SQL Solutions

COMPUTER SCIENCE MENTORS 61A

April 24–May 5, 2023

1 SQL

SQL (Structured Query Language) is a declarative programming language that allows us to store, access, and manipulate data stored in databases. Each database contains tables, which are rectangular collections of data with rows and columns. This section gives a brief overview of the small subset of SQL used by CS 61A; the full language has many more features.

1.1 Creating Tables

1.1.1 SELECT

SELECT statements are used to create tables. The following creates a table with a single row and two columns:

```
sqlite> SELECT "Adit" AS first, "Balasubramanian" AS last;
Adit|Balasubramanian
```

AS is an "aliasing" operation that names the columns of the table. Note that built-in keywords such as **AS** and **SELECT** are capitalized by convention in SQL. However, SQL is case insensitive, so we could just as easily write **as** and **select**. Also, each SQL query must end with a semicolon.

1.1.2 UNION

UNION joins together two tables with the same number of columns by "stacking them on top of each other". The column names of the first table are kept.

```
sqlite> SELECT "Adit" AS first, "Balasubramanian" AS last UNION
...> SELECT "Gabe", "Classon";
Adit|Balasubramanian
Gabe|Classon
```

1.1.3 CREATE TABLE

To create a named table (so that we can use it again), the **CREATE TABLE** command is used:

```
CREATE TABLE scms AS
    SELECT "Adit" AS first, "Balasubramanian" AS last UNION
    SELECT "Gabe", "Classon";
```

The remaining examples will use the following `team` table:

```
CREATE TABLE team AS
    SELECT "Gabe" AS name, "cat" AS pet, 11 AS birth_month UNION
    SELECT "Adit",         "none",       10 UNION
    SELECT "Alyssa",       "dog",         4 UNION
    SELECT "Esther",       "dog",         6 UNION
    SELECT "Maya",         "dog",         3 UNION
    SELECT "Manas",        "none",       11;
```

1.2 Manipulating other tables

We can also write **SELECT** statements to create new tables from other tables. We write the columns we want after the **SELECT** command and use a **FROM** clause to designate the source table. For example, the following will create a new table containing only the `name` and `birth_month` columns of `team`:

```
sqlite> SELECT name, birth_month FROM team;
Adit|10
...
Maya|3
```

Note that the order in which rows are returned is undefined.

An asterisk * selects for all columns of the table:

```
sqlite> SELECT * FROM team;
Adit|none|10
...
Maya|dog|3
```

This is a convenient way to view all of the content of a table.

We may also manipulate the table columns and use **AS** to provide a (new) name to the columns of the resulting table. The following query creates a table with each teammate's name and the number of months between their birth month and June:

```
sqlite> SELECT name, ABS(birth_month - 6) AS june_dist FROM team;
Adit|4
...
Maya|3
```

1.2.1 WHERE

WHERE allows us to filter rows based on certain criteria. The **WHERE** clause contains a boolean expression; only rows where that expression evaluates to true will be kept.

```
sqlite> SELECT name FROM team WHERE pet = "dog";
Alyssa
Esther
Maya
```

Note that = in SQL is used for equality checking, not assignment.

1.2.2 **ORDER BY**

ORDER BY specifies a value by which to order the rows of the new table. **ORDER BY** ... may be followed by **ASC** or **DESC** to specify whether they should be ordered in ascending or descending order. **ASC** is default. For strings, ascending order is alphabetical order.

```
sqlite> SELECT name FROM team WHERE pet = "dog" ORDER BY name DESC;
Maya
Esther
Alyssa
```

1.3 Joins

Sometimes, you need to compare values across two tables—or across two rows of the same table. Our current tools do not allow for this because they can only consider rows one-by-one. A way of solving this problem is to create a table where the rows consist of every possible combination of rows from the two tables; this is called an **inner join**. Then, we can filter through the combined rows to reveal relationships between rows. It sounds bizarre, but it works.

