CS10 Spring 2018 Final Exam Answers

Question 1: Which does NOT make the *Genome assembly computing problem* difficult? The letters in the genome input are all 26 letters (A-Z), a vast number of possible combinations. In fact, the input strings are only GCTA.

Question 2: What was wrong with early versions of the Google self-driving car at 4-way stops? It kept waiting for human drivers who would inch forward (looking for an advantage), so it'd be stuck there!

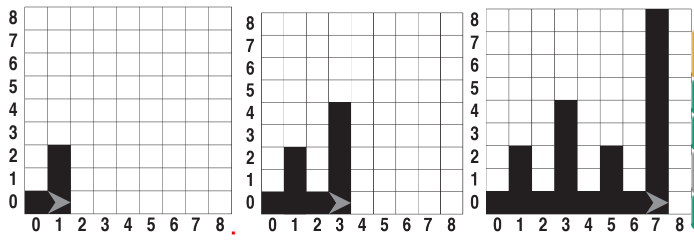
Question 3: Prof Marti Hearst talked about what device/concept her HCI group helped invent? Faceted Navigation (or similar web technology that lets you "prune" down what you want when searching)

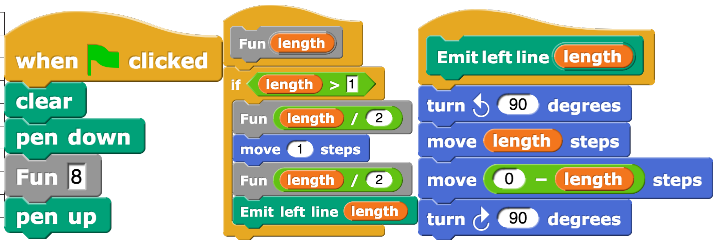
Question 4: What was one memorable moment from the Alumni Panel? None of the above

Question 5 What is the Halting Problem? It was used to prove that not all problems are decidable.

Question 6 What is 46_{16} divided by 12_8 written in Binary? $4*16+6*1=70_{10}$; $1*8+2*1=10_{10}$, $70_{10}/10_{10}=7_{10}=4+2+1=111_2$

Question 7a Your job is to shade in (completely!) *all* the pixels that will be colored in after calls to **Fun** with length set to **2**, **4** and **8.** See the diagrams





```
when [flag] clicked
clear
pen down
Fun (8)
pen up

Fun (length)
if <(length) > (1)>
  Fun ((length) / (2))
  move (1) steps
  Fun ((length) / (2))
  Emit left line (length)

Emit left line (length)
turn ↺ (90) degrees
move (length) steps
move ((0) − (length)) steps
turn ↻ (90) degrees
```

Question 7b Could **Fun** be rewritten iteratively? Yes, and in fact *any* recursive procedure can be written iteratively.

Question 8a What is equivalent to the expression reported by **`shuffle? helper`**? The helper checks whether list-of-booleans doesn't contain **`False`** (means it only contains **`True`**). The Boolean "and" returns **`True`** if and only if both its inputs are **`True`**, so cascading it with combine is equivalent. `combine with (< > and < >) items of (list of booleans)`

Question 8b What does **shuffle?** report for different inputs (of length at least 2)? The numbers 1 through N, in reverse order: True (and it's supposed to be True). Is a valid shuffle, but one of the numbers is replaced with -99 False (and it's supposed to be False) A list of N ones True (but it's supposed to be False)

Question 8c Fix the code so it works correctly Change `<(#s 1-N) contains [ ]>` to `<(shuffle) contains [ ]>` and Change `map (( )) over (shuffle)` to `map (( )) over (#s 1-N)`

Question 9 Instead of a paper final exam for BJC, we decide to use tablet computers, with each of the N problems printed on separate digital "page" (screen). On each page, there's a field for the answer and a *submit* button, which when clicked shows the next problem or a "*You're done!*" screen if they've answered all the questions. All students start on page 1, and there's no way to skip around or go back. When time is up, if the student is still working on a question, the system automatically clicks *submit* for them. The system records four pieces of information into a database (DB) each time *submit* is clicked; here's an example that was recorded for a 2-question exam. Note that student 99999999 fell asleep during question 1, so the system submitted it for them at the end of the exam. All the times in "Seconds since the exam started" will always be in chronological order.

Unique student ID	Seconds since the exam started	Question #	Auto-graded score for that question
12345678	60	1	9
11111111	100	1	10
11111111	110	2	5
12345678	260	2	4
99999999	600	1	2

Question 9a Which of the following could be answered by analyzing **<u>only</u>** the data in **DB** after the exam is finished? (select ALL that apply) How many students saw the *"You're done!"* screen after they finished the exam. Nope, since we don't know how many questions are on the exam. The number of questions on the exam. Nope (witness the sample DB, we don't know how many questions that had, only how many the students actually saw) The number of different students who took the exam Yep, we just count the size of the set of all Unique SIDs (we could easily use a python **`set`** on the first column) The highest overall score any student achieved. Sure, that's just the max for each student of their scores.

