Homework: From UML to SysML

Part 1: Conceptual Questions

Purpose and Motivation

Why was SysML created? What limitations of UML does it address?

Uml is built with Object-Oriented-Programming principles and focus in Software-Engineering in mind. Thus, it lacks the general focus on large scale multidisciplinary complex Systems-Engineering, which is why UML alone doesn't suffice. Apart from the different focus SysML also provides additional Diagramms.

Modeling Perspective

UML is based on object-oriented concepts, especially the UML Class diagram. How does SysML's *block-based* approach differ conceptually from UML's *class-based* approach?

The block-based approach in SysML means that the object-oriented way of implementation is not used, instead a block represents a Element with specific behaviors. It doesn't need to fit in the known object-oriented form, with attributes, classes and methods.

Scope

What kinds of system elements can be represented in SysML that are not typically modeled in UML?

Blocks in SysML are supposed to represent real world components, and can represent anything in Systems-Engineering such as Machines, Entities, Humans etc. This is why SysML is great for large scale Operations and is especially used by automotive and aerospace industries.

Focus

Give an example (maybe from your own experiences as a developer/student?) of a system where using UML alone would be insufficient, and explain how SysML can better represent it.

In the 4.semester a group of students (including me) where tasked with building a Galvanizing Station, to color and coat objects that were 3D printed from metall powder. The Task included steps that had to be undertaken with different chemicals. Thus a way to Modell the Human behavior and steps (which did not happen in the Software) would be required. SysML could be used to represent the different steps involved with handling chemicals, storing etc. that could itself not be done entirely with UML.

Part 2: Diagrams

Make a **comparison table** comparing UML diagrams and SysML diagrams.

- Indicate whether each is *reused*, *modified*, or *new* in SysML.
- For each SysML-specific diagram, write one short sentence about its purpose.

SysML is primarily a extension from UML which is why they both share some Diagrams. Other ones are either new or a utilized in a different way, due to the focus in Systems-Engineering instead of Software-Engineering.

Diagram	Status
Requirement diagram (req)	New
Use Case diagram (uc)	reused
Activity diagram (act)	modified
Sequence diagram (sd)	reused
State Machine diagram (stm)	reused
Block Definition Diagram (bdd)	new form / modified
Internal Block Diagram (ibd)	new form / modified
Parametric Diagram (par)	new
Package diagram (pkg)	reused

Diagram	Purpose
Requirement diagram (req)	Shows what the system must achieve.
Use Case diagram (uc)	Shows how to interact with the system and what functions are required.
Activity diagram (act)	Shows workflows and processes.
Sequence diagram (sd)	Shows interactions between blocks over time
State Machine diagram (stm)	Shows how the state changes based on actions or events.
Block Definition Diagram (bdd)	System blocks and in what way each block relates to the others
Internal Block Diagram (ibd)	Shows the inside of a block, and how inputs and outputs interact.
Parametric Diagram (par)	Shows utilized functions with inputs and outputs, and their physical dimensions (meters, Volts, hz, etc.)
Package diagram (pkg)	It shows how packages are grouped and dependent. Depicted as Folders.

Explain briefly:

- What is the **Block Definition Diagram (BDD)**?
- What are the main differences to the UML **Class Diagram**?

A block definition diagram shows system blocks and how they relate to each other. Blocks can be Machines, Humans, Entities, Groups, Concepts etc. The focus here is on the relationships between the blocks.

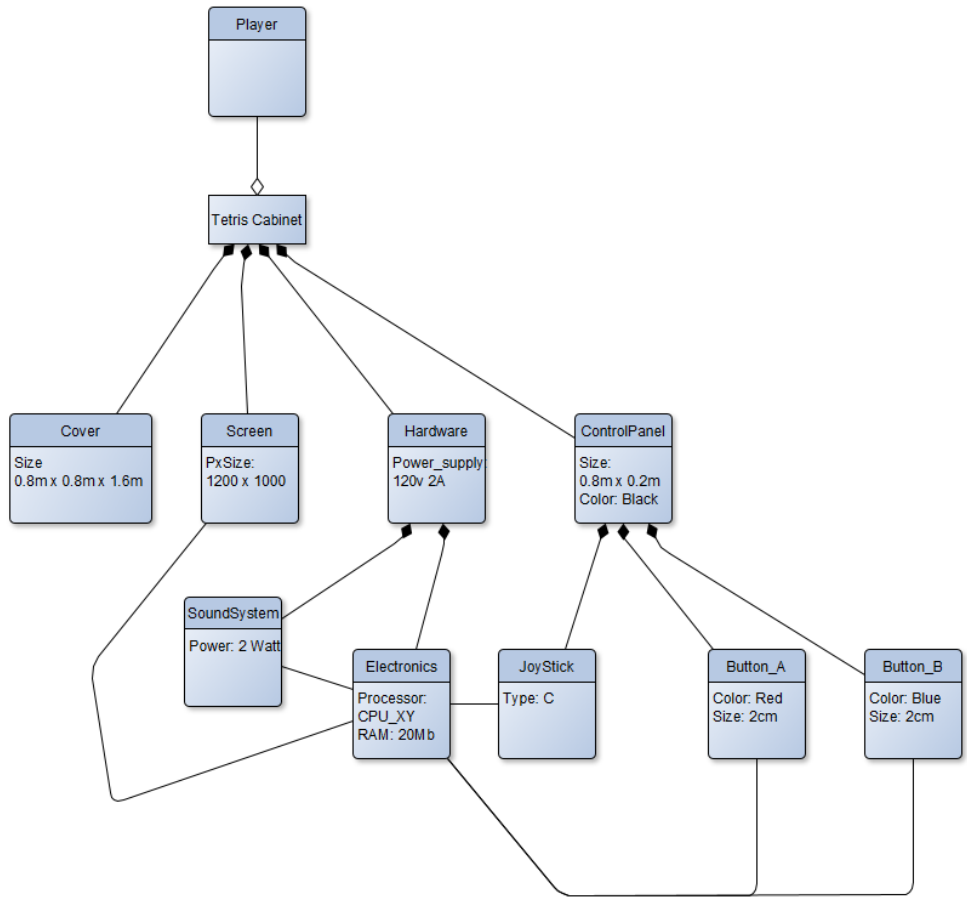
The difference to UML class diagrams is that BDDs are descriptions of system blocks, while Class Diagrams are descriptions of Classes, and are mainly focused on software.