An inner join is created by specifying multiple source tables in a **WHERE** clause. For example, `SELECT * FROM team AS a, team AS b;` will create a table with 36 rows and 6 columns. The table has 36 rows because each row represents one of 36 possible ways to select two rows from `team` (where order matters). The table has 6 columns because the joined tables have 3 columns each. We use **AS** to give the two source tables different names, since we are joining `team` to itself. The columns of the resulting table are named `a.name, a.pet, a.birth_month, b.name, b.pet, b.birth_month`.

For example, to determine all pairs of people with the same birth month, we can use an inner join:

```
sqlite> SELECT a.name, b.name FROM team AS a, team AS b WHERE a.name < b.name
   AND a.birth_month = b.birth_month;
Gabe|Manas
```

1.4 Aggregation

Aggregation uses information from multiple rows in our table to create a single row. Using an aggregation function such as **MAX**, **MIN**, **COUNT**, and **SUM** will automatically aggregate the table data into a single row. For example, the following will collapse the entire table into one row containing the name of the person with the latest birth month:

```
sqlite> SELECT name, MAX(birth_month) FROM team;
Manas|11
```

Note that there are multiple rows with the largest birth month. When this happens, SQL arbitrarily chooses one of the rows to use.

The **COUNT** aggregation function collapses the table into one row containing the number of rows in the table:

```
sqlite> SELECT COUNT(*) FROM team;
6
```

1.4.1 **GROUP BY**

GROUP BY groups together all rows with the same value for a particular column. Aggregation is performed on each group instead of on the entire table. There is then *exactly one row* in the resulting table for each group. As before, type of aggregation performed is determined by the choice of aggregation function. The following gives, for each type of pet, the information of the person with the earliest birth month who has that pet:

```
sqlite> SELECT name, pet, MIN(birth_month) FROM team GROUP BY pet;
Gabe|cat|11
Maya|dog|3
Adit|none|10
```

1.4.2 HAVING

Just as **WHERE** filters out rows, **HAVING** filters out groups. For example, the following selects for all types of pets owned by more than one teammate:

```
sqlite> SELECT pet FROM team GROUP BY pet HAVING COUNT(*) > 1;
dog
none
```

1.5 Syntax

The clauses of a **SELECT** statement always come in this order:

```
SELECT ... FROM ... WHERE ... GROUP BY ... HAVING ... ORDER BY ...;
```

The order roughly reflects the order in which the processing steps are applied. Note that all filtering of rows comes *before* aggregation. That is, aggregation is always performed after the row-by-row filtering is complete.

1. CSM 61A Content Team wants to put together an end of the year party for all its mentors (and some special guests, too!) themed around everyone's favorite things! Examine the table, `mentors`, depicted below, and answer the following questions.

Name	**Food**	**Color**	**Editor**	**Language**	**Animal**
Alyssa	Pork Bulgogi	Navy Blue	Vim	Java	Sea Otter
Vibha	Pasta	Teal	VSCode	Java	Naked Mole Rat
Adit	Protein Bar	Black	Vim	Python	Gorilla
Esther	Goldfish	Pastel Pink	VSCode	Python	Bunny
Aiko	Fries	Sky Blue	VSCode	Java	Cat
Aurelia	Dumpling	Pastel Yellow	VSCode	Python	Panda
Kaelyn	Popcorn	Blue	VSCode	Java	Panda

(a) Create a new table `mentors` that contains all the information above. (You only have to write out the first two rows.)

```
CREATE TABLE mentors AS
  SELECT 'Alyssa' as name, 'Pork Bulgogi' as food, 'Navy Blue' as
      color, 'Vim' as editor, 'Java' as language, 'Sea Otter' as animal
      UNION
  SELECT 'Vibha', 'Pasta', 'Teal', 'VSCode', 'Java', 'Naked Mole Rat'
      UNION
  SELECT 'Adit', 'Protein Bar', 'Black', 'Vim', 'Python', 'Gorilla'
      UNION
  SELECT 'Esther', 'Goldfish', 'Pastel Pink', 'VSCode', 'Python',
      'Bunny' UNION
  SELECT 'Aiko', 'Fries', 'Sky Blue', 'VSCode', 'Java', 'Cat' UNION
  SELECT 'Aurelia', 'Dumpling', 'Pastel Yellow', 'VSCode', 'Python',
      'Panda' UNION
  SELECT 'Kaelyn', 'Popcorn', 'Blue', 'VSCode', 'Java', 'Panda';
```

