Abdelghani Alidra
Badji Mokhtar university- Algeria

Prototyping Software product lines with Pharo

About me and this project

- I am doing Phd on Software runtime adaptation
  - based on Software Product Lines (SPL)
  - prototype new algorithms for SPL-based adaptation planning
  - focus on scalability issues
  - enlarge the project to reasoning on features model using dependencies between features.

→ A simple API to do complex reasoning algos

Software Product Lines

- Is another step towards the industrialization of software development.
- Addresses a particular market segment or domain
    - Automotive (Renault)
    - SmartPhones (Nokia)
    - ….
- Can have impressive impact on costs and delays
- If there are a lot of products that vary by some aspects but that share many components

Software Factory

clients

Products

Core assets

All phones most havea batery, asceen , a mic …

HD camera requires HD screen

camera can be either HD or SD

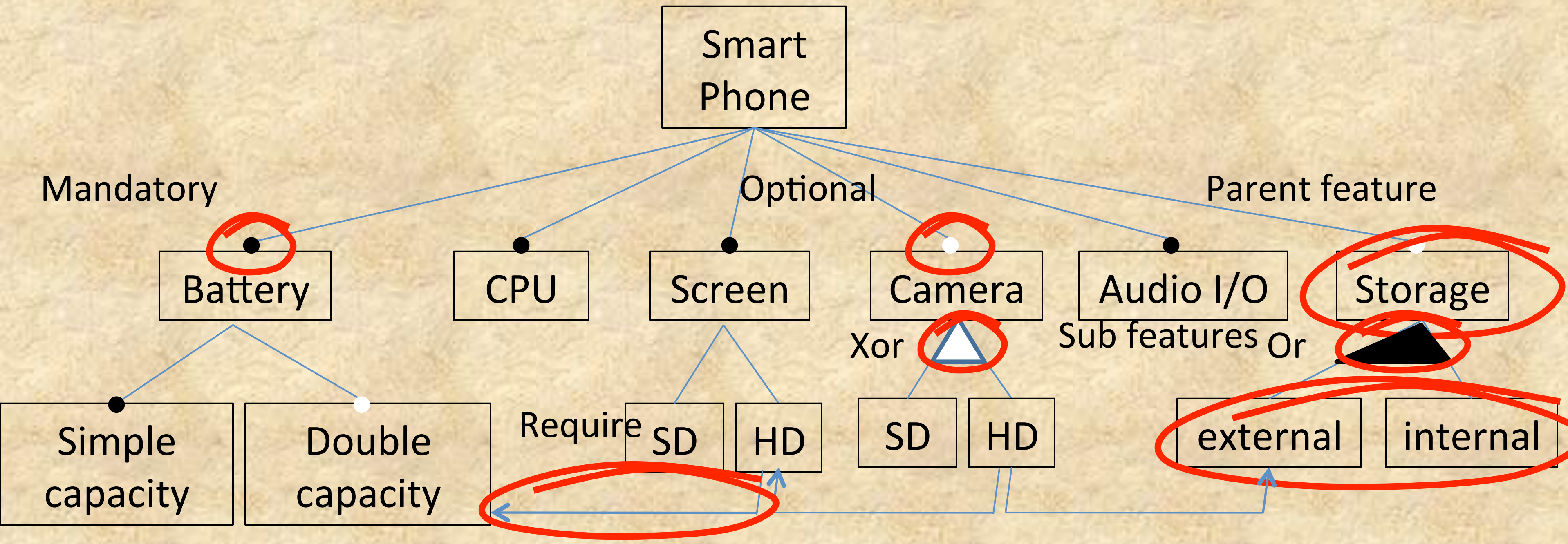
Variability info

Battery life requires large screen

Video games requires up to i5 processor

Selection policies

Feature modeling

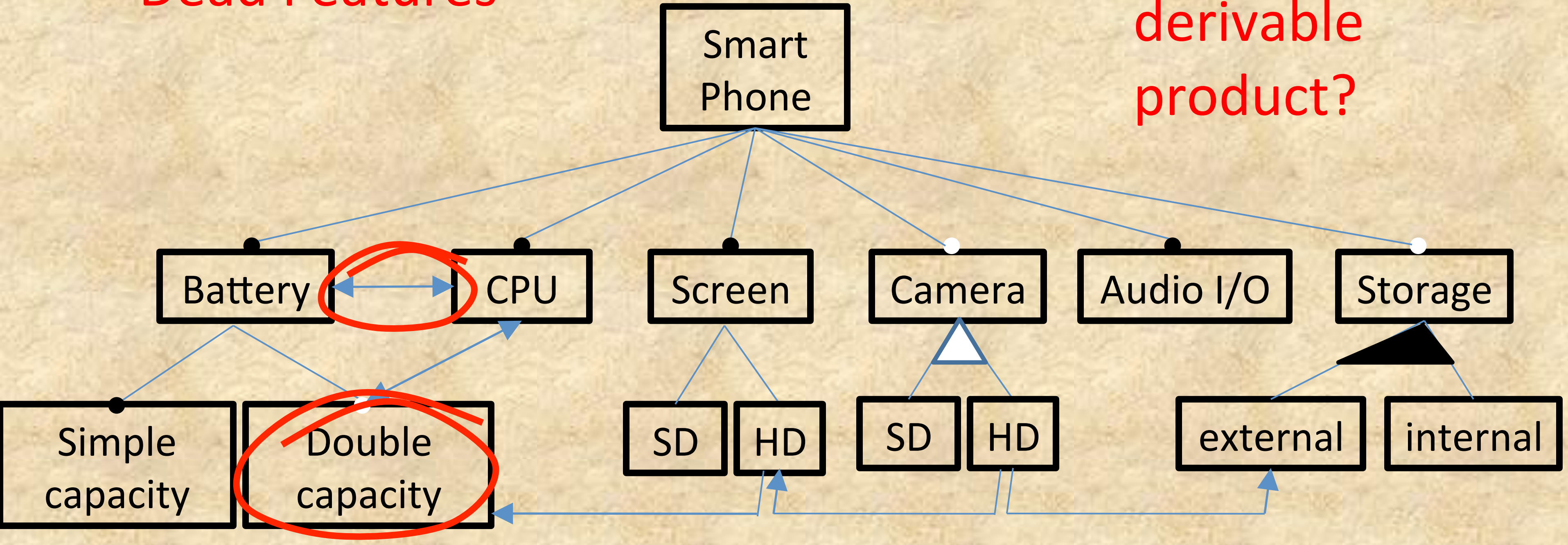


Allows some kind of reasoning

Some reasoning algorithms

SPL validity
Dead Features

Is a valid derivable product?



Reasoning on variability: existing approaches

- Mainly SAT/CSP solvers
- Drawback
  - Consider direct dependencies only.
  - Example:

Existing approaches : critisism

Step1: include parent and required features.
Exclude alternative feature

Step2: include parent of Camera

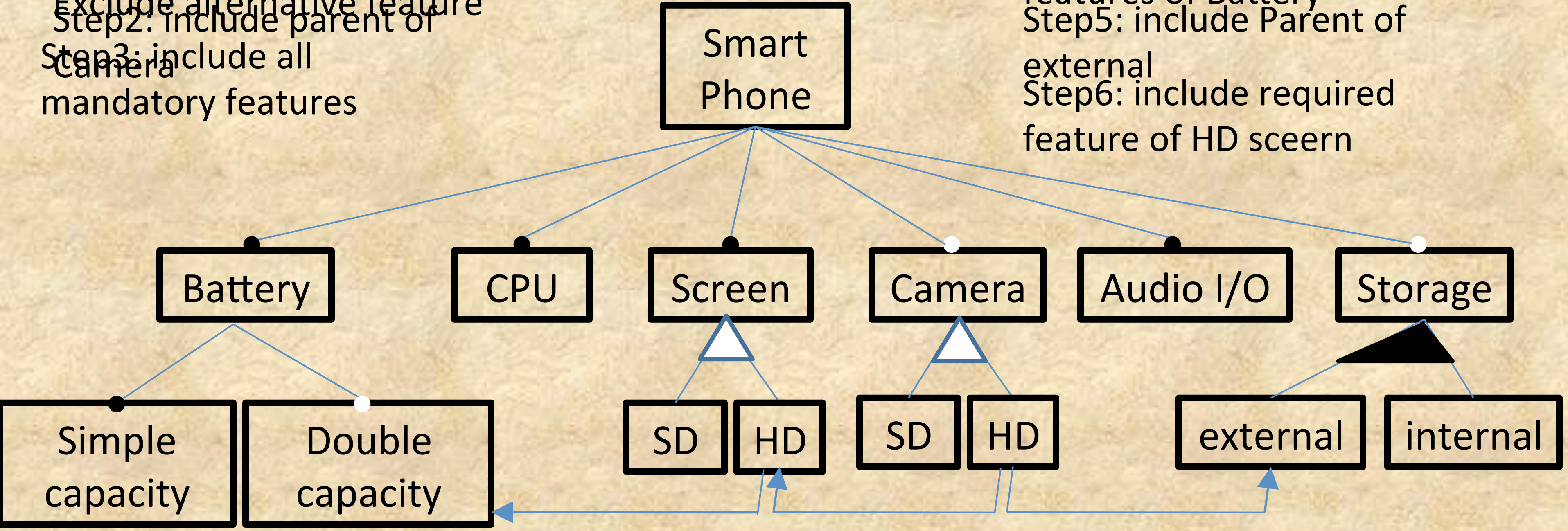
Step3: include all mandatory features

Step7: exclude alternative of Screen-HD

Step4: include mandatory features of Battery

Step5: include Parent of external

Step6: include required feature of HD sceern



RECURSIVE

Many minutes

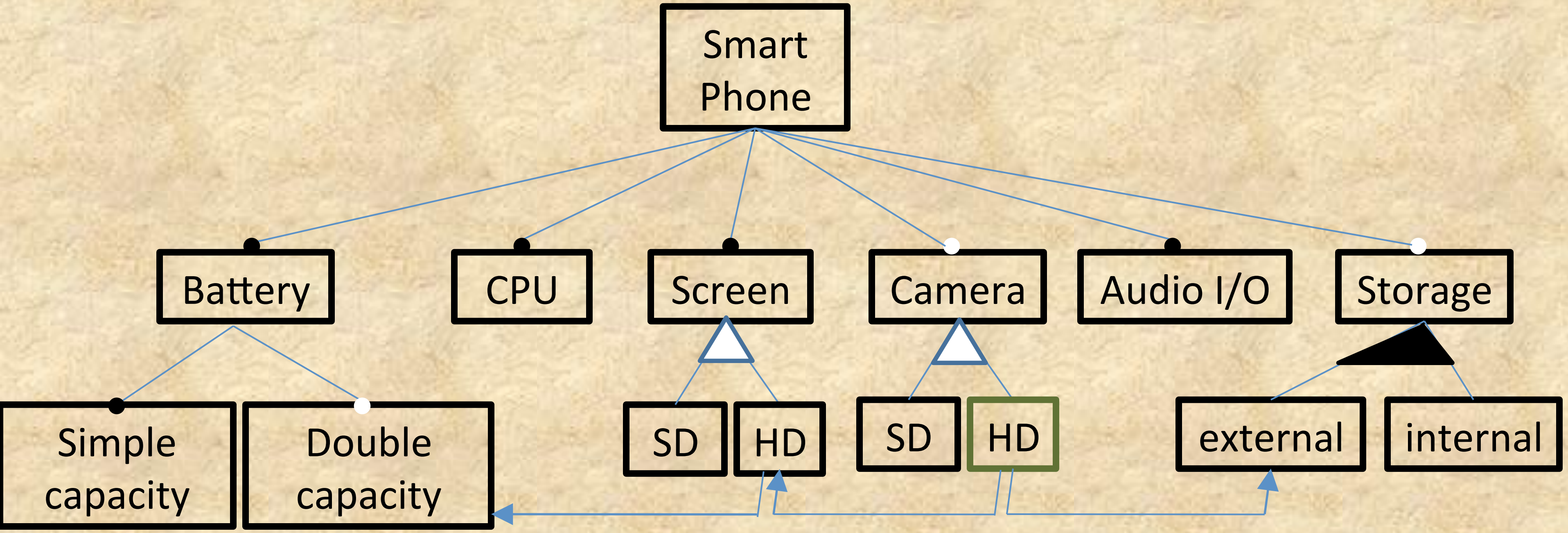
Feature knows all its dependencies

Our proposal : transitive dependencies

- We pre-compute all the dependencies of every feature.
  - A Dijkstra like algorithm
- Every feature knows all the features that it directly or indirectly:
  - requires
  - excludes
  - Is required by
- When a feature is set, it sets all the dependent ones in one step.

