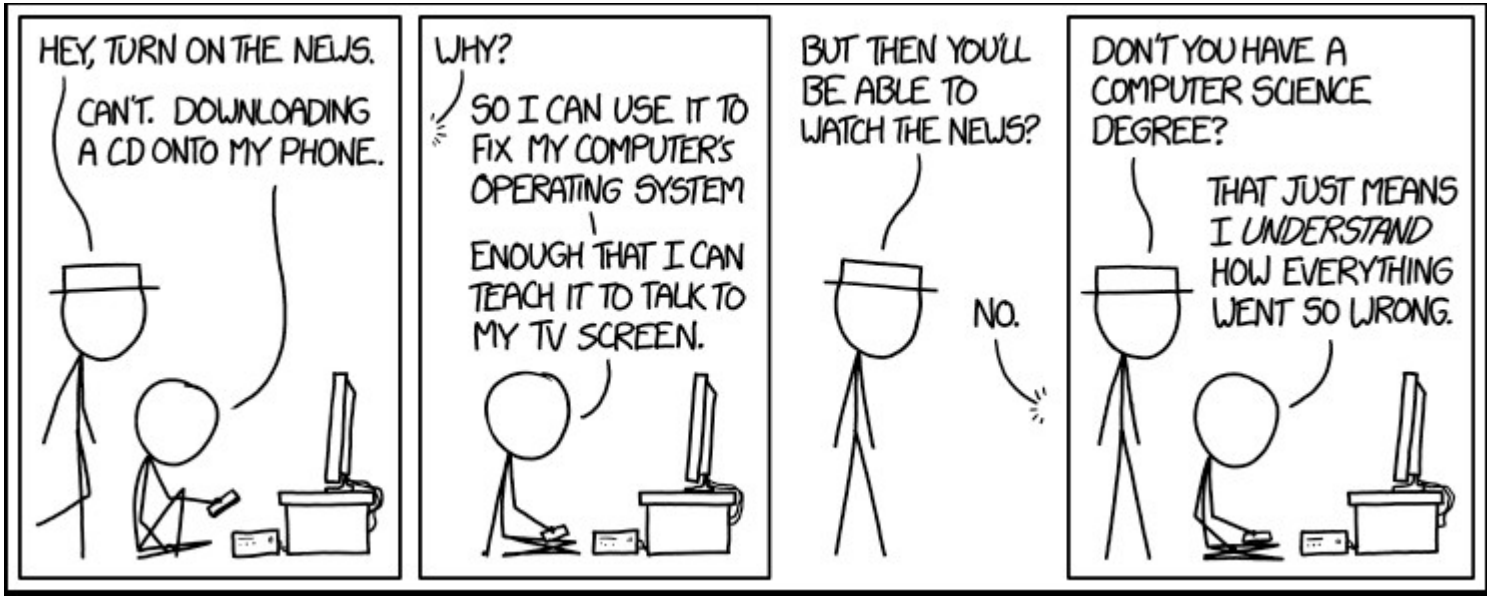
Week Two Lecture

Agenda

1. Shell Scripting
2. RegEx
3. Group Project Info
   - Application Architecture
   - Methods
4. Slides on sed, awk
5. Preview of Lab 2


HEY, TURN ON THE NEWS.
CAN'T. DOWNLOADING A CD ONTO MY PHONE.
WHY?
SO I CAN USE IT TO FIX MY COMPUTER'S OPERATING SYSTEM ENOUGH THAT I CAN TEACH IT TO TALK TO MY TV SCREEN.
BUT THEN YOU'LL BE ABLE TO WATCH THE NEWS?
NO.
DON'T YOU HAVE A COMPUTER SCIENCE DEGREE?
THAT JUST MEANS I UNDERSTAND HOW EVERYTHING WENT SO WRONG.

Introduction to Shell Programming

- Shell programming is one of the most powerful features on any UNIX system
- If you cannot find an existing utility to accomplish a task, you can build one using a shell script

Shell Program Structure

- A shell program contains high-level programming language features:
  - Variables for storing data
  - Decision-making control (e.g. if and case statements)
  - Looping abilities (e.g. for and while loops)
  - Function calls for modularity
- A shell program can also contain:
  - UNIX commands
  - Pattern editing utilities (e.g. grep, sed, awk)

Your Shell Programming Library

- Naming of shell programs and their output
  - Give a meaningful name
  - Program name example: findfile.csh
  - Do not use: script1, script2
  - Do not use UNIX command names
- Repository for shell programs
  - If you develop numerous shell programs, place them in a directory (e.g. bin or shellprogs)
  - Update your path to include the directory name where your shell programs are located

Steps to Create Shell Programs

- Specify shell to execute program
  - Script must begin with #! (pronounced "shebang") to identify shell to be executed

Examples:

```
#! /bin/sh          (defaults to bash, but be explicit)
#! /bin/bash
#! /bin/csh
#! /usr/bin/tcsh
```

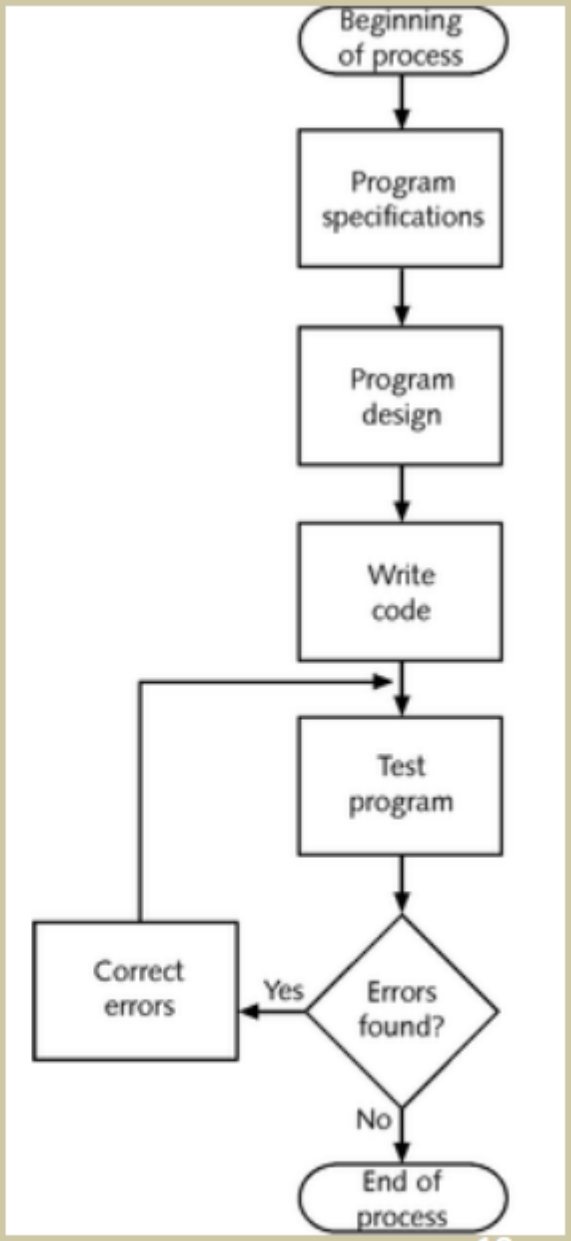
- Make the shell program executable
  - Use the "chmod" command to make the program/script file executable

Formatting Shell Programs

- Formatting of shell programs
  - Indent areas (3 or 4 spaces) of programs to indicate that commands are part of a group
  - To break up long lines, place a \ at the end of one line and continue the command on the next line
- Comments
  - Start comment lines with a pound sign (#)
  - Include comments to describe sections of your program
  - Help you understand your program when you look at it later

Steps of Programming

- Guidelines:
  - use good names for
    - script
    - variables
  - use comments
    - lines start with #
  - use indentation to reflect logic and nesting



Example: "HELLO" Script

```
#! /bin/bash
echo "Hello $USER"
echo "This machine is `uname -n`"
echo "The calendar for this month is:"
cal
echo "You are running these processes:"
ps
```

Variables

- 2 types of variables
  - Environment
    - valid for complete login session
    - upper case by convention
  - Shell
    - valid for each shell invocation
    - lower case
- To display value

  echo $variable

Predefined Shell Variables

Shell Variable	Description
PWD	The most recent current working directory.
OLDPWD	The previous working directory.
BASH	The full path name used of the bash shell.
RANDOM	Generates a random integer between 0 and 32,767
HOSTNAME	The current hostname of the system.
PATH	A list of directories to search of commands.
HOME	The home directory of the current user.
PS1	The primary prompt (also PS2, PS3, PS4).

