THE UNIVERSITY OF AUCKLAND

SEMESTER TWO, 2019
Campus: City

COMPUTER SCIENCE

COMPSCI 725 Practice Exam

(Time allowed: TWO hours)

NOTE: Do not write your name on your answer sheet!

Attachment 1 is referenced in Question 1. It presents experimental data from Mohanty (2019).

Attachment 2 lists the required readings in this course.

This is a **closed-book** examination.

Calculators are **not permitted** in this examination.

1. (15 marks, in total) The following questions refer to the experimental data from Mohanty (2019), as reproduced in Appendix 1 of this examination.

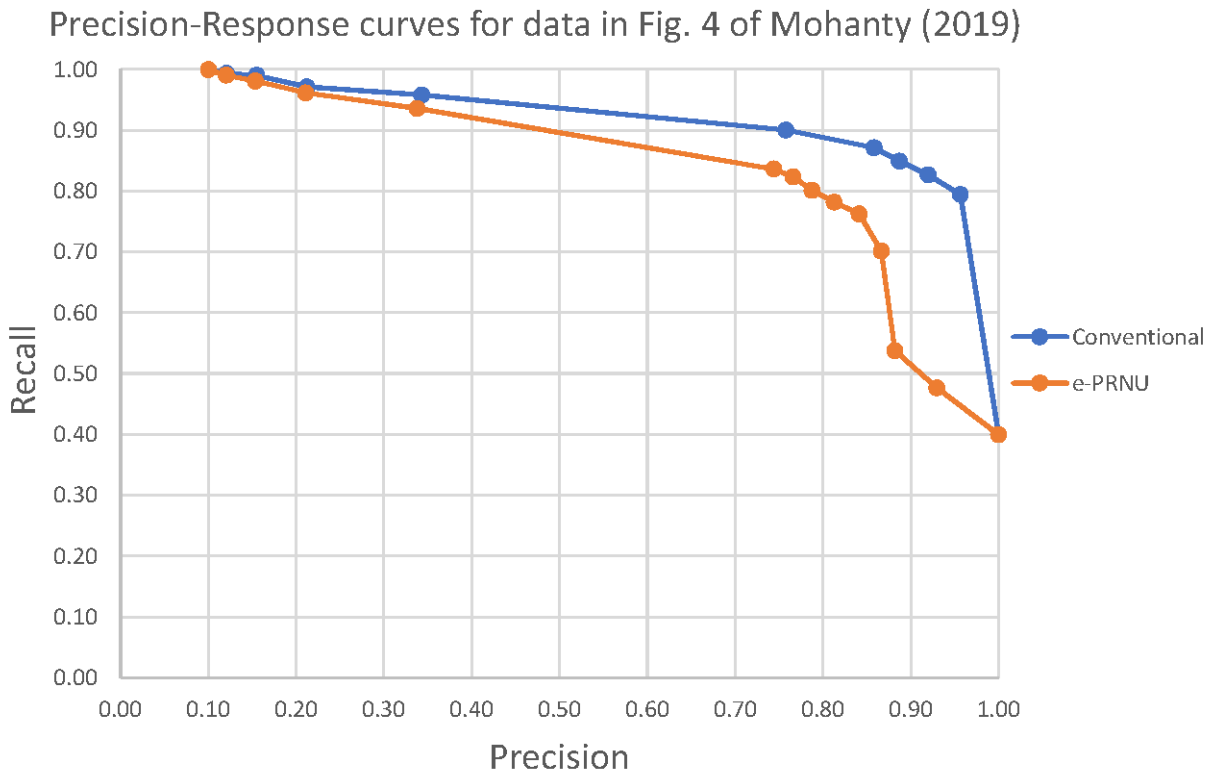
(a) (10 marks) You are a member of a digital-forensics team that is defending Mr X – who is on trial for murder. You have been asked to point out weaknesses in the prosecution's argument that Mr X's camera was used to take an incriminating photo.

Here is the prosecution's argument. Police have recovered an incriminating picture from a social media website. Police have also recovered a camera from Mr X. The police's forensics team have consulted with an independent expert, who advised them on how to compute an e-PRNU fingerprint digest by using photos taken by Mr. X's camera. The independent expert also advised them to use nine different cameras to take nine additional photos (one per camera). The expert then performed the e-PRNU matching process, as described in Mohanty (2019). The expert's report states: "It is extremely likely that Mr X's camera was used to take the incriminating photo, because the e-PRNU of this camera is an excellent match to the PRNU of the incriminating photo. Furthermore, the e-PRNU of Mr. X's camera is not a good match to the PRNU of any of the nine other photos provided."

