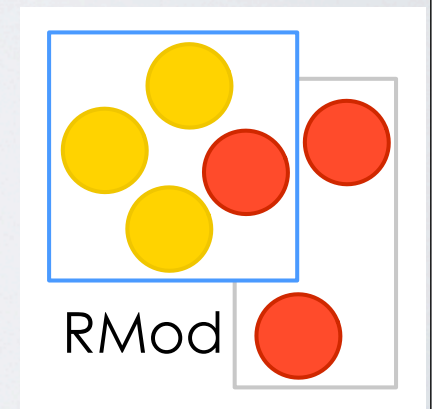


DETECTING SYSTEM CYCLES WITH DSM

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PhD Student - RMod Team

<http://rmod.lille.inria.fr>



DSM?

- Dependency Structural Matrix
 - How to organize tasks based on their dependencies?

ROADMAP

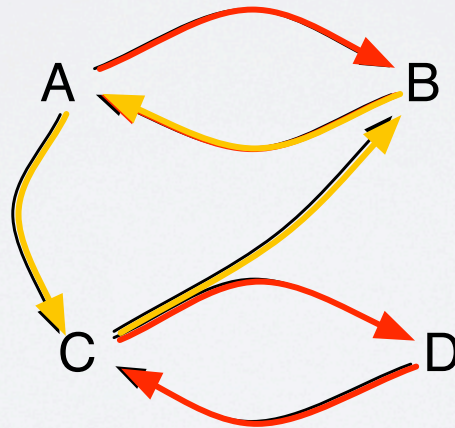
- A cycle?
- What is DSM?
- Using color for cycle detection
- DSM at Work
- Advanced features (research)

ROADMAP

- **A cycle?**
- What is DSM?
- Using color for cycle detection
- DSM at Work
- Advanced features (research)

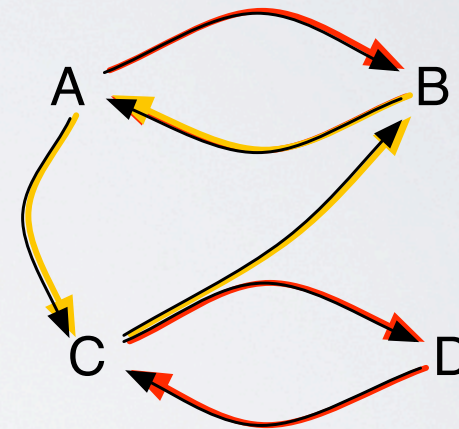
A CYCLE

- a path which comes back to its origin
- between 2 or more elements

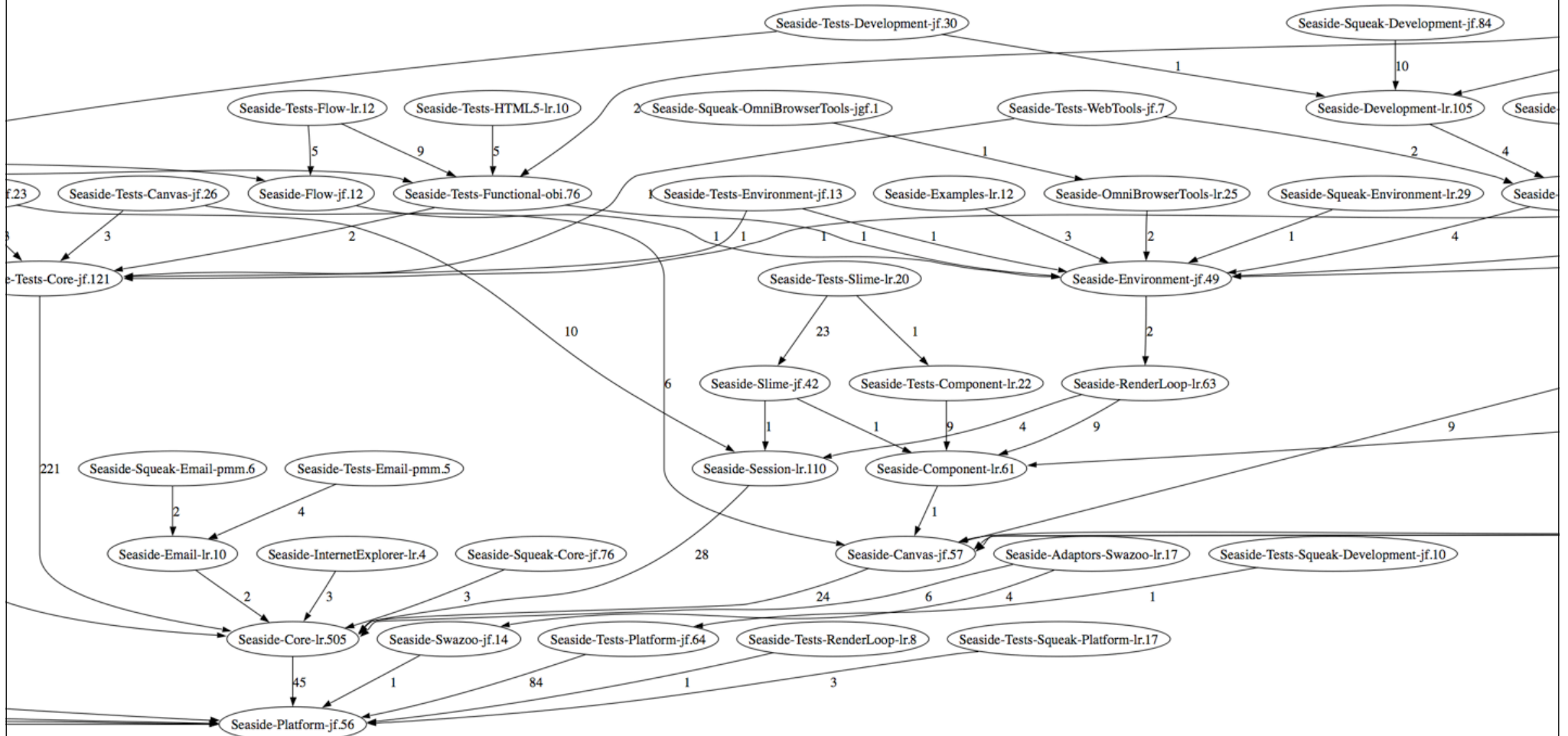


CYCLE PROBLEMS

- Dependency logic
- Modular?
- Build dependencies



YOU SAID GRAPH?



