



Scientific tribute to J.  
Monnot,

**Jérôme, complexity and  
polynomial approximation**

Bruno Escoffier

December 6th 2021, Lamsade, Univ. Paris Dauphine

# Jérôme, complexity and approximation

**PhD Thesis** : *Familles d'instances critiques et approximation polynomiale*,  
Université Paris-Dauphine, 1998

# Jérôme, complexity and approximation



LAMSADE,  
LABORATOIRE D'ANALYSE ET MODÉLISATION DE SYSTÈMES  
POUR L'AIDE À LA DÉCISION

Habilitation à Diriger des Recherches

*Approximation polynomiale : du rapport standard au rapport différentiel*

Jérôme Monnot

07 Novembre 2003

*Coordinateur* : Vangelis Paschos

*Membres du jury* :

Vangelis Paschos, Professeur à l'université *Paris IX* de Paris  
Refael Hassin (rapporteur), Professeur à l'université de Tel Aviv  
Giorgio Ausiello (rapporteur), Professeur à l'université *La Sapienza* de Rome  
Elias Koutsoupias (rapporteur), Professeur à l'université *Panepistimiopolis Ilissia* d'Athènes  
Michel Minoux, Professeur à l'université *Paris VI* de Paris  
Dominique de Werra, Professeur à *EPFL* de Lausanne  
Michel Habib (président), Professeur à l'université *Montpellier II* de Montpellier

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27 journal publications with  
« approximation » in the title

# Jérôme, complexity and approximation

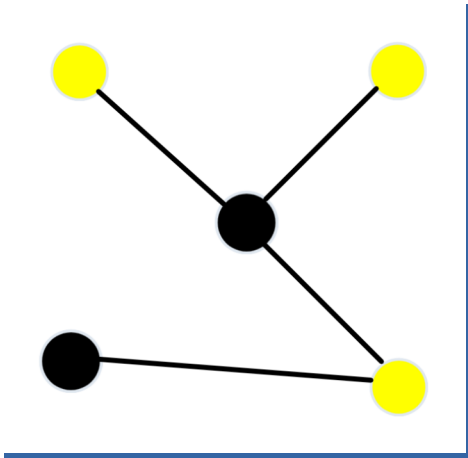
1. « Jé » as Generosity
2. « R » as Ratio
3. « O » as Operational (?)
4. « M » as 'Mais t'es bête ou quoi ?'
5. « E » as the End

# « Jé » as Generosity



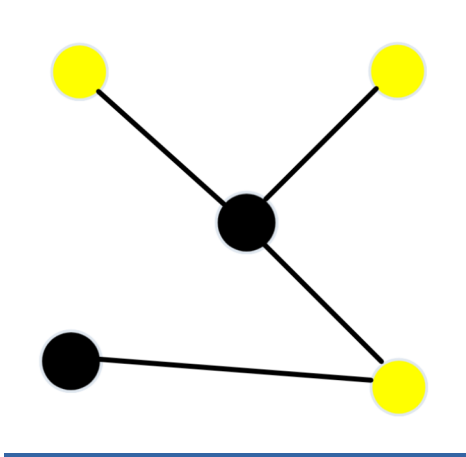
# « Jé » as Generosity

Coloring

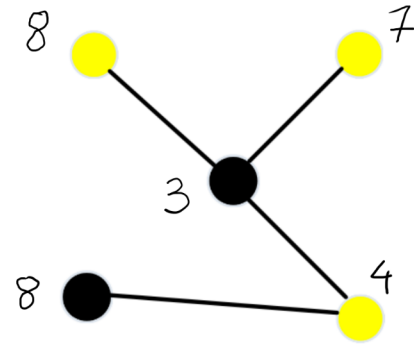


# « Jé » as Generosity

Coloring



Weighted coloring

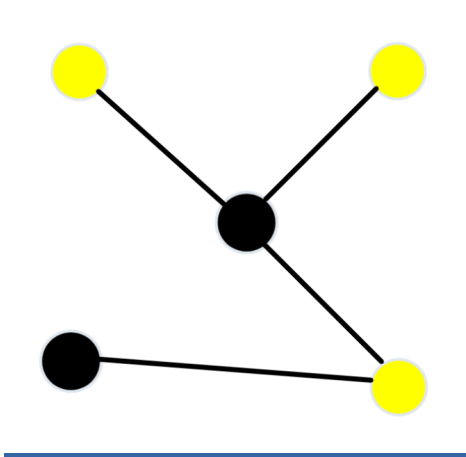


$$\begin{array}{r} w(\text{Black}) = 8 \\ w(\text{Yellow}) = 8 \\ \hline 16 \end{array}$$

