Tools Seminar

Week 9 - Visualization

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Overview

Visualization*

Visualization is used to **gain or show insights through data**

- Information visualization
  - not only statistical charts; various visualization forms help to show multi-attributes, topological structure, and complex relationships
  - actually it is a sub-topic of human-computer interaction (HCI) with top-tier conference CHI
  - good visualizations help your paper to be accepted!
- Scientific visualization
  - a sub-topic of CG
  - emphasizing on realistic renderings of volumes, surfaces, illumination sources, etc.

We will focus on information visualization

*Ref: https://shellywhen.github.io/Visualization/Outline-Visualization.html#slide=3

Catalog of Information visualization

- Tables
- Bar charts
- Flow charts
- Functions
- Graphs / Networks
- Time series
- Text
- Geo-spacial
- ...

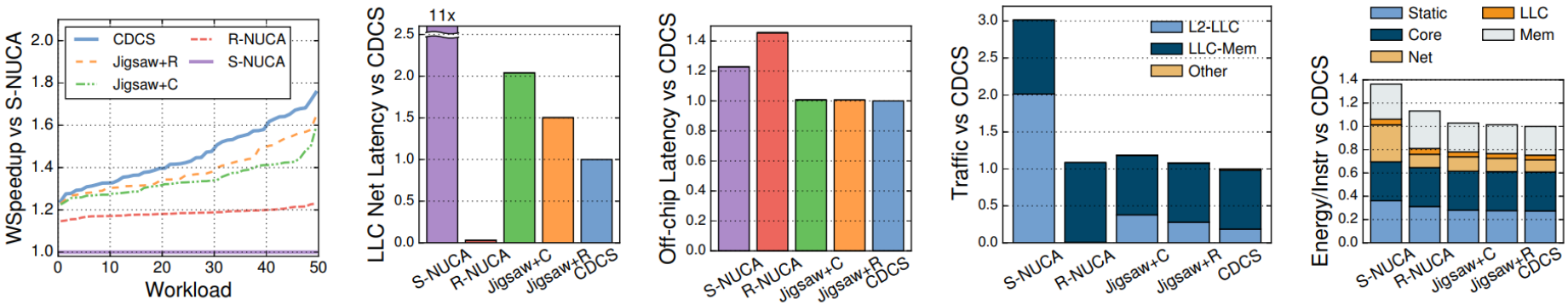
Tables

The most commonly seen data type

	Col 1	Col 2	Col 3
Row 1			
Row 2			
Row 3			

Tools: Excel, Tableau, LaTeX

Bar Charts



(a) Distribution of weighted speedups over S-NUCA. (b) Avg. on-chip latency on LLC accesses. (c) Avg. off-chip latency (due to LLC misses). (d) Breakdown of avg. on-chip network traffic per instruction. (e) Breakdown of avg. energy per instruction.

Fig source: Nathan Beckmann, Po-An Tsai, Daniel Sanchez, *Scaling Distributed Cache Hierarchies through Computation and Data Co-Scheduling*, HPCA, 2015

Tools: Matplotlib, Plotly

* Pay attention to the figures when you read papers. There exists lots of details!

