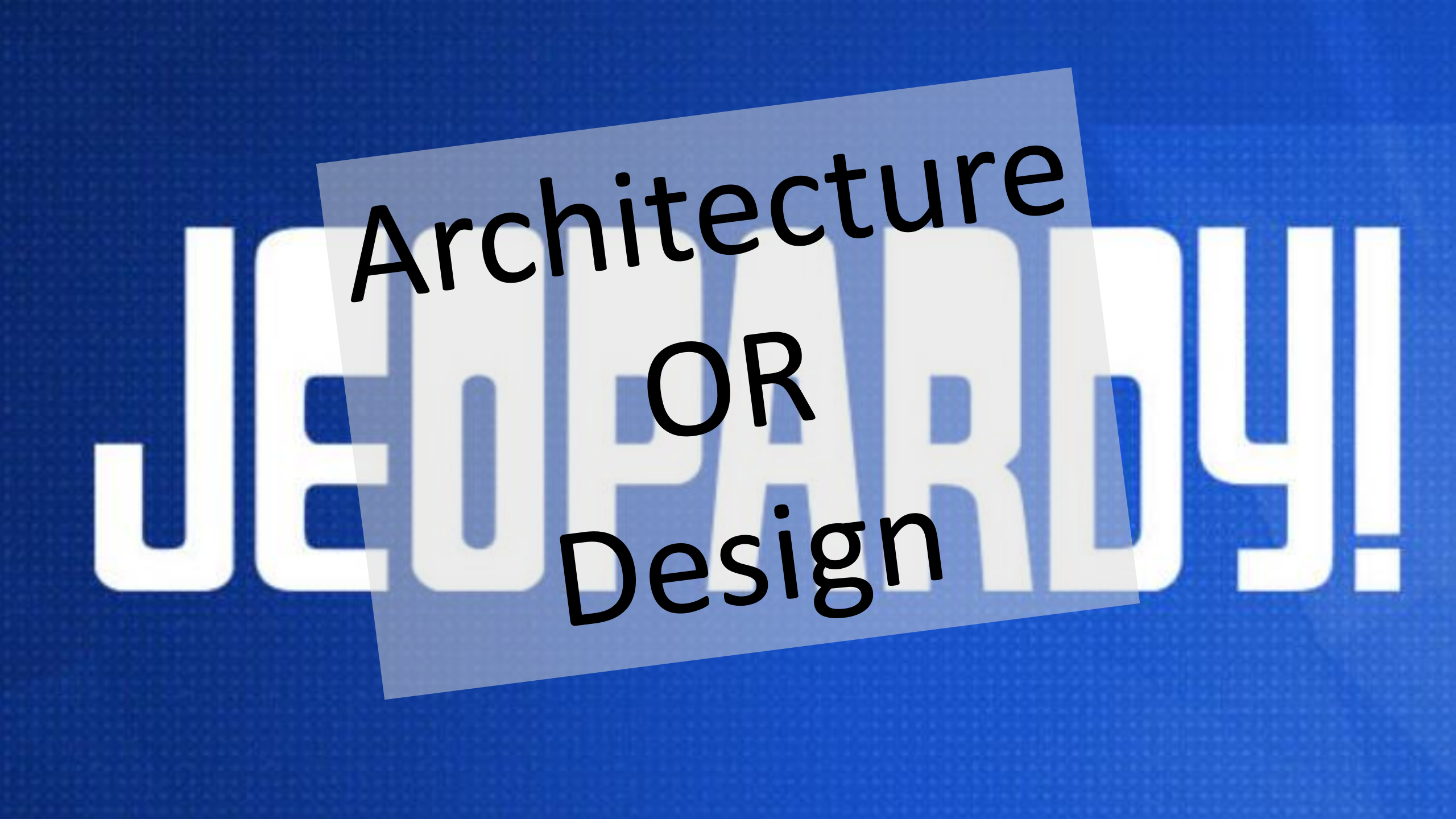

JEOPARDY!
Architecture
OR
Design

“We want a GUI layer, an analytics layer, and a data storage layer.”

Architecture Design

“We want a GUI layer, an analytics layer, and a data storage layer.”

Architecture

Design

“All new application need to extend the *Application* interface.”

Architecture Design

"All new application need to extend the *Application* interface."

Architecture

Design

“The application is available as a service deployed on cloud.”

Architecture Design

“The application is available as a service deployed on cloud.”

Architecture

Design

“We need a NoSQL database with a high availability rate.”

Architecture Design

“We need a NoSQL database with a high availability rate.”

Architecture

Design

“A method takes the type of an object as parameter and returns an instance of this type by calling the private constructor of the corresponding class.”

Architecture Design

“A method takes the type of an object as parameter and returns an instance of this type by calling the private constructor of the corresponding class.”

Architecture

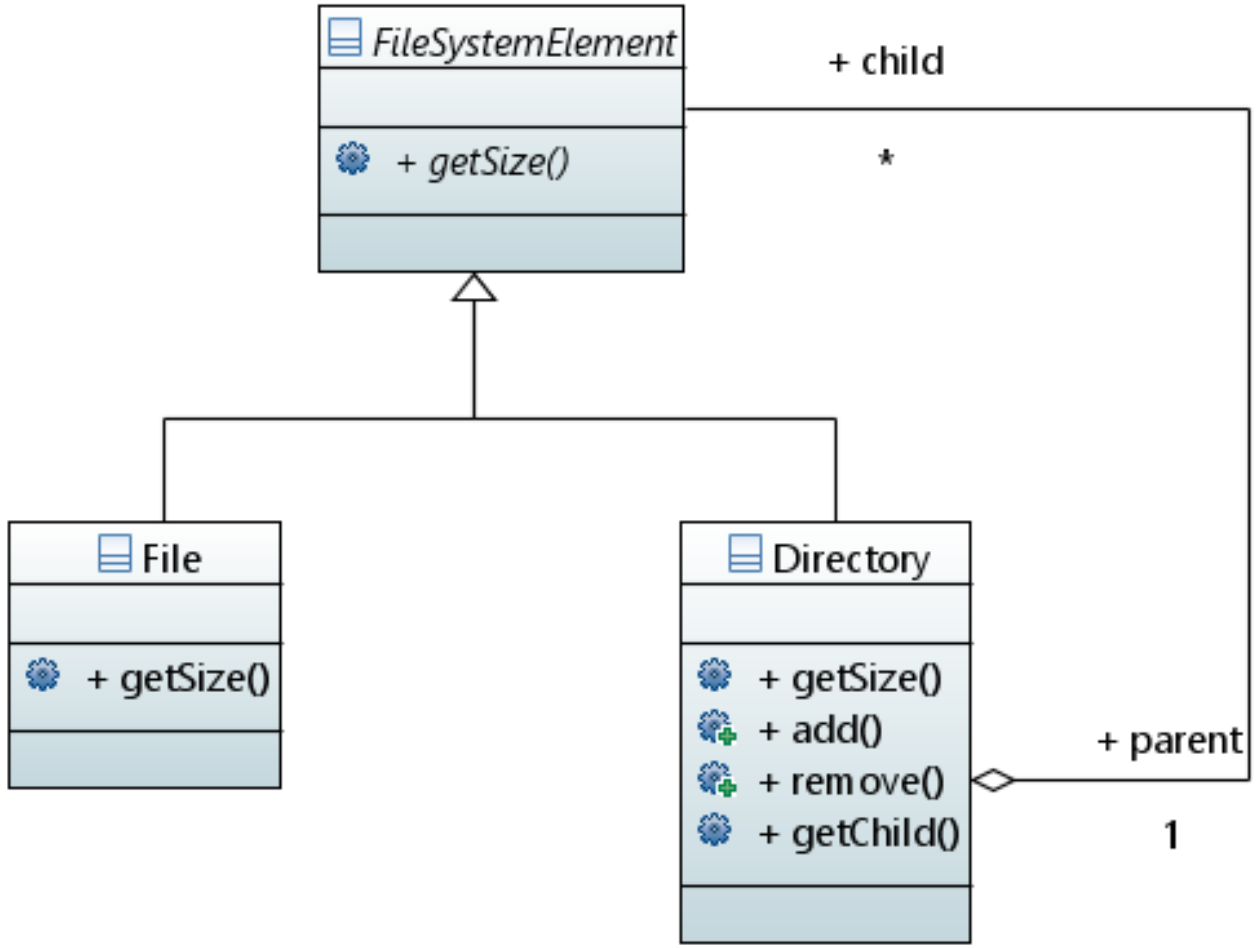
Design

Design Patterns

Design Patterns for $200

- You work for an accounting office and you develop a software to calculate the size of the entire file system. The `size` of a `Directory` is the sum of sizes of all `Files` in the directory.