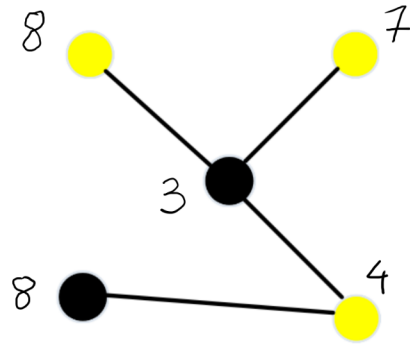


# « Jé » as Generosity

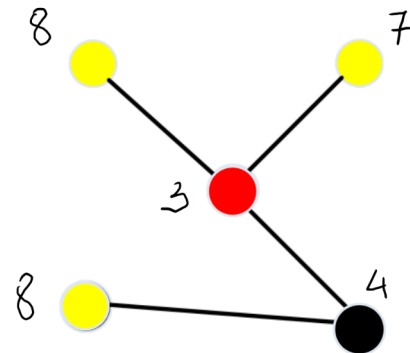
Coloring



Weighted coloring



$$\begin{array}{r} w(\text{Black}) = 8 \\ w(\text{Yellow}) = 8 \\ \hline 16 \end{array}$$

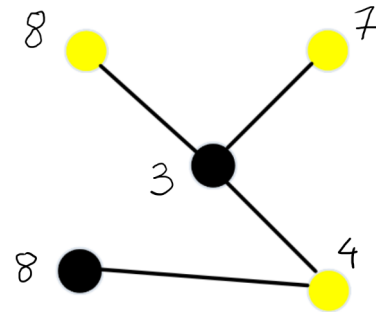


$$\begin{array}{r} w(\text{Black}) = 4 \\ w(\text{Yellow}) = 8 \\ w(\text{Red}) = 3 \\ \hline 15 \end{array}$$

# « Jé » as Generosity

Weighted coloring :

NP-hard in bipartite graphs  
(WG'02)

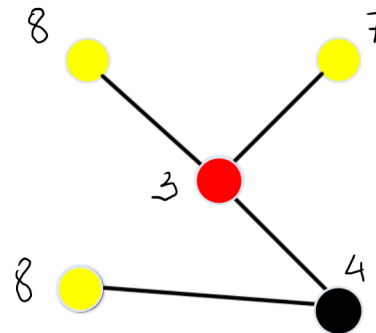


$$w(\text{Black}) = 8$$

$$w(\text{Yellow}) = 8$$

---

$$16$$



$$w(\text{Black}) = 4$$

$$w(\text{Yellow}) = 8$$

$$w(\text{Red}) = 3$$

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$$15$$

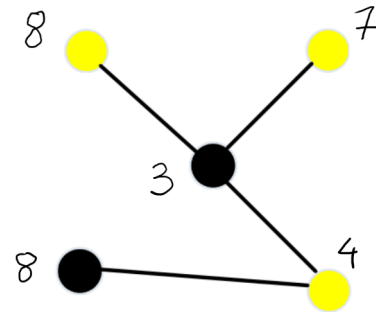
# « Jé » as Generosity

Weighted coloring :

NP-hard in bipartite graphs  
(WG'02)

NP-hard in interval graphs  
(IPL'06)

...