Flow charts

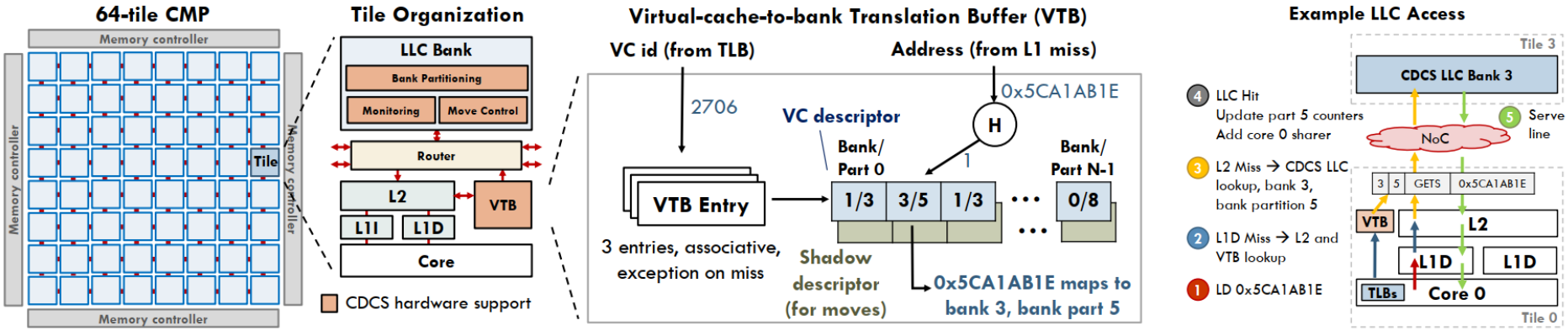
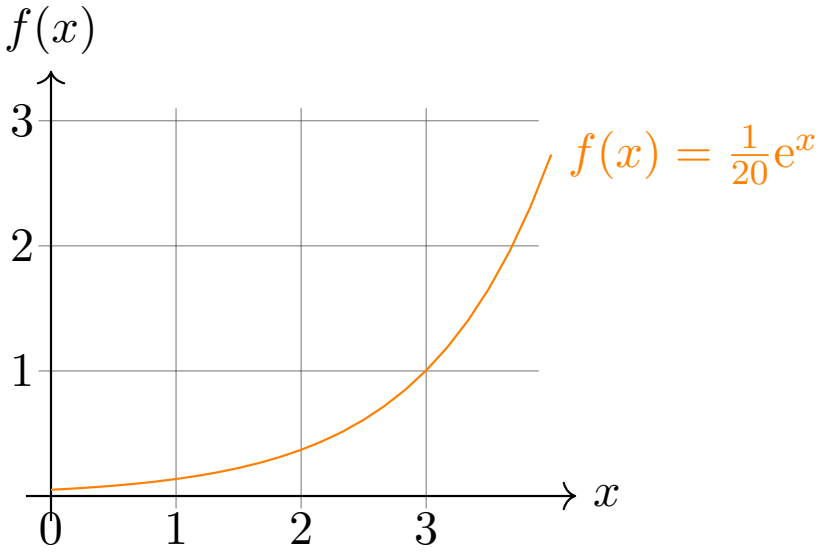
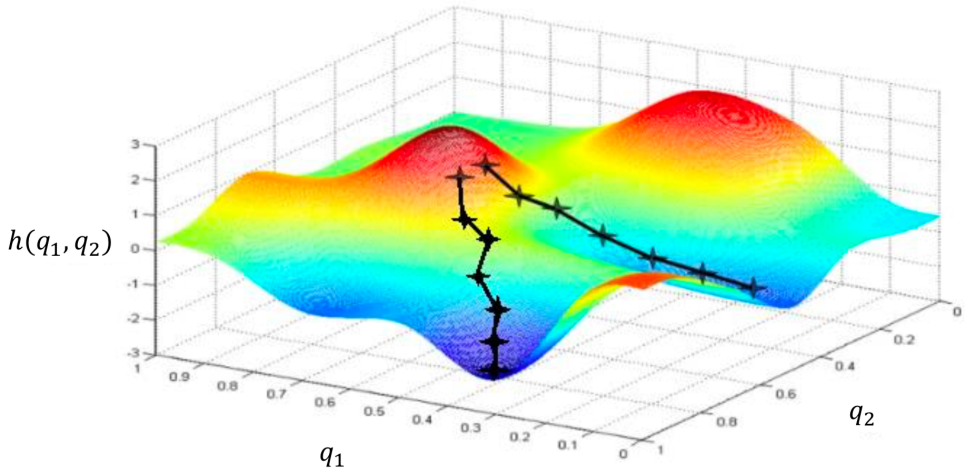


Fig source: Nathan Beckmann, Po-An Tsai, Daniel Sanchez, *Scaling Distributed Cache Hierarchies through Computation and Data Co-Scheduling*, HPCA, 2015

Tools: Microsoft Visio (enterprise version), draw.io

Functions (2D & 3D)





