

Discussion 11

Regular Expressions, SQL

Aditya Balasubramanian

`aditbala [at] berkeley [dot] edu`

Announcements

- **Scheme Checkpoint 1** due today (8/2)
- **Lab 10** due today (8/2)
- **HW 06** due Thursday (8/4)
- **Scheme Checkpoint 2** due Friday (8/5)
- Scheme contest due Friday (8/5)

Regular Expressions [RegEx]

Regular Expressions

- What are Regular Expressions?
 - A way to describe sets of strings that match certain criteria
 - Useful for pattern matching
- Resources to test Regular Expressions
 - <https://regexpr.com/>
 - <https://regex101.com/>

Character classes

- Search for any one of a set of characters
- Can specify set or use pre-defined sets

| Class | Description |
|--------|---|
| [abc] | Matches <code>a</code> , <code>b</code> , or <code>c</code> |
| [a-z] | Matches any character between <code>a</code> and <code>z</code> |
| [^A-Z] | Matches any character that is not between <code>A</code> and <code>Z</code> |
| \w | Matches any "word" character. Equivalent to <code>[A-Za-z0-9_]</code> |
| \d | Matches any digit. Equivalent to <code>[0-9]</code> |
| [0-9] | Matches a single digit in the range 0 - 9. Equivalent to <code>\d</code> |
| \s | Matches any whitespace character (spaces, tabs, line breaks) |
| . | Matches any character besides new line |

Combining Patterns

- There are multiple ways to combine patterns together in regular expressions

| Combo | Description |
|-------|---|
| AB | Matches a , b , or c |
| A B | Matches either A or B. Example: \d+ Inf matches either a sequence containing 1 OR more digits or "Inf" |

Quantifiers

- A pattern can be followed by one of these quantifiers to specify how many instances of the pattern can occur

| Combo | Description |
|-------|-------------|
|-------|-------------|

| | |
|---|---|
| * | 0 or more occurrences of the preceding pattern. Example: <code>[a-z]*</code> matches any sequence of lower-case letters or the empty string |
|---|---|

| | |
|---|---|
| + | 1 or more occurrences of the preceding pattern. Example: <code>\d+</code> matches any non-empty sequence of digits. |
|---|---|

| | |
|---|--|
| ? | 0 or 1 occurrences of the preceding pattern. Example: <code>[-+]?</code> matches an optional sign. |
|---|--|

| | |
|--------|--|
| {1, 3} | Matches the specified quantity of the preceding pattern. <code>{1, 3}</code> will match from 1 to 3 instances. <code>{3}</code> will match exactly 3 instances. <code>{3,}</code> will match 3 or more instances. Example: <code>\d{5, 6}</code> matches either 5 or 6 digit numbers |
|--------|--|

Groups

- Parentheses in RegEx are similar to arithmetic
 - `5 * 4 - 3`
 - `5 * (4 - 3)`
- `(Mahna)+`
 - matches strings with 1 or more `"Mahna"`
 - `"MahnaMahna"`
- `Mahna+`
 - match strings with `"Mahn"` followed by 1 or more `"a"` characters
 - `"Mahnaaaa"`
- Can use groups to determine what to output
 - Want to match valid phone numbers but ONLY want to output the area code

Anchors

| Symbol | Description |
|-----------------|--|
| <code>^</code> | Matches the beginning of a string. Example: <code>^(I You)</code> matches <code>I</code> or <code>You</code> at the start of a string |
| <code>\$</code> | Normally matches the empty string at the end of a string or just before a newline at the end of a string |
| <code>\b</code> | Matches a "word boundary", the beginning or end of a word. Example: <code>s\b</code> matches <code>s</code> characters at the end of words |

Special Characters

The following special characters are used above to denote types of patterns:

```
\ ( ) [ ] { } + * ? | $ ^ .
```

That means if you actually want to match one of those characters, you have to escape it using a backslash. For example, `\(1\+3\)` matches

```
"(1 + 3)".
```

Q1 , Q2

SQL

SQL

- What is SQL?
 - A declarative programming language
 - Database management
 - Do not describe computations, but rather the desired result of computations
- Resources
 - <https://sql.cs61a.org>

