

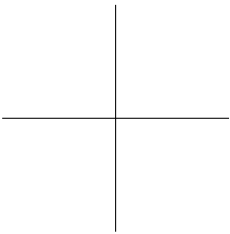
Tex Drawing using PGF

Zheng Rui

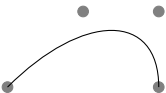
November 2, 2014

Fun starts from here:

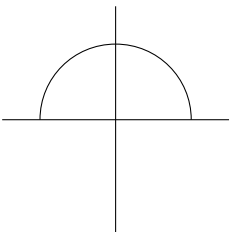
```
\begin{tikzpicture}
  \draw (-1.5, 0) -- (1.5, 0);
  \draw (0, -1.5) -- (0, 1.5);
\end{tikzpicture}
```



```
\begin{tikzpicture}
  \filldraw [gray] (0,0) circle (2pt)
    (1,1) circle (2pt)
    (2,1) circle (2pt)
    (2,0) circle (2pt);
  \draw (0,0) .. controls (1,1) and (2,1) .. (2,0);
\end{tikzpicture}
```



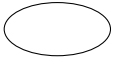
```
\begin{tikzpicture}
  \draw (-1.5,0) -- (1.5,0);
  \draw (0,-1.5) -- (0,1.5);
  \draw (-1,0) .. controls (-1,0.555) and (-0.555,1) .. (0,1)
    .. controls (0.555,1) and (1,0.555) .. (1,0);
\end{tikzpicture}
```



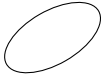
```
\tikz \draw (0,0) circle (10pt);
```



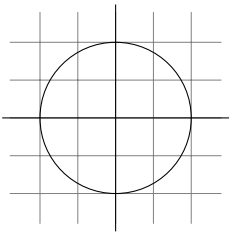
```
\tikz \draw (0,0) ellipse (20pt and 10pt);
```



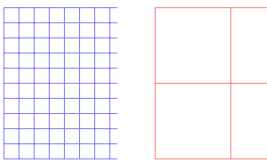
```
\tikz \draw[rotate=30] (0,0) ellipse (20pt and 10pt);
```



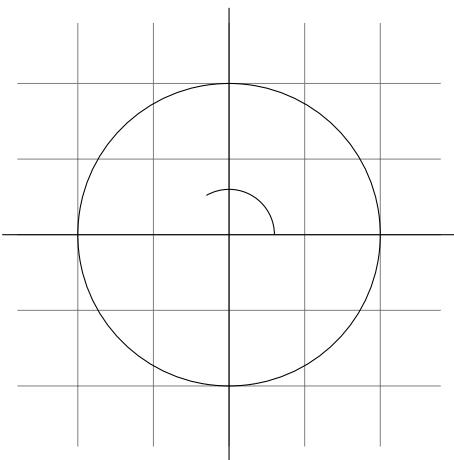
```
\begin{tikzpicture}
  \draw[step=.5cm, gray, very thin] (-1.4,-1.4) grid (1.4, 1.4);
  \draw (-1.5,0) -- (1.5,0);
  \draw (0,-1.5) -- (0,1.5);
  \draw (0,0) circle (1cm);
\end{tikzpicture}
```



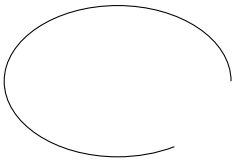
```
\begin{tikzpicture}
  [rui's grid/.style = {help lines, color=#1!50},
   rui's grid/.default = blue]
  \draw[step=.2cm, rui's grid] (0,0) grid (1.5,2);
  \draw[rui's grid=red] (2,0) grid (3.5,2);
\end{tikzpicture}
```



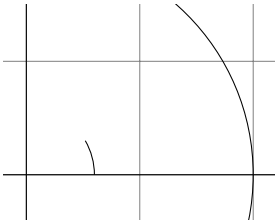
```
\begin{tikzpicture}[scale = 2]
  \draw[step=.5cm,gray,very thin] (-1.4,-1.4) grid (1.4,1.4);
  \draw (-1.5,0) -- (1.5,0);
  \draw (0,-1.5) -- (0,1.5);
  \draw (0,0) circle (1cm);
  \draw (3mm,0mm) arc (0:120:3mm);
\end{tikzpicture}
```



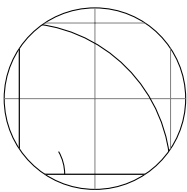
```
\tikz \draw (0,0) arc (0:300:1.5cm and 1cm);
```



```
\begin{tikzpicture}[scale=3]
  \clip (-0.1,-0.2) rectangle (1.1,0.75);
  \draw[step=.5cm,gray,very thin] (-1.4,-1.4) grid (1.4,1.4);
  \draw (-1.5,0) -- (1.5,0);
  \draw (0,-1.5) -- (0,1.5);
  \draw (0,0) circle (1cm);
  \draw (3mm,0mm) arc (0:30:3mm);
\end{tikzpicture}
```



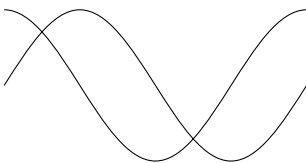
```
\begin{tikzpicture}[scale=2]
  \clip[draw] (0.5,0.5) circle (.6cm);
  \draw[step=.5cm,gray,very thin] (-1.4,-1.4) grid (1.4,1.4);
  \draw (-1.5,0) -- (1.5,0);
  \draw (0,-1.5) -- (0,1.5);
  \draw (0,0) circle (1cm);
  \draw (3mm,0mm) arc (0:30:3mm);
\end{tikzpicture}
```



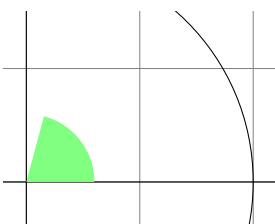
```
A sine \tikz \draw[x=1ex,y=1ex]
      (0,0) sin (2,1) cos (4,0) sin (6,-1) cos (8,0);
curve.
```

A sine  curve.

```
\tikz \draw (0,0) sin (1,1) cos (2,0) sin (3,-1) cos (4,0)
      (0,1) cos (1,0) sin (2,-1) cos (3,0) sin (4,1);
```



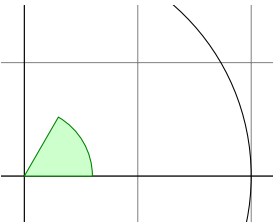
```
\begin{tikzpicture}[scale=3]
  \clip (-0.1,-0.2) rectangle (1.1,0.75);
  \draw[step=.5cm,gray,very thin] (-1.4,-1.4) grid (1.4,1.4);
  \draw (-1.5,0) -- (1.5,0);
  \draw (0,-1.5) -- (0,1.5);
  \draw (0,0) circle (1cm);
  \fill[green!50!white] (0,0) -- (3mm,0mm) arc (0:75:3mm) -- (0,0);
\end{tikzpicture}
```



```
\begin{tikzpicture}[line width=5pt]
  \draw (0,0) -- (1,0) -- (1,1) -- (0,0);
  \draw (2,0) -- (3,0) -- (3,1) -- cycle; % cycle is better
  \useasboundingbox (0,1.5); % make bounding box higher
\end{tikzpicture}
```



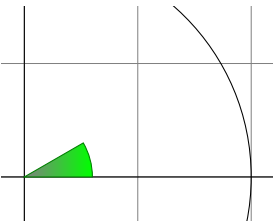
```
\begin{tikzpicture}[scale=3]
  \clip (-0.1,-0.2) rectangle (1.1,0.75);
  \draw[step=.5cm,gray,very thin] (-1.4,-1.4) grid (1.4,1.4);
  \draw (-1.5,0) -- (1.5,0);
  \draw (0,-1.5) -- (0,1.5);
  \draw (0,0) circle (1cm);
  \filldraw[fill=green!20!white, draw=green!50!black]
    (0,0) -- (3mm,0mm) arc (0:60:3mm) -- cycle;
\end{tikzpicture}
```



```
\begin{tikzpicture}[rounded corners,ultra thick]
  \shade[top color=yellow,bottom color=black] (0,0) rectangle +(2,1);
  \shade[left color=yellow,right color=black] (3,0) rectangle +(2,1);
  \shadedraw[inner color=yellow,outer color=black,draw=yellow]
    (6,0) rectangle +(2,1);
  \shade[ball color=green] (9,.5) circle (.5cm);
\end{tikzpicture}
```



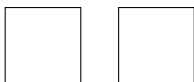
```
\begin{tikzpicture}[scale=3]
  \clip (-0.1,-0.2) rectangle (1.1,0.75);
  \draw[step=.5cm,gray,very thin] (-1.4,-1.4) grid (1.4,1.4);
  \draw (-1.5,0) -- (1.5,0);
  \draw (0,-1.5) -- (0,1.5);
  \draw (0,0) circle (1cm);
  \shadedraw[left color=gray,right color=green, draw=green!50!black]
    (0,0) -- (3mm,0mm) arc (0:30:3mm) -- cycle;
\end{tikzpicture}
```



```
\begin{tikzpicture}
  % "++" local coordinates move with pen
  \def\rectanglepath{-- ++(1cm,0cm) -- ++(0cm,1cm)
  -- ++(-1cm,0cm) --cycle}
  \draw (0,0) \rectanglepath;
  \draw (1.5,0) \rectanglepath;
\end{tikzpicture}
```

