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## INFOVIS: HIERARCHY AND GRAPHS

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# INFOVIS: HIERARCHY AND GRAPHS

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Bib: Alexandru C. Telea, Data Visualization: Principles and Practice. (Capítulo 11)

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## Graphs

- Represent relationships, such as:
  - Communication in Social Networks
  - Network traffic
  - Word semantic
  - Precedence
  - Routes

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## Trees

- Represent Hierarchy. Native applications such as:
  - Phylogenies
  - Family trees
  - File Structure
  - Government
  - ??

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## Trees and Graphs – non native

- Abstract structures
  - Similarities
  - Correlations
  - Precedence
  - Transformation
  - Etc.

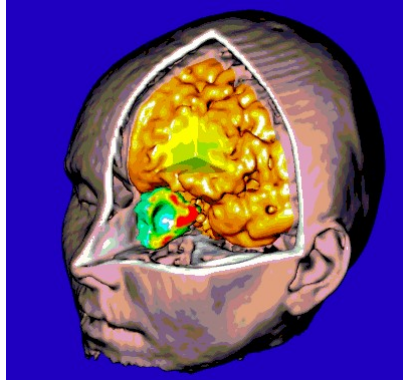
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## Types of data and SciVis

- Scientific Visualization vs. Infovis
- Ex:
  - SciVis
    - Mesh with scalar and vector data in each point
  - InfoVis
    - Attribute tables and similarity matrices

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## Parenthesis: SciVis in contrast with InfoVis



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## Parenthesis: SciVis in contrast with InfoVis

- SciVis: physical phenomena.
- Measurements and simulations
  - Applications: engineering, medicine, physics and other sciences.
- Data types: scalar, vector, tensor

## Data Types in Infovis

- May be more than numbers.
- They can be:
  - Nominal, ordinal, binary, discrete, continuous, and so on
  - Time varying and streaming

## Types of Attributes in InfoVis

Tipo de Dados	Domínio do Atributo	Operações	Exemplos
Nominal	Conjunto não ordenado	Comparação (=, ≠)	Texto, referências, elementos sintáticos, qualificadores
Ordinal	Conjunto ordenado	Ordenação (>, <, ≥, ≤)	Pontuação (ex. bom, médio, ruim)
Discreto	Conj. Inteiros e Naturais	Aritmética inteira	Contagem (ex. número de filhos, número de linhas de código, etc..)
Contínuo	Conj Real	Aritmética real	Taxas e medidas (ex. distância, similaridade, altura)
Relacionais	“tuplas” dos nominais	Agrupamentos, coleções	Ex. (co-autores, colegas, sócios, etc..)

## Types of Attributes in InfoVis

- Qualitative or quantitative?
  - Nominal and Ordinal qualitative
  - Discrete and continuous quantitative
  - Categorical may be nominal, ordinal, and discrete.

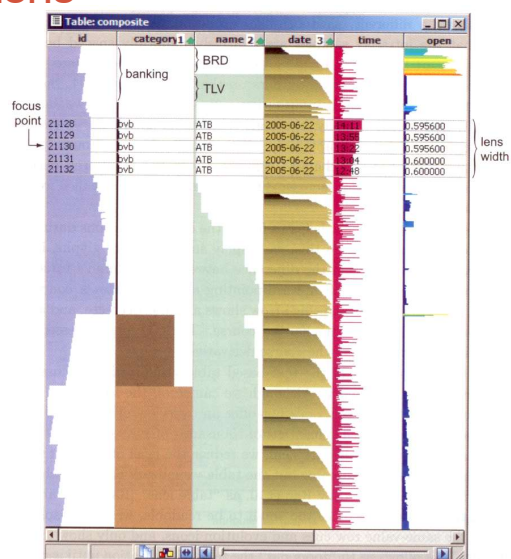
## Differences between types of Data in Infovis and SciVis

	SciVis	Infovis
<b>Data domain</b>	spatial $\subset \mathbb{R}^n$	abstract, non-spatial
<b>Attribute types</b>	numeric $\subset \mathbb{R}^m$	any data types
<b>Data points</b>	samples of attributes over domain	tuples of attributes without spatial location
<b>Cells</b>	support interpolation	describe relations
<b>Interpolation</b>	piecewise continuous	can be inexistent

## Table visualization

- Each column describes typically a separate attribute.
- Each table cell can have any of the previously mentioned data types.