(b) Write a query that has the same data, but alphabetizes the rows by name. (Hint: Use **`order by`**.)

```
Adit|Protein Bar|Black|Vim|Python|Gorilla
Aiko|Fries|Sky Blue|VSCode|Java|Cat
Alyssa|Pork Bulgogi|Navy Blue|Vim|Java|Sea Otter
Aurelia|Dumpling|Pastel Yellow|VSCode|Python|Panda
Esther|Goldfish|Pastel Pink|VSCode|Python|Bunny
Kaelyn|Popcorn|Blue|VSCode|Java|Panda
Vibha|Pasta|Teal|VSCode|Java|Naked Mole Rat
```

```
SELECT *
FROM mentors
ORDER BY name;
```

(c) Write a query that lists the food and the color of every person whose favorite language is *not* Python.

```
Pork Bulgogi|Navy Blue
Pasta|Teal
Fries|Sky Blue
Popcorn|Blue
```

```
SELECT food, color
  FROM mentors
  WHERE language != 'Python';

-- With aliasing (treating the table as a Python object) --
SELECT m.food, m.color
  FROM mentors as m
  WHERE m.language <> 'Python';
```

2. CS 61A wants to start a fish hatchery, and we need your help to analyze the data we've collected for the fish populations! Running a hatchery is expensive—we'd like to make some money on the side by selling some seafood (only older fish of course) to make delicious sushi.

   The table `fish` contains a subset of the data that has been collected. The SQL column names are listed in brackets.

`fish`

Species [species]	**Population [pop]**	**Breeding Rate [rate]**	**$/piece [price]**	**# of pieces per fish [pieces]**
Salmon	500	3.3	4	30
Eel	100	1.3	4	15
Yellowtail	700	2.0	3	30
Tuna	600	1.1	3	20

   (a) Write a query to find the three most populated fish species.

```
SELECT species
FROM fish
ORDER BY pop DESC
LIMIT 3;
```

   (b) Write a query to find the total number of fish in the ocean. Additionally, include the number of species we summed. Your output should have the number of species and the total population.

```
SELECT COUNT(species), SUM(pop)
FROM fish;
```

   (c) Profit is good, but more profit is better. Write a query to select the species that yields the greatest number of pieces for each price. Your output should include the species, price, and pieces.

```
SELECT species, price, MAX(pieces)
FROM fish
GROUP BY price;
```

   (d) Write a query that returns, for each species, the difference between our hatchery's revenue versus the competitor's revenue for one whole fish.

```
SELECT fish.species, (fish.price - competitor.price) * pieces
    FROM fish, competitor
    WHERE fish.species = competitor.species;
```

3. In this question, you have access to two tables.

   Grades, which contains three columns: **day**, `class`, and `score`. Each row represents the `score` you got on a midterm for some `class` that you took on some **day**.

   Outfits, which contains two columns: **day** and `color`. Each row represents the `color` of the shirt you wore on some **day**. Assume you have a row for each possible day.

`outfits`

Day	Color
11/5	Blue
9/13	Red
10/31	Orange

`grades`

Day	Class	Score
10/31	Music 70	88
9/20	Math 1A	72

   (a) Instead of actually studying for your finals, you decide it would be the best use of your time to determine what your "lucky shirt" is. Suppose you're pretty happy with your exam scores this semester, so you define your lucky shirt as the shirt you wore to the most exams.