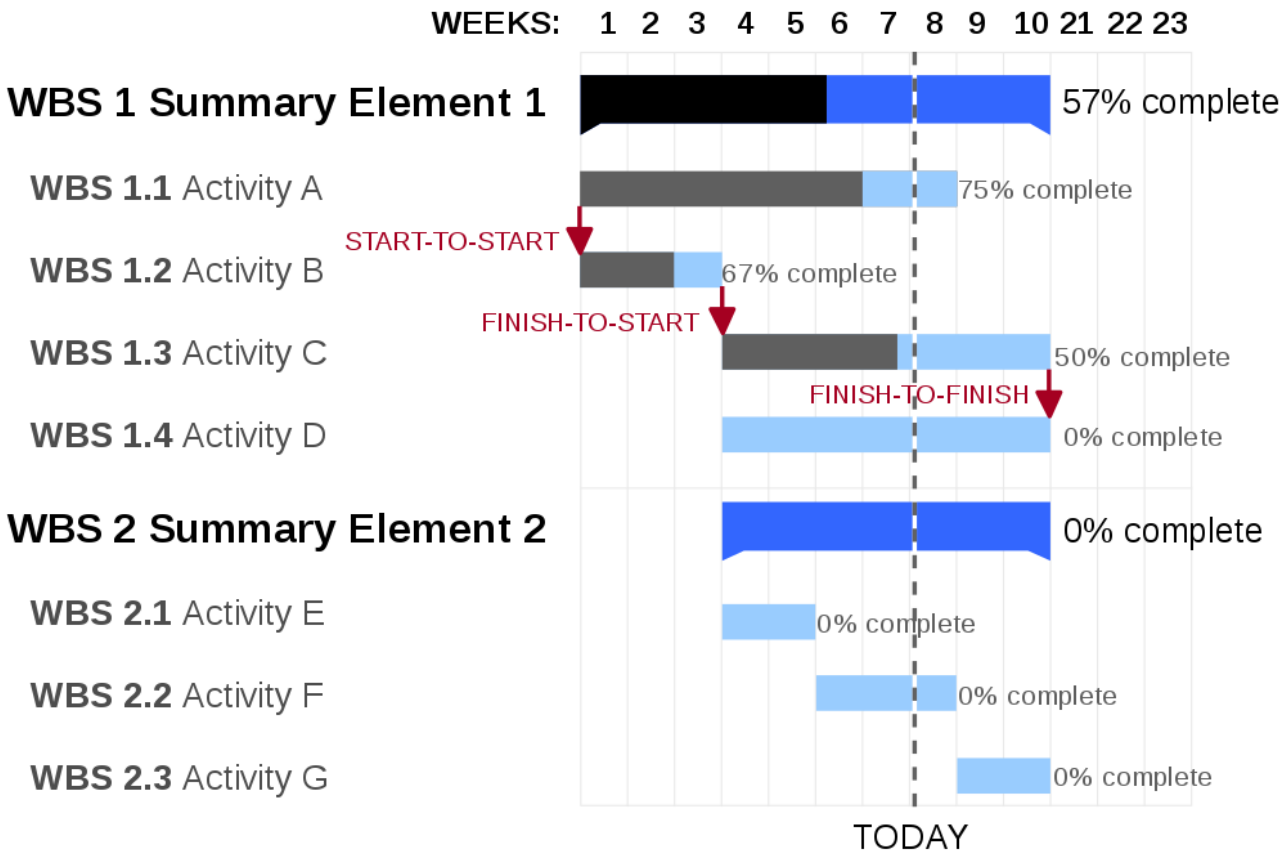
Tools: Matplotlib, Mathematica, LaTeX TikZ

Graphs/Networks

Fig source: https://digi.uga.edu/network-graphs/

- Node-link diagram, tree map, bubble chart
- Tools: networkx, LaTeX Tikzcd, LaTeX forest, Plotly

Time Series



- Line graph / Bar charts
- Gantt Chart
- Heat Map: Check your Github contribution (

Text

Tools: WordCloud, Wordle, . . .