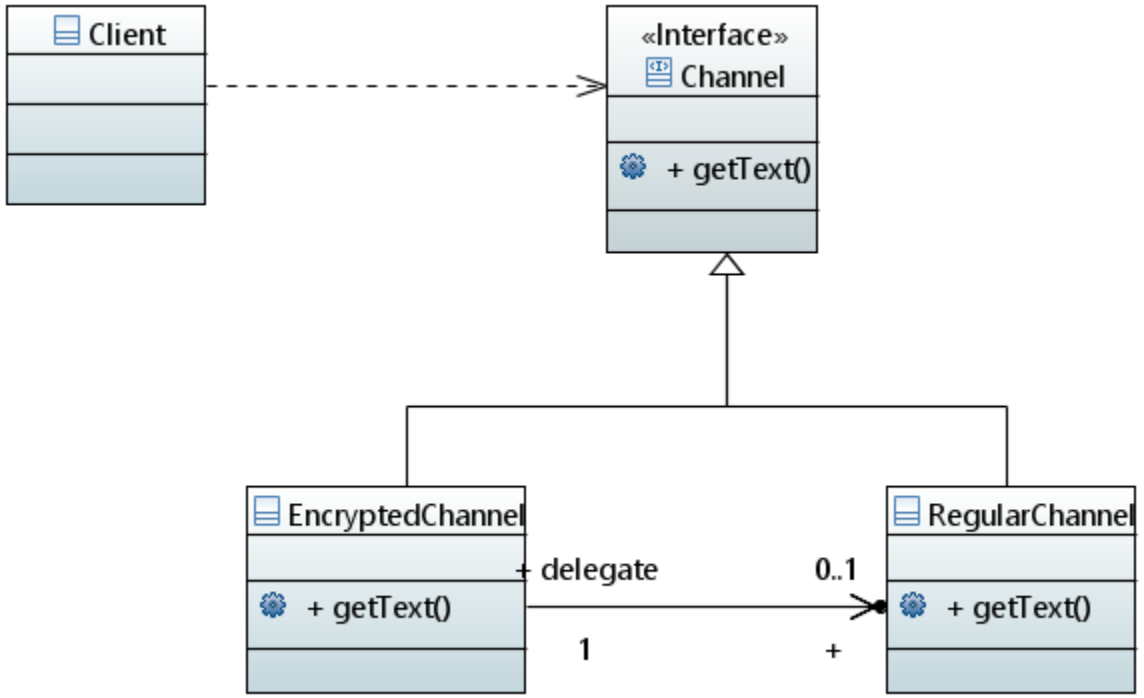
Solution #1 (composite)



Design Patterns for $400

- We have a configuration, where we send and receive data over a network. At a given moment, the flow of input data changes to encrypted. How do we need to change the client code?

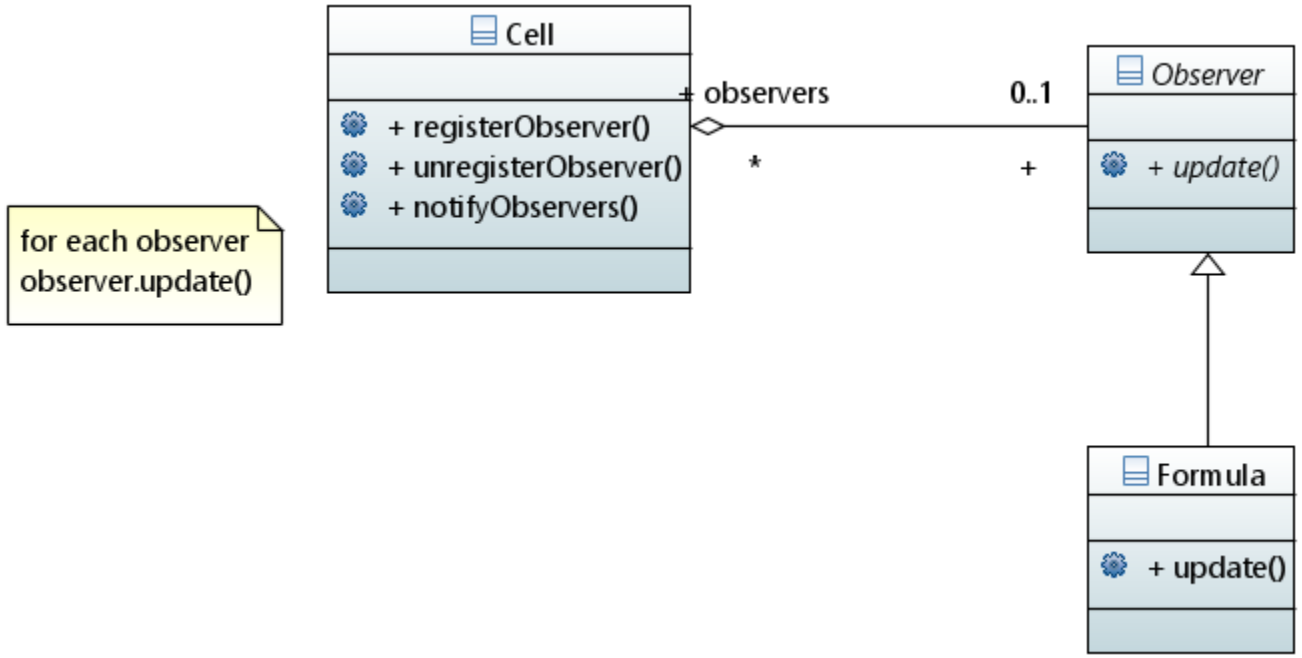
Solution #2 (proxy)



Design Patterns for $600

- You develop a spreadsheet application that allows to automatically calculate the contents of cells using functions, which depend on other cells.

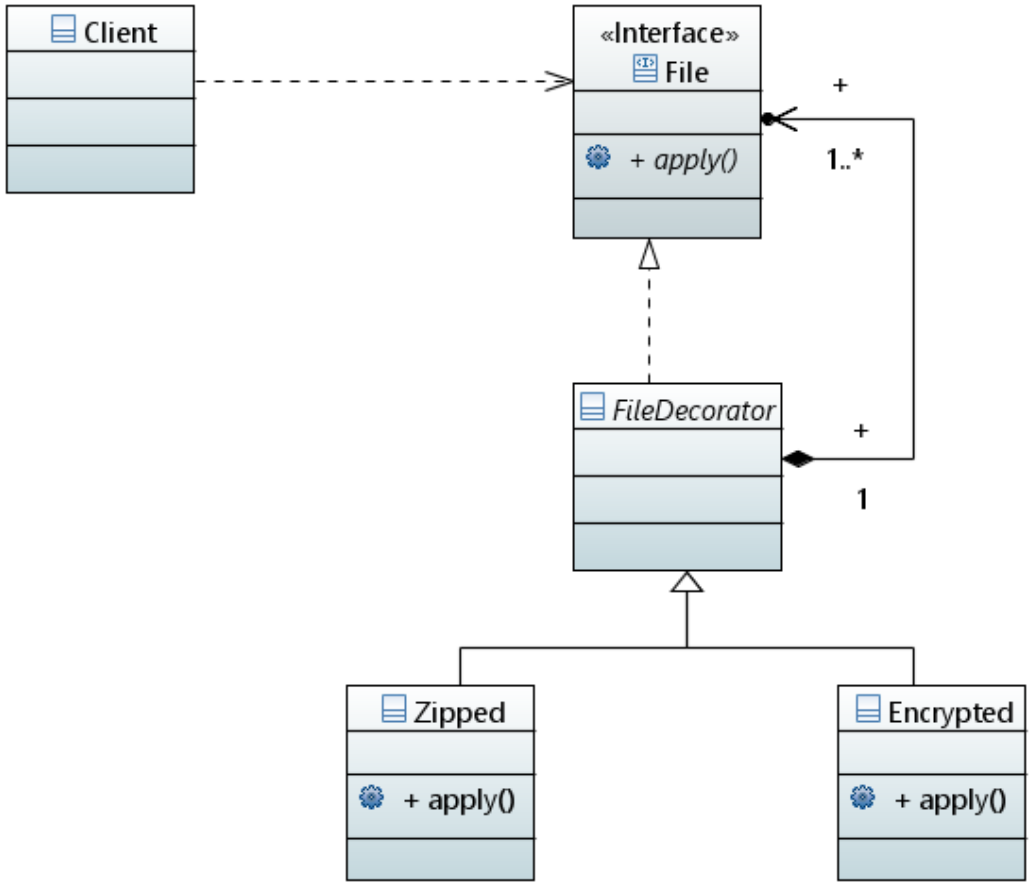
Solution #3 (observer)



Design Patterns for $800

- You wish to develop a file reader that is capable of reading a file, which may be (a) compressed, (b) encrypted, (c) compressed an encrypted, or (d) encrypted, then compressed, and then encrypted again.