ROADMAP

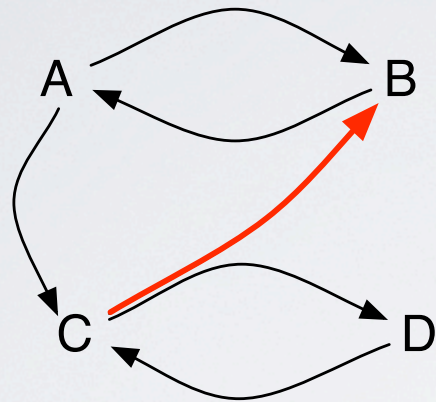
- A cycle?
- **What is DSM?**
- Using color for cycle detection
- DSM at Work
- Advanced features (research)

DEPENDENCY MATRIX

- Origin: process optimization
- Applied to dependency in software reengineering
- Compact
- Support cycle and layer identification

	A	B	C	D
A	■	x		
B	x	■	x	
C	x		■	x
D			x	■

A DEPENDENCY MATRIX



	A	B	C	D
A		X		
B	X		X	
C	X			X
D			X	

	A	B	C	D
A	0	1	0	0
B	1	0	1	0
C	1	0	0	1
D	0	0	1	0

PACKAGE STRUCTURE WITH DSM

- a cell is a dependency
 - information in a cell
- a column represents used packages
- a line represents using packages

A 4x4 Dependency Structure Matrix (DSM) with rows and columns labeled A, B, C, and D. The matrix contains numerical values in some cells and black squares in others. Red circles highlight the following cells: (A,A), (B,A), (B,B), (C,C), (D,C), and (D,D).

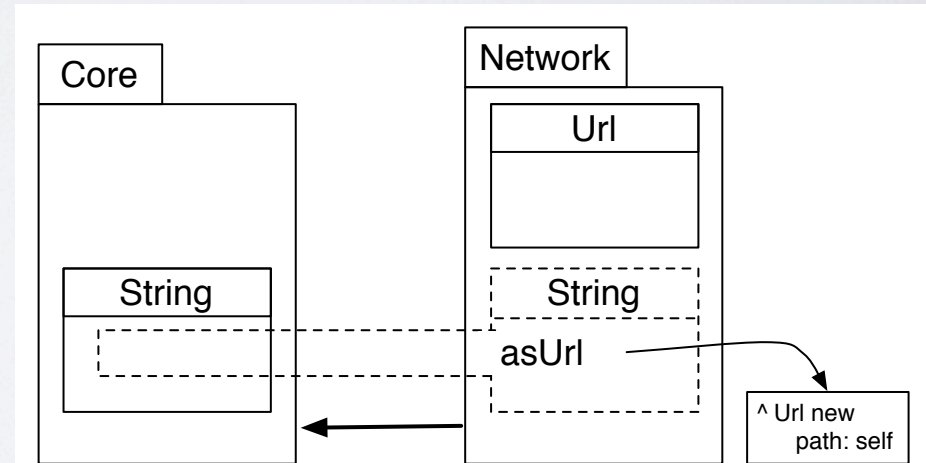
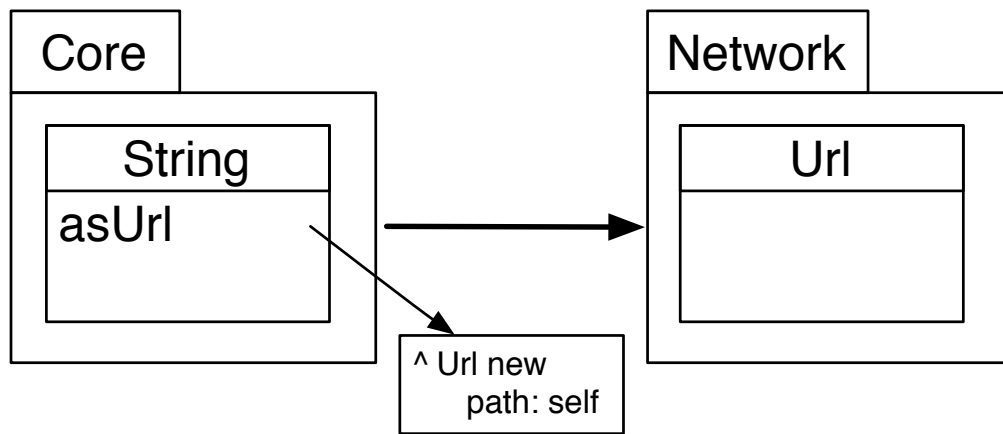
	A	B	C	D
A	■	2		
B	1	■	2	
C	4		■	8
D			1	■

DEPENDENCIES

- Inheritances
- Direct class references
- Invocations
- Extensions

EXTENSIONS

- reverse dependencies
- structure packages by concerns



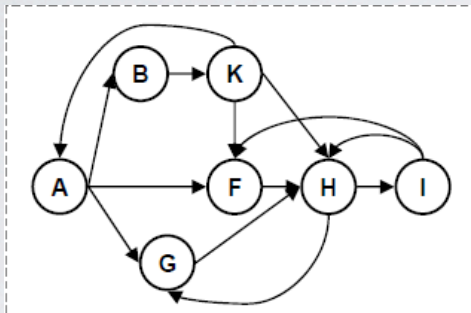
ROADMAP

- A cycle?
- **What is DSM?**
 - **detecting cycles**
- Using color for cycle detection
- DSM at Work
- Advanced features (research)

2 METHODS TO DETECT CYCLES

- Squared adjacency matrix
- Path searching

SQUARED ADJACENCY MATRIX



	A	B	F	G	H	I	K
A	X						X
B	X	X					
F	X		X			X	X
G	X			X	X		
H			X	X	X	X	X
I					X	X	
K		X					X

	A	B	F	G	H	I	K
A	0	0	0	0	0	0	1
B	1	0	0	0	0	0	0
F	1	0	0	0	0	1	1
G	1	0	0	0	1	0	0
H	0	0	1	1	0	1	1
I	0	0	0	0	1	0	0
K	0	1	0	0	0	0	0

	A	B	F	G	H	I	K
A	0	1	0	0	0	0	0
B	0	0	0	0	0	0	1
F	0	1	0	0	1	0	1
G	0	0	1	1	0	1	2
H	2	1	0	0	2	1	1
I	0	0	1	1	0	1	1
K	1	0	0	0	0	0	0

