Compression of jazz chord sequences

Romain VERSAEVEL

Tutored by Pr. David MEREDITH

13 août 2015

Contents

Contents

Chords

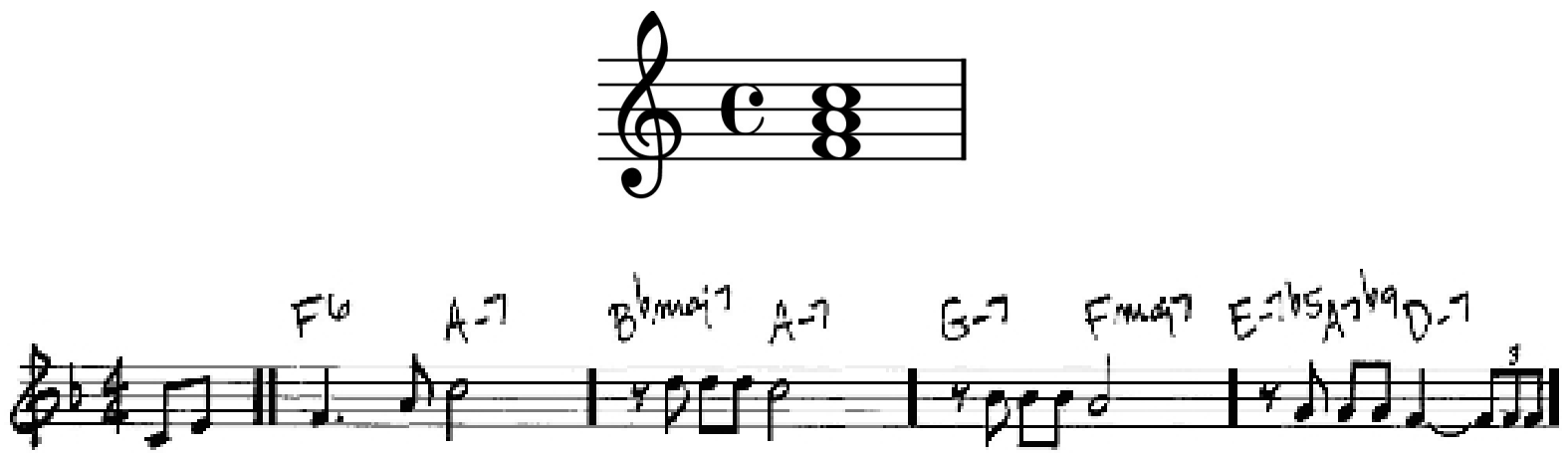
Definition

A *chord* is a set of at least three notes.

Chords

Definition

A *chord* is a set of at least three notes.



My data

A Child Is Born :

B♭M7; *E♭m*; *B♭M7*; *E♭m6*; *B♭M9*; *E♭m*; *A halfdim7*; *D7#9* . . .

My data

A Child Is Born :

$B\flat M7$; $E\flat m$; $B\flat M7$; $E\flat m6$; $B\flat M9$; $E\flat m$; $A\ halfdim7$; $D7\#9\ldots$

$$\underbrace{B\flat}_{\text{root note}}\ \underbrace{M7}_{\text{harmonic content}}$$

Mathematical chords

Notes are numbers.

Mathematical chords

Notes are numbers.

A	*A#*	*B*	*C*	*C#*	*D*	*D#*	*E*	*F*	*F#*	*G*	*G#*
0	1	2	3	4	5	6	7	8	9	10	11

Mathematical chords

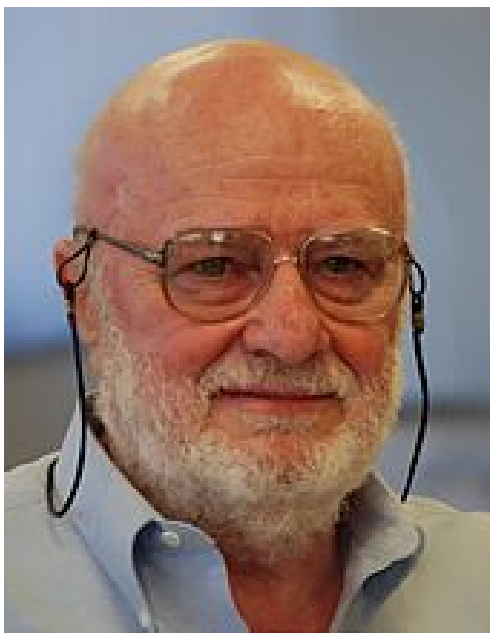
Notes are numbers.

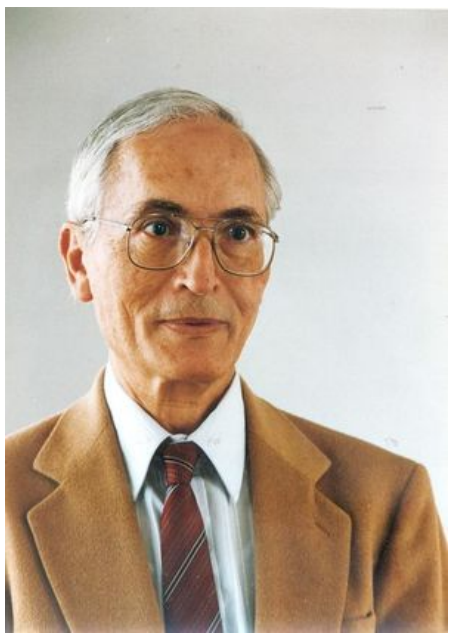
A	*A*#	*B*	*C*	*C*#	*D*	*D*#	*E*	*F*	*F*#	*G*	*G*#
0	1	2	3	4	5	6	7	8	9	10	11

$$\underbrace{B\flat}_{1}\ \underbrace{}_{+}\ \underbrace{M7}_{\{0;4;7;10\}}$$

Contents

Lempel-Ziv 77





LZ77 : example

Input

$\mathtt{I} = ABCABCABD$

Output

$(0, 0, A), (0, 0, B), (0, 0, C), (3, 5, D)$

LZ77 : example

Input

$\mathtt{I} = ABCABCABD$

Step	**Buffer**									**Input** (« preview »)								
0										A	B	C	A	B	C	A	B	D

Output

(0,0,A), $(0, 0, B)$, $(0, 0, C)$, $(3, 5, D)$

LZ77 : example

Input

$\mathtt{I} = ABCABCABD$

Step	**Buffer**									**Input** (« preview »)								
0										A	B	C	A	B	C	A	B	D
1									A	B	C	A	B	C	A	B	D	

Output

$(0, 0, A)$, **(0,0,B)**, $(0, 0, C)$, $(3, 5, D)$

LZ77 : example

Input

$\mathtt{I} = ABCABCABD$

Step	**Buffer**									**Input** (« preview »)								
0										A	B	C	A	B	C	A	B	D
1									A	B	C	A	B	C	A	B	D	
2								A	B	C	A	B	C	A	B	D		

Output

$(0, 0, A)$, $(0, 0, B)$, **(0,0,C)**, $(3, 5, D)$

LZ77 : example

Input

$\mathtt{I} = ABCABCABD$

Step	**Buffer**									**Input** (« preview »)								
0										A	B	C	A	B	C	A	B	D
1									A	B	C	A	B	C	A	B	D	
2								A	B	C	A	B	C	A	B	D		
3							A	B	C	A	B	C	A	B	D			