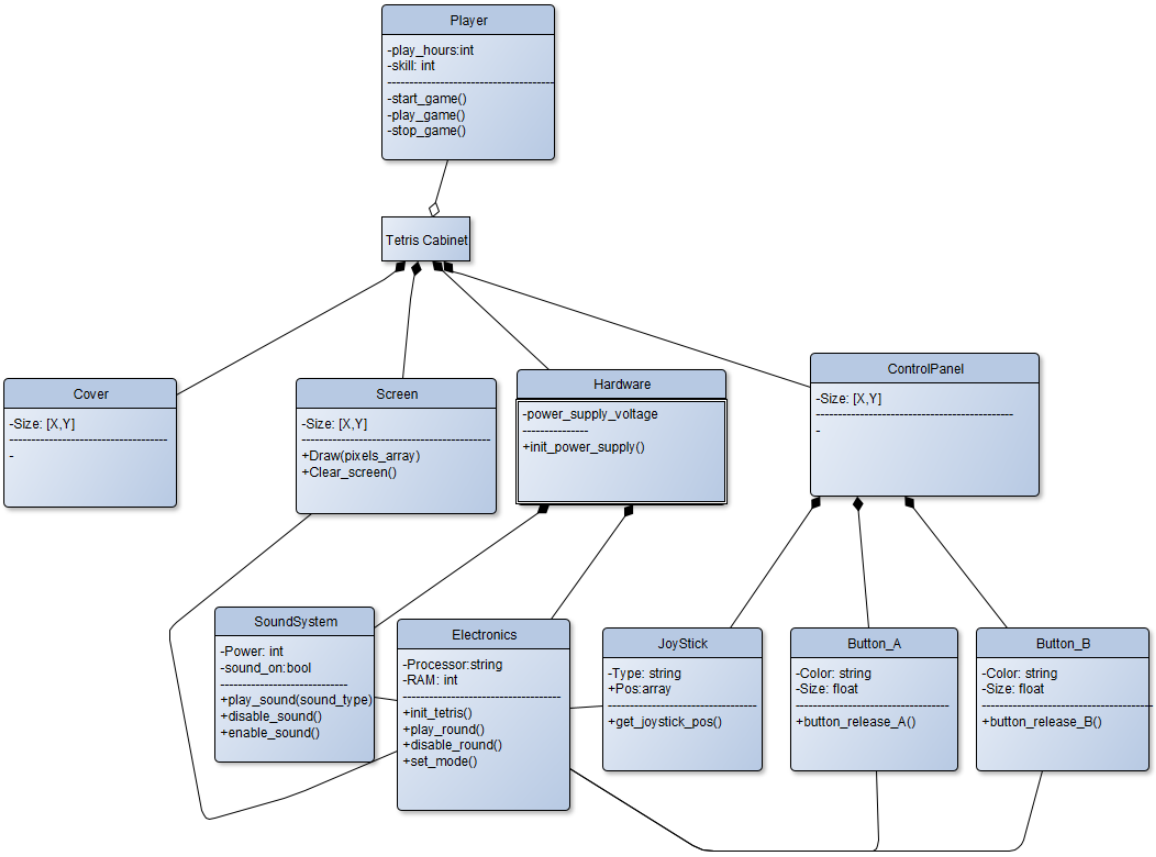
What is a **Parametric Diagram** in SysML?
How does it enhance system analysis compared to UML?

A Parametric Diagram is used to implement (mathematical) functions in SysML, it enables the computation of given inputs and makes it possible to express relationships between system blocks with mathematics. It also allows for physical units. (1)

UML does not support equations or parameters. SysML also allows for recursive simulation of input values, something that UML does not support.

Part 3: Examples





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