## Table Lens



## Tree Visualization

- Árvores são um tipo particular de dados relacionais
- Uma árvore possui um conjunto de nós e arestas
  - Toda aresta liga um par de nós
- Na prática, um par de nós são ligados com base em uma semântica específica

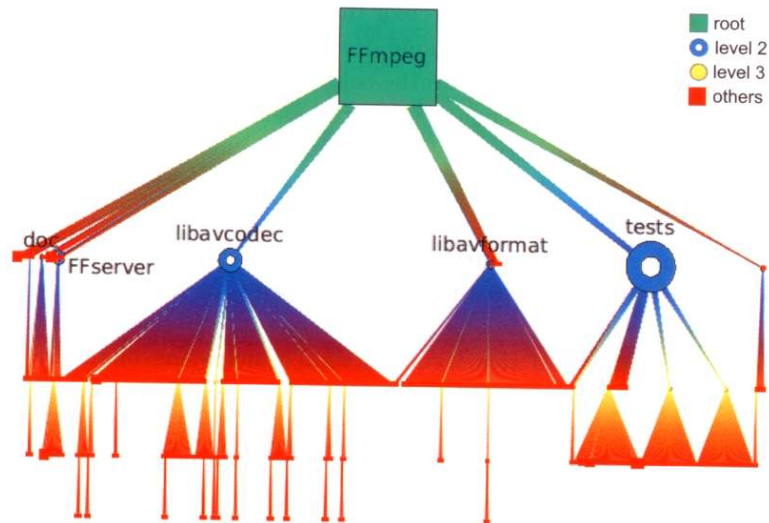
## Tree Visualization: ball-and-stick

- Ball-and-stick visualization also known as node-and-link visualization
- It maps:
  - Nodes as *glyphs*
  - Edges as lines and shapes
- Much screen space is necessary



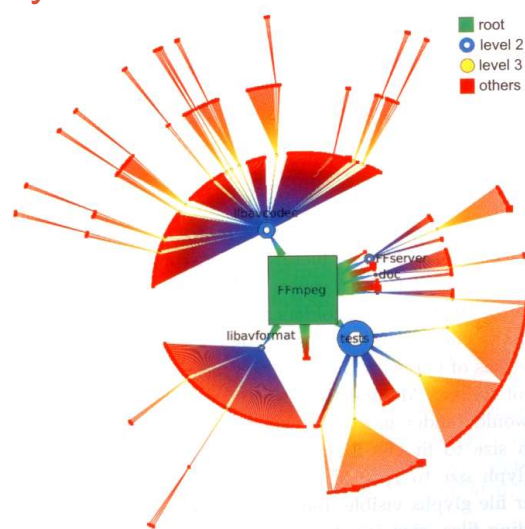
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## Ball-and-stick: file hierarchy Rooted tree layout

