Simplification of symbolic expressions with constraints

Lab 4 TDA452

Emma Ringström & Simon Jacobsson

Chalmers University of Technology

2021-12-17

Problem formulation

What we want to model:

$$x^4 + (y+1)z, \tag{1}$$
$$y = z - 1, \tag{2}$$
$$z = x^2. \tag{3}$$

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

$$2x^4. \tag{4}$$

Our model

```haskell
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