Switch-Compiler 1.0

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Contents

1	Hier	archica	Index		1
	1.1	Class I	Hierarchy		1
2	Clas	s Index			3
	2.1	Class I	_ist		3
3	Clas	s Docu	mentation		5
	3.1	mappe	r.src.flexpi	pe.flexpipe_configuration.FlexpipeConfiguration Class Reference	5
		3.1.1	Detailed	Description	5
		3.1.2	Member	Function Documentation	5
			3.1.2.1	display(self)	5
			3.1.2.2	getEarliestStageFromAssign(self, assignInfo)	6
			3.1.2.3	getPerLogAssignInfo(self)	6
	3.2	mappe	r.src.flexpi	pe.flexpipe_dependency_analysis.FlexpipeDependencyAnalysis Class Reference	6
	3.3	mappe	r.src.flexpi	pe.flexpipe_ilp_compiler.FlexpipeIlpCompiler Class Reference	6
		3.3.1	Construc	tor & Destructor Documentation	9
			3.3.1.1	init	9
		3.3.2	Member	Function Documentation	9
			3.3.2.1	blockOverlap(self, mem, sl1, log, sl2)	9
			3.3.2.2	blocksInSameStageAs(self, mem, sl)	9
			3.3.2.3	blocksInStage(self, mem, st)	9
			3.3.2.4	dependencyConstraint	9
			3.3.2.5	fillModel(self, startRowDict, numberOfRowsDict, model)	9
			3.3.2.6	numberOfRowsBounds	9
			3.3.2.7	setLb(self)	10
			3.3.2.8	setup(self, program, switch, preprocess)	10
			3.3.2.9	setupConstraints	10
			3.3.2.10	solve(self, program, switch, preprocess)	10
			3.3.2.11	wordLayoutConstraint	10
	3.4	mappe	r.src.flexpi	pe.flexpipe_lpt_compiler.FlexpipeLptCompiler Class Reference	10
		3.4.1	Detailed	Description	11
		342	Member	Function Documentation	11

iv CONTENTS

		3.4.2.1	assignRowsToTable(self)	. 11
		3.4.2.2	getBlocksInStage(self, mem, st)	. 11
		3.4.2.3	getMem(self, tableIndex)	. 11
		3.4.2.4	getMemTypesInStage(self)	. 12
		3.4.2.5	getNextRange(self)	. 12
		3.4.2.6	getNextTable(self)	. 12
		3.4.2.7	makeGraph(self, program)	. 12
		3.4.2.8	setupAssigned(self)	. 12
		3.4.2.9	setupDirty(self)	. 12
		3.4.2.10	setupLastBlock(self)	. 12
		3.4.2.11	setupNextTable(self)	. 12
		3.4.2.12	setupRowsPerBlock(self)	. 13
		3.4.2.13	setupSwitchToNext(self)	. 13
		3.4.2.14	setupTablesInBlock(self)	. 13
		3.4.2.15	solve(self, program, switch, preprocess)	. 13
		3.4.2.16	switchToNextStage(self)	. 13
3.5	mappe	r.src.flexpi	pe.flexpipe_preprocess.FlexpipePreprocess Class Reference	. 13
	3.5.1	Detailed	Description	. 14
	3.5.2	Member	Function Documentation	. 14
		3.5.2.1	blocksInStage(self, mem, st)	. 14
		3.5.2.2	setUseMemory(self)	. 14
3.6	mappe	r.src.flexpi	pe.flexpipe_switch.FlexpipeSwitch Class Reference	. 14
	3.6.1	Construc	stor & Destructor Documentation	. 15
		3.6.1.1	init	. 15
3.7	mappe	r.src.rmt.rr	mt_configuration.RmtConfiguration Class Reference	. 15
	3.7.1	Detailed Description		
	3.7.2	Member	Function Documentation	. 16
		3.7.2.1	checkWordsPerTable(self)	. 16
		3.7.2.2	display	. 16
		3.7.2.3	getColorsForTables(self)	. 16
		3.7.2.4	getEarliestStageFromAssign(self, assignInfo)	. 17
		3.7.2.5	getNumActiveSrams(self)	. 17
		3.7.2.6	getNumActiveTcams(self)	. 17
		3.7.2.7	getPerLogAssignInfo(self)	. 17
		3.7.2.8	getWordsPerTable(self)	. 17
		3.7.2.9	makeArrayToList(self, arr)	. 17
		3.7.2.10	showPic(self, filename, prefix)	. 17
3.8	mappe	r.src.rmt.rr	mt_dependency_analysis.RmtDependencyAnalysis Class Reference	. 17
	3.8.1	Member	Function Documentation	. 18
		3.8.1.1	showCriticalPath	. 18

CONTENTS

3.9	mappe	r.src.rmt.rm	t_ffd_compiler.RmtFfdCompiler Class Reference	18
	3.9.1	Member F	unction Documentation	18
		3.9.1.1	getOrderedTables(self)	18
3.10	mappe	r.src.rmt.rm	t_ffl_compiler.RmtFflCompiler Class Reference	19
	3.10.1	Member F	unction Documentation	19
		3.10.1.1	getOrderedTables(self)	19
3.11	mappe	r.src.rmt.rm	t_ffls_compiler.RmtFflsCompiler Class Reference	19
3.12	mappe	r.src.rmt.rm	t_greedy_compiler.RmtGreedyCompiler Class Reference	20
	3.12.1	Detailed D	escription	21
	3.12.2	Member F	unction Documentation	21
		3.12.2.1	getBestFitForBlocks(self, tableIndex, mem, lastBlock, numSramBlocksReserved)	21
		3.12.2.2	getBestFitForWords(self, tableIndex, mem, lastBlock, numWordsLeft)	21
		3.12.2.3	getIndex(self, table, names)	21
		3.12.2.4	getNextTable(self)	21
		3.12.2.5	getNumSramBlocksReserved(self)	21
		3.12.2.6	getPerPf(self, mem, tableIndex)	21
		3.12.2.7	solve(self, program, switch, preprocess)	21
3.13	mappe	r.src.rmt.ori	g_rmt_compiler.RmtIlpCompiler Class Reference	22
	3.13.1	Constructo	or & Destructor Documentation	23
		3.13.1.1	init	23
	3.13.2	Member F	unction Documentation	24
		3.13.2.1	actionAssignmentConstraint(self)	24
		3.13.2.2	actionCrossbarConstraint(self)	24
		3.13.2.3	assignmentConstraint(self)	24
		3.13.2.4	capacityConstraint(self)	24
		3.13.2.5	checkConstraints(self, model)	24
		3.13.2.6	dependencyConstraint(self)	24
		3.13.2.7	displayActiveRams(self, model)	24
		3.13.2.8	getEndAllMemTimesStartTimeOfStage(self)	24
		3.13.2.9	getNumActiveSrams(self)	24
		3.13.2.10	getNumActiveTcams(self)	25
		3.13.2.11	getStartAllMemTimesStartTimeOfStage(self)	25
		3.13.2.12	onePackingUnitForLogInStage(self)	25
		3.13.2.13	pipelineLatencyVariables(self)	25
		3.13.2.14	resolutionLogicConstraint(self)	25
		3.13.2.15	solve(self, program, switch, preprocess)	25
		3.13.2.16	useMemoryConstraint(self)	25
		3.13.2.17	wordLayoutConstraint(self)	25
3.14	mappe	r.src.rmt.rm	t_preprocess.RmtPreprocess Class Reference	26
	3.14.1	Detailed D	escription	26

vi CONTENTS

3.15.1	Detailed Description	27
3.15 mappe	er.src.rmt.rmt_switch.RmtSwitch Class Reference	27
	3.14.2.3 setUseMemory(self)	26
	3.14.2.2 GetMultipleBefore(self, maxValue, div)	26
	3.14.2.1 getMaxPf(self, logicalWidth, blockWidth)	26
3.14.2	Member Function Documentation	26