Output

$(0, 0, A)$, $(0, 0, B)$, $(0, 0, C)$, **(3,5,D)**

Input

$\mathtt{I} = ABCABCABD$

Decompression	Output
	$(0, 0, A)$
	$(0, 0, B)$
	$(0, 0, C)$
	$(3, 5, D)$

Input

$\mathtt{I} = ABCABCABD$

Decompression	Output
	(0,0,A)
	$(0, 0, B)$
	$(0, 0, C)$
	$(3, 5, D)$

Input

$\mathtt{I} = ABCABCABD$

Decompression	Output
A	**(0,0,A)**
	$(0, 0, B)$
	$(0, 0, C)$
	$(3, 5, D)$

Input

$\mathtt{I} = ABCABCABD$

Decompression	Output
A	$(0, 0, A)$
	(0,0,B)
	$(0, 0, C)$
	$(3, 5, D)$

Input

$\mathtt{I} = ABCABCABD$

Decompression	Output
A	$(0, 0, A)$
B	**(0,0,B)**
	$(0, 0, C)$
	$(3, 5, D)$

Input

$\mathtt{I} = ABCABCABD$

Decompression	Output
A	$(0, 0, A)$
B	$(0, 0, B)$
	(0,0,C)
	$(3, 5, D)$

Input

$\mathtt{I} = ABCABCABD$

Decompression	Output
A	$(0, 0, A)$
B	$(0, 0, B)$
C	**(0,0,C)**
	$(3, 5, D)$

Input

$\mathtt{I} = ABCABCABD$

Decompression	Output
A	$(0, 0, A)$
B	$(0, 0, B)$
C	$(0, 0, C)$
	(3,5,D)

Input

$\mathtt{I} = ABCABCABD$

Decompression	Output
A	$(0, 0, A)$
B	$(0, 0, B)$
C	$(0, 0, C)$
A	**(3,5,D)**
B	
C	

Input

$\mathtt{I} = ABCABCABD$

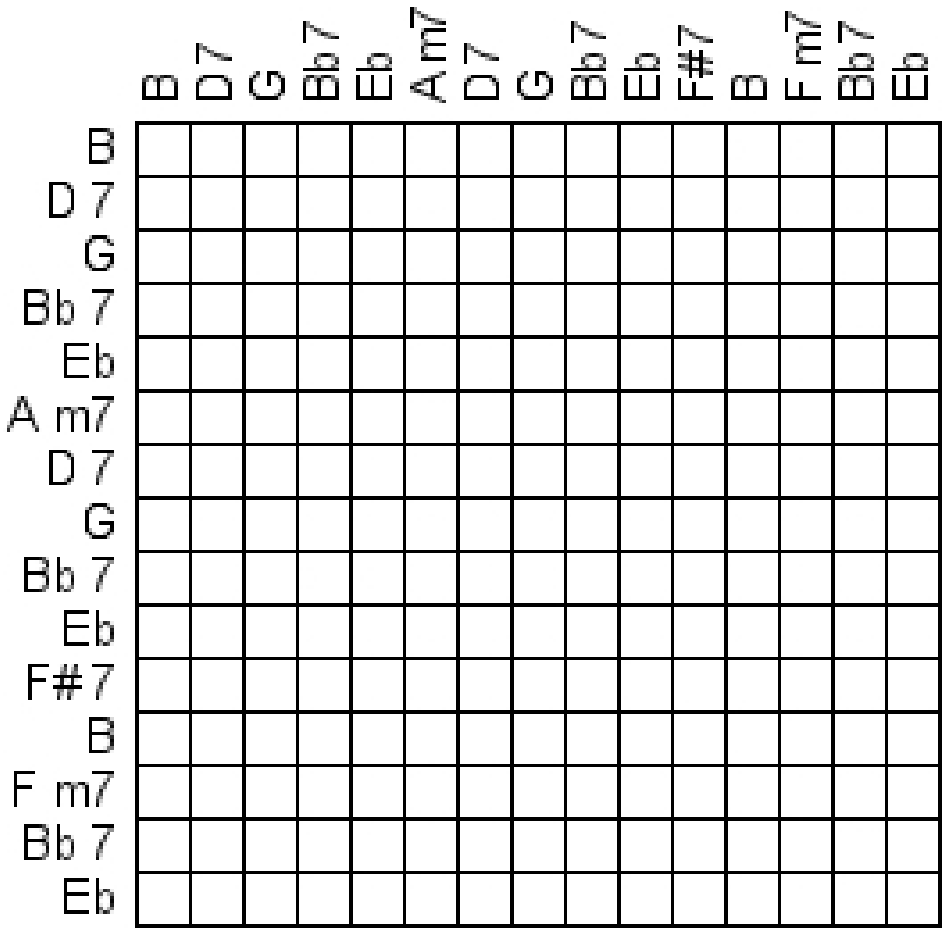
Decompression	Output
A	$(0, 0, A)$
B	$(0, 0, B)$
C	$(0, 0, C)$
A	**(3,5,D)**
B	
C	
A	
B	

Input

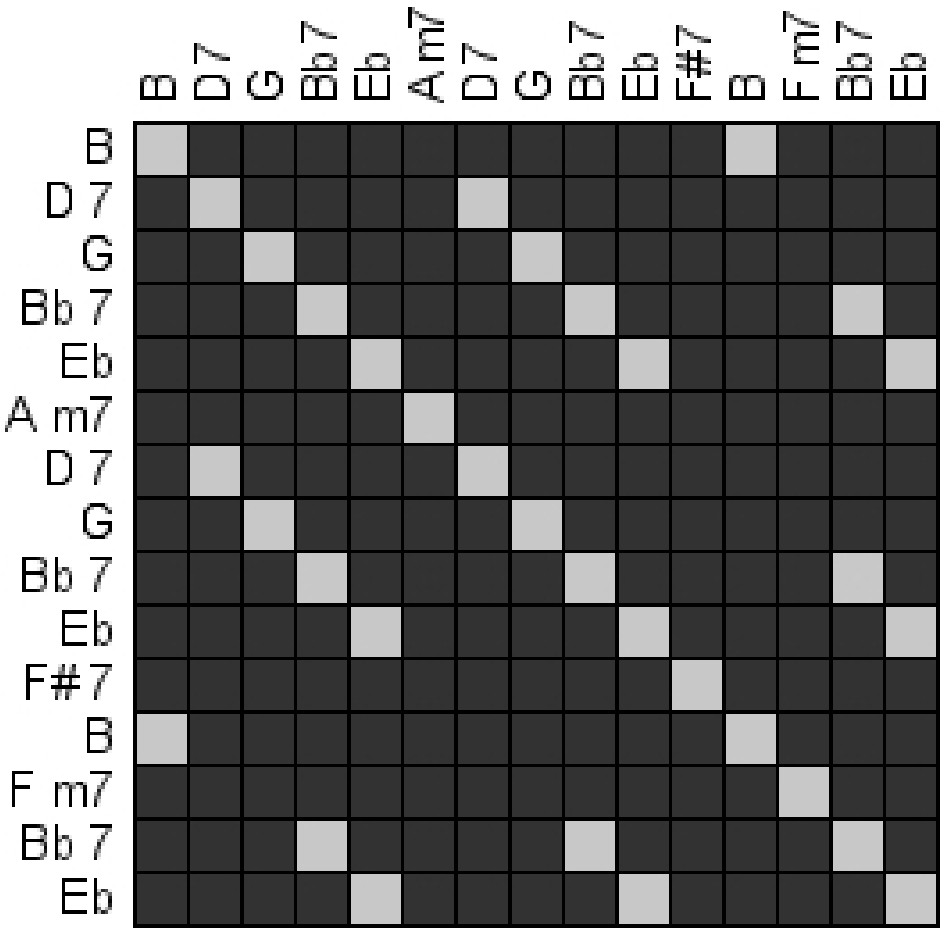
$\mathtt{I} = ABCABCABD$

Decompression	Output
A	$(0, 0, A)$
B	$(0, 0, B)$
C	$(0, 0, C)$
A	**(3,5,D)**
B	
C	
A	
B	
D	