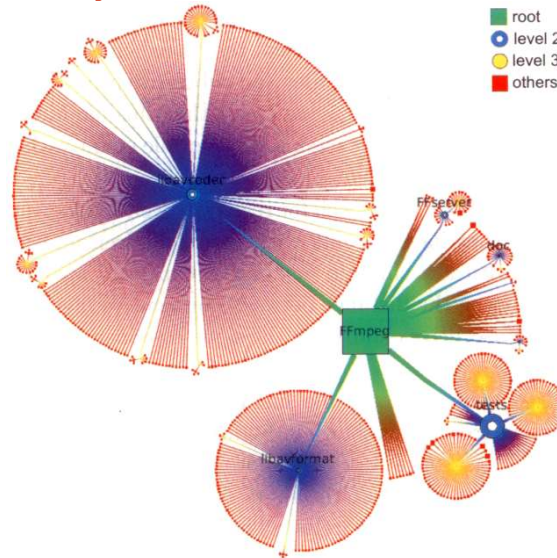


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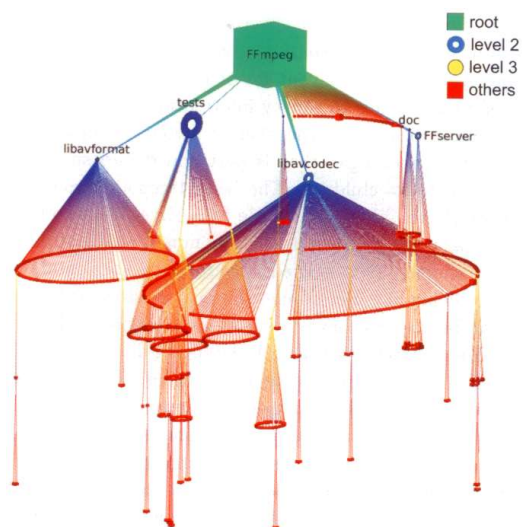
## Ball-and-stick: file hierarchy Radial Layout



### Ball-and-stick: file hierarchy Bubble-tree Layout



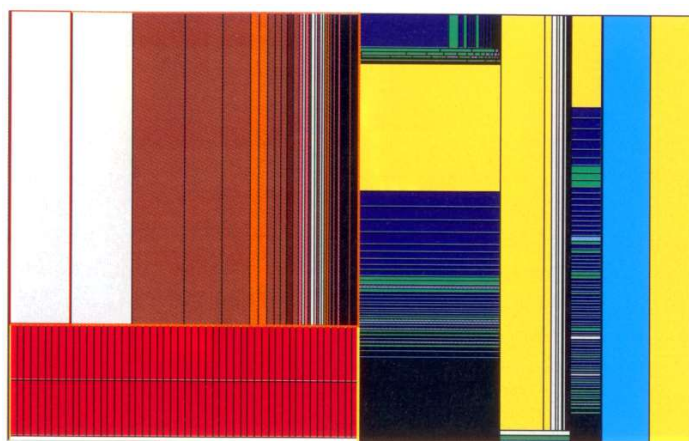
### Ball-and-stick: file hierarchy Cone-tree Layout



## Treemaps

- Presenting tree using all available pixel space
- Main approach
  - Sub-trees are rectangles
  - Rectangles are subdivided to contain further sub-trees.
  - Direction of subdivision is orthogonal to previous level

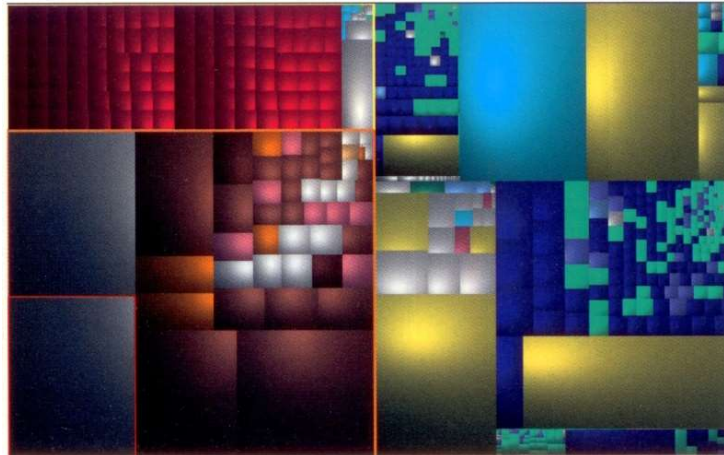
## Treemaps: file hierarchy



■ pgm   ■ c   ■ dll   ■ wav   ■ obj  
□ others   ■ cpp   ■ exe   ■ avi   ■ mov

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## Treemaps: file hierarchy Squarified treemap layout