Chapter 1

Hierarchical Index

1.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

mapper.src.flexpipe_configuration.FlexpipeConfiguration
mapper.src.flexpipe_dependency_analysis.FlexpipeDependencyAnalysis
mapper.src.flexpipe_ilp_compiler.FlexpipellpCompiler
mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler
mapper.src.flexpipe_preprocess.FlexpipePreprocess
mapper.src.flexpipe_switch.FlexpipeSwitch
mapper.src.rmt.rmt_configuration.RmtConfiguration
mapper.src.rmt.rmt_dependency_analysis.RmtDependencyAnalysis
mapper.src.rmt.rmt_greedy_compiler.RmtGreedyCompiler
mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler
mapper.src.rmt.rmt_preprocess.RmtPreprocess
mapper.src.rmt.rmt_switch.RmtSwitch
RmtGreedyCompiler
mapper.src.rmt.rmt_ffd_compiler.RmtFfdCompiler
mapper.src.rmt.rmt_ffl_compiler.RmtFflCompiler
mapper.src.rmt.rmt ffls compiler.RmtFflsCompiler

2 **Hierarchical Index**

Chapter 2

Class Index

2.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

mapper.src.flexpipe_flexpipe_configuration.FlexpipeConfiguration	5
mapper.src.flexpipe_dependency_analysis.FlexpipeDependencyAnalysis	6
mapper.src.flexpipe_ilp_compiler.FlexpipellpCompiler	6
mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler	0
mapper.src.flexpipe_preprocess.FlexpipePreprocess	3
mapper.src.flexpipe_switch.FlexpipeSwitch	4
mapper.src.rmt.rmt_configuration.RmtConfiguration	5
mapper.src.rmt.rmt_dependency_analysis.RmtDependencyAnalysis	7
mapper.src.rmt.rmt_ffd_compiler.RmtFfdCompiler	8
mapper.src.rmt.rmt_ffl_compiler.RmtFflCompiler	9
mapper.src.rmt.rmt_ffls_compiler.RmtFflsCompiler	9
mapper.src.rmt.rmt_greedy_compiler.RmtGreedyCompiler	0
mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler	2
mapper.src.rmt.rmt_preprocess.RmtPreprocess	6
mapper.src.rmt.rmt_switch.RmtSwitch	7

Class Index

Chapter 3

Class Documentation

3.1 mapper.src.flexpipe_configuration.FlexpipeConfiguration Class Reference

Public Member Functions

- def __init__ (self, program, switch, preprocess, version)
- def displayInitialConditions (self)
- def getPerLogAssignInfo (self)
- def getEarliestStageFromAssign (self, assignInfo)
- def configure (self, startRow, numberOfRows)
- def display (self)
- def getColorsFromTableGroups (self, tableGroups)
- · def showPic

Public Attributes

- logger
- program
- switch
- preprocess
- version
- da
- stMax
- logMax
- startRow
- numberOfRows
- colorNames

3.1.1 Detailed Description

Module to describe and \log a FlexPipe switch configuration for a given program

3.1.2 Member Function Documentation

3.1.2.1 def mapper.src.flexpipe_flexpipe_configuration.FlexpipeConfiguration.display (self)

Display configuration— tables in each memory type, in each stage. $% \left(1\right) =\left(1\right) \left(1\right) \left$

3.1.2.2 def mapper.src.flexpipe_flexpipe_configuration.FlexpipeConfiguration.getEarliestStageFromAssign (self, assignInfo)

```
Returns a mapping from tables to information about the first stage they could have started in—a table must start after all the tables it depends on have been completely assigned. The informations is a list of lists [@st, @dep, @prev, @prevEnd] which should be read as Table xx can't start before stage @st because of @dependency on table @prev which ends in stage @prevEnd, one for each @prev that the table depends on.
```

3.1.2.3 def mapper.src.flexpipe_flexpipe_configuration.FlexpipeConfiguration.getPerLogAssignInfo(self)

```
Return mapping from table to assignment info 'start': start stage (or -1 if not valid) 'end': end stage (or -1 if not valid)
```

The documentation for this class was generated from the following file:

· src/flexpipe/flexpipe_configuration.py

3.2 mapper.src.flexpipe_flexpipe_dependency_analysis.FlexpipeDependencyAnalysis Class Reference

Public Member Functions

- def __init__ (self, program)
- def getDigraph (self)
- def getDigraphFromStartNegative (self)
- def makePath (self, nodes, gr)
- def showPath
- def getPerLogProgramInfo (self)
- def getDigraphFromEndPositive (self)
- def getDigraphFromStartPositive (self)
- def showCriticalPath (self)

Public Attributes

- logger
- program
- logMax

The documentation for this class was generated from the following file:

• src/flexpipe/flexpipe_dependency_analysis.py

3.3 mapper.src.flexpipe_flexpipe_ilp_compiler.FlexpipellpCompiler Class Reference

Public Member Functions

- def init
- def iOSI (self, mem, order, sl)
- def iLSI (self, mem, log, sl)

- def iLSt (self, log, st)
- def iSIOL (self, mem, sl, order, log)
- def setDimensionSizes (self)
- def computeSum (self, dictCount)
- · def newVar
- def newConstr (self, expr)
- def blockOverlap (self, mem, sl1, log, sl2)
- def blocksInStage (self, mem, st)
- def blocksInSameStageAs (self, mem, sl)
- def flattenOrdSI (self, d, mem)
- def flattenLogSI (self, d, mem)
- def flattenLogSt (self, d, mem)
- def fillModel (self, startRowDict, numberOfRowsDict, model)
- def setup (self, program, switch, preprocess)
- def setupVariables (self, program, switch, preprocess)
- def setupConstraints
- def setupStartingDict (self)
- · def checkSolution
- def setupConstraintsForProductsAndBinarys
- def setupStartAndEndStagesVariables (self)
- def getXXOfLog
- def addProductConstraint (self, prod, cont, binary, ub)
- def addProductBinaryConstraint (self, prod, binary1, binary2)
- def addBinaryConstraint (self, binary, cont, ub, lb)
- def setLb (self)
- def numberOfRowsBounds
- def getXXOfOrd
- def getStartingAndEndingStages
- def overlapConstraint
- · def wordLayoutConstraint
- def oneOrderPerLogConstraint
- def maximumTablesPerBlockConstraint
- def useMemoryConstraint
- def assignmentConstraint
- · def dependencyConstraint
- def capacityConstraintByBlock
- def capacityConstraintByRow
- def setIlpResults (self)
- def solve (self, program, switch, preprocess)

Public Attributes

- logger
- granLb
- · greedyVersion
- timeLimit
- outputFileName
- · checking
- dictNumVariables
- numVariables
- dictNumConstraints
- numConstraints
- · testNumConstraints
- dimensionSizes

- · variablesByName
- variables
- names
- varUb
- varLb
- varType
- program
- · switch
- · preprocess
- orderMax

Constants.

- stMax
- slMax
- totalSIMax
- logMax
- rowMax
- maxSIMax
- wordMax
- · results

Variables.