User-defined Shell Variables

- Syntax:

```
varname=value
```

Example:

```
rate=7.65
echo "Rate today is: $rate"
```

- Use double quotes if the value of a variable contains white spaces

Example:

```
name="Thomas William Flowers"
```

Numeric variables

- Syntax:

```
let varname=value
```

- Can be used for simple arithmetic:

```
let count=1
let count=$count+20
let count+=1
```

Variables commands

- To delete both local and environment variables

  `unset varname`

- To prohibit change

  `readonly varname`

- list all shell variables (including exported)

  `set`

Shell Scripting Tutorials

For Practice and Further Reading:

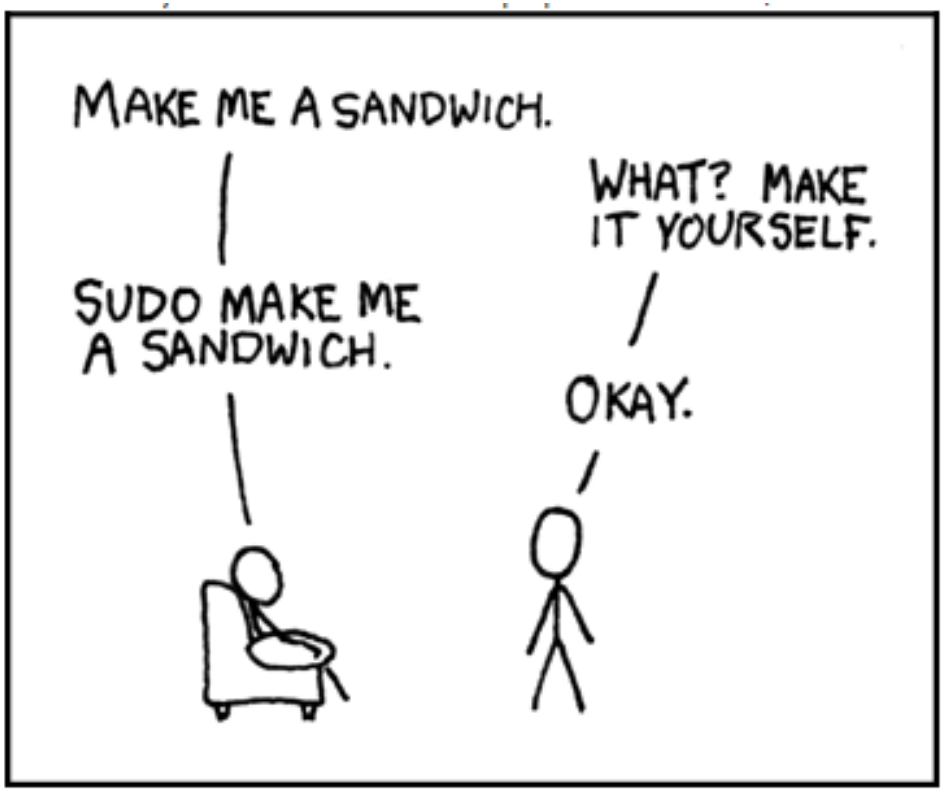
http://tldp.org/HOWTO/Bash-Prog-Intro-HOWTO.html

http://tldp.org/LDP/abs/html

https://store.xkcd.com/products/linux-cheat-shirt

Survey Observations

Shift Gears:



RegEx

- RegEx: A **regular expression** is a special text string for describing a search pattern.
- Think of **regular expressions** as wildcards on steroids.
- Wildcard notations such as *.txt finds all text files in a directory.
- The regex equivalent is ^.*\.txt$.

Metacharacters

RE Metacharacter	Matches…
.	**Any one character, except new line**
[a-z]	**Any one of the enclosed characters (e.g. a-z)**
*	**Zero or more of preceding character**
? or \?	**Zero or one of the preceding characters**
+ or \+	**One or more of the preceding characters**

- any non-metacharacter matches itself

The grep Utility

- "grep" command:
  searches for text in file(s)

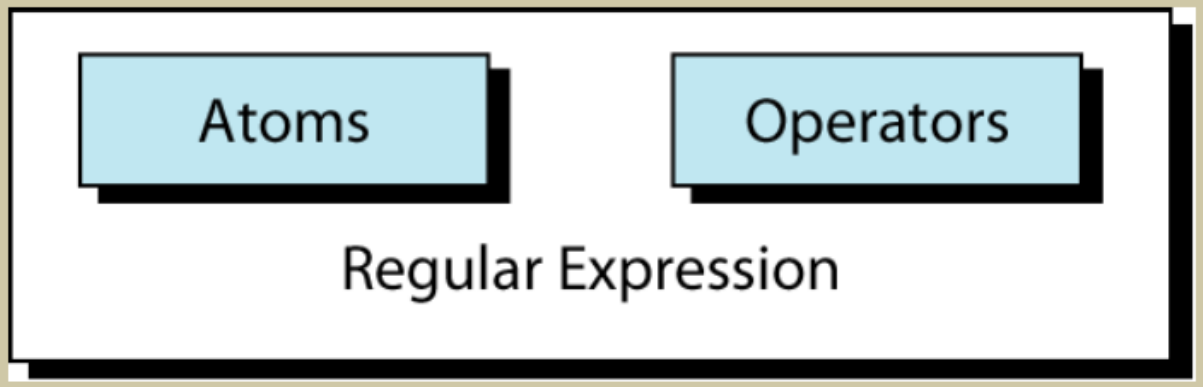
Examples:

```
% grep root mail.log
% grep r..t mail.log
% grep ro*t mail.log
% grep 'ro*t' mail.log
% grep 'r[a-z]*t' mail.log
```

more Metacharacters

RE Metacharacter	Matches…
^	**beginning of line**
$	**end of line**
char	**Escape the meaning of *char* following it**
[^]	**One character not in the set**
\<	**Beginning of word anchor**
\>	**End of word anchor**
( ) or \(\)	**Tags matched characters to be used later (max = 9)**
| or |	**Or grouping**
x\{m\}	**Repetition of character x, m times (x,m = integer)**
x\{m,\}	**Repetition of character x, at least m times**
x\{m,n\}	**Repetition of character x between m and m times**