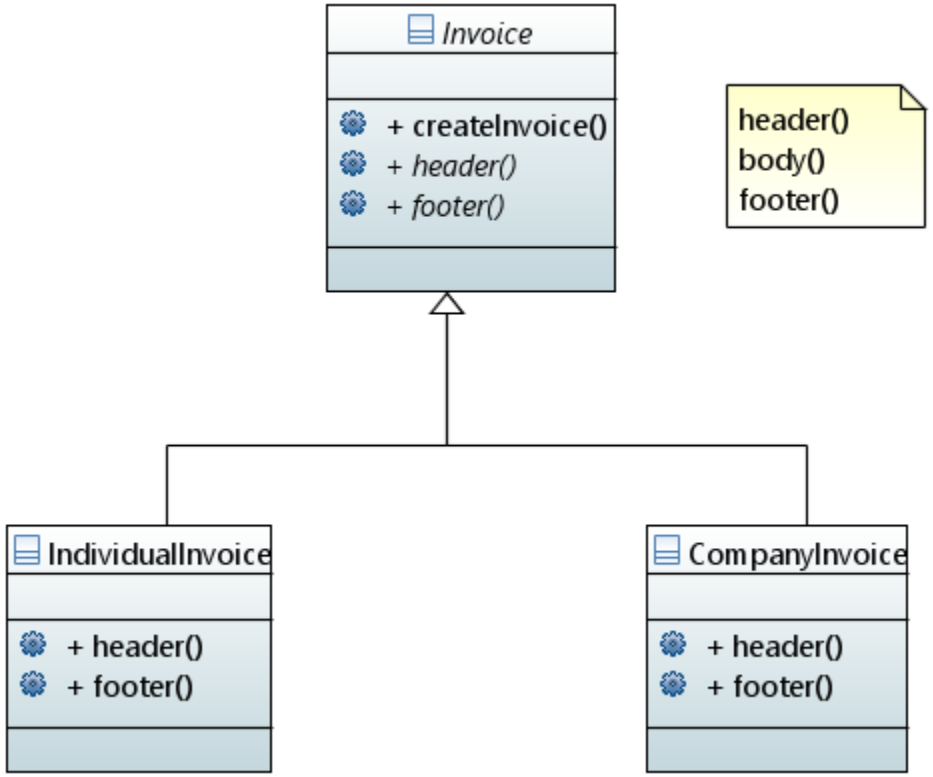
Solution #4 (decorator)



Design Patterns for $1000

- You have a system that prints invoices, one for individuals and an other for companies, which differ between each other on the header and the footer of the page. The content in the body of the invoice is a list of all elements, their prices and the total.

Solution #5 (template method)

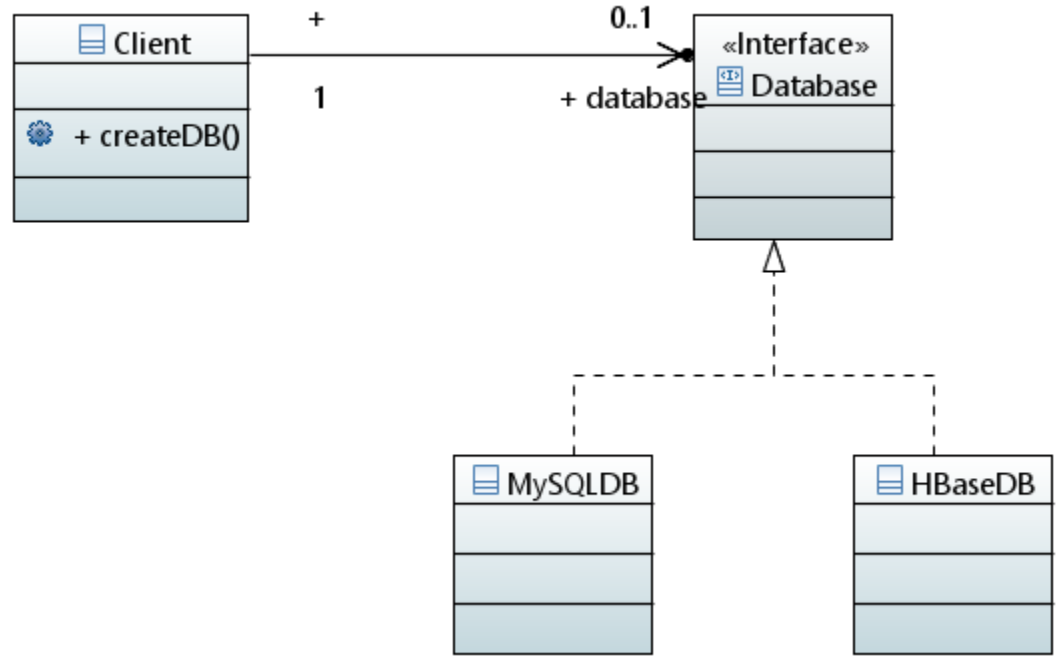


Design Patterns for $2000

- You have multiple databases, each of which having their own initialization, and you wish that your own application will be able to construct and use each of them in an interchangeable way (db1, db2, …) at the user's choice.

Solution #6 (factory method)

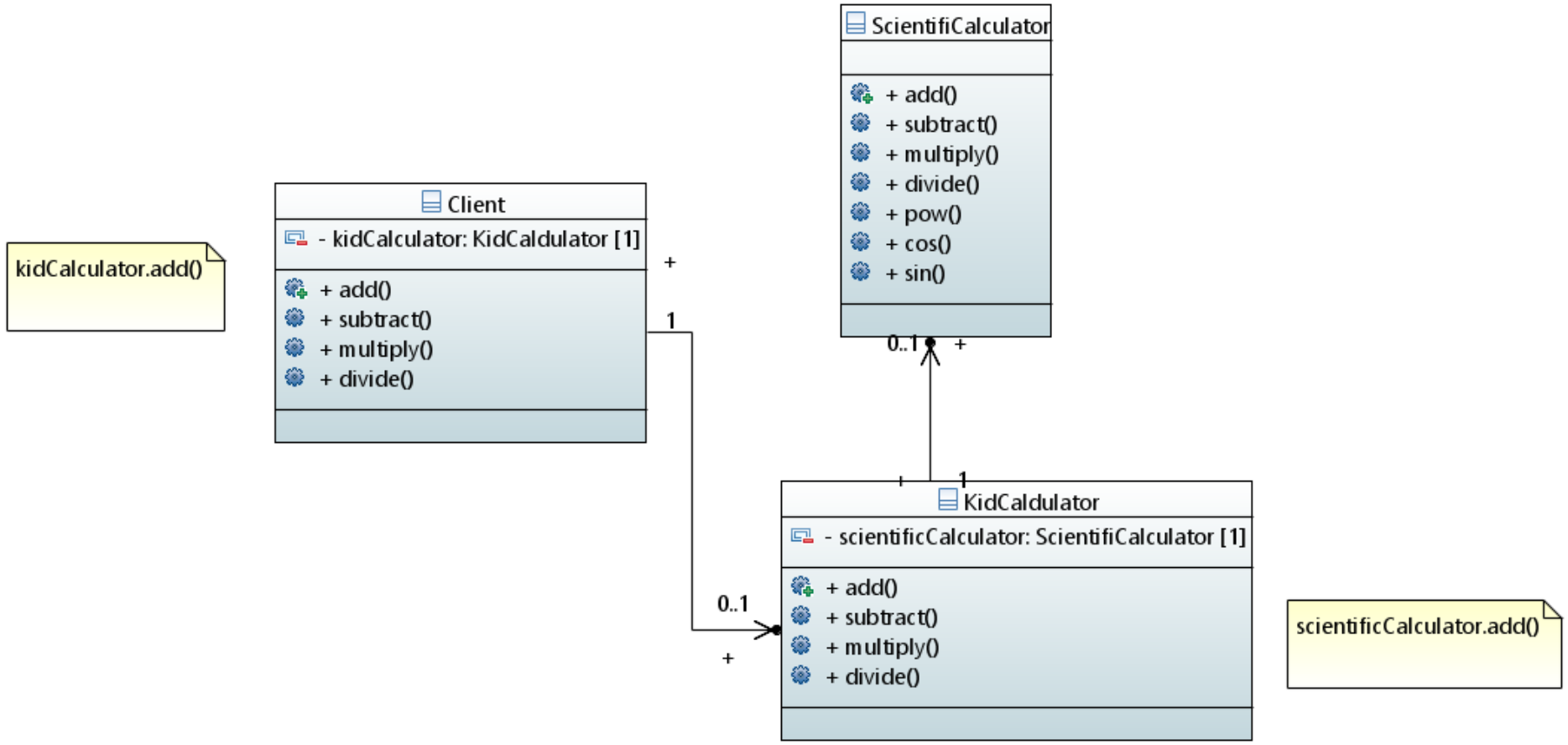
```
switch(dbType) {
case "mysql":
return new MySQLDB();
case "hbase":
return new HBaseDB();
default:
return null;
}
```



