Shell Programming

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Different shells (e.g. bash, ksh, tcsh, ash, sh) => different commands/scripts

Why a shell script?
- simple way to string together a bunch of UNIX-commands
- scripts are usually fast to get going
- portable across the whole UNIX world

Nevertheless: scripts are controversial.
- syntax is often ambiguous, wrong documented
- interpretation sometimes leads to surprising results

Helpful webpages:

http://tldp.org/HOWTO/Bash-Prog-Intro-HOWTO.html
http://tldp.org/LDP/abs/html/

http://www.google.de

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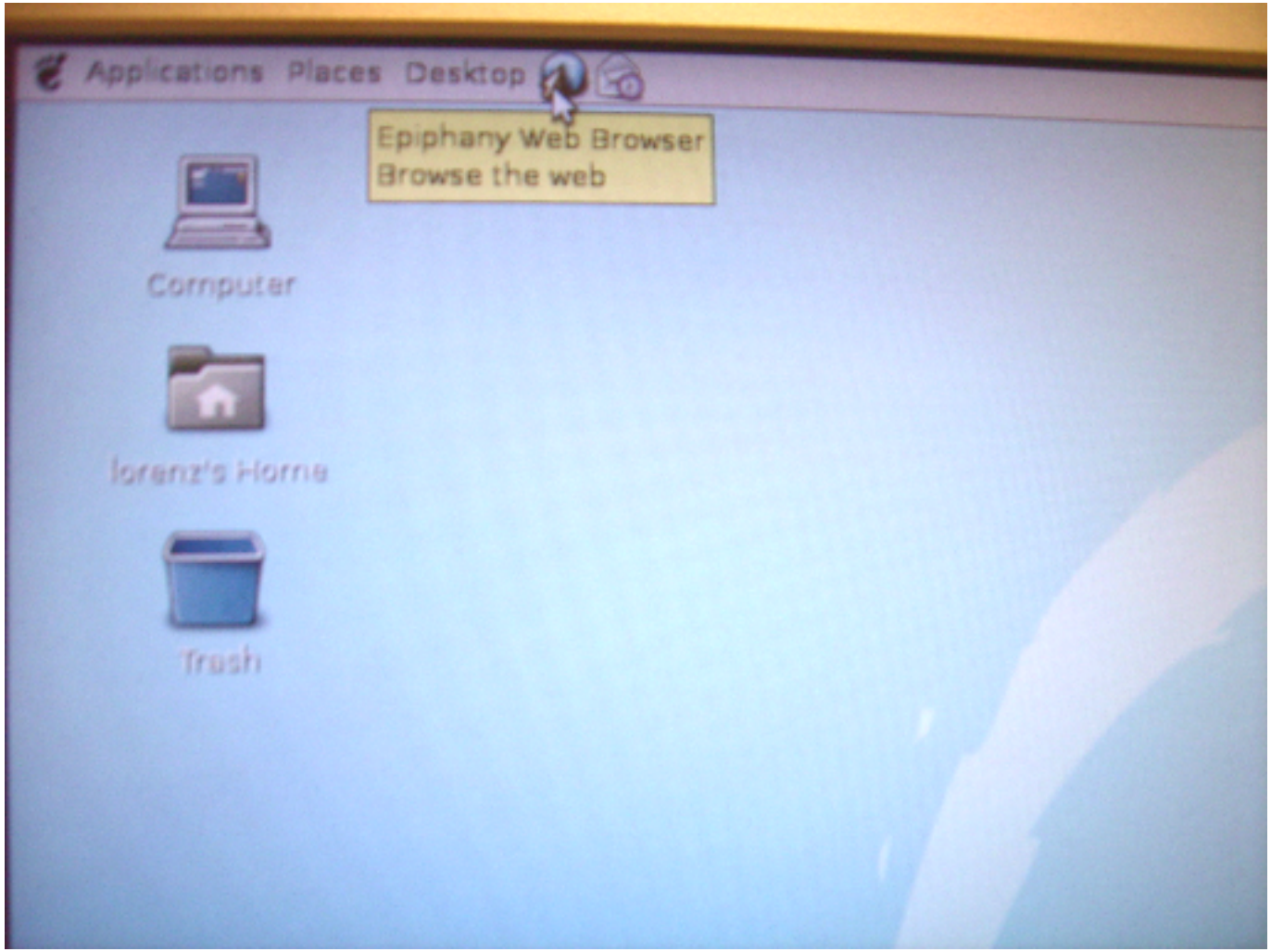
- google