   Write a query that will output the color of your lucky shirt and how many times you wore it.

```
SELECT color, count(g.day) AS cnt
    FROM outfits AS o, grades AS g
    WHERE o.day = g.day
    GROUP BY color
    ORDER BY cnt DESC
    LIMIT 1;
```

   (b) You want to find out which classes you need to prepare for the most by determining how many points you have so far. However, you only want to do so for classes where you did relatively poorly.

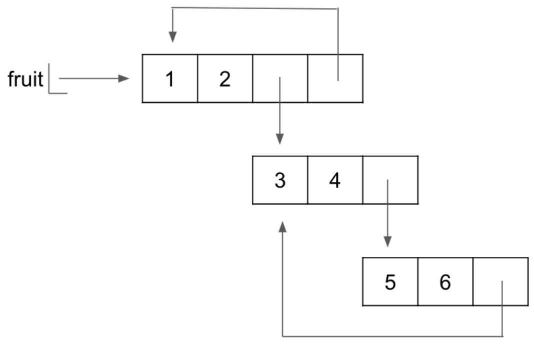
   Write a query that will output the sum of your midterm scores for each class along with the corresponding class, but only for classes in which you scored less than 80 points on at least one midterm. List the output from highest to lowest total score.

```
SELECT SUM(score), class
    FROM grades GROUP BY class
    HAVING MIN(score) < 80 ORDER BY SUM(score) DESC;
```

2 Environment Diagrams

1. Fill in each blank in the code example below so that its environment diagram is the following. You do not need to use all the blanks.

```
fruit = [1, 2, [3, 4]]
fruit.______________________________
fruit[3][2].______________________
fruit[2][2].______________________
fruit[3][3][2][2][2][1] = ____
```



```
fruit = [1, 2, [3, 4]]
fruit.append(fruit)
fruit[3][2].append([5, 6])
fruit[2][2].append(fruit[2])
fruit[3][3][2][2][2][1] = 4
```

3 Iterators

2. Define a **non-decreasing path** as a path from the root where each node's label is greater than or equal to the previous node along the path. A **subpath** is a path between nodes X and Y, where Y must be a descendent of X (ex: Y is a branch of a branch of X).

(a) Write a generator function `root_to_leaf` that takes in a tree `t` and yields all non-decreasing paths from the root to a leaf node, in any order. Assume that `t` has at least one node.

```
def root_to_leaf(t):
    """
    >>> t1 = Tree(3, [Tree(5), Tree(4)])
    >>> list(root_to_leaf(t1))
    [[3, 5], [3, 4]]
    >>> t2 = Tree(5, [Tree(2, [Tree(7), Tree(8)]), Tree(5, [Tree(6)])])
    [[5, 5, 6]]
    """

    if ____________________:

        _________________________

    for _________________________:

        if __________________________:

            for __________________________:

                ______________________________
```

```
def root_to_leaf(t):
    if t.is_leaf():
        yield [t.label]
    for b in t.branches:
        if t.label <= b.label:
            for path in root_to_leaf(b):
                yield [t.label] + path
```

The easiest way to approach this is to notice the two blocks of code that are provided: first an if statement, probably referring to a base case, and a for loop, which will probably be the recursive case. From the doctests, we can see that giving the function a tree that just has one node, or in other words `is_leaf()`, returns a list containing just that node.

In our recursive case we want to do two things. First, we want to check if the next branch value really is non-decreasing. Then, if it is, we want to append the result of calling `root_to_leaf` on the branch to the value of our current tree to create a complete path. So we recurse through each of the branches in `t` (`for b in t.branches`), then check if it is nondecreasing (`t.label <= b.label`), then yield our tree's label appended to the recursive call (the last two lines).

(b) Write a generator function `subpaths` that takes in a tree `t` and yields all non-decreasing subpaths that end with a leaf node, in any order. You may use the `root_to_leaf` function above, and assume again that `t` has at least one node.

```
def subpaths(t):

    yield from ______________________

    for b in t.branches:

        ______________________________
```

```
def subpaths(t):
    yield from root_to_leaf(t)
    for b in t.branches:
        yield from subpaths(b)
```

We can split this problem into two steps – yielding all subpaths for the current tree that we have, then yielding all subpaths for all other trees within this tree. It is important to realize that each node in the tree is merely a subtree of the original tree to solve this problem.