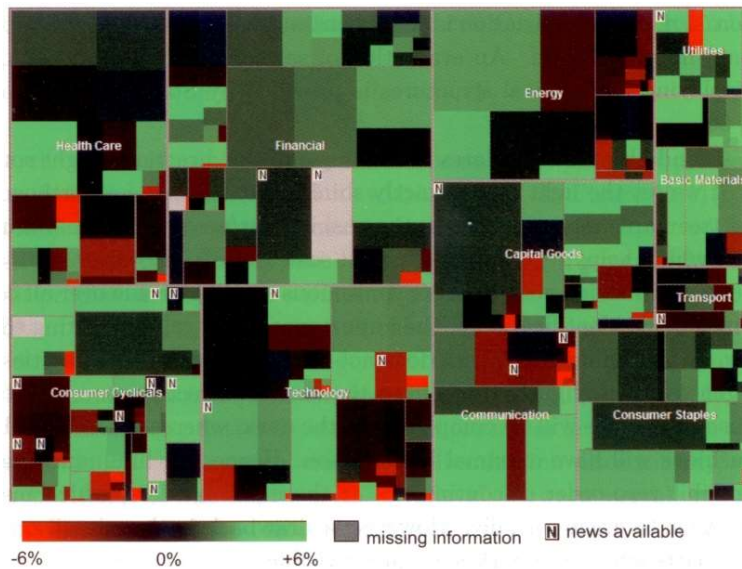
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## Treemaps: stock Market evolution in a year

- Rectangle
  - Firm
- Size
  - Capitalization in the market
- Color
  - Price fluctuation in the period
- *Glyph* 'N' indicates companies with interesting News in the financial Market.

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## Treemaps: evolução das bolsas no período de um ano



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## A special type of text

- Program/system code
- Software Evolution
- Plagiarism?

## Example: Code

- Visualization of C code with Seesoft
- Colors: age
  - Red recently modified
  - Blue code not changed for a log time.
- Small Windows with details
  - Actual source code