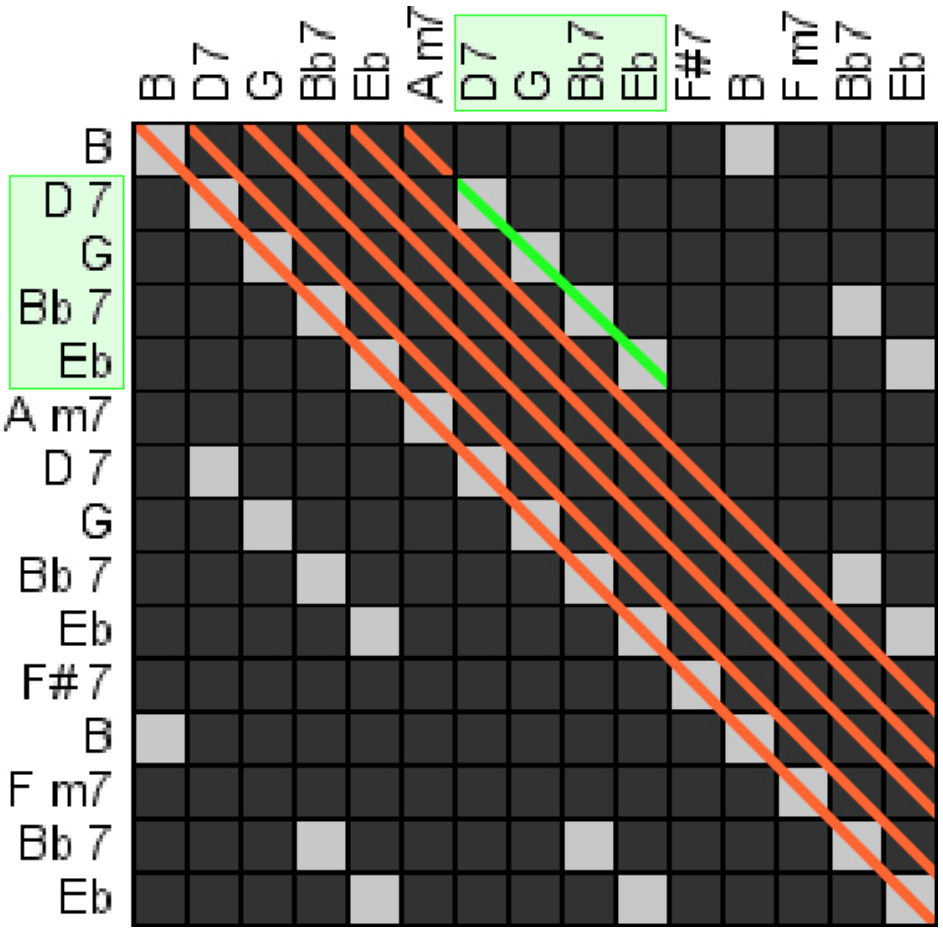
Diagonal patterns (1)



Diagonal patterns (1)



Diagonal patterns (1)



Diagonal patterns (2)

Step 1 Identify the patterns

Step 2 Find a (small) cover

Diagonal patterns (3)

Input

$\mathtt{I} = B; D7; G; B\flat 7; E\flat; Am7; D7; G; B\flat 7; E\flat; F\#7; B; Fm7; B\flat 7; E\flat$

Diagonal patterns (3)

Input

$\mathtt{I} = B; D7; G; B\flat 7; E\flat; Am7; D7; G; B\flat 7; E\flat; F\#7; B; Fm7; B\flat 7; E\flat$

Patterns

- B — $\{0; 11\}$;
- $B\flat 7;\ E\flat$ — $\{3; 8; 13\}$;
- $D7;\ G;\ B\flat 7;\ E\flat$ — $\{1; 6\}$;

Diagonal patterns (3)

Input

$\mathtt{I} = B; D7; G; B\flat 7; E\flat; Am7; D7; G; B\flat 7; E\flat; F\#7; B; Fm7; B\flat 7; E\flat$

Patterns

- B — $\{0; 11\}$;
- $B\flat 7$; $E\flat$ — $\{3; 8; 13\}$;
- $D7$; G; $B\flat 7$; $E\flat$ — $\{1; 6\}$;
- $D7$ — $\{1; 6\}$, G — $\{2; 7\}\ldots$

Diagonal patterns (3)

Input

$\mathtt{I} = B; D7; G; B\flat 7; E\flat; Am7; D7; G; B\flat 7; E\flat; F\#7; B; Fm7; B\flat 7; E\flat$

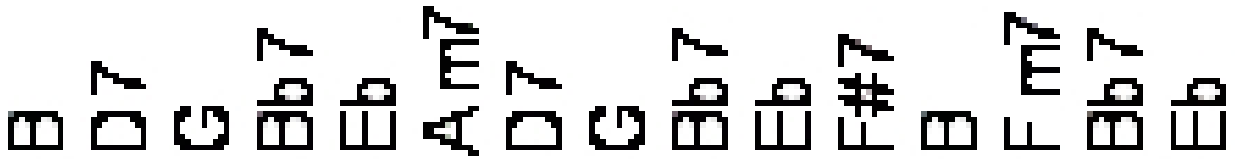
Patterns

- B — $\{0; 11\}$;
- $B\flat 7$; $E\flat$ — $\{3; 8; 13\}$;
- $D7$; G; $B\flat 7$; $E\flat$ — $\{1; 6\}$;
- $D7$ — $\{1; 6\}$, G — $\{2; 7\}\ldots$

