Extended FSP Grammar Specification

Thomas Ayles

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1 Grammar Rules

The following is a description of the grammar rules that provide the extended features of FSP. The grammar rules are meant to be read as replacements and additions to the complete grammar given in *Concurrency: State Models and Java Programs (Jeff Magee and Jeff Kramer, John Wiley and Sons, 1999)*. The rules are presented in the same style as the original grammar, and are designed to be read in conjunction with it.

1.1 Floating-point Expressions

The following are grammar rules for incorporating floating-point expressions into FSP specifications.

FloatExpression:
    AdditiveFloatExpr

AdditiveFloatExpr:
    MultiplicativeFloatExpr
    AdditiveFloatExpr `+` *AdditiveFloatExpr*
    AdditiveFloatExpr `-` *AdditiveFloatExpr*

MultiplicativeFloatExpr:
    UnaryFloatExpr
    MultiplicativeFloatExpr `*` *MultiplicativeFloatExpr*
    MultiplicativeFloatExpr `/` *MultiplicativeFloatExpr*

UnaryFloatExpr:
    BaseFloatExpr
    `+` *BaseFloatExpr*
    `-` *BaseFloatExpr*

BaseFloatExpr:
    FloatLiteral
    IntegerLiteral

Variable
ConstantIdent
`(` *FloatExpression* `)`

ConstantDef:
`const` *ConstantIdent* `=` *SimpleExpression*
`float` *ConstantIdent* `=` *FloatExpression*

Parameter:
ParameterIdent `=` *Expression*
ParameterIdent `=` *FloatExpression*

1.2 Probabilistic Choice

The following rules add probabilistic choice to the FSP grammar.

Choice:
ActionPrefix
NonDetChoice `|` *ActionPrefix*
ProbChoice `|` `(`*FloatExpression*`)` *LocalProcess*

NonDetChoice:
ActionPrefix
NonDetChoice `|` *ActionPrefix*

ProbChoice:
`(`*FloatExpression*`)` *LocalProcess*
ProbChoice `|` `(`*FloatExpression*`)` *LocalProcess*

1.3 Clock Setting and Testing

The following rules provide for the setting, testing, holding and resuming of clocks in FSP. Distribution labels range over the names given in Table 1.

PrefixActions:
ClockedActionLabels
PrefixActions `->` *ClockedActionLabels*

ClockedActionLabels:
$ClockGuard_{opt}$ *ActionLabels* $ClockSet_{opt}$
`<?` *Distribution* `?>` *ActionLabels*

ClockSet:
`<`*ClockSettings*`>`

ClockSettings:
    ClockSetting
    ClockSettings, *ClockSetting*

ClockSetting:
    ClockLabel: *Distribution*
    ClockLabel:`hold`
    ClockLabel:`resume`

ClockGuard:
    ?*ClockConditions*?

ClockConditions:
    ClockCondition
    ClockConditions, *ClockCondition*

ClockCondition:
    ClockLabel
    !*ClockLabel*

Distribution:
    DistributionLabel
    DistributionLabel(*DistributionParams*)

DistributionParams:
    FloatExpression
    DistributionParams, *FloatExpression*

ClockLabel:
    LowerCaseIdentifier

DistributionLabel:
    LowerCaseIdentifier

1.4 Measures

The following rules add measurement to the FSP language.

FSPDefinition:
    ConstantDef
    RangeDef
    SetDef
    ProcessDef
    CompositeDef

PropertyDef
ProgressDef
MenuDef
TimerDef
MeasureDef
CounterDef

TimerDef:
`timer` *ProcessIdent ActionPair*
`timer` *ProcessIdent* { *TimerPairs* }

TimerPairs:
ActionPair
`forall` *IndexRanges ActionPair*
TimerPairs, *ActionPair*
TimerPairs, `forall` *IndexRanges ActionPair*

ActionPair:
<*ActionsLabels*, *ActionsLabels*>

MeasureDef:
`measure` *ProcessIdent ActionPair*

CounterDef:
`counter` *ProcessIdent Set*

2 Supported Distribution Types

This appendix enumerates the classes of distributions that are supported in extended FSP. Each distribution class is listed with its name, its symbolic name, its parameter list and its distribution function. The distributions are presented in Table 1. Probability density functions are presented with their domain. The value of a probability density function outside its domain is zero.

Dist. Type	**Name**	**Parameters**	**P D F** $f(t)$
Exponential	`exp`	(r: float)	$\frac{e^{-(t/r)}}{r}$, $r \geq 0$
Uniform	`uniform`	(p: float, q: float)	$\frac{1}{q-p}$, $p \leq t \leq q$
Fixed	`fixed`	(k: float)	1, $t = k$
Erlang	`erlang`	(k: integer, θ: float)	$\frac{t^{k-1}e^{-(t/\theta)}}{(k-1)!\theta^k}$, $\theta \geq 0$
Gamma	`gamma`	(θ: float, β: integer)	$\frac{(t/\theta)^{\beta-1}e^{-(t/\theta)}}{a\int_0^\infty e^{-x}x^{\beta-1}dx}$
Geometric	`geometric`	(p: float)	$p^{t-1}(1-p)^t$, $t \geq 0$
Normal	`normal`	(μ: float, σ: float)	$\frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{1}{2}(\frac{t-\mu}{\sigma}^2)}$

Table 1: Available distributions as part of the core. Each distribution has a name by which it can be used in the FSP specification, as well parameters it takes. In the corresponding distribution functions, the parameters are referred to by their given names.