UC Berkeley's CS10 Spring 2018 Final Exam: Prof. Dan Garcia

Your Name (first last)	*SID*	*Lab TA's Name*
🡐 *Name of person on left (or aisle)*		*Name of person on right (or aisle)* 🡒

What's that Smell? Oh, it's Potpourri! (2 pts each for 1-6, low score dropped)

Fill in the correct circles & squares completely…like this: ● (select ONE) ■ (select ALL that apply)

Question 1: Which does NOT make the *Genome assembly computing problem* difficult? (select ONE)

- ○ There may be multiple errors in the input strings.
- ○ The input is only a small view of the genome (100s of characters) but the output is 10,000s of characters.
- ○ The letters in the genome input are all 26 letters (A-Z), a vast number of possible combinations.
- ○ The output genome has to have all the errors removed.
- ○ None of the Above.

Question 2: What was wrong with early versions of the Google self-driving car at 4-way stops? (select ONE)

- ○ It couldn't see the stop sign because its photo sensor was too small, so it drove right through!
- ○ It yielded to the driver on the *left* (instead of right), since that's how they drive where the developers live!
- ○ It kept waiting for human drivers who would inch forward (looking for an advantage), so it'd be stuck there!
- ○ It had trouble stopping at the right place since the road markings were often obscured, so it would back up!
- ○ None of the Above.

Question 3: Prof Marti Hearst talked about what device/concept her HCI group helped invent? (select ONE)

- ○ Pinch and Zoom (or similar mobile app technology that lets you change the size of an image with 2 fingers)
- ○ Google Glass (or similar camera + computer + display eyewear technology to record your world while out)
- ○ Faceted Navigation (or similar web technology that lets you "prune" down what you want when searching)
- ○ Amazon Alexa (or similar technology that lets you interact with a computer through speech and audio)
- ○ None of the above

Question 4: What was one memorable moment from the Alumni Panel? (select ONE)

- ○ The alumnus from Amazon talked about the fun of programming drones to do aerial package delivery.
- ○ The alumnus from Apple talked about their new "spaceship" campus and getting lost once inside it!
- ○ The alumnus from Facebook talked about how fun it was watching Mark Zuckerberg testify before congress!
- ○ The alumnus from GradeScope talked about the fun working for a small startup located so close to Cal!
- ○ None of the above

Question 5: What is the Halting Problem? (select ONE)

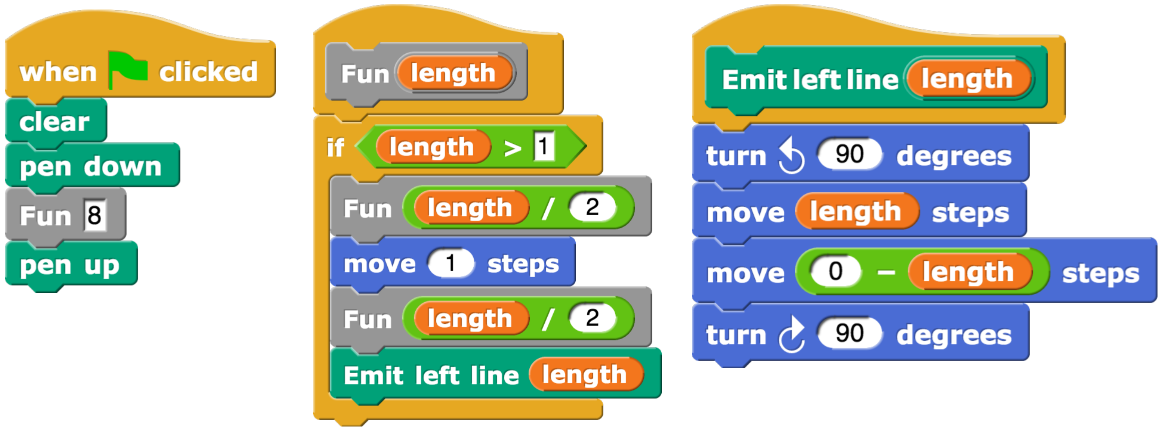
- ○ It was used to prove that not all problems are decidable.
- ○ It was one of a family of NP-complete problems; solve one efficiently, and you can solve them all!
- ○ It was the problem that was recently solved (to great acclaim), proving that P=NP once and for all!
- ○ It was the occurrence of "forever" blocks in Snap*!* code that prevent programs from stopping, or "halting".
- ○ None of the above

Question 6: What is 46_{16} divided by 12_8 written in Binary? (select ONE)

○	○	○	○	○	○	○	○	○
0_2	1_2	10_2	11_2	100_2	101_2	110_2	111_2	None of these

Question 7: *We put the* `Fun` *in Functional Programming…* (8 = 2+2+2+2 pts) SID: ______________

Consider the following two blocks and setup code:



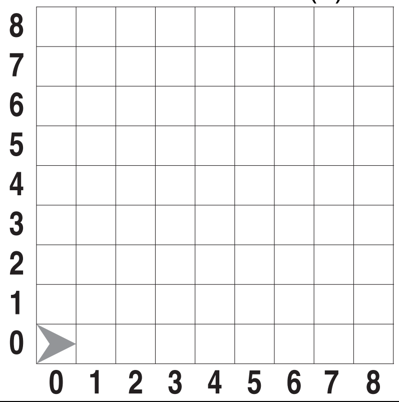
```
when [flag] clicked
clear
pen down
Fun 8
pen up
```

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

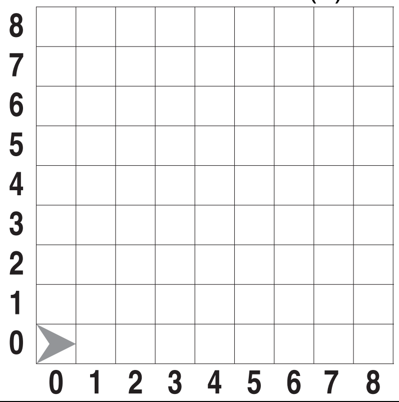
```
Emit left line (length)
turn ↺ 90 degrees
move (length) steps
move (0 − (length)) steps
turn ↻ 90 degrees
```

a) We're now to going to zoom in on pixels affected by calls to **`Fun`**; the sprite always starts in the lower left facing right, and the pen is in the *center* of the sprite. 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**; don't worry about drawing the sprite at the end. *Clarification: if the sprite were at (0,0) and moved 4 steps to the right, it would be at (4,0) and all pixels along the line from (0,0) through (4,0) would be shaded; 5 pixels in total.*

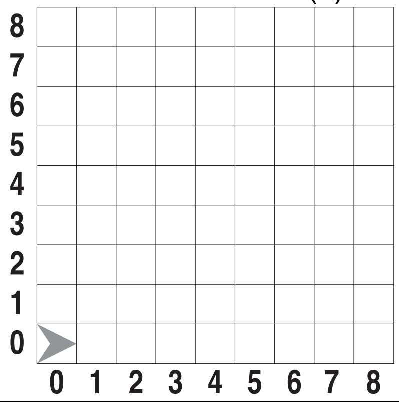
After the call to **`Fun`(2)**



After the call to **`Fun`(4)**



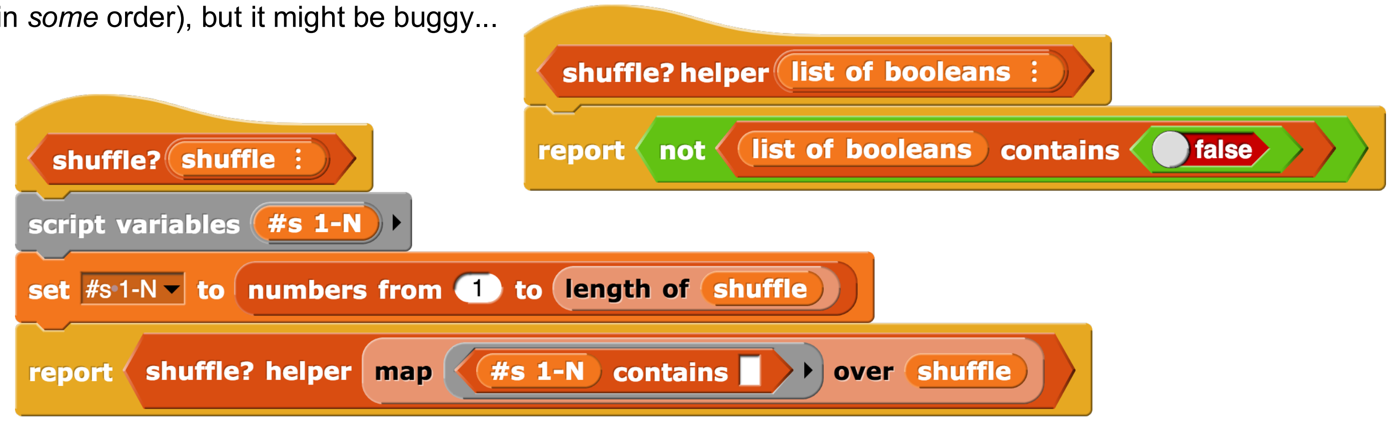
After the call to **`Fun`(8)**



b) Could **`Fun`** be rewritten iteratively? (select ONE)