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Matplotlib

Matplotlib

Matplotlib: A Python 2D plotting library which produces publication quality figures in a variety of hardcopy formats and interactive environments across platforms

`pip install matplotlib`

- Use Anaconda to install since the figure will pop out as a graphical window
- If you use WSL, you need to install graphical support
- **Highly recommend** to use Jupyter Notebook no matter which OS you use

* See `matplotlib.ipynb` for demos

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Draw.io

Draw.io

Draw.io is free online diagram software for making flowcharts, process diagrams, org charts, UML, ER and network diagrams

- Web-based
- Open-sourced
- Support LaTeXformulas
- Export as pdf files

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TikZ

TikZ

TikZ and PGF are TEXpackages for creating graphics programmatically

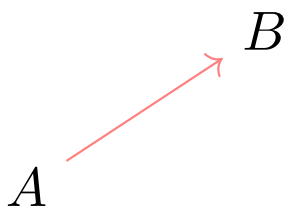
- If you have installed TeXLive completely, TikZ must has been installed
- Called by `\usepackage{tikz}`
- Manual: http://www.texample.net/media/pgf/builds/pgfmanualCVS2012-11-04.pdf
- English tutorial from Overleaf: https://www.overleaf.com/learn/latex/TikZ_package
- Chinese tutorial: https://www.latexstudio.net/archives/9774
- Wiki book: https://en.wikibooks.org/wiki/LaTeX/PGF/TikZ

* Tikz-cd: commutative diagrams

TikZ Basis

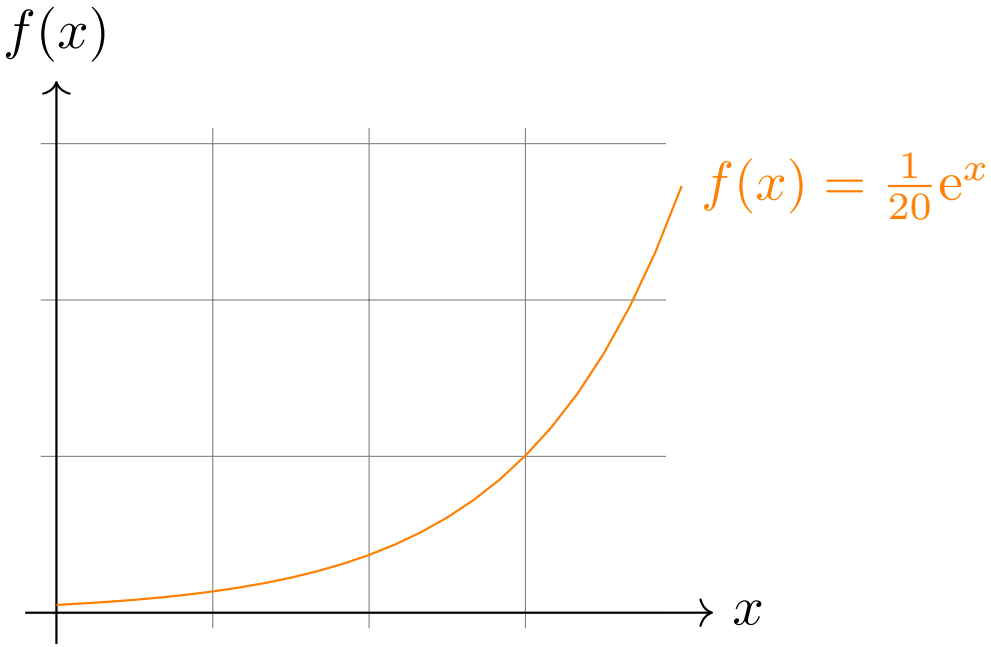
- `\begin{tikzpicture} ... \end{tikzpicture}`
- `\node [attribute] (nodelabel) at (coordinate) {texts};`
- `\draw (nodelabel) to (nodelabel);`
- Every command ends with `;`

