Computation Tree Logic (CTL)

A CTL formula can be generated according to the following BNF:

Φ ::= $p \mid \neg\Phi \mid \Phi \vee \Phi \mid \Phi \wedge \Phi \mid \Phi \Rightarrow \Phi \mid$

$EX(\Phi) \mid EF(\Phi) \mid EG(\Phi) \mid ESU(\Phi,\Phi) \mid EWU(\Phi,\Phi) \mid$

$AX(\Phi) \mid AF(\Phi) \mid AG(\Phi) \mid ASU(\Phi,\Phi) \mid AWU(\Phi,\Phi) \mid$

$EX_{back}(\Phi) \mid EF_{back}(\Phi) \mid EG_{back}(\Phi) \mid ESU_{back}(\Phi,\Phi) \mid EWU_{back}(\Phi,\Phi) \mid$

$AX_{back}(\Phi) \mid AF_{back}(\Phi) \mid AG_{back}(\Phi) \mid ASU_{back}(\Phi,\Phi) \mid AWU_{back}(\Phi,\Phi)$

Basic Data-Flow Properties: isDef, isUsed, isMod

isDef: A variable *A* is **defined** if the statement can (potentially) change the value of *A*, for instance by an assignment.

isUsed: A variable *A* or an expression *XopY* is **used** if there is any occurrence of *A* or *XopY* as an operand.

isMod: An expression *XopY* is **modified** if the statement defines *X* or *Y*.

The Four Basic Data-Flow Analyses

Live Variables:

$isLive(x) = ESU(\neg isDef(x), isUsed(x))$

Very Busy Expressions:

$isVBE(e) = ASU(\neg isMod(e), isUsed(e))$

Available Expressions:

$isAvail(e) = AX_{back}(ASU_{back}(\neg isMod(e), isGen(e)))$

where

$isGen(e) = isUsed(e) \wedge \neg isMod(e)$

Reaching Definitions:

$isReaching(a,s) = EX_{back}(ESU_{back}(isPreserved(a,s), s))$

where

$isPreserved(a,s) = \neg isDef(a) \wedge EF_{back}(s)$

The Fibonacci Program Model