To yield all non-decreasing subpaths for our current tree (that is all non-decreasing subpaths that start at our current node and end at the leaf nodes), we can just yield from our previous function, `root_to_leaf`, called on that node. For the rest of the subpaths, we want to recursively call `subpaths` on all our child nodes. This will give us all paths that end on the leaf nodes (because `root_to_leaf` ends on the leaf nodes) that start from any child on this tree. It is important to realize that the base case in this situation is implicit. If a leaf node is passed in and reaches the for loop, the for loop finds no items in `t.branches`, and will just terminate without calling the clause inside.

3. In the following problem, we will represent a bookshelf object using dictionaries.

   In the first section, we will set up the format. Here, we will directly work with the internals of the Bookshelf, so don't worry about abstraction barriers for now. Fill in the following functions based on their descriptions (the constructor is given to you):

```
def Bookshelf(capacity):
    """ Creates an empty bookshelf with a certain max capacity. """
    return {'size': capacity, 'books': {}}

def add_book(bookshelf, author, title):
    """
    Adds a book to the bookshelf. If the bookshelf is full,
    print "Bookshelf is full!" and do not add the book.
    >>> books = Bookshelf(2)
    >>> add_book(books, 'Jane Austen', 'Pride and Prejudice')
    >>> add_book(books, 'Daniel Kleppner', 'An Introduction to Mechanics
       5th Edition')
    >>> add_book(books, 'Kurt Vonnegut', 'Galapagos')
    Bookshelf is full!
    """
    if ________________________________:
        print('Bookshelf is full!')
    else:
        if author in bookshelf['books']:
            ______________________________________
        else:
            ______________________________________
```

```
    if len(bookshelf['books']) == bookshelf['size']:
        print('Bookshelf is full!')
    else:
        if author in bookshelf['books']:
            bookshelf['books'][author].append(title)
        else:
            bookshelf['books'][author] = [title]
```

```
def get_all_authors(bookshelf):
    """
    Returns a list of all authors who have at least one book in the
       bookshelf.
    >>> books = Bookshelf(10)
    >>> add_book(books, 'Jane Austen', 'Pride and Prejudice')
    >>> add_book(books, 'Sheldon Axler', 'Linear Algebra Done Right')
    >>> add_book(books, 'Kurt Vonnegut', 'Galapagos')
    >>> get_all_authors(books)
    ['Jane Austen', 'Sheldon Axler', 'Kurt Vonnegut']
    """
    return ___________________________________


        return list(bookshelf['books'].keys())
```

Now, complete the function `most_popular_author` **without breaking the abstraction barrier**. In other words, you are not allowed to assume anything about the implementation of a Bookshelf object, or use the fact that it is a dictionary. You can only use the methods above and their stated return values.

```
def most_popular_author(bookshelf):
    """
    Returns the author with the greatest number of books on this bookshelf.
    You can assume that the bookshelf is not empty.
    >>> books = Bookshelf(100)
    >>> add_book(books, 'Orson Scott Card', 'Xenocide')
    >>> add_book(books, 'Orson Scott Card', 'Children of the Mind')
    >>> add_book(books, 'J.R.R. Tolkien', 'The Hobbit')
    >>> most_popular_author(bookshelf)
    'Orson Scott Card'
    """
    return max(______________________________________________,

        key=_______________________________________________________)


        return max(get_all_authors(bookshelf), key=lambda x:
            len(get_author_books(x))
```

4. Find the $\Theta(\cdot)$ runtime bound for `hiya(n)`. Remember that Python strings are immutable: when we add two strings together, we need to make a copy.

```
def hiii(m):
    word = "h"
    for i in range(m):
        word += "i"
    return word

def hiya(n):
    i = 1
    while i < n:
        print(hiii(i))
        i *= 2
```

$\Theta(n^2)$.