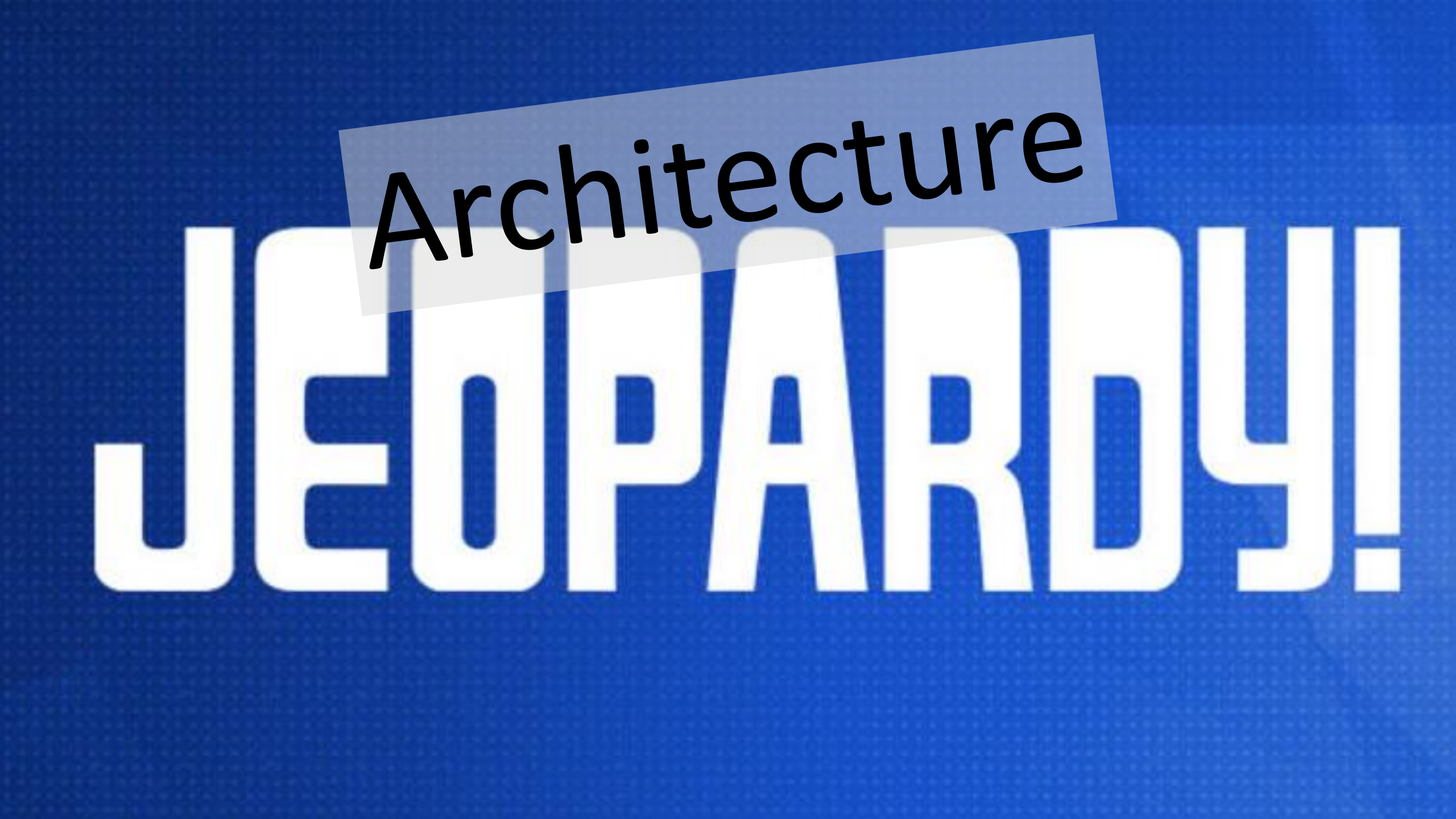
DAILY DOUBLE! ($4000)

- You are hired by MathWorks (the developers of Matlab). The company would like to provide software to elementary schools, byt they want to reuse existing code. Your are given code for a scientific calculator and your task is to develop a calculator for children with just the basic operations.

Solution #7 (adapter)



Architecture



Software Architecture for $200

- We search for a distributed data system with high fault tolerance and with high availability. The database contains numerous replicas and the nodes communicate with each other to identify errors.

Software Architecture for $200

- We search for a distributed data system with high fault tolerance and with high availability. The database contains numerous replicas and the nodes communicate with each other to identify errors.
- What is… “peer-to-peer”
- The system is the NoSQL database Apache Cassandra.

Software Architecture for $400

- We search for a data analytics system. An analytics task is submitted and it is replicated on multiple nodes. Each node works on a slice of the data. The results are assembled and aggregated before being returned.

Software Architecture for $400

- We search for a data analytics system. An analytics task is submitted and it is replicated on multiple nodes. Each node works on a slice of the data. The results are assembled and aggregated before being returned.
- What is… “master-slave”
- MapReduce: Hadoop, Spark…

Software Architecture for $600

- We search for a system to store and analyse tax returns. The computation and storage capacity is not a problem and the number of tax returns is roughly predicted.

Software Architecture for $600

- We search for a system to store and analyse tax returns. The computation and storage capacity is not a problem and the number of tax returns is roughly predicted.
- What is… “monolithic”
- Security is of the highest importance.

Software Architecture for $800

- We search for a data system to sell products of an e-store. Each product can be identified uniquely. The user can simply view a product, add a product, delete a product and update a product.

Software Architecture for $800

- We search for a data system to sell products of an e-store. Each product can be identified uniquely. The user can simply view a product, add a product, delete a product and update a product.
- What is… “REST”
- SOAP is too complicated for this application.

Software Architecture for $1000

- We search for a data analytics system. There are many algorithms to analyse the data. Each algorithm can change the data and prepare it for the following algorithm

Software Architecture for $1000

- We search for a data analytics system. There are many algorithms to analyse the data. Each algorithm can change the data and prepare it for the following algorithm
- What is… “pipe-filter”, if the order is predetermined.
- What is… “blackboard”, if the order is determined based on the most recent results.


Architecture
JEOPARDY!
Quality Version

Software architecture quality for $200

- We are looking for a financial system that monitors investments. The requirements are well defined. The system needs to be available 100% of the time. Our clients are our priority, their data need to remain private and we need to maintain their integrity.

Software architecture quality for $200

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- What is… CBA
- The system is critical. The conformity to the requirements, the security and the reliability are the priorities.

Software architecture quality for $400

- We are looking for a smart assistance system with the ability to understand and produce natural language. We will use multiple tools that already exist. As an innovative project, we can expect a lot of changes.

Software architecture quality for $400

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- What is… SOA
- Functional Suitability, Maintainability, Compatibility

Software architecture quality for $600

- We are looking for a system to monitor the environmental conditions of buildings. The system will notify the building manager in real time if there are problems. The system should function for any building and it should be integrated with existing equipment.

Software architecture quality for $600

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- What is… EDA
- Efficiency, Portability, Compatibility

Software architecture quality for $800

- We are looking for a system for an autonomic vehicle. The system will monitor the vehicle at all times and it cannot make errors. The security of the passengers is of utmost importance. The system should function for any vehicle.

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- What is… AOA
- Efficiency, Reliability, Security, Portability

Software architecture quality for $1000

- We are looking for a flight simulator. The system should have a simple interface, clear and concise to train pilots. It should be adaptive and easy to change in order to accommodate multiple scenarios in the future. It should avoid errors to ensure the proper training of the pilots.

