COMP2511

Tute04

Agenda

- Law of Demeter
- Liskov Substitution Principle
- Patterns!!!! YAY!!!!
- Composite Pattern
- Factory Pattern

Law of Demeter

A method should only communicate with its "immediate friends" and not "friends of friends". Method M of object O can use methods of:
- O.
- parameters of M.
- any object created in M.
- O's direct fields.

Fake Friends.
Real Problems.

ASKING FOR A FRIEND

Ronnie Riley

Law Of Demeter In Action?

X

DON'T: Directly go up to your friend's sibling and request them to help you out.

O

DO: Get your friend to ask their sibling to help you out on your behalf instead

Training

Do Getters Violate Law of Demeter's

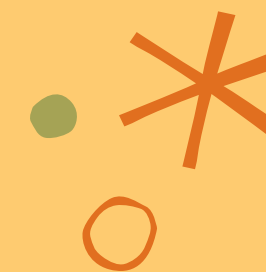And are getters bad design?

Liskov Substitution Principle

Objects of a superclass should be replaceable with objects of its subclasses without affecting the correctness of the program.

- Can replace superclass with subclass
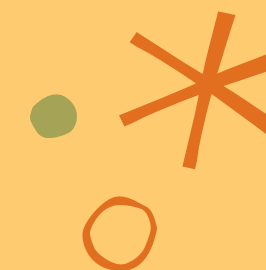- MUST MAINTAIN ALL GUARANTEES!!!

Online Seminar

PATTERNS!!!

Patterns

A common problem?

Evaluate the integrals in Problems 1–100.