Solution: We can determine the efficiency by approximately counting the number of characters we have to store upon a call to `hiya(n)`. First, let us determine the efficiency of a call `hiii(m)`. Within `hiii`'s for loop:

- When `i` is `1`, we store the string ”hi”, which is 2 characters.
- When `i` is `2`, we store the string ”hii”, which is 3 characters.

  ...

- When `i` is `m`, we store `m + 1` characters.

Adding up these values, we see that calling `hiii(m)` causes us to store on the order of m^2 characters. (The exact value is $\frac{m(m+3)}{2} = \frac{m^2}{2} + \frac{3}{2}m$, but we really only care about the highest order term.)

Now, when we make a call `hiya(n)`, we will make calls to `hiii(1)`, `hiii(2)`, `hiii(4)`, ..., `hiii(4)`. This will store approximately $1^2 + 2^2 + 4^2 + 8^2 + ... + n^2$ characters. Calculating out the partial sums of this sequence shows that

$$1^2 = 1$$

$$1^2 + 2^2 = 5 < 2 \cdot 2^2$$

$$1^2 + 2^2 + 4^2 = 21 < 2 \cdot 4^2$$

$$1^2 + 2^2 + 4^2 + 8^2 = 85 < 2 \cdot 8^2$$

At some point, we are reasonably convinced that this pattern holds. Thus the value of $1^2 + 2^2 + 4^2 + 8^2 + ... + n^2$ is approximately n^2, within a constant factor. So we store about n^2 characters upon a call to `hiya(n)`, which means the efficiency is $\Theta(n^2)$.

Let's use OOP design to help us create a supermarket chain (think Costco)! There are many different ways to implement such a system, so there is no concrete answer.

5. What classes should we consider having? How should each of these classes interact with each other?

   There are many ways of approaching this, but one way is to have a Supermarket class to represent the entire store, an Item class to represent a certain item, a Food class to represent an item that is a food (inherits from Item), and maybe a Customer class to represent someone buying items from that store.

6. For each class, what instance and class variables would it have?

   1. Supermarket – we might have instance variables such as profit, store name, location, and a list of the items in that store along with their quantity. Note that we prefer to store the quantity inside the Supermarket, since an Item might belong to multiple Supermarkets, and each Supermarket will have a separate quantity. We might even have a price associated with each item, since specific supermarkets may mark up prices in different areas.
   2. Item – we might have instance variables such as the name and the base price.
   3. Food – we will have it inherit of all the instance variables of the Item, and also whether it is yummy, maybe the food group it is in or the expiration date.
   4. Customer – we might have some personal information, the supermarket that they're buying from, and the history of their
   5. There are some details that have been missed as well! For example, not just food items expire. Feel free to just discuss this.

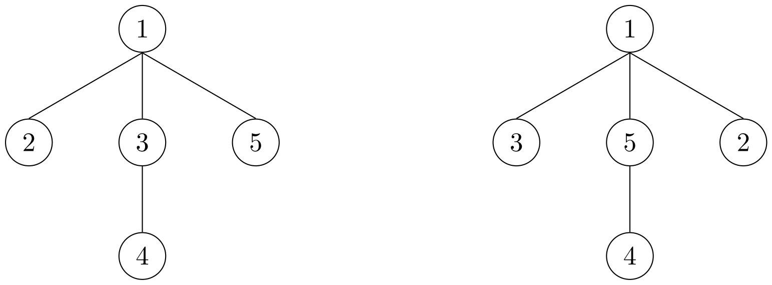
7. For each class, what class methods would they have? How would they interact with each other?