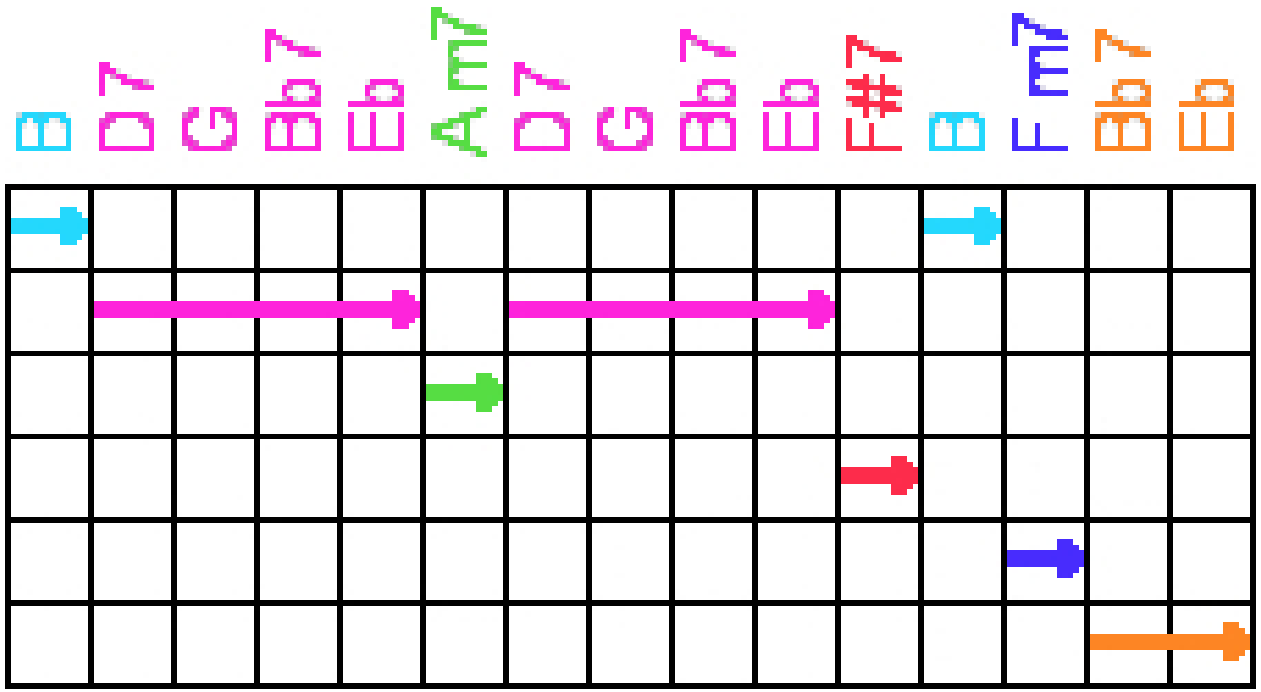
Output

- B — $\{0; 11\}$;
- $B\flat 7$; $E\flat$ — $\{13\}$;
- $D7$; G; $B\flat 7$; $E\flat$ — $\{1; 6\}$;
- $Am7$ — $\{5\}$, $F\#7$ — $\{10\}$, $Fm7$ — $\{12\}$

Diagonal patterns (4)



Diagonal patterns (4)



Contents

The magical ingredient

$$C = C'$$

The magical ingredient

$$C = C'$$
$$\downarrow$$
$$C \sim C'$$

All measures

- root note equivalence ;
- transposition equivalence ;
- PCS-Prime equivalence ;
- the F1-score ;
- Isaacson's similarity index ;
- Lewin's measure ;
- Morris' measure ;
- Rahn's measure ;
- Teitelbaum's measure.

Thresholds

Contents

Evaluation

Compression factor

Recovery factor

Evaluation

Compression factor

$$\frac{|\text{Input}|}{|\text{Output}|}$$

Recovery factor

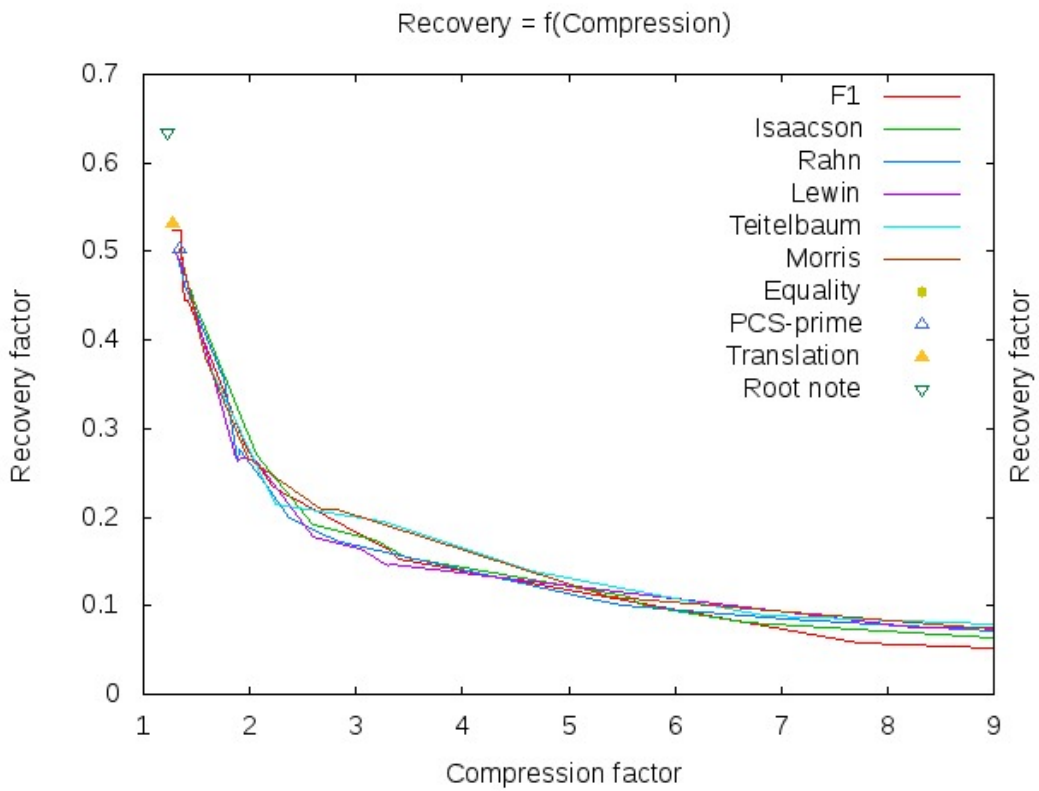
$$\frac{|\{i \mid \text{DECOMPRESS}(\text{COMPRESS}(\text{Input}))[i]=\text{Input}[i]\}|}{|\text{Input}|}$$

Comparison between measures (1)

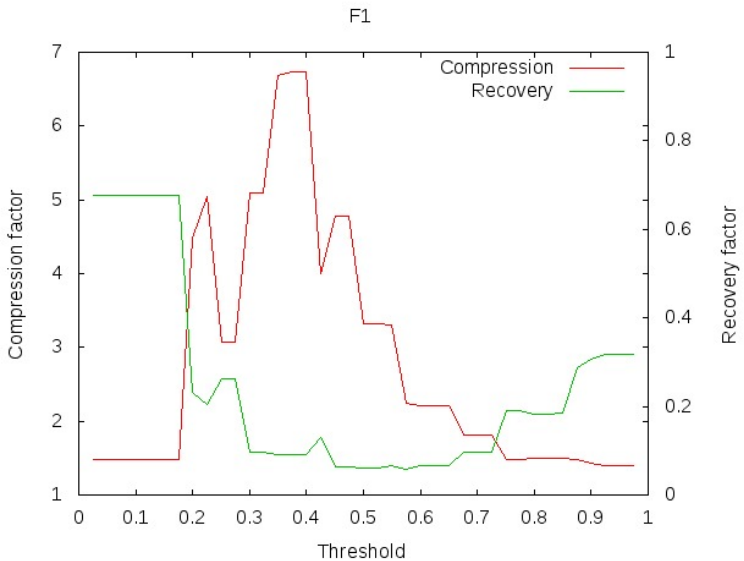
« Similarity measures are similar. »