Software architecture quality for $1000

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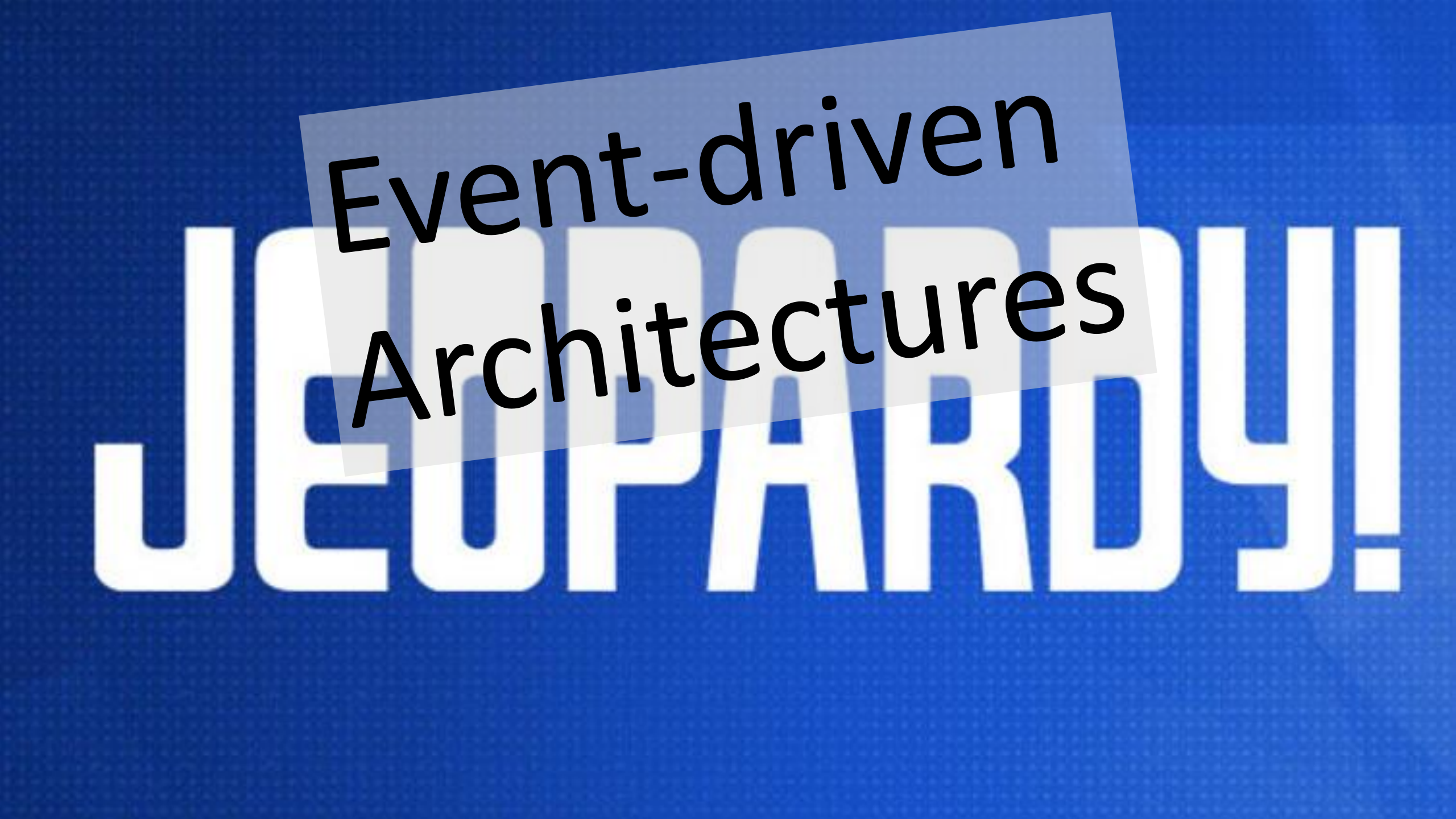
- What is… MDA
- Usability, Maintainability, Reliability


Event-driven
Architectures
JEOPARDY!

Event-driven Architectures for $200

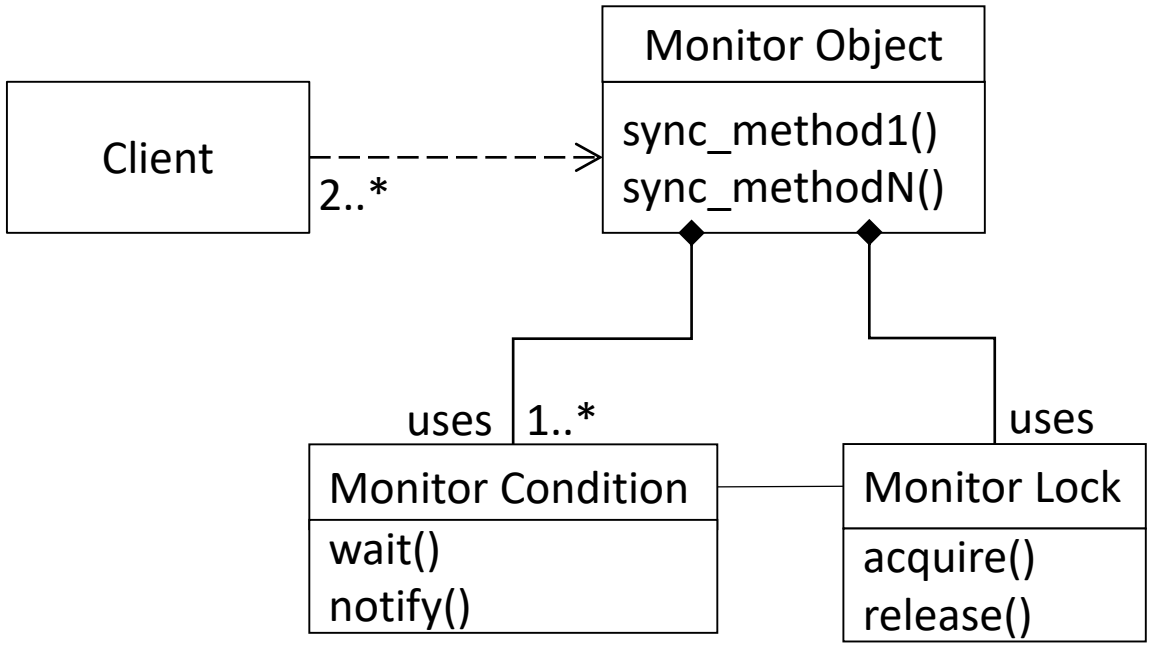
- We are in a fast food restaurant. Clients place their order in the cashier. If the order cannot be served immediately, the clients step aside and wait. When the order is ready, they step back at the front of the line to receive their meal from the cashier.

Event-driven Architectures for $200

- We are in a fast food restaurants. Clients place their order in the cashier. If the order cannot be served immediately, the clients step aside and wait. When the order is ready, they step back at the front line to receive their meal from the cashier.
- What is… Monitor Object