- m
- · word
- blocks
- · totalBlocks
- totalBlocksBinary
- startRow
- startRowUnit
- numberOfRows
- numberOfRowsBound
- numberOfRowsUnit
- numberOfRowsBinary
- startRowTimesNumberOfRowsBinary
- firstRowOfLog
- numberOfRowsOfLog
- numberOfRowsOfLogBinary
- firstRowOfOrd
- numberOfRowsOfOrd
- numberOfRowsOfOrdBinary
- ordToLog
- firstRowOfLogTimesOrdToLog
- numberOfRowsOfLogTimesOrdToLog
- blockAllMemBin
- ub
- Ib
- startingDict
- configs
- violated
- startAllMem
- · startAllMemTimesBlockAllMemBin
- endAllMem
- endAllMemTimesBlockAllMemBin

3.3.1 Constructor & Destructor Documentation

3.3.1.1 def mapper.src.flexpipe_ilp_compiler.FlexpipellpCompiler.__init__ (self, greedyVersion = None, timeLimit = None, outputFileName = None, granLb = None)

Initialize compiler with CPLEX parameters @timeLimit and @greedyVersion is 'lpt'/ None. If none, no starting solution is provided for CPLEX.

@outputFileName is name used to save file containing info about CPLEX parameters used.

@granLb is mapping from memory type to minimum physical table size i.e., assignments to logical tables in blocks of this memory type have at least granLb[mem] consecutive rows.

3.3.2 Member Function Documentation

3.3.2.1 def mapper.src.flexpipe_ilp_compiler.FlexpipellpCompiler.blockOverlap (self, mem, sl1, log, sl2)

Returns true if table @log starting in block @sl1 would overlap block @sl2

3.3.2.2 def mapper.src.flexpipe.flexpipe ilp compiler.FlexpipellpCompiler.blocksInSameStageAs (self, mem, sl)

Returns list of blocks for the stage (st) that sl is part of.

3.3.2.3 def mapper.src.flexpipe_ilp_compiler.FlexpipellpCompiler.blocksInStage (self, mem, st)

Returns indices of memory blocks of type @mem in stage @st Indexing starts at 0 and covers all blocks of every memory type in every stage.

3.3.2.4 def mapper.src.flexpipe_ilp_compiler.FlexpipellpCompiler.dependencyConstraint (self, model = None)

If $\log 2$ match depends on $\log 1$, then last stage (TCAM/ SRAM) of $\log 1$ is strictly before first stage (TCAM/ SRAM) of $\log 2$.

3.3.2.5 def mapper.src.flexpipe_ilp_compiler.FlexpipellpCompiler.fillModel (self, startRowDict, numberOfRowsDict, model)

Given information about starting row and number of row of each table in each block, fills in all the ILP variables. Used to get a starting solution for ILP from a greedy heuristic's output.

3.3.2.6 def mapper.src.flexpipe_ilp_compiler.FlexpipellpCompiler.numberOfRowsBounds (self, model = None)

Enforces "minimum (physical) table size" constraint. This helps us scale the ILP to handle FlexPipe where legally a logical table can be assigned any number of rows in each memory block (e.g., anywhere from 1 to maxmimum rows availabl) but this leads to a combinatorial explosion for ILP. This constraint enforces that tables if assigned to a block are assigned at least xx consecutive rows at a time.

3.3.2.7 def mapper.src.flexpipe_flexpipe_ilp_compiler.FlexpipellpCompiler.setLb (self)

Just initializes lower bounds on physical table sizes to default values if necessary

3.3.2.8 def mapper.src.flexpipe_ilp_compiler.FlexpipellpCompiler.setup (self, program, switch, preprocess)

Set up variables, constraints and starting solution (if specified) for CPLEX solver

3.3.2.9 def mapper.src.flexpipe_ilp_compiler.FlexpipellpCompiler.setupConstraints (self, model = None)

Sets up all the different constraints.

3.3.2.10 def mapper.src.flexpipe_llp_compiler.FlexpipellpCompiler.solve (self, program, switch, preprocess)

Returns a configuration for program in switch, given some preprocessed information, like packing unit sizes for different logical tables.

$\textbf{3.3.2.11} \quad \textbf{def mapper.src.flexpipe_ilp_compiler.FlexpipellpCompiler.wordLayoutConstraint (} \quad \textbf{\textit{self, model}} = \texttt{None} \quad \textbf{)}$

Relate number of rows of a table per block to number of blocks used and number of match entries (words) assigned

The documentation for this class was generated from the following file:

· src/flexpipe/flexpipe ilp compiler.py

3.4 mapper.src.flexpipe.flexpipe lpt compiler.FlexpipeLptCompiler Class Reference

Public Member Functions

- def __init__ (self)
- def getIndex (self, table, names)
- def getBlocksInStage (self, mem, st)
- def getNextTable (self)
- def getMem (self, tableIndex)
- def makeGraph (self, program)
- def getMemTypesInStage (self)
- def setupSwitchToNext (self)
- def setupTablesInBlock (self)
- def setupDirty (self)
- def setupAssigned (self)
- def setupLastBlock (self)
- def setupRowsPerBlock (self)
- def setupNextTable (self)
- def getNextRange (self)
- def assignRowsToTable (self)
- def switchToNextStage (self)
- def logCompilerAttempt (self, compilerAttempt)
- def solve (self, program, switch, preprocess)

Public Attributes

- logger
- gr
- memPerStage
- tablesInBlock
- · dirty
- · assigned
- lastBlockOfRow
- lastBlockOfTable
- startRowDict
- numberOfRowsDict
- orderedTables
- currentMem
- currentStage
- · program
- · switch
- preprocess
- · results
- table
- tableIndex
- mems
- numWordsLeft
- rowRange
- numAssigned
- numTables

3.4.1 Detailed Description

Greedy heuristic compiler for FlexPipe target,

3.4.2 Member Function Documentation

3.4.2.1 def mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler.assignRowsToTable (self)

Assign self.slRange and self.rowRange (chunk of consecutive blocks/ rows) to current table self.tableIndex. Here, we basically update the different data structures that track which table is assigned to which row/ block i.e., self.startRowDict[mem][t,sl], self.tablesInBlock[mem][sl][table] self.lastBlockOfRow[mem][st][r], self.numberOfRowsDict[mem][t,sl] self.dirty[mem][r,sl], self.lastBlockOfTable[mem][st][t], all of these are initialized in the various setup... functions.

3.4.2.2 def mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler.getBlocksInStage (self, mem, st)

Returns indices of memory blocks of type @mem in stage @st Indexing starts at 0 and covers all blocks of every memory type in every stage.

3.4.2.3 def mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler.getMem (self, tableIndex)

Returns valid memory types for given table

3.4.2.4 def mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler.getMemTypesInStage (self)

Get memory types in self.currentStage

3.4.2.5 def mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler.getNextRange (self)

Returns the next chunk of free consecutive blocks/ rows we can use to assign current self.table in self.currentStage.

$3.4.2.6 \quad def \ mapper.src.flexpipe_lpt_compiler.Flexpipe_lptCompiler.getNextTable \left(\begin{array}{c} self \end{array} \right)$

Get the next table from the heuristic order that hasn't been assigned yet.

3.4.2.7 def mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler.makeGraph (self, program)

Sets up dependency graph, only match edges force a table to a new stage, so are weighted 1, others are weighted 0.

Used to order tables in setupNextTable().

3.4.2.8 def mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler.setupAssigned (self)

Maps table name to last stage it was assigned to.

3.4.2.9 def mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler.setupDirty (self)

self.dirty[mem][row,sl] indicates if @row in the @sl-th @mem block has been assigned to some table. Filled in and used while assigning tables.