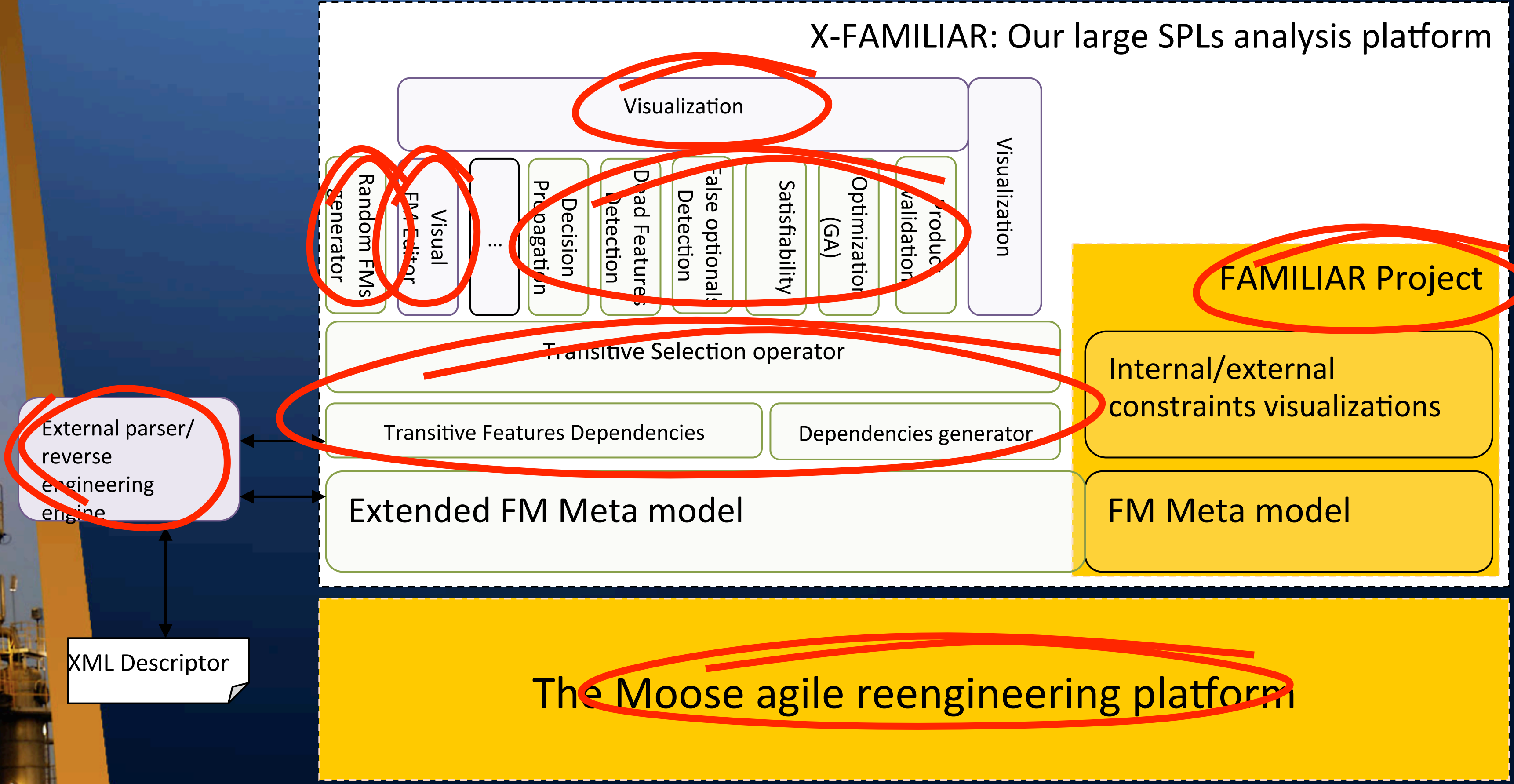
Our solution

Camera-HD transitively **requires**: Camera, SmartPhone,Audio I/O, Screen, CPU, Battery, SimpleCapacity, DoubleCapacitty, SceenHD, External, Strorage.
Camera-HD transitively **excludes:** Screen-SD