SQUARED ADJACENCY MATRIX

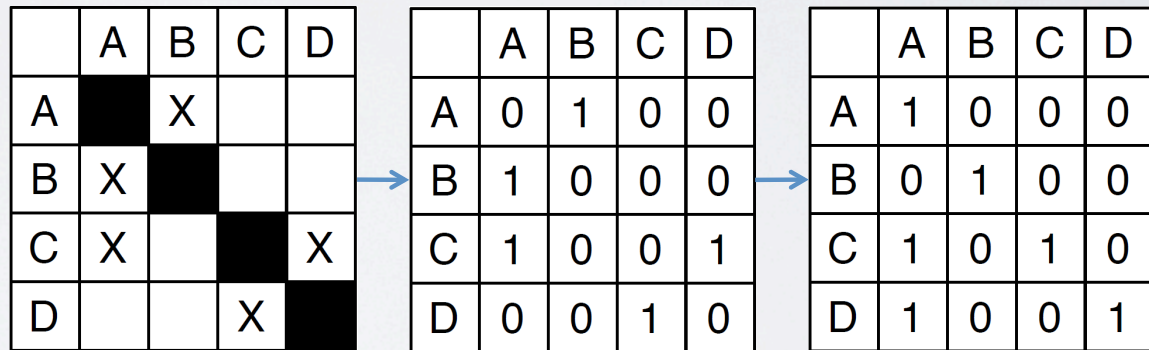
- Pros

- mathematical approach

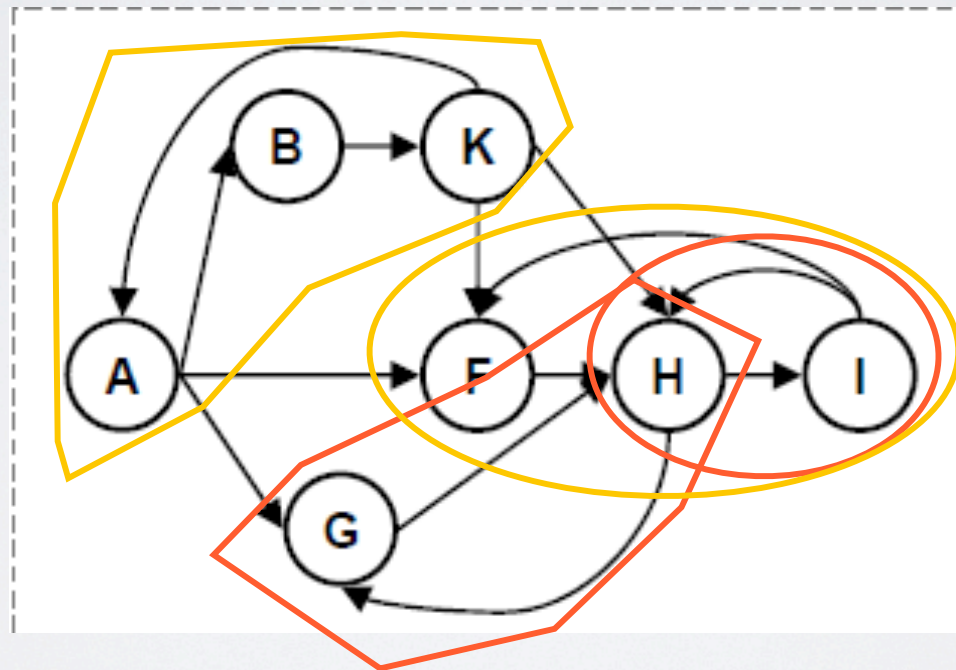
- Cons

- blurry cycles

- no information about path



PATH SEARCHING

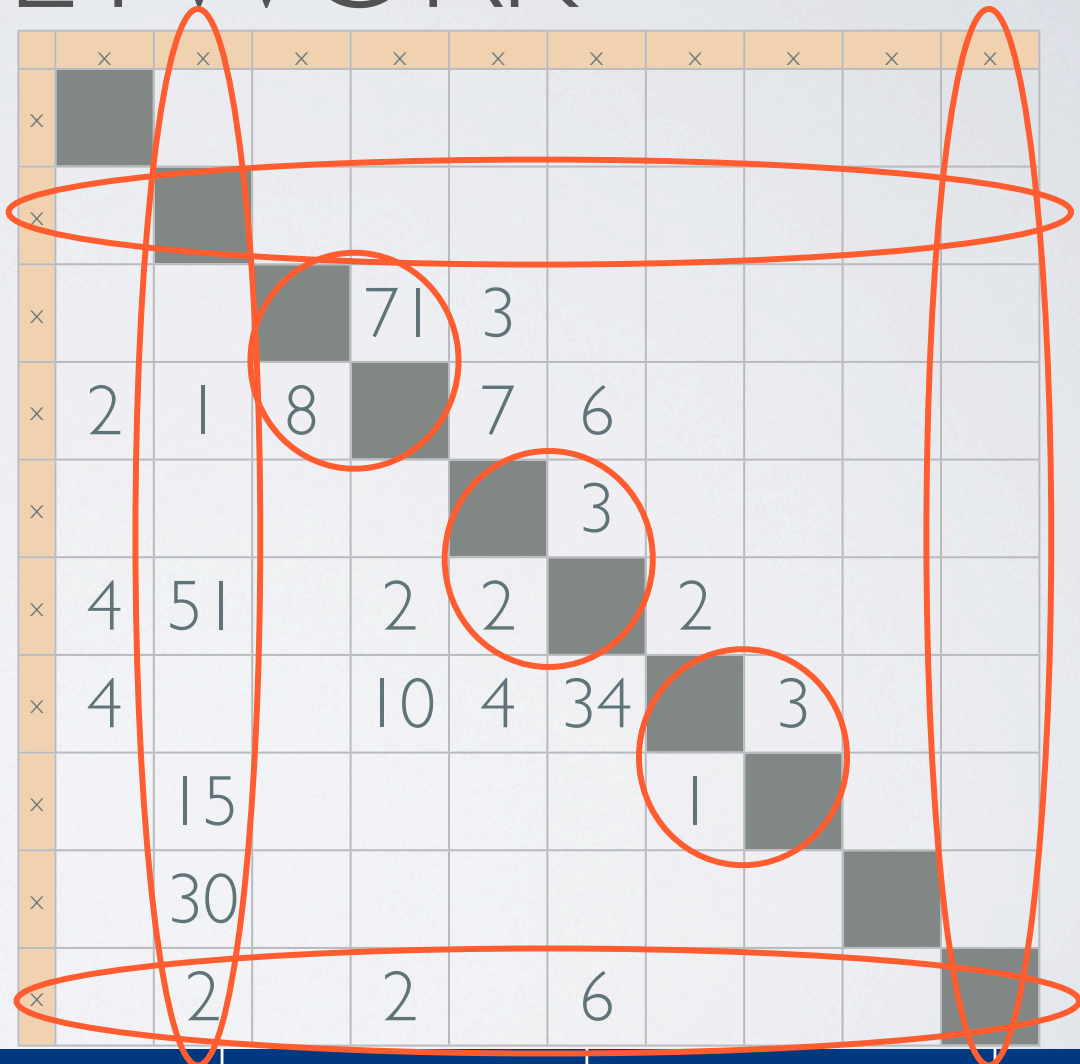


PATH SEARCHING

- Pros
 - information about path
- Cons
 - slow

BLACK AND WHITE NETWORK

- what do we see?



ROADMAP

- A cycle?
- **What is DSM?**
 - **what about cycles ?**
- Using color for cycle detection
- DSM at Work
- Advanced features (research)

FOLDING CYCLES TO FIND LAYERS

- When we have cycles we can consider the packages as a single one and continue...

FOLDING ...

	1	2	3	4	5	6	7	8	9	10
1	■									
2		■								
3			■	71	3					
4	2	1	8	■	7	6				
5					■	3				
6	4	51		2	2	■	2			
7	4			10	4	34	■	3		
8		15					1	■		
9		30							■	
10		2		2		6				■



	1	2	3+	9	10
1	■				
2		■			
3+	10	67	■		
9		30		■	
10		2	8		■



Layer3	1 2
Layer2	3+
Layer1	9 10

DSM...

- Pros
 - Cycle spotting