3.4.2.10 def mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler.setupLastBlock (self)

sets up self.lastBlockOfRow[mem][st][row] which is the last block in @mem, @st where @row has been assigned to some table. Initial value is -1. also sets up self.lastBlockOf[mem][st][tableIndex] which is the last block in @mem, @st that has been assigned to @tableIndex. Filled in and used while assigning tables.

3.4.2.11 def mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler.setupNextTable (self)

Orders tables in order of "most constrained first" (MCF) where a table is more constrained if it can go in only a few @possible_stages based on - its level (maxmimum distance from end of program in the dependency chain) - memory types it can go into Ties are broken in favor of wider tables first.

3.4.2.12 def mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler.setupRowsPerBlock (self)

Sets up the following containers startRowDict[mem][log,sl] which is @row if the table @log starts in @row of the @sl-th @mem memory block, and zero otherwise.

numberOfRows[mem][log,sl] = num which is the number of rows of table in the @sl-th @mem memory block (when the table's match entries start in the block). If there are no match entries in a block, or if a match entry starts in a previous block but only spills into this block @sl, then @num is 0.

3.4.2.13 def mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler.setupSwitchToNext (self)

Order available (st, mem) tuples, so we can iterate through self.memPerStage using switchToNext() when assigning tables

3.4.2.14 def mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler.setupTablesInBlock (self)

" Setup self.tablesInBlock[mem][sl] which will contain names of all the tables assigned to the sl-th block of type mem (index sl starts at 0 and covers all blocks of type mem in across all stages)
Filled in and used while assigning tables.

3.4.2.15 def mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler.solve (self, program, switch, preprocess)

Runs the MCF greedy heuristic and returns switch configuration

3.4.2.16 def mapper.src.flexpipe_lpt_compiler.FlexpipeLptCompiler.switchToNextStage (self)

Update current stage/ memory type to next st, mem, where mem is a valid memory type of the current table $\$

The documentation for this class was generated from the following file:

src/flexpipe/flexpipe lpt compiler.py

3.5 mapper.src.flexpipe.flexpipe preprocess.FlexpipePreprocess Class Reference

Public Member Functions

- · def __init__ (self)
- def blocksInStage (self, mem, st)
- def setUseMemory (self)
- def preprocess (self, program, switch)

Public Attributes

- logger
- use
- · switch
- · program
- · pfBlocks
- · toposortOrderStages

3.5.1 Detailed Description

Preprocessor module that precomputes information such as valid packing units for compiler to use.

3.5.2 Member Function Documentation

$3.5.2.1 \quad \text{def mapper.src.flexpipe_preprocess.FlexpipePreprocess.blocksInStage} \left(\begin{array}{ccc} \textit{self, mem, st} \end{array} \right)$

```
Returns indices of mem blocks in stage st
Indexing starts from first mem block in the first
stage and goes on till the last mem block over
all stages.
```

3.5.2.2 def mapper.src.flexpipe_preprocess.FlexpipePreprocess.setUseMemory (self)

```
Based on table's match type e.g., exact/ ternary etc., determine which switch memory types it can use e.g., SRAM and TCAM/ TCAM etc.
```

The documentation for this class was generated from the following file:

· src/flexpipe/flexpipe preprocess.py

3.6 mapper.src.flexpipe_flexpipe_switch.FlexpipeSwitch Class Reference

Public Member Functions

def __init__

Public Attributes

- logger
- memoryTypes
- numBlocks
- order
- numStages
- · depth
- width
- maxTablesPerBlock
- matchType

3.6.1 Constructor & Destructor Documentation

3.6.1.1 def mapper.src.flexpipe_flexpipe_switch.FlexpipeSwitch.__init__ (self, numBlocks = numBlocks, depth = depth, width = width, order = order, maxTablesPerBlock = maxTablesPerBlock) initialize with resources available in each stage The number of stages is implicit in the length of

```
the numBlocks[mem] and order lists.
The FlexPipe chip as described here has 4 stages.
Note we could also have represented it as having
  5 stages with the third and fourth stage
  executing simultaneously, see note below.
Stages in FlexPipe are not uniform- different stages
have different memory types, so for each memory
type we specify the number of blocks available in
each stage in @numBlocks.
@depth and @width are mappings from memory types to the
depth and width of inidividual blocks where-
 depth is the number of match entries the block can store
 width is the max. width of a match entry that can fit
 @order is a list indexed by stage number where @order[i]
 is the topological order of stage i in the
 execution graph (where nodes correspond to stages
 and there is an edge from stage x to y if y executes
 after x). E.g., in a pipeline where stage 3 and 4 execute simultaneously
 order[3] = order[4] etc.
 @maxTablesPerBlock is the maximum number of logical tables
 that can share a memory block
```

The documentation for this class was generated from the following file:

· src/flexpipe/flexpipe_switch.py

3.7 mapper.src.rmt.rmt_configuration.RmtConfiguration Class Reference

Public Member Functions

- def __init__ (self, program, switch, preprocess, layout, version)
- def getWordsPerTable (self)
- def checkWordsPerTable (self)
- def configure (self, layout)
- def getNumActiveSrams (self)
- def getNumActiveTcams (self)
- def getPowerForRamsAndTcams (self)
- def getPipelineLatency (self)
- def getStartTimeOfStage (self)
- def getColorsForTables (self)
- def showDict (self, d)
- def showList (sef, I)
- def showPic (self, filename, prefix)
- def getEarliestStageFromAssign (self, assignInfo)
- · def display
- def getPerLogAssignInfo (self)
- def displayFractionUsed (self)
- · def displayInitialConditions (self)
- · def showIntList

- · def showInt (self, num)
- · def showIntArray
- def makeArrayToList (self, arr)

Public Attributes

- logger
- program
- da
- · switch
- preprocess
- · version
- stMax
- logMax
- · typeColor
- pfMax
- · packingUnits
- wordsPerLog
- · totalUnassignedWords
- layout
- · blocks
- · totalBlocks
- logColors

3.7.1 Detailed Description

Module to describe and log an RMT switch configuration for a given program

3.7.2 Member Function Documentation

3.7.2.1 def mapper.src.rmt.rmt_configuration.RmtConfiguration.checkWordsPerTable (self)

Check if enough match entries have been assigned for each table

3.7.2.2 def mapper.src.rmt.rmt_configuration.RmtConfiguration.display (self, paths = [])

Display configuration, in many different ways- fraction of TCAMs/ SRAMs used, power, pipeline latency start time of stages, tables in each stage, memories used by tables in each stage, dependencies that force tables to start in a particular stage (useful for debugging program manually)

3.7.2.3 def mapper.src.rmt.rmt_configuration.RmtConfiguration.getColorsForTables (self)

Fills in self.logColors, a map from table index to color info (HEX, tuple)

3.7.2.4 def mapper.src.rmt.rmt_configuration.RmtConfiguration.getEarliestStageFromAssign (self, assignInfo)

Returns a mapping from tables to information about the first stage they could have started in— a table must start after all the tables it depends on have been completely assigned. The informations is a list of lists [@st, @dep, @prev, @prevEnd] which should be read as Table xx can't start before stage @st because of @dependency on table @prev which ends in stage @prevEnd, one for each @prev that the table depends on.

