

# Drawing Graphs using Dot and Graphviz

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tup]] : How I use Emacs Org Mode to write novels and short stories

## 1 License

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## 2 Introduction

### 2.1 What is DOT?

DOT is a plain text graph description language. It is a simple way of describing graphs that both humans and computer programs can read.

### 2.2 What is Graphviz?

Graphviz is open source graph visualization software. Graph visualization is a way of representing structural information as diagrams of abstract graphs and networks.

### 2.3 Who is this document for?

This document was originally written as quick reference for myself. It was then extended to become a tutorial for Computing students. It's now offered to anyone who wants to learn DOT by example.

### 2.4 Related Materials

You can find links to similar documents posts at my blog [tech.tonyballantyne.com](http://tech.tonyballantyne.com)

If you have stumbled across this document by accident whilst looking for my work as an SF and Fantasy writer, the following links may be more useful to you

- [tonyballantyne.com](http://tonyballantyne.com): Blog about my novels and short stories
- [Emacs Tutorial](#) : A brief introduction to Emacs for writers
- [My Emacs Writing Setup](#) : How I use Emacs Org Mode to write novels and short stories

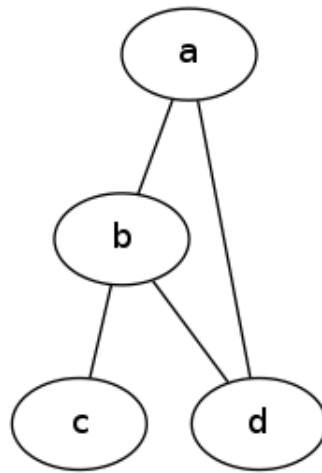
## 3 Setup

You will need to have the Graphviz suite of programs installed on your computer to follow this tutorial. Graphviz can be downloaded for free from the Graphviz site: <http://www.graphviz.org/Home.php>

## 4 Basic Examples

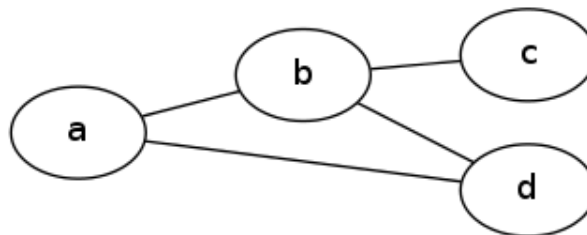
### 4.1 Simple Graph

```
graph graphname {  
    a -- b;  
    b -- c;  
    b -- d;  
    d -- a;  
}
```



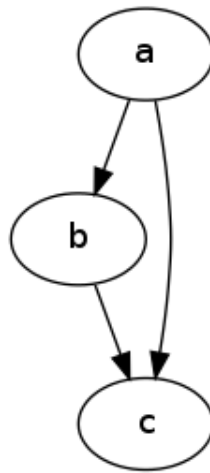
## 4.2 Same Graph, Different Layout

```
graph graphname {  
    rankdir=LR; //Rank Direction Left to Right  
    a -- b;  
    b -- c;  
    b -- d;  
    d -- a;  
}
```



## 4.3 Simple Digraph (Directional Graph)

```
digraph graphname{  
    a -> b;  
    b -> c;  
    a -> c;  
}
```

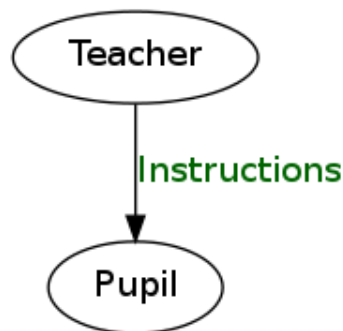


#### 4.4 Simple Digraph with Labels

```

digraph graphname{
    T [label="Teacher"]      // node T
    P [label="Pupil"]      // node P

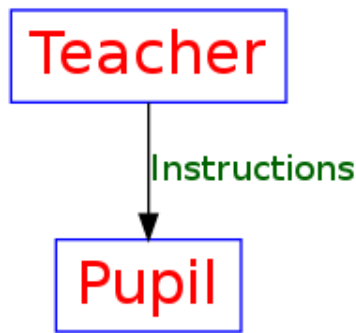
    T->P [label="Instructions", fontcolor=darkgreen] // edge T->P
}
  
