17-708 SOFTWARE PRODUCT LINES: CONCEPTS AND IMPLEMENTATION

ANALYSIS OF FEATURE MODELS

CHRISTIAN KAESTNER
CARNEGIE MELLON UNIVERSITY
INSTITUTE OF SOFTWARE RESEARCH
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

\[(X_1 \land Y_1) \lor (X_2 \land Y_2) \lor \ldots \lor (X_n \land Y_n).\]
\[(X_1 \lor X_2 \lor \ldots \lor X_n) \land (Y_1 \lor X_2 \lor \ldots \lor X_n) \land (X_1 \lor Y_2 \lor \ldots \lor X_n) \land (Y_1 \lor Y_2 \lor \ldots \lor Y_n) \lor \ldots \lor (Y_1 \lor Y_2 \lor \ldots \lor Y_n).\]

Equi-satisfiable transformations

\[(Z_1 \lor \ldots \lor Z_n) \land (\neg Z_1 \lor X_1) \land (\neg Z_1 \lor Y_1) \land \ldots \land (\neg Z_n \lor X_n) \land (\neg Z_n \lor Y_n).\]

In practice analysis of feature models with 20000 options usually still tractable
ANALYSIS IN LINUX (OR LACK THEREOF)

3-value logic
Demo