3.7.2.5 def mapper.src.rmt.rmt_configuration.RmtConfiguration.getNumActiveSrams (self)

```
For each table in each stage,
- number of RAMs for a match packing units (max if many types)
- + number of RAMs for an action packing unit
```

3.7.2.6 def mapper.src.rmt.rmt_configuration.RmtConfiguration.getNumActiveTcams (self)

```
If match data width is less than TCAM width, only a fraction of TCAM is active/ consumes power.
```

3.7.2.7 def mapper.src.rmt.rmt_configuration.RmtConfiguration.getPerLogAssignInfo (self)

```
Return mapping from table to assignment info 'start': start stage (or -1 if not valid) 'end': end stage (or -1 if not valid)
```

3.7.2.8 def mapper.src.rmt.rmt_configuration.RmtConfiguration.getWordsPerTable (self)

Get match entries per table per stage.

3.7.2.9 def mapper.src.rmt.rmt_configuration.RmtConfiguration.makeArrayToList (self, arr)

```
Makes an encapsulated array [[2], [5], [4]] into a list [2, 5, 4].
```

3.7.2.10 def mapper.src.rmt.rmt_configuration.RmtConfiguration.showPic (self, filename, prefix)

Output a picture of the configuration to a file called @prefix@filename

The documentation for this class was generated from the following file:

• src/rmt/rmt_configuration.py

3.8 mapper.src.rmt.rmt_dependency_analysis.RmtDependencyAnalysis Class Reference

Public Member Functions

- def __init__ (self, program)
- def getDigraph (self)
- def addWeights (self, originalGr, tableWeights)

- def reverseEdges (self, originalGr)
- def makePath (self, nodes, gr)
- · def showPath
- def getPerLogProgramInfo
- def flipEdgeSign (self, originalGr)
- · def showCriticalPath

Public Attributes

- logger
- program
- logMax

3.8.1 Member Function Documentation

3.8.1.1 def mapper.src.rmt_rmt_dependency_analysis.RmtDependencyAnalysis.showCriticalPath (self, gr = None)

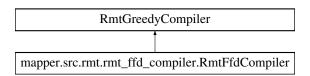
show critical path- i.e., longest path of dependencies, where weight of dependency edge is 1 if it forces a table into a new stage.

The documentation for this class was generated from the following file:

· src/rmt/rmt_dependency_analysis.py

3.9 mapper.src.rmt.rmt_ffd_compiler.RmtFfdCompiler Class Reference

Inheritance diagram for mapper.src.rmt.rmt_ffd_compiler.RmtFfdCompiler:



Public Member Functions

- def init
- · def getLimitingResourceUse (self, table)
- def getOrderedTables (self)

Public Attributes

- logger
- orderedTables

3.9.1 Member Function Documentation

3.9.1.1 def mapper.src.rmt.rmt_ffd_compiler.RmtFfdCompiler.getOrderedTables (self)

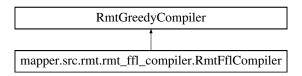
Return tables in order of limiting resource- if a table needs 2 out 8 available input xbar units and 512 of say 1024 available bits of the action data xbar (in every stage), then action data xbar is the limiting resources, since it need 50% of the available resource per stage (vs 25% for input xbar).

The documentation for this class was generated from the following file:

· src/rmt/rmt_ffd_compiler.py

3.10 mapper.src.rmt.rmt_ffl_compiler.RmtFflCompiler Class Reference

Inheritance diagram for mapper.src.rmt.rmt_ffl_compiler.RmtFflCompiler:



Public Member Functions

- def __init__
- def getOrderedTables (self)

Public Attributes

- logger
- orderedTables

3.10.1 Member Function Documentation

3.10.1.1 def mapper.src.rmt.rmt_ffl_compiler.RmtFflCompiler.getOrderedTables (self)

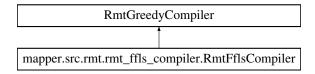
Return tables in order of level- number of edges in the longest dependency path to the end of the program, where an edge/ dependency has weight 1 if it forces the second table to a new stage

The documentation for this class was generated from the following file:

· src/rmt/rmt_ffl_compiler.py

3.11 mapper.src.rmt.rmt_ffls_compiler.RmtFflsCompiler Class Reference

Inheritance diagram for mapper.src.rmt.rmt_ffls_compiler.RmtFflsCompiler:



Public Member Functions

- def __init__
- def getNumStages (self, tableIndex)
- def getOrderedTables (self)

Public Attributes

- logger
- orderedTables

The documentation for this class was generated from the following file:

· src/rmt/rmt_ffls_compiler.py

3.12 mapper.src.rmt.rmt_greedy_compiler.RmtGreedyCompiler Class Reference

Public Member Functions

- · def __init__
- def getIndex (self, table, names)
- · def getBestFitForWords (self, tableIndex, mem, lastBlock, numWordsLeft)
- def getPerPf (self, mem, tableIndex)
- def getBestFitForBlocks (self, tableIndex, mem, lastBlock, numSramBlocksReserved)
- def getNextTable (self)
- def getMem (self, tableIndex)
- def getInputCrossbarSubunits (self, tableIndex, mem)
- def getMaximumInputCrossbarSubunits (self, tableIndex, mem)
- def getAvailableInputCrossbarSubunits (self, tableIndex, mem)
- def getWidthActionData (self, tableIndex)
- def getMaximumWidthActionData (self, tableIndex, mem)
- def getAvailableWidthActionData (self, tableIndex, mem)
- · def updateLastBlockAndAssign
- def getNumSramBlocksReserved (self)
- def logCompilerAttempt (self, compilerAttempt)
- def solve (self, program, switch, preprocess)

Public Attributes

- numSramBlocksReserved
- version
- logger
- program
- switch
- preprocess
- · results
- gr
- blocksPerSt
- numBlocks
- blocksPerPf
- wordsPerPf
- layout
- block
- · word
- inputCrossbar
- actionCrossbar
- lastBlock
- · assigned
- currentStage
- table
- numWordsLeft

3.12.1 Detailed Description

Greedy heuristic compiler, the specific greedy heuristic is determined by the getOrderedTables function defined in child classes RmtFFlCompiler and RmtFfdCompiler etc.

3.12.2 Member Function Documentation

3.12.2.1 def mapper.src.rmt.rmt_greedy_compiler.RmtGreedyCompiler.getBestFitForBlocks (self, tableIndex, mem, lastBlock, numSramBlocksReserved)

Given number of blocks available, find a config. (i.e., pick a packing unit) to fit the maximum number of entries possible Based solely on memory resources needed for match and action data, not other resources like crossbar units etc.

3.12.2.2 def mapper.src.rmt.rmt_greedy_compiler.RmtGreedyCompiler.getBestFitForWords (self, tableIndex, mem, lastBlock, numWordsLeft)

Given the number of match entries left, find minimum number of blocks needed to fit all of them Based solely on memory resources needed for match and action data, not other resources like crossbar units etc.

3.12.2.3 def mapper.src.rmt_greedy_compiler.RmtGreedyCompiler.getIndex (self, table, names)

Returns index of table in names

3.12.2.4 def mapper.src.rmt.rmt_greedy_compiler.RmtGreedyCompiler.getNextTable (self)

Get the next table from the heuristic order that hasn't been assigned yet.

$3.12.2.5 \quad def\ mapper.src.rmt.rmt_greedy_compiler.RmtGreedyCompiler.getNumSramBlocksReserved\ (\quad \textit{self}\)$

Returns number SRAM blocks reserved for the action data of tables that will go in $\ensuremath{\mathsf{TCAM}}$

3.12.2.6 def mapper.src.rmt.rmt_greedy_compiler.RmtGreedyCompiler.getPerPf (self, mem, tableIndex)

Get packing unit configurations for given table in given memory type.