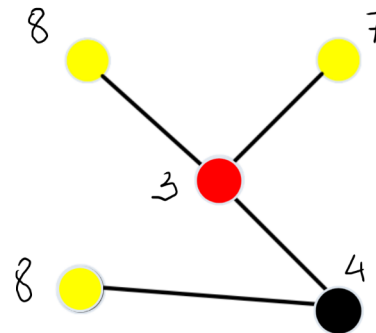


$$w(\text{Black}) = 8$$

$$w(\text{Yellow}) = 8$$

---

$$16$$



$$w(\text{Black}) = 4$$

$$w(\text{Yellow}) = 8$$

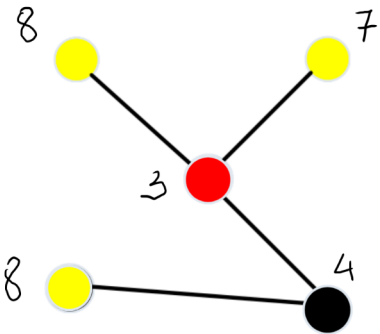
$$w(\text{Red}) = 3$$

---

$$15$$

# « Jé » as Generosity

At work...



$$\begin{array}{r} w(\text{Black}) = 4 \\ w(\text{Yellow}) = 8 \\ w(\text{Red}) = 3 \\ \hline 15 \end{array}$$

And outside !



# Jérôme, complexity and approximation

1. « Jé » as Generosity
2. « R » as **Ratio**
3. « O » as Operational (?)
4. « M » as 'Mais t'es bête ou quoi ?'
5. « E » as the End

# « R » as Ratio

Approximation algorithms.

Def: A is an  $\gamma$ -approximation algo:

$$\forall G, \text{val}(A(G)) \leq \gamma \times \text{opt}(G)$$

# « R » as Ratio

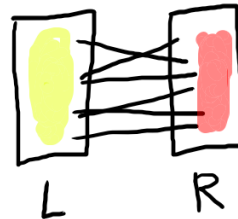
Approximation algorithms.

Def: A is an  $r$ -approximation algo:

$$\forall G, \text{val}(A(G)) \leq r \times \text{opt}(G)$$

Weighted coloring :

$G$  : bipartite



$$w(L) \leq W_{\max}$$

$$w(R) \leq W_{\max}$$

---

$$\text{val} \leq 2W_{\max}$$

$$W_{\max} \leq \text{opt}(G)$$

$$\rightarrow \text{val} \leq 2 \text{opt}(G)$$

# « R » as Ratio

Approximation algorithms.

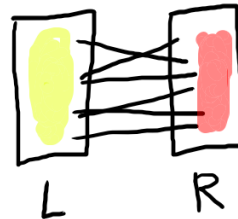
Def: A is an  $r$ -approximation algo:

$$\forall G, \text{val}(A(G)) \leq r \times \text{opt}(G)$$

Th (ISAAC '04): There exists  
a  $\frac{8}{7}$ -appx algo. in bipartite graphs

Weighted coloring :

$G$ : bipartite



$$w(L) \leq W_{\max}$$

$$w(R) \leq W_{\max}$$

$$\text{val} \leq 2W_{\max}$$

$$W_{\max} \leq \text{opt}(G)$$

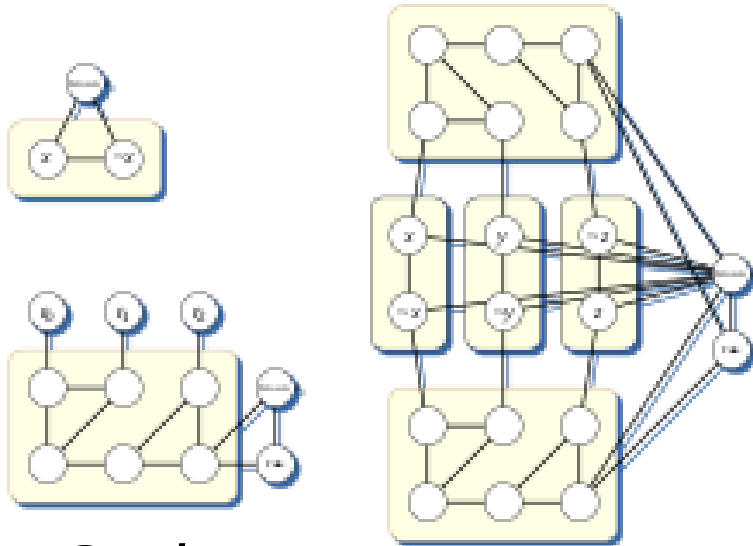
$$\rightarrow \text{val} \leq 2 \text{opt}(G)$$



