Refactoring Module Structure

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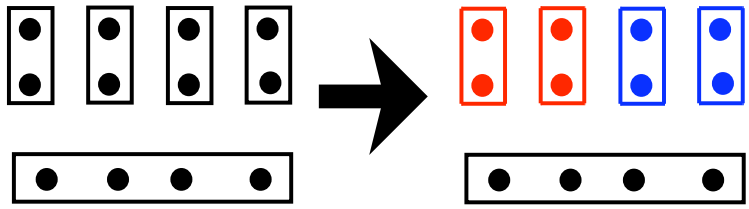
Outline

Motivation

- We have a complex Erlang software
  - Consists of modules and functions
- Over time, it has grown to be even more complex
  - Maintenance became nearly impossible
- The modules should be grouped into blocks that are small enough to be maintained effectively



RefactorErl, an Erlang Refactoring Tool

- Refactoring is meaning-preserving source code transformation
- RefactorErl is a tool that refactors Erlang source code
- Refactoring needs static semantical analysis . . .
- . . . and module restructuring needs the same!

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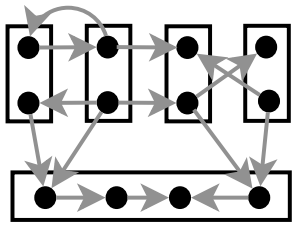
Idea

Use the infrastructure of RefactorErl for module restructuring

Module Restructuring Steps

1. Analysis
2. Clustering
3. Result selection
4. Splitting files
5. Transformation

- Required information:
  - Function call graph
  - Record usage
- Provided by RefactorErl



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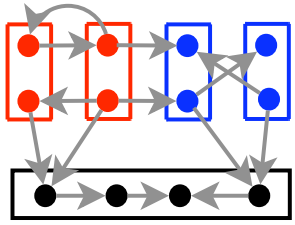
- Group related modules
  - Call each others functions
  - Use the same record
- Many results with different number of groups
- Many possible parametrization



Module Restructuring Steps

1. Analysis
2. Clustering
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- Measure which is the best clustering
- Automatic selection from a big result set
- Uses the same analysis results

Module Restructuring Steps

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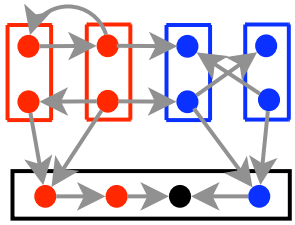
- Library modules: many incoming calls
  - Filtered before clustering
  - Used from more clusters
- Parts used from only one cluster are selected
- The same is done for header files



Module Restructuring Steps

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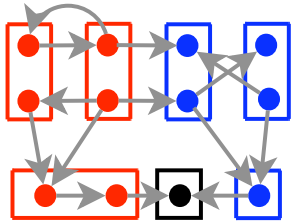
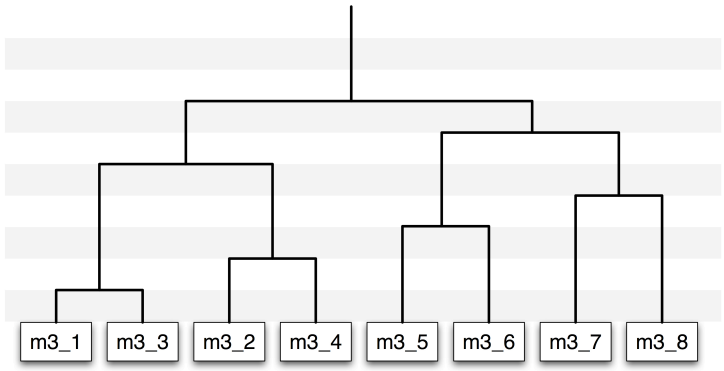
- The physical splitting of files is a refactoring
- Needed refactoring steps:
  - Move function definition
  - Move record definition
  - Move macro definition



Clustering

- Modules are sorted into clusters
- Hierarchical clustering algorithm



- The clustering algorithm can be parametrized with functions
  - e.g. how to compute the "distance" of two clusters

Fitness function

- Different clusterings are rated by a fitness function
- We used the MQ fitness function: the more internal and less external connection a clustering has, the better it is

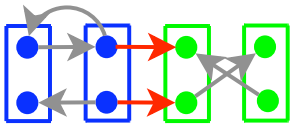


Figure: Clustering with better fitness value

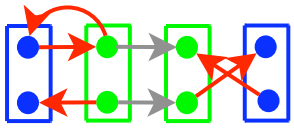
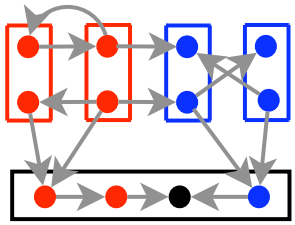


Figure: Clustering with worse fitness value

Splitting

- After a clustering is chosen, we have:
  - Clusters of modules
  - Stand-alone library modules
- Goal: splitting the library modules into smaller parts
  - Functions, records, and macros are assigned to clusters based on exclusive usage
  - Simple graph algorithm



Results with Industrial Software

- 188K lines of code, 6104 functions in 106 modules
- Clustering takes about 2 minutes – lots of parameters have been possible to try
- The resulting 4 clusters needed small manual corrections
- Module and header splitting, dead code elimination

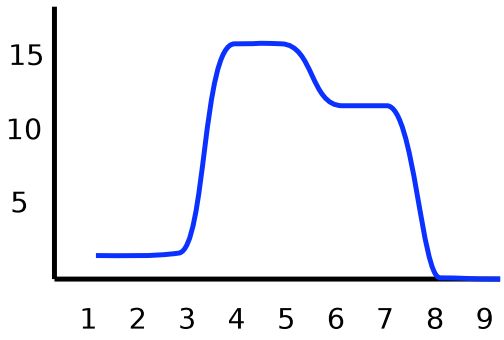


Figure: MQ fitness values for cluster numbers

Summary

- Developed a module restructuring method based on RefactorErl
- Successfully applied it on industrial software

Plans:

- Tool support for applying the results
- Clustering functions of one module