3.12.2.7 def mapper.src.rmt.rmt_greedy_compiler.RmtGreedyCompiler.solve (self, program, switch, preprocess)

Runs a greedy heuristic and returns switch configuration

The documentation for this class was generated from the following file:

src/rmt/rmt_greedy_compiler.py

3.13 mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler Class Reference

Public Member Functions

- def init
- · def setDimensionSizes (self)
- · def computeSum (self, dictCount)
- def **P** (self, I, m)
- def actionAssignmentConstraint (self)
- def capacityConstraint (self)
- · def wordLayoutConstraint (self)
- def useMemoryConstraint (self)
- def assignmentConstraint (self)
- def pipelineLatencyVariables (self)
- def getStartAllMemTimesStartTimeOfStage (self)
- def getEndAllMemTimesStartTimeOfStage (self)
- def checkPipelineLatencyConstraint (self, model)
- · def pipelineLatencyConstraint (self)
- def checkStartingAndEndingStagesConstraint (self, model)
- def displayActiveRams (self, model)
- def displayStartingAndEndingStages (self, model)
- def getStartingAndEndingStages (self)
- def dependencyConstraint (self)
- def maximumStageConstraint (self)
- · def getBlockBinary (self)
- def getLayoutBinary (self)
- def checkInputCrossbarConstraint (self, model, mem)
- def inputCrossbarConstraint (self)
- def getBlockAllMemBinary (self)
- · def resolutionLogicConstraint (self)
- · def actionCrossbarConstraint (self)
- def onePackingUnitForLogInStage (self)
- def getNumActiveSrams (self)
- def getNumActiveTcams (self)
- def getPowerForRamsAndTcamsObjective (self)
- def startAndEndStagesVariables (self)
- def getXxAllMemTimesBlockAllMemBin (self)
- def getIlpStartingDictValues (self, block, layout, word, startTimeOfStage)
- def displayMaximumStage (self, model)
- · def solve (self, program, switch, preprocess)
- def setIlpResults (self, solverTimes, nIterations)
- · def checkConstraints (self, model)

Public Attributes

- logger
- objectiveStr

self.logger.debug("Displaying greedy solution") greedyConfig.display()

- · relativeGap
- greedyVersion
- emphasis
- variableSelect
- timeLimit
- · treeLimit

- · workMem
- nodeFileInd
- workDir
- ignoreConstraint
- dictNumVariables
- numVariables
- · dictNumConstraints
- numConstraints
- dimensionSizes
- startTimeOfStage
- startAllMemTimesStartTimeOfStage
- endAllMemTimesStartTimeOfStage
- startTimeOfStartStageOfLog
- startTimeOfEndStageOfLog
- numActiveSrams
- numActiveTcams
- powerForRamsAndTcams
- startAllMem
- · startAllMemTimesBlockAllMemBin
- endAllMem
- endAllMemTimesBlockAllMemBin
- program
- switch
- · preprocess
- all
- pfMax

Constants.

- stMax
- logMax
- blockMax
- wordMax
- results

Variables.

- m
- word
- blockblockBin
- layout
- layoutBin
- blockAllMemBin
- isMaximumStage
- totalBlocksForStBin
- isMaximumStageTimesTotalBlocksForStBin
- startingDict

3.13.1 Constructor & Destructor Documentation

3.13.1.1 def mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler.__init__ (self, relativeGap, greedyVersion, objectiveStr = 'maximumStage', emphasis = 0, timeLimit = None, treeLimit = None, variableSelect = None, ignoreConstraint = None, workMem = None, nodeFileInd = None, workDir = None)

```
Initialize compiler with CPLEX parameters
@relativeGap is a fraction f so that CPLEX will stop at a solution that
is within f of the optimal, corresponds to CPX_PARAM_EPGAP in CPLEX
@greedyVersion is one of 'ffl'/ 'ffd' etc.
@objectiveStr is one of pipelineLatency, maximumStage, powerForRamsAndTcams
other parameters are optional .. (see pycpx for more info)
```

3.13.2 Member Function Documentation

3.13.2.1 def mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler.actionAssignmentConstraint (self)

How many action words we can fit.

3.13.2.2 def mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler.actionCrossbarConstraint (self)

No more than 1280 bits of action from each stage.

3.13.2.3 def mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler.assignmentConstraint (self)

All match entries must be assigned somewhere in the pipeline.

3.13.2.4 def mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler.capacityConstraint (self)

Don't use more memories than available in each stage for action, match

3.13.2.5 def mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler.checkConstraints (self, model)

Given a complete model with all variables filled in, checks against (some of) the inequality constraints that define the ILP and warns if anything's violated. Used to check greedy solutions, and other starting solutions.

3.13.2.6 def mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler.dependencyConstraint (self)

If log2 action depends on log1, then last stage (any mem) of log1 is strictly before first stage (any mem) of log2.

3.13.2.7 def mapper.src.rmt.orig rmt compiler.RmtllpCompiler.displayActiveRams (self, model)

For each table in each stage,
- number of RAMs for a match packing units (enforce one type per st)
- + number of RAMs for an action packing unit

3.13.2.8 def mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler.getEndAllMemTimesStartTimeOfStage (self)

Defining product variable endAllMem x StartTimeOfStage

3.13.2.9 def mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler.getNumActiveSrams (self)

For each table in each stage,
- number of RAMs for a match packing units (enforce one type per st)
- + number of RAMs for an action packing unit

3.13.2.10 def mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler.getNumActiveTcams (self)

If match data width is less than TCAM width, only a fraction of TCAM is active/ consumes power.

3.13.2.11 def mapper.src.rmt.orig rmt compiler.RmtllpCompiler.getStartAllMemTimesStartTimeOfStage (self)

Defining product variable StartAllMem x StartTimeOfStage

3.13.2.12 def mapper.src.rmt.orig rmt_compiler.RmtllpCompiler.onePackingUnitForLogInStage (self)

Restrict logical tables to use same packing unit in a stage instead of combinations of different size packing units in the same stage. Packing units in different stages can be different though.

3.13.2.13 def mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler.pipelineLatencyVariables (self)

Variables for start and end time of stages

3.13.2.14 def mapper.src.rmt.orig rmt compiler.RmtllpCompiler.resolutionLogicConstraint (self)

Limits number of match tables per stage. Since table match resolution logic can only handle a finite number

3.13.2.15 def mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler.solve (self, program, switch, preprocess)

Returns a configuration for program in switch, given some preprocessed information, like possible packing units for different logical tables.

3.13.2.16 def mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler.useMemoryConstraint (self)

assign blocks of logical table to mem only if it's allowed e.g., a ternary table can't use SRAM blocks. Preprocessor computes what's allowed (self.preprocess.use)

3.13.2.17 def mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler.wordLayoutConstraint (self)

Relating number of packing units to number of blocks used/ words per row fit

The documentation for this class was generated from the following file:

src/rmt/orig_rmt_compiler.py

3.14 mapper.src.rmt.rmt_preprocess.RmtPreprocess Class Reference

Public Member Functions

- def __init__ (self)
- def gcd (self, a, b)
- def lcm (self, a, b)
- def getMaxPf (self, logicalWidth, blockWidth)
- def setUseMemory (self)
- def **preprocess** (self, program, switch)
- def GetMultipleBefore (self, maxValue, div)

Public Attributes

- logger
- use
- program
- switch
- · toposortOrderStages
- layout
- word
- NumPackingFactors
- · inputCrossbarNumSubunits
- · actionCrossbarNumBits
- · actionWidths

3.14.1 Detailed Description

Preprocessor module that precomputes information such as candidate packing units for compiler to use.

