



Departamento de Informática

Mestrado em Engenharia Informática

Exame Recurso – Sistemas de Computação Móvel e Ubíqua

2º Semestre, 2010/2011

CLOSED BOOK. Duration: **2 hours 30 minutes**

NAME: _____ **NUMBER:** _____

IMPORTANT: Read the text carefully before answering. **Succinct answers are preferred.**

Question 1 – Regarding pervasive/ubiquitous computing as a computer systems discipline...

- a) What is pervasive/ubiquitous computing?
- b) Discuss the main driving forces and motivations behind the emergence of pervasive computing.
- c) What are the main challenges regarding pervasive computing that make this different from (traditional) computer systems in general? Explain.

Question 2 – Regarding location systems...

- a) Discuss the main challenges involved in obtaining the location/position of a device.
- b) Scene analysis is one technique that is useful in this context. Explain it and discuss its weak and strong points...
- c) How can *proximity* be used in the context of location systems? Explain.
- d) GPS is a positioning system widely used today. To establish the position of the receiver, data from 4 GPS satellites is needed. Accuracy will typically be increased if more satellites are visible. Criticize this sentence, explaining your reasoning.

Question 3 – Regarding wireless networking...

- a) What are the main characteristics of wireless links?
- b) What are the main challenges associated with wireless networking?
- c) Bluetooth is a mature wireless networking technology. Its specification has provisions for a little used broadcast mode, allowing the master node to communicate to all slaves. Describe one possible use/application of this mode in the context of mobile or pervasive computing.

Question 4 – On the subject of context-aware computing...

- a) What are the main issues/steps when designing and implementing a context-aware application?
- b) Describe the main abstract properties associated with contextual information (in all its forms).
- c) For at most three of the properties listed above, discuss their impact on application behavior.
- d) Context sensing services can be implemented at different levels. Present at most one **clear** advantage and **serious** drawback of implementing that logic at the application level, at the operating system level, or as a middleware. **Explain.**

Question 4 – Wireless sensor networks (WSNs) are an example manifestation of pervasive computing...

- a) WSNs are very often designed with one particular application in mind. What kind of implications does that have on the overall software design that drives each sensor node?
- b) What is *geographic routing*? And what is the main problem when designing an algorithm based on this technique?
- c) *Proactive routing* and *reactive routing* are two competing design philosophies for WSNs. Depending on the **expected** network traffic patterns (sporadic, periodic, short, long, etc.) which of the two is best in principle? Explain.

Question 5 – “Data Mule is an evocative term for a vehicle[/person] that physically carries a computer with storage between remote locations to effectively create a data communication link.” (*from wikipedia.org*)

- a) Disseminating road traffic conditions (among drivers/cars) has been proposed as one scenario that could be solved with *data muling* techniques. Bluetooth and ad-hoc WIFI have been tried with limited success as enabler technologies for this sort of approach to that scenario. What might be the problem?
- b) The idea of data muling can be extended to implement a multi-hop data forwarding system (a MANET of sorts), for instance, by exchanging data whenever two “mules” casually meet or cross. To improve the effectiveness (delivery success) of this technique it is possible resort to epidemic broadcast approaches and aggressively “flood” the data muling network. Assuming the mules are smartphones (iOS/Android, etc.), describe a few strategies/ideas to optimize the data mule routing protocol and mitigate (alleviate) the usual problems associated with flooding.

Question 6 – Mobile IP is an extension to the TCP/IP stack to add provisions for roaming terminals...

- a) Specifically, what does Mobile IP offer? Explain.
- b) Describe in broad terms how Mobile IP works.
- c) Mobile IP is still little used in practice, an indication that for most of today’s applications it is not needed. Explain why you **agree** or do **not agree** with this reasoning.

Question 7 – Monitoring road traffic in metropolitan areas is often touted as a paradigmatic application that can be developed around Participatory Sensing principles...

- a) One way to tackle the above scenario is to focus on what *usually happens* on the road network, for instance to allow navigation software to compute routes based on expected average road conditions (for instance, to avoid typical traffic hotspots, at given times of day). Describe the key ideas/ingredients of a participatory sensing solution and architecture for achieving this purpose.
- b) Knowing what *is currently happening* on the road network is a related problem. It has the potential to allow choosing routes based on actual road conditions, as to avoid traffic jams, accidents and other abnormal conditions. Considering the CarTel system, which of its characteristics (if any) would you highlight as to be suited to address this real-time road monitoring scenario? Describe any improvements (and why) that you consider CarTel lacks to address this problem effectively.