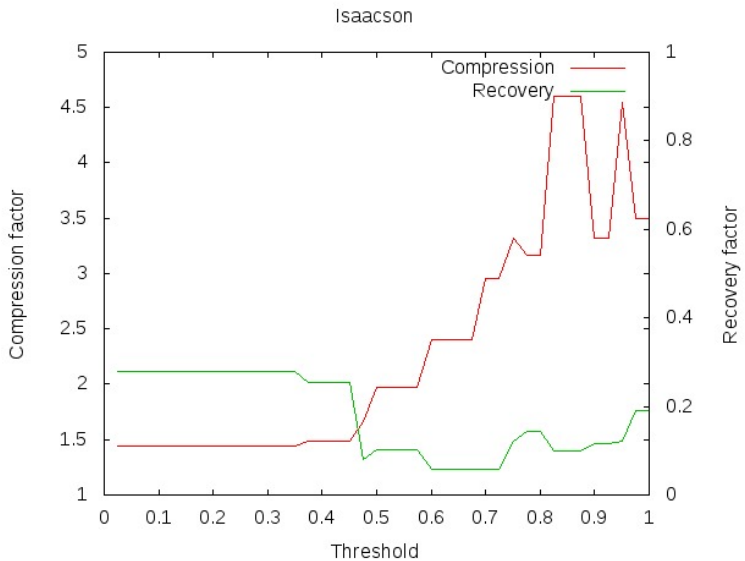
Comparison between measures (1)

« Similarity measures are similar. »

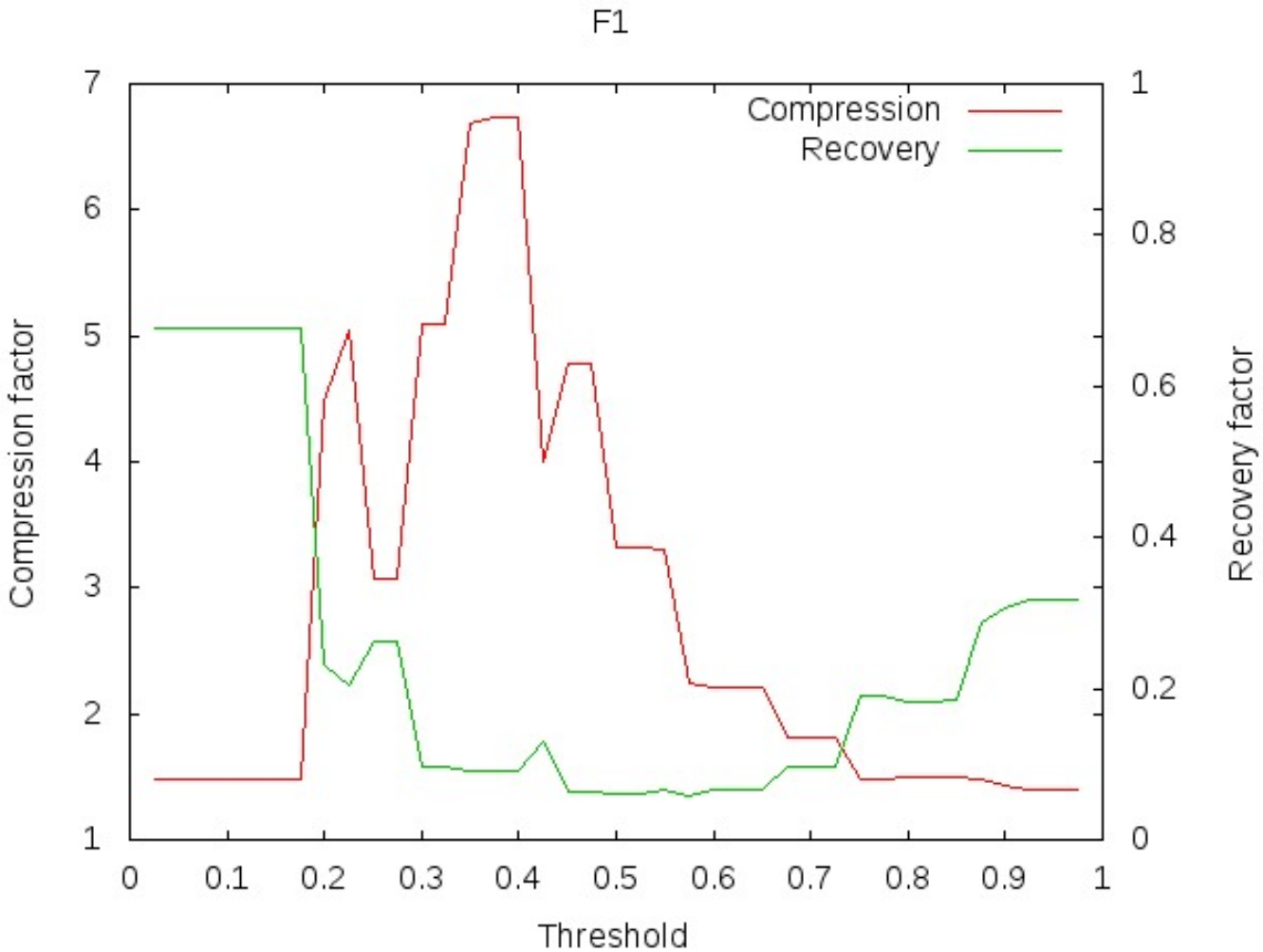


Comparison between measures (2)