1. $\int \dfrac{1}{\sqrt{x}(1+x)}\,dx$

2. $\int \dfrac{\sec^2 t}{1+\tan t}\,dt$

3. $\int \sin x \sec x\,dx$

4. $\int \dfrac{\csc x \cot x}{1+\csc^2 x}\,dx$

5. $\int \dfrac{\tan \theta}{\cos^2 \theta}\,d\theta$

6. $\int \csc^4 x\,dx$

7. $\int x \tan^2 x\,dx$

8. $\int x^2 \cos^2 x\,dx$

9. $\int x^5 \sqrt{2-x^3}\,dx$

10. $\int \dfrac{1}{\sqrt{x^2+4}}\,dx$

11. $\int \dfrac{x^2}{\sqrt{25+x^2}}\,dx$

12. $\int (\cos x)\sqrt{4-\sin^2 x}\,dx$

13. $\int \dfrac{1}{x^2-x+1}\,dx$

14. $\int \sqrt{x^2+x+1}\,dx$

15. $\int \dfrac{5x+31}{3x^2-4x+11}\,dx$

16. $\int \dfrac{x^4+1}{x^2+2}\,dx$

17. $\int \dfrac{1}{5+4\cos\theta}\,d\theta$

18. $\int \dfrac{\sqrt{x}}{1+x}\,dx$

19. $\int \dfrac{\cos x}{\sqrt{4-\sin^2 x}}\,dx$

20. $\int \dfrac{\cos 2x}{\cos x}\,dx$

21. $\int \dfrac{\tan x}{\ln(\cos x)}\,dx$

22. $\int \dfrac{x^7}{\sqrt{1-x^4}}\,dx$

23. $\int \ln(1+x)\,dx$

24. $\int x \sec^{-1} x\,dx$

25. $\int \sqrt{x^2+9}\,dx$

26. $\int \dfrac{x^2}{\sqrt{4-x^2}}\,dx$

27. $\int \sqrt{2x-x^2}\,dx$

28. $\int \dfrac{4x-2}{x^3-x}\,dx$

29. $\int \dfrac{x^4}{x^2-2}\,dx$

30. $\int \dfrac{\sec x \tan x}{\sec x + \sec^2 x}\,dx$

31. $\int \dfrac{x}{(x^2+2x+2)^2}\,dx$

32. $\int \dfrac{x^{1/3}}{x^{1/2}+x^{1/4}}\,dx$

33. $\int \dfrac{1}{1+\cos 2\theta}\,d\theta$

34. $\int \dfrac{\sec x}{\tan x}\,dx$

35. $\int \sec^3 x \tan^3 x\,dx$

36. $\int x^2 \tan^{-1} x\,dx$

37. $\int x(\ln x)^3\,dx$

38. $\int \dfrac{1}{x\sqrt{1+x^2}}\,dx$

39. $\int e^x \sqrt{1+e^{2x}}\,dx$

40. $\int \dfrac{x}{\sqrt{4x-x^2}}\,dx$

41. $\int \dfrac{1}{x^3\sqrt{x^2-9}}\,dx$

42. $\int \dfrac{x}{(7x+1)^{17}}\,dx$

43. $\int \dfrac{4x^2+x+1}{4x^3+x}\,dx$

44. $\int \dfrac{4x^3-x+1}{x^3+1}\,dx$

45. $\int \tan^2 x \sec x\,dx$

46. $\int \dfrac{x^2+2x+2}{(x+1)^3}\,dx$

47. $\int \dfrac{x^4+2x+2}{x^5+x^4}\,dx$

48. $\int \dfrac{8x^2-4x+7}{(x^2+1)(4x+1)}\,dx$

49. $\int \dfrac{3x^5-x^4+2x^3-12x^2-2x+1}{(x^3-1)^2}\,dx$

50. $\int \dfrac{x}{x^4+4x^2+8}\,dx$

51. $\int \dfrac{1}{4+5\cos\theta}\,d\theta$

Patterns

Has a common solution

$$\int \frac{1}{a^2-x^2 \, (a^2-x^2)^{\frac{1}{2}}} \, dx \qquad x = a\sin\theta$$

$$\frac{dx}{d\theta} = a\cos\theta$$

$$= \int \frac{1}{(a^2-a^2\sin^2\theta)^{\frac{3}{2}}} \, (a\cos\theta \, d\theta)$$

$$= \int \frac{1}{(a^2-a^2\sin^2\theta)\sqrt{a^2-a^2\sin^2\theta}} \, a\cos\theta \, d\theta$$

$$= \int \frac{1}{a^3\cos^2\theta} \, d\theta$$

$$= \frac{1}{a^3} \int \sec^2\theta \, d\theta$$

$$= \frac{1}{a^3} \tan\theta + c$$

$$\int_0^{\frac{a}{2}} \frac{1}{(a^2-x^2)^{\frac{3}{2}}} \, dx$$

When $x = \frac{a}{2}$
$$\frac{a}{2} = a\sin\theta$$
$$\sin\theta = \frac{1}{2}$$
$$\theta = \frac{\pi}{6}$$

$$= \frac{1}{a^3} \int_0^{\frac{\pi}{6}} \sec^2\theta \, d\theta$$

$$= \frac{1}{a^3} \left[\tan\theta \right]_0^{\frac{\pi}{6}}$$

$$= \frac{1}{a^3} \left[\frac{1}{\sqrt{3}} - 0 \right]$$

$$= \frac{1}{\sqrt{3} \, a^3}$$

When $x = 0$
$$0 = a\sin\theta$$
$$\sin\theta = 0$$
$$\theta = 0$$

\#

14) $\frac{d}{dx} \ln\cot x$

$$= \frac{-\csc^2 x}{\cot x}$$

$$= -\frac{1}{\sin^2 x} \cdot \tan x$$

$$= -\frac{1}{\sin^2 x} \frac{\sin x}{\cos x}$$

$$= -\frac{2}{2\sin x \cos x}$$

$$= -2\csc 2x$$

Since $\frac{d}{dx} \ln\cot x = -2\csc 2x$

$$\ln\cot x = \int -2\csc 2x \, dx$$

$$\int \csc 2x \, dx = -\frac{1}{2} \ln\cot x$$
$$= \frac{1}{2} \ln\tan x$$

Let $x = \frac{\theta}{2}$, $\frac{dx}{d\theta} = \frac{1}{2}$

$$\int \csc\theta \left(\frac{1}{2} d\theta \right) = \frac{1}{2} \ln\tan \frac{\theta}{2}$$

