

## 1) Unification Traces

a)  $\text{Unify}((P \times Y), (P a Z)) \{a/x, Z/Y\}$  Returns  $\{a/x, Z/Y\}$

$\swarrow \nearrow \{\}$   
 $\text{Unify}(P, P)$   $\text{Unify}((\overset{a}{x} Y), (a Z))$   
 $\swarrow \nearrow \{a/x\}$   $\swarrow \nearrow \{Z/Y\}$   
 $\text{Unify}(x, a)$   $\text{Unify}(Y, Z)$

b)  $\text{Unify}(\text{ancestor}(x, \text{father } x), (\text{ancestor david george}))$  Fails

$\swarrow \nearrow \{\}$   
 $\text{Unify}(\text{ancestor}, \text{ancestor})$   $\text{Unify}((\overset{\text{david}}{x} (\text{father } \overset{\text{david}}{x})), (\text{david george}))$  Fail  
 $\swarrow \nearrow \{\text{david}/x\}$   $\swarrow \nearrow \text{FAIL}$   
 $\text{Unify}(x, \text{david})$   $\text{Unify}((\text{father david}), \text{george})$   
 $\swarrow \nearrow \text{FAIL}$

c)  $\text{Unify}((q x), (\text{not } q x))$

$\swarrow \nearrow \text{Fail}$   
 $\text{Unify}(q, \text{not})$

Fails  
 $q \neq \text{not}$   
 are constants  
 and not equal

Unify  
 $E1 = \text{father}, E2 = \text{George} \leftarrow \text{constants}$   
 $\& \text{ not equal.}$

## 2) Jane Doe

4 Dependents.

Steady Income of \$30,000

Savings of \$15,000

$4 \times \$5000 = 20,000$  needed in savings

$4 \times \$4000 + \$15,000 = 31,000$  needed in steady income

"Jane Doe does not earn enough in steady income  
 & does not have enough saved, therefore she  
 should invest in her savings"

Main Features: Savings(adequate), Savings(inadequate), income(adequate), income(inadequate)  
 investment(Type)

Strategies: 1. Savings(inadequate)  $\rightarrow$  investment(save)  
 2. Savings(adequate)  $\wedge$  income(adequate)  $\rightarrow$  investment(stock)  
 3. Savings(adequate)  $\wedge$  income(inadequate)  $\rightarrow$  investment(combo)

Predicates needed:  $\text{minSavings}(x) = 5000 \times x$ ,  $\text{minIncome}(x) = 4000 \times x + 15000$   
 $\text{greater}(x, y) = x > y$

Terms of our Problem: SavedAmount(15000), earnings(30,000, steady), dependents(4)

2)  $\text{Unify}((\text{dependents } 4), (\text{dependents } x_1)) - \text{return} = \{4/x_1\}$

$\text{Unify}((\text{earnings } 30000 \text{ steady}), (\text{earnings } x_2 \text{ steady})) - \text{return} = \frac{\text{unifications}}{\{30000/x_2\}}$

$\text{Unify}((\text{SavedAmount } 15000), (\text{SavedAmount } x_3)) - \text{return} = \{15000/x_3\}$

$\forall x, \text{earnings}(x, \text{steady}) \wedge \exists x_2 (\text{dependents}(x_2) \wedge \neg \text{greater}(30000, \text{minIncome}(x_2)))$   
 $\longrightarrow \text{Income}(\text{inadequate})$

Substituting...

$\text{earnings}(30000, \text{steady}) \wedge \text{dependents}(4) \wedge \neg \text{greater}(30000, 31000)$   
 $\uparrow \text{true} \quad \uparrow \text{true} \quad \uparrow \text{true}$   
 $\longrightarrow \text{Income}(\text{inadequate})$

\* Janes income is inadequate.

$\forall x, \text{SavedAmount}(x_1) \wedge \exists x_2 \text{dependents}(x_2) \wedge \neg \text{greater}(x_1, \text{minSavings}(x_2))$   
 $\longrightarrow \text{Savings}(\text{inadequate})$

Substituting...

$\text{SavedAmount}(15000) \wedge \text{dependents}(4) \wedge \neg \text{greater}(15000, 20000)$   
 $\uparrow \text{true} \quad \uparrow \text{true} \quad \uparrow \text{true}$   
 $\longrightarrow \text{Savings}(\text{inadequate})$

\* Janes Savings is inadequate.

$\text{Savings}(\text{inadequate}) \rightarrow \text{Investment}(\text{Savings})$

Janes savings are inadequate, therefore, she should invest in savings.

3. Diagnostic Sentences:

1. "If the engine is faulty and the vehicle is emitting a clicking noise and the lights come on, then the problem is the starter"
2. "If the engine is not working and the lights come on and the vehicle is not emitting clicking noises, then the problem is that its out of gas."
3. "If the engine is not working and the lights won't come on and the vehicle is not emitting clicking noises, then the problem is the battery"

Features: Engine(working), Engine(Faulty), Lights(on), Lights(off),  
EmittingNoise(clicking), EmittingNoise(None)

Problem(starter), Problem(Gas), Problem(Battery)

Predicate Sentences :

1.  $\text{Engine}(\text{faulty}) \wedge \text{Lights}(\text{on}) \wedge \text{EmmittingNoise}(\text{clicking})$   
 $\longrightarrow \text{Problem}(\text{Starter})$
2.  $\neg \text{Engine}(\text{working}) \wedge \text{Lights}(\text{on}) \wedge \text{EmmittingNoise}(\text{None})$   
 $\longrightarrow \text{Problem}(\text{Gas})$
3.  $\neg \text{Engine}(\text{working}) \wedge \text{Lights}(\text{off}) \wedge \text{EmmittingNoise}(\text{None})$   
 $\longrightarrow \text{Problem}(\text{Battery})$