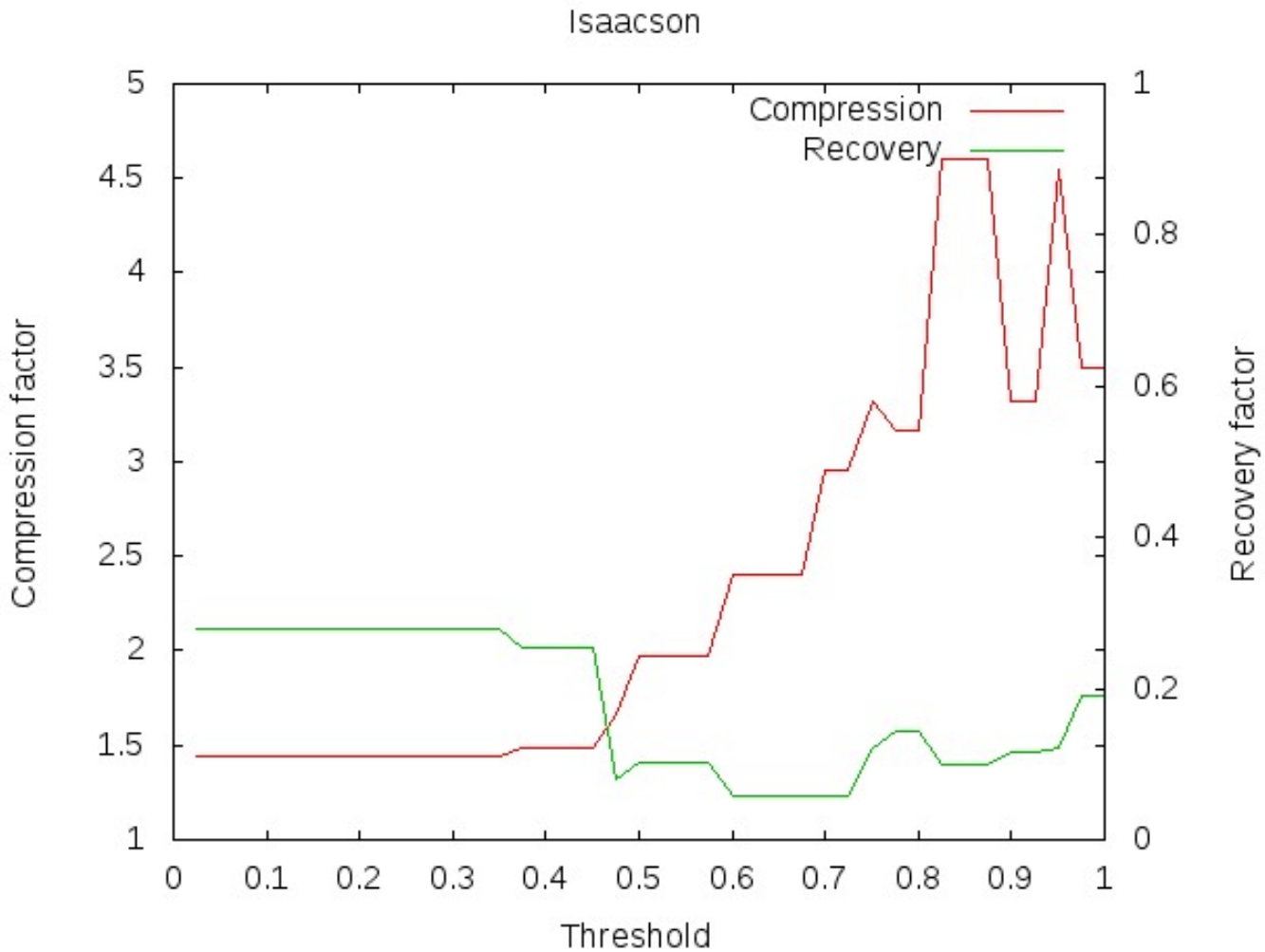




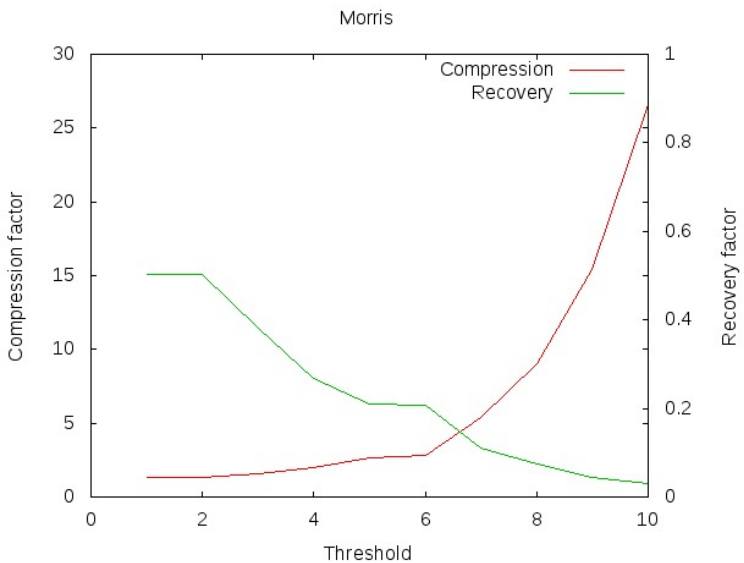
Comparison between measures (2)

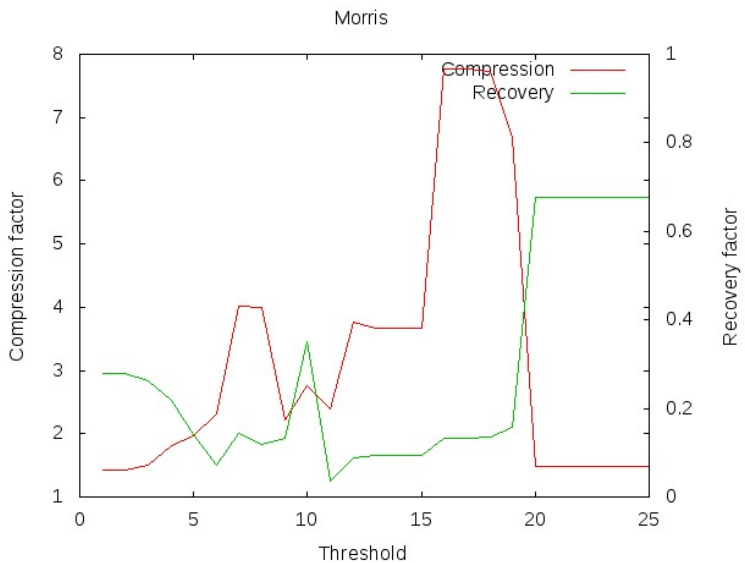


Comparison between measures (2)

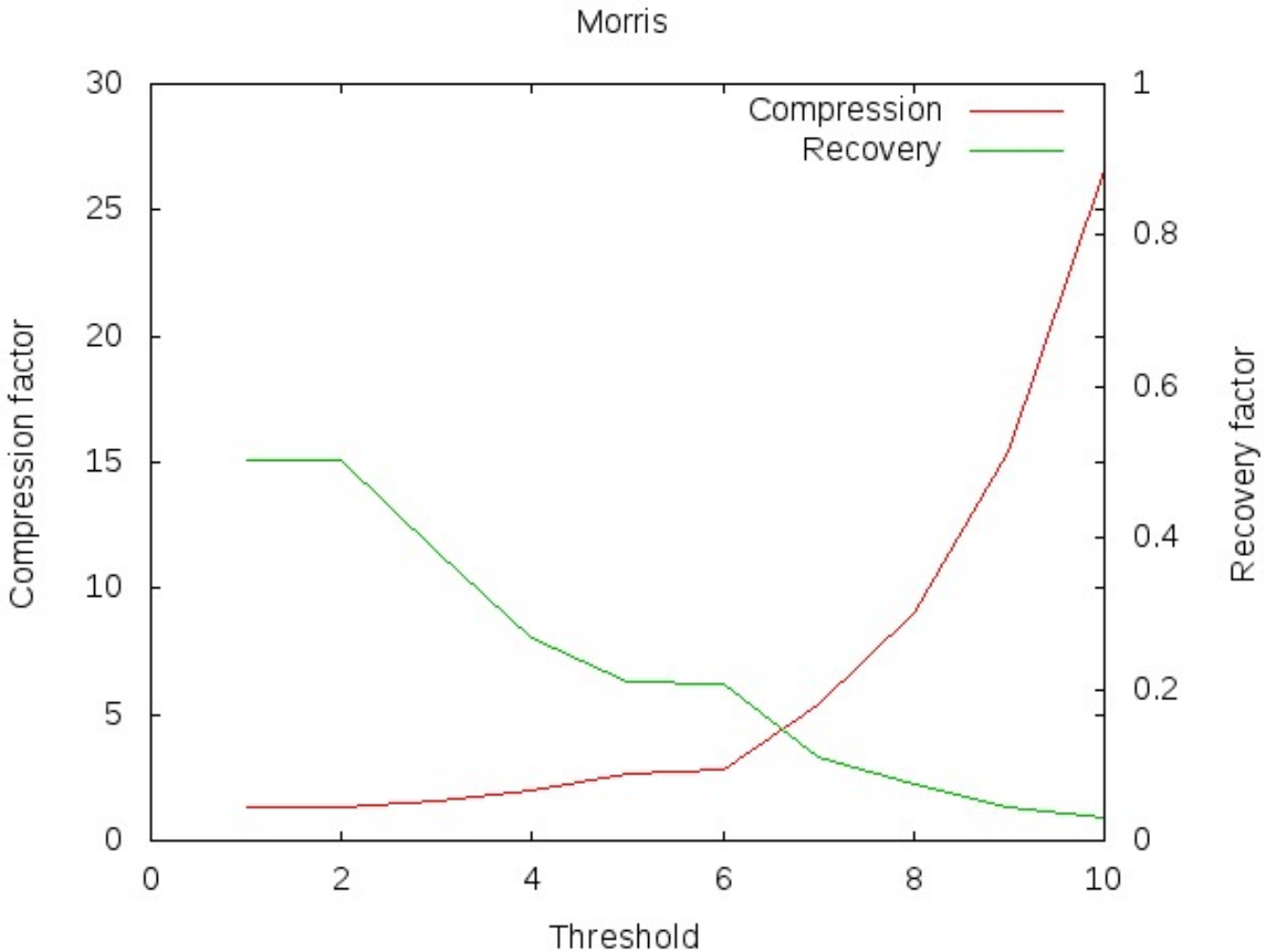


Comparison between algorithms (1)