SELECT

- Create a table with two rows, columns as `first` and `last`

```
sqlite> SELECT "Ben" AS first, "Bitdiddle" AS last UNION  
...> SELECT "Louis", "Reasoner";
```

| first | last |
|-------|-----------|
| Ben | Bitdiddle |
| Louis | Reasoner |

```
SELECT [columns]
```

FROM

- SELECT specific values from an existing table with a FROM clause

```
sqlite> SELECT name, division FROM records;
```

| name | division |
|-----------------|------------|
| Alyssa P Hacker | Computer |
| ... | ... |
| Robert Cratchet | Accounting |

```
SELECT [columns] FROM [tables]
```

WHERE

- filter out rows using a WHERE clause

```
sqlite> SELECT * FROM records WHERE title = "Programmer";
```

| name | division | title | salary | supervisor |
|-----------------|----------|------------|--------|---------------|
| Alyssa P Hacker | Computer | Programmer | 40000 | Ben Bitdiddle |
| Cy D Fect | Computer | Programmer | 35000 | Ben Bitdiddle |

```
SELECT [columns] FROM [tables] WHERE [condition]
```


ORDER BY

- Order rows with the ORDER BY clause

```
sqlite> SELECT name, salary FROM records  
...> WHERE division = "Accounting" ORDER BY salary desc;
```

| name | salary |
|-----------------|--------|
| Eben Scrooge | 75000 |
| Robert Cratchet | 18000 |

```
SELECT [columns] FROM [tables] WHERE [condition]  
ORDER BY [criteria]
```

Q4 , Q5 , Q6

JOIN

- What to do when you want to combine data from multiple tables
 - JOIN them!
- What happens when you use the JOIN clause?
 - Have a new row for each combination of the input table
 - If two tables are joined and the left table has m rows and the right table has n rows, then the joined table will have $m*n$ rows

JOIN (Example)

- Let's say we have a `meetings` table that displays what `Day` each `Division` has a meeting
- Our goal is to determine what `Day` each employee has a meeting
- First step
 - Combine table `records` and `meetings`
- Second step
 - Only include the rows where the `records.division = meetings.division`

JOIN (Example) (Combining)

```
SELECT name, day FROM records, meetings;
```

| name | day |
|-----------------|-----------|
| Alyssa P Hacker | Monday |
| Alyssa P Hacker | Monday |
| Alyssa P Hacker | Wednesday |
| Alyssa P Hacker | Wednesday |
| ... | ... |
| Robert Cratchet | Wednesday |

JOIN (Example) (Filtering)

Ambiguous Joins

```
SELECT a.name, b.day FROM records AS a, meetings AS b
WHERE a.division = b.division;
```

| name | day |
|-----------------|-----------|
| Alyssa P Hacker | Wednesday |
| Ben Bitdiddle | Wednesday |
| ... | ... |
| Robert Cratchet | Monday |

STEP BY STEP

Slides by Aditya Balasubramanian

Q6 , Q7 , Q8

Aggregation

- What if we want to obtain data from our table (i.e. `max`, `min`)
 - `MAX`, `MIN`, `COUNT`, and `SUM`

```
SELECT name, MAX(salary) FROM records;
```

| name | MAX(salary) |
|-----------------|-------------|
| Oliver Warbucks | 150000 |

```
sqlite> SELECT COUNT(*) from RECORDS;  
9
```


GROUP BY

- group rows in a column to be aggregated with the GROUP BY clause

```
sqlite> SELECT division, MIN(salary) FROM records  
GROUP BY division;
```

| division | MIN(salary) |
|----------------|-------------|
| Accounting | 18000 |
| Administration | 150000 |
| Computer | 25000 |

STEP BY STEP

HAVING

- Filter GROUPS with the HAVING clause

```
sqlite> SELECT title FROM records GROUP BY title  
HAVING COUNT(*) > 1;
```

title

Programmer

STEP BY STEP

Q9 , Q10 , Q11

Thank you!!!

Attendance Form -> <https://tinyurl.com/adit-disc11>

Anon Feedback -> <https://tinyurl.com/adit-anon>