```



#### 4.5 Same Graph, Different Shape and Colour

```

digraph graphname {
    T [label="Teacher" color=Blue, fontcolor=Red, fontsize=24, shape=box] //
    P [label="Pupil" color=Blue, fontcolor=Red, fontsize=24, shape=box] // node P
    T->P [label="Instructions", fontcolor=darkgreen] // edge T->P
}
  
```



Here are some of the shapes you can use... box, polygon, ellipse, oval, circle, point, egg, triangle, plaintext, diamond, trapezium, parallelogram, house, pentagon, hexagon, septagon, octagon, doublecircle, doubleoctagon, tripleoctagon

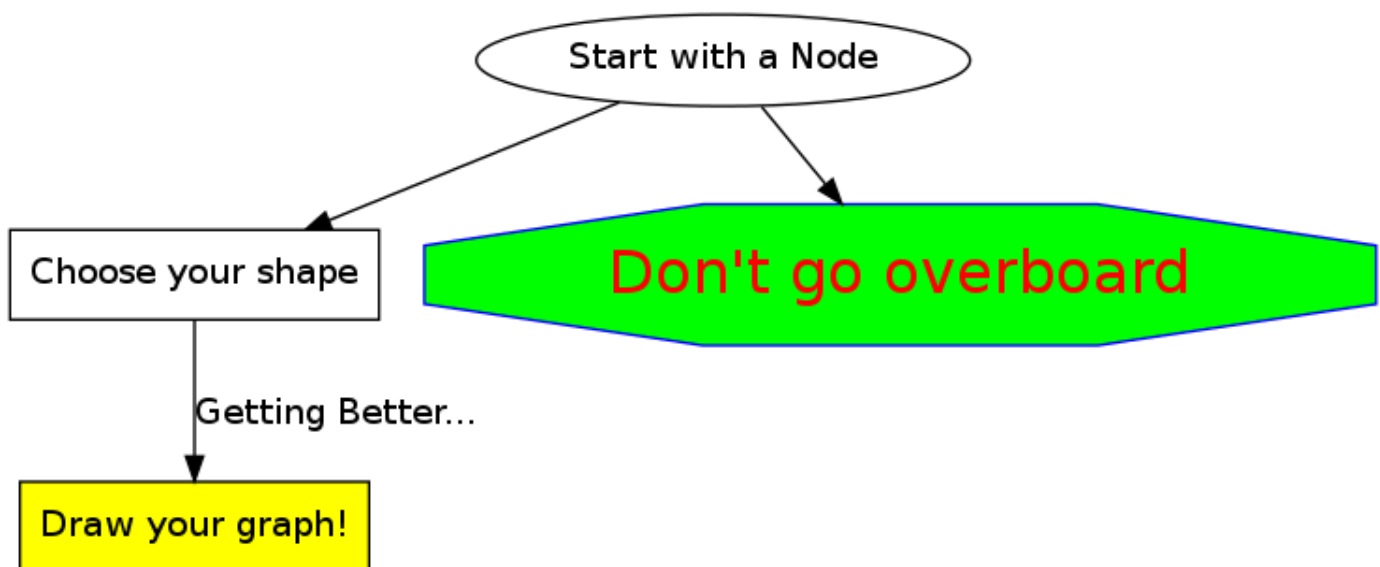
There are lots more available here... <http://www.graphviz.org/content/node-shapes>

## 4.6 Summary

```

digraph summary{
    start [label="Start with a Node"]
    next [label="Choose your shape", shape=box]
    warning [label="Don't go overboard", color=Blue, fontcolor=Red, fontsize=24, style=filled, fillcolor=yellow]
    end [label="Draw your graph!", shape=box, style=filled, fillcolor=yellow]

    start->next
    start->warning
    next->end [label="Getting Better...", fontcolor=darkblue]
}
  