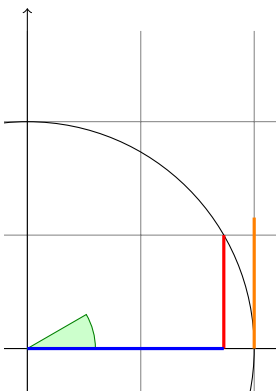


```
\begin{tikzpicture}
  \def\rectanglepath{-- +(1cm,0cm) -- +(1cm,1cm) -- +(0cm,1cm) -- cycle}
  \draw (0,0) \rectanglepath;
  \draw (1.5,0) \rectanglepath;
\end{tikzpicture}
```



```
\begin{tikzpicture}[scale=3]
  \clip (-0.1,-0.2) rectangle (1.1,1.51);
  \draw[step=.5cm,gray,very thin] (-1.4,-1.4) grid (1.4,1.4);
  \draw[>-] (-1.5,0) -- (1.5,0);
  \draw[->] (0,-1.5) -- (0,1.5);
  \draw (0,0) circle (1cm);
  \filldraw[fill=green!20,draw=green!50!black]
    (0,0) -- (3mm,0mm) arc (0:30:3mm) -- cycle;
  \draw[red,very thick] (30:1cm) -- +(0,-0.5);
  \draw[blue,very thick] (30:1cm) ++(0,-0.5) -- (0,0);

  \path [name path=upward line] (1,0) -- (1,1);
  \path [name path=sloped line] (0,0) -- (30:1.5cm);
  %find intersection of two invisible path
  \draw [name intersections={of=upward line and sloped line, by=x}]
    [very thick,orange] (1,0) -- (x);
\end{tikzpicture}
```



```
\begin{tikzpicture}[>=stealth]
  \draw [<->] (0,0) arc (180:30:10pt);
  \draw [<<- ,very thick] (1,0) -- (1.5cm,10pt)
    -- (2cm,0pt) -- (2.5cm,10pt);
\end{tikzpicture}
```



```
\begin{tikzpicture}[ultra thick]
  \draw (0,0) -- (0,1);
  \begin{scope}[thin]
    \draw (1,0) -- (1,1);
    \draw (2,0) -- (2,1);
  \end{scope}
  \draw (3,0) -- (3,1);
\end{tikzpicture}
```



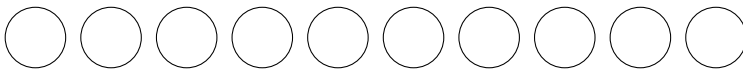
```
\tikz \draw (0,0) -- (0,0.5) [xshift=2pt] (0,0) -- (0,0.5);
```



```
\begin{tikzpicture}[even odd rule,rounded corners=2pt,x=10pt,y=10pt]
  \filldraw[fill=red] (0,0) rectangle (1,1)
    [xshift=5pt,yshift=5pt] (0,0) rectangle (1,1)
    [rotate=45] (-1,-1) rectangle (2,2);
\end{tikzpicture}
```



```
\tikz \foreach \x in {1,...,10}
\draw (\x,0) circle (0.4cm);
```

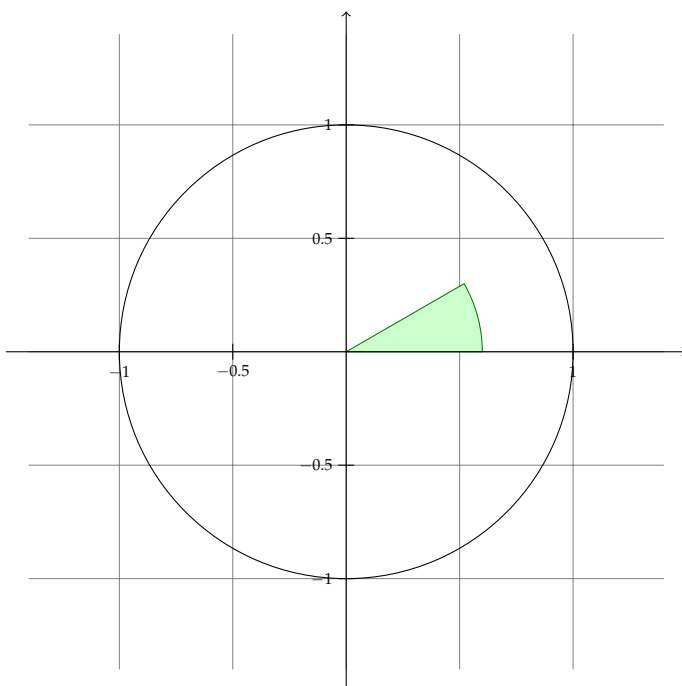


```
\begin{tikzpicture}
\foreach \x in {1,2,...,5,7,8,...,12}
\foreach \y in {1,...,5}
{
\draw (\x,\y) +(-.5,-.5) rectangle ++(.5,.5);
\draw (\x,\y) node{\x,\y};
}
\end{tikzpicture}
```

1,5	2,5	3,5	4,5	5,5
1,4	2,4	3,4	4,4	5,4
1,3	2,3	3,3	4,3	5,3
1,2	2,2	3,2	4,2	5,2
1,1	2,1	3,1	4,1	5,1

7,5	8,5	9,5	10,5	11,5	12,5
7,4	8,4	9,4	10,4	11,4	12,4
7,3	8,3	9,3	10,3	11,3	12,3
7,2	8,2	9,2	10,2	11,2	12,2
7,1	8,1	9,1	10,1	11,1	12,1

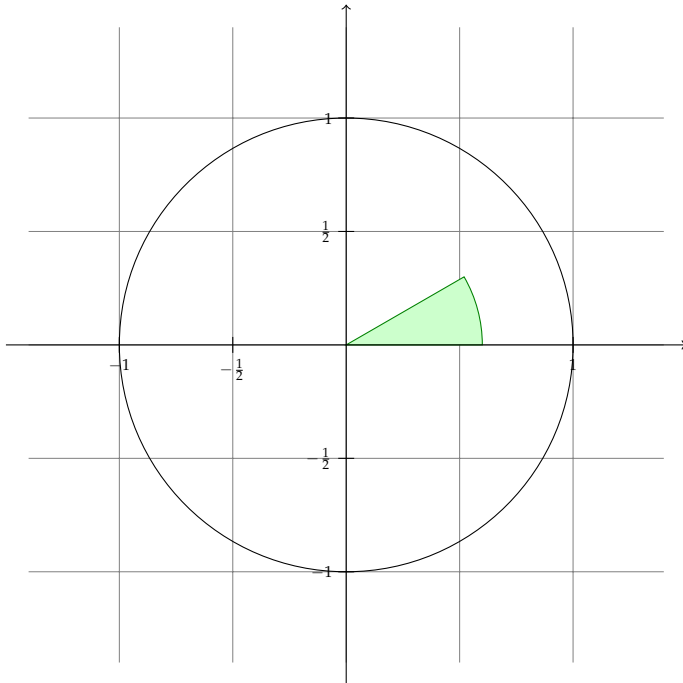
```
\begin{tikzpicture}[scale=3]
\clip (-1.51,-1.51) rectangle (1.51,1.51);
\draw[step=.5cm,help lines] (-1.4,-1.4) grid (1.4,1.4);
\filldraw[fill=green!20,draw=green!50!black]
(0,0) -- (6mm,0mm) arc (0:30:6mm) -- cycle;
\draw[>-] (-1.5,0) -- (1.5,0);
\draw[>-] (0,-1.5) -- (0,1.5);
\draw (0,0) circle (1cm);
\foreach \x in {-1,-0.5,1}
\draw (\x cm,1pt) -- (\x cm,-1pt) node[anchor=north] {\x};
\foreach \y in {-1,-0.5,0.5,1}
\draw (1pt,\y cm) -- (-1pt,\y cm) node[anchor=east] {\y};
\end{tikzpicture}
```



```

\begin{tikzpicture}[scale=3]
  \clip (-1.51,-1.51) rectangle (1.51,1.51);
  \draw[step=.5cm,help lines] (-1.4,-1.4) grid (1.4,1.4);
  \filldraw[fill=green!20,draw=green!50!black]
    (0,0) -- (6mm,0mm) arc (0:30:6mm) -- cycle;
  \draw[>-] (-1.5,0) -- (1.5,0);
  \draw[>-] (0,-1.5) -- (0,1.5);
  \draw (0,0) circle (1cm);
  \foreach \x/\xtext in {-1,-0.5/-.5\frac{1}{2},1}
    \draw (\x cm,1pt) -- (\x cm,-1pt) node[anchor=north] {\xtext};
  \foreach \y/\ytext in {-1,-0.5/-.5\frac{1}{2},0.5/\frac{1}{2},1}
    \draw (1pt,\y cm) -- (-1pt,\y cm) node[anchor=east] {\ytext};
\end{tikzpicture}