Mr. X insists that his camera could not have been used to take the incriminating photo. Your job is to provide expert advice to Mr. X's lawyers. Is there any reasonable doubt about the validity of the police expert's report, based on your knowledge of Mohanty (2019)? Explain briefly.

(b) (5 marks) A junior member of your forensics team has produced an alternative visualisation of the data in Figure 4 of Mohanty (2019), shown below in Figure 1. After you confirm that this plot is accurate, can you use this as part of your defense of Mr X? Explain briefly.

Figure 1: PR curve: e-PRNU with digest vs conventional scheme with digest, redrawn from Fig. 4 of Mohanty (2019).



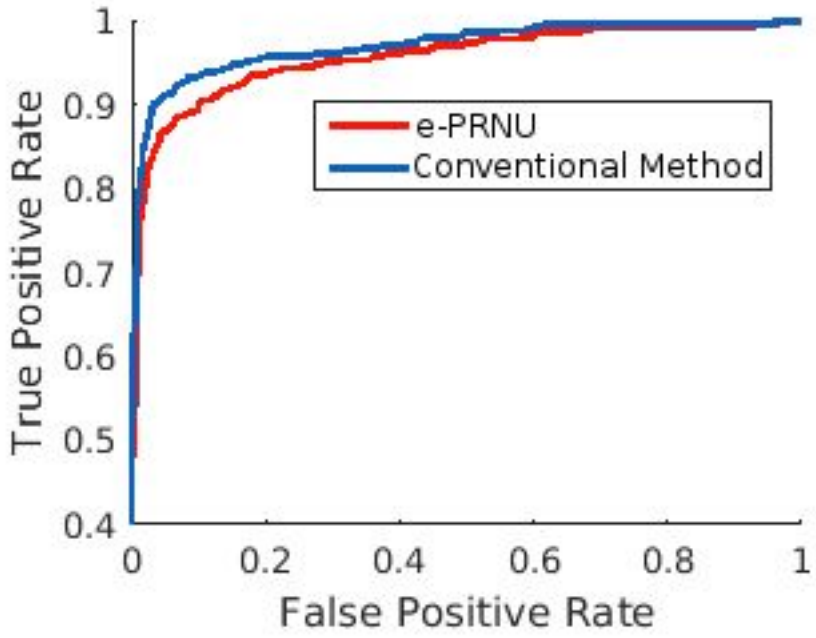
ATTACHMENT FOLLOWS

Attachment 1. For use in Question 1 of this examination.

Quoting from Mohanty (2019):

> Our test environment consisted of 10 cameras of 10 different brands... From each camera, we took 10 images for calculating the fingerprint and 40 query images for the correlation. The chosen images had not gone through geometric processing, such as scaling, cropping, and rotation. The generated Pearson correlation coefficient was matched against a threshold that was set per each camera...
>
> Fig. 4 shows the comparison of ROC curve of e-PRNU (in red) with the ROC curve of the plaintext-based conventional scheme (in blue) when fingerprint digest was used. These curves were obtained by averaging the error rates experimentally obtained from 10 different cameras. As can be seen in the graph, e-PRNU has comparable error rates with respect to the conventional scheme. This means that even if we round off values to perform the encryption, the lack of precision does not affect too much the validity of the results obtained with e-PRNU...

Figure 4: ROC curve: e-PRNU with digest vs conventional scheme with digest, reproduced from Mohanty (2019).



Attachment 2.

The following articles were on the assigned reading list this semester.

Ahmad 2018	Electronic crime investigations in a virtualised environment: A forensic process and prototype for evidence collection and analysis
Al-Mohair 2015	Hybrid human skin detection using neural network and k-means clustering technique
De Bock 2016	JPGcarve: An advanced tool for automated recovery of fragmented JPEG files
Domingues 2016	Digital forensic artifacts of the Cortana device search cache on Windows 10 Desktop
Lampson 2004	Computer security in the real world
Li 2019	IoT forensics: Amazon Echo as a use case
Mohanty 2019	e-PRNU: Encrypted domain PRNU-based camera attribution for preserving privacy
Oriwoh 2013	Internet of Things forensics: Challenges and approaches
Quick 2014	Google Drive: Forensic analysis of data remnants