Regular Expression

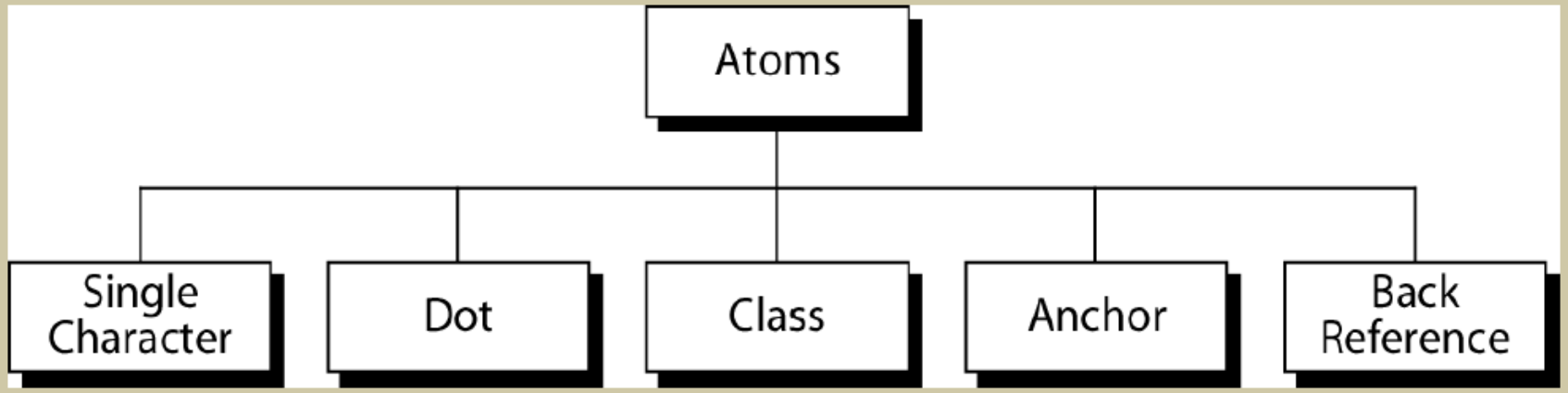


An atom specifies what text is to be matched and where it is to be found.

An operator combines regular expression atoms.

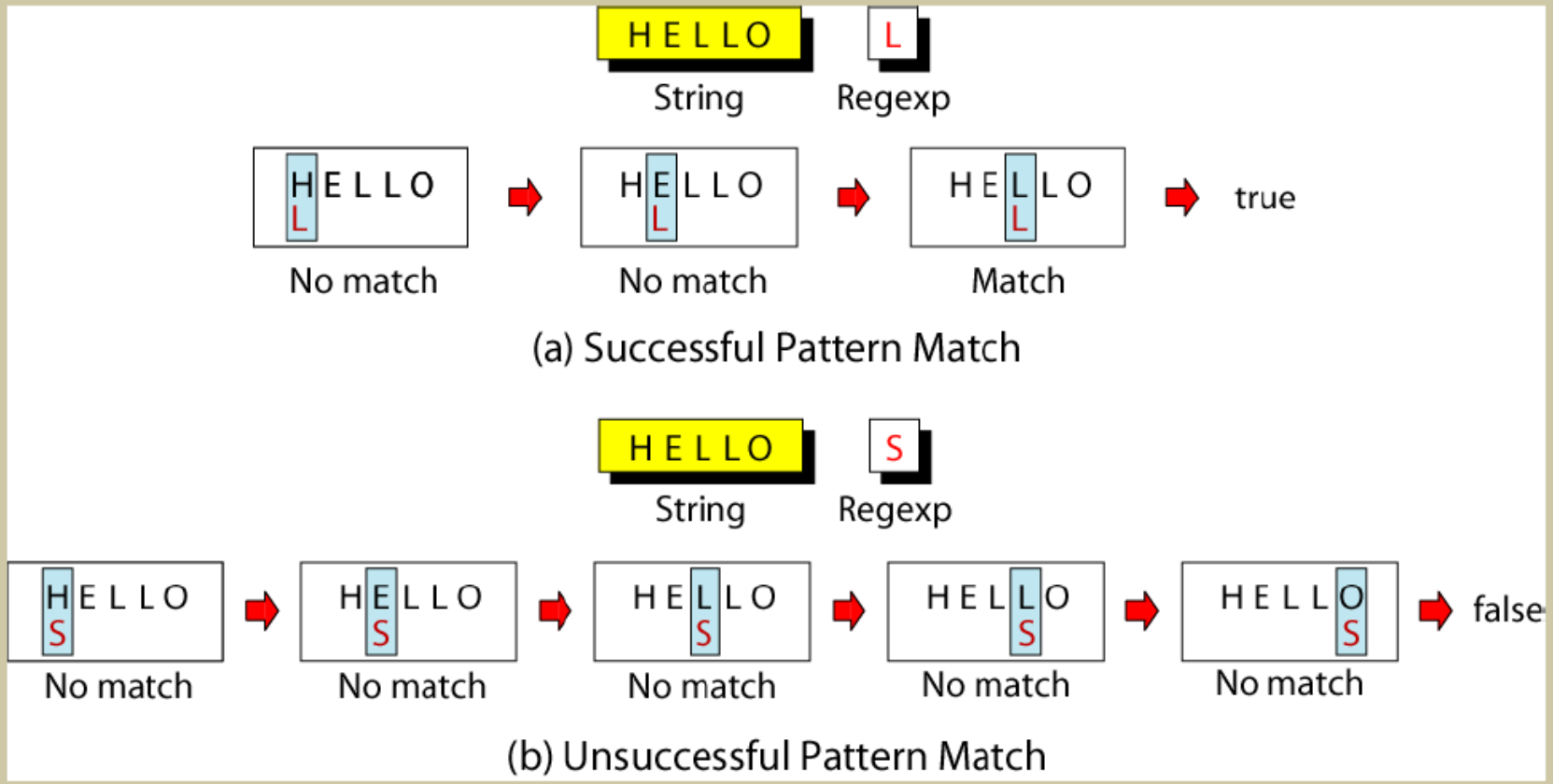
Atoms

An atom specifies what text is to be matched and where it is to be found.



