CSE 374
Programming Concepts & Tools

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Lecture 5 – Regular Expressions, grep, Other Utilities

(Thanks to Hal Perkins)

Where we are

- Done learning about the shell and it’s bizarre “programming language” (but pick up more on hw3)
- Today: Specifying string patterns for many utilities, particularly grep and sed (also needed for hw3)
- Next: sed

- And then: a real programming language – C

Globbing vs Regular Expressions

- "Globbing" refers to shell filename expansion
- "Regular expressions" are a different but overlapping set of rules for specifying patterns to programs like grep. (Sometimes called "pattern matching")
- More distinctions:
  - Regular expressions as in CS/mathematics
  - "Regular expressions" in grep
  - "Extended regular expressions" in egrep
    - Same as grep –E
  - Other variations in other programs…

Real Regular Expressions

- Some of the crispest, elegant, most useful CS theory out there. What computer scientists know and ill-educated hackers don't (to their detriment).
- A regular expression p may "match" a string s.
- If p =
  - – b matches the single character 'b' (basic reg. exp.)
  - – p1p2 if we can write s as s1s2, where p1 matches s1, p2 matches s2.
  - – p1 | p2, … if p1 matches s or p2 matches s
    - (in egrep, for grep use \|)
  - – p1*, if there is an i ≥ 0 such that p1…p1 (i times) matches s.
    - (for i = 0, matches the zero-character string ε)

Conveniences

- Most regular expressions allow various abbreviations for convenience, but these do not make the language any more powerful
  - *p*+ is *pp**
  - *p*? is (ε | *p*)
  - [zd-h] is z | d | e | f | g | h
  - [^a-z] is any character except a-z
  - . matches “any” character
  - *p*{*n*} is *p*…*p* (p repeated *n* times)
  - *p*{n,} is *p*…*pp** (*p* repeated *n* or more times)
  - *p*{n,m} is *p* repeated *n* through *m* times

grep – beginning and end of lines

- By default, grep matches each line against **.***p***.***
- You can anchor the pattern with ^ (beginning) and/or $ (end) or both (match whole line exactly)
- These are still “real” regular expressions

- NOTE: grep -o will return just the matches instead of the whole line!

* is greedy

- finding sections in HTML file
- egrep ‘<div>.*</div>’ index.html
- .* matches as far as possible even over a </div>
- use [^chars…] to make . match less

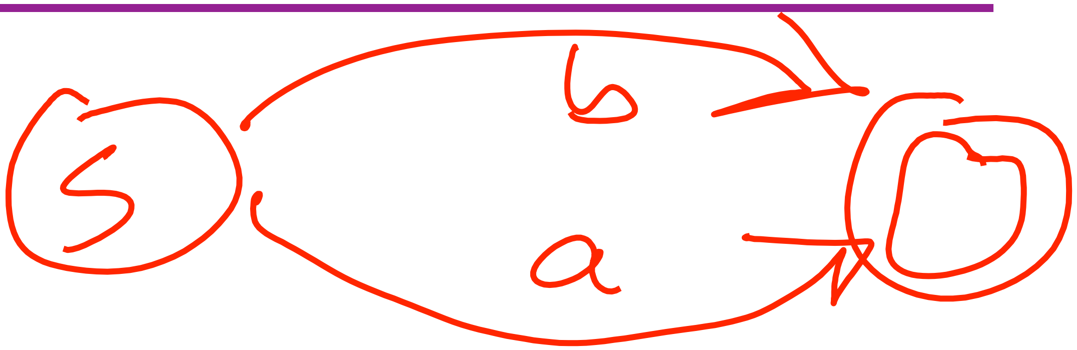
- this *does not* mean .*p.* will match any string. You still need to match the whole regular expression

Gotchas

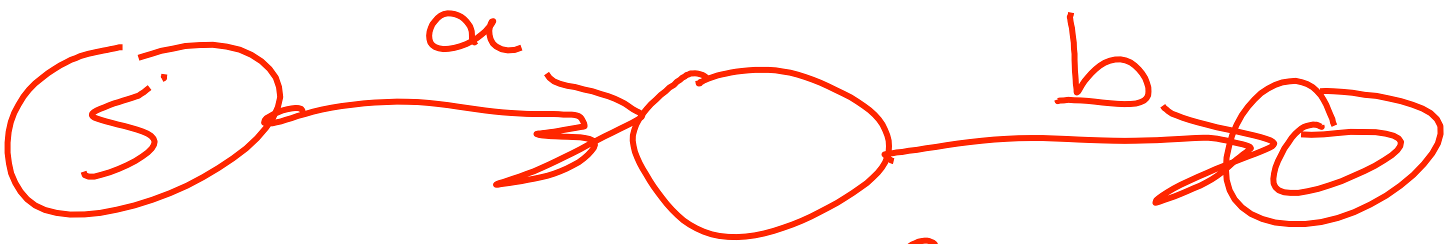
- Modern (i.e., gnu) versions of grep and egrep use the same regular expression engine for matching, but the input syntax is different for historical reasons
  - For instance, \{ for grep vs { for egrep
  - See grep manual sec. 3.6
- Must quote patterns so the shell does not muck with them – and use single quotes if they contain $ (why?)
- Must escape special characters with \ if you need them literally: \. and . are very different
  - But inside [ ] many more characters are treated literally, needing less quoting (\ becomes a literal!)