3.14.2 Member Function Documentation

3.14.2.1 def mapper.src.rmt_preprocess.RmtPreprocess.getMaxPf (self, logicalWidth, blockWidth)

```
minimum number of memory blocks needed for match entries to fit evenly in each row without wasting any bits. Any more blocks and we can view it as a combination of smaller packing units
```

3.14.2.2 def mapper.src.rmt.rmt_preprocess.RmtPreprocess.GetMultipleBefore (self, maxValue, div)

```
Get multiple of div just before maxValue
```

3.14.2.3 def mapper.src.rmt.rmt_preprocess.RmtPreprocess.setUseMemory (self)

```
Based on table's match type e.g., exact/ ternary etc., determine which switch memory types it can use e.g., SRAM and TCAM/ TCAM etc.
```

The documentation for this class was generated from the following file:

src/rmt/rmt_preprocess.py

3.15 mapper.src.rmt.rmt_switch.RmtSwitch Class Reference

Public Member Functions

def __init__

Public Attributes

- logger
- memoryTypes
- matchType
- numBlocks
- toposortOrderStages
- unpackableMemTypes
- numStages
- · depth
- width
- inputCrossbarNumSubunits
- inputCrossbarWidthSubunit
- · actionCrossbarNumBits
- resolutionLogicNumMatchTables
- matchDelay
- actionDelay
- successorDelay
- power
- · typesIn
- inMem
- · allTypes

3.15.1 Detailed Description

 $\ensuremath{\mathsf{RMT}}$ switch. Describes resources to be configured in the $\ensuremath{\mathsf{RMT}}$ switch.

The documentation for this class was generated from the following file:

src/rmt/rmt_switch.py

Index

init	mapper::src::rmt::rmt_configuration::RmtConfiguration,
mapper::src::flexpipe::flexpipe_ilp_compiler::	16
FlexpipeIlpCompiler, 9	displayActiveRams
mapper::src::flexpipe::flexpipe_switch::Flexpipe ← Switch, 15	mapper::src::rmt::orig_rmt_compiler::Rmtllp← Compiler, 24
mapper::src::rmt::orig_rmt_compiler::Rmtllp←	
Compiler, 23	fillModel
actionAssignmentConstraint mapper::src::rmt::orig_rmt_compiler::RmtIlp↔	mapper::src::flexpipe::flexpipe_ilp_compiler::← FlexpipeIlpCompiler, 9
Compiler, 24	1D 1575 DI 1
actionCrossbarConstraint	getBestFitForBlocks
mapper::src::rmt::orig_rmt_compiler::Rmtllp↔ Compiler, 24	mapper::src::rmt::rmt_greedy_compiler::Rmt← GreedyCompiler, 21
assignRowsToTable	getBestFitForWords
mapper::src::flexpipe::flexpipe_lpt_compiler::← FlexpipeLptCompiler, 11	mapper::src::rmt::rmt_greedy_compiler::Rmt← GreedyCompiler, 21
assignmentConstraint	getBlocksInStage
mapper::src::rmt::orig_rmt_compiler::Rmtllp↔ Compiler, 24	mapper::src::flexpipe::flexpipe_lpt_compiler::← FlexpipeLptCompiler, 11
hla alc Occavion	getColorsForTables
blockOverlap mapper::src::flexpipe::flexpipe_ilp_compiler::←	mapper::src::rmt::rmt_configuration::RmtConfiguration,
FlexpipellpCompiler, 9	getEarliestStageFromAssign
blocksInSameStageAs mapper::src::flexpipe::flexpipe_ilp_compiler::←	mapper::src::flexpipe::flexpipe_configuration::← FlexpipeConfiguration, 5
FlexpipeIlpCompiler, 9 blocksInStage	mapper::src::rmt::rmt_configuration::RmtConfiguration,
mapper::src::flexpipe::flexpipe_ilp_compiler::	getEndAllMemTimesStartTimeOfStage
FlexpipeIlpCompiler, 9	mapper::src::rmt::orig_rmt_compiler::RmtIlp←
mapper::src::flexpipe::flexpipe_preprocess::←	Compiler, 24
FlexpipePreprocess, 14	getIndex
capacityConstraint	mapper::src::rmt::rmt_greedy_compiler::Rmt← GreedyCompiler, 21
mapper::src::rmt::orig_rmt_compiler::Rmtllp←	getMaxPf
Compiler, 24 checkConstraints	mapper::src::rmt::rmt_preprocess::RmtPreprocess,
mapper::src::rmt::orig_rmt_compiler::Rmtllp←	26
Compiler, 24	getMem
checkWordsPerTable	mapper::src::flexpipe::flexpipe_lpt_compiler::
mapper::src::rmt::rmt_configuration::RmtConfiguration	n, FlexpipeLptCompiler, 11
16	getiviem lypesin Stage
	mapper::src::flexpipe::flexpipe_lpt_compiler::←
dependencyConstraint	FlexpipeLptCompiler, 11
mapper::src::flexpipe::flexpipe_ilp_compiler::	GetMultipleBefore
FlexpipeIlpCompiler, 9	mapper::src::rmt::rmt_preprocess::RmtPreprocess,
mapper::src::rmt::orig_rmt_compiler::Rmtllp←	26
Compiler, 24	getNextRange
display	mapper::src::flexpipe::flexpipe_lpt_compiler::← FlexpipeLptCompiler, 12
mapper::src::flexpipe::flexpipe_configuration::← FlexpipeConfiguration, 5	getNextTable