 - Layer
- Cons
 - Reading
 - Where to fix first?

ROADMAP

- A cycle?
- What is DSM?
- **Using color for cycle detection**
- DSM at Work
- Advanced features (research)

ENHANCEMENT ONE: COLOR

- Direct Cycle in red
- Indirect cycle in yellow
- Complexe cycle in pale blue

	A	B	C	D
A		X		
B	X		X	
C	X			8
D			1	

ENHANCEMENT TWO: DEPENDENCIES

- Inheritances
- Direct class references
- Invocations
- Extensions

AN EXAMPLE

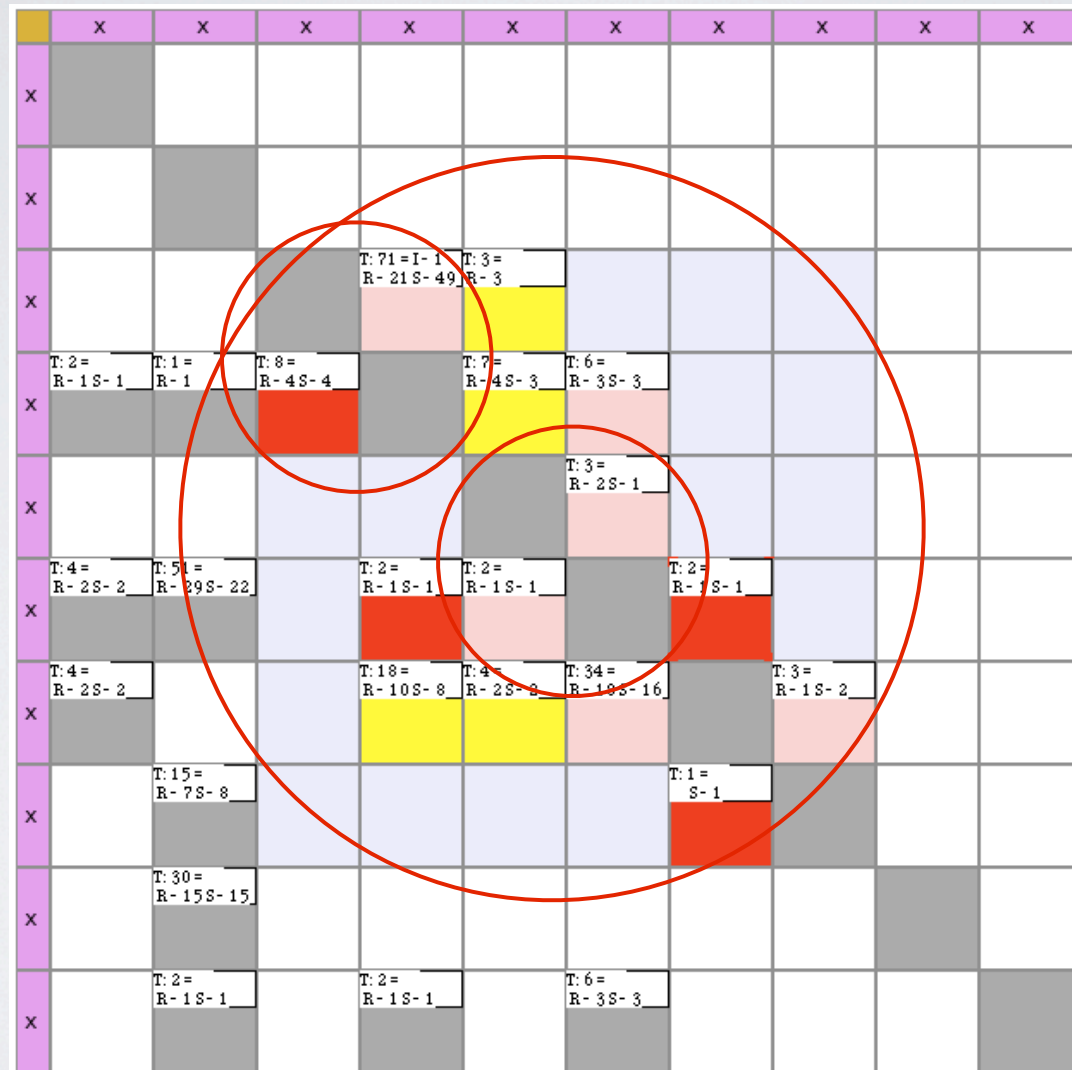
	1	2	3	4	5	6	7	8	9	10
1										
2										
3				T: 71 = I-1 R- 24S-49	T: 3 = R- 3					
4	T: 2 = R- 1S-1	T: 1 = R- 1	T: 8 = R- 4S-4		T: 7 = R- 4S-3	T: 6 = R- 3S-3				
5						T: 3 = R- 2S-1				
6	T: 4 = R- 2S-2	T: 51 = R- 29S-22		T: 2 = R- 1S-1	T: 2 = R- 1S-1		T: 2 = R- 1S-1			
7	T: 4 = R- 2S-2			T: 18 = R- 10S-8	T: 4 = R- 2S-2	T: 34 = R- 18S-16		T: 3 = R- 1S-2		
8		T: 15 = R- 7S-8					T: 1 = S-1			
9		T: 30 = R- 15S-15								
10		T: 2 = R- 1S-1		T: 2 = R- 1S-1		T: 6 = R- 3S-3				