Question 9b Somehow the first column (Unique student ID) gets corrupted (lost). If we didn't care about the *actual* student ID, but only that each student had a different ID that was consistent throughout the **DB**, when are we *guaranteed* to be able to recreate the first column using *only* the other values in **DB**? (select ALL that apply) When there is only one student Yes, that would just be one number When no student finishes the first question Yes, because there would be no ambiguity, they'd all just be a different number. When only one student finishes the first question before time is up (i.e., clicked submit themselves) Yes, since there'd be no ambiguity. The first row would be the student who clicked submit themselves. The other rows would be people who, like student 99999999 had the system click submit for them, so they would be next. There would be one student who finished more than one, and they would have the same new Unique Student ID as the student in the first row. When exactly two students finish the first question before time is up (i.e., clicked submit themselves) No, just like the example, this one can't be disambiguated. When no two students are ever on the same question at the same moment in time (except the first) Yes, we can do it. This one is a little complicated, but essentially it involves never having a situation that can't be disambiguated. If there's never two people at the same question, then as the students are moving forward, there's never a case when (just like the example in the table) we don't know who completed question 2 in the third row.

Question 9c Assume the first column is fine, but now the *third column* (Question #) gets corrupted (lost). We want to recreate it using only the values in the "Unique Student IDs" column in the **DB**. That is, assuming you pulled out the first column in **DB** as a list called **SIDs**, the following function should return the third column as a list.

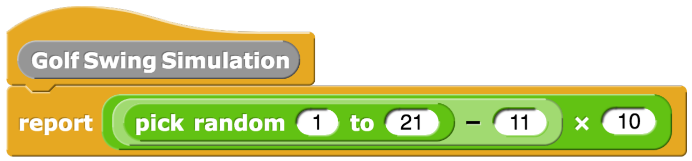
```
def SIDs_to_questions(SIDs):
      D={}
      questions = []
      for SID in SIDs:
            if SID in D:
                  D[SID] += 1
            else:
                  D[SID] = 1
            questions.append(D[SID])
      return questions
```

Question 10a We recreated a script of playing in the interpreter, but we may have gotten some of it wrong. For each response, indicate if it is correct, and if it's not, what the right answer should be.

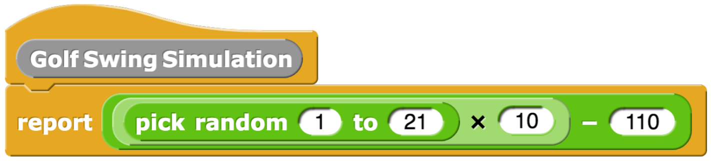
```
>>> S = "1234"
>>> S[1:3]
"23"
>>> S+S
"12341234"
>>> "3" in S
True
>>> S[2]="0"
Error (strings are immutable)
>>> [x+1 for x in range(4) if x != 2]
[1,2,4]
>>> def mystery(word):
...   if word[0] in "aeiou":
...     return word+"ay"
...   else:
...     return mystery(word[len(word)-1] + word[0:len(word)-1])
>>> mystery("school")
"olschoay"
>>> mystery("sky")
Infinite Loop (Error also accepted, since Python errors on infinite recursion)
```

Question 10b Assume for this problem that **mystery** was given a **word** with many characters, and returned successfully. What is its running time (as a function of the length of **word**)? You may also assume that slicing, concatenation and determining length are constant-time operations Linear (constant work is done for each letter) & Reasonable Time

Question 11a You want to write code that will simulate your golf swing, which means randomly hitting one of these posts *exactly* (so there's an equal chance of hitting -80 as there is of hitting 10). You don't want your simulation ever to miss a post, so it should never return, say, 93. Only the #s: -100, -90, …, 90, 100. There are two possible answers:



```
Golf Swing Simulation
report (((pick random 1 to 21) − 11) × 10)
```



```
Golf Swing Simulation
report (((pick random 1 to 21) × 10) − 110)
```

Question 11b We want to simulate swinging the club 1,000 times, and we'd like to record every *unique swing* into a list called UNIQUE SWINGS. For example, if the first five swings of our simulation were 0 (great swing!), it should only add 0 *once* to the UNIQUE SWINGS list. We code it as shown above. What do you think about it? It's buggy; it could add the same number twice to the list, since it's calling a random simulation twice, once in the check (let's say the list didn't contain the swing, so it went into the body of the if) and once in the add (which could have simulated a swing that WAS on the list)