

C0337/C0581 Specimen Paper

Disclaimer

This is a specimen paper, an example of how some questions are asked, and how the mark distribution could possibly look like. However, the exam will have more questions, questions may cover different and additional content, and may be weighted differently. The tone and style of the paper will be similar, but studying solely based on these example will thus be insufficient.

Example Questions

1. (a) RetailShops Inc. and Laptop Inc. start a long-term business collaboration. For the collaboration they use two applications on top of cloud infrastructure to which only these two companies have access.

RetailShops Inc. has built an application for logistics called Shiplt. Laptop Inc. built a project-planning application (PlanApp) to coordinate all its internal departments for research, development, and sales. Both applications exist for more than 15 years, and only receive updates for bug fixes.

PlanApp is built on top of the standard Microsoft Windows operating system and the .NET middleware platform. Shiplt runs on top of the Linux operating system using Java and its middleware.

- (i) Draw a diagram with the software and hardware stacks necessary to implement this system. Be as specific as possible based on the details provided. [6 marks]

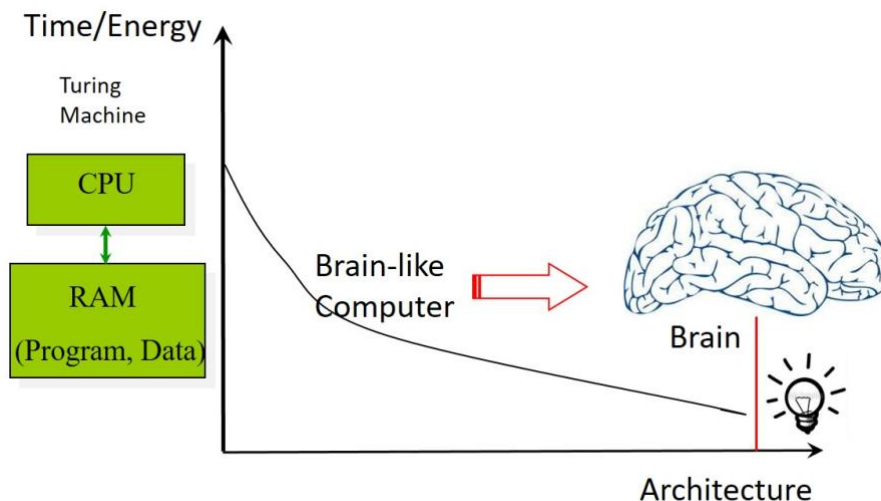
- (ii) To minimize the manual maintenance effort, the maintenance of everything but the custom software parts is delegated to the cloud operator.

List the parts of the software stacks that are maintained by the cloud operator. [2 marks]

- (iii) Which type of cloud services and which type of cloud should be used? Assume that the Shiplt and PlanApp applications are highly sensitive to Laptop Inc. and RetailShops Inc.'s business. Briefly explain your reasoning. [4 marks]

- (b) Why could the specific physical location where data is stored be an issue for a cloud application? Name and describe issues and give a concrete examples. [4 marks]

2. Prof. Frank Wang published a research paper recently, in which he elaborated his Brain-like Computer in the below diagram. As also illustrated in the diagram, a Turing machine is a mathematical model of computation that defines an abstract machine, which manipulates symbols on a strip of tape according to a table of rules. Turing Machine was historically implemented by introducing the stored-program concept.



(a) Why can a Turing machine be represented by two boxes? What are they?

[6 marks]

(b) List two advantages and two disadvantages of such an architecture.

[8 marks]

(c) Why is the Brain-like Computer technically positioned between the Turing Machine and the human brain?

[6 marks]

3. (a) What is special about distributed systems? Use two examples to explain what they are, and why we care about them.

[4 marks]

(b) Consider the program below:

```
String a = "hello";
String b = "world";
String c = "!";
String d = a+b;
String e = c;
String f = e;
```

(i) This program is safely parallelisable, i.e., one can split this program into several sub-programs that can be executed concurrently while exhibiting the same observational behaviour as the original program. Give a safe parallelisation of this program, and explain your reasoning.

[4 marks]

(ii) Pick two instructions (lines of code) from the program above that cannot be safely executed in parallel and give a reason why.

[2 marks]

(c) The next questions are about file systems.

Consider the following sequence of file operations that should be executed on a machine with 20 blocks of memory (arranged in a one-dimensional way).

Assuming the machine runs a file system that uses *contiguous allocation*, which instruction, if any, will fail first because the machine ran out of memory (i.e., there is not enough disk space to create the requested file)? Explain your reasoning by drawing or describing the state of disk after each operation. [8 marks]

1. Create file A (size = 2 blocks)
2. Create file B (size = 7 blocks)
3. Create file C (size = 5 blocks)
4. Create file D (size = 3 blocks)
5. Delete file C
6. Create file E (size = 4 blocks)
7. Delete file D
8. Create file F (size = 6 blocks)
9. Delete file A
10. Create file G (size = 3 blocks)