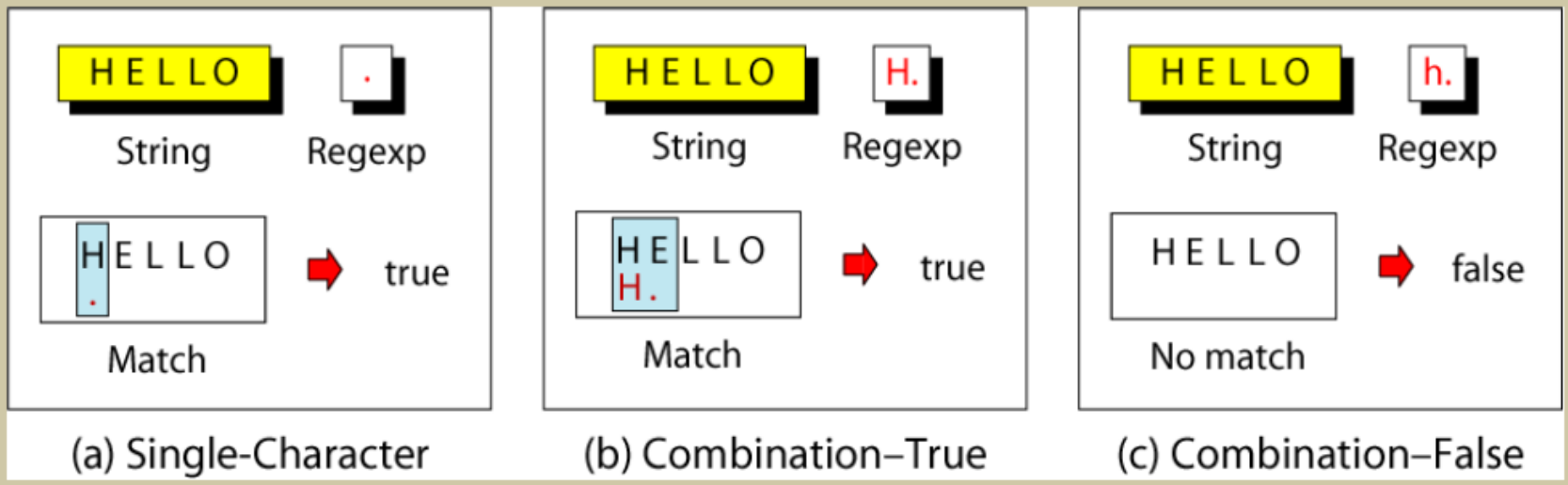
Single-Character Atom

A single character matches itself



Dot Atom

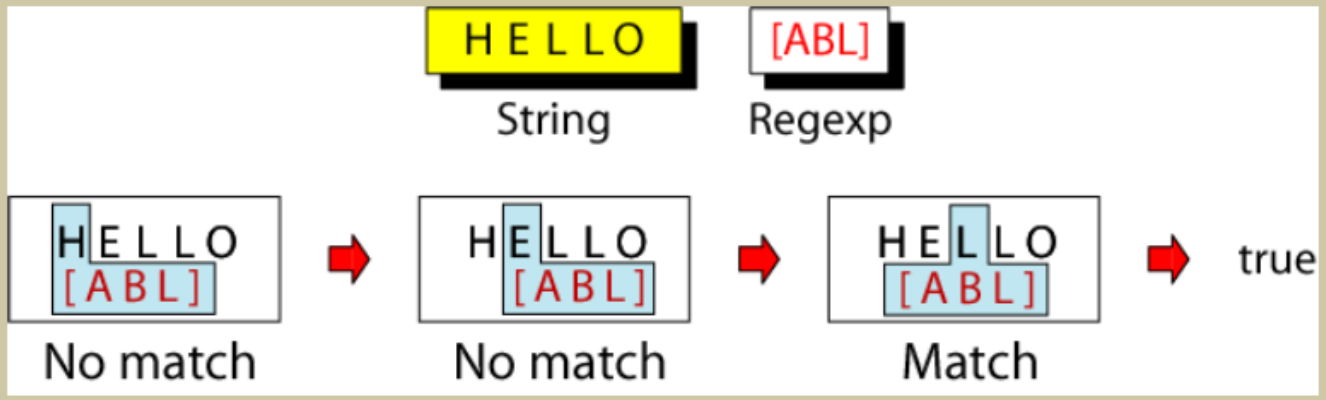
matches any single character except for a new line character (\n)



Class Atom

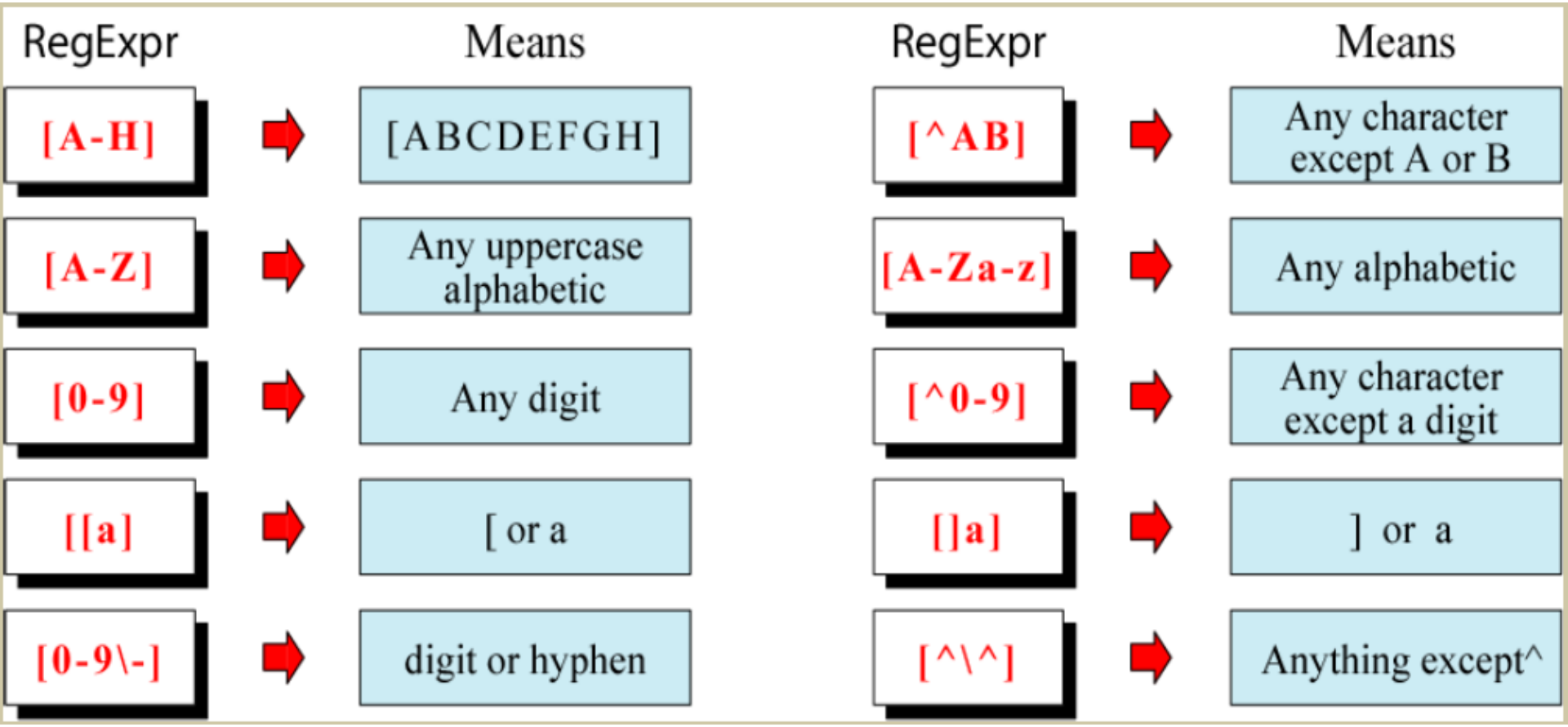
matches only single character that can be any of the characters defined in a set:

Example: [ABC] matches either A, B, or C.



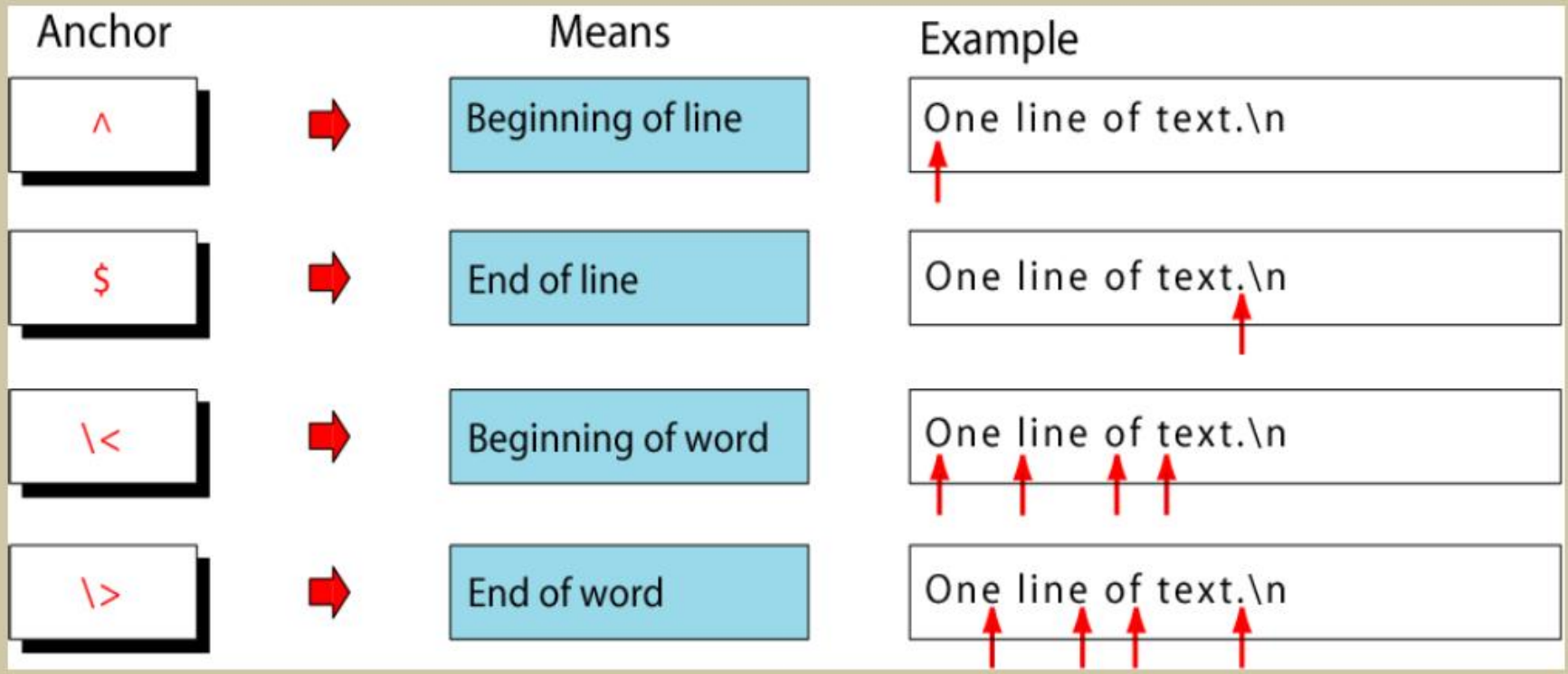
Notes:

1) A range of characters is indicated by a dash, e.g. [A-Q]
2) Can specify characters to be excluded from the set, e.g. [^0-9] matches any character other than a number.


RegExpr
Means
[A-H]
[ABCDEFGH]
[A-Z]
Any uppercase alphabetic
[0-9]
Any digit
[[a]
[or a
[0-9\-]
digit or hyphen
RegExpr
Means
[^AB]
Any character except A or B
[A-Za-z]
Any alphabetic
[^0-9]
Any character except a digit
[]a]
] or a
[^\^]
Anything except^

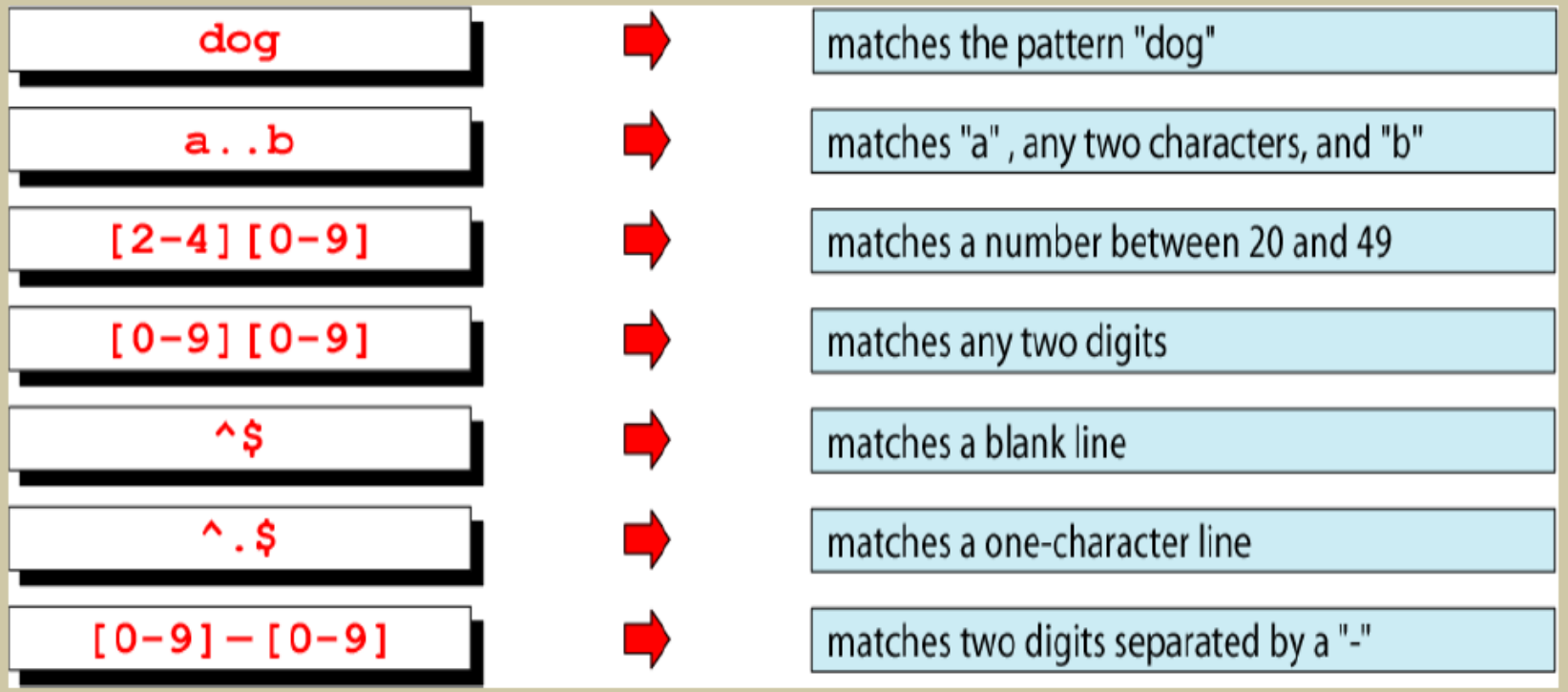
Anchors

Anchors tell **where** the next character in the pattern **must** be located in the text data.



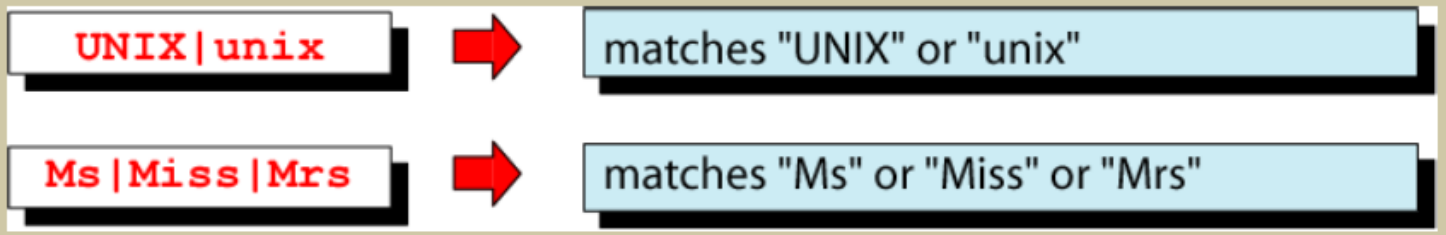
Sequence Operator

In a sequence operator, if a series of atoms are shown in a regular expression, there is no operator between them.



