2021 Computing with the Cloud Exam

Question 1a

Together with friends, you are building a new app called JustRead for the local community of Canterbury, its universities, students, and the general population. Your first prototype is essentially a search field, some details on found books, and a button to reserve a specific book for pickup.

As first partners, you managed to have the Beaney in Canterbury, the Templeman library on campus, and the library in Sturry participating. The first challenge is to integrate their different search and order systems. To get a better understanding of where you stand, you start by sketching the overall architecture of the existing systems, and what you plan for your own system.

From initial conversations, you know:

- The systems of the Templeman library are hosted by the University of Kent's own Cornwallis Data Centre
- The systems run on hardware shared with other services provided by the university.
- The inventory-and-booking system is written in Java and runs inside a docker container.
- The Beaney and the library in Sturry use the same system, hosted by an unnamed 3rd-party provider. Though, you have heard that it is a custom system using the .NET middleware directly on top of Windows.
- You got a start-up grant from a cloud provider who offered to host a Function-as-a-Service architecture for the first year for free. For the moment, you will only need a function to search for books, and one to reserve a specific book.

(i). Draw a diagram with the cloud software stacks of the described system. Be as specific as possible, based on the details provided. Make sensible assumptions for elements omitted.

[Insert Image]

(ii) On the diagram for (i), indicate the likely Type of Cloud Service and Type of Cloud for each stack.

Templeman Library:

- SaaS (You don't control the infrastructre, platform, or software, but you control the functions which are deployed)
- Hybrid (relies on the third-party cloud)

Beaney and library cloud:

- PaaS (because you don't control the hardware or underlying operating system, but you can deploy as many verisons of the app as possible)
- Private (doesn't rely on anyone else)

Third-party cloud:

- FaaS (provides a number of specific functions, and not even the app)
- Private (doesn't rely on anyone else)

Part B

The Internet Protocol (IP) can sometimes surprise with its flexibility. Since the overall design is close enough to the principles of the OSI Protocol Model, IP is independent of the Data Link and Physical network layers.

And some Norwegians indeed showed successful IP network transmission is possible with carrier pigeons.

(i) If we would want to attempt to use carrier pigeons to establish a TCP connection between Canterbury and London, how long would it take to successfully establish the transmission under perfect conditions? (Assume the pigeons are perfectly reliable.) Explain how you come to your result.

[insert answer]

For the experiment, let's assume that the concrete distance between Canterbury and London is 60miles (or ca. 100km) and our pigeons fly with a speed of 60 miles per hour (or ca. 100km/h).

(ii) With current technology and considering the weight a pigeon can carry, we are able to send 2TB of data on an USB stick with a pigeon. On a 4G mobile network, we can likely send about 2MB/s. Which of the two transport media would have the shorter message transmission time for a 2TB message? (We again assume pigeons to be perfectly reliable).

Briefly explain your reasoning.

Question 2

a. Draw a diagram to describe the inter-neuron communication in Steve Furber's SpiNNaker (Spiking Neural Network Architecture), and explain your diagram.

[insert image]

b. The traditional Turing architecture is not energy-efficient. Explain what cause this issue in the Turing computer and how Steve Furber's SpiNNaker, as an example of a non-Turing computer, addresses the above issue.

Question 3: Map/Reduce and related technologies

a. Consider a web with the pages 0, 1, 2, 3. The pages have the following links: 0→1, 0→2, 2→3, 3→2. What is the PageRank of each page? Show the steps of your reasoning.

[insert answer]

(ii) To the web described in part (a) we add page 4 and the following links: 0→4, 4→0, 1→4, 4→1, 2→4, 4→2, 3→4, 4→3. What is the PageRank of each page now? Show the steps of your reasoning. Give the answer as decimal numbers with two decimals.

[insert answer]