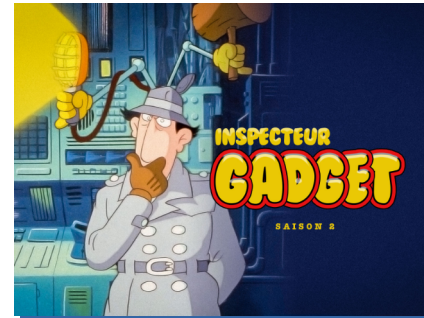
# « R » as Ratio

Negative results : NP-hardness, approximation hardness

*Jérôme, the art of designing reductions*



*Gadget*



# « R » as Ratio

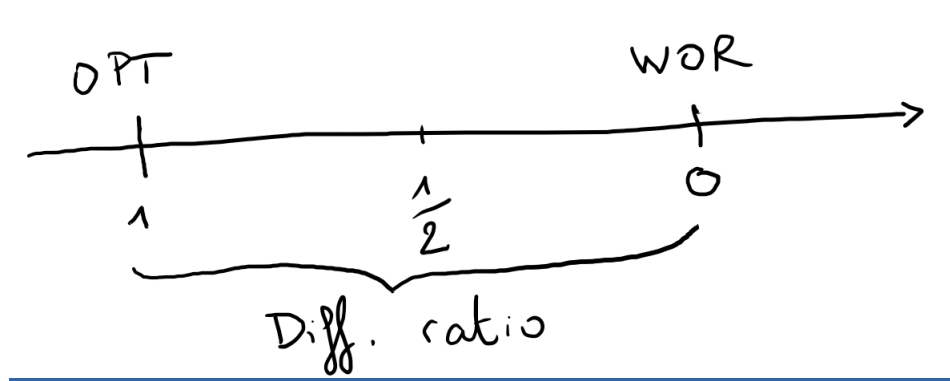
Weighted coloring :

Th (ISAAC '04): There exists  
a  $\frac{8}{7}$ -approx algo. in bipartite graphs

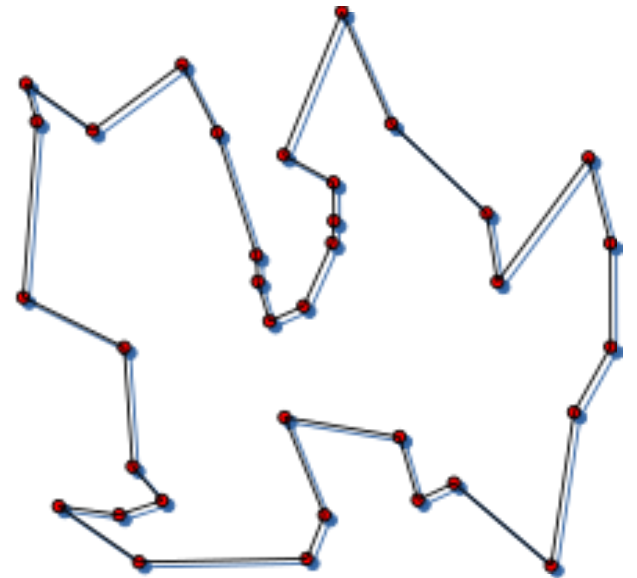
Th (WG'02): There is no  $(\frac{8}{7} - \epsilon)$ -approx algo  
in bipartite graphs, unless  $P = NP$ .