Alternation Operator: | or \|

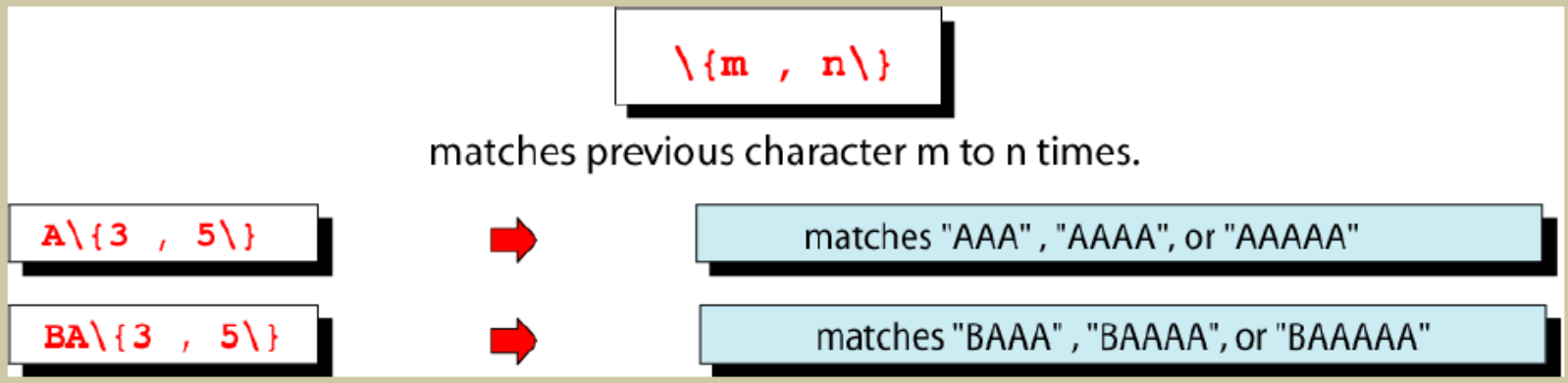
operator (| or \|) is used to define one
or more alternatives



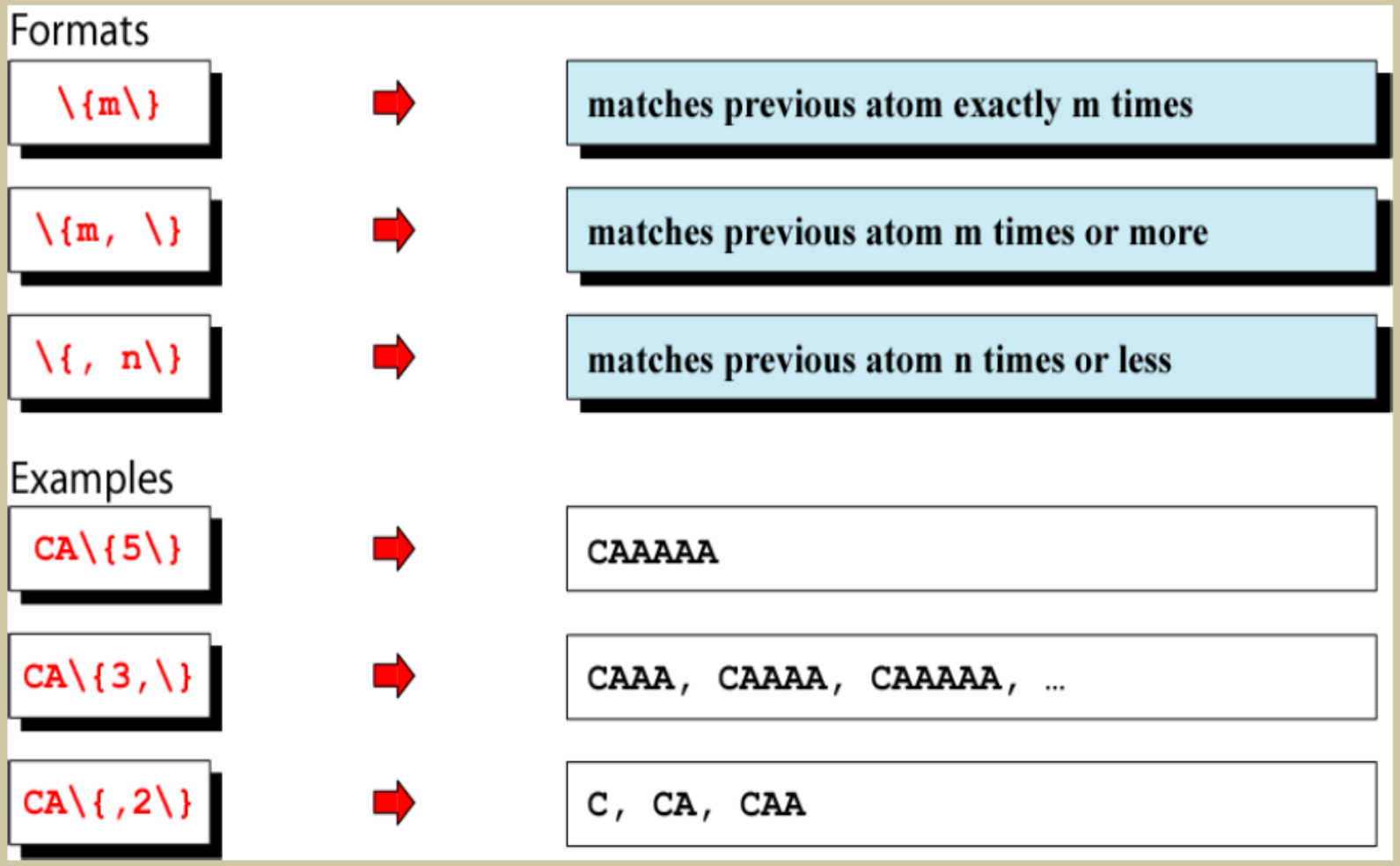
Note: depends on version of "grep"

Repetition Operator: \{...\}

The repetition operator specifies that the atom or expression immediately before the repetition may be repeated.



Basic Repetition Forms



Short Form Repetition Operators: * + ?

Formats

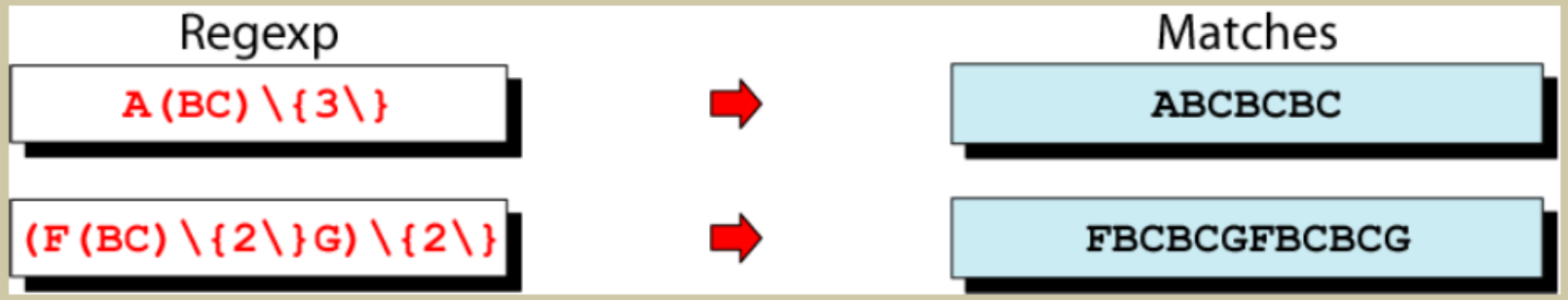
`*`	➡	special case: matches previous atom zero or more times
`+`	➡	special case: matches previous atom one or more times
`?`	➡	special case: matches previous atom 0 or one time only

Examples

`BA*`	➡	B, BA, BAA, BAAA, BAAAA, . . .
`B.*`	➡	B, BA . . . BZ, BAA . . . BZZ, BAAA . . . BZZZ, . . .
`.*`	➡	zero or more characters
`.+`	➡	one or more characters
`[0-9]?`	➡	zero or one digit

Group Operator

In the group operator, when a group of characters is enclosed in parentheses, the next operator applies to the whole group, not only the previous characters.



Note: depends on version of "grep"
use \(and \) instead

Further Reading:

- http://regexone.com/
- http://www.zytrax.com/tech/web/regex.htm
- http://docs.python.org/2/howto/regex.html
- **http://misc.yarinareth.net/regex.html**

Shift Gears:


UGH, I HATE WHEN APPS MAKE ARBITRARY CHANGES TO THEIR UI.
STUFF I DO ALL THE TIME JUST GOT WAY HARDER FOR NO REASON!
MAN.
YOU ARE NOT GONNA LIKE GETTING OLD.