```



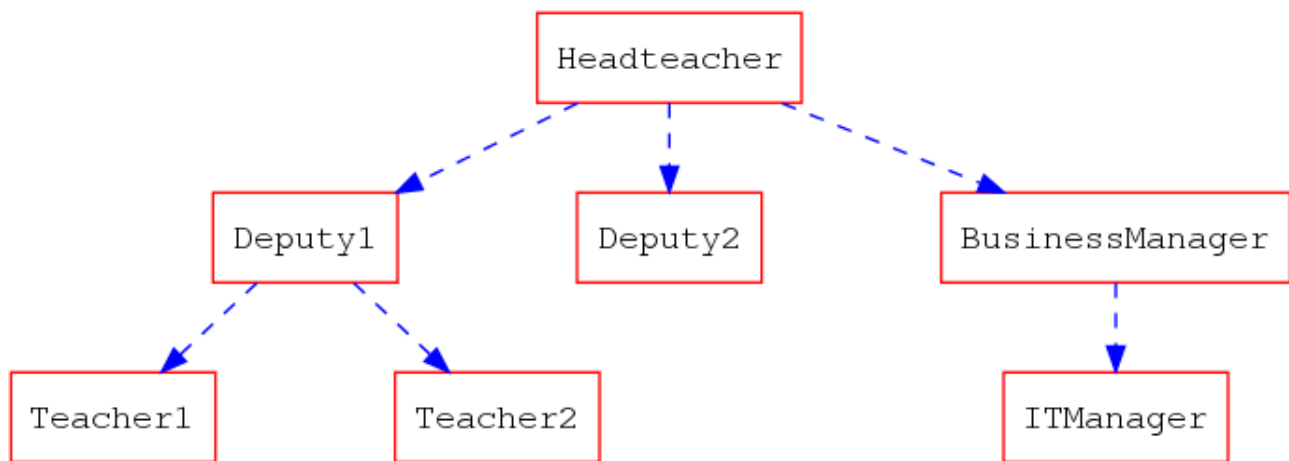
## 5 More Advanced

## 5.1 Saving Time

It takes time defining each node individually. The following way is quicker

```
digraph hierarchy {
    nodesep=1.0 // increases the separation between nodes
    node [color=Red,fontname=Courier,shape=box] //All nodes will this shape and color
    edge [color=Blue, style=dashed] //All the lines look like this

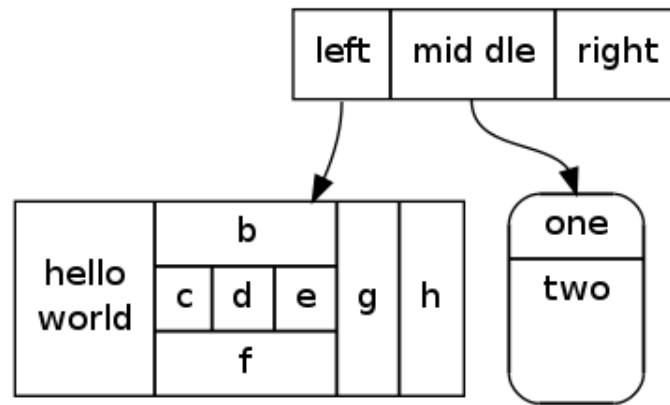
    Headteacher->{Deputy1 Deputy2 BusinessManager}
    Deputy1->{Teacher1 Teacher2}
    BusinessManager->ITManager
    {rank=same;ITManager Teacher1 Teacher2} // Put them on the same level
}
```



## 5.2 Records

You can now use HTML to define these sort of blocks. Find out more at <http://www.graphviz.org/doc/info/shapes.html>

```
digraph structs {
    node[shape=record]
    struct1 [label="<f0> left|<f1> mid\ dle|<f2> right"];
    struct2 [label="{<f0> one|<f1> two\n\n\n}" shape=Mrecord];
    struct3 [label="hello\nworld |{ b |{c|<here> d|e}| f}| g | h"];
    struct1:f1 -> struct2:f0;
    struct1:f0 -> struct3:f1;
}
```