```



```

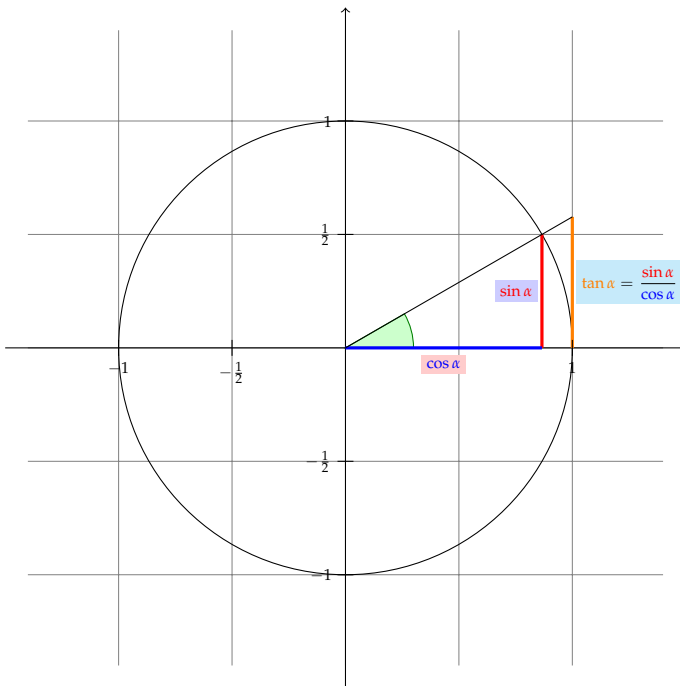
\begin{tikzpicture}[scale=3]
  \draw[step=.5cm,gray,very thin] (-1.4,-1.4) grid (1.4,1.4);
  \filldraw[fill=green!20,draw=green!50!black] (0,0) -- (3mm,0mm) arc
    (0:30:3mm) -- cycle;
  \draw[>-] (-1.5,0) -- (1.5,0) coordinate (x axis);
  \draw[>-] (0,-1.5) -- (0,1.5) coordinate (y axis);
  \draw (0,0) circle (1cm);

  \draw[very thick,red]
    (30:1cm) -- node[left=1pt,fill=blue!20] {\sin \alpha} (30:1cm |- x axis);
  \draw[very thick,blue]
    (30:1cm |- x axis) -- node[below=2pt,fill=red!20] {\cos \alpha} (0,0);

  \path [name path=upward line] (1,0) -- (1,1);
  \path [name path=sloped line] (0,0) -- (30:1.5cm);
  \draw [name intersections={of=upward line and sloped line, by=t}]
    [very thick,orange] (1,0) -- node [right=1pt,fill=cyan!20]
    {\displaystyle \tan \alpha \color{black}=
      \frac{\color{red}\sin \alpha}{\color{blue}\cos \alpha}} (t);
  \draw (0,0) -- (t);

  \foreach \x/\xtext in {-1,-0.5/-.5\frac{1}{2},1}
    \draw (\x cm,1pt) -- (\x cm,-1pt) node[anchor=north] {\xtext};
  \foreach \y/\ytext in {-1,-0.5/-.5\frac{1}{2},0.5/\frac{1}{2},1}
    \draw (1pt,\y cm) -- (-1pt,\y cm) node[anchor=east] {\ytext};
\end{tikzpicture}

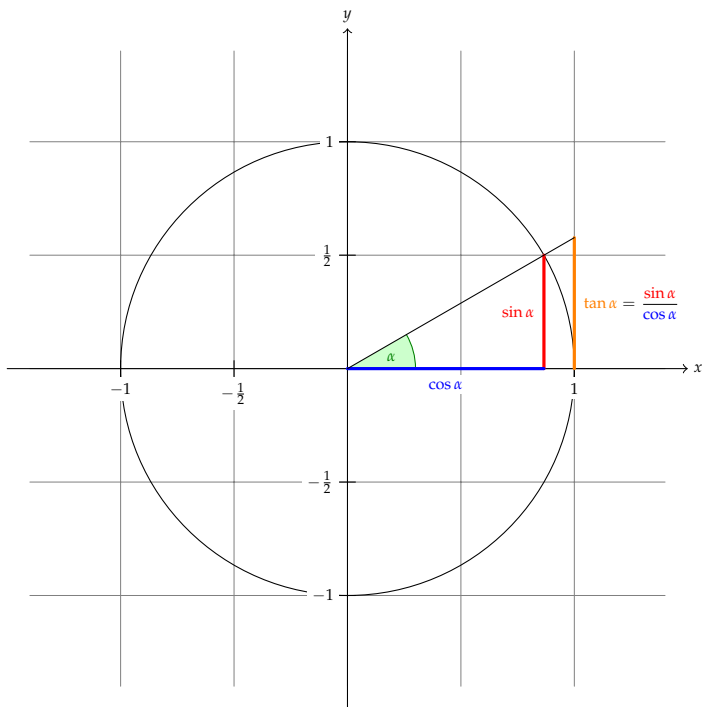
```



```
\begin{tikzpicture}
  \draw (0,0) .. controls (6,1) and (9,1) ..
  node[near start,sloped,above] {near start}
  node {midway}
  node[very near end,sloped,below] {very near end} (12,0);
\end{tikzpicture}
```



```
\begin{tikzpicture}
[scale=3,line cap=round,
% Styles
axes/.style=,
important line/.style={very thick},
information text/.style={rounded corners,fill=red!10,inner sep=1ex}]
% Local definitions
\def\costhirty{0.8660256}
% Colors
\colorlet{anglecolor}{green!50!black}
\colorlet{sincolor}{red}
\colorlet{tancolor}{orange!80!black}
\colorlet{coscolor}{blue}
% The graphic
\draw[help lines,step=0.5cm] (-1.4,-1.4) grid (1.4,1.4);
\draw (0,0) circle (1cm);
\begin{scope}[axes]
  \draw[>-] (-1.5,0) -- (1.5,0) node[right] {$x$} coordinate(x axis);
  \draw[>-] (0,-1.5) -- (0,1.5) node[above] {$y$} coordinate(y axis);
  \foreach \x/\xtext in {-1, -.5/-\frac{1}{2}, 1}
    \draw[xshift=\x cm] (0pt,1pt) -- (0pt,-1pt) node[below,fill=white] {$\xtext$};
  \foreach \y/\ytext in {-1, -.5/-\frac{1}{2}, .5/\frac{1}{2}, 1}
    \draw[yshift=\y cm] (1pt,0pt) -- (-1pt,0pt) node[left,fill=white] {$\ytext$};
\end{scope}
\end{scope}
\filldraw[fill=green!20,draw=anglecolor] (0,0) -- (3mm,0pt) arc(0:30:3mm);
\draw (15:2mm) node[anglecolor] {$\alpha$};
\draw[important line,sincolor]
(30:1cm) -- node[left=1pt,fill=white] {$\sin \alpha$} (30:1cm |- x axis);
\draw[important line,coscolor]
(30:1cm |- x axis) -- node[below=2pt,fill=white] {$\cos \alpha$} (0,0);
\path [name path=upward line] (1,0) -- (1,1);
\path [name path=sloped line] (0,0) -- (30:1.5cm);
\draw [name intersections={of=upward line and sloped line, by=t}]
[very thick,orange] (1,0) -- node [right=1pt,fill=white]
{$\displaystyle \tan \alpha \color{black}=\frac{\color{red}\sin \alpha}{\color{blue}\cos \alpha}$} (t);
\draw (0,0) -- (t);
\draw[xshift=2.0cm]
node[right,text width=6cm,information text]
{
  The {\color{anglecolor} angle $\alpha$} is $30^\circ$ in the
  example ($\pi/6$ in radians). The {\color{sincolor}sine} of
  $\alpha$, which is the height of the red line, is
  \[
    {\color{sincolor} \sin \alpha} = 1/2.
  \]
  By the Theorem of Pythagoras ...
};
\end{tikzpicture}
```

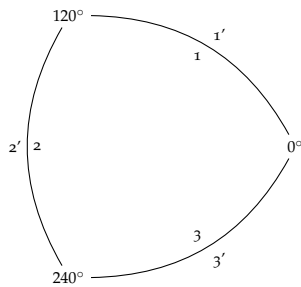



The angle α is 30° in the example ($\pi/6$ in radians). The sine of α , which is the height of the red line, is

$$\sin \alpha = 1/2.$$

By the Theorem of Pythagoras ...

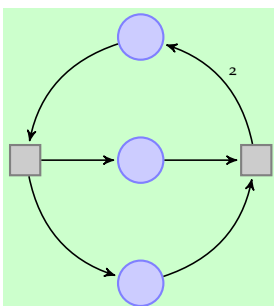
```
\begin{tikzpicture}[auto,bend right,scale=2]
  \node (a) at (0:1) {$0^\circ$};
  \node (b) at (120:1) {$120^\circ$};
  \node (c) at (240:1) {$240^\circ$};
  \draw (a) to node [swap] {1} (b);
  (b) to node [swap] {2} (c);
  (c) to node [swap] {3} (a);
\end{tikzpicture}
```



```
\begin{tikzpicture}
  \node[place] (waiting) {};
  \node[place] (critical) [below=of waiting] {};
  \node[place] (semaphore) [below=of critical] {};

  \node[transition] (leave critical) [right=of critical] {}
    edge [pre] (critical)
    edge [post,bend right] node[auto,swap] {2} (waiting)
    edge [pre, bend left] (semaphore);
  \node[transition] (enter critical) [left=of critical] {}
    edge [post] (critical)
    edge [pre, bend left] (waiting)
    edge [post,bend right] (semaphore);

  % background box
  \begin{scope}[on background layer]
    \node [fill=green!20,fit=(waiting) (critical) (semaphore)
      (leave critical) (enter critical)] {};
  \end{scope}
\end{tikzpicture}
```



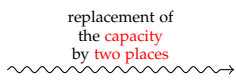
```
\begin{tikzpicture}
\draw [->,decorate,decoration=sake] (0,0) -- (2,0);
\end{tikzpicture}
```