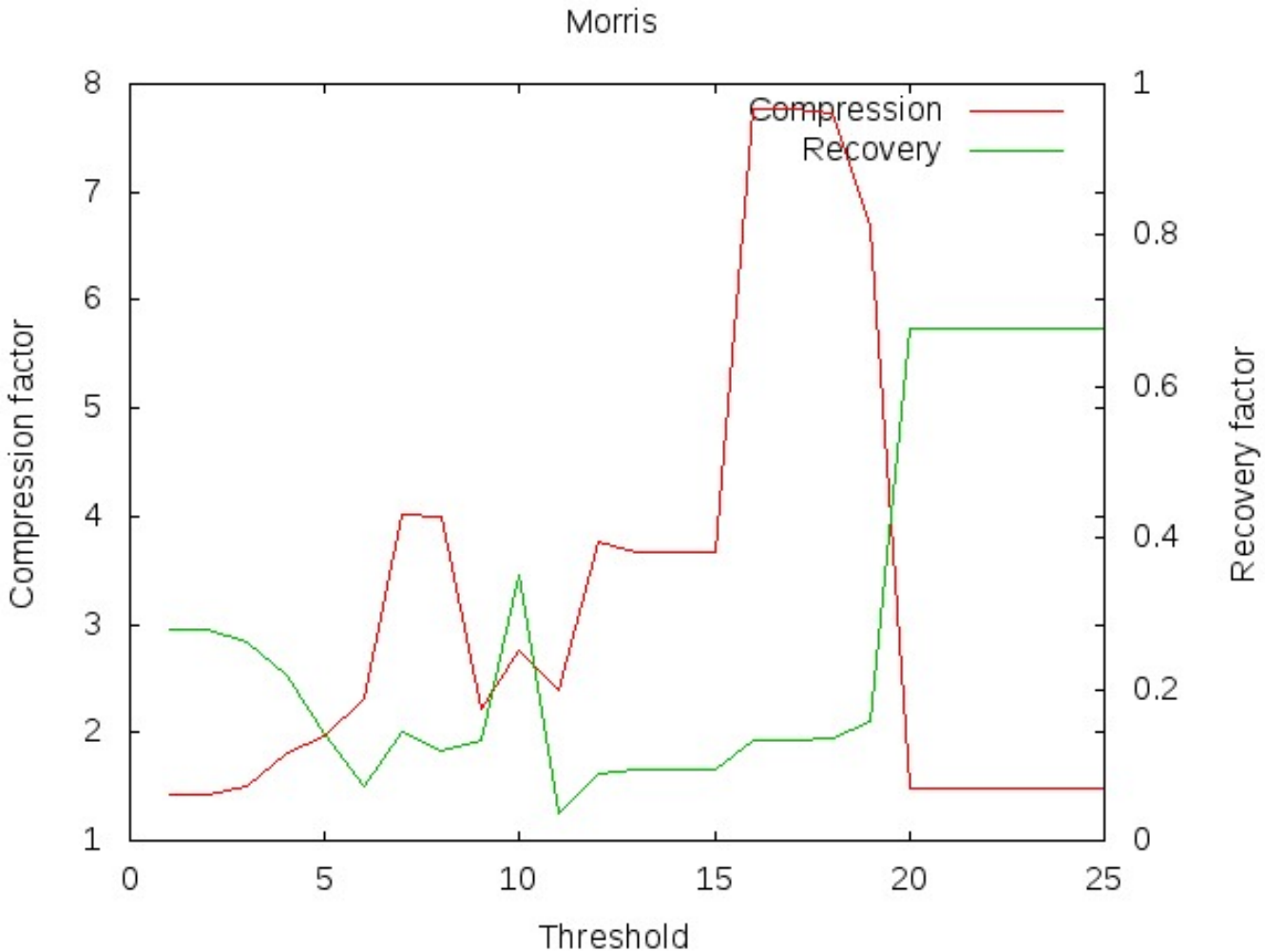




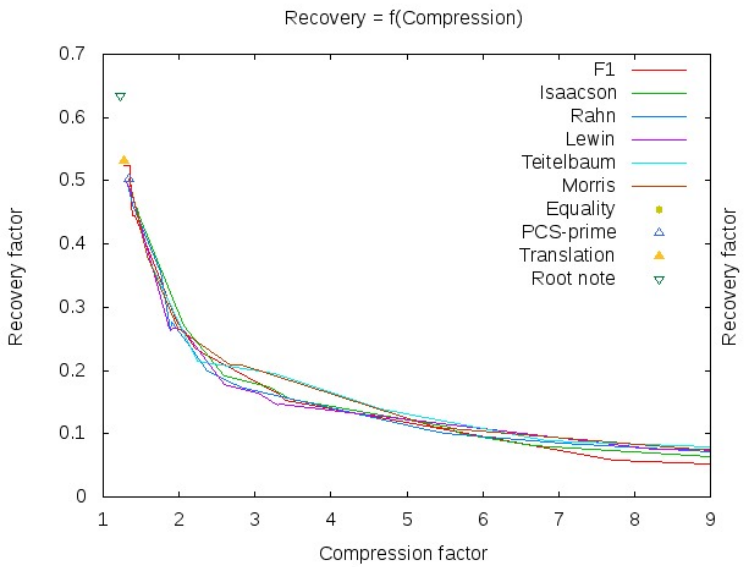
Comparison between algorithms (1)

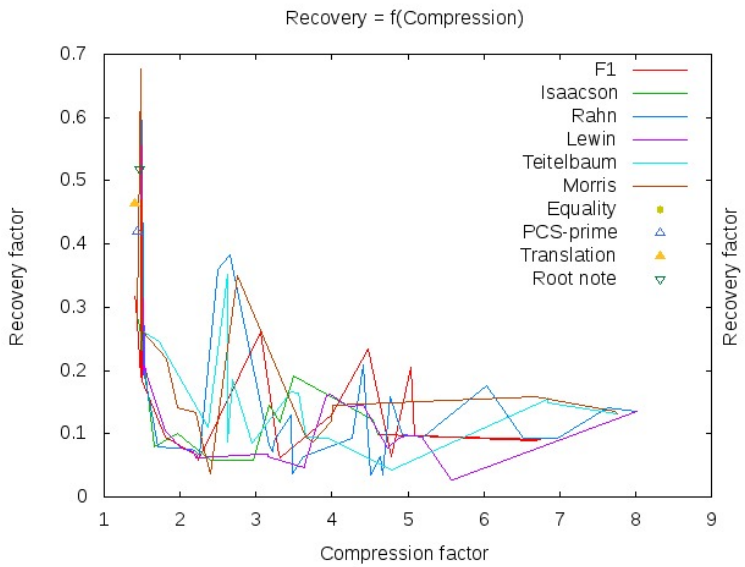


Comparison between algorithms (1)