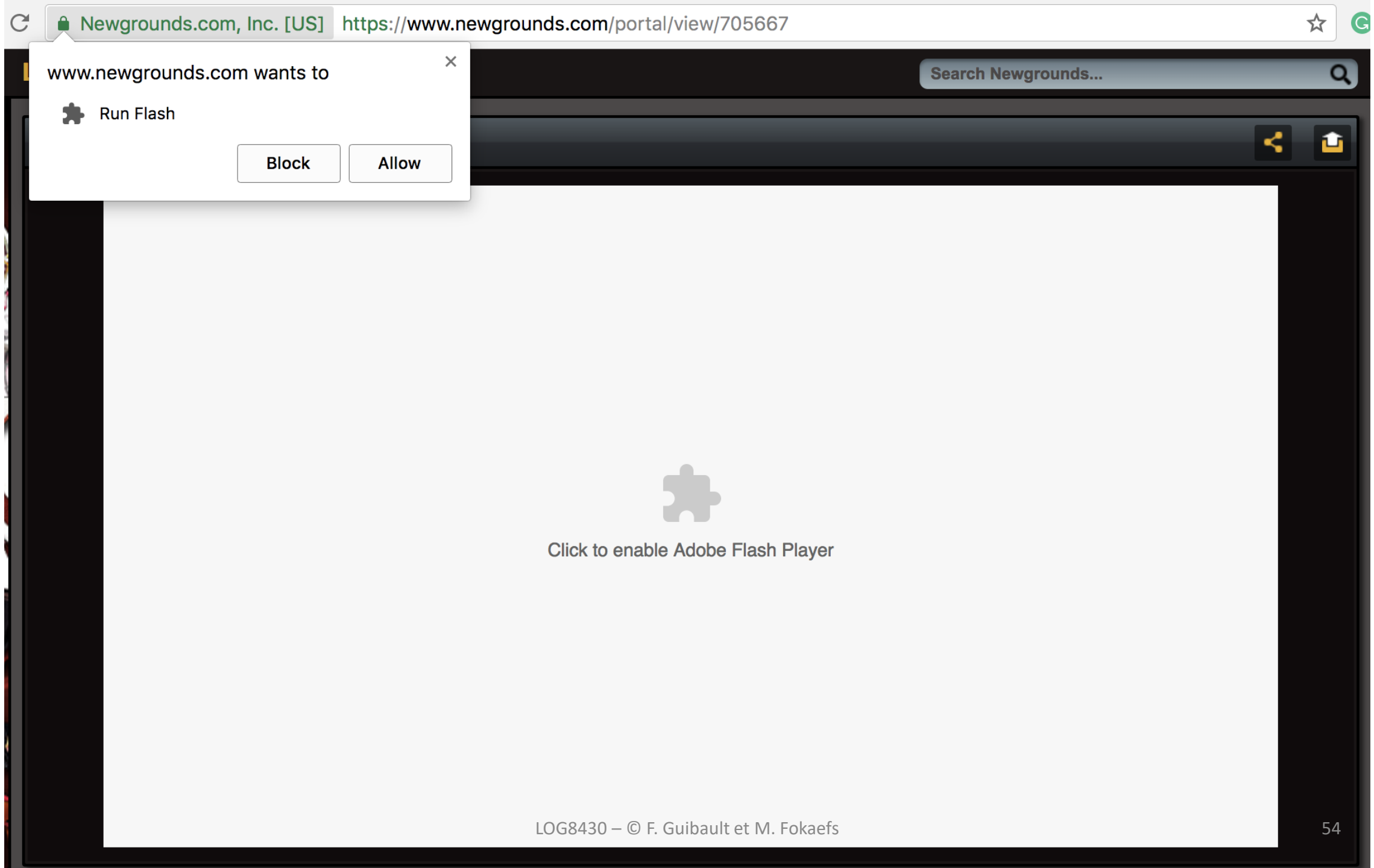
Monitor Object

- **Structure** :



Event-driven Architectures for $400

- Chrome uses plugins to allow the presentation of certain media types, like Flash. When a page that contains such media needs to be loaded the browser checks if the appropriate plugin is installed. If it is, the browser automatically invokes the plugin to handle the media.


Newgrounds.com, Inc. [US]
https://www.newgrounds.com/portal/view/705667
www.newgrounds.com wants to
Run Flash
Block
Allow
Search Newgrounds...
Click to enable Adobe Flash Player

Event-driven Architectures for $400

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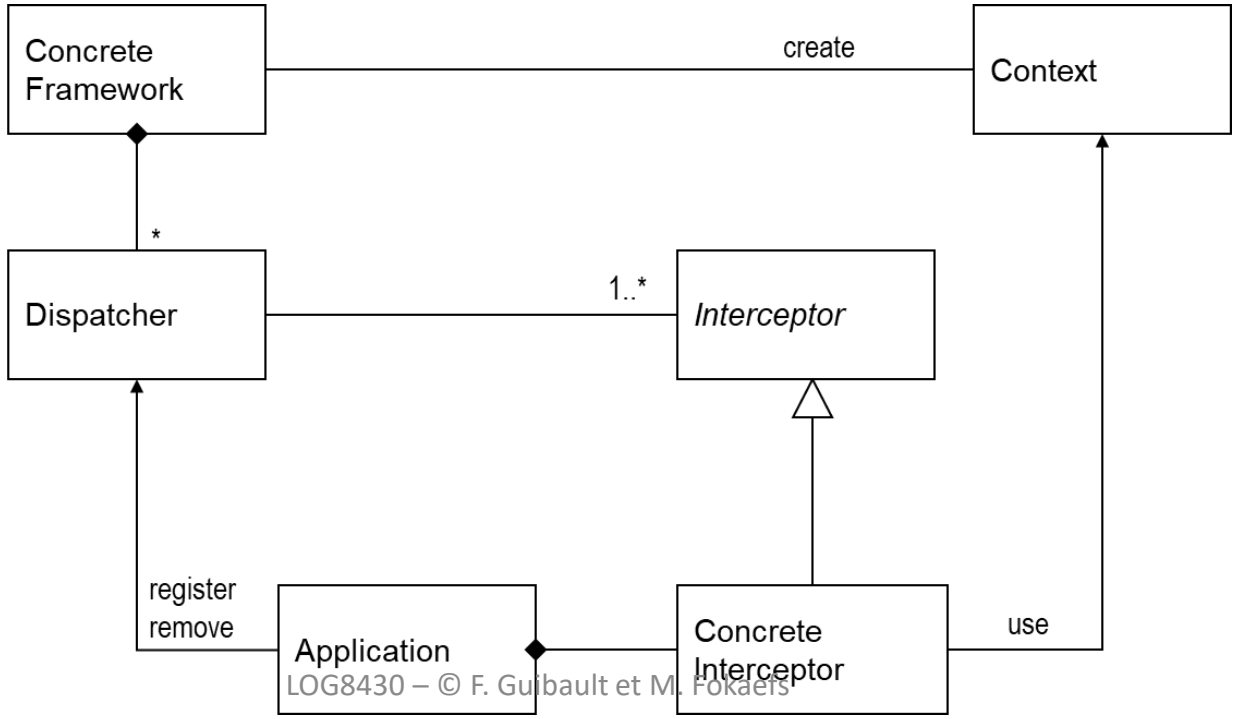
Event-driven Architectures for $400

- Chrome uses plugins to allow the presentation of certain media types, like Flash. When a page that contains such media needs to be loaded the browser checks if the appropriate plugin is installed. If it is, the browser automatically invokes the plugin to handle the media.
- What is… Interceptor

Interceptor

- **Objective:** Allow services to be added in a framework in a transparent way and to be started automatically when certain events occur.
- **Application:** When a framework needs to be able to register and trigger new services that were not originally planned. Also, to allow applications to control the behavior and the functionality of the framework.
- **Structure** :



Event-driven Architectures for $600

- A FedEx Airbill contains a section labeled: 'Your Internal Billing Reference Information (Optional: First 24 characters will appear on invoice).’ The sender of a package uses this field as a confirmation. This confirmation is returned by FedEx to the sender with the invoice that notifies the sender that the transaction has completed. FedEx deliberately defines this field very loosely: it is a maximum of 24 characters, which are otherwise 'untyped.' Therefore, senders can use the field in a variety of ways. For example, a sender can populate this field with the index of a record for an internal database or with a name of a file containing a 'to-do list' to be performed after the acknowledgment of the FedEx package delivery has been received.

Event-driven Architectures for $600

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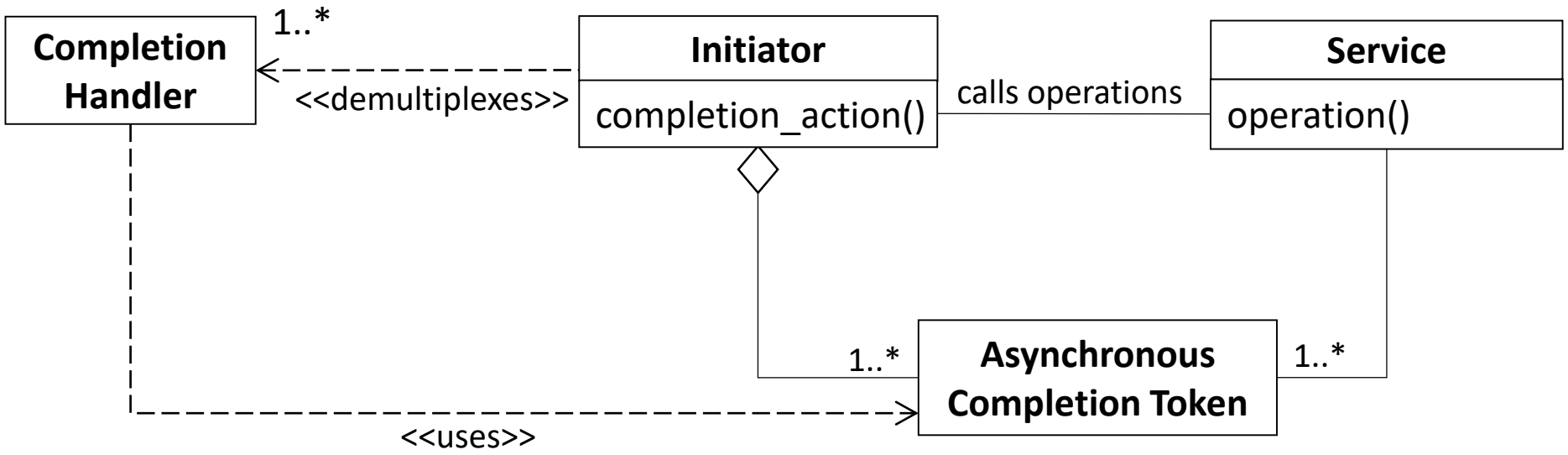
- What is… Asynchronous Completion Token (ACT)