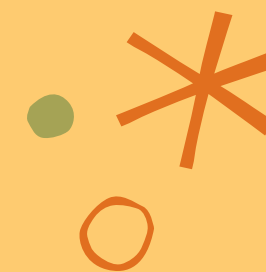$$\int \csc\theta \, d\theta = \frac{1}{2} \ln\tan \frac{\theta}{2} +$$

Patterns

Easy answers!!!

- $\int 1\,dx = x + C$
- $\int a\,dx = ax + C$
- $\int x^n\,dx = \frac{x^{n+1}}{n+1} + C;\ n \neq -1$
- $\int \sin x\,dx = -\cos x + C$
- $\int \cos x\,dx = \sin x + C$
- $\int \sec^2 x\,dx = \tan x + C$
- $\int \csc^2 x\,dx = -\cot x + C$
- $\int \sec x(\tan x)\,dx = \sec x + C$
- $\int \csc x(\cot x)\,dx = -\csc x + C$
- $\int \frac{1}{x}\,dx = \ln|x| + C$
- $\int e^x\,dx = e^x + C$
- $\int a^x\,dx = \frac{a^x}{\ln a} + C;\ a > 0, a \neq 1$
- $\int \frac{1}{\sqrt{1-x^2}}\,dx = \sin^{-1} x + C$
- $\int \frac{1}{1+x^2}\,dx = \tan^{-1} x + C$
- $\int \frac{1}{|x|\sqrt{x^2-1}}\,dx = \sec^{-1} x + C$

Composite Pattern

The common problem?

A model where we can treat individual objects (leaves) the same as a group of them (composites):