CLARIFY DEPENDENCIES

NetworkTest

	x	x	x	x	x	x	x	x	x	x
x										
x										
x				T: 71=I-1 R-21S-49	T: 3= R-3					
x	T: 2= R-1S-1	T: 1= R-1	T: 8= R-4S-4		T: 7= R-4S-3	T: 6= R-3S-3				
x						T: 3= R-2S-1				
x	T: 4= R-2S-2	T: 51= R-29S-22		T: 2= R-1S-1	T: 2= R-1S-1		T: 2= R-1S-1			
x	T: 4= R-2S-2			T: 18= R-10S-8	T: 4= R-2S-2	T: 34= R-18S-16		T: 3= R-1S-2		
x		T: 15= R-7S-8					T: 1= S-1			
x		T: 30= R-15S-15								
x		T: 2= R-1S-1		T: 2= R-1S-1		T: 6= R-3S-3				

DETECT CYCLES



OFFER PROGNOSTIC

	x	x	x	x	x	x	x	x	x	x
x										
x										
x				T: 71=I-1 R- 21S-49	T: 3= R- 3					
x	T: 2= R- 1S-1	T: 1= R- 1	T: 8= R- 4S-4		T: 7= R- 4S-3	T: 6= R- 3S-3				
x						T: 3= R- 2S-1				
x	T: 4= R- 2S-2	T: 51= R- 29S-22		T: 2= R- 1S-1	T: 2= R- 1S-1		T: 2= R- 1S-1			
x	T: 4= R- 2S-2			T: 18= R- 10S-8	T: 4= R- 2S-2	T: 34= R- 18S-16		T: 3= R- 1S-2		
x		T: 15= R- 7S-8					T: 1= S-1			
x		T: 30= R- 15S-15								
x		T: 2= R- 1S-1		T: 2= R- 1S-1		T: 6= R- 3S-3				

DISYMMETRIC

- Remove ?
- Reverse links ?
- ???

	X	X	X	X	X	X	X	X	X	X
X										
X										
X					T: 71=1-1 R- 21S-49	T: 3= R- 3				
X	T: 2= R- 1S-1	T: 1= R- 1	T: 8= R- 4S-4		T: 7= R- 4S-3	T: 6= R- 3S-3				
X						T: 3= R- 2S-1				
X	T: 4= R- 2S-2	T: 51= R- 29S-22		T: 2= R- 1S-1	T: 2= R- 1S-1		T: 2= R- 1S-1			
X	T: 4= R- 2S-2			T: 18= R- 10S-8	T: 4= R- 2S-2	T: 34= R- 18S-16		T: 3= R- 1S-2		
X		T: 15= R- 7S-8					T: 1= S-1			
X		T: 30= R- 15S-15								
X		T: 2= R- 1S-1		T: 2= R- 1S-1		T: 6= R- 3S-3				

SYMMETRIC

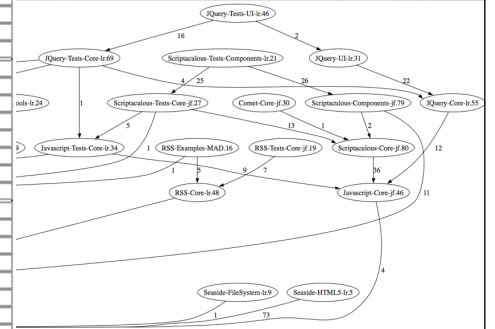
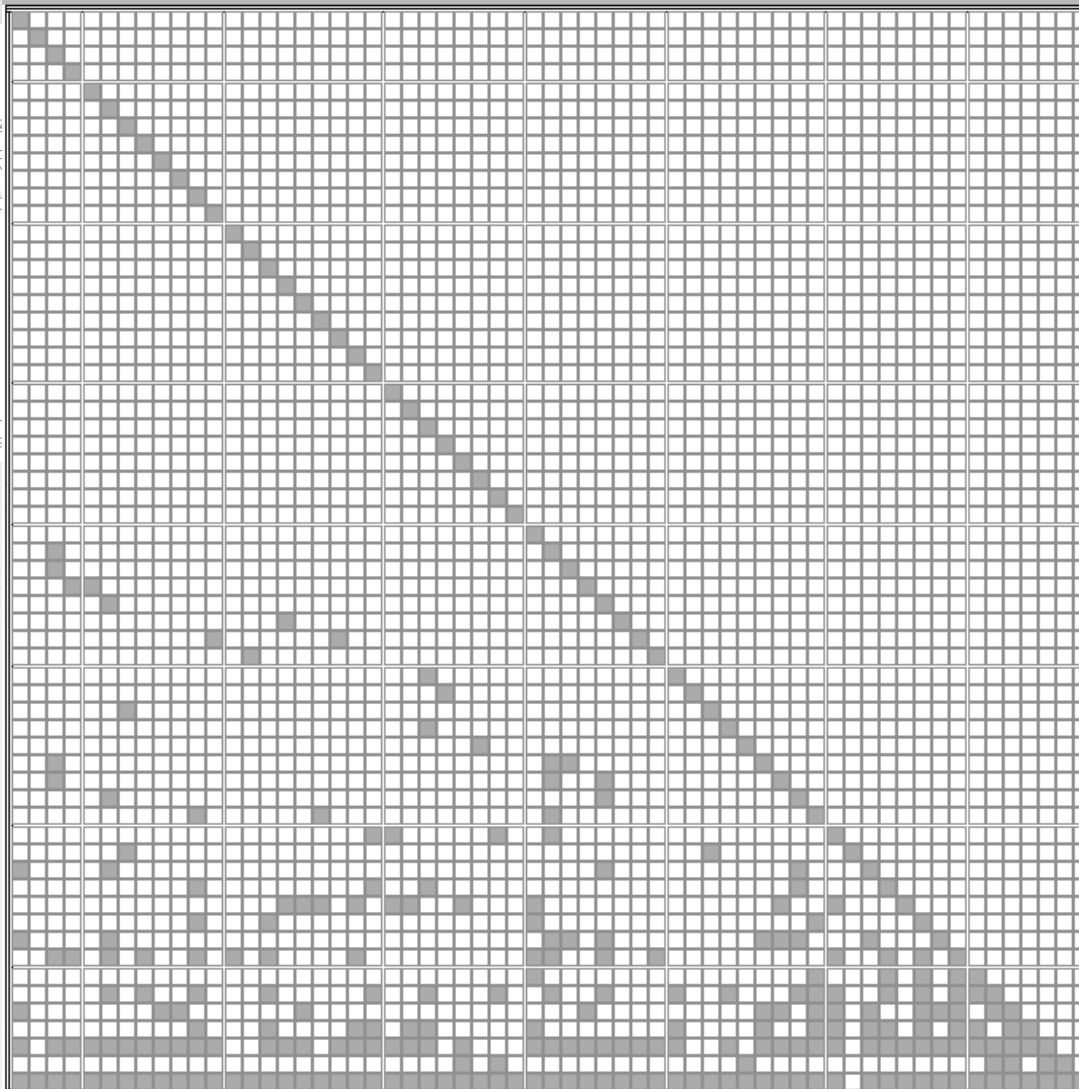
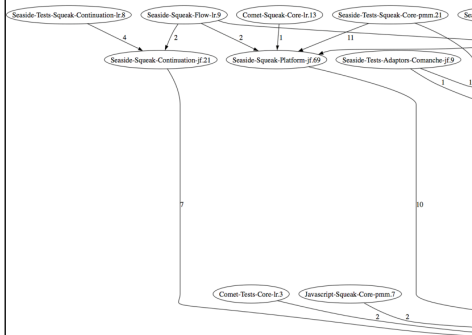
- Merge ?
- Make two different packages ?
- ???