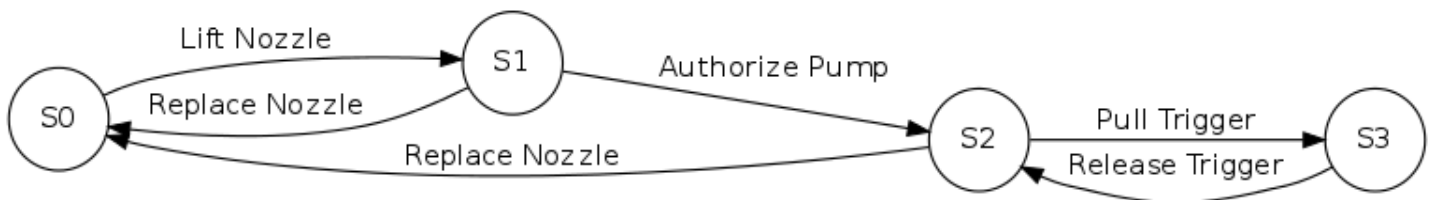
## 6 Some Example Graphs

### 6.1 Finite State Machine

```

digraph finite_state_machine {
    rankdir=LR;
    size="8,5"
    node [shape = circle];
    S0 -> S1 [ label = "Lift Nozzle" ]
    S1 -> S0 [ label = "Replace Nozzle" ]
    S1 -> S2 [ label = "Authorize Pump" ]
    S2 -> S0 [ label = "Replace Nozzle" ]
    S2 -> S3 [ label = "Pull Trigger" ]
    S3 -> S2 [ label = "Release Trigger" ]
}

```

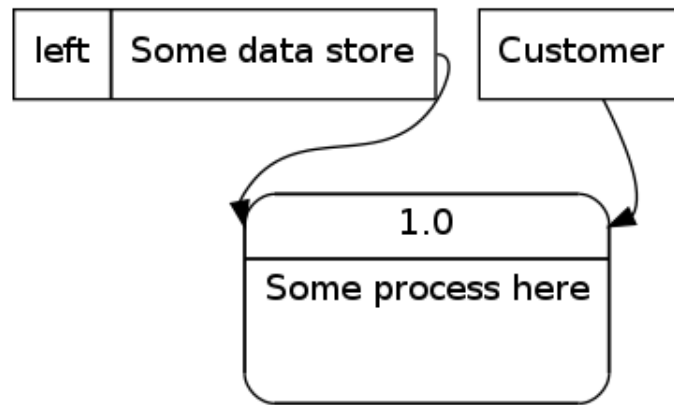


### 6.2 Data Flow Diagrams

```

digraph dfd{
    node[shape=record]
    store1 [label="<f0> left|<f1> Some data store"];
    proc1 [label="{<f0> 1.0|<f1> Some process here\n\n\n}" shape=Mrecord];
    entil [label="Customer" shape=box];
    store1:f1 -> proc1:f0;
    entil-> proc1:f0;
}

```



## 6.3 Data Flow Diagrams 2

The following uses subgraphs to display different levels. Note that subgraphs must start with the prefix `cluster_` or they won't work. It will only work with dot layout.

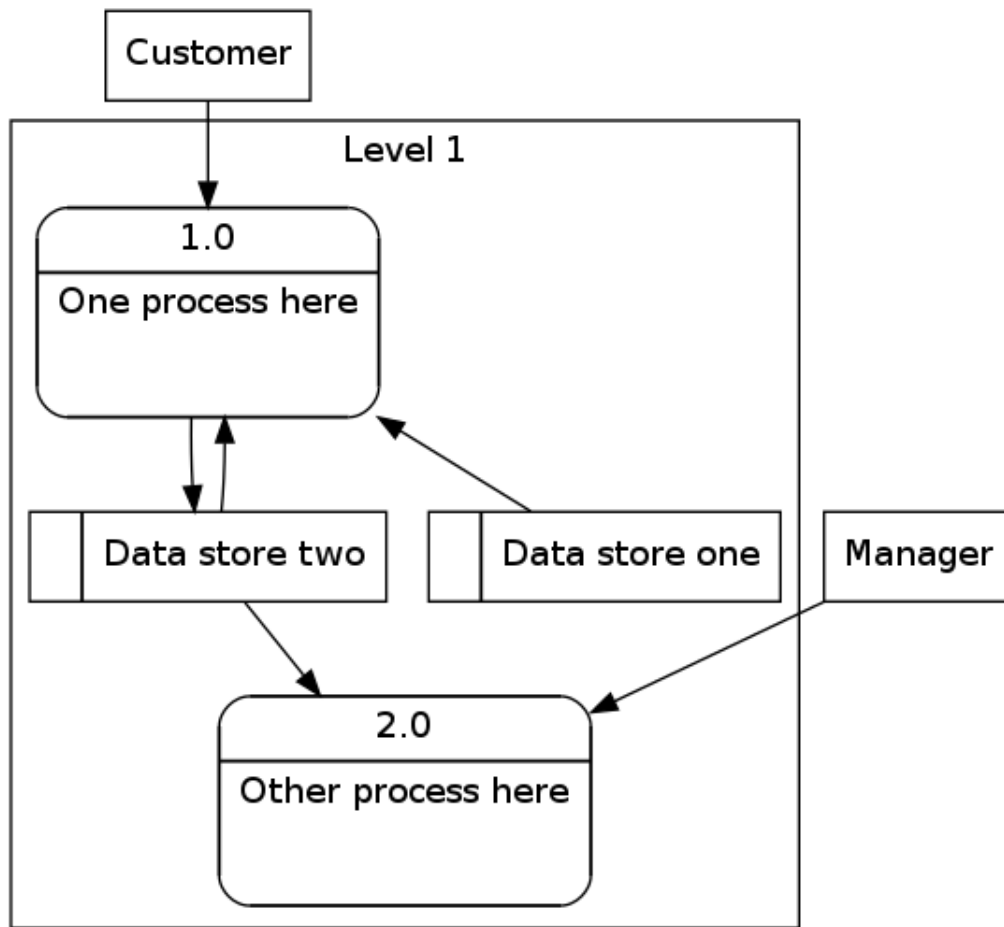
```

digraph dfd2{
  node[shape=record]
  subgraph level0{
    enti1 [label="Customer" shape=box];
    enti2 [label="Manager" shape=box];
  }
  subgraph cluster_level1{
    label = "Level 1";
    proc1 [label="{<f0> 1.0|<f1> One process here\n\n\n}" shape=Mrecord];
    proc2 [label="{<f0> 2.0|<f1> Other process here\n\n\n}" shape=Mrecord];
    store1 [label="{<f0>      |<f1> Data store one"}];
    store2 [label="{<f0>      |<f1> Data store two"}];
    {rank=same; store1, store2}
  }

  enti1 -> proc1
  enti2 -> proc2
  store1 -> proc1
  store2 -> proc2
  proc1 -> store2
  store2 -> proc1
}