One step instead of 7 steps

An infrastrucute for reasoning of large feature models



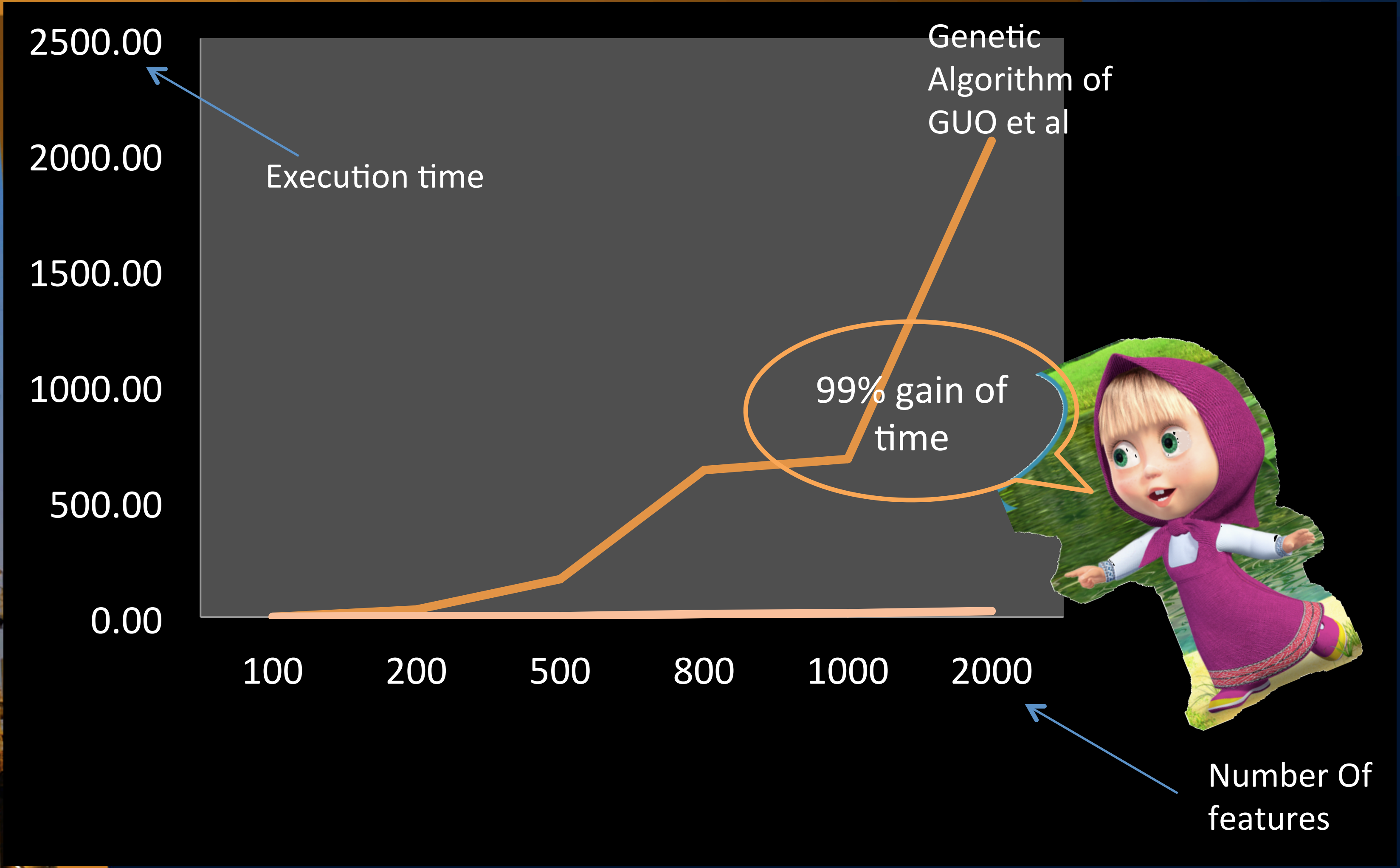
X-FAMILIAR: Our large SPLs analysis platform
Visualization
Random FMs Generator
Visual FM Editor
…
Decision Propagation
Dead Features Detection
False optionals Detection
Satisfiability
Optimization (GA)
Product validation
Visualization
FAMILIAR Project
Transitive Selection operator
Transitive Features Dependencies
Dependencies generator
Internal/external constraints visualizations
External parser/ reverse engineering engine
Extended FM Meta model
FM Meta model
XML Descriptor
The Moose agile reengineering platform

fppt.com

Evaluation of the proposal

- Do algorithms based on transitive dependency perform better (faster) than existing ones?
- The optimal features selection problem (very complex)
- Two algorithms are compared:
  - GA of Guo et al
  - GA based on transitive dependency

Experimental results



Some issues though

- Not able to create FM larger than 5000 features because memory availability problems
  - Spur will bring a solution?
- The genetic algorithm of Guo et al is rather slow compared to one implemented in other languages (order of minutes/seconds)
  - Little code optimization
  - The meta model is perhaps a bit complex
  - maybe the Moose image and the VM compared to compiled languages

Future works

- Implement the other tools
  - Agile Visualizations
  - Importer/exporter
  - Visual editor
  - Reverse engineering
  - …
- Extend the meta model
  - Attributes
  - Complex crosstree constraints
- More comparisons
  - Other reasoning algorithms
  - SAT/CSP algorithms
  - May be try some hybridizations (SAT solver based on feature dependencies)
- Finish and Document the Genetic Algorithms framwork
  - Available at: http://smalltalkhub.com/#!/~Alidra/GeneticAlgorithmsFramework
  - Please use it/contribute

Thank you

EUROPEA