Asynchronous Completion Token (ACT)

- **Structure** :



Event-driven Architectures for $800

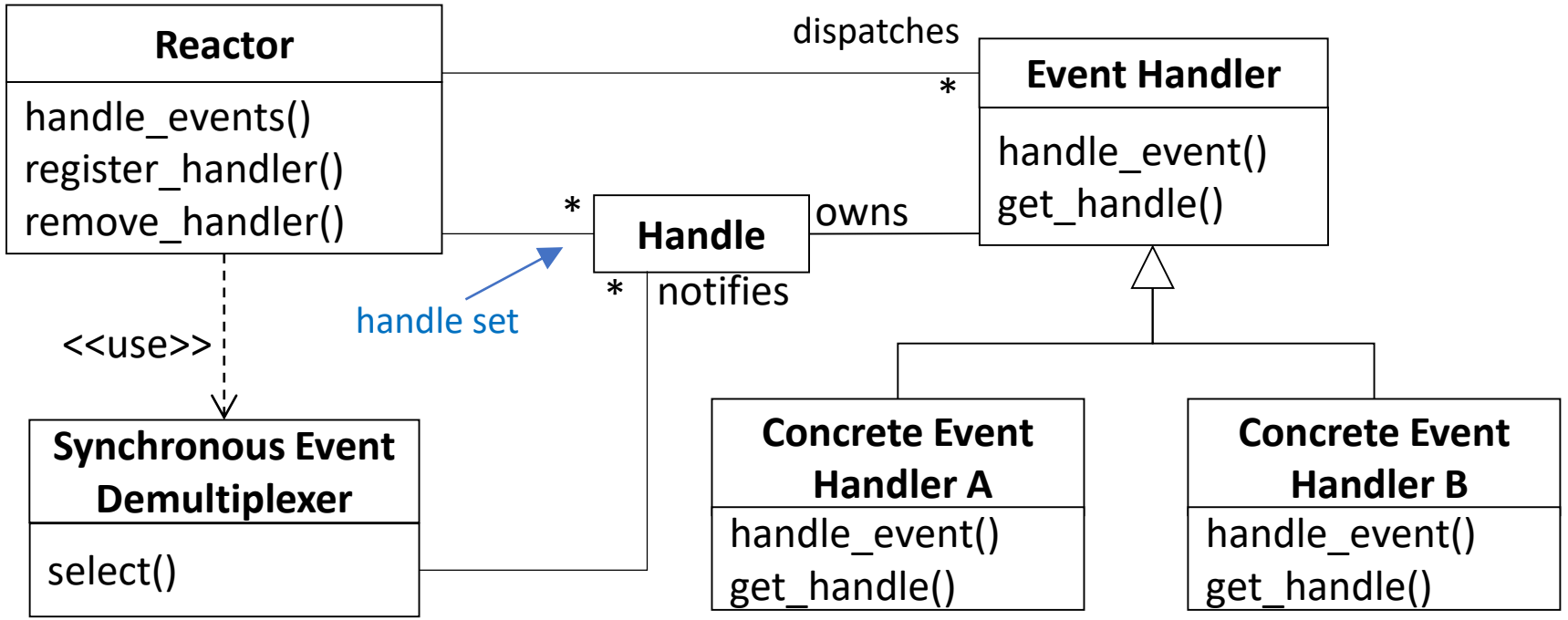
- You probably have a mobile phone associated with a specific phone number. People can call that number and reach you. When somebody does, your phone rings and you may choose to respond and carry out the conversation with the person on the other side of the line.

Event-driven Architectures for $800

- You probably have a mobile phone associated with a specific phone number. People can call that number and reach you. When somebody does, your phone rings and you may choose to respond and carry out the conversation with the person on the other side of the line.
- What is… Reactor

Reactor

- **Structure** :



Event-driven Architectures for $1000

- Travelers arrive at an airport and some of them go to grab a taxi. The taxis are waiting in a line and so do the passengers, wait to be served one at a time. Normally, the first passenger will be served by the first taxi, but in certain cases a taxi driver may choose to serve a particular destination.

Event-driven Architectures for $1000

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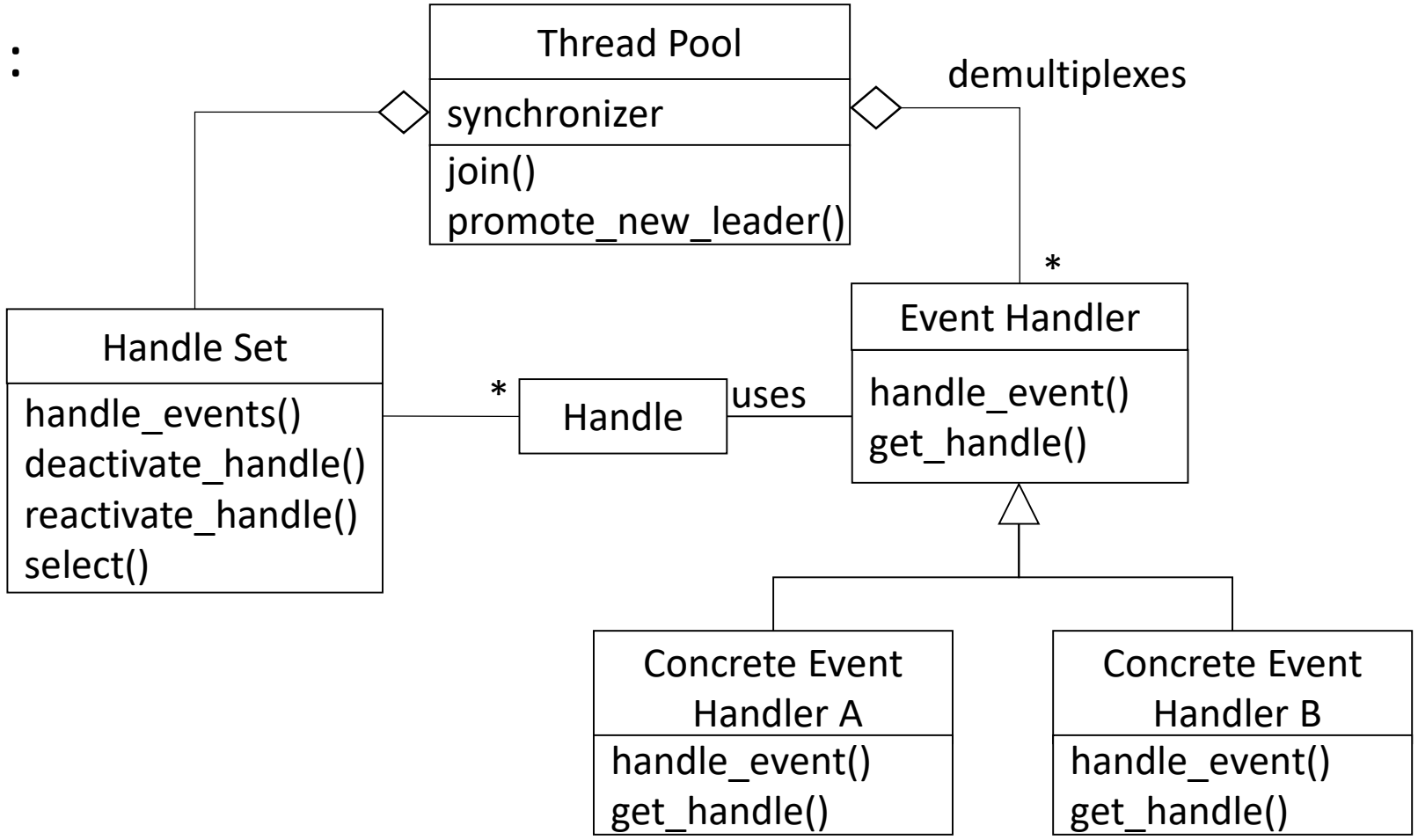
- What is… Leader/Followers

Leader/Followers

- **Structure** :



SOA

JEOPARDY!

SOA for $200

- We want to develop a system to manage graduate studies at GIGL. Put the SOA styles in order from best to worst.