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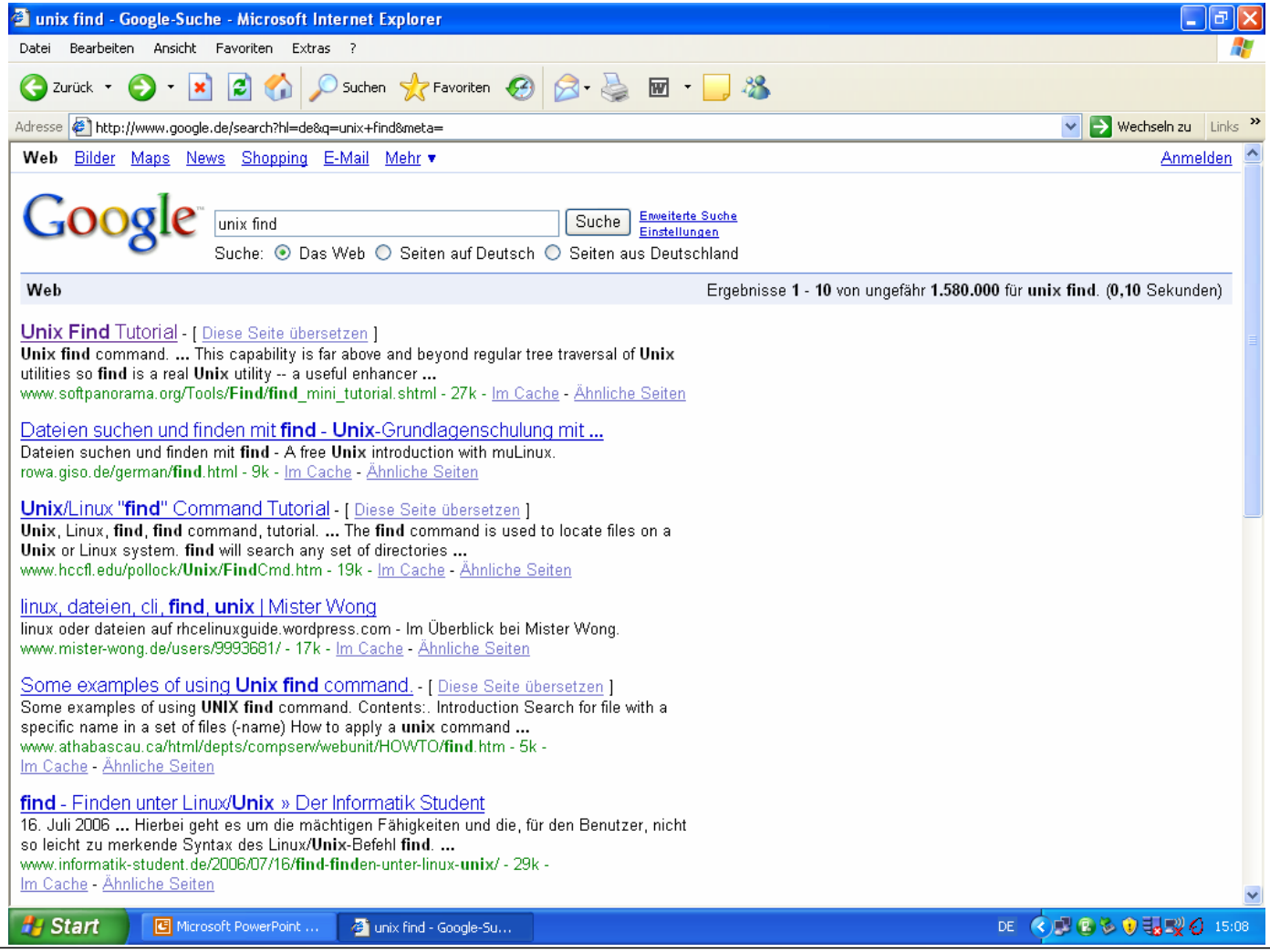
- google



Google (part 1): Reading your mind

see http://www.ams.org/featurecolumn/archive/pagerank.html

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The problem:

given is
- a library with 25 billion documents
- no centralized organisation
- no librarians
- anyone can add documents

You are interested in information. You only know some keywords.

further complication:
Google claims more then 25 billion indexed pages. 95% of the text in the Web is composed of only some 1,000 words. How can we distinguish the important pages from the unimportant ones?