TikZ Example



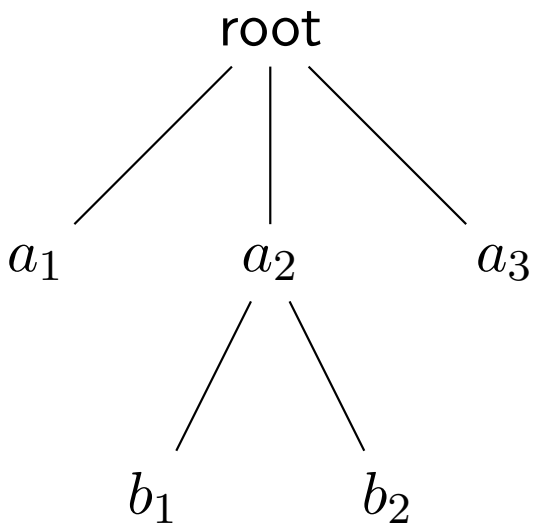

```
\begin{tikzpicture}
\node [left] (a) at (0,0) {$A$};
\node [right] (b) at (1,1) {$B$};
\draw [color=red!50,->] (a) -- (b);
\end{tikzpicture}
```

* Use `cycle` to draw closed curves

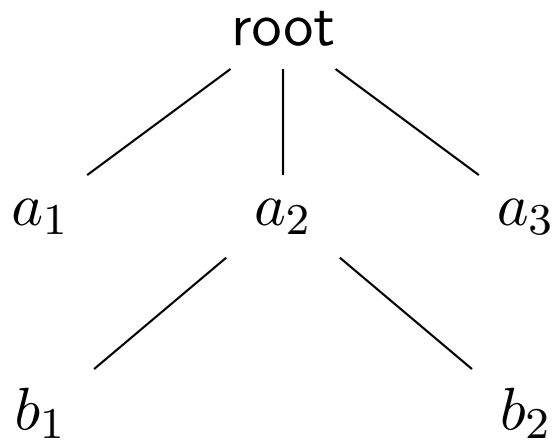



```
\begin{tikzpicture}[domain=0:4]
\draw[very thin,color=gray] (-0.1,-0.1) grid (3.9,3.1);
\draw[->] (-0.2,0) -- (4.2,0) node[right] {$x$};
\draw[->] (0,-0.2) -- (0,3.4) node[above] {$f(x)$};
\draw[color=orange] plot (\x,{0.05*exp(\x)})
    node[right] {$f(x) = \frac{1}{20} \mathrm e^x$};
\end{tikzpicture}
```

Tree

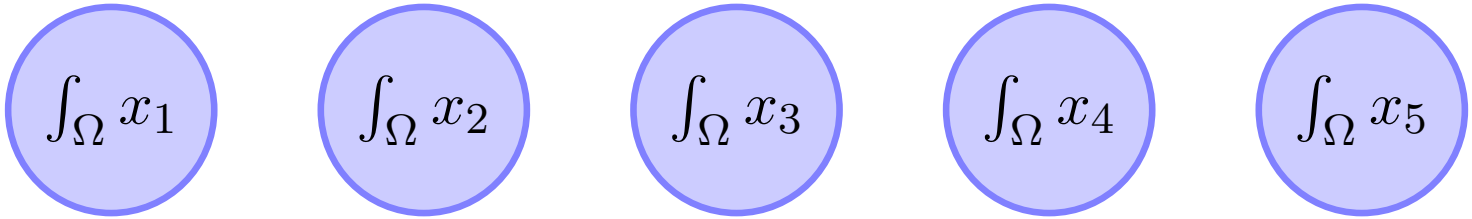



```
\begin{tikzpicture}
\node {root}
    child {node {$a_1$}}
    child {node {$a_2$}
        child {node {$b_1$}}
        child {node {$b_2$}}}
    child {node {$a_3$}};
\end{tikzpicture}
```




```
\begin{tikzcd}[column sep=scriptsize]
& \text{root}\arrow[dash,dl]
  \arrow[dash,d]\arrow[dash,dr] & \\
a_1 & a_2\arrow[dash,dl]\arrow[dash,dr] & a_3\\
b_1 & & b_2
\end{tikzcd}
```

Control Command (Loop)




```
\begin{tikzpicture}
[L1Node/.style={circle,
    draw=blue!50, fill=blue!20, very thick,
    minimum size=10mm},
 L2Node/.style={rectangle,
    draw=green!50, fill=green!20, very thick,
    minimum size=10mm}]
\foreach \x in {1,...,5}
    \node[L1Node] (w1_\x) at (2*\x, 0){$\int_\Omega x_\x$};
\end{tikzpicture}
```

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Summary

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- TikZ