# « R » as Ratio

**Differential** approximation



Traveling salesman problem



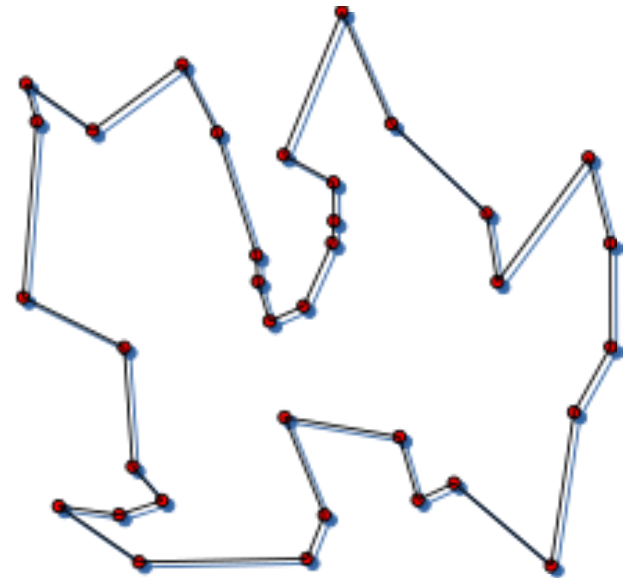
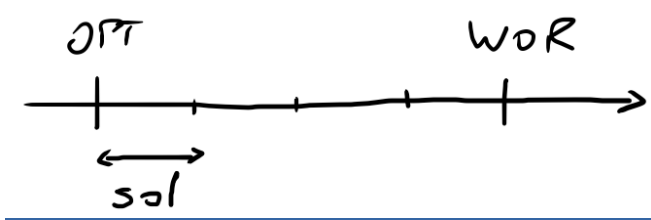
# « R » as Ratio

**Differential** approximation

Traveling salesman problem

IPL'01, EJOR'02, TCS'08

Th (TCS'08): There is a  $(\frac{3}{4} - \epsilon)$ -diff.  
appx. algo for TSP



# « R » as Ratio

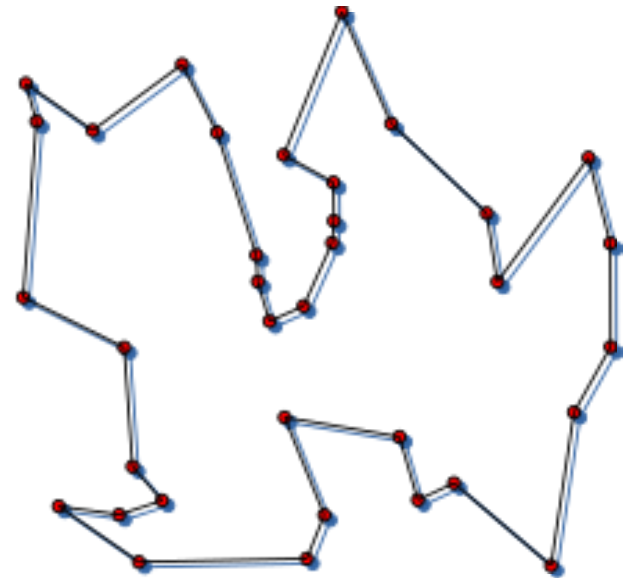
**Differential** approximation

Traveling salesman problem

IPL'01, EJOR'02, TCS'08

Th (TCS'08): There is a  $(\frac{3}{4} - \epsilon)$ -diff.  
approx. algo for TSP

Note : improved to  $3/4$  in 2020 !  
(Amano, Makino, Arxiv)



# « R » as Ratio

Weighted coloring, TSP, but also...

Spanning tree, Steiner Tree, Hamiltonian Path and Routing problems, Set Cover, Hypocoloring, Matching, Path Partition, Independent Set, Connected Vertex Cover, Dominating Set, Upper Domination, Labeled problems,...

With 76 co-authors

# Jérôme, complexity and approximation

1. « J é » as Generosity
2. « R » as Ratio
3. « O » as **Operational (?)**
4. « M » as 'Mais t'es bête ou quoi ?'
5. « E » as the End

# « Ô » as Operational (?)

For Jérôme, a computer is for :