Impossible?

Google (part 1): Reading your mind

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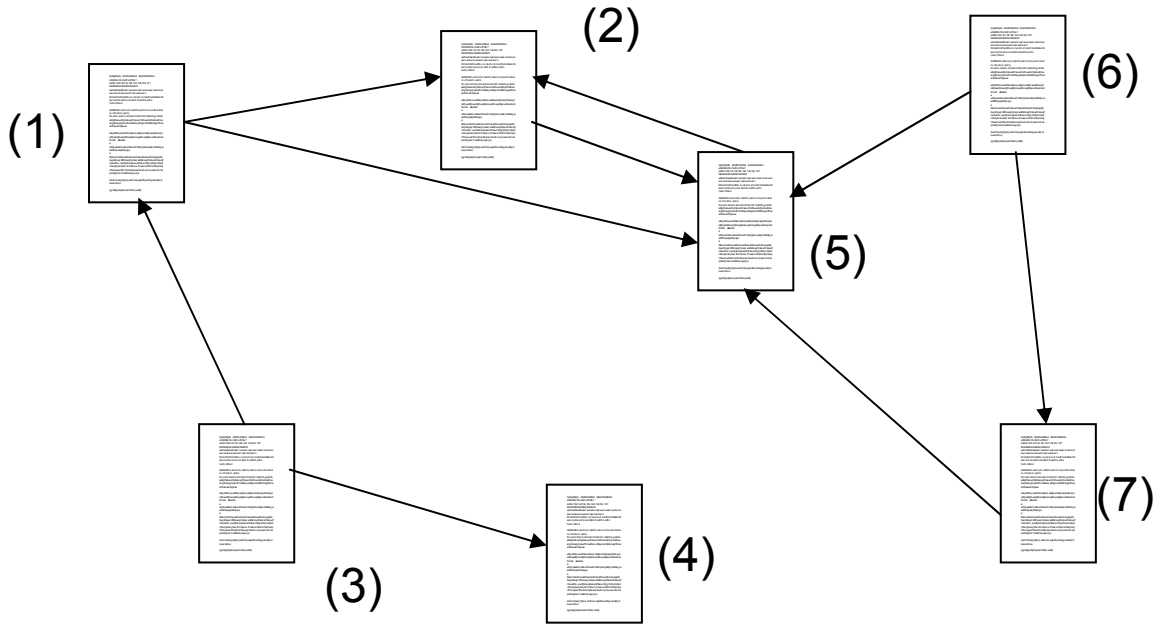
The heart of the google software is the PageRank algorithm.



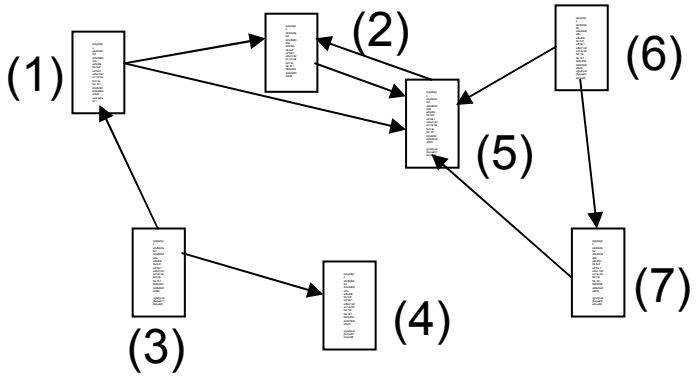
Let P be a web page.
We call I(P) the importance of P.

Let P_j have l_j many outgoing links.
If P_i is such a page, P_j will pass $1/l_j$ „importance“ to P_i.

