Module 4: Operating System Structures

In this group activity, we will start to practice problem solving with the ADJ approach.

- Length: 50 minutes

Introduction

In general, a design problem has the flavor of picking one solution among many options, and where the "best" solution may not be immediately apparent. For this course, we use the following steps for solving a design problem: Analysis, Design, and Justification.

- **Analysis:** a translation of the original ill-defined problem[1] into concrete requirements that can be evaluated.
- **Design:** a solution to the problem being solved.
- **Justification:** an argument which supports your design as being superior to other potential designs which also satisfy the analysis requirements.

The problem we will examine in this activity is selecting an operating system structure for a scenario. This makes the *design* relatively simple - a design for this type of problem is selecting one of the four operating-system structures (organic, layered, microkernel, and modular). We are not building the system, but merely providing an architecture level solution. Different operating system structures offer both benefits and drawbacks over one another, and it's important to detemine what kind of structure should be used for different use-cases.

Task 0x0 (5 minutes): Getting Started

Start by forming a group of 6 ± 1 people, and reading over this document. We suggest arguing over what exactly Cesar and Prof. Acuña mean by **Analysis**, **Design**, and **Justification**.

Task 0x1 (10 minutes): Analyzing a problem

You and your team are tasked with designing an operating-system for an interstellar probe that is meant to run for hundreds of years. The probe should also support monitoring many specific instruments. What structure (simple, layered, microkernel, or modular) should you choose for its kernel?

This is an operating-system structure problem - the end result of the problem would be choosing one of the four structures. However, the problem is unclear. Without knowing exactly what a solution looks like, we cannot evaluate different designs and determine which is the best. We cannot hope to justify our design over a competing design. Discuss and answer the following questions within your group:

1. What are requirements of the scenario? They should be specific, measurable, and relevant[2].
2. Is the problem solvable?
3. What assumptions do you need to make?

[1] https://en.wikipedia.org/wiki/Problem_solving
[2] https://en.wikipedia.org/wiki/SMART_criteria

Task 0x3 (15 minutes) : Picking a design

You and your team are responsible for designing and implementing an operating system for a new mobile device. Luckily another team has already completed analysis and has provided you with a requirements list. Your manager has asked you to consider the following requirements, and to propose the best operating system structure for the new device.

1. *Your operating system must run as fast as possible*
2. *Your operating system must be as secure as possible*
3. *You can pick any programming language you see fit*
4. *Your operating system should require little to no maintenance (very independent)*
5. *Your operating system should be easy to implement to save on costs*
6. *You have three weeks to design and implement your OS*

Again, this is an operating-system structure design problem. This problem is a little better than the last one - someone has elicited requirements for us. We just need to pick one of the four designs. Discuss and answer the following questions within your group:

1. Are these goals specific, measurable, and relevant? (Almost a trick question!)
2. Is it realistic to meet all of your manager's requirements? Explain.
3. If you had to sacrifice a few requirements to prioritize others, which requirements would you prioritize for a mobile device and why?
4. Based on your answer to #2, choose an operating system structure design appropriate for your company's new mobile device while meeting your manager's requirements as closely as possible.

Task 0x4 (20 minutes): Presentations

Each group will be asked to share their answers, with the class, to the questions in either Task 0x1 or Task 0x3.