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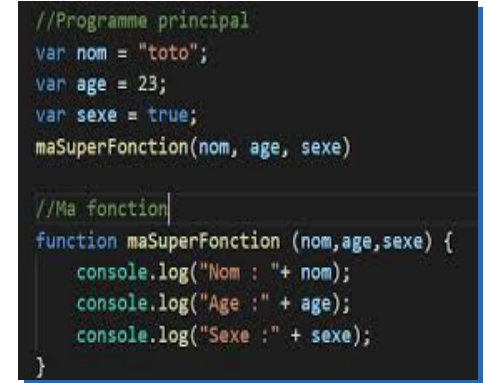
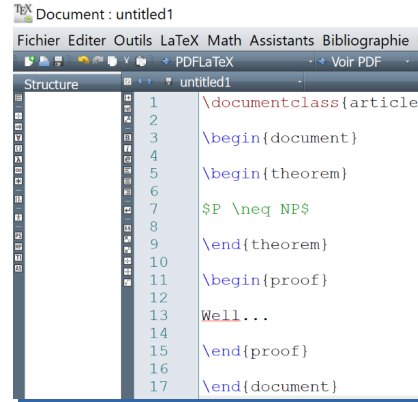
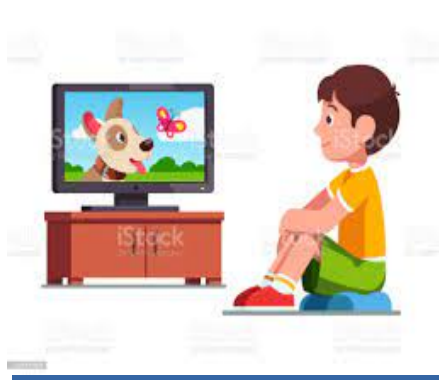


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PDFLaTeX Voir PDF
Structure untitled1
1 \documentclass{article}
2
3 \begin{document}
4
5 \begin{theorem}
6
7 $P \neq NP$
8
9 \end{theorem}
10
11 \begin{proof}
12
13 Well...
14
15 \end{proof}
16
17 \end{document}
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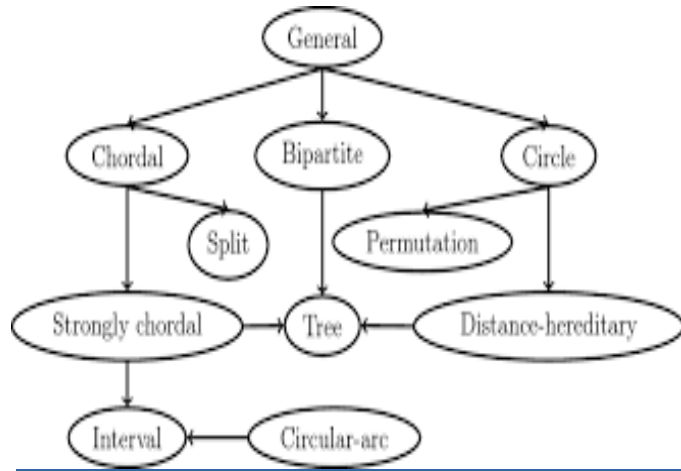


# « Ô » as Operational (?)

For Jérôme, a computer is for :



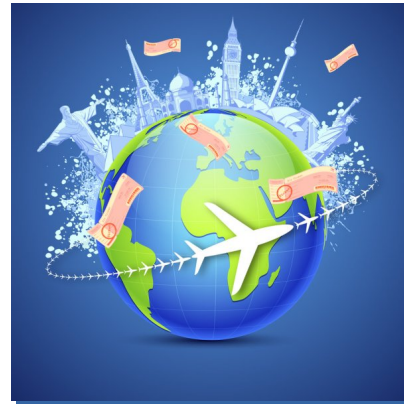
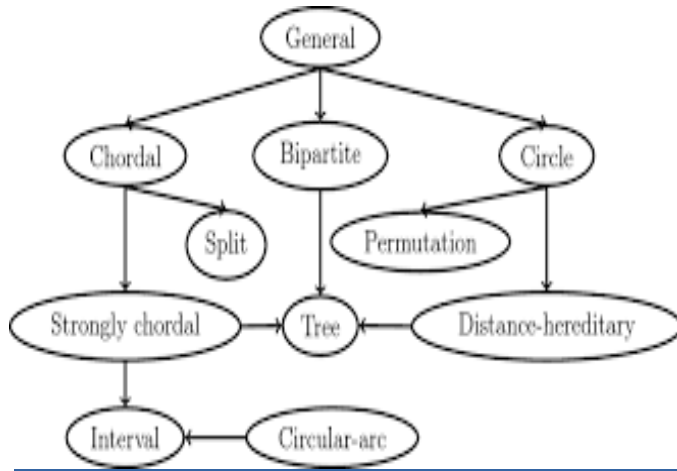
# « Ô » as Operational (?)