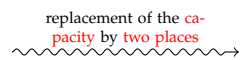
```
\begin{tikzpicture}
\draw [->,decorate,
decoration={snake,amplitude=.4mm,segment length=2mm,post length=1mm}]
(0,0) -- (3,0);
\end{tikzpicture}
```



```
\begin{tikzpicture}
\draw [->,decorate,
decoration={snake,amplitude=.4mm,segment length=2mm,post length=1mm}]
(0,0) -- (3,0)
node [above,align=center,midway]
{
replacement of\\
the \textcolor{red}{capacity}\\
by \textcolor{red}{two places}
};
\end{tikzpicture}
```



```
\begin{tikzpicture}
\draw [->,decorate,
decoration={snake,amplitude=.4mm,segment length=2mm,post length=1mm}]
(0,0) -- (3,0)
node [above,text width=3cm,align=center,midway]
{
replacement of the \textcolor{red}{capacity} by
\textcolor{red}{two places}
};
\end{tikzpicture}
```



```

\begin{tikzpicture}
  [node distance=1.3cm,on grid,>=stealth',bend angle=45,auto,
  every place/.style={minimum size=6mm,thick,draw=blue!75,fill=blue!20},
  every transition/.style={thick,draw=black!75,fill=black!20},
  red place/.style={place,draw=red!75,fill=red!20},
  every label/.style={red}]

  \node [place,tokens=1] (w1) {}
  \node [place] (c1) [below=of w1] {}
  \node [place] (s) [below=of c1,label=above:$s\le 3$] {}
  \node [place] (c2) [below=of s] {}
  \node [place,tokens=1] (w2) [below=of c2] {}

  \node [transition] (e1) [left=of c1] {}
  edge [pre,bend left] (w1)
  edge [post,bend right] (s)
  edge [post] (c1);
  \node [transition] (e2) [left=of c2] {}
  edge [pre,bend right] (w2)
  edge [post,bend left] (s)
  edge [post] (c2);
  \node [transition] (l1) [right=of c1] {}
  edge [pre] (c1)
  edge [pre,bend left] (s)
  edge [post,bend right] node[swap] {2} (w1);
  \node [transition] (l2) [right=of c2] {}
  edge [pre] (c2)
  edge [pre,bend right] (s)
  edge [post,bend left] node {2} (w2);

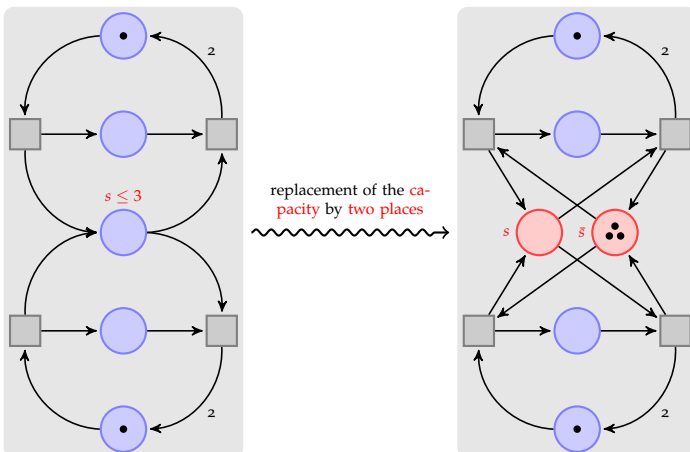
  \begin{scope}[xshift=6cm]
    \node [place,tokens=1] (w1') {}
    \node [place] (c1') [below=of w1'] {}
    \node [red place] (s1') [below=of c1',xshift=-5mm] {}
    [label=left:$s$]
    \node [red place,tokens=3] (s2') [below=of c1',xshift=5mm] {}
    [label=left:$\bar{s}$]
    \node [place] (c2') [below=of s1',xshift=5mm] {}
    \node [place,tokens=1] (w2') [below=of c2'] {}

    \node [transition] (e1') [left=of c1'] {}
    edge [pre,bend left] (w1')
    edge [post] (s1')
    edge [pre] (s2')
    edge [post] (c1');
    \node [transition] (e2') [left=of c2'] {}
    edge [pre,bend right] (w2')
    edge [post] (s1')
    edge [pre] (s2')
    edge [post] (c2');
    \node [transition] (l1') [right=of c1'] {}
    edge [pre] (c1')
    edge [pre] (s1')
    edge [post] (s2')
    edge [post,bend right] node[swap] {2} (w1');
    \node [transition] (l2') [right=of c2'] {}
    edge [pre] (c2')
    edge [pre] (s1')
    edge [post] (s2')
    edge [post,bend left] node {2} (w2');
  \end{scope}

  \begin{scope}[on background layer]
    \node (r1) [fill=black!10,rounded corners,fit=(w1)(w2)(e1)(e2)(l1)(l2)] {};
    \node (r2) [fill=black!10,rounded corners,fit=(w1')(w2')(e1')(e2')(l1')(l2')] {};
  \end{scope}

  \draw [shorten >=1mm,-to,thick,decorate,
  decoration={snake,amplitude=.4mm,segment length=2mm,
  pre=moveto,pre length=1mm,post length=2mm}]
  (r1) -- (r2) node [above=1mm,midway,text width=3cm,align=center]
  {replacement of the \textcolor{red}{capacity} by \textcolor{red}{two places}};
\end{tikzpicture}

```



```

\begin{tikzpicture}
  \coordinate (A) at (0,0);
  \coordinate (B) at (1.25,0.25);
  \draw[blue] (A) -- (B);
\end{tikzpicture}

```

```

\begin{tikzpicture}
  \coordinate [label=left:\textcolor{blue}{$A$}] (A) at (0,0);
  \coordinate [label=right:\textcolor{blue}{$B$}] (B) at (1.25,0.25);
  \draw[blue] (A) -- (B);
\end{tikzpicture}

```

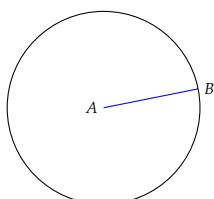


```

\begin{tikzpicture}
  \coordinate [label=left:{$A$}] (A) at (0,0);
  \coordinate [label=right:{$B$}] (B) at (1.25,0.25);
  \draw[blue] (A) -- (B);

  \draw (A) let
    \p1 = ($ (B) - (A) $)
    in
    circle ({veclen(\x1, \y1)});
\end{tikzpicture}

```

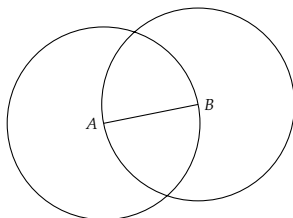


```

\begin{tikzpicture}
  \coordinate [label=left:{$A$}] (A) at (0,0);
  \coordinate [label=right:{$B$}] (B) at (1.25,0.25);
  \draw (A) -- (B);

  \draw let
    \p1 = ($ (B) - (A) $),
    \n2 = {veclen(\x1,\y1)}
    in
    (A) circle (\n2)
    (B) circle (\n2);
\end{tikzpicture}

```

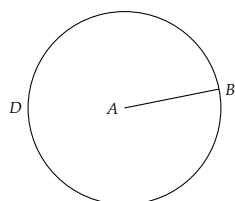


```

\begin{tikzpicture}
  \coordinate [label=left:$A$] (A) at (0,0);
  \coordinate [label=right:$B$] (B) at (1.25,0.25);
  \draw (A) -- (B);

  \node [draw,circle through=(B),label=left:$D$] at (A) {};
\end{tikzpicture}

```



```

\begin{tikzpicture}
  \coordinate [label=left:$A$] (A) at (0,0);
  \coordinate [label=right:$B$] (B) at (1.25,0.25);
  \draw (A) -- (B);

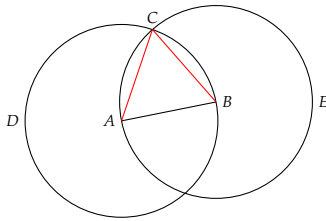
  \node (D) [name path=D,draw,circle through=(B),label=left:$D$] at (A) {};
  \node (E) [name path=E,draw,circle through=(A),label=right:$E$] at (B) {};

  % Name the coordinates, but do not draw anything:
  \path [name intersections={of=D and E}];

  \coordinate [label=above:$C$] (C) at (intersection-1);

  \draw [red] (A) -- (C);
  \draw [red] (B) -- (C);
\end{tikzpicture}

```



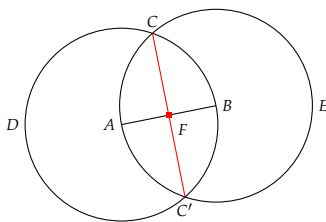
```
\begin{tikzpicture}
\coordinate [label=left:$A$] (A) at (0,0);
\coordinate [label=right:$B$] (B) at (1.25,0.25);
\draw [name path=A--B] (A) -- (B);

\node (D) [name path=D,draw,circle through=(B),label=left:$D$] at (A) {};
\node (E) [name path=E,draw,circle through=(A),label=right:$E$] at (B) {};

\path [name intersections={of=D and E, by={ [label=above:$C$]C, [label=below:$C'$]C'}}];

\draw [name path=C--C',red] (C) -- (C');

\path [name intersections={of=A--B and C--C',by=F}];
\node [fill=red,inner sep=1pt,label=-45:$F$] at (F) {};
\end{tikzpicture}
```



```
\begin{tikzpicture}[thick,help lines/.style={thin,draw=black!50}]
\def\A{\textcolor{input}{$A$}}
\def\B{\textcolor{input}{$B$}}
\def\C{\textcolor{output}{$C$}}
\def\D{$D$}
\def\E{$E$}

\colorlet{input}{blue!80!black}
\colorlet{output}{red!70!black}
\colorlet{triangle}{orange}

\coordinate [label=left:\A] (A) at ($ (0,0) + .1*(rand,rand) $);
\coordinate [label=right:\B] (B) at ($ (1.25,0.25) + .1*(rand,rand) $);

\draw [input] (A) -- (B);

\node [name path=D,help lines,draw,label=left:\D] (D) at (A) [circle through=(B)] {};
\node [name path=E,help lines,draw,label=right:\E] (E) at (B) [circle through=(A)] {};

\path [name intersections={of=D and E,by={ [label=above:\C]C}}];

\draw [output] (A) -- (C) -- (B);

\foreach \point in {A,B,C}
\fill [black,opacity=.5] (\point) circle (2pt);

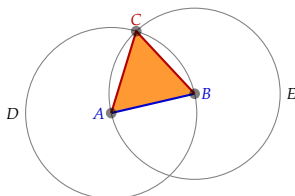
\begin{pgfonlayer}{background}
\fill [triangle!80] (A) -- (C) -- (B) -- cycle;
\end{pgfonlayer}

\node [below right, text width=10cm,align=justify] at (4,3) {
\small\textbf{Proposition I}\par
\textit{To construct an \textcolor{triangle}{equilateral triangle}
on a given \textcolor{input}{finite straight line}.}
\par\vskip1em
Let \A\B be the given \textcolor{input}{finite straight line}. \dots
};
\end{tikzpicture}
```

Proposition I

To construct an *equilateral triangle* on a given *finite straight line*.