## Code

The screenshot shows the Seesoft IDE interface. The main window displays a grid of code files, each with a vertical color bar on its left side. The colors range from blue (older code) to red (recently modified code). A central window is open, showing the source code for 'file1.c, line 408 of 834'. The code is as follows:

```

*(IS_GET_DAT (pctx1st_ptr))
{
    /* Get DSL Information */
    /* the macro call IS_GET_DAT has ja
    /* the DFB for us, how lucky we are!
    */
    dsinfo.dsl = ddb_ptr->pdf;
    /* Use #Retval for RTERRASSRY/RTI
    RtRetval = dGetInput(LDLEOLUP, st
    switch (RtRetval) {
    case GLSUCCESS:
        break;
    }
}

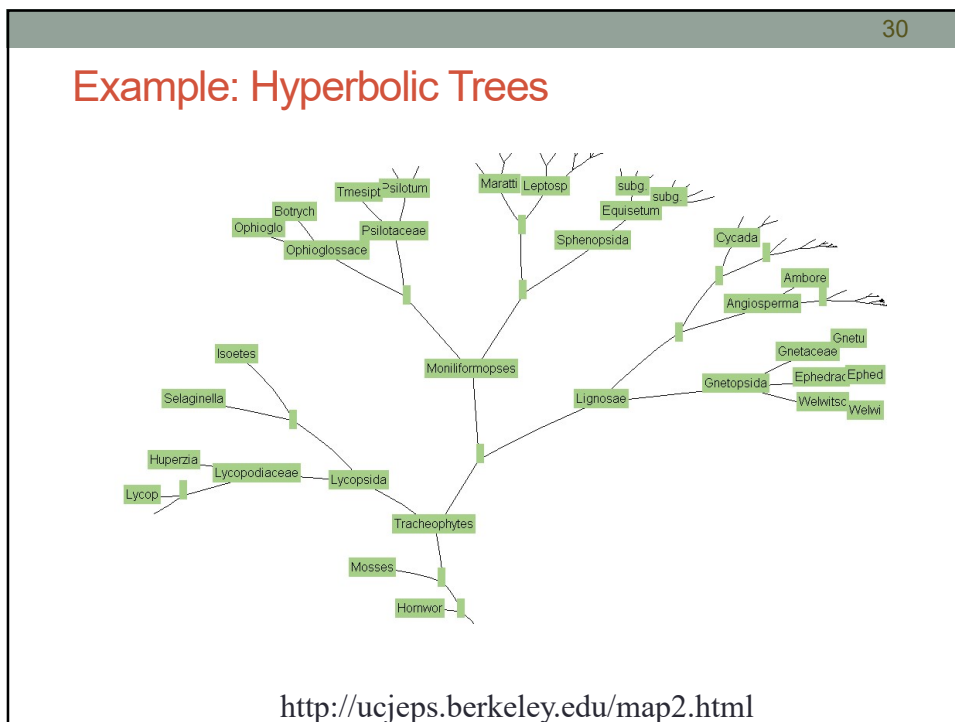
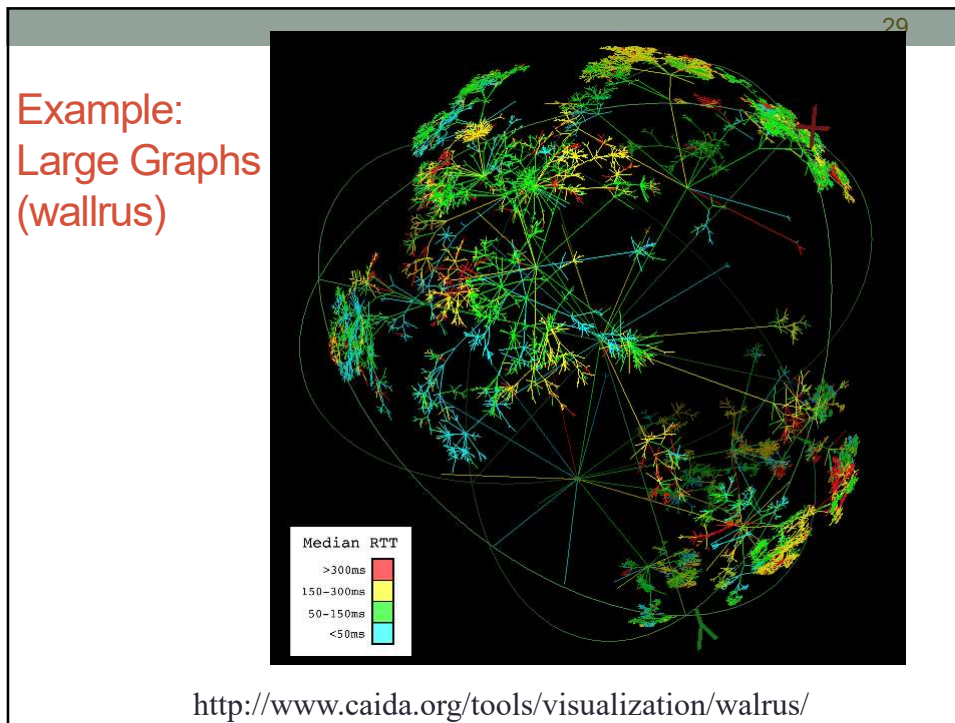
```

At the bottom left of the IDE, there is a status bar with the following information:

```

Stats 327227227
lines 18255/18255/18255
files 828262

```





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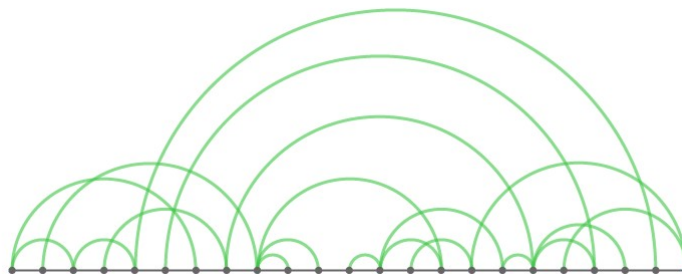
## Graph Layouts

- Node – link
  - Force-based
  - Ring
  - Spectral or Connectivity – based
  - Arcs - linear