○ Yes, and in fact *any* recursive procedure can be written iteratively.
○ Yes, and it's *fairly common* to be able to write recursive solutions iteratively, but not always.
○ Yes, but it's *fairly rare* to be able to write recursive solutions iteratively, Most of the time you can't.
○ No *because it's a command*. Had it been a reporter or a predicate, we would have been able to do it.
○ No; *it's one of the rare cases* of recursive solutions that can't be written iteratively. Most of the time you can.
○ No; *it's fairly common* not to be able to rewrite recursive solutions iteratively. Sometimes you can, though.
○ No; you can *never rewrite recursive solutions in an iterative manner.*

Question 8: *He knew something about the levels of gravitivity and polarity…* (12 pts = 3+2+2+2+3)
You have cards, numbered 1-N, which are placed in ANY order into a list; this is called a *shuffle*. We want to write a block to determine if a list is a valid shuffle (i.e., it has *all* the numbers 1-N [where N is the length of the list] in *some* order), but it might be buggy...



```
shuffle? helper (list of booleans ⋮)
report (not (list of booleans contains (false)))
```

```
shuffle? (shuffle ⋮)
script variables (#s 1-N)
set #s 1-N to (numbers from 1 to (length of shuffle))
report (shuffle? helper (map ((#s 1-N) contains [ ]) over shuffle))
```

a) What is equivalent to the expression reported by **`shuffle? helper`**? (select ONE)

○ combine with (⬡ or ⬡) items of (list of booleans)

○ combine with (⬡ and ⬡) items of (list of booleans)

○ not (combine with (⬡ or ⬡) items of (list of booleans))

○ not (combine with (⬡ and ⬡) items of (list of booleans))

b) What does **`shuffle?`** report for different inputs (of length at least 2)? (select ONE per row)

Input	**`shuffle?`** would report
The numbers 1 through N, in reverse order	false ○ ○ true
Is a valid shuffle, but one of the numbers is replaced with -99	false ○ ○ true
A list of N ones	false ○ ○ true

c) Fix the code so it works correctly (select ALL that apply)

☐ Change (false) to (true)

☐ Remove the (not ⬡)

☐ Change ((#s 1-N) contains [ ]) to ((shuffle) contains [ ])

☐ Change (map ( ) over (shuffle)) to (map ( ) over (#s 1-N))

Question 9: *What do tablets eat for dinner? iPad Thai…* (28 = 2*9+10 pts)

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

a) 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.
☐ The number of questions on the exam.
☐ The number of different students who took the exam.
☐ The highest overall score any student achieved.

b) 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
☐ When no student finishes the first question
☐ When only one student finishes the first question before time is up (i.e., clicked submit themselves)
☐ When exactly two students finish the first question before time is up (i.e., clicked submit themselves)
☐ When no two students are ever on the same question at the same moment in time (except the first)

c) 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. Fill in the grid below to put up to 6 lines of python into our code on the left AND tell us where to indent the lines. **Write the code in the area on the left** (as a backup). You might not need all 6 lines, and if a command is not used, leave its row blank.

```
def SIDs_to_questions(SIDs):
    D={}
    questions = []
    for SID in SIDs:
1
2
3
4
5
6
    return questions
 A   B   C   D   E
```

	Line number 1	2	3	4	5	6	Indent A	B	C	D	E
`if SID in SIDs:`	○	○	○	○	○	○	○	○	○	○	○
`if SID in questions:`	○	○	○	○	○	○	○	○	○	○	○
`if SID in D:`	○	○	○	○	○	○	○	○	○	○	○
`questions.append(SID)`	○	○	○	○	○	○	○	○	○	○	○
`questions.append(D[SID])`	○	○	○	○	○	○	○	○	○	○	○
`questions.append(SIDs)`	○	○	○	○	○	○	○	○	○	○	○
`questions.append(D[SIDs])`	○	○	○	○	○	○	○	○	○	○	○
`questions.append(D)`	○	○	○	○	○	○	○	○	○	○	○
`D[SID] += 1`	○	○	○	○	○	○	○	○	○	○	○
`D[SID] -= 1`	○	○	○	○	○	○	○	○	○	○	○
`D[SID] = 1`	○	○	○	○	○	○	○	○	○	○	○
`else:`	○	○	○	○	○	○	○	○	○	○	○

Question 10: *Would you like another `pie[1:3]`?* (18 = 2*9 pts)

a) 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]
"123" 🡐 ○ Correct!   ○"23"   ○"12"   ○ Error   ○ Infinite Loop

>>> S+S
"2468" 🡐 ○ Correct!   ○2468   ○"12341234"   ○ Error   ○ Infinite Loop

>>> "3" in S
True 🡐 ○ Correct!   ○False   ○ Error   ○ Infinite Loop

>>> S[2]="0"
1034 🡐 ○ Correct!   ○"1034"   ○1204   ○"1204"   ○ Error   ○ Infinite Loop

>>> [x+1 for x in range(4) if x != 2]
[3,4,5]  🡐 ○ Correct!   ○[1,2,4]   ○[1,2,4,5]   ○[2,4,5]   ○ Error   ○ None of these
```

