# 0907702 Computer Performance Evaluation (Fall 2014)

## Midterm Exam

رقم الشعبة: 1 الرقم التسلسلي: الاسم:

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**Instructions**: Time **60** minutes. Open book and notes exam. No electronics. Please answer all problems in the space provided and limit your answer to the space provided. **No questions are allowed**.

*<Good Luck>*

**Q1.** Assume that you want to evaluate a memory system composed of a DRAM memory module and a bus that interconnects this memory with the processor. Also assume that the specifications of both the memory module and the bus are known to you.

*[10 marks]*

a) Among the three main evaluation techniques, which one do you use? State your assumptions and justification for the selection you make.

**Assuming that I don't have the system to perform measurements, I would use analytical modeling because it is sufficient for this simple system and is not expensive.**

b) How would you validate the results of your selected technique?

**Using measurements on a similar system.**

**If no such a system is available, I must use simulation.**

c) What performance metrics would you use in your study?

**Peak performance, sustained bandwidth, response time, error probability.**

d) Recall that there are two definitions for the response time. What definition would you use and why?

**I would use Definition 1 if the processor supports critical word first and early restart.**

**Otherwise, I would use Definition 2.**

e) Assuming that you want to use a workload in this study, what type of workload would you use and why?

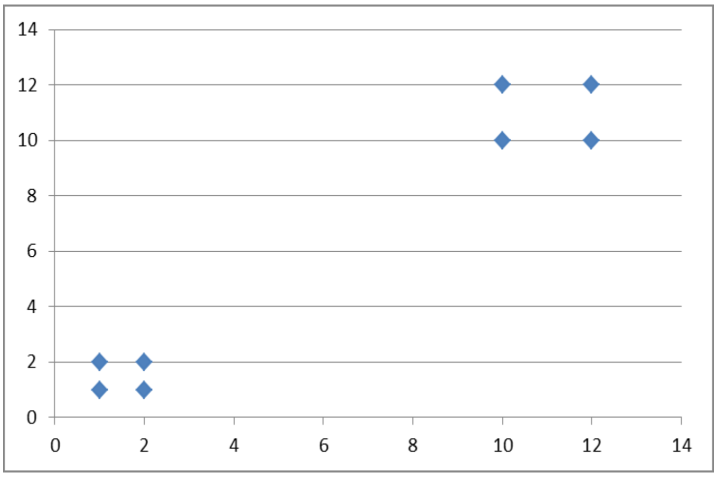
**Microbenchmark: synthetic workload that focuses on exercising the memory system.**

**Q2.** The workload of a computer system was monitored and two metrics were measured ($m_1$ and $m_2$) for eight workload instances shown in the table below. Using the technique you think is the best in this case, characterize this workload.

*[5 marks]*

| **Instance** | $m_1$ | $m_2$ |
|---|---|---|
| *1* | 1 | 1 |
| *2* | 2 | 1 |
| *3* | 1 | 2 |
| *4* | 2 | 2 |
| *5* | 10 | 12 |
| *6* | 12 | 10 |
| *7* | 10 | 10 |
| *8* | 12 | 12 |

**When the data is plotted on a scatter graph (as show below), we notice that there are two distinct clusters.**



**So we use clustering and report the centers of the two clusters:**

**Cluster 1: (1.5, 1.5)**

**Cluster 2: (11, 11)**

**Q3.** Assume that you have the following code, instrument this code so that you can thoroughly monitor its performance, i.e., rewrite it with the added instrumentation code.

*[5 marks]*

```
main() {
  int size;
  printf("Enter size: ");
  scanf("%d", &size);
  int x[] = init_array(size);
  calc_array(x);
  print_results(x);
}
```

```
main() {
  int size;
  printf("Enter size: ");
  scanf("%d", &size);
  printf("Calling init_array with size %d at time %d/n",
         size, time());
  int x[] = init_array(size);
  printf("Calling calc_array at time %d/n", time());
  calc_array(x);
  printf("Calling print_results at time %d/n", time());
  print_results(x);
  printf("Return from print_results at time %d/n", time());
}
```

**Q4.** Given the following performance of two systems on three benchmarks,

| Benchmark | System A<br>(tps) | System B<br>(tps) |
|---|---|---|
| I | 1000 | 2000 |
| II | 2000 | 1600 |
| III | 60 | 30 |

Using ratio games, how the makers of System A would advertise the advantage of their system?

*[5 marks]*

**As the metric is higher is better, we use System B as reference.**

| **Benchmark** | **System A** | **System B** |
|---|---|---|
| **I** | **0.5** | **1** |
| **II** | **1.25** | **1** |
| **III** | **2.0** | **1** |
| **Average** | **1.25** | **1** |

**Therefore, makers of System A would advertise that their system has a relative performance of 25% higher than System B using these three benchmarks.**

**Q5.** Using SimPack, write a simulator to find the utilization of a system composed of one server. Assume that the inter-arrival time has an exponential distribution of mean = 60 seconds and the service time has an exponential distribution of mean = 50 seconds. The simulator should simulate the arrivals of 1000 jobs.

*[5 marks]*

```
#include <stdio.h>
#include "queuing.h"

#define NEW_ARRIVAL     1
#define REQUEST_SERVER  2
#define RELEASE_SERVER  3

TOKEN a_token;

int server,          /* server facility descriptor   */
  njs = 1000;        /* no. of jobs to simulate  */

main() {
  int event
  init_simpack(LINKED);
  server = create_facility("Server", 1);
  schedule(NEW_ARRIVAL, 0, a_token);

  while (njs) {
     next_event(&event, &a_token);

     switch(event) {
     case NEW_ARRIVAL:
          schedule(REQUEST_SERVER, 0, a_token);
          update_arrivals();
          schedule(NEW_ARRIVAL, (TIME) expntl(60), a_token);
          break;

     case REQUEST_SERVER:
          if (request(server, a_token, j) == FREE)
               schedule(RELEASE_SERVER, (TIME) expntl(50), a_token);
          break;

     case RELEASE_SERVER:
          update_completions();
          njs--;
          break;
     }
  }
  report_stats();
}
```