30 INDEX

mapper::src::flexpipe::flexpipe_lpt_compiler::← FlexpipeLptCompiler, 12	mapper.src.rmt.rmt_ffl_compiler.RmtFflCompiler, 19 mapper.src.rmt.rmt_ffls_compiler.RmtFflsCompiler, 19
mapper::src::rmt::rmt_greedy_compiler::Rmt←	mapper.src.rmt.rmt_greedy_compiler.RmtGreedy ←
GreedyCompiler, 21 getNumActiveSrams	Compiler, 20
mapper::src::rmt::orig_rmt_compiler::Rmtllp←	mapper.src.rmt.rmt_preprocess.RmtPreprocess, 26 mapper.src.rmt.rmt_switch.RmtSwitch, 27
Compiler, 24	mapper::src::flexpipe::flexpipe_configuration::Flexpipe ←
mapper::src::rmt_configuration::RmtConfiguratio	
17	display, 5
getNumActiveTcams	getEarliestStageFromAssign, 5
mapper::src::rmt::orig_rmt_compiler::Rmtllp←	getPerLogAssignInfo, 6
Compiler, 24	mapper::src::flexpipe::flexpipe_ilp_compiler::Flexpipe ↔
mapper::src::rmt::rmt_configuration::RmtConfiguratio	
17	init, 9
getNumSramBlocksReserved	blockOverlap, 9
mapper::src::rmt::rmt_greedy_compiler::Rmt←	blocksInSameStageAs, 9
GreedyCompiler, 21	blocksInStage, 9
getOrderedTables	dependencyConstraint, 9
mapper::src::rmt::rmt_ffd_compiler::RmtFfd↔	fillModel, 9
Compiler, 18	numberOfRowsBounds, 9
mapper::src::rmt::rmt_ffl_compiler::RmtFfl↔	setLb, 9
Compiler, 19	setup, 10
getPerLogAssignInfo	setupConstraints, 10
mapper::src::flexpipe::flexpipe_configuration::← FlexpipeConfiguration, 6	solve, 10
mapper::ere::rmt::rmt_configuration::RmtConfiguratio	wordLayoutConstraint, 10
17	mapper::src::flexpipe::flexpipe_lpt_compiler::Flexpipe
getPerPf	LptCompiler
mapper::src::rmt::rmt_greedy_compiler::Rmt←	assignRowsToTable, 11
GreedyCompiler, 21	getBlocksInStage, 11
getStartAllMemTimesStartTimeOfStage	getMem, 11
mapper::src::rmt::orig_rmt_compiler::Rmtllp←	getMemTypesInStage, 11
Compiler, 25	getNextRange, 12 getNextTable, 12
getWordsPerTable	makeGraph, 12
mapper::src::rmt::rmt_configuration::RmtConfiguratio	setupAssigned, 12
17	setupDirty, 12
marka Amar Talliat	setupLastBlock, 12
makeArrayToList	· N. ITH 40
mapper::src::rmt::rmt_configuration::RmtConfiguratio	setupRowsPerBlock, 12
17 makeGraph	setupSwitchToNext, 13
mapper::src::flexpipe::flexpipe_lpt_compiler::↔	setupTablesInBlock, 13
FlexpipeLptCompiler, 12	solve, 13
mapper.src.flexpipe_flexpipe_configuration.Flexpipe ←	switchToNextStage, 13
Configuration, 5	mapper::src::flexpipe::flexpipe_preprocess::Flexpipe←
mapper.src.flexpipe_flexpipe_dependency_analysis. ←	Preprocess
FlexpipeDependencyAnalysis, 6	blocksInStage, 14
$mapper.src.flexpipe.flexpipe_ilp_compiler.FlexpipeIlp {\leftarrow}$	setUseMemory, 14
Compiler, 6	mapper::src::flexpipe::flexpipe_switch::FlexpipeSwitch
$mapper.src.flexpipe.flexpipe_lpt_compiler.FlexpipeLpt \leftarrow$	init, 15
Compiler, 10	mapper::src::rmt::orig_rmt_compiler::RmtllpCompiler
mapper.src.flexpipe.flexpipe_preprocess.Flexpipe ←	init, 23
Preprocess, 13	actionAssignmentConstraint, 24
mapper.src.flexpipe_flexpipe_switch.FlexpipeSwitch, 14	actionCrossbarConstraint, 24
mapper.src.rmt.orig_rmt_compiler.RmtllpCompiler, 22	assignmentConstraint, 24
mapper.src.rmt.rmt_configuration.RmtConfiguration, 15	capacityConstraint, 24
mapper.src.rmt.rmt_dependency_analysis.Rmt↔	checkConstraints, 24
DependencyAnalysis, 17	dependencyConstraint, 24
mapper.src.rmt.rmt_ffd_compiler.RmtFfdCompiler, 18	displayActiveRams, 24

INDEX 31

getEndAllMemTimesStartTimeOfStage, 24 getNumActiveSrams, 24	mapper::src::flexpipe::flexpipe_ilp_compiler:: FlexpipeIlpCompiler, 9
getNumActiveTcams, 24 getStartAllMemTimesStartTimeOfStage, 25 onePackingUnitForLogInStage, 25	setUseMemory mapper::src::flexpipe::flexpipe_preprocess::← FlexpipePreprocess, 14
pipelineLatencyVariables, 25 resolutionLogicConstraint, 25	mapper::src::rmt::rmt_preprocess::RmtPreprocess, 26
solve, 25	setup
useMemoryConstraint, 25 wordLayoutConstraint, 25	mapper::src::flexpipe::flexpipe_ilp_compiler::← FlexpipeIlpCompiler, 10
mapper::src::rmt::rmt_configuration::RmtConfiguration	setupAssigned
checkWordsPerTable, 16	mapper::src::flexpipe::flexpipe_lpt_compiler::
display, 16	FlexpipeLptCompiler, 12
getColorsForTables, 16	setupConstraints
getEarliestStageFromAssign, 16	mapper::src::flexpipe::flexpipe_ilp_compiler::←
getNumActiveSrams, 17	FlexpipeIlpCompiler, 10
getNumActiveTcams, 17	setupDirty
getPerLogAssignInfo, 17	mapper::src::flexpipe::flexpipe_lpt_compiler::←
getWordsPerTable, 17	FlexpipeLptCompiler, 12
makeArrayToList, 17	setupLastBlock
showPic, 17	mapper::src::flexpipe::flexpipe_lpt_compiler::←
mapper::src::rmt::rmt_dependency_analysis::Rmt←	FlexpipeLptCompiler, 12
DependencyAnalysis	setupNextTable
showCriticalPath, 18	mapper::src::flexpipe::flexpipe_lpt_compiler::←
mapper::src::rmt::rmt_ffd_compiler::RmtFfdCompiler	FlexpipeLptCompiler, 12
getOrderedTables, 18	setupRowsPerBlock
mapper::src::rmt::rmt_ffl_compiler::RmtFflCompiler	mapper::src::flexpipe::flexpipe_lpt_compiler::←
getOrderedTables, 19	FlexpipeLptCompiler, 12
mapper::src::rmt::rmt_greedy_compiler::RmtGreedy ←	setupSwitchToNext
Compiler	mapper::src::flexpipe::flexpipe_lpt_compiler::←
getBestFitForBlocks, 21	FlexpipeLptCompiler, 13
getBestFitForWords, 21	setupTablesInBlock
getIndex, 21	mapper::src::flexpipe::flexpipe_lpt_compiler::←
getNextTable, 21	FlexpipeLptCompiler, 13
getNumSramBlocksReserved, 21	showCriticalPath
getPerPf, 21	mapper::src::rmt::rmt_dependency_analysis::←
solve, 21	RmtDependencyAnalysis, 18
mapper::src::rmt::rmt_preprocess::RmtPreprocess	showPic
getMaxPf, 26	mapper::src::rmt::rmt_configuration::RmtConfiguration
GetMultipleBefore, 26	17
setUseMemory, 26	solve
- O(D	mapper::src::flexpipe::flexpipe_ilp_compiler::
numberOfRowsBounds	FlexpipeIlpCompiler, 10
mapper::src::flexpipe::flexpipe_ilp_compiler::	mapper::src::flexpipe::flexpipe_lpt_compiler::
FlexpipeIlpCompiler, 9	FlexpipeLptCompiler, 13
and Declared In the color Observa	mapper::src::rmt::orig_rmt_compiler::RmtIlp←
onePackingUnitForLogInStage	Compiler, 25
mapper::src::rmt::orig_rmt_compiler::Rmtllp↔	mapper::src::rmt::rmt_greedy_compiler::Rmt←
Compiler, 25	GreedyCompiler, 21
ninglinal stangy//sviebles	switchToNextStage
pipelineLatencyVariables	mapper::src::flexpipe::flexpipe_lpt_compiler::
mapper::src::rmt::orig_rmt_compiler::Rmtllp←	FlexpipeLptCompiler, 13
Compiler, 25	• • • • • •
resolutionLogicConstraint	useMemoryConstraint
mapper::src::rmt::orig_rmt_compiler::Rmtllp←	mapper::src::rmt::orig_rmt_compiler::Rmtllp↔
Compiler, 25	Compiler, 25
Compiler, 20	, -
setLb	wordLayoutConstraint
	- · · · · · · · · · · · · · · · · · · ·

32 INDEX

mapper::src::flexpipe::flexpipe_ilp_compiler::← FlexpipeIlpCompiler, 10 mapper::src::rmt::orig_rmt_compiler::RmtIlp← Compiler, 25