```
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")
"schoolay"
```

○	○	○	○	○	○	○	○
Correct!	`"oolay"`	`"oolschay"`	`"loohcs"`	`"loohcsay"`	`"olschoay"`	Error	Infinite Loop

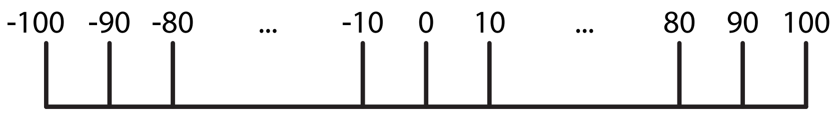
```
>>> mystery("sky")
"skyay"
```

○	○	○	○	○	○	○
Correct!	`"yay"`	`"yskay"`	`"yks"`	`"yksay"`	Error	Infinite Loop

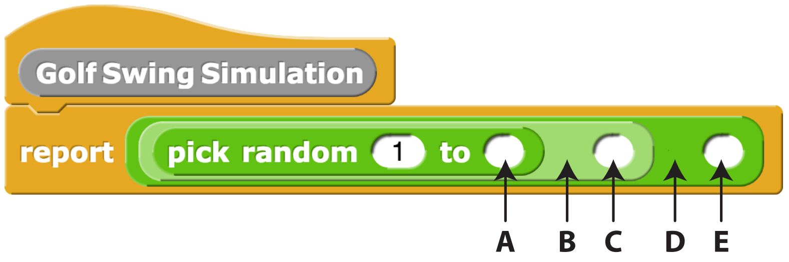
b) Assume for this problem that **`mystery`** was given a **`word`** with many characters, and returned successfully. What is its running time (as a function of the length of **`word`**)? You may also assume that slicing, concatenation and determining length are constant-time operations. (select ONE for each side)

○	○	○	○	○	○		○	○
Constant	Logarithmic	Linear	Quadratic	Cubic	Exponential		Reasonable Time	Not Reasonable Time

Question 11: *Gambling is illegal at Bushwood, sir, and I never slice…* (9 pts=6+3)
Playing golf is so frustrating; you mean to hit it straight, but you end up hitting it to the left sometimes and to the right sometimes. In the far wall of your backyard (facing you) you'd like to be able to measure where you hit it, so you put up posts 10 feet apart from -100 (a far left shot) through 0 (perfect!!) through 100 (a far right shot).



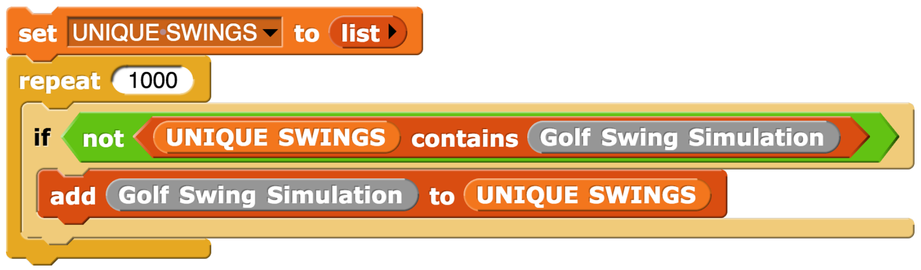
a) You want to write code that will simulate your golf swing, which means randomly hitting one of these posts *exactly* (so there's an equal chance of hitting -80 as there is of hitting 10). You don't want your simulation ever to miss a post, so it should never return, say, 93. Only the #s: -100, -90, …, 90, 100. Complete the code; unfortunately someone already typed a 1 into the 1st argument of `pick random`.



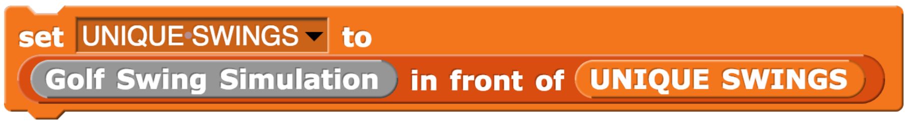
```
Golf Swing Simulation
report ( ( pick random (1) to ( ) ) ( ) ( ) )
```

	+	−	×	/	9	10	11	19	20	21	90	100	110	190	200	210
A	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
B	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
C	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
D	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
E	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

b) 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? (select ONE)



```
set UNIQUE SWINGS to list
repeat 1000
    if not ( UNIQUE SWINGS contains Golf Swing Simulation )
        add Golf Swing Simulation to UNIQUE SWINGS
```

○ It's buggy, replace the **add** with 

```
set UNIQUE SWINGS to ( Golf Swing Simulation in front of UNIQUE SWINGS )
```

○ It's buggy; remove the `not ⬡`.
○ It's buggy; it could add more than 1000 swings to the list.
○ It's buggy; it could add the same number twice to the list.
○ Works great!