AVMf
An Open-Source Implementation of the Alternating Variable Method

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AVM is Everywhere

Application Domains
AVM is Everywhere

Application Domains

Workloads
AVM is Everywhere

Application Domains

Workloads

Testing
AVM is Everywhere

Application Domains

- Workloads
- Testing

Software Product Lines
AVM is Everywhere

AVM is used in varied domains

Application Domains

- Workloads
- Testing

Software Product Lines
Exploring AVM

Input Vector
Exploring AVM

Input Vector

\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]
Exploring AVM

Input Vector

\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]
Exploring AVM

Input Vector

\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]

Objective Function
Exploring AVM

Input Vector

\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]
Exploring AVM

Input Vector

\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]

Exploratory Moves
Exploring AVM

Input Vector
\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]

Exploratory Moves
Positive or negative “direction”?
Exploring AVM

Input Vector

\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]

Pattern Moves
Exploring AVM

Input Vector

\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]

Pattern Moves

Improve objective value?
Exploring AVM

Input Vector

\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]

Pattern Moves

Improve objective value?

Yes! pattern or No! explore
Exploring AVM

Input Vector

\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]

Pattern Moves

Improve objective value?

Yes! pattern or No! explore
Exploring AVM

Input Vector

\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]
Exploring AVM

Input Vector

\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]

Exploratory and Pattern Moves
Exploring AVM

Input Vector

\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]

Exploratory and Pattern Moves

Consider all input vector variables
Exploring AVM

Input Vector

\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]

Exploratory and Pattern Moves

Consider all input vector variables
Exploring AVM

Input Vector

\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]

Exploratory and Pattern Moves

Revisit each \( x_i \) in the input vector
Exploring AVM

Input Vector

\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]

Exploratory and Pattern Moves

Restart for local optimum
Exploring AVM

Input Vector

\[ \vec{x} = (x_1, x_2, \ldots, x_n) \]

Exploratory and Pattern Moves

Continue until termination condition
AVM Innovations

Search Algorithms

Geometric
AVM Innovations

Search Algorithms

Geometric

Lattice
AVM Innovations

Search Algorithms

Geometric

Lattice

Iterated Pattern
AVM Innovations

Search Algorithms

Geometric  Lattice

Iterated Pattern

Better search for many landscapes
AVM Innovations

Search Algorithms

Geometric

Lattice

Iterated Pattern

Provably faster for unimodal
AVM Innovations

Representations
AVM Innovations

Representations

Decimals
AVM Innovations

Representations

Decimals
Strings

Integers
AVM Innovations

Representations

Decimals  Strings

Integers

Handle real-world programs
Missing Features

Data?

Method?
Missing Features

>Data?

>>Method?
Key Challenge

Prior AVMs lack provably faster methods!
Tools Using AVM

Test Generation
Tools Using AVM

Test Generation

AUSTIN
Tools Using AVM

Test Generation

AUSTIN
EvoSuite
Tools Using AVM

Test Generation

- AUSTIN
- EvoSuite
- SchemaAnalyst
Tools Using AVM

AVM is used in many tools

- Test Generation
- AUSTIN
- EvoSuite
- SchemaAnalyst
Extracting AVM

Fitness?  Search?
Extracting AVM

Fitness?

Search?
Extracting AVM

Fitness?

Search?
Key Challenge

Hard to extract AVM from custom software!
Rescued by AVMf
Rescued by AVMf

Original AVM plus enhancements for data and search
Rescued by AVMf

Clear implementation of core algorithms
Rescued by AVMf

Adheres to the principles of object-oriented design
Rescued by AVMf

Free and open-source software from avmframework.org
Rescued by AVMf
Rescued by AVMf

New Application Domain
Rescued by AVMf
Rescued by AVMf

New Search Algorithm
Design of AVMf
Design of AVMf

Configure
Design of AVMf

Configure

Represent
Design of AVMf
Design of AVMf

Objective
Design of AVMf
Design of AVMf

See the paper for more design and implementation details
Design of AVM

The tool’s website contains extensive documentation
AVMf Demonstration
AVMf Demonstration

java org.avmframework.examples.Quadratic
AVMf Demonstration

java org.avmframework.examples.StringOptimization
AVMf Demonstration

demonstration

java org.avmframework.
examples.GenerateInputData
AVMf Demonstration

Input → Output

Stochastic Behavior
AVMf Demonstration

Already run:

- git clone & mvn package
AVMf’s Contributions
AVMf’s Contributions

Overcomes the challenges of using AVM
AVMf’s Contributions

Provably faster searches and new data types
AVMf’s Contributions

Accessible object-oriented and algorithmic design
AVMf’s Contributions

Open-source download from avmframework.org