What’s happening inside?

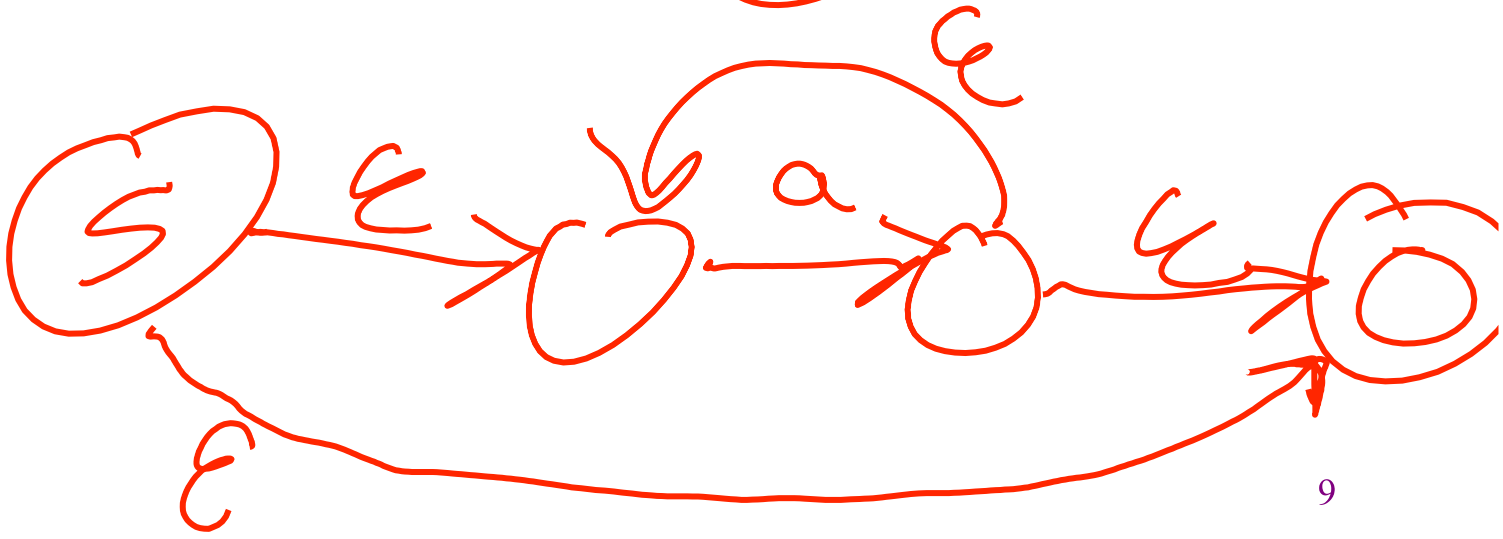
- a | b



- ab



- a*



Previous matches – back references

- Up to 9 times in a pattern, you can group with (*p*) and refer to the matched text later!
  - (Need backslashes in sed.)
- You can refer to the text (most recently) matched by the nth group with \n.
- Simple example: double-words `^\([a-zA-Z]*\)\1$`
- You cannot do this with actual regular expressions; the program must keep the previous strings.
  - Especially useful with sed because of substitutions.

Other utilities

- Some very useful programs you can learn on your own:
  - find (search for files, e.g., find /usr -name words)
  - diff (compare two files' contents; output is easy for humans and programs to read (see patch))
- Also:
  - For many programs the -r flag makes them recursive (apply to all files, subdirectories, subsubdirectories, …).
  - So "delete everything on the computer" is cd /; rm -rf * (be careful!)

Summary

- Regular expressions are a powerful tool for searching text
- grep, egrep provide regular expression matching in the shell
- Next: we'll use sed for more powerful text *processing*, like find & replace, where back references will be useful
- all of this will be used in HW3