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## Graph Layouts

- Arcs

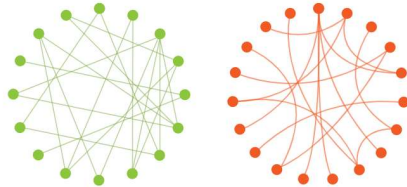


<https://datavizcatalogue.com/>



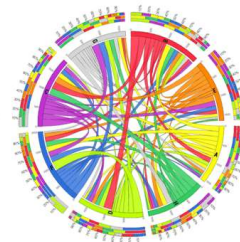
## Graph Layouts

- Ring / chord



<https://datavizcatalogue.com/>

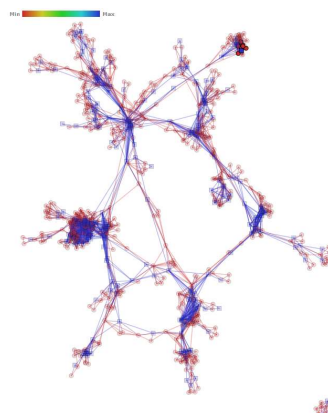
	A	B	C	D	E	F	G	H
A	54	133	157	94	88	145	167	133
B	49	113	111	113	202	53	7	92
C	66	230	69	862	223	62	106	817
D	60	138	49	85	98	98	122	87
E	53	86	15	91	91	20	69	127
F	118	32	62	219	135	95	60	64
G	134	108	73	44	103	139	37	145
H	74	210	84	120	9	42	45	131



[http://circo.ca/intro/tabular\\_visualization/](http://circo.ca/intro/tabular_visualization/)

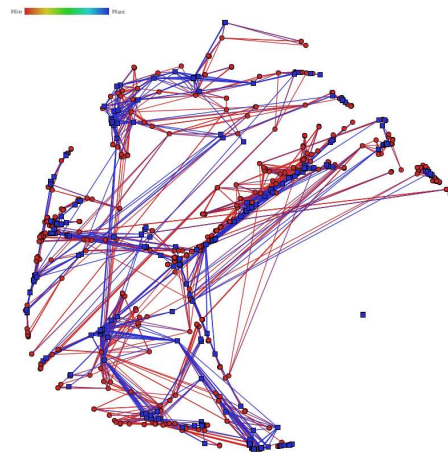
## Graph Layouts

- Force-based



## Graph Layouts

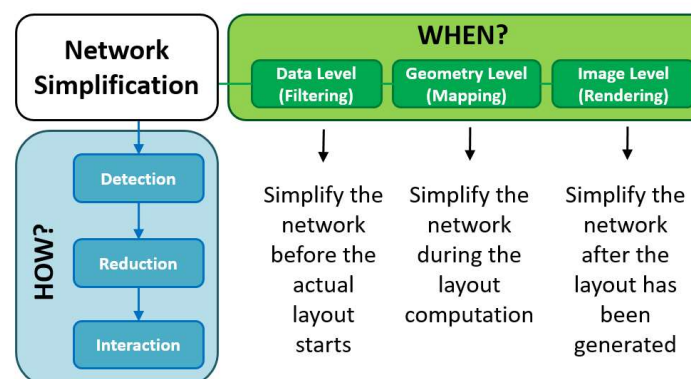
- Connectivity based / Spectral



## Large Graphs

- Compact/ Multiscale views

A Conceptual Framework to Solve this Problem



Fonte: Hans-Jörg Schulz, Christophe Hurter. Grooming the hairball - how to tidy up network visualizations?. INFOVIS 2013, IEEE Information Visualization Conference, Oct 2013, Atlanta, United States.

## References

- Alexandru C. Telea. **Data visualization: principles and practice**. A K Peters. Ltd. Capitulo 11.
- MARTINS, R.; ANDERY, G. F.; HEBERLE, H.; PAULOVICH, F. V.; LOPES, A. A.; PEDRINI, H.; MINGHIM, R. **Multidimensional Projections for Visual Analysis of Social Networks**  
Journal of Computer Science and Technology (2012)