Requirements and Specifications

Final Exam 2025/26 [90 min]

1 – Requirements

Assume that a version of your 'Digital Wallet' system is designed to be used (solely) in the context of *Queima das Fitas*.

1.1. Draw a Contextual Design **physical model** of its usage. Don't forget to identify likely breakdowns.

1.2. Present one **use-case** that reflects one possible interaction represented in the physical model above (Obs.: don't use '*login*' neither '*logout*'!).

1.3. List one **bdd scenario** that could be used to validate that use-case.

1.4. Present one **structured concrete scenario** of a non-functional requirement related to the use-case above. State and describe what is the NFR being made concrete.

2 – Specifications

Consider the following Dafny specification. The method Sqrt is declared but not implemented (it has a specification only), while Hypotenuse is a method that calls Sqrt.

```
method Sqrt(x:int) returns (s:int)
    requires x >= 0
    ensures  x == s*s

method Hypotenuse(a:int, b:int) returns (h:int)
    requires a >= 0 && b >= 0
    ensures  a*a + b*b == h*h
{
    h := Sqrt(a*a + b*b);
}
```

2.1. In your own words, explain the contract of the method Hypotenuse.

2.2. Using the contract of Sqrt, derive the Weakest Precondition that must hold immediately before the call to Sqrt in Hypotenuse. State the condition precisely.

2.3. The integer square root of a non-negative integer n is defined as the largest integer r such that $r^2 \leq n < (r+1)^2$. Explain why it would be very problematic to implement the method Sqrt so that it satisfies the currently stated postcondition (x == s*s).

2.4. Rewrite the contract of the method Sqrt so that it precisely specifies the integer square root.