# « Ô » as Operational (?)

With more or less success :-)

Concept of  
worldtour paper

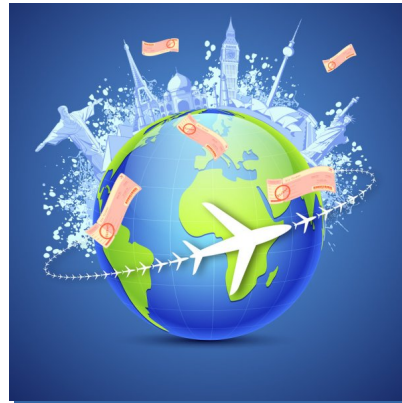
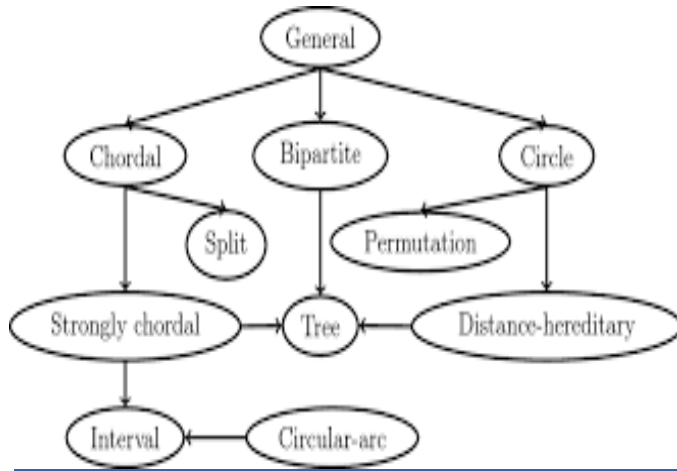


# « Ô » as Operational (?)

With more or less success :-)

Concept of  
worldtour paper

Your article is  
accepted but ...



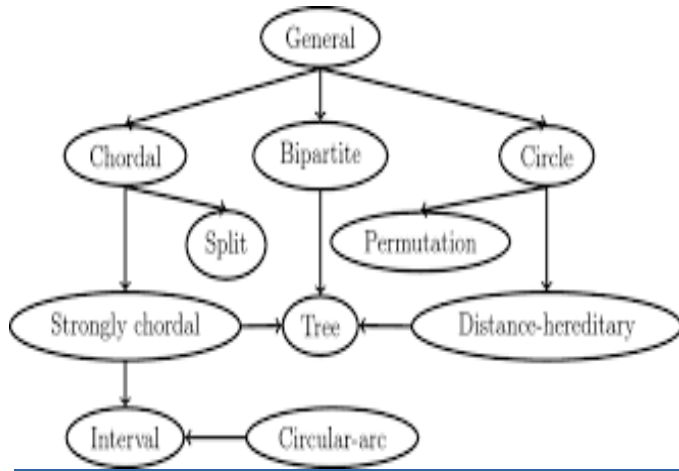
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Your article is  
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3. « O » as Operational (?)
4. « M » as **‘Mais t’es bête ou quoi ?’**
5. « E » as the End

« M » as « Mais t'es bête ou quoi »

Working sessions with Jérôme

« Prends un feutre et va au tableau »



« M » as « Mais t'es bête ou quoi »

Working sessions with Jérôme

« Prends un feutre et va au tableau »

« Mais t'es bête ou quoi »



« M » as « Mais t'es bête ou quoi »

Working sessions with Jérôme

« Prends un feutre et va au tableau »

« Mais t'es bête ou quoi »

Always with humor – including  
self-mockery !



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# « E » as the End

Bye bye Jéjé