- Mathematical equation (numbers are leaves, operators are composites).
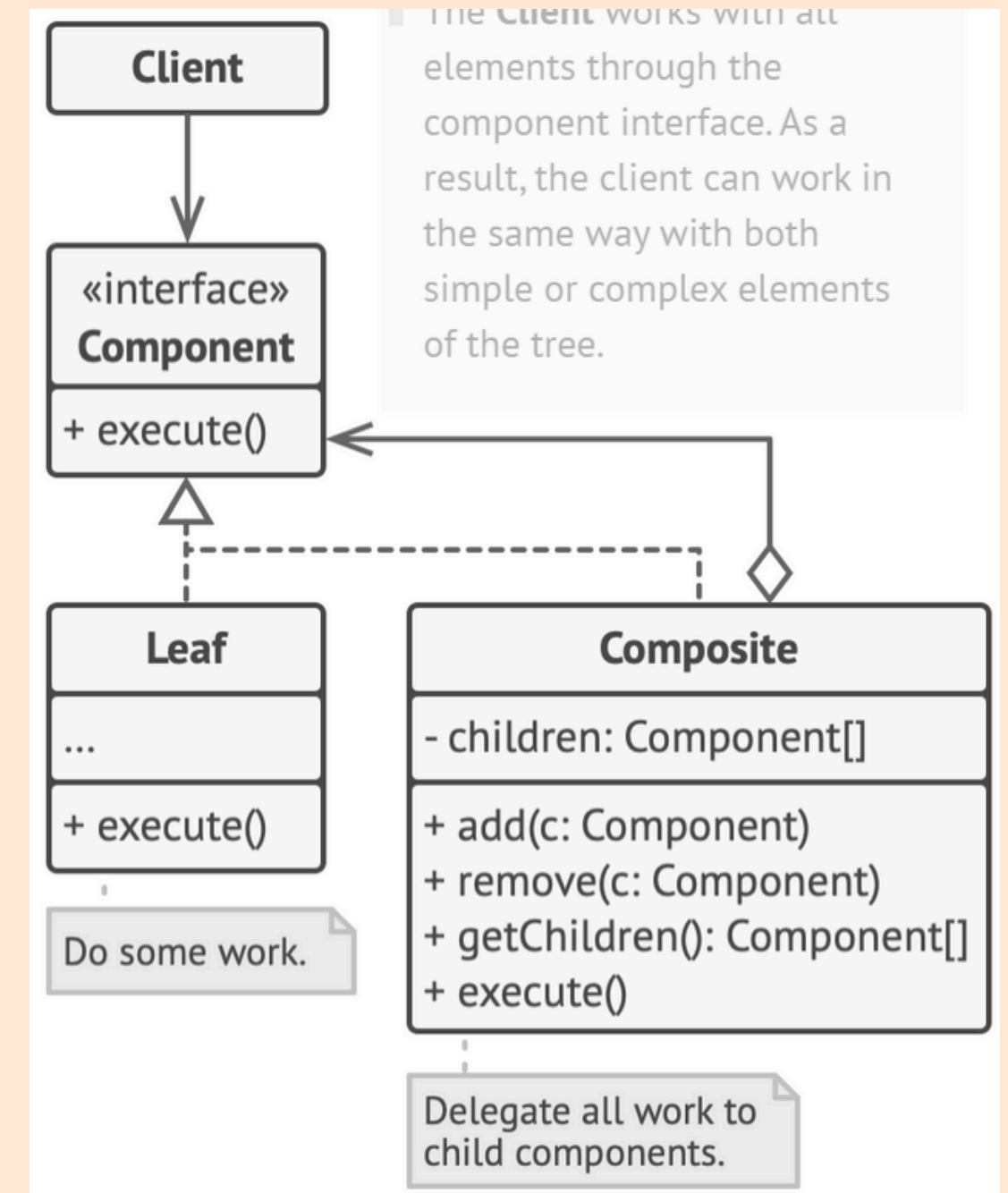