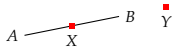
Let *AB* be the given *finite straight line*. ...



```

\begin{tikzpicture}
  \coordinate [label=left:$A$] (A) at (0,0);
  \coordinate [label=right:$B$] (B) at (1.25,0.25);
  \draw (A) -- (B);
  \node [fill=red,inner sep=1pt,label=below:$X$] (X) at ($ (A)!0.5!(B) $) {};
  \node [fill=red,inner sep=1pt,label=below:$Y$] (Y) at ($ (A)!1.5!(B) $) {};
\end{tikzpicture}

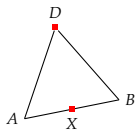
```



```

\begin{tikzpicture}
  \coordinate [label=left:$A$] (A) at (0,0);
  \coordinate [label=right:$B$] (B) at (1.25,0.25);
  \draw (A) -- (B);
  \node [fill=red,inner sep=1pt,label=below:$X$] (X) at ($ (A)!0.5!(B) $) {};
  \node [fill=red,inner sep=1pt,label=above:$D$] (D) at
    ($ (X) ! {\sin(60)*2} ! 90:(B) $) {};
  \draw (A) -- (D) -- (B);
\end{tikzpicture}

```

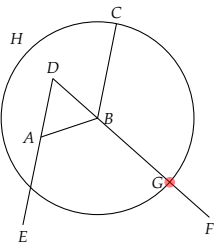


```

\begin{tikzpicture}
  \coordinate [label=left:$A$] (A) at (0,0);
  \coordinate [label=right:$B$] (B) at (0.75,0.25);
  \coordinate [label=above:$C$] (C) at (1,1.5);
  \draw (A) -- (B) -- (C);
  \coordinate [label=above:$D$] (D) at
    ($ (A) ! .5 ! (B) ! {\sin(60)*2} ! 90:(B) $) {};
  \node (H) [name path=H, label=135:$H$,draw,circle through=(C)] at (B) {};
  \draw (D) -- ($ (D) ! 3.5 ! (B) $) coordinate [label=below:$F$] (F);
  \draw (D) -- ($ (D) ! 2.5 ! (A) $) coordinate [label=below:$E$] (E);

  \path [name path=B--F] (B) -- (F);
  \path [name intersections={of=H and B--F,by={label=left:$G$}G}}];
  \fill[red,opacity=.5] (G) circle (2pt);
\end{tikzpicture}

