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# Software Product Lines

## Exercise 1: Introduction

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### 1. Tailor-Made vs. Mass-Produced

Imagine you are starting a company that designs customizable backpacks. You would want that customers can choose different sizes, colors, materials, and extra pockets.

- (a) What is the difference between a tailor-made backpack and a mass-produced backpack?
- (b) Would it be smart to offer mass customization for backpacks instead of using only tailor-made or mass production? Why or why not?

### 2. Understanding Features, Configurations, and Dependencies

You are the proud owner of *Bite & Build*, a fast-food restaurant famous for its fully customizable meals. Every day, your hungry customers walk in, excited to build their own unique meals by mixing and matching the ingredients and options your restaurant offers. There are so many possible combinations that even your regular customers can try something new every time!

Your restaurant's success depends on understanding how these customized orders come together, how the options interact, and how to keep everything organized in the kitchen.

- (a) Describe the complete journey from the moment a customer starts building their meal to the moment it is served. Use the following terms correctly in your explanation: feature, domain, configuration, and product.
- (b) Create a menu by listing at least ten features that customers can select to customize their meals.
- (c) Some ingredients might depend on each other or might not work together at all. Can you think of two or more features that either depend on each other or create a conflict (for example, combinations that cannot be served together)?
- (d) Are there differences between selling fast food (or other “hardware”) and selling software?

### 3. Software Product Lines

- (a) What is a software product line?
- (b) In which situations and why should software product lines be used?
- (c) Are the following systems software product lines? Justify your answer.  
*Linux, Visual Studio Code, HP Printer Driver, Microsoft Office, Spotify, Minecraft*
- (d) Give further examples of software systems which are (not) product lines.

#### 4. Promises of Software Product Lines

Software product lines promise multiple advantages over traditional single-system development. Summarize and explain the key benefits of using software product lines in practice. Also, describe how up-front investment in product-line engineering pays off over time. Support your answer with a concrete example(s).

#### 5. Challenges of Software Product Lines

When working with software product lines (SPLs), various situations can occur that require careful attention during development and management.

Below are six scenarios that can happen when working with software product lines. Each scenario is related to one typical challenge that developers commonly face.

For each of the following scenarios, **identify** the software product line challenge that the scenario represents and **briefly explain why this situation might lead to a problem** in the context of software product lines.

- (a) A company rapidly copies the entire source code of a successful product to meet the urgent request of a different customer in another country. To save time, they create a second product with minor changes in configuration files.
- (b) In a software project that supports regional market variations, dozens of optional features are activated depending on local regulations. After several development cycles, it becomes difficult for teams to understand how individual features are implemented in the source code.
- (c) A company introduces an advanced build system that automatically generates product variants based on feature selections. However, developers often struggle to successfully assemble complete products from selected features.
- (d) A smartphone manufacturer offers customers the option to configure their phones online by selecting up to 20 optional features like waterproofing, extra storage, face recognition, multiple camera setups, or gaming optimizations. The company provides hundreds of different customer-specific phones each year.
- (e) A customer configures a custom smart home system by combining voice-controlled lighting with advanced security features. Both features are available for all customers and can be selected in any combination using an online configurator.
- (f) An electric car company has been evolving its software product line for over ten years, continuously adding new driving modes, safety features, entertainment apps, and country-specific adjustments.