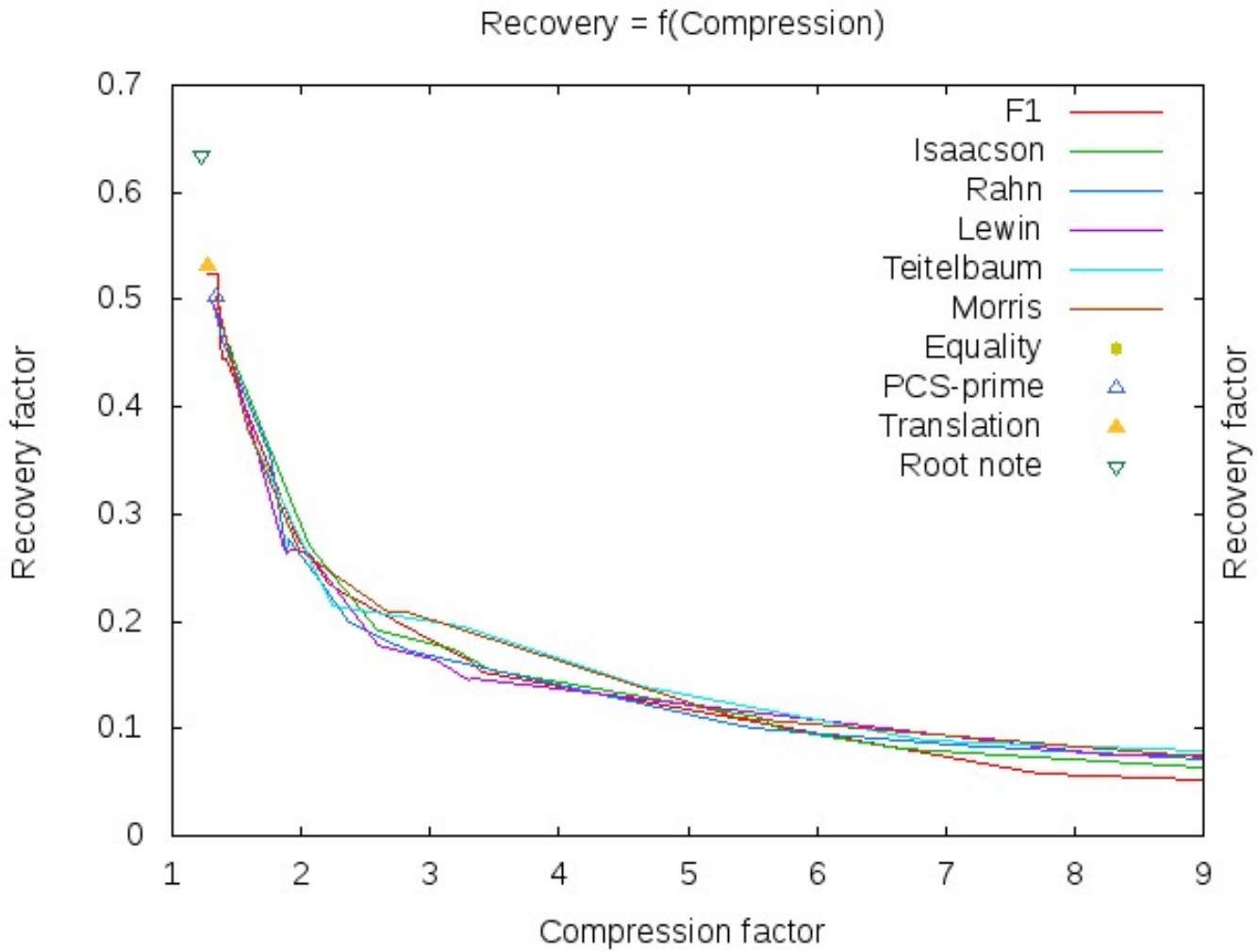


Comparison between algorithms (2)

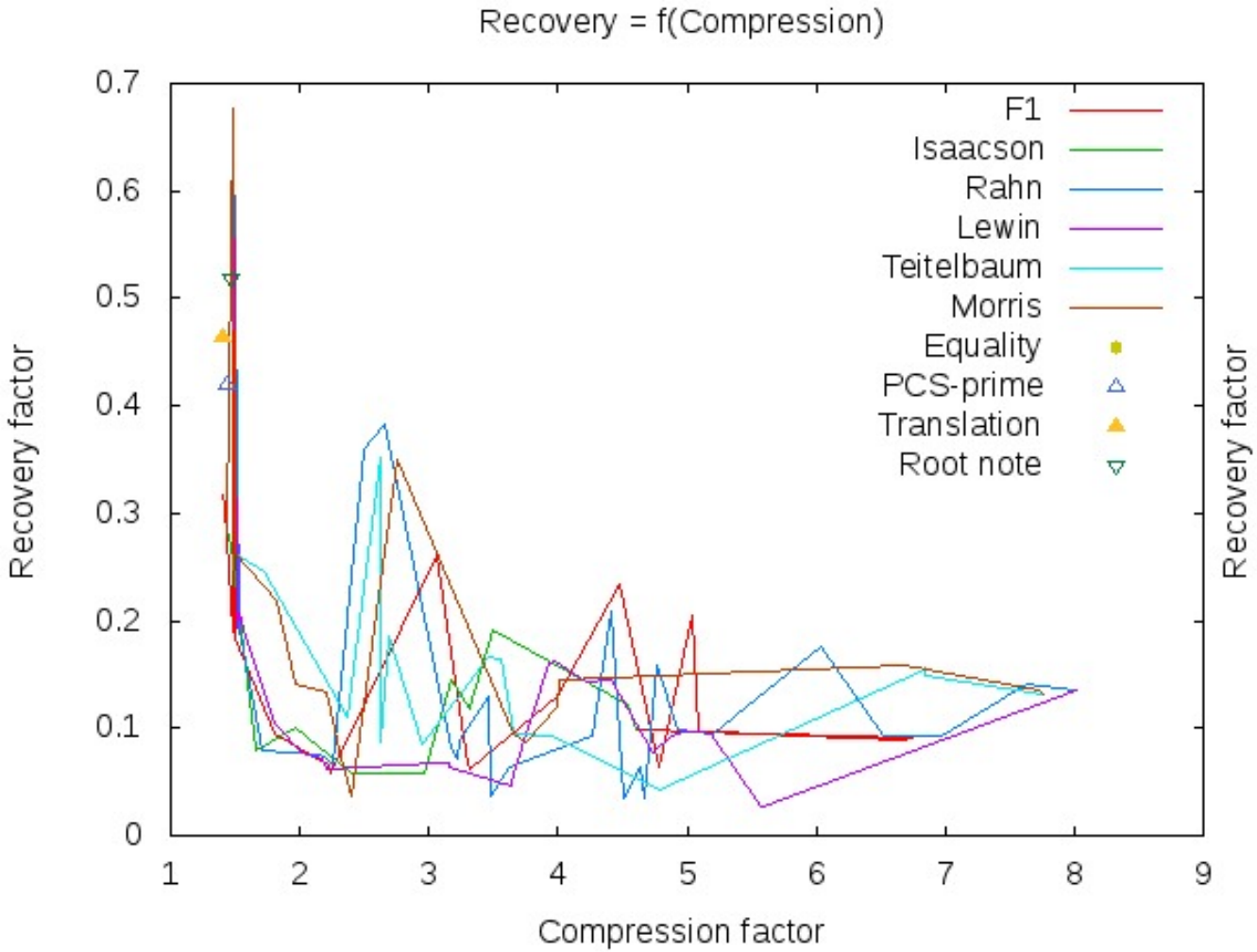




Comparison between algorithms (2)



Comparison between algorithms (2)




That's all Folks!