



# Simplification of symbolic expressions with constraints

Lab 4 TDA452

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# Problem formulation

What we want to model:

$$x^4 + (y + 1)z, \quad (1)$$

$$y = z - 1, \quad (2)$$

$$z = x^2. \quad (3)$$

Substituting (2), followed by (3), simplifies (1) to

$$2x^4. \quad (4)$$

# Our model

```
newtype Variable = Variable String
    deriving Eq
```

```
data Expr =
    N Integer
  | V Variable
  | Add [Expr]
  | Mul [Expr]
  | Pow Expr Expr
```

# Canonical form of expressions

`toCanonical :: Expr -> Expr`

- distributes multiplication over addition
- combines terms with the same factors
- removes multiplication by 1 and addition by 0
- etc

# Simplification

```
newtype Rule = Rule (Variable, Expr)
```

```
findSimplest :: Expr -> [Rule] -> Expr
```

- builds a list of new expressions by applying a list of rules
- iterates
- prunes the expression list according to some heuristic

# Example

$$-28 + 16xy + 7z + 8wx, \quad (5)$$

$$x = y + 2z \quad (6)$$

$$z = 2y^2 \quad (7)$$

$$w = z \quad (8)$$

$$-28 + 14y^2 + 80xy^2 \quad (9)$$