```



```

\begin{tikzpicture}[thick,help lines/.style={thin,draw=black!50}]
  \def\A{\textcolor{orange}{$A$}} \def\B{\textcolor{input}{$B$}}
  \def\C{\textcolor{input}{$C$}} \def\D{$D$}
  \def\E{$E$} \def\F{$F$}
  \def\G{$G$} \def\H{$H$}
  \def\K{$K$} \def\L{\textcolor{output}{$L$}}

  \colorlet{input}{blue!80!black} \colorlet{output}{red!70!black}

  \coordinate [label=left:\A] (A) at ($ (0,0) + .1*(rand,rand) $);
  \coordinate [label=right:\B] (B) at ($ (1,0.2) + .1*(rand,rand) $);
  \coordinate [label=above:\C] (C) at ($ (1,2) + .1*(rand,rand) $);

  \draw [input] (B) -- (C);
  \draw [help lines] (A) -- (B);

  \coordinate [label=above:\D] (D) at ($ (A)!0.5!(B) ! {\sin(60)*2} ! 90:(B) $);

  \draw [help lines] (D) -- ($ (D)!3.75!(A) $) coordinate [label=135:\E] (E);
  \draw [help lines] (D) -- ($ (D)!3.75!(B) $) coordinate [label=-45:\F] (F);

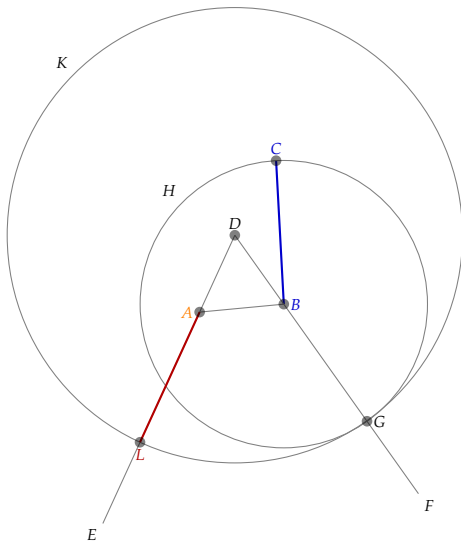
  \node (H) at (B) [name path=H,help lines,circle through=(C),draw,label=135:\H] {};
  \path [name path=B--F] (B) -- (F);
  \path [name intersections={of=H and B--F,by={label=right:\G}G}}];

  \node (K) at (D) [name path=K,help lines,circle through=(G),draw,label=135:\K] {};
  \path [name path=A--E] (A) -- (E);
  \path [name intersections={of=K and A--E,by={label=below:\L}L}}];

  \draw [output] (A) -- (L);

  \foreach \point in {A,B,C,D,G,L}
    \fill [black,opacity=.5] (\point) circle (2pt);
\end{tikzpicture}

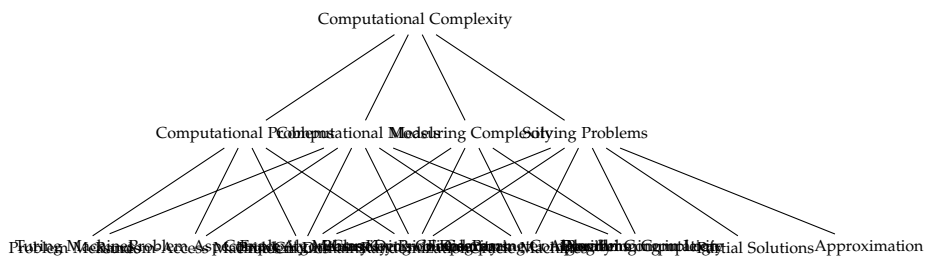
```



```

\begin{tikzpicture}
\node {Computational Complexity} % root
  child { node {Computational Problems}
    child { node {Problem Measures} }
    child { node {Problem Aspects} }
    child { node {Problem Domains} }
    child { node {Key Problems} }
  }
  child { node {Computational Models}
    child { node {Turing Machines} }
    child { node {Random-Access Machines} }
    child { node {Circuits} }
    child { node {Binary Decision Diagrams} }
    child { node {Oracle Machines} }
    child { node {Programming in Logic} }
  }
  child { node {Measuring Complexity}
    child { node {Complexity Measures} }
    child { node {Classifying Complexity} }
    child { node {Comparing Complexity} }
    child { node {Describing Complexity} }
  }
  child { node {Solving Problems}
    child { node {Exact Algorithms} }
    child { node {Randomization} }
    child { node {Fixed-Parameter Algorithms} }
    child { node {Parallel Computation} }
    child { node {Partial Solutions} }
    child { node {Approximation} }
  }
};
\end{tikzpicture}

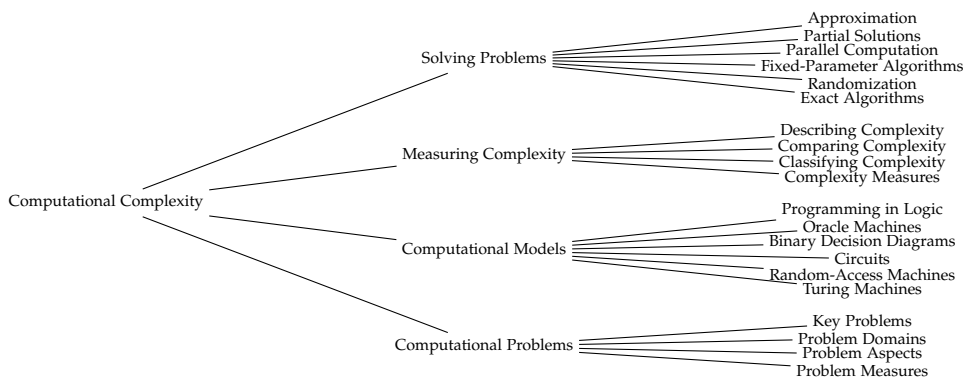
```



```

\begin{tikzpicture}[font=\tiny,
    grow=right, level 1/.style={sibling distance=6em},
    level 2/.style={sibling distance=1em}, level distance=5cm]
\node {Computational Complexity} % root
  child { node {Computational Problems}
    child { node {Problem Measures} }
    child { node {Problem Aspects} }
    child { node {Problem Domains} }
    child { node {Key Problems} }
  }
  child { node {Computational Models}
    child { node {Turing Machines} }
    child { node {Random-Access Machines} }
    child { node {Circuits} }
    child { node {Binary Decision Diagrams} }
    child { node {Oracle Machines} }
    child { node {Programming in Logic} }
  }
  child { node {Measuring Complexity}
    child { node {Complexity Measures} }
    child { node {Classifying Complexity} }
    child { node {Comparing Complexity} }
    child { node {Describing Complexity} }
  }
  child { node {Solving Problems}
    child { node {Exact Algorithms} }
    child { node {Randomization} }
    child { node {Fixed-Parameter Algorithms} }
    child { node {Parallel Computation} }
    child { node {Partial Solutions} }
    child { node {Approximation} }
  }
};
\end{tikzpicture}

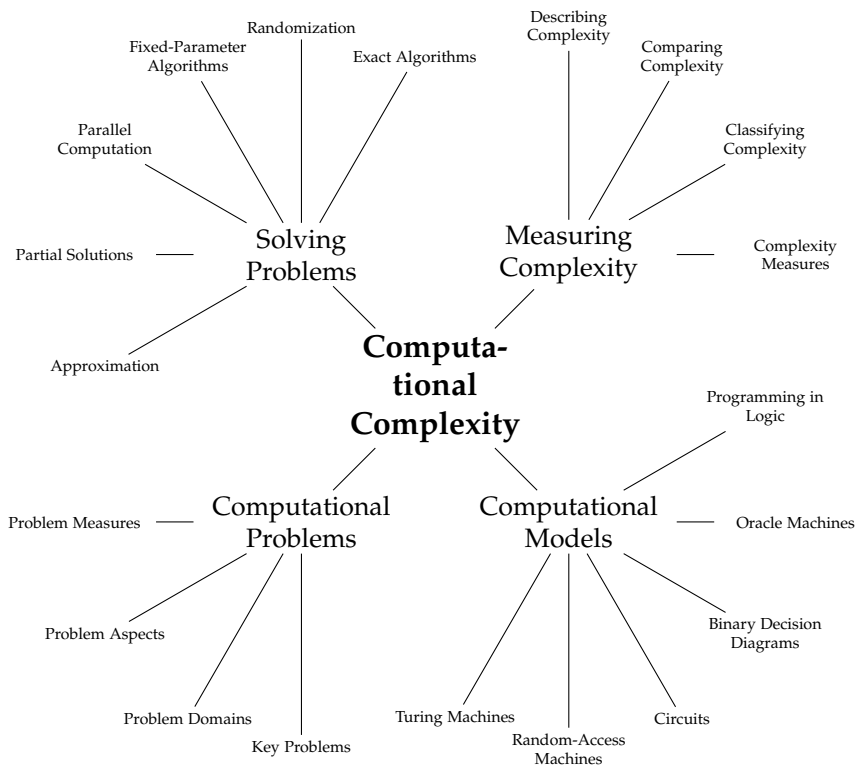
```



```

\begin{tikzpicture}[font=\footnotesize, text width=2.7cm, align=flush center,
    grow cyclic,
    level 1/.style={level distance=2.5cm, sibling angle=90},
    level 2/.style={text width=2cm, font=\tiny, level distance=3cm, sibling angle=30}]
\node[font=\normalsize\bfseries] {\hskip0pt Computational Complexity} % root
  child { node {Computational Problems}
    child { node {Problem Measures} }
    child { node {Problem Aspects} }
    child { node {Problem Domains} }
    child { node {Key Problems} }
  }
  child { node {Computational Models}
    child { node {Turing Machines} }
    child { node {Random-Access Machines} }
    child { node {Circuits} }
    child { node {Binary Decision Diagrams} }
    child { node {Oracle Machines} }
    child { node {Programming in Logic} }
  }
  child { node {Measuring Complexity}
    child { node {Complexity Measures} }
    child { node {Classifying Complexity} }
    child { node {Comparing Complexity} }
    child { node {Describing Complexity} }
  }
  child { node {Solving Problems}
    child { node {Exact Algorithms} }
    child { node {Randomization} }
    child { node {Fixed-Parameter Algorithms} }
    child { node {Parallel Computation} }
    child { node {Partial Solutions} }
    child { node {Approximation} }
  }
};
\end{tikzpicture}

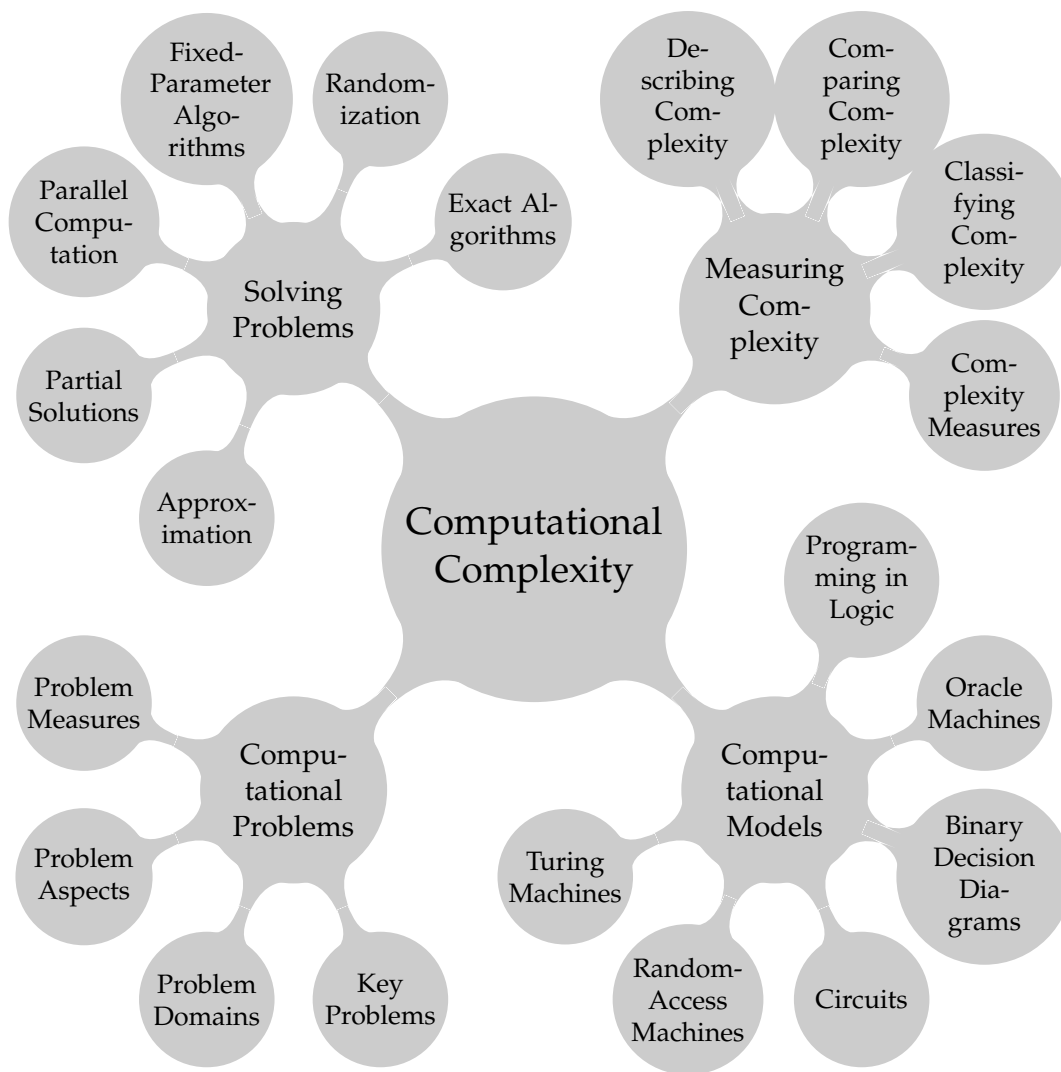
```

```

\begin{tikzpicture}[mindmap, every node/.style={concept, execute at begin node=\hskip0pt}, % execute ... is to get rid of overfullbox warning
concept color=black!20,
grow cyclic,
level 1/.append style={level distance=4.5cm, sibling angle=90},
level 2/.append style={level distance=3cm, sibling angle=45}]
\node[root concept] {Computational Complexity} % root
  child { node {Computational Problems}
    child { node {Problem Measures} }
    child { node {Problem Aspects} }
    child { node {Problem Domains} }
    child { node {Key Problems} }
  }
  child { node {Computational Models}
    child { node {Turing Machines} }
    child { node {Random-Access Machines} }
    child { node {Circuits} }
    child { node {Binary Decision Diagrams} }
    child { node {Oracle Machines} }
    child { node {Programming in Logic} }
  }
  child { node {Measuring Complexity}
    child { node {Complexity Measures} }
    child { node {Classifying Complexity} }
    child { node {Comparing Complexity} }
    child { node {Describing Complexity} }
  }
  child { node {Solving Problems}
    child { node {Exact Algorithms} }
    child { node {Randomization} }
    child { node {Fixed-Parameter Algorithms} }
    child { node {Parallel Computation} }
    child { node {Partial Solutions} }
    child { node {Approximation} }
  }
};
\end{tikzpicture}

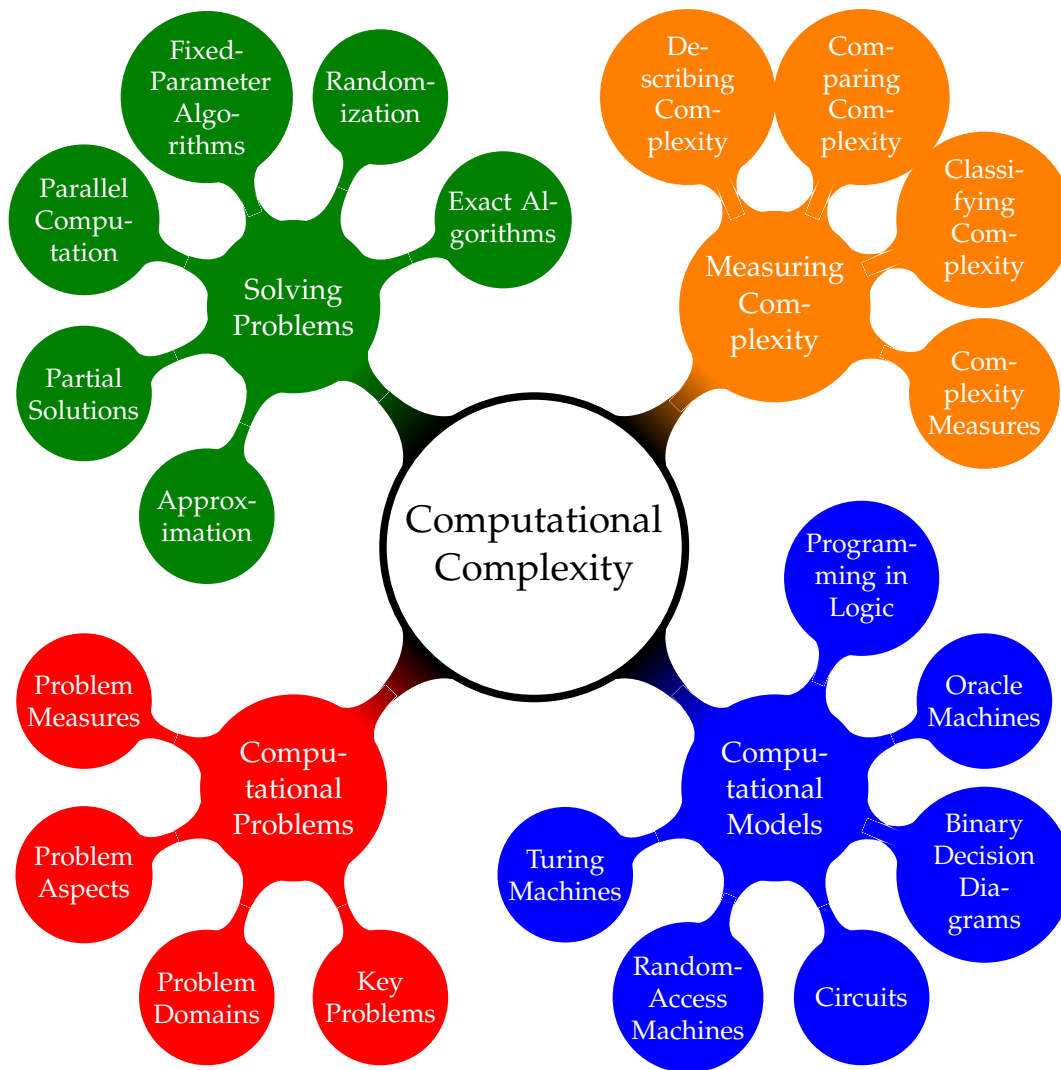
```



```

\begin{tikzpicture}
[mindmap,
every node/.style={concept, execute at begin node=\hskip0pt},
root concept/.append style={
concept color=black, fill=white, line width=1ex, text=black},
text=white,
grow cyclic,
level 1/.append style={level distance=4.5cm, sibling angle=90},
level 2/.append style={level distance=3cm, sibling angle=45}}
\node[root concept] {Computational Complexity} % root
child [concept color=red] { node {Computational Problems}
child { node {Problem Measures} }
child { node {Problem Aspects} }
child { node {Problem Domains} }
child { node {Key Problems} }
}
child [concept color=blue] { node {Computational Models}
child { node {Turing Machines} }
child { node {Random-Access Machines} }
child { node {Circuits} }
child { node {Binary Decision Diagrams} }
child { node {Oracle Machines} }
child { node {Programming in Logic} }
}
child [concept color=orange] { node {Measuring Complexity}
child { node {Complexity Measures} }
child { node {Classifying Complexity} }
child { node {Comparing Complexity} }
child { node {Describing Complexity} }
}
child [concept color=green!50!black] { node {Solving Problems}
child { node {Exact Algorithms} }
child { node {Randomization} }
child { node {Fixed-Parameter Algorithms} }
child { node {Parallel Computation} }
child { node {Partial Solutions} }
child { node {Approximation} }
}
};
\end{tikzpicture}

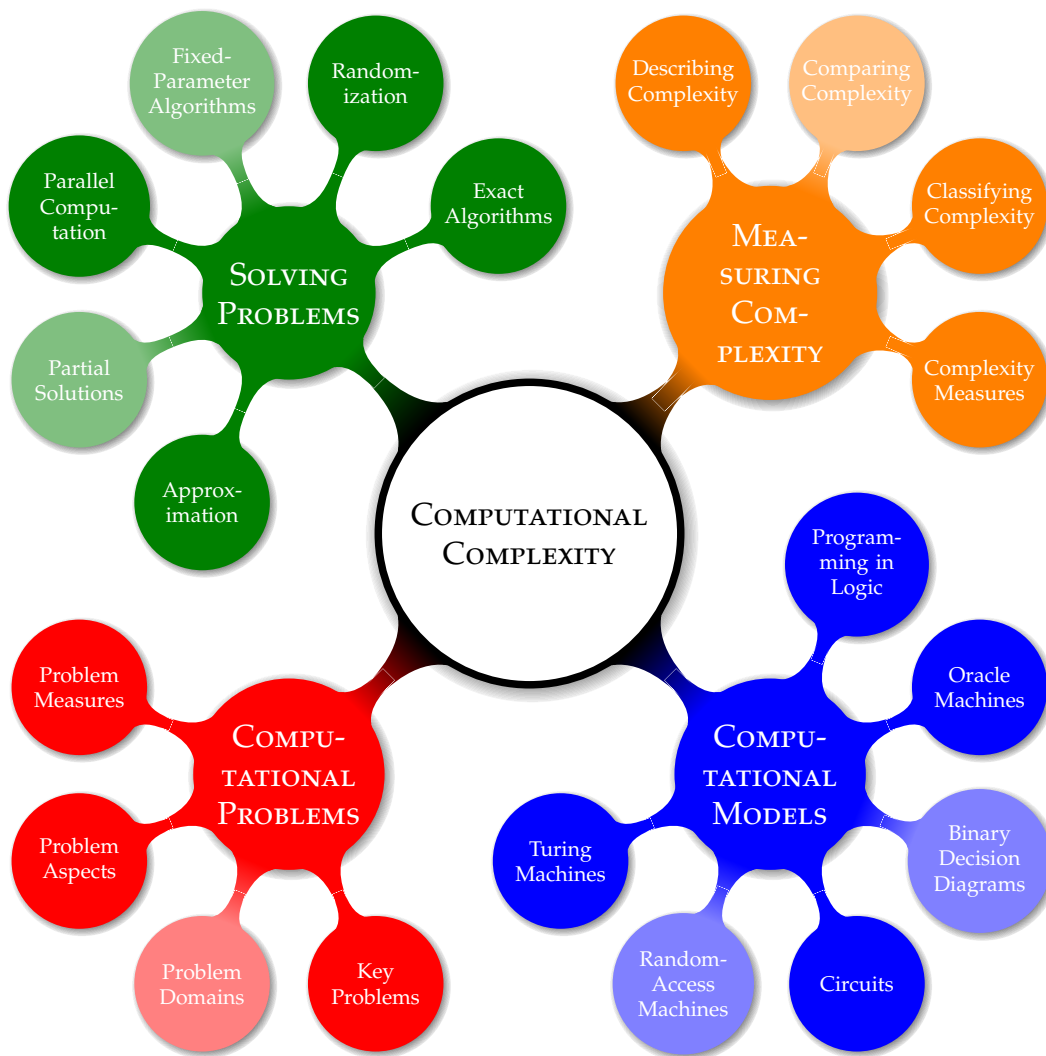
```



```

\begin{tikzpicture}[mindmap]
\begin{scope}
  every node/.style={concept, circular drop shadow, execute at begin node=\hskip0pt},
  root concept/.append style={
    concept color=black, fill=white, line width=1ex, text=black, font=\normalsize\scshape,
    text=white,
    computational problems/.style={concept color=red,faded/.style={concept color=red!50}},
    computational models/.style={concept color=blue,faded/.style={concept color=blue!50}},
    measuring complexity/.style={concept color=orange,faded/.style={concept color=orange!50}},
    solving problems/.style={concept color=green!50!black,faded/.style={concept color=green!50!black!50}},
    grow cyclic,
    level 1/.append style={level distance=4.5cm, sibling angle=90, font=\normalsize\scshape},
    level 2/.append style={level distance=3cm, sibling angle=45, font=\scriptsize}
  }
\node[root concept] {Computational Complexity} % root
  child [computational problems] { node {Computational Problems}
    child { node {Problem Measures} }
    child { node {Problem Aspects} }
    child [faded] { node {Problem Domains} }
    child { node {Key Problems} }
  }
  child [computational models] { node {Computational Models}
    child { node {Turing Machines} }
    child [faded] { node {Random-Access Machines} }
    child { node {Circuits} }
    child [faded] { node {Binary Decision Diagrams} }
    child { node {Oracle Machines} }
    child { node {Programming in Logic} }
  }
  child [measuring complexity] { node {Measuring Complexity}
    child { node {Complexity Measures} }
    child { node {Classifying Complexity} }
    child [faded] { node {Comparing Complexity} }
    child { node {Describing Complexity} }
  }
  child [solving problems] { node {Solving Problems}
    child { node {Exact Algorithms} }
    child { node {Randomization} }
    child [faded] { node {Fixed-Parameter Algorithms} }
    child { node {Parallel Computation} }
    child [faded] { node {Partial Solutions} }
    child { node {Approximation} }
  }
};
\end{scope}
\end{tikzpicture}