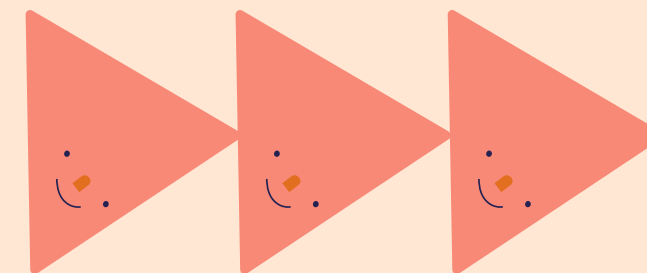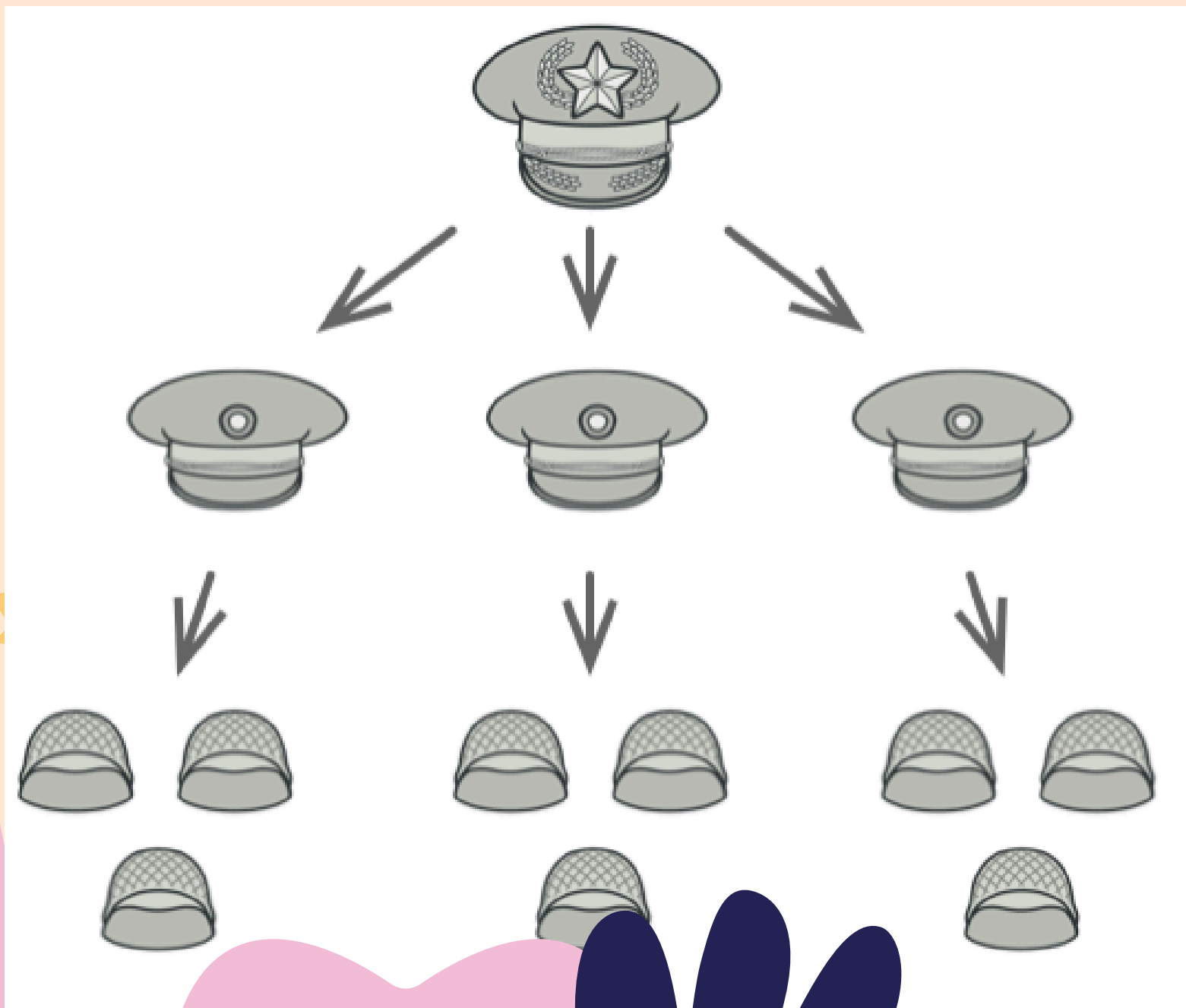- File systems (files are leaves, folders are composites)