```





## 6.4 Object Inheritance

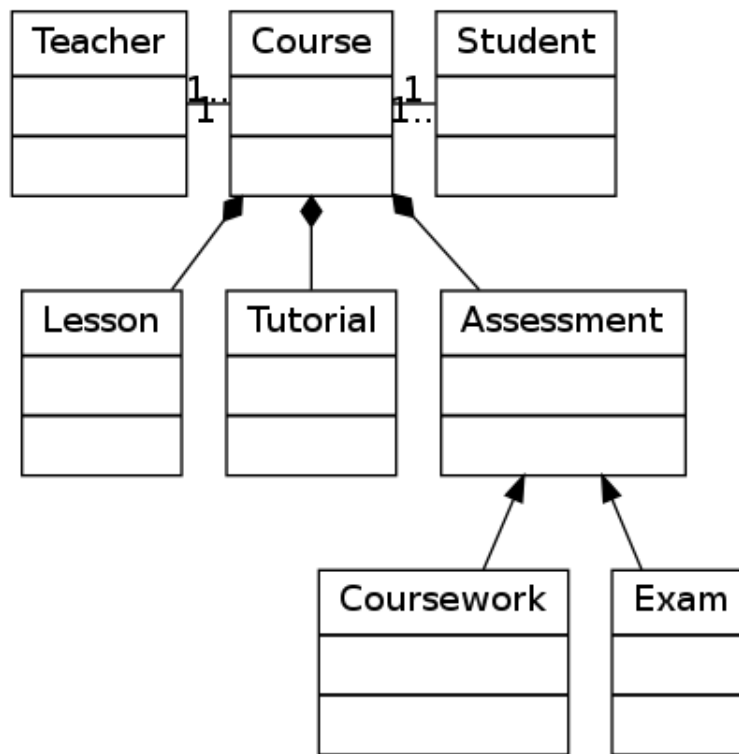
```

digraph obj{
  node[shape=record];
  rankdir="BT";

  teacher [label = "{<f0> Teacher|<f1> \n |<f2> \n }"];
  course [label = "{<f0> Course|<f1> \n |<f2> \n }"];
  student [label = "{<f0> Student|<f1> \n |<f2> \n }"];
  lesson [label = "{<f0> Lesson |<f1> \n |<f2> \n }"];
  tutorial [label = "{<f0> Tutorial|<f1> \n |<f2> \n }"];
  assessment [label = "{<f0> Assessment|<f1> \n |<f2> \n }"];
  coursework [label = "{<f0> Coursework|<f1> \n |<f2> \n }"];
  exam [label = "{<f0> Exam|<f1> \n |<f2> \n }"];

  {rank=same; teacher course student}

  teacher->course [dir="forward",arrowhead="none",arrowtail="normal",headlabel="1",tail
  student->course [dir="forward",arrowhead="none",arrowtail="normal",headlabel="1",tail
  lesson->course [dir="forward",arrowhead="diamond",arrowtail="normal"];
  tutorial->course [dir="forward",arrowhead="diamond",arrowtail="normal"];
  assessment->course [dir="forward",arrowhead="diamond",arrowtail="normal"];
  coursework->assessment;
  exam->assessment;
}
  
