

## Homework A

*Due Fri 6 Feb, 2015 by midnight IST. Total of 100 points.*

*Submit the homework solution as a PDF file by email with the subject line (and file name)*

*SE252\_JAN2015\_HW-A\_StudentName.*

*Be succinct. The points allocated to each question gives you a sense of the depth of explanation required.*

*State assumptions you are making. Use the lecture, slides and text books as primary information source.*

*Always provide citations/footnotes for external sources of information.*

### Virtual Machines [20 points]

- 1) Popek and Goldberg in CACM, 1974 described efficiency, equivalence and resource control as three properties required off virtual machine managers (VMMs). Discuss if the “containerized” models followed by Docker and LCX have these three properties. What are the relative advantages and disadvantages of using containers as opposed to hardware assisted virtual machines? [20 points]

### IaaS Data Centre [20 points]

- 2) You are doing a viability study for *Megh First Inc.*, an IaaS Cloud service provider who is planning to construct a new Generation 3 data centre in Bangalore. They use *shipping containers* for consolidating their data centre that are pre-packaged units of management. You are given the following information (Note: Rs.1L = Rs.1,00,000):
  - Each shipping container has self-contained networking, servers, air conditioning (AC) units and UPS. A container has **27 server racks** each with **13 servers**. Each server has **32 CPU cores**. It costs **Rs.625L** to purchase and deploy one container.
  - For each ~~rack server~~, the electricity load consumed by the computing-related activities is ~~105.3kW~~ **105.3W per hour**. *This load is constant*, and does not change based on usage level of the servers. This load *does not* include *non-computing* related power usage, such as for AC, lighting, etc.
  - Its costs **Rs.10L/month** to rent a warehouse that can store up to 10 containers.
  - BESCOM charges you **Rs.10 per KWh** of power.
  - A system administrator's salary is **Rs.1.2L per month**, and one sys admin can manage up to **5 containers**.
  - You plan to charge your customers **Rs.4 per CPU core-hour** (e.g. Rs.4 per hour for Small VM with 1 core, Rs.8 per hour for Medium VM with 2 cores, etc.).
  - Assume there are no additional charges for network bandwidth, taxes, security guard, etc.
- a. Say you plan to initially purchase **10 containers** for the data centre and you expect an average utilization of **70%** of your CPU cores by your customers. How many months will it take for you

to break even and start making a profit if your Power Usage Efficiency (PUE) is **1.50**? If the life span of the machines is **3 years**, what is the total profit you would have made at the end of **3 years**? [10 points]

- b. You are given an option of upgrading the AC units in each container. There are two models: *Model MC240* costs **Rs.2L per container** and can improve the PUE from **1.50** to **1.30**. *Model MX340* costs **Rs.10L per container** and reduces the PUE from **1.5** to **1.18** and. Which would you choose, and why? [5 points]
- c. A Cloud computing startup company, *Timepass LLC*, approaches Megh First Inc and offers to purchase the spare utilization capacity of **30%** in their data centre if it is sold at a bulk discount rate of **Rs.1 per CPU core**. Would you recommend that Megh First accept the offer? Why/why not? [5 points]

*NOTE: State your assumption. Provide basic formulae and calculations for your results. You may round off the final values to multiples of 1L.*

### **(III) \* as a Service [45 points]**

- 3) The CTO of a growing eCommerce company, *Snap Kart Ltd*, is evaluating proposals to move her enterprise services, applications and data to a Cloud rather than their private data centre. You are brought in to provide advice as a consultant. Come up with a list of 10 questions you would ask her about her company to help you decide whether they should move to a Cloud. And if so, what type of Cloud. [30 points]
- 4) Discuss the layers typically present in a layered Cloud architecture. What is the rationale for such a layering? How does the market-oriented pricing vary at these different layers (TB, Chapter 4)? [15 points]

### **(IV) SOA [15 points]**

- 5) Discuss how a message-oriented middleware can be used within a Service Oriented Architecture within an Enterprise (TB, Chapter 5)? [15 points]