```



```

\def\lecture#1#2#3#4#5#6{
  \node [annotation, #3, scale=0.65, text width=4cm, inner sep=2mm] at (#4) {
    Lecture #1: \textcolor{orange}{\textbf{#2}}
    \list{--}{\topsep=2pt\itemsep=0pt\parsep=0pt
      \parskip=0pt\labelwidth=8pt\leftmargin=8pt
      \itemindent=0pt\labelsep=2pt}
    #5
  \endlist
};
}

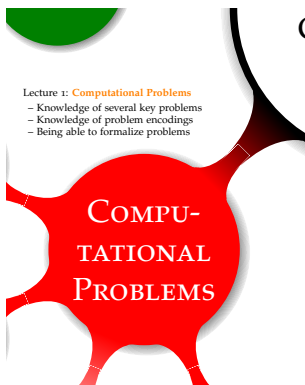
```

```

\begin{tikzpicture}[mindmap]
\clip (-5,-5) rectangle ++ (4,5);
\begin{scope}
every node/.style={concept, circular drop shadow, execute at begin node=\hskip0pt},
root concept/.append style={
concept color=black, fill=white, line width=1ex, text=black, font=\normalsize\scshape},
text=white,
computational problems/.style={concept color=red,faded/.style={concept color=red!50}},
computational models/.style={concept color=blue,faded/.style={concept color=blue!50}},
measuring complexity/.style={concept color=orange,faded/.style={concept color=orange!50}},
solving problems/.style={concept color=green!50!black,faded/.style={concept color=green!50!black!50}},
grow cyclic,
level 1/.append style={level distance=4.5cm, sibling angle=90, font=\normalsize\scshape},
level 2/.append style={level distance=3cm, sibling angle=45, font=\scriptsize}
\node[root concept] (Computational Complexity) {Computational Complexity} % root
child [computational problems] { node (Computational Problems) {Computational Problems}
child { node (Problem Measures) {Problem Measures} }
child { node (Problem Aspects) {Problem Aspects} }
child [faded] { node (Problem Domains) {Problem Domains} }
child { node (Key Problems) {Key Problems} }
}
child [computational models] { node (Computational Models) {Computational Models}
child { node (Turing Machines) {Turing Machines} }
child [faded] { node (Random-Access Machines) {Random-Access Machines} }
child { node (Circuits) {Circuits} }
child [faded] { node (Binary Decision Diagrams) {Binary Decision Diagrams} }
child { node (Oracle Machines) {Oracle Machines} }
child { node (Programming in Logic) {Programming in Logic} }
}
child [measuring complexity] { node (Measuring Complexity) {Measuring Complexity}
child { node (Complexity Measures) {Complexity Measures} }
child { node (Classifying Complexity) {Classifying Complexity} }
child [faded] { node (Comparing Complexity) {Comparing Complexity} }
child { node (Describing Complexity) {Describing Complexity} }
}
child [solving problems] { node (Solving Problems) {Solving Problems}
child { node (Exact Algorithms) {Exact Algorithms} }
child { node (Randomization) {Randomization} }
child [faded] { node (Fixed-Parameter Algorithms) {Fixed-Parameter Algorithms} }
child { node (Parallel Computation) {Parallel Computation} }
child [faded] { node (Partial Solutions) {Partial Solutions} }
child { node (Approximation) {Approximation} }
};
\end{scope}

\lecture{1}{Computational Problems}{above,xshift=-3mm}
{Computational Problems.north}{
\item Knowledge of several key problems
\item Knowledge of problem encodings
\item Being able to formalize problems
}{2014-11-01}
\end{tikzpicture}