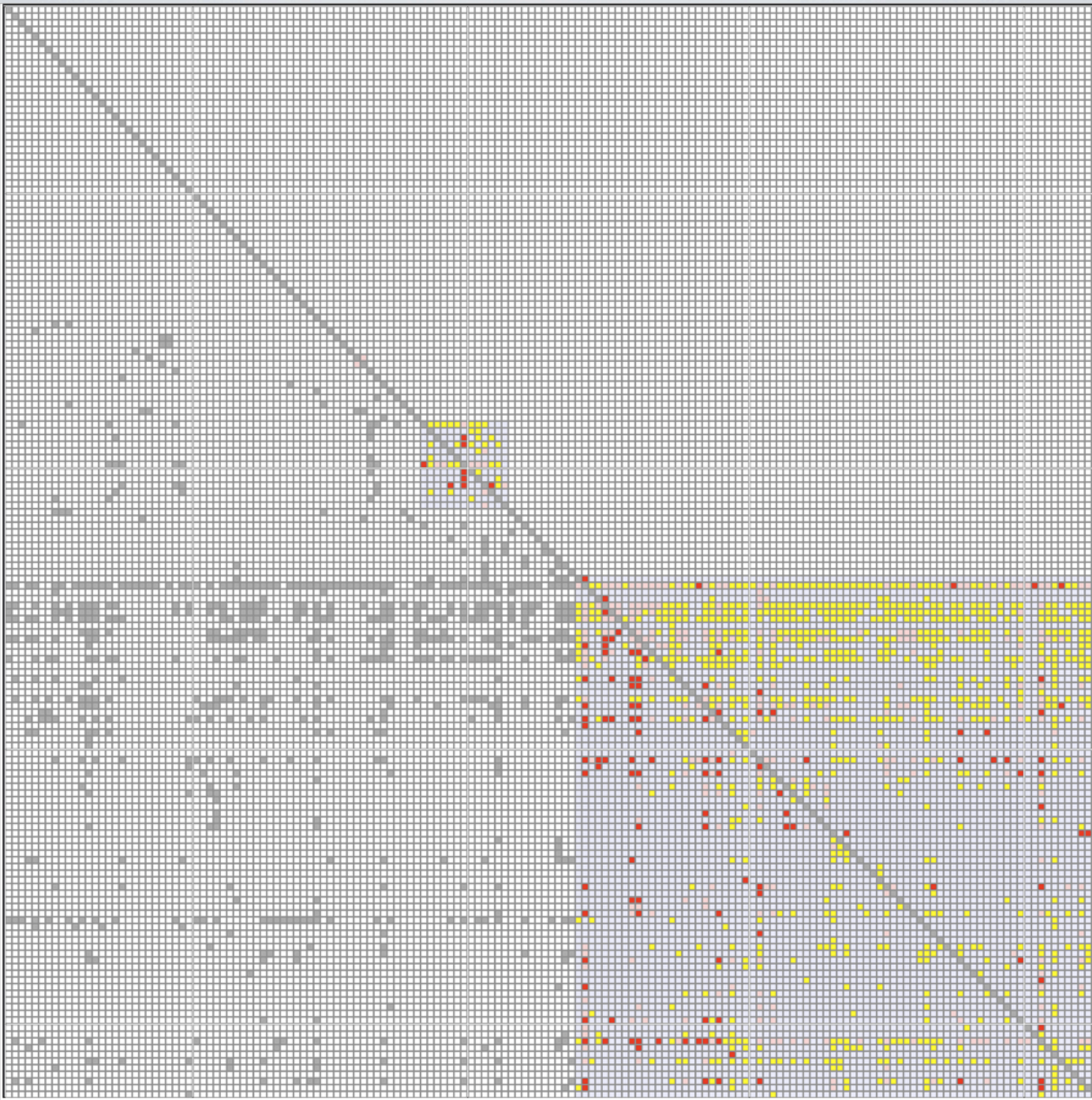
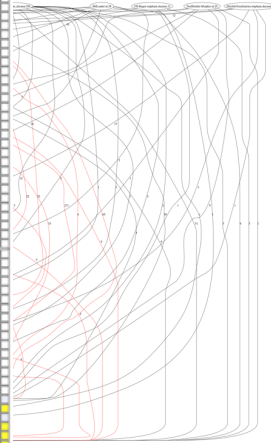
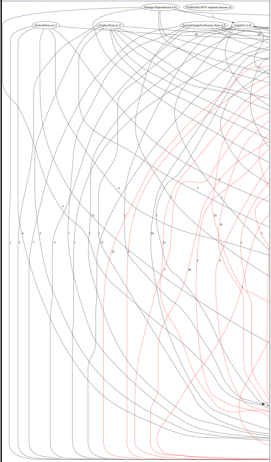
	X	X	X	X	X	X	X	X	X	X
X										
X										
X				T: 71=1-1 R- 21S-49	T: 3= R- 3					
X	T: 2= R- 1S-1	T: 1= R- 1	T: 8= R- 4S-4		T: 7= R- 4S-3	T: 6= R- 3S-3				
X						T: 3= R- 2S-1				
X	T: 4= R- 2S-2	T: 51= R- 29S-22		T: 2= R- 1S-1	T: 2= R- 1S-1		T: 2= R- 1S-1			
X	T: 4= R- 2S-2			T: 18= R- 10S-8	T: 4= R- 2S-2	T: 34= R- 18S-16		T: 3= R- 1S-2		
X		T: 15= R- 7S-8					T: 1= S-1			
X		T: 30= R- 15S-15								
X		T: 2= R- 1S-1		T: 2= R- 1S-1		T: 6= R- 3S-3				