SOA for $200

- We want to develop a system to manage graduate studies at GIGL. Put the SOA styles in order from best to worst.
- What is… REST, RPC, Microservices, SOAP

SOA for $400

- We want to develop a service to manage the graduate studies at GIGL. What are the differences in the implementation between the 4 styles?

SOA for $400

- We want to develop a service to manage the graduate studies at GIGL. What are the differences in the implementation between the 4 styles?
- REST: 4 methods (GET, PUT, POST, DELETE), 3 resources (students, courses, supervisors)
  - http://dgigl.ca/students
  - POST: http://dgigle.ca/students/999999
- RPC: possibly 12 methods one for each combination.
  - http://dgigl.ca/get?studentid=999999
  - http://dgigl.ca/add?coursed=LOG8430&name=Architecture
- Microservices: possibly 24 methods to process the collections and the individual resources differently.
- SOAP: a possibility like REST, since the type of the resource can be used to distinguish between the functionalities (overload).
  - add(Student s)
  - add(Course c)

SOA for $600

- What is the property of SOA that facilitates portability but prevents testability and maintainability?

SOA for $600

- What is the property of SOA that facilitates portability but prevents testability and maintainability?
- What is… abstract interfaces
- The clients and the services are independent at language level, but the implementation details of the service are hidden, which makes it difficult to understand how the service works or where it was changed.

SOA for $800

- A service composition can resemble which other architectural style?

Software Architecture for $800

- A service composition can resemble which other architectural style?
- What is… “pipe-filter”
- The network is the pipe.

SOA for $1000

- We want to develop software for the library. The software will allow the addition, removal, update and read of information no books. Moreover, we will be able to search for a book by its title, create collections of books, or sort a book collection by the name of their authors. Design an architecture using the SOA styles.

Software Architecture for $1000

- We want to develop software for the library. The software will allow the addition, removal, update and read of information no books. Moreover, we will be able to search for a book by its title, create collections of books, or sort a book collection by the name of their authors. Design an architecture using the SOA styles.
- What is… a REST service for the GET, PUT, POST, DELETE methods and a RPC/SOAP service for the other functionalities.


MapReduce
JEOPARDY!

MapReduce for $200

- We want to develop a program to count the words of thousands of documents organized in folders with the first letter of the file's name ("A", "B", "C"…). You have 27 workers. Describe the MapReduce implementation for this problem.

MapReduce for $200

- We want to develop a program to count the words of thousands of documents organized in folders with the first letter of the file's name ("A", "B", "C"…). You have 27 workers. Describe the MapReduce implementation for this problem.

1) Send a folder to each worker.
   a) Be careful! Not all folders contain the same amount of files! You can assign an appropriate size to the workers or use less workers and send some of the least popular letters to a single worker.
2) Map tasks count the words of files per file.
3) Reduce tasks add the results per folder and for the entire file system.
   a) You can have multiple levels of Reduce tasks and the input of a reduce task can be the output of a previous reduce task.

MapReduce for $400

- We have the CRA database for income taxes. The CRA has multiple data servers around the country. We want to find who paid the most taxes in 2018. Describe the MapReduce implementation for this problem.

MapReduce for $400

- We have the CRA database for income taxes. The CRA has multiple data servers around the country. We want to find who paid the most taxes in 2018 per province and in the entire country.. Describe the MapReduce implementation for this problem.

1. Every data server can run a replica of the maximum algorithm.
2. The Map tasks are to find the maximum in a single server.
3. Reduce tasks to find the maximum per province and another Reduce task to find the overall maximum of the country.

MapReduce for $600

- We want to find the player with the most average goals per game in the entire history of NHL. Each team keep record of their own statistics. (Do not consider teams that do not exist now). Describe the MapReduce implementation for this problem.

MapReduce for $600

- We want to find the player with the most average goals per game in the entire history of NHL. Each team keep record of their own statistics. (Do not consider teams that do not exist now). Describe the MapReduce implementation for this problem.

1. The data server of each team will run a replica of the algorithm.
2. Map tasks are to find the average per team.
3. Reduce tasks will find the maximum over the returned averages.
4. And the answer is… Mike Bossy (0.762) of the NY Islanders (1977-1987).

MapReduce for $800

- Each University holds all defended theses in their respective library. We want to search in the entire world for theses that contain the term “DevOps” in their title. Describe the MapReduce implementation for this problem.

MapReduce for $800

- Each University holds all defended theses in their respective library. We want to search in the entire world for theses that contain the term “DevOps” in their title. Describe the MapReduce implementation for this problem.

1. The data server of each university will run a replica of the grep/search algorithm.
2. The Map tasks are the searches with the “DevOps” string on the title.
3. The reduce tasks will simply aggregate the individual results from the map tasks in a list.

MapReduce for $1000

- We want a complete lists of all cities, villages and communities of the world order by population in decreasing order. Census servers in each country contain population data. Describe the MapReduce implementation for this problem.

MapReduce for $1000

- We want a complete lists of all cities, villages and communities of the world order by population in descending order. Census servers in each country contain population data. Describe the MapReduce implementation for this problem.

1. Each census server can run a replica of the sorting algorithm.
2. The map tasks will store the cities per country.
3. The reduce task will aggregate the total list ordered in descending order.

MapReduce for $2000

- We want a complete lists of all cities, villages and communities of the world order by population in decreasing order. Census servers in each country contain population data. Describe the MapReduce implementation for this problem.
- Bonus question: What is the most suitable sorting algorithm for this case?

MapReduce for $2000

- We want a complete lists of all cities, villages and communities of the world order by population in decreasing order. Census servers in each country contain population data. Describe the MapReduce implementation for this problem.
- Bonus question: What is the most suitable sorting algorithm for this case?
- “What is…” mergesort
- In fact, RDDs (or similar data formats) are key-value pairs, which means that sorting can be very efficient and simple over keys.
- If we want to sort by value, one solution is with “compound keys”, where we can combine the primary key with the column we want to sort and then sort by key automatically.


NoSQL
JEOPARDY!

NoSQL for $200

- We develop an application for a commercial company. The company manages contracts and invoices of commercial transactions. The data need to be stored in a secure and persistent way for a long time. The company functions at a global level with a great quantity of transactions.

NoSQL for $200

- We develop an application for a commercial company. The company manages contracts and invoices of commercial transactions. The data need to be stored in a secure and persistent way for a long time. The company functions at a global level with a great quantity of transactions.
- “What is …”: Document
- The contracts and the invoices are files.
- We should be able to retrieve the documents by using keys or by querying their attributes.
- The quantity of data requires a NoSQL solution.

NoSQL for $400

- Wikipedia! Develop Wikipedia!

NoSQL for $400

- Wikipedia! Develop Wikipedia!
- “What is …”: Document?
  - One possibility
  - We can treat each page as a document.
  - So we can retrieve a page by its key or by its metadata.
- “What is …”: graph
  - A better solution.
  - There are links between the pages. The links can also represent complex relationships (hierarchy, taxonomy, partonomy).
  - In fact, we have a network of pages.

NoSQL for $600

- We have a monitoring system for cloud resources. In frequent and fast enough intervals, the system sends measurements (CPU, memory, disk, network) for each resource (virtual machine).

NoSQL for $600

- We have a monitoring system for cloud resources. In frequent and fast enough intervals, the system sends measurements (CPU, memory, disk, network) for each resource (virtual machine).
- “What is …”: Key-value
- The structure of the data is pretty simple.
- We have a need for increased efficiency.
- It is possible to take advantage of the memory for fast and efficient data ingestion.

NoSQL for $800

- For the previous monitoring system, which processing architecture would you choose?

NoSQL for $800

- For the previous monitoring system, which processing architecture would you choose?
- “What is …”: Kappa
  - If we only have data ingestion.
  - If we use a “push” method: the resources send their measurements to the monitoring system.
- But! If we also add analyses to the monitoring or it is the system that requests the measurements from the resources (“pull” method), we have problems.
  - We have the “observer’s effect”: by requesting the measurements, the monitoring affects the measurements themselves (because we execute additional code).
  - In this case, it is better to use the Lambda architecture.

NoSQL for $1000

- Databases for biological data have existed for quite some time now. They contain data for genes, proteins, organisms. The entities have attributes, but it is possible to discover new attributes in the future. Various analyses and tools already exist to help us study the natural world.

NoSQL for $1000

- Databases for biological data have existed for quite some time now. They contain data for genes, proteins, organisms. The entities have attributes, but it is possible to discover new attributes in the future. Various analyses and tools already exist to help us study the natural world.
- “What is …”: Wide-column
- The flexibility of the structure is required.
- It is possible that relational databases already exist.
- It is certain that clients for these databases already exist, which suppose the existence of a schema.