

# Architectural Pattern/Style Exercises

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Software Architecture and Design

2021 Semester 1

# Scenario 1: ACME Corporation

- ❖ ACME Corp. is a multi-industry company that produces every product type imaginable.
- ❖ The corporation hosts its E-commerce website with the architecture shown below.
- ❖ Can you tell from the diagram which architectural pattern/style is used?



# Exercise 1.1

- ❖ Because ACME Corp. sells various kinds of products, the company regularly updates the user interface of its E-commerce website.
- ❖ Which architectural pattern/style should be applied to promote modifiability of the user interface?
- ❖ Based on the given diagram, please draw an updated version to illustrate your answer.

# Exercise 1.2

- ❖ A royal customer, Wile E. Coyote, recently complains that the E-commerce website is slow to load and very unresponsive.
- ❖ After troubleshooting, an architect points out that the bottleneck is the application server.
- ❖ ACME Corp. decides to deploy more instances of application server to solve the issue.
- ❖ How many instances of application server should be used to support 15000 requests per second (RPS)?
- ❖ Please draw a diagram to reflect changes to the deployment.
- ❖ Given that:
  - ❖ An instance of web server can serve up to 16000 RPS
  - ❖ An instance of application can serve up to 4000 RPS

# Exercise 1.2: Recommended Readings

- ❖ Linux Web Server Performance Benchmark – 2016 Results  
<https://www.rootusers.com/linux-web-server-performance-benchmark-2016-results/>
- ❖ Testing the Performance of NGINX and NGINX Plus Web Servers  
<https://www.nginx.com/blog/testing-the-performance-of-nginx-and-nginx-plus-web-servers/>

```
1 Availability = MTBF / (MTBF+MTTR)
2
3 a -- b -- c
4
5 Availability web = 8751.23 / (8751.23 + 8.77)
6   = 0.999
7 Availability app = 8716.08 / (8716.08 + 43.92)
8   = 0.995
9 Availability db = 0.99
10
11 0.999 * 0.995 * 0.99 =
12
13 1 - 0.995 = 0.005
14 in case of 4 parallel server = (0.005)^4
```

Scientific

1 - 0.000000000625 =

0.999999999375

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## Exercise 1.3

0.98900999938186875

- ◆ ACME Corp. manufactures and uses its own computer hardware for all web server, application server, and database server instances. MTBF and MTTR for all server types are:

Type	Web Server	Application Server	Database Server
MTBF	8751.23 hours	8716.08 hours	8672.40 hours
MTTR	8.77 hours	43.92 hours	87.60 hours

- ◆ Please calculate the availability of the system from the result of exercise 1.2!
- ◆ For this exercise, please do not consider any performance degradation of the system.
- ◆ One year has 365 days.



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## Exercise 1.3 (Extra)

