

Online Evaluation

The questions cover a broad range of topics, and we don't expect anyone to know all of them. If something is unfamiliar, we recommended clicking "I don't know" rather than guessing. Please record time used in finishing all questions and report it in the last question.

Multiple Choice Questions

1. How is the hostname (e.g. www.abc.com) used during an HTTP request? *

- (a) It's used in BGP (routing protocol) that routers use to get TCP packets from client machine to server;
- (b) It's used in Browser to decide what IP address to send the request to, and it also send as a header so that the server can choose what content to display;
- (c) I don't know.
- (d) It's only used by the server which receives your request to decide what content to server. Browser treats it like the rest of the URL;
- (e) It's used in the DNS lookup that browser does, but ignored by the HTTP server;

2. Why do programs with memory leaks often have sensible slow down before they crash? *

- (a) The L1 cache runs out of space, and then CPU has to access main memory more often;
- (b) As the system runs out of memory, swapping increases and swapping is slow;
- (c) When it is slowly runs out of memory, fragmentation increases, and memory access time goes up;
- (d) I don't know
- (e) Memory leaks cause buffer overflows, which reduces memory bandwidth available to CPU;

3. How do system threads in the same process share call stack and heap space? *

- (a) They share a single call stack but access different heap spaces;
- (b) They have different call stacks and access different heap spaces;
- (c) I don't know.
- (d) They have different call stacks but access the same heap space;
- (e) They both share a single call stack and access the same heap space;

4. You want to make a dynamic set data structure which has a getNearest function.

E.g. if the set holds {1, 30, 60}, getNearest(29) should return 30; Which of the implementation would be fastest? Assumption is that you have around 40K items in the set, and you want add/remove/getNearest to run equally fast. *

- (a) A hash set from numbers to the nearest value to them in the set;
- (b) A balance binary search tree of values;
- (c) An unsorted linked list of values
- (d) I don't know.
- (e) A sorted array of values;

5. What is the best data structure for a list type which supports sub-linear time for all of these operators: append(), getAt(index), removeAt(index); *

- (a) A binary tree, where each node is augmented with its number of descendants;
- (b) I don't know
- (c) A hash-map from indexes to items;
- (d) A double-linked list;
- (e) Two stacks, one with the items in reversed order, and links between two copies of each item;
- (f) A dynamic array

6. When would a read-write lock likely be better than a simple mutex? *

- (a) I don't know
- (b) Control access to a database from a cluster of worker processes;
- (c) Control access to a dynamic list class in a read-heavy concurrent environment;
- (d) Control access to a critical section for very short duration;
- (e) Control access to a dynamic class in a write-heavy environment;

7. You are building a video editing program. It runs on a single thread. Now you want to consider making it multi-threaded. which is accurate? *

- (a) I don't know
- (b) Modern operation systems use a GIL (global interpreter lock). This can limit the efficiency of multiple-threading;
- (c) Threads will slow down your application. Asynchronous design is better;
- (d) If your program is CPU-bound, adding threads may make it faster on multiple-core processors;
- (e) Adding threads will allow your program to edit multiple videos at once;

8. What is the output of this program (pseudo code)?

```

VAR m = 1
VAR n = 1
VAR i = 3
REPEAT UNTIL i = 10 DO
    VAR t = n
    n = m + n
    m = t
    i = i + 1
END DO
OUTPUT n
Your answer *
```

- (a) 35
- (b) 55
- (c) I don't know.
- (d) 21
- (e) 34

9. You are working with a guy who is less knowledgeable than you. You two have different ideas on how to solve one technical problem. What is your preferred way to handle it? Please check all that apply. * (multiple choice)

- (a) Try to convince him with some data. If the data is in favor of your judgement, accept your solution, otherwise, accept his.
- (b) Try to solve the difference privately, then escalate it to the manager if it does not work.
- (c) Try to convince him with your knowledge. If that does not work, email all team members for their opinions.
- (d) Try to convince him if the problem is important; not to argue with him if the problem is trivial: both solutions are acceptable, and whoever owes the task should make the decision.

Coding question

Write a console program using Python, Java, or C++. You need to debug/run it on your own computer. Make sure your code compiles and runs as expected and copy/paste it below. If you are applying for front end, you may also use HTML+Javascript, and post a link below to your web page.

You need to code a single-digit arithmetic practicing program for K-2 elementary students.

- ☐ **Requirements:**
- ☐ **1. Randomly generate addition questions (e.g. $5+7=?$) and wait for an answer from the user;**
- ☐ **2. If the answer is correct, the program will ask a new question, otherwise, it asks the same question until the user answers it correctly;**
- ☐ **3. Numbers in questions should be large than 0 and less than 10; i.e. maximal is $9+9$, minimal is $1+1$;**
- ☐ **4. Repeat this process for N questions (you may decide N by yourself), and then show the total seconds used to answer these questions, along with top 5 questions with number of seconds answering it. The top 5 questions are ranked by total number of seconds before the user answer it correctly;**
- ☐ **5. Don't ask repeated questions in one session. E.g. if " $5+7=?$ " is asked before, it should not re-ask the same problem, but asking " $7+5=?$ " is ok.**

☐ ☐ **Bonus point: support single-digit subtraction questions.**

Your completed code *

How many minutes did you use to complete all above questions? *