Composite Pattern

The common solution?

1. Identify leaves and composites
2. Create Leaf and Composite classes that both implement a Component interface
3. Add a list of Components to the Composite class (since composites contain more composites or leaves):
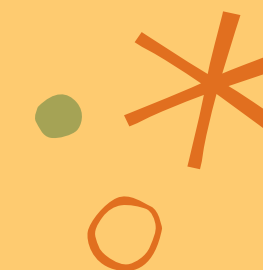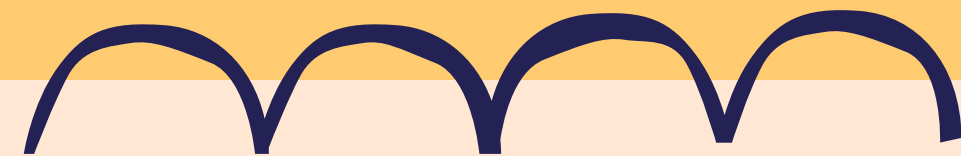   private Component[] children

Composite Pattern

Calculator

Factory Pattern

Factory Pattern

The common problem?

We want to create different types of objects depending on the conditions:

- Shipping company wants to create different vehicles (cargo ship, cargo aircraft, truck) depending on needs.
- Minecraft needs to spawn in different mobs depending on what conditions the player is in (creepers!!!).
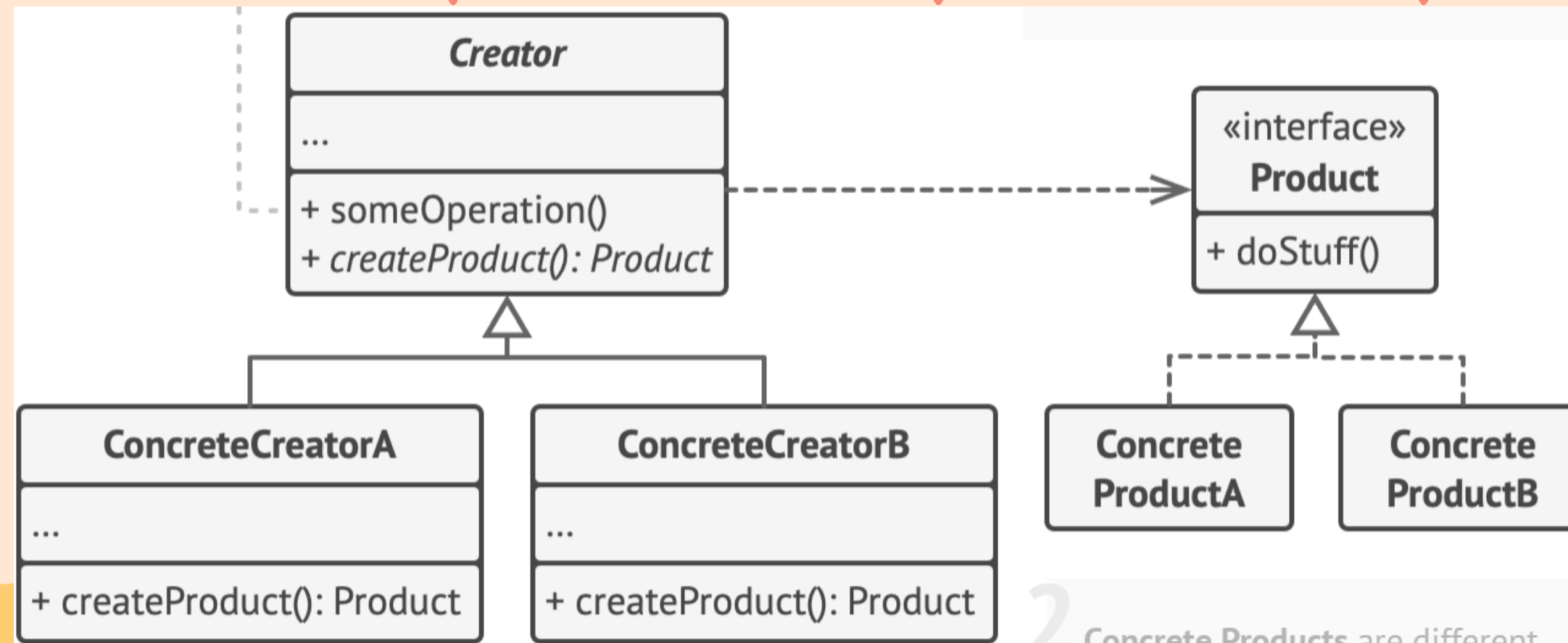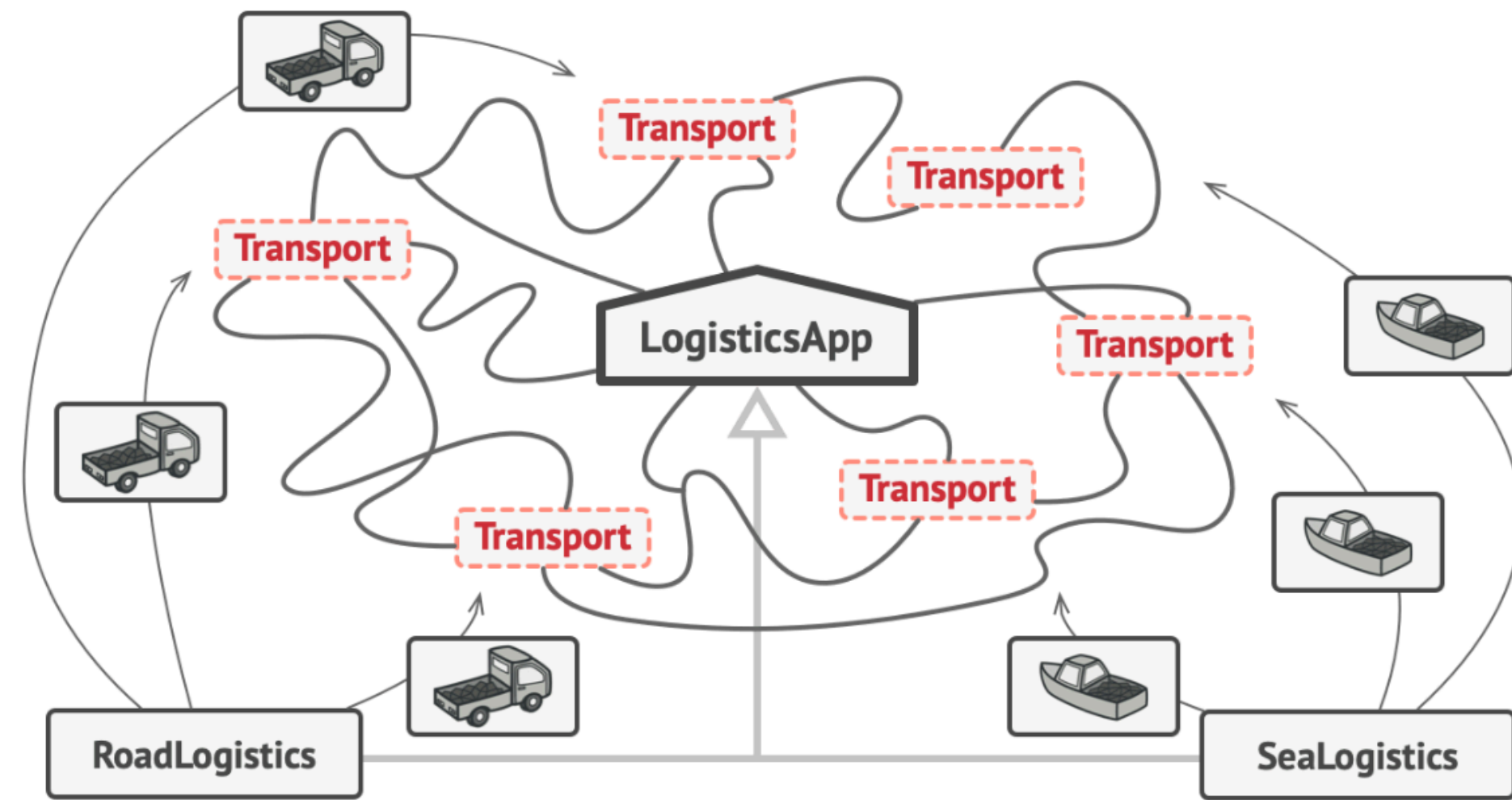
Factory Pattern

The common solution?

1. Create Factory abstract class, with a createProduct() abstract method.
2. Create Concrete Factories extending Factory for each Object.
3. Create a Product interface that Factory implements, with an action() abstract method.
4. Make each Object implement the Product interface

Factory Pattern

Transport

Transport

Transport

Transport

Transport

Transport

LogisticsApp

RoadLogistics

SeaLogistics

Creator
...
+ someOperation() + *createProduct(): Product*

«interface» **Product**
+ doStuff()

ConcreteCreatorA
...
+ createProduct(): Product

ConcreteCreatorB
...
+ createProduct(): Product

Concrete ProductA

Concrete ProductB

2 Concrete Products are different

Factory Pattern & Abstraction

How does the Factory Pattern allow us to abstract object construction?