ROADMAP

- A cycle?
- What is DSM?
- Using color for cycle detection
- **DSM at Work**
 - Seaside 2.9 (no cycle....)
 - Pharo
- Advanced features (research)

SEASIDE 2.9

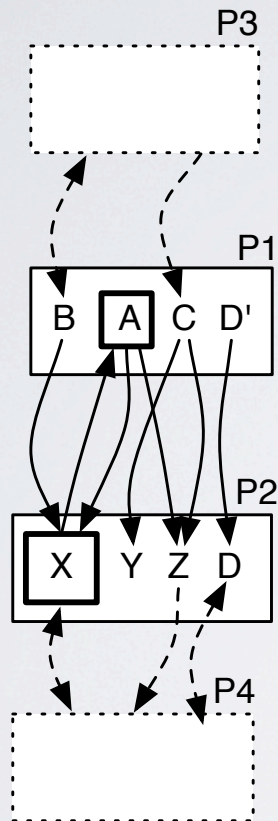




ROADMAP

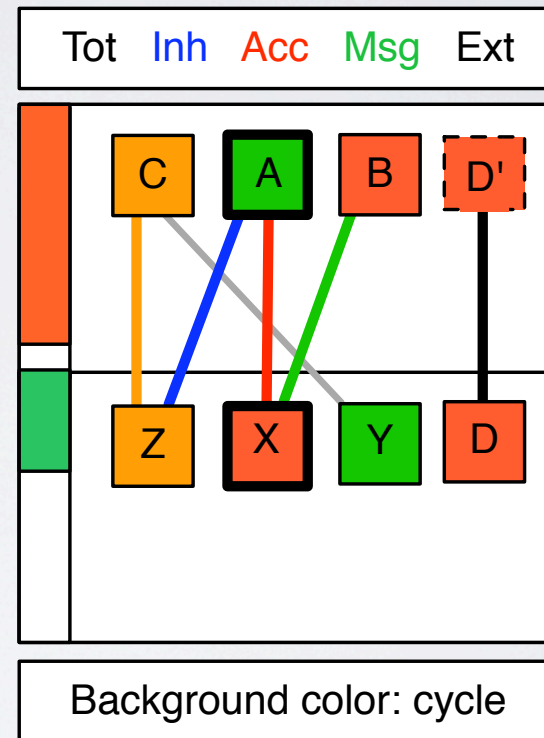
- A cycle?
- What is DSM?
- Using color for cycle detection
- DSM at Work
- **Advanced features (research)**