   1. Once again, these are just suggestions:
   2. Supermarket
      - `check_quantity(Item)`: looks up the available quantity of that item
      - `checkout_items(Customer)`: returns the total sum of items in a customer's shopping cart, and clears their shopping cart
   3. Item
      - `check_quantity(Supermarket)`: calls `supermarket.check_quantity(self)`
   4. Food
      - `time_to_expire()`: returns an integer representing how many days before this item expires
      - `is_yummy()`: returns a boolean value of whether this item is yummy or not!
   5. Customer
      - `enter(Supermarket)`: create a shopping cart for customer in this supermarket, if it doesn't already exist
      - `leave(Supermarket)`: clear customer's shopping cart
      - `buy_item(Item)`: add item to customer's shopping cart
      - `checkout_items()`: calls `supermarket.checkout_items(Customer)`

7 Trees

8. Implement `rotate`, which takes in a tree and rotates the labels at each level of the tree by one to the left destructively. This rotation should be modular (That is, the leftmost label at a level will become the rightmost label after running rotate). You do NOT need to rotate across different branches.

   For example, given tree `t` on the left, `rotate(t)` should mutate `t` to give us the right.



```
def rotate(t):
  """
  >>> t1 = Tree(1, [Tree(2), Tree(3, [Tree(4)]), Tree(5)])
  >>> rotate(t1)
  >>> t1
  Tree(1, [Tree(3), Tree(5, [Tree(4)]), Tree(2)])
  >>> t2 = Tree(1, [Tree(2, [Tree(3), Tree(4)]),
                    Tree(5, [Tree(6)])])
  >>> rotate(t2)
  >>> t2
  Tree(1, [Tree(5, [Tree(4), Tree(3)]),
                    Tree(2, [Tree(6)])])
  """
  branch_labels = ______________________________

  n = len(t.branches)

  for ________________________________:

    ________________________________________

    ________________________________________

    ________________________________________
```

```
def rotate(t):
  branch_labels = [b.label for b in t.branches]
  n = len(t.branches)
  for i in range(n):
    branch = t.branches[i]
    branch.label = branch_labels[(i + 1) % n]
    rotate(branch)
```

8 Scheme Lists

9. Star-Lord is cruising through space and can't afford to crash into any asteroids along the way. Let his path be represented as a (possibly nested) list of integers, where an asteroid is denoted with a 0, and stars and planets otherwise. Every time Star-lord sees (visits) an asteroid (0), he merges the next planet/star with the asteroid. In other words, construct a NEW list so that all asteroids (0s) are replaced with a list containing the planet followed by the asteroid (e.g. (planet 0)). You can assume that the last object in the path is not an asteroid (0).

```
;Doctests
scm> (collision (list 1 2 3 0 4))
(1 2 3 (4 0))
scm> (collision (list 4 3 (list 0 1) 2))
(4 3 ((1 0)) 2)
scm> (collision (list 1 -2 0 -3 4 0 -5 6))
(1 -2 (-3 0) 4 (-5 0) 6)
scm> (collision (list 1 0 0 2 3))
(1 (0 0) 2 3)

;Asteroids can merge with other asteroids too

(define (collision lst)

  (cond ((__________________________) lst)

    ((__________________________________)

      __________________________________________)

    ((__________________________________)

      (cons ___________________________________

        __________________________________________))

    (else ________________________________________)
  )
)
```

```
(define (collision lst)
  (cond ((null? lst) nil)
    ((list? (car lst))
      (cons (collision (car lst)) (collision (cdr lst))))
    ((and (equal? (car lst) 0) (not (null? (cdr lst))))
      (cons (list (car (cdr lst)) (car lst))
        (collision (cdr (cdr lst)))))
    (else(cons (car lst) (collision (cdr lst))))
  )
)

#Alternate solution (No cond form)

(define (collision lst)
  (if (null? lst)
    lst
    (if (list? (car lst))
      (cons (collision (car lst)) (collision (cdr lst)))
      (if (equal? (car lst) 0)
        (cons (list (cadr list) (car lst)) (collision (cddr lst)))
        (cons (car lst) (collision (cdr lst)))
      )
    )
  )
)
```