```



```

\begin{tikzpicture}[
  mindmap,
  concept color=black,
  root concept/.append style={
    concept,
    circular drop shadow,
    fill=white, line width=1ex,
    text=black, font=\large\scshape}
]

\clip (-1.5,-5) rectangle ++(4,10);

\node [root concept] (Computational Complexity) {Computational Complexity};

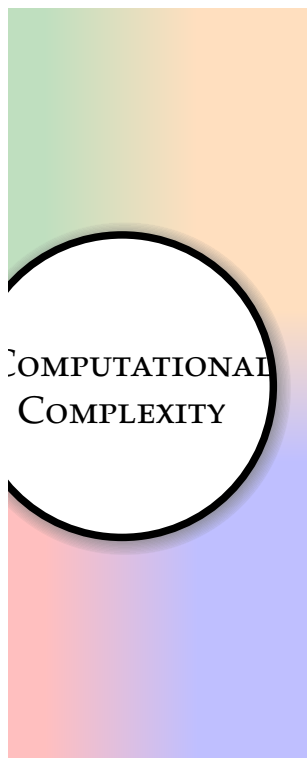
\begin{pgfonlayer}{background}
  \clip (-1.5,-5) rectangle ++(4,10);

  \colorlet{upperleft}{green!50!black!25}
  \colorlet{upperright}{orange!25}
  \colorlet{lowerleft}{red!25}
  \colorlet{lowerright}{blue!25}

  % The large rectangles:
  \fill [upperleft] (Computational Complexity) rectangle ++(-20,20);
  \fill [upperright] (Computational Complexity) rectangle ++(20,20);
  \fill [lowerleft] (Computational Complexity) rectangle ++(-20,-20);
  \fill [lowerright] (Computational Complexity) rectangle ++(20,-20);

  % The shadings:
  \shade [left color=upperleft,right color=upperright]
    ([xshift=-1cm]Computational Complexity) rectangle ++(2,20);
  \shade [left color=lowerleft,right color=lowerright]
    ([xshift=-1cm]Computational Complexity) rectangle ++(2,-20);
  \shade [top color=upperleft,bottom color=lowerleft]
    ([yshift=-1cm]Computational Complexity) rectangle ++(-20,2);
  \shade [top color=upperright,bottom color=lowerright]
    ([yshift=-1cm]Computational Complexity) rectangle ++(20,2);
\end{pgfonlayer}
\end{tikzpicture}

```



```

\begin{tikzpicture}
  \calendar [day list downward,
    name=cal,
    dates=2009-04-01 to 2009-04-14]
    if (weekend)
      [black!50];
\end{tikzpicture}

```

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```
\def\newlecture#1#2#3#4#5#6{
  % As before:
  \node [annotation, #3, scale=0.65, text width=4cm, inner sep=2mm, fill=white] at (#4) {
    Lecture #1: \textcolor{orange}{\textbf{#2}}
    \list{--}{\topsep=2pt\itemsep=0pt\parsep=0pt
      \parskip=0pt\labelwidth=8pt\leftmargin=8pt
      \itemindent=0pt\labelsep=2pt}
      #5
    \endlist
  };
  % New:
  \node [anchor=base west] at (cal-#6.base east) {\textcolor{orange}{\textbf{#2}}};
}
```

```

\begin{tikzpicture}
\begin{scope}[
mindmap,
every node/.style={concept, circular drop shadow, execute at begin node=\hskip0pt},
root concept/.append style={
concept color=black, fill=white, line width=1ex, text=black, font=\normalsize\scshape},
text=white,
computational problems/.style={concept color=red,faded/.style={concept color=red!50}},
computational models/.style={concept color=blue,faded/.style={concept color=blue!50}},
measuring complexity/.style={concept color=orange,faded/.style={concept color=orange!50}},
solving problems/.style={concept color=green!50!black,faded/.style={concept color=green!50!black!50}},
grow cyclic,
level 1/.append style={level distance=4.5cm, sibling angle=90, font=\normalsize\scshape},
level 2/.append style={level distance=3cm, sibling angle=45, font=\scriptsize}]
\node[root concept] (Computational Complexity) {Computational Complexity} % root
child [computational problems] { node [yshift=-1cm] (Computational Problems) {Computational Problems}
child { node (Problem Measures) {Problem Measures} }
child { node (Problem Aspects) {Problem Aspects} }
child [faded] { node (Problem Domains) {Problem Domains} }
child { node (Key Problems) {Key Problems} }
}
child [computational models] { node [yshift=-1cm] (Computational Models) {Computational Models}
child { node (Turing Machines) {Turing Machines} }
child [faded] { node (Random-Access Machines) {Random-Access Machines} }
child { node (Circuits) {Circuits} }
child [faded] { node (Binary Decision Diagrams) {Binary Decision Diagrams} }
child { node (Oracle Machines) {Oracle Machines} }
child { node (Programming in Logic) {Programming in Logic} }
}
child [measuring complexity] { node [yshift=1cm] (Measuring Complexity) {Measuring Complexity}
child { node (Complexity Measures) {Complexity Measures} }
child { node (Classifying Complexity) {Classifying Complexity} }
child [faded] { node (Comparing Complexity) {Comparing Complexity} }
child { node (Describing Complexity) {Describing Complexity} }
}
child [solving problems] { node [yshift=1cm] (Solving Problems) {Solving Problems}
child { node (Exact Algorithms) {Exact Algorithms} }
child { node (Randomization) {Randomization} }
child [faded] { node (Fixed-Parameter Algorithms) {Fixed-Parameter Algorithms} }
child { node (Parallel Computation) {Parallel Computation} }
child [faded] { node (Partial Solutions) {Partial Solutions} }
child { node (Approximation) {Approximation} }
};
\end{scope}

\calendar [day list downward,
month text=\textcolor{red}{\%mt} \%y0,
month yshift=3.5em,
name=cal,
at={(-.5\textwidth-5mm,.5\textheight-1cm)},
dates=2009-04-01 to 2009-06-18]
if (weekend)
[black!25]
if (day of month=1) {
\node at (Opt,1.5em) [anchor=base west] {\small\tikzmonthtext};
};

\newlecture{1}{Computational Problems}{above,xshift=-5mm,yshift=5mm}
{Computational Problems.north}{
\item Knowledge of several key problems
\item Knowledge of problem encodings
\item Being able to formalize problems
}{2009-04-08}

\newlecture{2}{Computational Models}{above left}
{Computational Models.west}{
\item Knowledge of Turing machines
\item Being able to compare the computational power of different
models
}{2009-04-15}

\begin{pgfonlayer}{background}
\clip[xshift=-1cm] (-.5\textwidth,-.5\textheight) rectangle ++(\textwidth,\textheight);

\colorlet{upperleft}{green!50!black!25}
\colorlet{upperright}{orange!25}
\colorlet{lowerleft}{red!25}
\colorlet{lowerright}{blue!25}

% The large rectangles:
\fill [upperleft] (Computational Complexity) rectangle ++(-20,20);
\fill [upperright] (Computational Complexity) rectangle ++(20,20);
\fill [lowerleft] (Computational Complexity) rectangle ++(-20,-20);
\fill [lowerright] (Computational Complexity) rectangle ++(20,-20);

% The shadings:
\shade [left color=upperleft,right color=upperright]
([xshift=-1cm]Computational Complexity) rectangle ++(2,20);
\shade [left color=lowerleft,right color=lowerright]
([xshift=-1cm]Computational Complexity) rectangle ++(2,-20);
\shade [top color=upperleft,bottom color=lowerleft]
([yshift=-1cm]Computational Complexity) rectangle ++(-20,2);
\shade [top color=upperright,bottom color=lowerright]
([yshift=-1cm]Computational Complexity) rectangle ++(20,2);
\end{pgfonlayer}
\end{tikzpicture}

```


April 2009

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Computational Problems

Computational Models

May 2009

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June 2009

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