```



## 6.5 Entity Relationship

```

digraph ER{
    node[shape=box];
    Book;
    Customer;
    Loan;
    {rank=same;Book, Customer, Loan}
    Book->Loan[dir="forward",arrowhead="crow",arrowtail="normal"];
    Customer->Loan[dir="forward",arrowhead="crow",arrowtail="normal"];
}
  
```



## 7 Reference

Here are the most useful attributes you will need when drawing graphs. The full list can be found here:

<http://graphviz.org/doc/info/attrs.html>

### 7.1 Graph Attributes

- label="My Graph"; Label a graph itself
- rankdir=LR; Lay the graph out from Left to Right, instead of Top to Bottom

- {rank=same; a, b, c } Group nodes together at the same level of a graph
- splines="line"; Force edges to be straight, no curves or angles
- K=0.6; Used to influence the 'spring' used in the layout, Can be used to push nodes further apart, which is especially useful for twopi and sfdp layouts

## 7.2 Vertex Attributes

- [label="Some Label"] Labels the Vertex
- [color="red"] Colors the Vertex
- [fillcolor="blue"] Fills the Vertex with the specified colour

## 7.3 Edge Attributes

- [label="Some Label"] Labels the Edge (Useful for Weights)
- [color="red"] Colors the Vertex (Useful for Paths)
- [penwidth=2.0] Adjusts the thickness of the edge line, Very useful for Paths

## 7.4 Size, Background Colour

fixedsize=true; size="1,1"; resolution=72; bgcolor="#C6CFD532";

# 8 Appendices

## 8.1 Further Reading

- [http://linuxdevcenter.com/pub/a/linux/2004/05/06/graphviz\\_dot.html](http://linuxdevcenter.com/pub/a/linux/2004/05/06/graphviz_dot.html)
- <http://graphs.grevian.org/index.html>

## 8.2 Using Emacs Org Mode

Emacs org mode is an ideal environment for writing, executing and exporting Dot graphics

### 8.2.1 Setup

Download and install graphviz and add the path to the exec-path variable

You will need to update your .emacs file to load dot as a babel language. The following is a useful babel setup for dot and other languages

```
(org-babel-do-load-languages
 (quote org-babel-load-languages)
 (quote ((emacs-lisp . t)
         (java . t)
         (dot . t)
         (ditaa . t)
         (R . t)
         (python . t)
         (ruby . t)
         (gnuplot . t)
         (clojure . t)
         (sh . t)
         (ledger . t)
         (org . t)
         (plantuml . t)
         (latex . t))))
```

### 8.2.2 Embedding Dot in Emacs

Org mode can interpret different languages by using the Library Of Babel. To do so, enclose the code in `begin_src` and `end_src` tags as below. You'll need to add command line arguments as shown.

A shortcut to make a `begin_src` block is to type `<s [TAB]`

```
#+begin_src dot :file ./img/example1.png :cmdline -Kdot -Tpng
graph graphname {
    a -- b;
    b -- c;
    b -- d;
    d -- a;
}
#+end_src
```

### 8.2.3 The Command Line

The section `:cmdline -Kdot -Tpng` in the `#+begin_src dot :file ./img/example1.png :cmdline -Kdot -Tpng` section are command line arguments. They tell dot how to render and display.

- `-Kdot` use dot layout. The other layouts you can try are `Kneato`, `Kcirco`, `Ktwopi`, `Kfdp` and `Ksfdp` for different layouts
- `-Tpng` render as png

The full command line arguments can be found here: <http://graphviz.org/content/command-line-invocation>

Date: <2013-10-21 Mon>

Author: Tony Ballantyne

Created: 2018-09-01 Sat 12:33

Emacs 23.3.1 (Org mode 8.0.2)

[Validate](#)