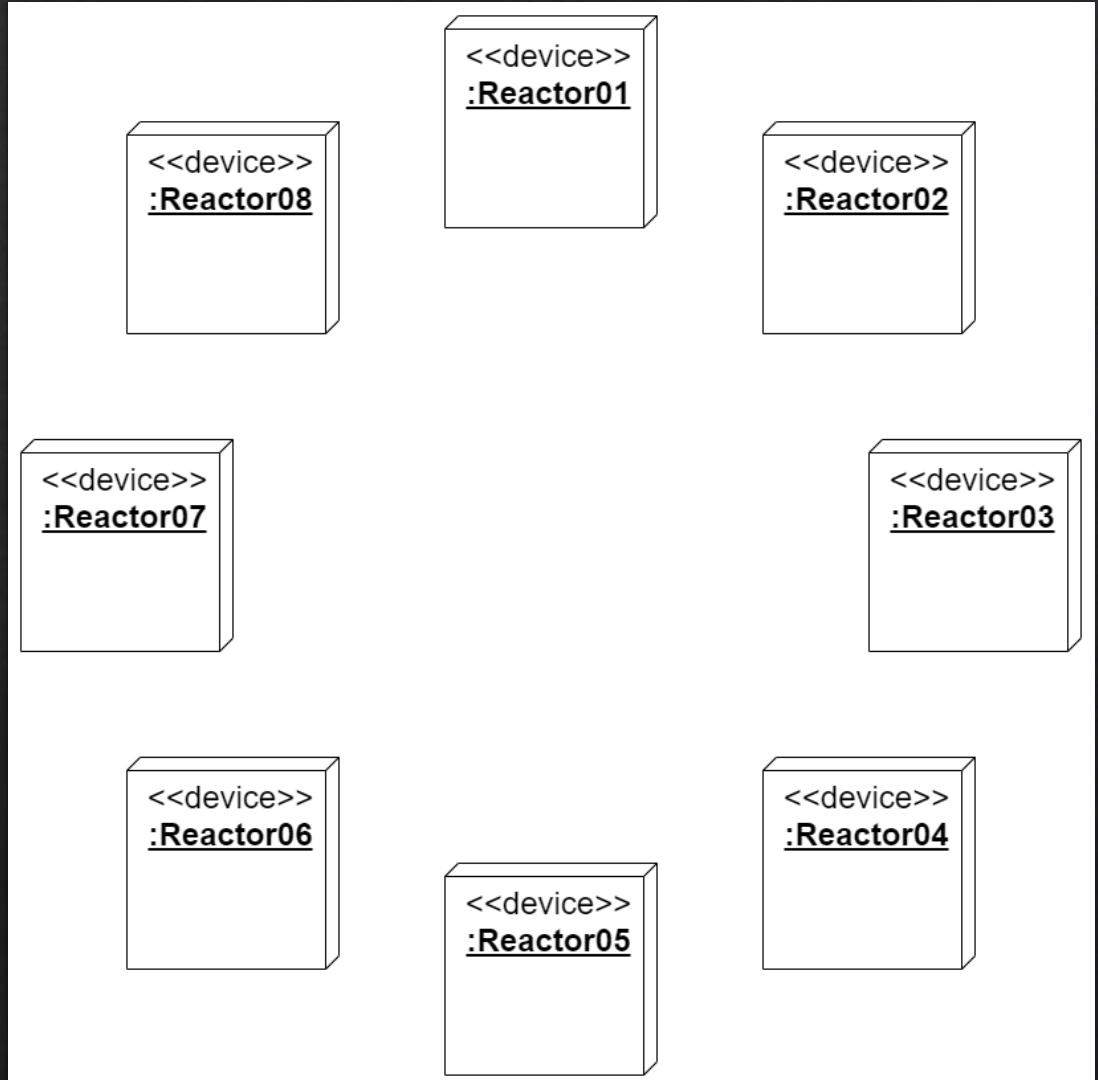
1. If the performance degradation is not acceptable and minimum number of 15000 RPS is required, what is the new value for the availability?
2. What change would you introduce to the deployment to achieve “5 nines” high availability?

# Scenario 2: Shinra Electric Power Company

- ❖ Shinra Electric Power Company operates many reactors that harvest energy beneath the earth's surface to generate electricity.
- ❖ The location of the reactors are geographical dispersed. Each one is located in each sector of the capital city.
- ❖ There is no hierarchical structure of reactors. All of them are equally important as each one of them provides power to each sector of the capital city.
- ❖ Power consumption of all the sectors are varying. A sector may leave electricity surplus at one point in time, but the same sector may demand a larger amount of electricity than its reactor can generate at another point in time.

# Exercise 2.1

- ❖ Shinra company wants to enable energy trading among sectors of the city.
- ❖ All reactors need a mechanism to exchange information of their electricity demands and surplus.
- ❖ As a software architect, your job is to design the architecture of such a software system!!
- ❖ Suppose that there 8 reactors in total, please draw a diagram to illustrate the architecture.



## Exercise 2.2:

- ❖ Suppose that there are some difficulties in communication between the 8 reactors:
  - ❖ The communication links between reactors can only be simplex (unidirectional link).
  - ❖ One reactor can connect to the maximum of 2 outgoing and 2 incoming links only.
  - ❖ A reactor may indirectly communicate with another reactor through a group of intermediate reactors.
- ❖ Given the above constraints, can you re-design and re-draw your diagram to support communication among all the reactors with minimum number of hop?
  - ❖ One source reactor must be able to send message to any destination within 3 hops only!!

## Exercise 2.3: Failure

1. A group of nature lovers disagree with the energy harvesting beneath the earth's surface. They force the reactor number 1 to shutdown. What are the consequences of this change?
2. Next, the same group of nature lovers forces the reactor number 5 to shutdown. What are the consequences of this change?

Time reserved for our assignment