EDSM

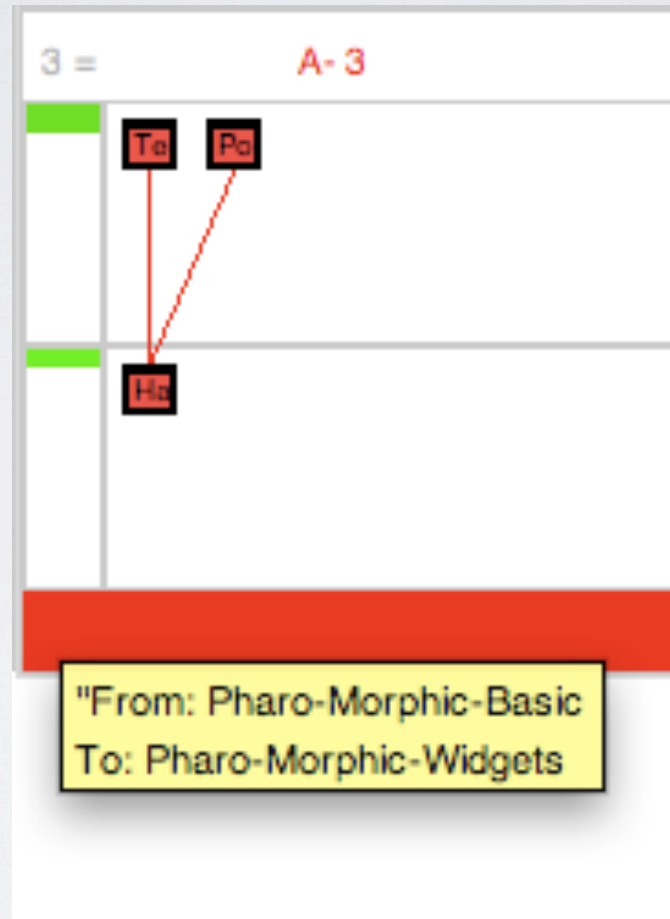


Source P1

Target P2



EXAMPLE OF A CELL

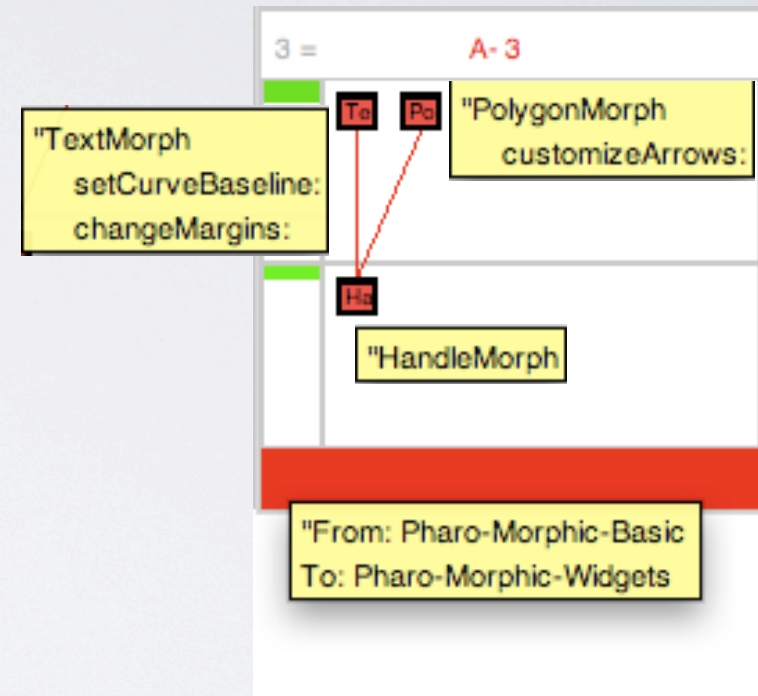


DETAILED INFORMATION

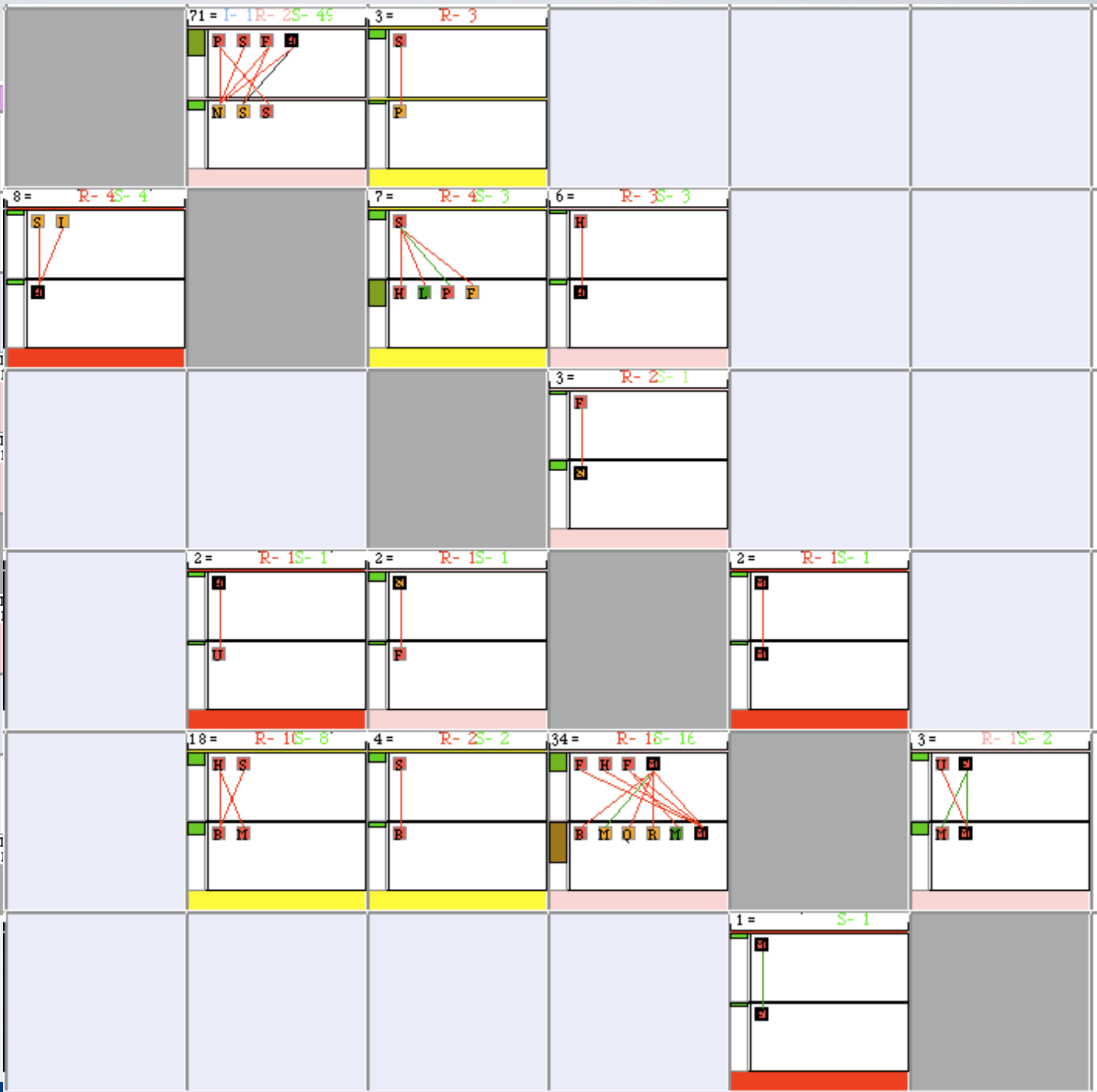


Classes in Morhic-Basic use classes in Morhic-Widgets

Classes in Morhic-Widgets use classes in Morhic-Basic



	X	X	X	X	X
X					
X					
X			T: 71 = I-1 R- 21 S- 49	T: 3 = R- 3	
X	T: 2 = R- 1 S- 1	T: 1 = R- 1	T: 8 = R- 4 S- 4	T: 7 = R- 4 S- 3	
X					
X					
X	T: 4 = R- 2 S- 2	T: 51 = R- 29 S- 22	T: 2 = R- 1 S- 1	T: 2 = R- 1 S- 1	
X	T: 4 = R- 2 S- 2		T: 18 = R- 10 S- 8	T: 4 = R- 2 S- 2	
X		T: 15 = R- 7 S- 8			
X		T: 30 = R- 15 S- 15			
X		T: 2 = R- 1 S- 1	T: 2 = R- 1 S- 1		



DSM IN SOFTWARE REENGINEERING

- Clarify dependencies
- Detect cycles
- Offer prognostic (pink/red)
- Lattix (www.lattix.com)
- <http://moose.unibe.ch/>