Let B_i be the set of pages linking to P_i. Then the importance relation between a page and its neighbours is as follows:

$$I(P_i) := \sum_{P_j \in B_i} I(P_j)/l_j$$

Google (part 1): Reading your mind



$$I(P_i) := \sum_{P_j \in B_i} I(P_j)/l_j$$?? → chicken vs. egg problem

Define a matrix $\mathbf{H} = (h_{ij})$ with

$$h_{ij} := \begin{cases} 1/l_j & \text{if } P_j \in B_i \\ 0 & \text{otherwise} \end{cases}$$

$$\mathbf{H} = \begin{pmatrix} 0 & 0 & ½ & 0 & 0 & 0 & 0 \\ ½ & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & ½ & 0 & 0 & 0 & 0 \\ ½ & 1 & 0 & 0 & 0 & ½ & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & ½ & 0 \end{pmatrix}$$

and a vector **I** of PageRanks: $\mathbf{I} := \begin{pmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{pmatrix}$

Then I = H*I.

In other words:
I is eigenvector of the matrix **H** with eigenvalue 1.

to be continued ... soon

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- How to get a shell

The bash

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A first example

```
#!/bin/bash -vx
echo "My first script" > fst_exa.txt
cat fst_exa.txt
cat fst_exa.txt | wc
rm fst_exa.txt
```

The script has got the name `fst_exa.bash`. The ‚correct' way to start is **/bin/bash fst_exa.bash**. Shorter: **./fst_exa.bash**

Another simple example, using parameters → def_params.bash

```
#!/bin/bash
echo "Script name is              [$0]"
echo "First Parameter is          [$1]"
echo "Second Parameter is         [$2]"
echo "Process ID is               [$$]"
echo "Parameter Count is          [$#]"
echo "All Parameters              [$@]"
echo "The FLAGS are               [$-]"
```

The bash

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Useful example-commands for scripting are

`sort`	sorts lines in various orders
`grep`	searches for expressions in strings or files
`basename`	strips the path from a path string to leave just the filename
`dirname`	removes the file from a path string to leave just the pathname
`cut`	prints selected parts of lines from a file to stdout → `cf. unix_for_while.bash`
`wc`	count the characters, words, or lines
`tr 'a' 'b'`	transform characters → unix_tr.bash
`expr`	simple arithmetic processor → `example in unix_expr.bash`
`eval`	evaluate variables → `example in unix_eval.bash`
`echo`	output strings
`date`	shows a date string
`head | tail`	access head- or tail-lines in files
`tar`	packing or unpacking an archive (a collection of several files in one file)

The bash

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Accents and quotations → unix_accents_quotes.bash
(be careful with spaces!)

```
#!/bin/sh
# This is a comment!
echo "Hello World"   # This is a comment, too!
echo "Hello World"
echo "Hello * World"
echo Hello * World
echo Hello World
echo "Hello" World
echo Hello "      " World
echo "Hello \"*\" World"
echo `hello` world
echo 'hello' world
```

The bash

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Complex Commands group simple commands into control sets.

- loop structures:
  - **for** *name* [**in** ...] **do** list-of-commands **done**

```
alphabet="a b c d e"                    # Initialise a string
count=0                                 # Initialise a counter
for letter in $alphabet                 # Set up a loop control
  do                                    # Begin the loop
    count=`expr $count + 1`             # Increment the counter
    echo "Letter $count is [$letter]" # Display the result
  done                                  # End of loop
```

The bash

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Complex Commands group simple commands into control sets.

- loop structures:
  - **while** *condition* **do** list-of-commands **done**
    → unix_for_while.bash

```
alphabet="a b c d e"                                    # Initialise a string
count=0                                                 # Initialise a counter
while [ $count -lt 5 ]                                  # Set up a loop control
  do                                                    # Begin the loop
      count=`expr $count + 1`                           # Increment the counter
      position=`bc $count + $count - 1`                 # Position of next letter
      letter=`echo "$alphabet" | cut -c$position-$position`
                                                        # Get next letter
      echo "Letter $count is [$letter]"                 # Display the result
  done
```

The bash

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Complex Commands group simple commands into control sets.

- the if structure
  - **if** *condition1* **then** list-of-commands1
    [**elif** *condition2* **then** list-of-commands2] ...
    [**else** list-of-commandsn] **fi**

Example: → unix_test_if.bash

```
#!/bin/bash -vx
if test -w $1
then
  echo "File $1 existiert" #-w file exists and write-rights
fi

#in the following: [...] implicitely calls "test"
if [ -f $1/$2 ] #-f file exists and is simple file
then
    echo "This filename [$2] exists"
elif [ -d $1 ] #-d directory exists
then
    echo "This dirname [$1] exists"
else
    echo "Neither [$1] nor [$2] exist"
fi
```