component. The customer object in the business layer can be a local Spring bean or a remote EJB3 bean. From a Microsoft platform perspective, the customer screen can be an ASP active server pages module using the. Considerations The layered architecture pattern is a solid general-purpose pattern, making it a good starting point for most applications, particularly when you are not sure what architecture pattern is best suited for your application. However, there are a couple of things to consider from an architecture standpoint when choosing this pattern. The first thing to watch out for is what is known as the architecture sinkhole anti-pattern. This anti-pattern describes the situation where requests flow through multiple layers of the architecture as simple pass-through processing with little or no logic performed within each layer. The presentation layer passes the request to the business layer, which simply passes the request to the persistence layer, which then makes a simple SQL call to the database layer to retrieve the customer data. The data is then passed all the way back up the stack with no additional processing or logic to aggregate, calculate, or transform the data. Every layered architecture will have at least some scenarios that fall into the architecture sinkhole anti-pattern. The key, however, is to analyze the percentage of requests that fall into this category. The rule is usually a good practice to follow to determine whether or not you are experiencing the architecture sinkhole anti-pattern. It is typical to have around 20 percent of the requests as simple pass-through processing and 80 percent of the requests having some business logic associated with the request. However, if you find that this ratio is reversed and a majority of your requests are simple pass-through processing, you might want to consider making some of the architecture layers open, keeping in mind that it will be more difficult to control change due to the lack of layer isolation. Another consideration with the layered architecture pattern is that it tends to lend itself toward monolithic applications, even if you split the presentation layer and business layers into separate deployable units. While this may not be a concern for some applications, it does pose some potential issues in terms of deployment, general robustness and reliability, performance, and scalability. Pattern Analysis The following table contains a rating and analysis of the common architecture characteristics for the layered architecture pattern. The rating for each characteristic is based on the natural tendency for that characteristic as a capability based on a typical implementation of the pattern, as well as what the pattern is generally known for. Overall agility is the ability to respond quickly to a constantly changing environment. While change can be isolated through the layers of isolation feature of this pattern, it is still cumbersome and time-consuming to make changes in this architecture pattern because of the monolithic nature of most implementations as well as the tight coupling of components usually found with this pattern. Ease of deployment Rating: Depending on how you implement this pattern, deployment can become an issue, particularly for larger applications. One small change to a component can require a redeployment of the entire application or a large portion of the application , resulting in deployments that need to be planned, scheduled, and executed during off-hours or on weekends. As such, this pattern does not easily lend itself

toward a continuous delivery pipeline, further reducing the overall rating for deployment. A developer can mock a presentation component or screen to isolate testing within a business component, as well as mock the business layer to test certain screen functionality. While it is true some layered architectures can perform well, the pattern does not lend itself to high-performance applications due to the inefficiencies of having to go through multiple layers of the architecture to fulfill a business request. Because of the trend toward tightly coupled and monolithic implementations of this pattern, applications build using this architecture pattern are generally difficult to scale. You can scale a layered architecture by splitting the layers into separate physical deployments or replicating the entire application into multiple nodes, but overall the granularity is too broad, making it expensive to scale. Ease of development Rating: Ease of development gets a relatively high score, mostly because this pattern is so well known and is not overly complex to implement. Because most companies develop applications by separating skill sets by layers presentation, business, database , this pattern becomes a natural choice for most business-application development. Stacking kiln for bulk firing of one pattern source:

8: architect-k establishes monolithic house along the coast of south korea

BRAINFACTORY - ARCHITECTURE & DESIGN. Project Description. Monolithic House is an apartment located in Castrovillari (CS), in the southern Italy, so defined because the creative concept behind the project plays with the volumetric subtractions of a monolithic block.

9: Monolithic kernel - Wikipedia

A monolithic application is self-contained, and independent from other computing applications. The design philosophy is that the application is responsible not just for a particular task, but can perform every step needed to complete a particular function.

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