Group Project Info

Objective:

To give students the opportunity to practice using software development methods and tools.

Specifics:

Team formation.

- 5 students per team
- From the same lab section
- Team composition determined by class

Group Project Info

Requirements

- A working software application
  - includes a “front-end”, “back-end”, and a database.
- Documentation of the development processes
- Use of repository for ALL deliverables
- Milestones – evidence of progress along the way
- Each milestone has specific required deliverables
- Work as a team
- Follow a “methodology”

Group Project Info

Grading

- A working software application
  - includes a “front-end”, “back-end”, and a database.

- Documentation of the development processes

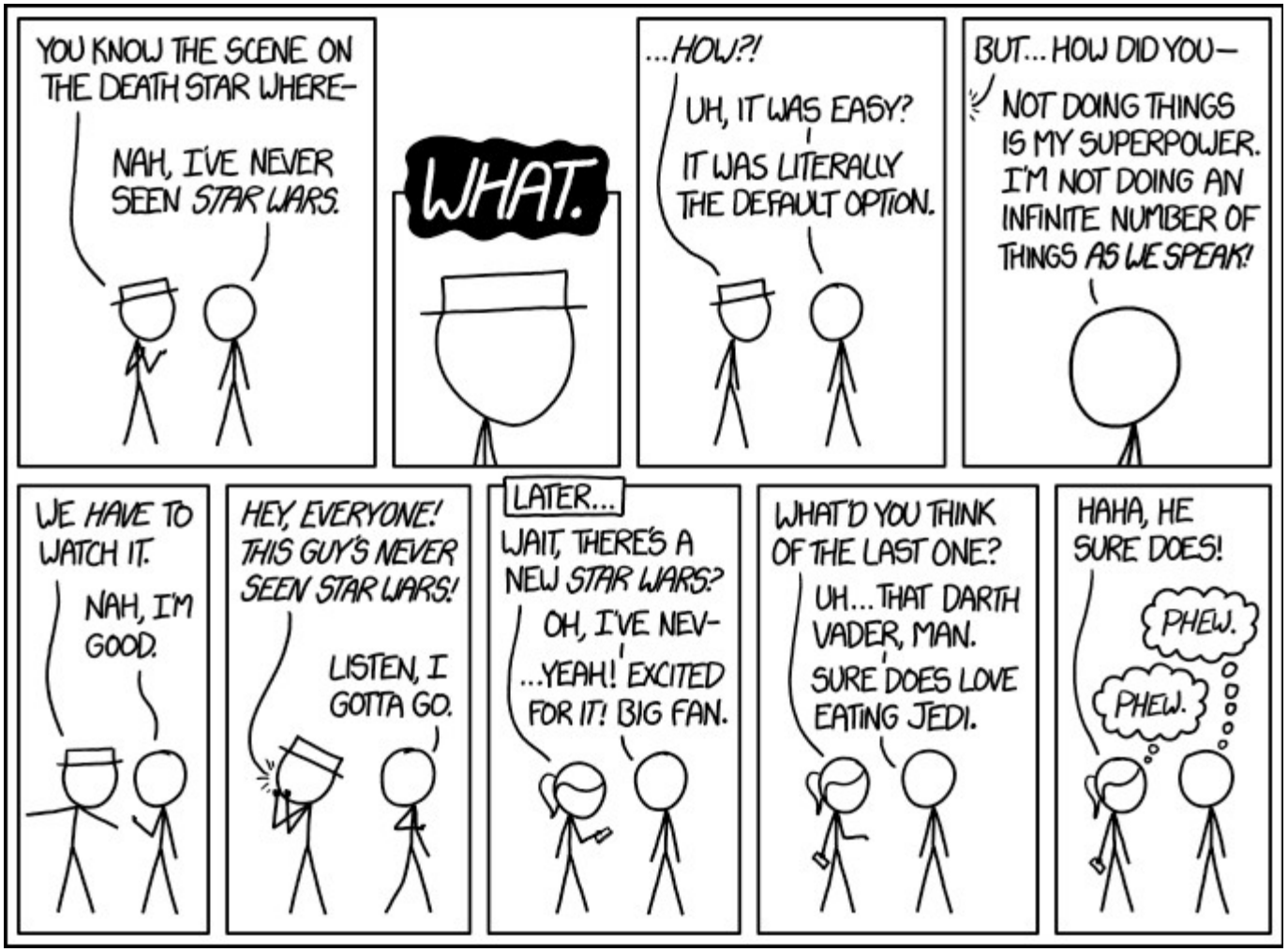
- Milestones – evidence of progress along the way:
  – Milestones 1-6 are submitted and graded as a team
  – Adjustments based on Participation
    - Milestone # 8 (Peer Evaluations)
    - Github “commits”

Group Project Info

Milestones

Milestone 1	40 points	Project Proposal	Week 2
Milestone 2	40 points	Project Tools & Agile Methodology	Week 2
Milestone 3	40 points	Database Design	Week 3
Milestone 4	40 points	Unit / Integration Testing	Week 4
Milestone 5	40 points	Project Presentations	Week 5
Milestone 6	50 points	Final Report	Week 5

Shift Gears:


YOU KNOW THE SCENE ON THE DEATH STAR WHERE–
NAH, I'VE NEVER SEEN STAR WARS.
WHAT.
...HOW?!
UH, IT WAS EASY?
IT WAS LITERALLY THE DEFAULT OPTION.
BUT... HOW DID YOU–
NOT DOING THINGS IS MY SUPERPOWER. I'M NOT DOING AN INFINITE NUMBER OF THINGS AS WE SPEAK!
WE HAVE TO WATCH IT.
NAH, I'M GOOD.
HEY, EVERYONE! THIS GUY'S NEVER SEEN STAR WARS!
LISTEN, I GOTTA GO.
LATER...
WAIT, THERE'S A NEW STAR WARS?
OH, I'VE NEV–
...YEAH! EXCITED FOR IT! BIG FAN.
WHAT'D YOU THINK OF THE LAST ONE?
UH... THAT DARTH VADER, MAN. SURE DOES LOVE EATING JEDI.
HAHA, HE SURE DOES!
PHEW.
PHEW.

AWK

- a programming language designed for text processing
- Used for processing regular expressions in a script
- Used when the text is in file / delimited field format
- typically used as a data extraction and reporting tool
- a powerful standard feature of most Unix-like operating systems.

awk operations:

- scans a file line by line
- splits each input line into fields
- compares input line/fields to pattern
- performs action(s) on matched lines

Useful for:

- transforming data files
- Producing formatted reports

Programming constructs:

- format output lines for reports
- arithmetic and string operations
- conditionals and loops

Basic awk Script

- consists of patterns & actions:

```
pattern {action}
```

  - if pattern is missing, action is applied to all lines
  - if action is missing, the matched line is printed
  - must have either pattern or action

Example:

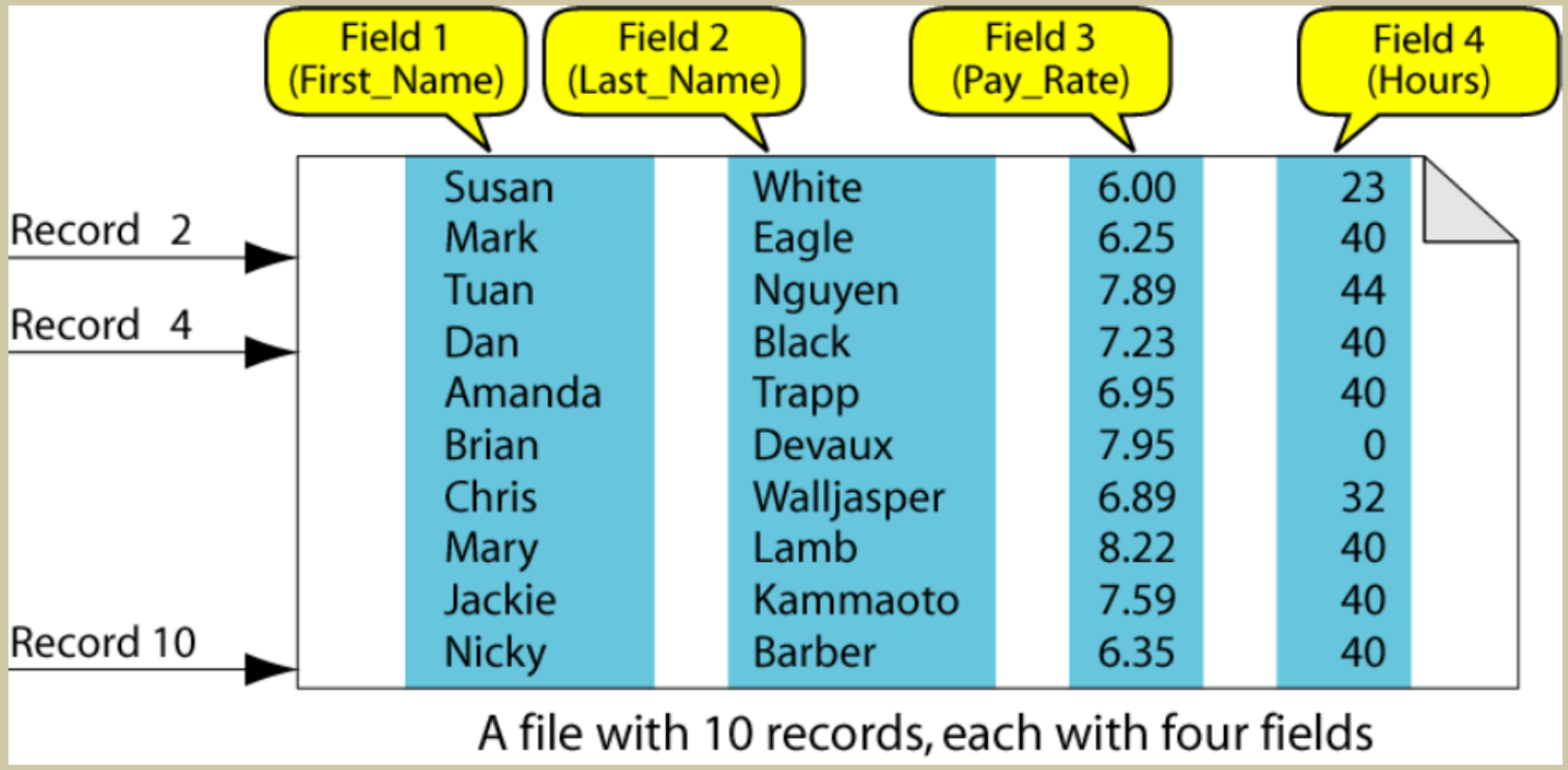
```
awk '/for/' testfile
```

  - prints all lines containing string “for” in testfile

Basic Terminology: input file

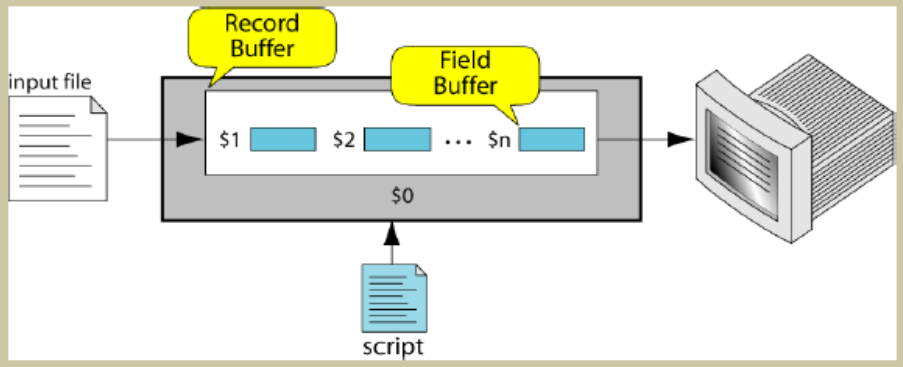
- A field is a unit of data in a line
- Each field is separated from the other fields by the field separator
  - default field separator is whitespace
- A record is the collection of fields in a line
- A data file is made up of records

Example Input File



A file with 10 records, each with four fields

Buffers



- awk supports two types of buffers: record and field
- field buffer:
  - one for each fields in the current record.
  - names: $1, $2, …
- record buffer :
  - $0 holds the entire record

Some System Variables

FS	Field separator (default=whitespace)
RS	Record separator (default=\n)
NF	Number of fields in current record
NR	Number of the current record
OFS	Output field separator (default=space)
ORS	Output record separator (default=\n)
FILENAME	Current filename

Example: Records and Fields

```
% cat emps
Tom Jones          4424    5/12/66 543354
Mary Adams         5346    11/4/63 28765
Sally Chang        1654    7/22/54 650000
Billy Black        1683    9/23/44 336500

% awk '{print NR, $0}' emps
1 Tom Jones        4424    5/12/66 543354
2 Mary Adams       5346    11/4/63 28765
3 Sally Chang      1654    7/22/54 650000
4 Billy Black      1683    9/23/44 336500
```

Example: Colon as Field Separator

```
% cat em2
Tom Jones:4424:5/12/66:543354
Mary Adams:5346:11/4/63:28765
Sally Chang:1654:7/22/54:650000
Billy Black:1683:9/23/44:336500

% awk -F: '/Jones/{print $1, $2}' em2
Tom Jones 4424
```

Example: match input record

```
% cat employees2
Tom Jones:4424:5/12/66:543354
Mary Adams:5346:11/4/63:28765
Sally Chang:1654:7/22/54:650000
Billy Black:1683:9/23/44:336500

% awk -F: '/00$/' employees2
Sally Chang:1654:7/22/54:650000
Billy Black:1683:9/23/44:336500
```

Example: explicit match

```
% cat datafile
northwest NW     Charles Main         3.0    .98    3    34
western   WE     Sharon Gray          5.3    .97    5    23
southwest SW     Lewis Dalsass        2.7    .8     2    18
southern  SO     Suan Chin            5.1    .95    4    15
southeast SE     Patricia Hemenway    4.0    .7     4    17
eastern   EA     TB Savage            4.4    .84    5    20
northeast NE     AM Main              5.1    .94    3    13
north     NO     Margot Weber         4.5    .89    5     9
central   CT     Ann Stephens         5.7    .94    5    13

% awk '$5 ~ /\.[7-9]+/' datafile
southwest SW     Lewis Dalsass        2.7    .8     2    18
central   CT     Ann Stephens         5.7    .94    5    13
```

- Further Reading:

www.hcs.harvard.edu/~dholland/computers/awk.html

https://www.digitalocean.com/community/tutorials/how-to-use-the-awk-language-to-manipulate-text-in-linux

sed

- a programming language designed for text processing
- Used for processing regular expressions in a script
- Used when the text is in a stream (no delimited field structure)
- typically used as a stream editor (thus the name)
- a powerful standard feature of most Unix-like operating systems

sed

sed operations:

- Loops through a file line by line
- Looks for text patterns
- Executes commands on a match
  - Substitute, delete, insert a new line, etc.

Useful for:

- Transforming data files
- Finding text strings and changing them

Programming constructs:

- A rather primitive language

- Further Reading:

http://www.wikiwand.com/en/Sed

https://www.tutorialspoint.com/sed/sed_overview.htm

End of Lecture Two