

17-708 SOFTWARE PRODUCT LINES: CONCEPTS AND IMPLEMENTATION

ANALYSIS OF FEATURE MODELS

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LEARNING GOALS

Translation from feature models to logic formulas

Reasoning about various properties using SAT queries and achievable benefits

Understanding limitations and challenges

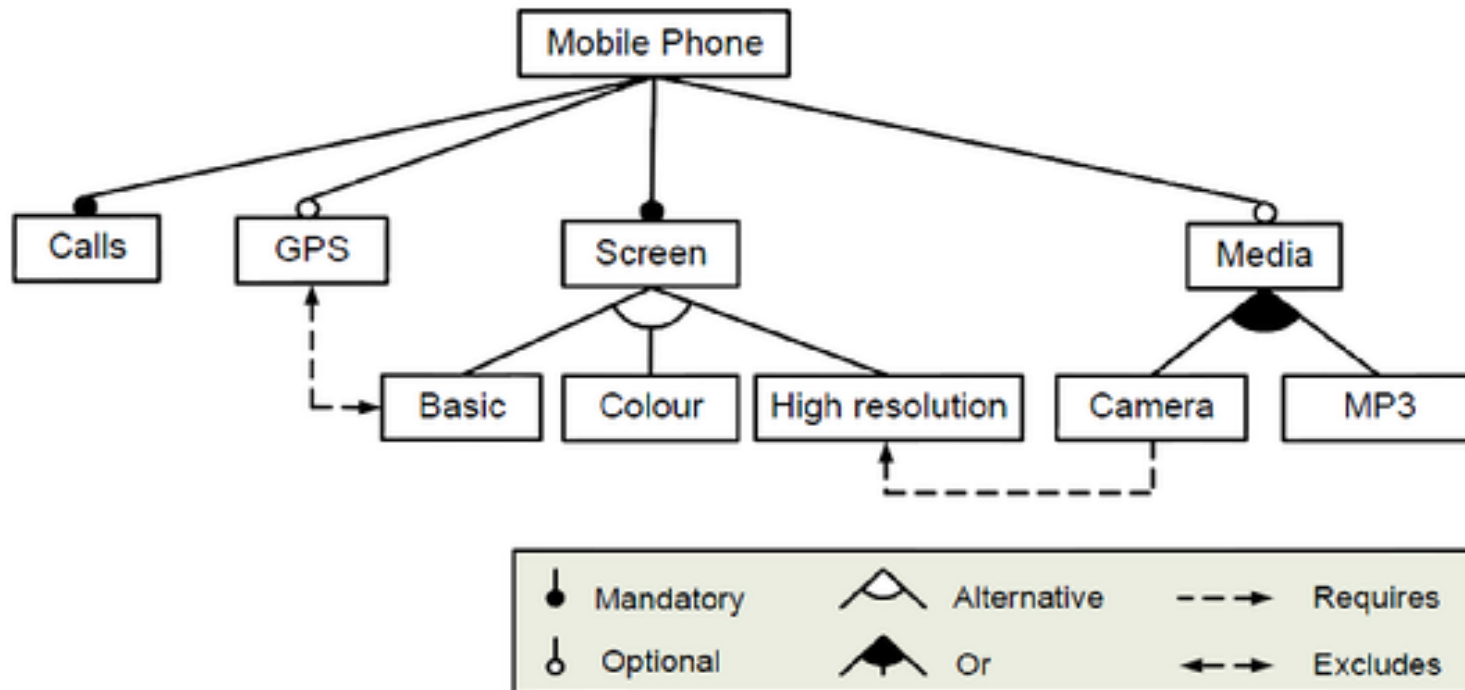
Solvers in practical tools (or lack thereof)

FODA

ANALYSIS OF FEATURE MODELS

IN-CLASS EXERCISE

Translate the following feature model to a propositional formula



ANALYSIS QUESTIONS

Configuration x valid?

At least one valid configuration? (consistency)

Valid partial configuration?

Constraint propagation?

Dead feature? False optional feature?

Comparing two feature models?

Optimization?

Atomic sets?

List/count all valid configurations? Weight of features?

Metrics?

EQUIVALENT MODELS

Create two feature models that describe the same configuration space.

Should there be a normal form for feature models?

ANALYSIS IN FEATUREIDE

Demo

SCALABILITY

np-hard

Tree-shaped problems are easier

Translation to CNF

$$(X_1 \wedge Y_1) \vee (X_2 \wedge Y_2) \vee \dots \vee (X_n \wedge Y_n).$$

$$(X_1 \vee X_2 \vee \dots \vee X_n) \wedge (Y_1 \vee X_2 \vee \dots \vee X_n) \wedge (X_1 \vee Y_2 \vee \dots \vee X_n) \wedge (Y_1 \vee Y_2 \vee \dots \vee X_n) \wedge \dots \wedge (Y_1 \vee Y_2 \vee \dots \vee Y_n).$$

Equi-satisfiable transformations

$$(Z_1 \vee \dots \vee Z_n) \wedge (\neg Z_1 \vee X_1) \wedge (\neg Z_1 \vee Y_1) \wedge \dots \wedge (\neg Z_n \vee X_n) \wedge (\neg Z_n \vee Y_n).$$

In practice analysis of feature models with 20000 options usually still tractable

ANALYSIS IN LINUX (OR LACK THEREOF)

3-value logic

Demo

FURTHER READING

Benavides, D., Segura, S., & Ruiz-Cortés, A. (2010). Automated analysis of feature models 20 years later: A literature review. *Information Systems*, 35(6), 615-636.

Batory, D. (2005). *Feature models, grammars, and propositional formulas* (pp. 7-20). Springer Berlin Heidelberg.

Mendonca, M., Wąsowski, A., & Czarnecki, K. (2009, August). SAT-based analysis of feature models is easy. In *Proceedings of the 13th International Software Product Line Conference* (pp. 231-240). Carnegie Mellon University.

Apel, S., Batory, D., Kästner, C., & Saake, G. (2013). *Feature-Oriented Software Product Lines*. Berlin: Springer. Chapter 10.1